A5WTC On-line Assessment Report

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1 Introduction

1.1 Background to the Scheme

In September 2001, the Department for Regional Development (of which Roads Service was part) formulated "Shaping Our Future: the Regional Development Strategy for Northern Ireland 2025". That strategy was intended to guide the future development of the region up to 2025 and provided guidance on a range of social, economic and environmental matters, which are implemented through the plans and strategies of Government Departments. The Regional Development Strategy (RDS) has since been updated to guide the future development of the region up to 2035.

An integral feature of the Regional Development Strategy (RDS) was the requirement to develop a Regional Transportation Strategy having a vision of "a modern, integrated and sustainable transportation system which benefits society, the economy and the environment and which actively contributes to social inclusion and everyone's quality of life". In July 2002, the Assembly approved the strategic direction and underlying principles of the 'Regional Transportation Strategy for Northern Ireland 2002-2012' (RTS).

1.1.1 Regional Transportation Strategy

The RTS identified strategic transportation investment priorities and considered potential funding sources over a ten year period as well as setting down guidance as to how funding would be split between areas and transport modes.

Delivery of the RTS was progressed through three multi modal transport plans, one of which was the Regional Strategic Transport Network - Transport Plan (RSTN - TP), published in March 2005.

The Regional Strategic Transport Network (RSTN) of Northern Ireland comprises the rail network, five Key Transport Corridors, four Link Corridors, and the Belfast Metropolitan Transport Corridors and the remainder of the trunk road network. It was previously identified that the RSTN comprises approximately 5% of the total road network but carries approximately 35% of the traffic.

1.1.2 The Existing A5 Key Transport Corridor

The A5 Western Transport Corridor (A5 WTC) is one of five Key Transport corridors in Northern Ireland as defined in the RTS. The corridor starts in the North West of the province at Londonderry and runs 88km south to the border, close to the village of Aughnacloy. The A5 WTC feeds into the N2 in the Republic of Ireland at the Moy Bridge border crossing and together the A5 and N2 provide a strategic link between Dublin and the North West. Within the extent of the scheme itself there are strategic links between the urban centres of Londonderry, Strabane, Omagh, and Aughnacloy. The existing corridor, in addition, provides crucial links from both Dublin and Northern Ireland to urban centres in County Donegal.

The A5 is intersected by four key routes, including the A4 Key Transport Corridor (Belfast - Enniskillen – Sligo), the A32 Trunk Road (Enniskillen – Omagh), the A505 Trunk Road (Omagh - Cookstown) and the A38/N14, Lifford/Strabane link Road. The A5 also links to the A6 Key Transport Corridor (Londonderry - Belfast) and the A2 Key Transport Corridor (Londonderry – Limavady) within the city of Derry.

Figure 1-1 Map of Northern Ireland highlighting the location of the existing A5

The existing A5 WTC is a 'patch work' of differing width single carriageway roads with intermittent stretches of climbing lanes and overtaking opportunities. This lack of consistency in the road design parameters leads to the use of inappropriate high speeds through the good lengths of the road resulting in a lack of appreciation for the poorer conditions of the road ahead. In excess of 200 side road junctions currently connect with the A5 with over 420 domestic/commercial and field accesses, excluding those in the various urban settlements, adjacent to the a5.

1.1.3 Dual Carriageway

Following the announcement of intentions to upgrade the A5 Key Transport Corridor, Mouchel were commissioned by The Department for Regional Development, Roads Service (now Department for Infrastructure, TransportNI), to develop proposals to upgrade the A5 to dual carriageway standard. Scheme proposals were developed in accordance with the Scheme Assessment Process contained within the Design Manual for Roads and Bridges (DMRB), which sets out the three stage scheme assessment process. The DMRB is the national design guidance developed and used in the UK primarily for the design, implementation and maintenance of Trunk Road Works, the A5 being part of the Region's Trunk Road Network.

Development of the scheme proposals was presented in various reports including:-

- Preliminary Options Report – September 2008 (sub-titled, Scheme Assessment Report 1 – Constraints Report); and,
- Preferred Options Report – July 2009 (sub-titled, Stage 2 Scheme Assessment Report)

During the development and assessment of scheme options that ultimately led to the identification of the preferred route and design option it was concluded that an on-line utilisation of the existing A5 corridor to dual carriageway standard was not a justifiable proposition compared to other options.

As was subsequently presented at the Public Inquires into the proposals in 2011, an On-line Dual Carriageway was not considered appropriate not least in light of:-

i) the number of settlements along the existing route;
ii) the number of accesses onto the existing route;
iii) the sub-standard nature of the existing A5;

iv) the number and nature of existing utilities (water, electricity and telecommunication services, etc.) along the existing route;

v) safety during construction given the requirement to maintain traffic flow along the existing A5 corridor; and,

vi) the consequent disruption and delays to traffic that would accrue during construction.

1.2 Purpose of this Report

Both prior to, during and since the previous public inquiries into the project, there have been continued queries raised regarding the need to construct the proposed dual carriageway off-line, that is predominantly away from the existing A5.

This report has been prepared to provide further evidence to support the conclusion that providing a dual carriageway along the existing A5 corridor is not a realistic proposition in light of the impacts of such a proposal compared to other available options.

1.3 Previous and Current Assessment Methodology

1.3.1 Overview

At the time of the previous route option appraisal processes, various criteria were adopted to assist in the development and comparison of route options. For consistency of assessment, the same criteria were also applied to the on-line corridor assessment. Commentary is provided below on the scheme assessment criteria that was adopted previously prior to undertaking this most recent on-line assessment.

1.3.2 Category of Dual Carriageway

The implications of a dual carriageway standard has a fundamental influence on the development of scheme options for an on-line proposal due to the large number of accesses and minor roads that currently connect to the existing A5. The provision of a central reservation with no breaks and a continuous safety barrier running the length of the proposed dual carriageway effectively precludes the provision of direct access for a considerable proportion of minor roads and private properties on and off any new dual carriageway. Therefore, when considering proposals to improve the existing A5 on-line, alternative access arrangements for the majority of properties and minor roads affected must also be considered.

1.4 Format of Report

1.4.1 Development Methodology – Preferred Corridor to Routes

As identified in the 2009 Preferred Options Report, the development of the Route Options was carried out in four principal steps as described below:-

1) Develop Route Options within the Preferred Corridor avoiding, where possible, significant constraints;
2) Present these Route Options to the public at a series of public consultation events and obtain comment;
3) Carry out initial assessments of the Route Options. Eliminate areas where Routes cannot easily be developed;
4) Develop Routes within the retained lengths of Route Options and undertake full length scheme assessments.

In the Preliminary Options Report the scheme was split into three sections to aid in defining the Preferred Corridor and similarly these three sections have been used in these on-line assessments. The three sections are:-

- Section 1: New Buildings to South of Strabane
- Section 2: South of Strabane to South of Omagh
- Section 3: South of Omagh to Aughnacloy.

In developing the dual carriageway design the continuity between Sections 1 and 2 and Sections 2 and 3 was an important factor requiring close liaison. In line with the 2009 Preferred Options Report, the DMRB design standards provide the parameters that are used to design roads. To maintain consistency throughout the scheme the following key alignment design parameters were defined and used:-

- Design speed of 120kph;
- Side slopes at 1:3 for cuttings and embankments;
- No departures to or relaxation of standards;
- Vertical alignment to suit natural drainage pathways for surface water runoff;
- Maintain existing road network wherever possible;
- Aim to achieve an earthworks balance within each Section;

- Ensure proper connectivity with the existing and future strategic road network (including A5/A6 link, A4, N14/N15 interchange and the N2) and major settlements.

The 2009 Preferred Options Report also identified that the Constraints Database was considerable and there was a need to define a high level list of assumptions by which the route option development could proceed. Therefore the following criteria was employed for the original route option assessment, and again, for this on-line dual carriageway assessment:-

1) Avoid residential properties wherever possible, then commercial properties followed by agricultural buildings;
2) Avoid designated sites/buildings in the hierarchy of International, European, UK, NI and finally local importance;
3) Avoid areas where a combination of minor constraints would result in significant impacts;
4) Avoid areas of alluvial/peat materials which may also be flood plains and require expensive construction;
5) Avoid flood plains where mitigation by compensatory area would not be readily achievable.

1.5 Focus of Assessment

The primary focus of this assessment was to identify the range and nature of constraints and impacts that would influence the development of a scheme option for the on-line upgrade of the existing A5 corridor to Dual Carriageway, as per the DMRB. The key objectives of this on-line assessment were: -

- To optimise the upgrade of the existing A5 corridor to Dual Carriageway standard.
- To develop a preliminary design to minimise the impact on the natural and built environment, minimising the requirement for additional land take.
- To develop a preliminary design to increase the safety of road users on the A5 and providing good Non-Motorised User (NMU) connectivity along the A5.
- To identify constraints in providing a dual carriageway along the existing A5 corridor
- To identify appropriate sections of off-line dual carriageway to connect on-line dualled sections, where it was considered that the constraints in providing a dual

carriageway along the existing A5 corridor were too onerous to be considered realistic propositions.

- To compare specific '*Specimen On-line Assessment'* areas with the A5WTC Proposed Scheme Route, in terms of: -
    - Economy
    - Highways
    - Structures
    - Geotechnical
    - Drainage
    - Environment

1.6 Assessment Process

As stated above the basis of this On-line Assessment Report is to establish the impact a dual carriageway along the existing A5 corridor would have on the natural and built environment. The Assessment Process has been based on three specific approaches to assessment;

- Assessment of on-line elements for the On-line Dual Carriageway based initially on a *70m Buffer Zone* described in more detail below;
- Assessment of off-line elements for the On-line Dual Carriageway. That is sections of upgrade where it was simply considered too onerous to examine on-line widening as an option. This occurred predominantly where the existing A5 is routed through existing settlements. The assessment was based on a *50m Buffer Zone* described in more detail below; and,
- *Assessment of Specimen On-line Assessment Areas*, that is, areas where, given the number and/or location of constraints, it was considered prudent to examine the options and implications thereof in greater detail and provide direct comparison with the A5WTC Proposed Scheme dual carriageway.

1.6.1 70m Buffer Zone

A *70m wide 'Buffer Zone'* was assessed to consider the impact that widening the existing A5 would have on properties and towns directly adjacent to the carriageway corridor, where the proposed upgrade was intended to be on-line. The 70m buffer width was selected to allow for the provision of local access roads, or Collector Roads as they were referred to, to run parallel to the dual carriageway. As described above, due to the purpose of the dual carriageway and the prohibition of local and private

accesses on and off the dual carriageway, primarily for road safety reasons, properties that currently access directly onto the A5 must be provided with an alternative means of access.

With the previously identified preferred dual carriageway option being totally off-line, once opened, strategic traffic would move onto the new dual carriageway. This would leave the former A5 available for local traffic to continue to make local journeys along it between individual properties and local settlements and facilities. If widening of the A5 was undertaken, the issue arises that the sections of former A5 running through settlements where widening was not undertaken would require to be connected together to maintain appropriate access to outlying properties and holdings.

The on-line option therefore require the inclusion of new roads to *collect* the traffic from these properties and redirect that traffic to appropriate locations where that traffic can then safely access the dual carriageway and/or other parts of the local road network. Given that the minimum width of the dual carriageway would be 26.1m. The minimum width of a local road would be 14.3m. An appropriate width of corridor to undertake the initial assessment was deemed to be 70m as it includes sufficient width for the carriageways, verges and potential earthworks, visibility sightlines for the side road junction with the existing A5, working room for construction such as service diversions and/or temporary traffic diversions, and potential environmental mitigation works such as noise barriers or planting..

The 70m Buffer Zone was therefore a nominal value to accommodate the width of potential local access requirements and the width of the dual carriageway. Supporting drawings are in Appendix B.

Having identified the extent of the 70m Buffer Zone on plan the assessment could then detail the properties, infrastructure and businesses severely affected by the increased road footprint. The assessment of the 70m Buffer Zone also served to demonstrate the impact on local access due to the construction of an On-line Dual Carriageway.

1.6.2 50m Buffer Zone

It was considered that dualling certain sections of the existing A5 was not a viable proposition. At these locations a 50m Buffer Zone was selected to examine the impact that widening the existing A5 would have on adjacent properties, local accesses and

side roads. The 50m Buffer Zone allowed primarily for the bypassing of towns and settlement areas for the avoidance of major constraints. Supporting Drawings are in Appendix C.

At a simple level the 50m Buffer Zone allowed for the width of the dual carriageway and a reasonable level of potential earthworks. However, after the initial review it was recognised that the '*50m Buffer Zone'* would need to be increased in width in a number of areas due to a number of criteria. The criteria included:-

- Implications of the existing topography on side slopes
- Implications of necessary side road structures to accommodate local road diversions
- Implications of accommodating specific local access
- Implications arising from the provision of potential accommodation structures

This criteria increased the *'buffer zone'* from 50m to 75m, 100m and 120m in specific areas.

The assessment of the off-line 50m Buffer Zone also assessed;

- the realignment of the existing A5 to provide for local access at locations where the On-line Dual Carriageway converged/diverged from the existing A5, and,
- the realignment of the side roads, identifying the potential closure of some of these side roads and identifying locations where accommodation structures may be required.

1.6.3 Specimen On-line Assessment Areas

A number of areas were identified along the 50m Buffer Zone where it was considered appropriate to develop a *Specimen Design Level* of detail, that is, a greater level of detail to:-

- provide further insight into the implications of a design;
- provide further reassurance that a design could be delivered at that location; or,
- to establish a design option at a heavily constrained location.

Two Assessment Areas were considered from each section of the A5, the assessment areas were:

1. Section 1 – *Maghermason Bypass*
2. Section 1 – *2+1 Climbing Lane Ballymagorry*
3. Section 2 – *Victoria Bridge Bypass*
4. Section 2 - *Newtownstewart Bypass*

5. Section 3 - *Greenmount Road Junction*
6. Section 3 - *Garvaghy Bypass*

These areas were chosen as a relevant comparison to the A5WTC Proposed Scheme Route. The direct impact of additional land requirements and diversions of the side roads, and accommodation tracks could then be evaluated. Supporting Drawings are in Appendix D.

The preliminary design of these On-line Specimen Assessment Areas included –

- A5WTC Horizontal Alignment
- A5WTC Vertical Alignment
- A5 Local Access Horizontal Alignment
- A5 Local Access Vertical Alignment
- Side Road Horizontal Alignment
- Side Road Vertical Alignment

The Specimen On-line Dual Carriageway alignments should provide a greater insight into the impact an On-line Dual Carriageway has on the environment and local road network. This may be demonstrated in the provision of the sections of A5 Collector Road, realignment of side roads and provision of access for residents.

1.6.4 Assessment Process

Having identified an option for the on-line upgrade of the A5 to dual carriageway from a highway engineering perspective based on the previous chapters, the option was circulated to the variety of disciplines involved with this project to review the potential implications of the options from their perspectives. For example, considerations and implications pertain not just to highway design and local access, but also to drainage requirements; flood risk implications; environmental considerations such as noise, air quality, landscape and community impact; buildability issues during construction; impacts on existing utilities such as electricity, water and telecommunications; traffic matters; financial implications; etc.

Disciplines provided initial feedback on the on-line option and ultimately commentary on the final on-line option together with qualitative and/or quantitative assessment of the assessed impacts.

1.7 Format of Report

This Report has been prepared to collate the assessments from the respective disciplines regarding an on-line upgrade of the existing A5 to a dual carriageway. Typically assessments by each discipline have been presented for the three sections into which the A5 project was previously split, namely:-

- Section 1: New Buildings to South of Strabane
- Section 2: South of Strabane to South of Omagh
- Section 3: South of Omagh to Aughnacloy.

This report is divided into the following sections:-

- Section 2 presents the Existing Conditions;
- Section 3 details the Engineering Assessment;
- Section 4 details the Environmental Assessment;
- Section 5 details the Traffic and Economic Assessment; and,
- Section 6 provides Comparison of On-line against Proposed Scheme Route
- Section 7 provides Conclusions

2 Existing Conditions

2.1 Introduction

Over the past twenty five years a series of local upgrades have been carried out along the entire length of the existing A5 in an attempt to improve both safety and journey times. Figure 2.1 shows the locations of these improvement schemes and Table 2.1 provides details of the scheme.

Table 2-1 Schemes carried out on A5

Upgrade Schemes carried out on the existing A5 prior to 2010			
1	Southbound climbing lane	16	Newtownstewart Bypass
2	Southbound right hand turning lane	17	Road realignment/widening
3	Road realignment/widening	18	Southbound right hand turning lane
4	Bend realignment/superelevation	19	Road realignment/widening
5	Road realignment/widening	20	Omagh Bypass Phase 2
6	Burn Dennet bridge widening	21	Omagh Through – Pass Phase 1
7	Northbound nearside passing bay	22	Omagh Bypass Phase 3
8	Northbound Two plus One and bridge widening	23	Southbound Two plus One
9	Refurbish overbridge/deck raised	24	Road widening
10	Strabane Bypass Phase 1	25	Southbound Two plus One
11	Strabane Bypass Phase 2	26	North and south bound right hand turning lanes
12	Road realignment and south bound right hand turning lane	27	Southbound overtaking lane and right hand turning lanes
13	North and south bound right hand turning lanes	28	Northbound right hand turning lane
14	Southbound nearside passing bay	29	Northbound climbing lane
15	Southbound right hand turning lane	30	Tullyvar Road realignment/Two plus One scheme

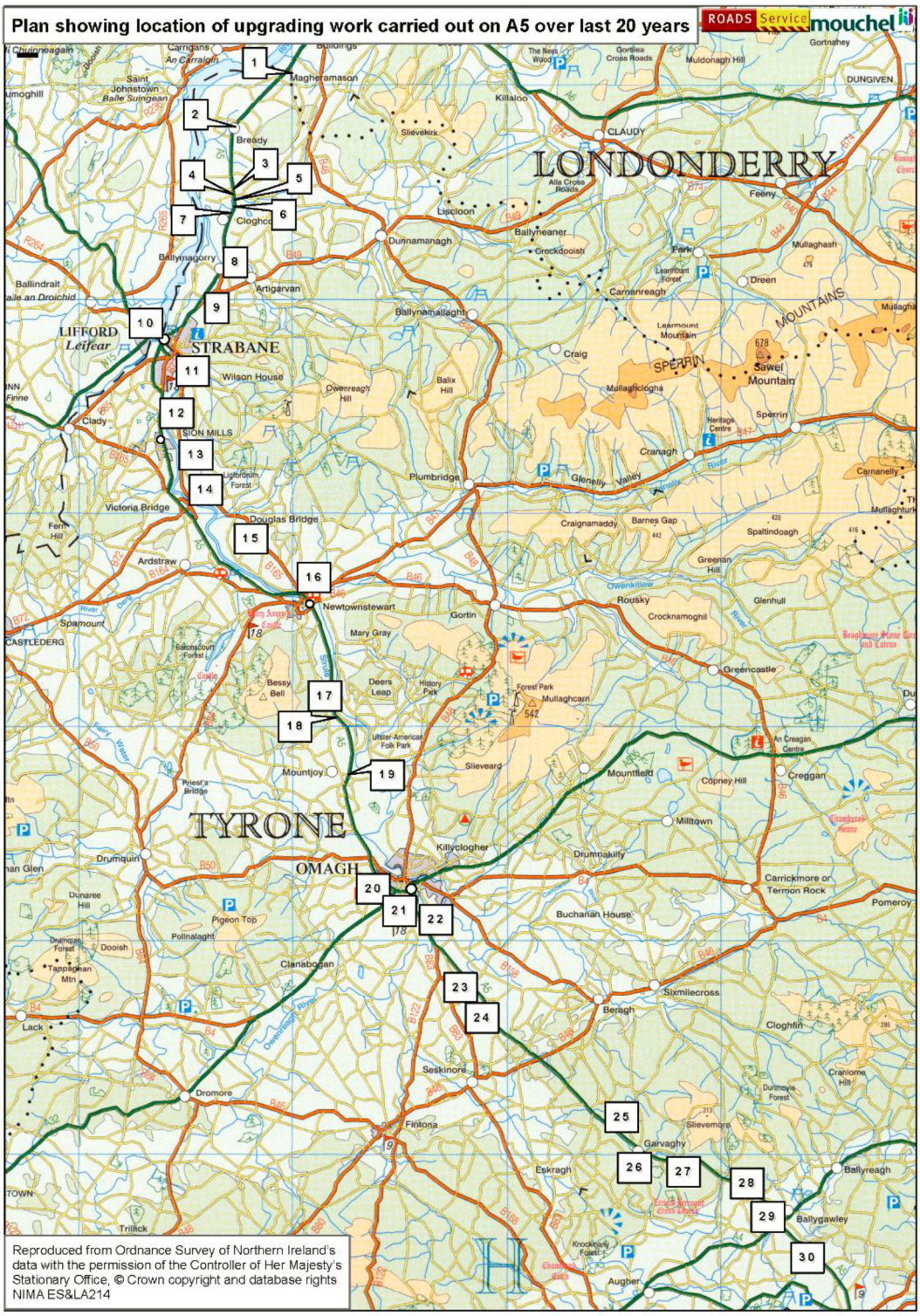

Figure 2-1 Upgrades to the existing A5 prior to 2010

A complete report of the Description of Current Network can be found in the *A5WTC Preliminary Options Report –Constraints Report Chapter 2, para 2.2.*

2.2 Existing Highway Network

A preliminary assessment of the existing Highway Network within the study area has been undertaken based on information available from published sources, consultations with statutory authorities, and field surveys.

A brief summary of the existing highway network is provided below:-

- The existing A5 is approximately 23km long in Section 1, 29.4km in Section 2 and 32km in Section 3. It is single carriageway with varying cross section widths but generally has a standard carriageway width of 7.3m.
- Large sections of the existing A5 have a design speed of 100kph in accordance with the Design Manual for Roads and Bridges (DMRB) TD9/93. A geometric assessment of the stopping sight distance, the horizontal alignment and the vertical alignment has been carried out. The assessment confirms that the specific desirable minimum geometric standard is not regularly achieved along the existing road.
- The majority of the existing A5 is derestricted, therefore the national speed limit of 60mph applies. However, within settlements the speed limit is reduced generally to 30mph or 40mph. As described above, some sections of the road are not of a suitable geometric standard; thus an imposed speed limit of 50mph and 40mph is applied to some of the affected areas.
- There are a number of A-Class roads and B-Class roads which connect with the existing A5. A local side road network also provides access to the developments and farms on either side of the A5. Over 200 side roads connect with the existing A5 (mainly priority junctions); and there are over 400 private, commercial and field accesses along the road, excluding those in settlement areas, such as Strabane and Omagh.
- There are a limited number of over-taking opportunities along the existing A5 except for the 2+1 climbing lanes.
- As previously explained, a number of localised improvements to the road have been carried out over recent years, however, significant causes of delay and accidents remain.
- Hardstrips are not a regular highways feature, verge widths vary significantly and footways are generally present in and around settlements only. Lay-bys are provided frequently, and public transport services occasionally utilise them as bus stops.

A full schedule of sources and consultations can be found in the *A5 WTC Preliminary Options Report- Chapter 2, Section 2.4*

2.3 Existing Drainage Conditions

A preliminary assessment of the existing drainage and hydrological conditions along the A5 corridor has been undertaken based on information available from published sources, consultations with statutory authorities and field surveys.

A summary of the existing drainage and hydrological conditions, including any constraints associated with dualling the existing A5, are as follows:-

- The watercourses along the existing A5 vary in nature and in size, from small streams to major rivers.
- There are approximately 109 watercourse crossings along the length of the existing A5.
- The water collected on the road is generally drained and discharged into these watercourses and associated systems.

2.3.1 Section 1

The watercourses in Section 1 flow from the south to the north, joining with the River Foyle which discharges into Lough Foyle, north of Londonderry. The Foyle basin comprises the Mourne River and the River Foyle. The Glenmornan and the Burn Dennet join the River Foyle near Ballymagorry.

As Lough Foyle experiences tidal activity (2 high tides per lunar day), it exerts a tidal influence on the River Foyle as far upstream as Strabane.

Some of the most significant floodplain areas in Section 1 are Burn Dennet, Foyle and Ballymagorry Burn. Through discussions with TransportNI and Rivers Agency, it has been identified that the following sections of the existing A5 have been prone to historical flooding:-

- South of Burn Dennet Bridge.
- Urney Road

There are a number of flood defence systems between New Buildings and Sion Mills. These structures vary from area to area; for example, there are concrete flood defences in Strabane, clay embankments along the Burn Dennet, and earthen embankments along the Glenmornan River in Ballymagorry.

2.3.2 Section 2

The primary watercourse located in Section 2 is the Strule/ Mourne River, flowing from Omagh to Strabane (from south to north). Its principle tributaries include the Fairywater, River Derg and the Owenkillew River, which both largely have rural catchment areas.

Some of the most significant floodplain areas in Section 2 are Owenkillew River and Fairy Water. Through discussions with TransportNI and Rivers Agency, it has been identified that the following sections of the existing A5 have been prone to historical flooding:-

- The Fairywater.
- North of Mountjoy.
- The River Derg

There are defended floodplains to the north west of Omagh, close to the Fairywater and concrete flood walls exist in Omagh.

2.3.3 Section 3

The main catchment areas located in Section 3 are the Camowen basin, the Quiggery Water basin and the Drumragh basin - all which feed into the River Foyle. The River Foyle flows northwards where it discharges into Lough Foyle. The River Blackwater flows southward towards Lough Neagh.

The most significant floodplain areas in Section 3 are Owenreagh River, Fintona River, Seskinore River and Roughan River. Through discussions with TransportNI and Rivers Agency, it has been identified that the following sections of the existing A5 have been prone to historical flooding:-

- Area west of Ballygawley Roundabout.

- Low-lying ground around River Blackwater, Aughnacloy.
- The fields adjacent Tattyreagh Road.

A full schedule of sources and consultations can be found in the *A5 WTC Preliminary Options Report - Chapter 4, Section 4.4.*

2.4 Existing Geotechnical Conditions

A preliminary assessment of the key geological & geotechnical constraints within the study area has been undertaken based on information available from published sources, consultations with statutory authorities, and field surveys.

A summary of the existing geotechnical conditions, including any constraints associated with dualling the existing A5, is provided below.

2.4.1 Section 1

The existing A5 dictates an east-west division. To the west of the A5, there is a floodplain associated with the River Foyle. Floodplains are broad, flat areas of land consisting of alluvium.

To the east of the A5, Precambrian rocks associated with the Sperrin Mountains lead to rapid land variation (steep sloped valleys and summits) and can come close to the ground surface. It can be expensive where excavation earthworks are required for new roads due to this hard, shallow rock.

2.4.2 Section 2

North of Newtownstewart, the valley system is wide with sand and gravel deposits. However, the valley is narrow, with steep sided hills, south of Newtownstewart. At the outskirts of the valley, the ground rises steeply into the Sperrin Mountains and Bessy Bell.

Similar to Section 1, there are floodplains due to the close proximity of the Mourne River and the River Strule. It has been confirmed that the sands, gravels and clays (alluvium) associated with the floodplains can be up to 25m deep at Strabane and Newtownstewart.

South of Mountjoy, the topography levels to form an open, lower-lying landscape.

As the existing A5 travels further south, mounds of stony clay, known as drumlins, begin to form around Omagh.

2.4.3 Section 3

Drumlins are frequent along the route, especially in Section 3. Expensive drumlin excavation would be likely if the existing A5 were to be straightened and/or widened.

Blanket bogs, raised bogs and peat forming in between drumlin areas are common. Peat is highly compressible and presents expensive complications in terms of structure and road foundations.

Floodplains associated with the Ballygawley River and the River Blackwater are encountered near Ballygawley and Aughnacloy, which are predicted to consist of soft clay and gravel.

2.4.4 Contaminated Land

There are a number of industrial sites, petrol filling stations and disused corn and flax mills located along the existing A5 which pose a risk to ground contamination.

The Strabane and Omagh areas are considered the most likely to suffer from ground contamination – due to historical and existing land-use; including gasworks sites, abattoirs, petrol filling stations and various other industrial sites.
There are known landfill sites in 6 locations and areas which suffer from fly tipping have been identified.

Before construction would commence, the affected land would need to undergo remediation processes. These processes could range from treating the contaminated land, to completely excavating the land and re-filling the excavation with uncontaminated earth. These processes can be expensive and time consuming, especially if excavation is required.

A full schedule of sources and consultations can be found in the A5 WTC Preliminary Options Report- Chapter 2, Section 2.4 and Chapter 4, Section 4.3.

2.5 Existing Structures

A preliminary assessment of the key existing structures constraints within the study area has been undertaken based on information available from published sources, consultations with statutory authorities, and field surveys.

A summary of the existing structures, including any constraints associated with upgrading the existing A5, are as follows:-

- There are currently 42 bridges along the length of the existing A5.
- 32 of these bridges carry the existing A5 over watercourses and vary significantly in terms of span, type and construction.
- The bridges have a median span of 4.1m and a maximum span of 118.9m. The current state of these bridges are highlighted below:-
    - 4 bridges are considered to be in poor condition;
    - 21 bridges are considered to be in fair condition; and,
    - 17 bridges are considered to be in good or very good condition.
- There are also 79 smaller bridges and culverts with a span less than 1.8m, and 21 retaining walls over 1m in height along the existing A5.
- The majority of the existing structures located along the route could be widened albeit various constraints adjacent to these structures would introduce issues.
- The minority of the structures would need to undergo remedial action, or be completely rebuilt, as some are considered to be at high risk of needing major repairs in the short to medium term. Vertical alignment issues have also been identified during the geometric assessment.

A full schedule of sources and consultations can be found in the A5 WTC Preliminary Options Report- Chapter 2, Section 2.5 and Chapter 4, Section 4.1.

2.6 Existing Pavement Conditions

A preliminary assessment of the key existing pavement conditions within the study area has been undertaken based on information available from published sources, consultations with statutory authorities, and field surveys. Below is a brief summary of these constraints:-

- The existing road pavement is in a variable state, with some sections having been recently resurfaced and upgraded, while others are showing signs of deterioration.
- There are several relatively new sections of pavement throughout the scheme, such as the recently completed Strabane and Omagh Through Passes, Tullyvar upgrade and the Newtownstewart Bypass.
- Various surveys have been carried out to assess the condition of the road between the Craigavon Bridge in Londonderry and Aughnacloy.

Full details on the condition of the existing pavement can be found in A5WTC Preliminary Options Report- Chapter 4 para 4.2.

2.7 Existing Environmental Conditions

Identification of the key environmental constraints within the environmental study area has been completed using information available from published sources, consultations with statutory authorities and field surveys.

A summary of the existing environmental conditions, including any constraints associated with upgrading the existing A5 is provided below.

2.7.1 Section 1

There are numerous residential, agricultural and commercial properties/buildings between New Buildings and Sion Mills. There are several settlements which can be recognised as key environmental receptors with regards to air quality, visual, land use, noise and community.

The largest settlements in this section are New Buildings and Strabane. There are a range of communities/amenities within these settlements such as schools, places of worship, cemeteries, etc.

A significant number of heritage sites of different eras and types exist in Section 1, including used and disused corn mills, flax mills, St. Comgall's Well and the former Strabane Canal.

The River Foyle and its tributaries, the River Faughan and its tributaries and the Finn River are Special Areas of Conservation (SAC), which are internationally protected sites due to their vegetation and / or wildlife.

McKean's Moss I and II are located north of Ballymagorry and are Areas of Special Scientific Interest (ASSI).

There is the potential for invertebrate assemblages, barn owls, bats, fish, otter, smooth newts and other species in the watercourses, properties and grasslands located in the on-line assessment study area.

Full details of the then existing environment conditions for Section 1 can be found in *A5WTC Preliminary Options Report- Chapter 2, Section 2.7.2 and Chapter 5, Section 5.6.*

2.7.2 Section 2

There are numerous residential, agricultural and commercial properties/buildings between Sion Mills and the South of Omagh. There are several settlements which can be recognised as key environmental receptors with regards to air quality, visual, land use, noise and community.

The largest settlements in this study area are Newtownstewart and Omagh. There are a range of communities/amenities within these settlements such as schools, hospitals, places of worship, etc.

A number of heritage sites of different eras and types are situated throughout the section, including mill ponds, flax mill sites, a Franciscan Friary and a Holy Well.

The Sperrins Area of Outstanding Natural Beauty (AONB), Harry Avery's Castle and the Ulster-American Folk Park are sites of natural landscape and cultural significance. The River Foyle and its tributaries, the Owenkillew River, Tully Bog, Fairywater Bogs and Monegal Bog are Special Areas of Conservation (SAC) close to the A5, which are

internationally protected sites due to the Annex I habitats and / or the Annex II species they support.

There is the potential for invertebrate assemblages, barn owls, bats, fish, otter, smooth newts and other species in the watercourses, properties and grasslands located in the on-line assessment study area.

Full details of the then existing environment conditions for Section 2 can be found in *A5WTC Preliminary Options Report- Chapter 2, Section 2.7.3 and Chapter 5, Section 5.6.*

2.7.3 Section 3

There are numerous residential, agricultural and commercial properties/buildings between the South of Omagh and Aughnacloy. There are several settlements which can be recognised as key environmental receptors; with regards to air quality, visual, land use, noise and community.

The largest settlements in this study area are Garvaghy, Ballygawley and Aughnacloy. There are a range of communities/amenities within these settlements such as schools, places of worship, orange halls, etc.

A number of heritage sites of different eras and types are presented throughout the section, including a creamery site, a bronze-age mound and urn burial, limestone quarry and a lime kiln.

Clogher Park, Favour Royal and The Thistle are Registered Parks, Gardens and Demesnes of Historic Interest. There is the potential for invertebrate assemblages, barn owls, bats, fish, otter and other species in the watercourses, properties and grasslands located in the on-line assessment study area.

Full details of the then existing environment conditions for Section 3 can be found in *A5WTC Preliminary Options Report- Chapter 2, Section 2.7.4 and Chapter 5, Section 5.6.*

2.8 Existing Traffic Conditions

A preliminary assessment of the key existing traffic within the study area has been undertaken based on information available from published sources, consultations with statutory authorities and field surveys. Transport NI has a system of Automatic Traffic Counters which regularly monitor the traffic flows on key roads within Northern Ireland. Collision data has also been collected by the PSNI on all roads within Northern Ireland.

A summary of the existing traffic conditions, including any constraints associated with dualling the existing A5, are as follows:-

- A comprehensive survey of traffic has also been previously undertaken in the engineering study area, in order to provide data for the development of the Transport Models and to understand the travel patterns on the existing A5 and other key roads. Details of this data was reported in A5WTC Preliminary Options Report - Chapter 2, Section 2.8 and Chapter 6.
- The traffic flows on the existing A5 lead to congestion during peak times, especially in urban areas. The flow ranges measured in vehicles per day (vpd) are highlighted below (Ave. Mondays to Thursday, October 2013):

    - Between Londonderry and Omagh 11,000 – 18,500 vpd
    - Omagh Throughpass 18,000 vpd
    - Between Omagh and Ballygawley 11,500 vpd
    - Between Ballygawley and Aughnacloy 8,000 vpd

- Due to the nature and number of the vehicles, the prevailing traffic conditions during peak periods, and, the geometric standard of the existing A5, speeds and journey times are variable. HGVs and agricultural vehicles force lighter vehicles to slow down, which can lead to overtaking at unsuitable locations, increasing the possibility of collisions. Suitable overtaking opportunities are intermittent along the existing road.
- The collision rates on the A5 are similar to the United Kingdom's average for similar roads. However, the ratio of serious and fatal accidents is higher than the Northern Ireland average.

Full details of the existing traffic conditions can be found in A5WTC Preliminary Options Report - Chapter 2, Section 2.8 and Chapter 6.

2.9 Existing Utilities

A preliminary assessment of the key utilities along the A5 corridor has been undertaken based on information available from published sources, consultations with statutory authorities and field surveys.

A summary of the existing utilities, including any constraints associated with upgrading the existing A5, are as follows:-

- There are extensive electricity, potable water supply, sewage networks and telecommunication apparatus located within the vicinity of the existing A5.
- Services are concentrated within development limits and service providers utilise the existing A5 as a strategic corridor to transfer services between settlements. The major services in the engineering study area are as follows:-
    - NIE 110kV, 33kV, 11kV & MV
    - NIW mains & combined sewers
    - 3
    - O2
    - EE
    - Vodafone
    - Gas apparatus
    - BT (overhead & underground)
    - Atlas Communications (NI) Ltd
    - Eir
    - Virgin Media
- There can be substantial costs involved in diverting utilities, particularly fibre optic cables and relocating electric overhead lines and associated supporting towers. Any directly affected services would require alterations and / or diversionary works.
- In addition to the permanent diversionary works, temporary works may be essential in order to maintain services during construction phases, which could also attract significant associated costs.

Full details of the extent of the existing utility infrastructure is reported in A5WTC Preliminary Options Report - Chapter 4, Section 4.5.

3 Engineering Assessment

3.1 On-line Dual Carriageway

It is recognised that, in a lot of instances, it is not appropriate to construct a dual carriageway through development areas because of the significant impacts associated with loss of property and severance. In this assessment, therefore, it has been identified that bypasses would be required for New Buildings, Magheramason, Ballymagorry, Strabane, Sion Mills, Newtownstewart, Omagh, Ballygawley and Aughnacloy. Through the development of the Proposed Scheme the optimum locations for these bypasses has been identified and the On-line Dual Carriageway incorporates the Proposed Scheme Route alignment where appropriate.

The development of the On-line Dual Carriageway was established with the '70m Buffer' Route which utilised the entire existing A5 without by passing any settlements, avoiding properties or buildability issues.

From the 70m Buffer Route it was established that major constraints of properties and development limits were to be avoided where possible, which led to the '50m Buffer' Route.

The On-line '50m Buffer' Route and Specimen Design Route have been developed to produce a compliant design with no Departures from Standard on the mainline.

The Dual Carriageway alignment allowed for the use of the existing A5 at a number of locations. The '50m Buffer' has been designed to ensure a horizontal alignment is achieved with a compliant horizontal and vertical alignment carried out for the Specimen Design areas.

The following is a brief overview of the 50m Buffer Route detailing the route and implications it has for the side roads and existing A5. This is not a definitive list, highlighting the main aspects of the route.

The assessment of the On-line Dual Carriageway and review of the existing A5 started at Craigavon Bridge. This is approximately 4450m from the start of the A5WTC Proposed Scheme Route corridor assessment at New Buildings.

To ensure consistency with previously published reports, and to ensure a comparison could be made with this information it was deemed necessary to keep with this chainage. Therefore throughout this report the start chainage would be 4450m with all other chainage measured from this location.

The Proposed Scheme chainage starts at 0m at New Buildings. All published documents and brochures relating to this scheme would have chainage 0m at this location. For the purposes of this report the aforementioned chainage of 4450m would be the reference point and start chainage.

3.1.1 Section 1

The alignment, as shown in Appendix B and C, begins with a bypass around New Buildings from CH 4450 – Ch 5650, due to the impact upgrading the existing road would have to properties, the existing road infrastructure and the residents of New Buildings.

The start of this dual carriageway uses the Proposed Scheme Route from CH 4400 – 5250. This On-line Dual Carriageway uses the same alignment as the Proposed Scheme Route for approximately 830m before connecting to the new junction roundabout.

The new junction is shown on the south side of New Buildings, the alignment utilises approximately 500m of the existing of A5 before moving off-line for the bypass of Magheramason. In utilising this length of A5, approximately 935m of new single carriageway would need to be constructed for a Collector Road and the realignment of Tagharina Road.

After the bypass of Maghermason, Dunnalong Road would need to be realigned by approximately 500m and bridge over the On-line Dual Carriageway. The on-line alignment then utilises the existing A5 for 1000m, this results in the 468m realignment of Meenagh Road to Keery Road over the On-line Dual Carriageway.

The alignment moves off-line to avoid the village of Bready. At this location the alignment follows the Proposed Scheme Route, from CH 10200 – 11250. The alignment utilises the Proposed Scheme Route bypassing Bready and requiring the

large earthwork cutting. The On-line Dual Carriageway uses approximately 1000m of the Proposed Scheme Route.

This alignment would result in the construction of approximately 730m of A5 Collector Road and the realignment of Grangefoyle Road, Willow Road and Grange Road with approximately 1050m of side road diversions required. Willow Road would have no direct access onto the A5 Collector Road.

The On-line Dual Carriageway would cross the Burn Dennet River before utilising the existing A5 from CH 13950 – 16450 through Cloghor before moving off-line to bypass the town of Ballymagorry. The utilisation of the existing A5 at this location results in the construction of 2700m of new A5 Collector Road, and the realignment of Loughneas Avenue, which would be diverted on to Cloghor Road.

The dual carriageway bypasses the village of Ballymagorry crossing the Glenmornan River, Greenlaw Road and Park Road. A strategic junction location is proposed on north side of Strabane. This junction links the existing A5 with the proposed scheme, at this location the route remains off-line and runs parallel to the existing Derry Road into Strabane.

At this location the On-line Dual Carriageway follows the same alignment as the Proposed Scheme Route, from CH 18300- CH 22250. The On-line Dual Carriageway uses approximately 3800m of the Proposed Scheme Route. This is due to the number of properties at this location.

From CH 18850 – CH 22500 the volume of properties, services, business' and existing road infrastructure in this area do not permit the existing A5 to be utilised for the dual carriageway.

The dual carriageway bypasses the existing road infrastructure of the Bradley Way and Asda roundabouts. To utilise this area of the existing A5 would have buildability issues while maintaining access to properties, retail and through traffic.

The dual carriageway uses the existing bypass, Great Northern Link road, for the dual carriageway. This road corridor has a road footprint of 26.1m, it is anticipated that a retaining wall would need to be constructed for a length of 1.45km either side of the

carriageway from CH22550- CH24000. The need for retaining wall is due to the limited area available to increase the width of the existing embankments. This retaining wall would reduce the impact on the properties adjacent to the Great Northern Link, however a number of properties may still be affected.

When using the Great Northern Link as the dual carriageway corridor Urney Road would be significantly affected. This would cause the junction of Urney Road and Great Northern Link to be closed, with a 667m diversion of Urney Road on to Great Northern Link to tie in with the junction with B72 Bradley Way. A number of properties would be severely affected.

In using the Great Northern Link as a dual carriageway, local traffic would use the existing B72 Bradley Way. This would cause high traffic volumes through Strabane and may significantly impact on the flow of traffic through the town. In contrast local traffic may use the new dual carriageway as a 'rat run' which would result in a negative impact on the dual carriageway and may result in higher traffic volumes on the strategic route.

A strategic junction is located at end of the Great Northern Link Road. This junction would form a link between the Dual Carriageway, Lifford town (N14) and B72 Melmount Road. This junction would provide numerous links, and may need to be increased in size in order to facilitate all the free flowing movement of the strategic traffic through Strabane.

At this junction location, Castletown Road and Strahans Road would need to be realigned. The realignment of Strahans Road may cause issues when connecting to the proposed roundabout. This would create a 5 arm roundabout on this strategic junction.

The On-line Dual Carriageway route continues off-line from the existing A5 due to the proximity of Strabane and Sion Mills. The On-line Dual Carriageway uses the same alignment as the Proposed Scheme at this location. From CH 25650 – CH 26550 the On-line Dual Carriageway uses approximately 860m of the Proposed Scheme Route.

A number of side roads are affected by this On-line Dual Carriageway route including Orchard Road. The junction of Castletown Road and Knockroe Road would need to

be realigned and a structure provided. Knockroe Road is realigned by 715m.The route continues off-line and a new strategic junction is provided north of Sion Mills.

The approximate length of the existing A5 in Section 1 (New Buildings to Sion Mills) is 22.95km. The On-line Dual Carriageway uses approximately 5.65km of the existing A5, which equates to 25% of utilisation of the existing road network.

Table 3-1 Section 1 Length of Existing A5 Utilised as On-line Dual Carriageway

Length of Existing A5 (m)	Length of Existing A5 Utilised as On-line Dual Carriageway (m)	% of Existing A5 Utilised as On-line Dual Carriageway
22950	5650	25%

The total length of On-line Dual Carriageway is approximately 23.2km. This route utilises approximately 5.65km of the existing A5 road, which equates to 24%.

Table 3-2 Section 1 Percentage of Dual Carriageway On-line

Total Length of On-line Dual Carriageway (m)	Length of Existing A5 Utilised for On-line Dual Carriageway (m)	% of Proposed Dual Carriageway On-line
23200	5650	24%

Whilst 5.65km of the existing A5 would be utilised for the dual carriageway a new A5 Collector Road of 7.46km would need to be constructed. The existing A5 can be used as A5 Collector for approximately 16.75km, with the remaining existing A5 used as local or property accesses.

As the On-line Dual Carriageway moves away from the existing A5, and utilises the Proposed Scheme Route for over 7km. See Table 3.3

Table 3-3 Section 1 On-line Dual Carriageway Utilising Proposed Scheme Route

Existing A5 Chainage	Approximate Utilised Length of Proposed Scheme Route (m)
4400 - 5250	831
10200 - 11250	1001
18300 - 22250	3872
23150 - 23500	516
25650 - 26550	860
TOTAL	**7080**

In Section 1 the On-line Dual Carriageway uses over 30% of the Proposed Scheme Route.

3.1.2 Section 2

The On-line Dual Carriageway continues off-line from the existing A5, bypassing the village of Sion Mills, affecting a number of side roads. Primrose Park, Garden Road and Seein Road would need to be realigned, with Seein Road and Primrose Park bridged over the dual carriageway and Garden Road diverted under the dual carriageway.

The On-line Dual Carriageway follows the same alignment as the Proposed Scheme Route from CH 26550 -26900 for approximately 350m around the village of Sion Mills.

The On-line Dual Carriageway route utilises the existing A5 north of Victoria Bridge, from CH 29450 – 31950, this results in the provision of approximately 700m of new A5 Collector Road tying in to Melmount Road through the village of Victoria Bridge.

The A5 Collector Road would increase traffic though the village, which may cause traffic disruption and increase noise and traffic pollution. Additional vehicles such as tractors would need to use the town as a through traffic route.

The On-line Dual Carriageway utilises the existing A5 for 2500m, however due to the proximity of the properties and the vertical alignment a retaining wall would need to be constructed from CH 29800 – CH 31150 in order to reduce landtake and the impact on properties and business in Victoria Bridge. A number of the direct accesses from

the village to the existing A5 would be stopped up with a number of side roads realigned.

Limited access junctions are proposed at the north and south of Victoria Bridge to provide connectivity between the village and the dual carriageway. Similar to the north of Victoria Bridge, 2000m of new A5 Collector Road is needed south of Victoria Bridge to provide a connection for local traffic. Although when utilising this section of the existing A5 no side roads are affected, there are a number of private accesses directly affected, which would cause difficulty to landowners and may cause severance issues which may require additional accommodation structures and significant lengths of private access roads.

At CH 32800 the On-line Dual Carriageway crosses to the east of the existing A5, with the existing A5 retained. At his location Old Bridge Road is stopped up with access maintained at CH 33650. The On-line Dual Carriageway route crosses the River Derg with a proposed structure of 29m and there are significant earthworks at this location due to the existing ground conditions and proximity to the river.

South of the Derg crossing the route runs parallel and to the east of the existing A5, there are a number of private access issues as well as accommodation structures required from CH 33950 to 36050. The On-line Dual Carriageway utilises the existing A5 at CH 36050 requiring 1628m of new A5 Collector Road. Deerpark Road ties in to the new A5 Collector Road at CH 35950 with a new accommodation structure provided for the properties to the east of the On-line Dual Carriageway.

The A5 Collector Road ties in to the existing Strabane Road, which runs through the village of Newtownstewart, whilst the On-line Dual Carriageway utilises the existing Newtownstewart bypass. The A5 Collector Road would increase traffic though the village, which may cause traffic disruption and increase noise and traffic pollution. Additional vehicles such as tractors would need to use the town as a through traffic route.

Utilising the existing Newtownstewart bypass requires significant works to the existing road infrastructure, with existing structures to be widened and the road being significantly widened to ensure a compliant design is achieved with no Departures from Standard.

There are significant side road realignments required in using the Newtownstewart bypass. The Douglas Road and Plumbridge Road would need to be realigned, with Douglas Road requiring a realignment of 1021m.

Due to the difficulty in providing a junction at one location, it is anticipated that there would be junctions on the north and south side of Newtownstewart. These junctions would provide links with dual carriageway at Newtownstewart.

The On-line Dual Carriageway continues to utilise the existing A5 with a new structure required over the River Strule and flood plain at CH 38150. There are significant earthworks from CH 38500 – 41800 due to the topography of the existing ground. The typical cross sections for the length of the scheme can be found in Appendix A. Below is a typical cross section detailing the earthworks, On-line Dual Carriageway and A5 Collector Road.

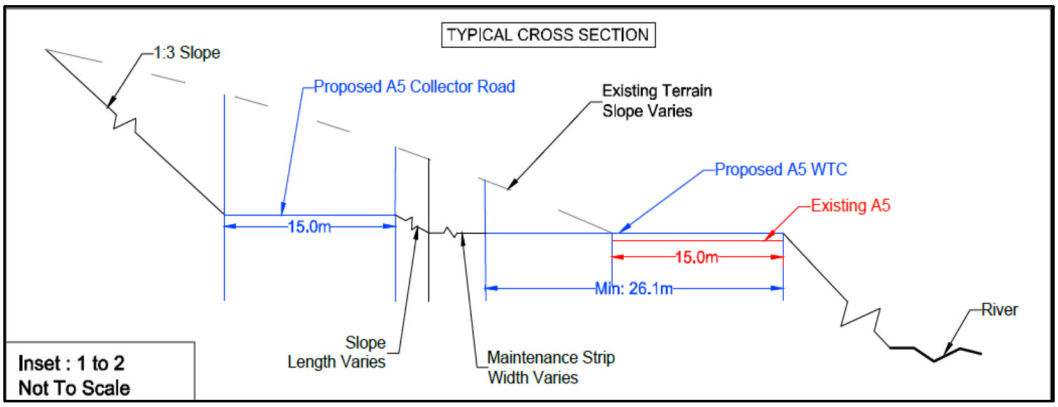

Figure 3-1 Cross Section for Section 2

At these locations the width of the Buffer is significantly increased to 150m. 3876m of new A5 Collector Road is required south of Newtownstewart and ties in to the existing A5 at CH 42400. The A5 Collector road would require significant earthworks due to the vertical alignment and tie in to the existing Moyle Road, this alignment requires a 385m realignment of Grange Road.

This area would require significant land take due to the realignments of the existing road infrastructure and the topography. The On-line Dual Carriageway can only be widened to the west of the existing A5, due to the constraints of the River Strule to the

east. There is significant cutting along the west of the existing A5, this is due to the increase in the footprint of the proposed On-line Dual Carriageway.

The route would require a dual carriageway width of 26.1m plus an additional 15m for the A5 Collector Road, which gives a road construction width of 41.1m. However due to the topography in this area, the area for the construction of the On-line Dual Carriageway route is pushed out to 150m, over three times the proposed carriageway widths.

A number of side roads and accesses would be affected from CH39350 – CH42350 this includes Hamilton's Road and West Road. There is difficulty in providing compliant design to meet the current standards due the existing vertical geometry. The existing roads provide access for a number of landowners which would need to be kept open. A number of structures would be required to keep these roads open and sub-standard geometry employed due to the topography.

At CH 41600 the A5 Collector Road switches from the west of the On-line Dual Carriageway to the east. The switch is required to allow the A5 Collector road to tie in to the existing road at CH 42400, to provide access to properties and limit the impact on landowner owners. The skewed structure required is approximately 250m in length and would cross over the dual carriageway. There would be significant costs in constructing this structure.

The On-line Dual Carriageway follows the same alignment as the Proposed Scheme Route from CH 42650 -43550 for approximately 900m. The Proposed Scheme Route at this location avoids a number of properties and environmental constraints.

The dual carriageway continues off-line to the west of the existing A5 to avoid properties and businesses, the existing A5 is used as the A5 Collector Road from CH 42400 to CH 43400. Gordon's Lane would need to be realigned due to the alignment of the On-line Dual Carriageway. Due to the existing alignment of Gordon's Lane, significant works would be required to allow for a suitable standard of design. Drawing 718736-S2-0800-1430 shows an indicative realignment of Gordon's Lane.

The On-line Dual Carriageway utilises the existing A5 again at CH 43650 until CH 47900. In utilising the existing A5, approximately 3304m of new A5 Collector Road

would be required. In order to reduce the landtake required for the A5 Collector Road, this road is realigned to the existing Broadford Road which would need to be upgraded to reflect the current standards for a 100kph design speed. This realignment would allow for access to be maintained to the Ulster-American Folk Park. The park is a significant constraint along the existing A5 and access would need to be maintained.

The original A5 road would be de-trunked and utilised as a private access for a number of properties with an accommodation structure provided under the On-line Dual Carriageway at CH 45150.

The On-line Dual Carriageway continues to use the existing A5 road footprint, which results in the A5 Collector Road crossing from the eastern side of the existing A5 to the west. The switch provides access to a number of properties and land boundaries, and ties in to the existing A5 at CH46750. Using the existing A5 allows the connectivity with the village of Mountjoy, through Mountjoy Avenue and Castletown Avenue.

However, due to the On-line Dual Carriageway on the eastern side of the existing A5, structures would be required on Gortnagarn Road and Connaghty Road to keep these roads open.

At CH 47800 the On-line Dual Carriageway crossed over the existing A5 road, this results in a skewed span structure of approximately 70m. The On-line Dual Carriageway switches to join the junction proposed to the north of Omagh and continues west of Omagh bypassing the town, providing a link to the A32.

The On-line Dual Carriageway uses over 8km of the Proposed Scheme Route around the town of Omagh.

The approximate length of the existing A5 in Section 2 (Sion Mills to South of Omagh) is 29.40km. The On-line Dual Carriageway uses approximately 11.50km of the existing A5, which equates to 39% of utilisation of the existing A5 road network.

Table 3-4 Section 2 Length of Existing Utilised as On-line Dual Carriageway

Length of Existing A5 (m)	Length of Existing A5 Utilised as On-line Dual Carriageway (m)	% of Existing A5 Utilised as On-line Dual Carriageway
29400	**11500**	**39%**

The total length of On-line Dual Carriageway route is approximately 31.3km. This route utilises approximately 11.5km of the existing A5 road, which equates to 36%.

Table 3-5 Section 2 Percentage of Proposed Dual Carriageway On-line

Total Length of On-line Dual Carriageway (m)	Length of Existing A5 Utilised for On-line Dual Carriageway (m)	% of Proposed Dual Carriageway On-line
31300	**11500**	**36%**

When the existing A5 is utilised for the On-line Dual Carriageway a new A5 Collector road must be constructed to allow for local traffic. The length of the A5 Collector road is approximately 12.10km.

The existing A5 can be used as the A5 Collector for approximately 17.90km, with the remaining existing A5 used a local or property accesses.

As the On-line Dual Carriageway moves away from the existing A5,it utilises the Proposed Scheme Route for nearly 10km.

Table 3-6 Section 2 On-line Dual Carriageway Utilising Proposed Scheme Route

Existing A5 Chainage	Utilised Length of Proposed Scheme Route (m)
26550 - 26900	351
42650 - 43550	902
49100 - 56900	8366
TOTAL	**9619**

In Section 2 the On-line Dual Carriageway uses 31% of the Proposed Scheme Route.

3.1.3 Section 3

The On-line Dual Carriageway continues south of Omagh from the west to create a junction at the existing Seskinore Road. This junction would provide a link between the existing A5 and the dual carriageway. As part of the provision of the junction at this location the existing Seskinore Road is realigned over 619m and a new roundabout provided on the existing A5.

The dual carriageway continues to the east utilising the existing A5 at CH 58500 to CH 60800, which would result in a number of side road diversions and the provision of approximately 2339m of new A5 Collector Road.

The On-line Dual Carriageway utilises Doogary Road, this results in the realignment of Camowen Road for approximately 71m. A new structure would be proposed for the realigned Drumconnelly Road which is diverted under the proposed dual carriageway. Due to the properties and businesses on the westerly side of the existing A5, a new local side road access is required. The existing A5 can be utilised to provide this access which would tie in to a junction with realigned Drumconnelly Road and Tattykeel Road. The length of the local side road access is approximately 671m.

Cranmore Road would be realigned by 97m in order to tie in to the new A5 Collector Road, the collector road ties back in to the existing A5 at CH 60800. This allows Tullyrush Road to remain open with the southern part of Tullyrush Road realigned for 140m under the proposed dual carriageway. The dual carriageway continues to run parallel on the westerly side of the existing A5, which allows the existing A5 to remain as the A5 Collector Road.

The On-line Dual Carriageway utilises the existing A5 from CH 61700 to CH 63250, which would require approximately 1547m of new A5 Collector Road. The provision of the new collector road would allow connectivity between the side roads, properties and landowners, thus keeping Rarone Road, Drumconnelly Road and Crannoge Road open albeit realigned. A structure would be provided for Rarone Road and Drumconnelly Road to pass below the dual carriageway, which results in 145m realignment of Rarone Road and 145m realignment of Drumconnelly Road. Crannoge Road would be realigned to tie in to the new A5 Collector Road.

A strategic junction is proposed to link the B46 Moylagh Road, existing A5 and dual carriageway. The location of the junction on the B46 would provide access to the village of Moylagh and surrounding areas. This junction would be a compact junction to reduce the landtake and impact on properties, however there would be significant realignments to the B46 and A5 which would result in additional landtake and impact on properties.

From CH 64950 – CH 66500 the On-line Dual Carriageway continues off-line, due to the geometry of the existing A5. The geometry of the existing A5 is sub-standard for a Design Speed of 100kph, significant works would be required to upgrade this stretch of carriageway to a Design Speed of 120kph. The substandard Horizontal restricts the utilisation of the existing A5, if more of the existing A5 were to be utilised, a new A5 Collector Road would need to be constructed and there would be significant impact on properties and landtake. Kiladroy Road would remain open and be diverted under the on-line dual carriageway, this would increase the earthworks at this location.

The dual carriageway continues to utilise the existing A5 from CH 66600 – CH 68550, which would result in the requirement for new 1424m of new A5 Collector Road and the realignment of Greenmount Road. Greenmount Road would be bridged over the On-line Dual Carriageway and A5 Collector Road which results in 872m realignment and structure. The realigned Greenmount Road would no longer tie into the existing A5, and it now ties in to Cloghemy Road. The realignment of Greenmount Road would cause difficulties for the residents on the A5 and Greenmount Road with private accesses significantly diverted. This realignment would significantly increase journey times for existing travellers.

The existing A5 is utilised as the A5 Collector Road from CH 68600 – CH 71400 through the village of Garvaghy. The On-line Dual Carriageway crosses from the west to the east of the existing A5 due to the existing development at Garvaghy. This cross over would result in a skewed structure with a span of approximately 70m on the existing A5 and a structure on Radergan Road.

Due to the utilisation of A5 at this location Roscavey Road and Garvaghy Bridge Road are realigned to tie in to the new structure on Radergan Road, the lengths of the realignments are 402m and 716m respectively. Leaving the village of Garvaghy 1159m of new A5 Collector Road is required due to the utilisation of the existing A5

for the On-line Dual Carriageway. Due to the topography at this location there are significant earthworks associated with the On-line Dual Carriageway, the Buffer Zone is increased to 140m, which results in an increased landtake.

2220m of new A5 Collector Road is required from CH 73000-CH 75200 due to the utilisation of the existing A5. The new A5 Collector Road would cross over the On-line Dual Carriageway with the 800m realigned Garvaghy Bridge Road tying in at CH 73850m.

Due to the drumlin topography at this location significant earthworks are required for the cutting and filling earthworks, the buffer zone is increased to 240m. The buffer zone is 120m from CH 74350 due to the 4% vertical gradient for a dual carriageway, there is a requirement for additional fill to maintain a design with no Departures from Standard. There are a number of side roads which would be realigned due to the raised alignment of the A5 Collector Road, this includes 115m of Tullyrush Road and 325m private access track.

The On-line Dual Carriageway moves to off-line at CH 75200 due to the substandard geometry of the existing A5. The dual carriageway has an impact on three side roads, Glencull Road, Ballynasaggart Road and Tullylinton Road which would be stopped up and realigned 932m, 55m and 478m respectively. A new underbridge structure is provided to link these realigned roads to the A5 Collector Road.

The realigned side roads allow the On-line Dual Carriageway to utilise the existing A5 from CH 75950 to CH 76400, which results in the provision of 458m of new A5 Collector Road and the 76m realignment of Greenhill Road. The dual carriageway continues off-line before utilising the existing climbing lane CH 77500- 78550m. In utilising this alignment the A5 Collector Road is realigned 458m in to the village of Ballygawley. The A5 Collector Road would increase traffic though the village, which may cause traffic disruption and increase noise and traffic pollution. Additional vehicles such as tractors would need to use the town as a through traffic route.

There could be a requirement for an additional junction on the north side of the village due to the utilisation of the climbing lane and the requirements for traffic to use the Ballygawley Roundabout for access from the town. This junction would require additional land. Due to the utilisation of the existing A5 at this location Crew Road and

Richmond Lane need to be realigned 538m and 451m respectively with an overbridge structure to tie in to the realigned A5 Collector Road. The realignment of these roads and the closure of the direct access on to the existing A5 would have a detrimental effect on properties and business in the area, causing a detour of over 2km though Ballygawley or along country lanes i.e. Richmond Lane, with significant substandard horizontal and vertical geometry. These country lanes may be unsuitable for large agricultural vehicles and HGV, and could need to be upgraded to a suitable standard requiring more land.

The On-line Dual Carriageway ties in to the existing Ballygawley Roundabout at CH 78600 and continues at the Tullyvar Roundabout CH 79100. The On-line Dual Carriageway utilises the existing A5 Tullyvar Road which had recently been upgraded with a 2+1 climbing lane. This part of the existing A5 is substandard vertically and has a substandard sight stopping distance for a dual carriageway, in addition there are a number of side roads and field access on to the climbing lane.

4285m of new A5 Collector Road is constructed from the Tullyvar Roundabout to the north of Aughnacloy, it could be possible to upgrade some of the existing road network for the A5 Collector Road such as the Tullywinny Road. The existing roads are substandard and significant works would be required to provide a standard design, which would require additional landtake.

AT CH 80450 Tullywinny Road is realigned 242m over the dual carriageway and ties in to the new A5 Collector Road. The new overbridge structure spans approximately 50m over the dual carriageway. The A5 Collector Road runs parallel to the On-line Dual Carriageway from CH 81050 to CH 83250 before it ties in to the existing A5 north of Aughnacloy near to Junction 16. The On-line Dual Carriageway moves off-line to bypass Aughnacloy to the west avoiding the development limits. The dual carriageway continues south before connecting in to the existing A5 on the south side of the village.

The approximate length of the existing A5 in Section 3 (South of Omagh to Aughnacloy) is 29.65km. The On-line Dual Carriageway uses approximately 15.35km of the existing A5, which equates to 52% of utilisation of the existing road network.

Table 3-7 Section 3 Length of Existing Utilised as On-line Dual Carriageway

Length of Existing A5 (m)	Length of Existing A5 Utilised as On-line Dual Carriageway (m)	% of Existing A5 Utilised as On-line Dual Carriageway
29650	**15350**	**52%**

The total length of proposed On-line Dual Carriageway is approximately 30.5km. This route utilises approximately 15.35km of the existing A5 road, which equates to 50%.

Table 3-8 Section 3 Percentage of Dual Carriageway On-line

Total Length of On-line Dual Carriageway (m)	Length of Existing A5 Utilised for On-line Dual Carriageway (m)	% of Dual Carriageway On-line
30500	**15350**	**50%**

When the existing A5 is utilised for the dual carriageway a new A5 Collector road must be constructed to allow for local traffic. The length of the new A5 Collector Road is approximately 15.40km.

The existing A5 can be used as A5 Collector, approximately 12.70km, with the remaining existing A5 used a local or property accesses.

Due to the topography and constraints in Section 3, the Proposed Scheme Route is over 150m from the existing A5. This means it is impossible to switch between the On-line Dual Carriageway and Proposed Scheme Route. Before Junction 16 just over 1500m of the Proposed Route is utilised by the On-line Dual Carriageway.

Table 3-9 Section 3 On-line Dual Carriageway Utilising Proposed Scheme Route

Existing A5 Chainage	Utilised Length of Proposed Scheme Route (m)
56900- 58600	1657
83650 -86350	4380
TOTAL	**6037**

In Section 3 the On-line Dual Carriageway uses less than 20% of the Proposed Scheme Route.

3.1.4 Conclusion

The A5 from New Buildings to Aughnacloy is approximately 82km. The existing A5 is sub-standard both in horizontal and vertical geometry for large parts of the 82km, with this alignment having a number of Departures from Standard. Existing Departures from Standard include, horizontal geometry, vertical geometry, stopping sight distance etc.

Due to the sub-standard nature of the existing A5 significant works are required to meet the current standards for a dual carriageway, which has a design speed of 120kph. These works would include realignment of the existing utilised carriageway to bring it up to standard.

32.5km of the existing A5 can be utilised for the On-line Dual Carriageway which equates to 40% of the A5. However, although 40% would be utilised, significant works would be required in upgrading these sections to dual carriageway standard as no Departures from Standard are permitted for the Dual Carriageway.

These works including significant cuttings and/or embankments along the A5 alignment which would increase the landtake for the scheme, this can be seen in the areas of Specimen Design. The Specimen Design areas show the impact the dual carriageway utilising the existing A5 and A5 Collector Road would have on the built environment.

Although 32.5km of the existing A5 is utilised for the dual carriageway, approximately 35km of new A5 Collector Road is required. There would be an additional 2.5km required of Collector Road in utilising the existing A5 for a dual carriageway.

The dual carriageway and A5 Collector roads have an impact on the existing side road network, this would require approximately 37.5km of realignment and diversion works of these roads.

The new length of On-line Dual Carriageway is approximately 85km long. The total length of new road constructed required is approximately 157.5km. The table below compares the road lengths on On-line Dual Carriageway with the A5WTC Proposed Scheme Route. (All lengths are approximate).

Table 3-10 Length of new roads

	On-line Dual Carriageway	Proposed Scheme Route
Dual Carriageway	85.0km	85.0km
A5 Collector Road	35.0km	0.0km
Side Roads	37.5km	42.5km
Total	**157.5km**	**127.5km**

There is an additional 60.3km of road construction required for the On-line Dual Carriageway, which is equivalent to extra 62% of the road construction required on the A5WTC Proposed Scheme Route. Whilst in Sections 1 and 2 the On-line Dual Carriageway uses over 30% of the Proposed Scheme Route, and just less than 20% in Section 3.

3.2 Geotechnical Strategy & Engineering Requirements

Significant engineering constraints would be placed on the widening of the existing A5 corridor both on-line and immediately adjacent to the current corridor.

There are a significant amount of commercial and domestic properties that would require large amounts of reinforced earthworks and retaining walls to minimise the acquisition of land from the frontages to these properties.

Widening of the existing A5 corridor would require considerable earthworks to achieve a satisfactory vertical and horizontal alignment. This would involve a combination of widening, lowering and raising of the alignment. If constructed alongside the live carriageway, the earthworks would be significantly constrained by operational restrictions and involve working in short sections with significant traffic management. This would also result in significant disturbance and delays to existing traffic during construction and traffic may have to be diverted along local routes to avoid clashes with construction traffic. The recent construction of the A4, which was widened on-line for the first 5km from Dungannon illustrates these difficulties. Construction of an on-line solution is therefore likely to be considerably more constrained, lengthy and costly than any off-line solution.

3.2.1 Section 1

The main issues in this section relate to the Bready cutting CH 10500 to CH11250, the disused landfills north of Strabane and the retaining walls which would be required to widen the road along the existing A5 through southern Strabane.

From CH 4400- CH 5650 the on-line dual carriageway is generally across agricultural land. No significant constraints were noted. Maps show that rock in this area is close to the surface. The on-line dual carriageway would be constructed on sidelong ground with cuttings up to 3m deep to the east of the A5.

From New Buildings to Magheramason the on-line dual carriageway would be constructed generally off-line to the west of the existing A5. The dual carriageway is likely to be carried at grade from CH 5700- CH 6500 with minor cutting from CH 6500- CH7200. It would generally be constructed over areas of glacial till. An overbridge is proposed at CH 6750 to carry a private access road over the dual carriageway. The bridge would be expected to be constructed on firm to stiff glacial till.

Soft ground may be associated with the 2 small watercourses at Taghnarina Road at CH 6300 and CH 7025 near Magheramason and may be required to be excavated and replaced before the construction of the culverts and the carriageway at these locations.

The On-line Dual Carriageway would then pass off-line to the west of the village of Magheramason generally over glacial till with alluvium associated with the Blackstone Burn at CH 7350. The dual carriageway would likely be constructed in shallow cutting with a maximum cutting height of 6m and small embankment with maximum height of 5m. Cuttings would be constructed with slopes of 1v: 2.5h. Embankments would be constructed with slopes of 1v: 2.5h.

Soft ground may be associated with alluvium around the Blackstone Burn which may have to be realigned for 75-100m. Additionally soft areas may be associated with 3 small watercourses south of Dunnalong Road at CH 7950, CH 8025 and 8400.

Immediately south of Magheramason the On-line Dual Carriageway would be constructed by widening the northbound carriageway of the existing A5 from CH 8450- CH 9500 before diverging to the west between CH 9550- CH 9950.It would be constructed mainly at grade with embankment near Tamnabrady Road to a height of

8m. It would be constructed over areas with rock close to the surface. Embankments would be constructed with slopes of 1v: 2.5h.

Soft ground may be associated with the watercourse south of Ballybeeny Road at CH 9750.

An Overbridge would carry the realigned Meenagh Road over the dual carriageway at CH 8950 and would likely be constructed on shallow pad foundations on bedrock. A retaining wall may be required on the east side on approach to Tamnabrady Road between CH 10100- CH 10200 which would likely be constructed on bedrock.

South of Tamnabrady Road, the On-line Dual Carriageway would cross to the east of the A5. To the east of the A5 the alignment would be carried initially on embankment to CH 10500 and would be generally 7.5m high. It would be carried in shallow cut from CH 10500 to CH11250 up to 5.5m deep as the overall alignment rises up on an off-line route east of Bready. There may be a significant amount of rock excavation to form the alignment on the side of Sollus Hill. Earthworks would be constructed on glacial till or shallow bedrock.

An underbridge would be constructed to carry the main alignment over the existing A5 at CH 10200 that would be used for access and would likely be constructed on glacial tills and shallow bedrock.

A backfilled quarry and disused waste water treatment plant are located to the west of the existing A5 immediately north of Bready at CH 10600 and CH 11000. These would affect the local access road.

Contamination would be associated with the reclaimed area found at CH 10400 and quarry with fly tipping at CH 11200, near the top of the hill.

Soft alluvium would be expected to be encountered from CH 11200- CH 11350 and it is likely that it would have to be excavated and replaced before earthwork construction.

From CH 11700-CH 13700 the On-line Dual Carriageway would be expected to be constructed adjacent to the existing carriageway. No significant constraints were noted. Glaciofluvial sands and gravels are indicated along the length of this section. The alignment would generally be constructed at grade with more significant embankments on the approach to the Burn Dennet River from CH13450.

From CH 13700-CH 15400 the dual carriageway would continue along the existing A5. Some ground instability was noted just south of Cloghcor Road to the east of the alignment at CH 15100. River alluvium is present at CH13800-CH14000 and CH14400-CH14450. Maps indicate that glaciofluvial sands and gravels predominate in that area with areas of alluvium associated with the Burn Dennet River. Staged construction would be required for the construction of the embankments adjacent to the Burn Dennet River.

The On-line Dual Carriageway would comprise a combination of off-line to the east of the existing alignment between Cloghcor and re-joining the existing alignment just north of Lowry's Lane and CH 15400. It would be mainly constructed on embankment between 4-9.5m high with an average height of approximately 6m. Embankments would be constructed with slopes of 1v: 2.5h. Earthworks would be constructed over glaciofluvial sands and gravels. Under bridges would be constructed to carry the alignment over Cloghcor road at CH 14925 and Lowry's Lane at CH 15550. They would be expected to be constructed over sands and gravels.

The dual carriageway would continue along the existing A5 to immediately north of Ballymagorry and then sweeps off-line to the west of Ballymagorry. It would be constructed on Embankment between 4 and 8m high. Earthworks would be constructed over glaciofluvial sands and gravels and alluvium expected to be up to 8m deep. Embankments would be constructed with slopes of 1v: 2.5h. An underbridge would be constructed near Ballyheather Road at CH 16475 to take the On-line Dual Carriageway over the realigned existing A5 which would be used for local access with an additional underbridge at Greenlaw Road at CH 17175. A culvert would be constructed to carry the alignment over the Glenmoran River at CH 17100. A watercourse diversion would be required between Greenlaw Road and Park Road from CH 17300- CH 17500.

The underbridge near Ballyheather Road would be expected to be constructed on glaciofluvial sands and gravels and would be constructed on pad foundations. The remaining earthworks and structures are likely to be constructed over an area of alluvium up to 8m deep. Design of the road would be difficult over the soft ground of the Foyle floodplain and care would be needed in the selection of the alignment to keep – as far as possible – to the higher (better) sandy ground. This preference is however limited by the need to keep as close as possible to an on-line route. The existing Victoria Road keeps to the edge of the glacial outwash sand ridges on the

edge of the floodplain. Embankments would have to be constructed by staged construction over the alluvial material and structures would have to be piled. There is a risk of bearing capacity failure, adverse settlement, instability, lateral movements and high groundwater which would have to be considered at detailed design stage.

South of Ballymagorry the On-line Dual Carriageway would continue off-line to the west. The dual carriageway would be constructed on embankment up to 8m high. The earthworks and structures would be constructed over alluvium up to 8m deep. Embankments would be constructed with slopes of 1v: 2.5h. Under bridges would be required to carry the On-line Dual Carriageway over Park Road and south of Park Road at CH 17600 to carry the dual carriageway over a private access road. A watercourse diversion would be required south of Park Road from CH 17600- CH 17925.

Embankments would have to be constructed by staged construction over the alluvial material and structures would have to be piled. There is a risk of bearing capacity failure, adverse settlement, instability, lateral movements and high groundwater and these would have to be considered at detailed design.

From CH 18500-CH 20100 alluvium should be expected along much of this section up to 8m deep associated with the floodplain of the Foyle River between Ballymagorry and north of Strabane. Maps indicate that alluvium associated with the Foyle floodplain predominate in that area with smaller areas of glaciofluvial gravels.

From CH 20100-CH 21800 alluvium is again expected along much of this section up to 8m deep associated with the floodplain of the Foyle River.

The dual carriageway alignment would be impacted by a former landfill site from CH 21000 and CH 21400. Risk assessments and remediation strategies would have to be incorporated in the detailed design.

Contamination and unstable ground would be expected from the former and now infilled Strabane Canal from CH 20750- CH 20950 and from industrial buildings associated with the former railway at CH 21550.

From CH 21800-CH 23450 river alluvium is evident at CH 21800-CH 22500. Made ground is indicated to the east of the existing A5 at CH 23400. Maps indicate that

alluvium and glaciofluvial sands and gravels extend throughout the section. Retaining walls would be required to widen the existing A5 between CH 22950- CH 23400.

Between CH 23450-CH 24900 peat is noted from CH 24650- 24900. Contamination would possibly be associated with Orchard Road Landfill site at CH 24500 and associated with reclaimed ground from CH 24775 and CH 24825. Glacial Till and local peat predominate in this area.

From CH 24900-CH 26450 no significant constraints were noted and the dual carriageway would be constructed over glacial till and glaciofluvial sand and gravels

The connection to the Finn crossing bridge would generally be constructed over hummocky glacial moraine and glacial till. Alluvium is associated with the river Finn. The On-line Dual Carriageway passes close to, but avoids the Urney Road landfill site.

3.2.2 Section 2

The most significant issues that would need to be addressed in Section 2 would be the construction of the dual carriageway alongside and between the existing bridges across the Mourne River in Newtownstewart and the constraints posed by the steep sided Strule river valley south of Newtownstewart.

The On-line Dual Carriageway would be constructed off-line between Sion Mills and Glebe before re-joining the existing A5 at Victoria Bridge at CH 29450. It would be constructed mainly in cutting from CH 26320- CH 27070 with a general cutting depth of 5-9m with an average depth of approximately 7m. From CH 27070 - CH 29420 it would generally be carried on embankment from 4-15m high with an average depth of approximately 6m. The higher sections of embankment would be constructed between CH 28470 – CH28970. From CH 29420 to CH 29920 the dual carriageway would be in cutting with more significant cutting to the west of the alignment up to 10m deep. It would generally be at grade from CH 29920-CH 30870 where it would connect back onto the existing A5 before moving back on to embankment from CH 30870- CH 32370.

Directly North of Garden Road there is a reservoir. South of Garden Road there is a landfill site just outside the buffer zone. Parallel to Bellspark Road there is another landfill site and a possible fuel storage tank which could pose a contamination threat.

Earthwork side slopes would be constructed with angles of 1v:2.5h. Mid slope berms may be required where earthwork heights exceed 10m. The earthworks would generally be constructed over firm to stiff glacial tills, hummocky glacial moraines and glacial sands and gravels.

An overbridge would be constructed at CH 26570 to carry the realigned Primrose Road over the On-line Dual Carriageway and an underbridge at CH 27395 to carry the realigned Garden Road over the dual carriageway. A culvert would be required at CH 27570. The overbridge and underbridge are expected to be constructed on pad foundations over firm to still glacial till. Soft ground would require to be excavated and replaced particularly where it could underlie the proposed culvert at CH 27570.

Lake alluvium would be expected to be encountered west of Bellspark Road from CH 28425- CH 28875. There would be a potential low to medium risk of contamination from the farm buildings immediately west of Bellspark road. Alluvium is associated with the Mourne River and could be impacted close to Victoria Bridge. At Victoria Bridge the dual carriageway alignment is constrained by the bend in the Mourne River and the steeply rising slopes to the west.

The dual carriageway would be along the existing A5 from CH 29450- CH 29750 where it would be constructed to the west of the existing A5 to CH 31150. There are a number of Industrial sites and waste water treatment sites around Victoria Bridge. Soft ground would be expected with the alluvium at Liscreevaghan Burn from CH 30400- CH 30550. Peat may be encountered west of Victoria Bridge at CH 30950- CH 31150

An underbridge would be constructed at Seein Road at CH 28170 and Bellspark Road at CH 28470. Culverts would be required at CH 28045 and CH 26320. The underbridges at CH 28170 and CH 28470 and culvert at CH 28045 would be expected to be founded on pad foundations over firm to stiff clay. Depending on the depth of the lake alluvium the culvert at CH 28845 may require pile foundations.

A retaining wall may be necessary to the east of the alignment from CH 30670-CH 30970 to constrain the embankment behind the houses in Victoria Bridge. Soft spots would have to be excavated where the retaining wall encroaches onto an area of alluvium.

An underbridge would be constructed at CH 31295 to carry the dual carriageway over Stone Road at CH 32270. The underbridge at CH 31295 would be expected to be

constructed on glacial tills and the underbridge at CH 32270 would be constructed on glacial fluvial sands and gravels.

From CH 32900- CH 36050 the dual carriageway would be constructed parallel to the east of the existing A5.

From CH 32450-CH 32700 there is an active quarry. Contamination and instability could be associated with any workings or reclamation of this quarry

Soft ground is expected with the alluvium at the Derg River from CH 33400- CH 33550. Maps indicate a mineral occurrence (Gold) associated with the Derg. The dual carriageway generally avoids the gravel pits at Deerpark but a gravel pit is indicated to the east of the A5 at CH 34700. The dual carriageway would generally be constructed over glaciofluvial sands and gravels with smaller areas of alluvium.

The dual carriageway would intersect gravel pits from CH 33850- CH33950 and CH 35000- CH 35150 and a possible former gravel pit at CH 35950. It is unknown what materials could be used to backfill with, and ground treatment could be required in this area. The dual carriageway would be constructed over glaciofluvial sands and gravels.

From CH 35350- CH 36050 the On-line Dual Carriageway would be constructed to the east of the A5 on embankment with height between 2 and 11m high with an average height of 4m. Embankment side slopes would be at an angle of 1v:2.5h. Earthworks would be constructed over glaciofluvial sands and gravels. It would then follow the existing A5 on minor embankment before more significant embankment up to 13m on the approach to the widened Mourne Bridge. An underbridge would be constructed at CH 36050 to carry the dual carriageway over a private access. The underbridge would be expected to be founded on pad foundations over glaciofluvial sand and gravels. A small historic gravel pit would be encountered at CH 35950. The nature of the backfilling is unknown. Any contaminated material could be required to be excavated and disposed offsite.

The On-line Dual Carriageway would be constructed on embankment from CH 36550- CH 37050 on the approaches to the bridge crossing the Mourne and generally at grade from CH 37100 - CH 38100. The majority of the earthworks would be constructed over alluvium associated with the River Mourne. The alluvium associated with the Mourne is expected to be up to 11m deep. Approach embankments to the bridge crossing the Mourne would either have to be constructed on a piled platform or by staged

construction. Mid-slope berms would have to be incorporated into embankments greater than 10m high. The Mourne Bridge would need to be piled. Soft ground may be required to be excavated beneath the culvert. There is a risk of bearing capacity failure, adverse settlement, instability, lateral movements and high groundwater. An additional culvert would be required at CH 37000. Soft ground may be required to be excavated beneath the culvert.

The On-line Dual Carriageway would be mainly constructed at grade by widening the existing A5 from CH 37650 - CH 38500. The existing carriageway would be widened over areas of alluvium. Staged construction or piled platform could be required for the widening of the existing carriageway over the alluvium. A section of the dual carriageway would be constructed on a new embankment to the east of the existing road from CH 38500 - CH 38750. The embankments would be up to 14m high and would be constructed over glaciofluvial sands and gravels and alluvium adjacent to the Strule. The existing bridge carrying the A5 over the River Strule would be required to be widened. A retaining wall could be required to reduce the impact of the embankment on the river Strule from CH 38500- CH 38750. The retaining wall would be constructed over alluvium and may be required to be piled. A number of low to medium risk industrial sites are located close to the dual carriageway at CH 37600 and CH 37825. Any contamination associated with the industrial sites would need to be excavated and disposed offsite.

From CH 38600 - CH 39050 the On-line Dual Carriageway would be constructed on asymmetric embankment to the east of the existing A5. Embankments would be up to 15m high. Earthworks would be constructed mainly over alluvium associated with the River Strule and glaciofluvial sands and gravels. From CH 39050 - CH 40000 the dual carriageway would be constructed by widening the existing A5 to the west mainly at grade. The dual carriageway alignment at this section is expected to be carried over hummocky glacial moraines. Embankment side slopes would be constructed with side slopes of 1v:2.5h. Design options for the embankment may consist of excavate and replace, staged construction or piled embankments. Mid slope berms would be required where the embankments are greater than 10m high. There is a risk of bearing capacity failure, adverse settlement, instability, lateral movements and high groundwater which would have to be taken into account at detailed design stage.

An overbridge would be required at CH 39550 to provide private access over the proposed dual carriageway. A culvert could be required at CH 39150. The bridge could

need to be piled depending on the depth of the alluvial material. A retaining wall could be required between CH 39225 and CH 39475 to reduce the impact of the embankment on the River Strule. A piled foundation could be required due to alluvium. Medium risk contamination sites have been identified at CH 39725. Any contaminated soil associated with the industrial sites could need to be excavated and disposed offsite.

The local access A5 south of Newtownstewart would be constructed in large cutting. Cuttings would be up to 19m high. The On-line Dual Carriageway would be constructed on the existing slopes that rise significantly at 1:5- 1:10 to the west away from the River Strule. The dual carriageway would mainly be constructed over hummocky glacial moraines. Cuttings would be constructed at 1:2.5 in till and 1:1 in rock. Mid slope berms would be required where cuttings are greater than 10m high and at any rock clay interface. Instability could occur in the steep slopes to the west of the dual carriageway.

From CH 39725 - CH 41375 the corridor is constrained by the river Strule to the east with land falling towards it and significant steep slopes rising towards the west. Alluvium would be expected to be encountered running along the eastern extents. Use of reinforced earth may be necessary to avoid the edges of earthworks stepping into the Strule River.

Possible made ground and infilling at CH 41450 and medium risk of contamination at CH 42550.

Peat is expected to be encountered from CH 47675 - CH 49900 which would need to be excavated before construction

Peat is expected to be encountered in association with the Tully Drain from CH 49400-CH 49600. Alluvium would be associated with the Fairywater. Contamination could be encountered from the former Nestle site situated immediately adjacent and east of the buffer zone at CH 49750. Soft ground and contaminated areas may need to be excavated before construction.

The On-line Dual Carriageway would follow the Proposed Scheme Route west of Omagh from the Fairywater to Seskinore Road and has therefore not been assessed as part of this review.

3.2.3 Section 3

The most significant features in Section 3 relate to the peat bogs at Tattykeel and Doogary, the terrain constraints around Garvaghy and the construction of the dual carriageway through Star Bog south of Garvaghy.

From CH 57350- CH 58000 peat would be encountered between Seskinore Road and Tattykeel Road to 7m. The ground may have to be surcharged prior to construction in this area.

From CH 58500- CH 60100 peat is present to the west of the existing A5 from CH 58700- CH 59450 to 3m below ground level. The peat would likely be excavated prior to construction, or embankments constructed by staged construction.

Between CH 58650 at Doogary and CH 63550 the On-line Dual Carriageway would be widened adjacent to the existing A5. Published maps indicate peat immediately west of the existing A5 from CH 58700- CH 58950 at Doogary Bog and both sides of the A5 from CH59400- CH 59450 which would be up to 8m thick. The peat would either need to be replaced or the road constructed on a piled platform in this location.

Infilling with unknown materials has occurred from CH 58950- CH59150 to the west of the A5. This material could require excavation and disposal or lead to unstable ground conditions that would be required to be dealt with at the detailed design stage.

A former mill pond is indicated at CH 59525- CH 59575 which could give rise to a risk of unstable ground conditions which would have to be addressed at detailed design.

Peat is indicated on mapping to the east of the A5 from CH 59800- CH 60100. Raised peat is indicated on mapping to the east of the A5 from CH 60100- CH 60500 and from CH 60450- CH 61650. Peat would be required to be excavated and replaced.

Fly tipping of unknown materials is present at CH 61050 east of the A5. This material would have to be excavated and disposed offsite.

Soft ground and raised peat to 2.5m below ground level are present from CH 61650- CH 62300. There is an infilled quarry at CH 62000. The nature of infilling is unclear and would give rise to a risk of unstable ground conditions which would have to be dealt with at the detailed design stage and may require excavation and replace solutions.

The dual carriageway would be constructed off-line to the east of the existing A5 between CH 63500- CH 64350

Soft ground and alluvium is present from CH 64150- CH 64275 and CH 64625- CH 64875. Contamination could possibly be associated with the petrol station at CH 64900. Soft ground and contaminated areas would have to be excavated and disposed of prior to construction.

The on-line dual carriageway would be constructed to the southwest of the existing A5 from CH 64350- CH 67400. The dual carriageway would likely be carried on embankment over areas of glacial till and rock close to surface with smaller isolated areas of alluvium and peat. Embankments would generally be constructed with side slopes of 1v:2.5h.

A watercourse diversion would be required from CH 65200- CH 65350 and CH 65600- CH 65750. An underbridge providing private access would be constructed at CH 65325 with an underbridge carrying the On-line Dual Carriageway over the existing Killadroy road at CH 66125. Culverts may be required at CH 65675 and CH 66700. It would be likely that the culverts and underbridges would be founded on bedrock with rock expected to be close to surface.

Soft ground could be associated with the watercourse diversion and the areas of peat and alluvium. These would have to be excavated and replaced before embankment construction.

The On-line Dual Carriageway would be constructed to the southwest of the existing A5 from CH 66700- CH 67400. From CH 67400- CH 68200 the On-line Dual Carriageway would incorporate the existing A5 with a new carriageway providing local access constructed further to the north east. The dual carriageway would be at grade or embankment adjacent to the existing carriageway from CH 66700- CH 67400 and the existing carriageway embankment widened to carry the On-line Dual Carriageway to the southwest from CH 67400- CH 68200. The realigned A5 Collector Road would constructed in a cutting to the northeast from CH 67950- CH 68200. Embankments would generally be constructed with side slopes of 1v:2.5h. Cuttings would generally constructed with side slopes of 1v:2.5h. The earthworks would be constructed over areas with rock close to the surface and areas of alluvial deposit.

An overbridge would be constructed at CH 67400 to carry the realigned Greenmount Road over the On-line Dual Carriageway an underbridge would be constructed at CH 68100 to carry the dual carriageway over the realigned Springhill road. A culvert may be required at CH 67750.

Geotechnical risks could include adverse settlement, instability of embankment slopes and potential stability issues due to high ground water which would have to be considered at detailed design stage. Where the alluvium is <4m deep the embankment would likely be constructed by excavation and replacement of the alluvium; where it is deeper than 4m it would be surcharged using starter layers and staged construction. The Greenmount Road overbridge would be expected to be founded on shallow bedrock. Soft ground could have to be excavated beneath the footprint of the culvert and the Springhill road underbridge. A petrol station is noted at CH 67500 which could be a potential source of contamination.

The dual carriageway would be carried on embankment adjacent to the southwest of the existing A5 from CH 68200- CH 69200. Embankment height would generally range from 4-7.5m high with an average height of 5m. Earthworks would be constructed overlying alluvium in addition to a realigned watercourse from CH 68450- CH 68900. A culvert may be required at CH 69100.

The dual carriageway would likely to be carried on embankment over alluvium associated with the Routingburn Extension from off-line CH 69200- CH 69950. A watercourse diversion would be required from CH 69200- CH 69600. The embankment height would be expected to be between 7-15m high with an average height of approximately 9m. Embankment would be constructed at 1v: 2.5h. Construction would be considerably constrained between the existing A5 and the water course.

An underbridge would be constructed at CH 69600 to take the Proposed Scheme Route over the existing A5. A culvert would be required at CH 69925.

A retaining wall could be required from CH 69700- CH-69900 along the northbound carriageway where the On-line Dual Carriageway interacts with the existing A5 embankment. Where the alluvium is <4m deep the embankment would likely be constructed by excavation and replacement of the alluvium; where it is deeper than 4m it would be surcharged using starter layers and staged construction.

For the foundation of the culvert it is likely that the alluvium would be excavated down to firm stratum. For the foundation of the retaining wall it is likely that the alluvium would be excavated down to firm stratum.

Geotechnical risks could include adverse settlement, instability of embankment slopes and potential stability issues due to high ground water which would need to be considered at detailed design stage.

From CH 69650- CH 70700 the dual carriageway would likely be carried on embankment over Glacial Till to the east of the existing A5 through Garvaghy. The embankment height would be expected to be between 4-13m high with an average height of approximately 7m. Embankment would be constructed at 1v: 2.5h. An underbridge would be constructed at CH 70600 to carry the A5 over Radergan Road.

Starter layers may be required if there were any soft ground areas. It is likely that the underbridge would be constructed on spread foundations

From CH 70700- CH 71780 the dual carriageway is likely to incorporate the existing A5 and be carried on embankment over glacial till, glaciofluvial sand and gravel and alluvium. Rock is indicated to be close to the surface from CH 71400-CH 71780. The embankment height would be expected to be between 5-10m high with an average height of approximately 7.5m. Embankment would be constructed at 1v: 2.5h. Culverts may be required at CH 70975 and CH 71420.

Geotechnical risks could include adverse settlement, instability of embankment slopes and potential stability issues due to high ground water. Alluvium would have to be excavated and replaced from CH 71250- CH 71400 and beneath the culvert. Starter layers may be required if there are any soft ground areas.

The On-line Dual Carriageway may encounter a former quarry at CH 71150 and CH 72000

From CH 71780- CH 72200 the dual carriageway would be constructed in an asymmetrical cutting between 6-12m high. Rock is indicated to be close to the surface along this section. Cuttings in till would generally be constructed at 1v: 2.5h, cuttings in rock may be steeper at 1v: 1h.

The dual carriageway would be excavated into a cutting off the southbound carriageway. Issues may arise due to the excavatability of the rock. Mid slope berms and slope drainage may be required at the rock clay interface.

From CH 72350- CH 73150, the dual carriageway would generally be carried at grade with maximum cutting or embankment height at 2m. It would divert to the north of the existing A5 at CH 72600. It would cross an area of peat at Star Bog and also areas where rock is close to surface. Two culverts could be required at CH 72850 and CH 72950. Peat would be required to be excavated from CH 72150- CH 73250 or the ground surcharged depending on the depth of peat prior to the construction of the carriageway. Peat and soft ground would be required to be excavated from beneath the footprint of the culverts to create a firm stratum on which spread foundations could be laid. A piled platform for the earthwork and culverts could be an alternative option. A disused quarry was also noted at CH 73150.

From CH 73150- CH 73700, the dual carriageway would be carried in cutting from 4-21m deep. The On-line Dual Carriageway would cross to the south of the existing A5 at CH 73400.

The cuttings would be constructed in areas of till and areas where rock is expected to be close to the surface. Cuttings in till would generally be constructed at 1v: 2h, cuttings in rock may be at 1v: 2h. A culvert could be constructed at CH 73350 as an overbridge carrying the A5 Collector Road provides access over the dual carriageway. Issues would arise due to the excavatability of the rock. Mid slope berms would be required where the slopes are higher than 10m and slope drainage could be required at the rock clay interface. It is expected that the culvert and overbridge would be constructed on spread foundations over shallow bedrock.

From CH 73700 - CH 74150 the dual carriageway would be constructed in asymmetrical cutting from 8-17m with an average of 10m to the south of the dual carriageway. The On-line Dual Carriageway would tie into the existing A5 at CH 74300 where it would continue on embankment to CH 74750 at an average height of 5m. It would be expected to be constructed on glaciofluvial sands and gravels. Embankments would be constructed at 1v: 2.5h. Cuttings would be constructed at 1v: 2.5h. A water course diversion would be required from CH 74350-CH 74500 so there would be a risk of soft ground conditions which would need to be dealt with at the detailed design. A shallow retaining wall could be required from CH 74500- CH 74650

to limit encroachment onto a watercourse to the north of the dual carriageway. Mid slope berms would be required where the slopes are higher than 10m.

Soft ground and alluvium should be expected from CH 75175- CH 75225. Possible contamination could be associated with the disused quarry at CH 75100 to the west of the existing A5. The site of two historic ring forts located to the south of the existing A5 at CH 75350 and CH 75750

Soft Ground and alluvium is associated with the Ballygawley Water from CH 77900-CH 78150. Alluvium is associated with the Ballygawley Water from CH 78150-CH 78450, CH79100- CH 78800 and 79600- CH79650. Soft ground and alluvium would be encountered just west of the A5 at CH81150-CH81200. Contamination could be associated with a backfilled quarry east of the A5 at CH81250. There would be a risk of adverse settlement, instability, lateral movements and high groundwater which would have to be considered at detailed design stage.

River alluvium is encountered along the existing A5 at chainage CH82100-CH82250, CH82400-CH82500 and CH82950-CH83050.

The active Tullyvar Landfill Site is located at CH81600-CH81800. Contamination may be associated with a small backfilled limestone quarry at CH81750 and a backfilled gravel pit and quarry located at CH8320. The dual carriageway design would need to avoid the site of the landfill and associated plant yard. Otherwise, significant pollution control works and possibly a waste management license could be required. The terrain around Tullyvar is significantly elevated and widening of the existing 2+1 alignment may require significant rock excavation.

The alignment around Aughnacloy is the same as the Proposed Scheme Route and therefore has not been assessed in this report.

3.2.4 Conclusion

Section 1

In comparison with the Proposed Scheme Route, the On-line Dual Carriageway has additional geotechnical constraints associated with construction adjacent to the line of the existing road including requirements for retaining walls to accommodate widening of the existing A5 where there are adjoining properties or alternatively requirements to demolish additional properties to accommodate the widened earthworks.

Reconstruction of the existing A5 corridor would also be required in places to give an acceptable alignment, and temporary and permanent retaining structures would be required to allow these works to be undertaken.

Between the Ballymagorry bypass and Junction 3, the Proposed Scheme Route makes better use of gravel ridges in the Foyle River flood plain whereas the On-line Dual Carriageway is constrained to cross areas of soft Alluvium. Conversely however, in some locations, following the line of the A5 avoids areas of Alluvium crossed by the Proposed Scheme Route where that runs further to the west. South of Strabane, the On-line Dual Carriageway avoids the Strahans Road Quarry.

Overall, it is considered that the On-line Dual Carriageway has additional geotechnical constraints compared with the Proposed Scheme Route, particularly the additional requirements for retaining structures in Section 1.

Section 2

In comparison with the Proposed Scheme Route, the On-line Dual Carriageway has additional geotechnical constraints associated with construction adjacent to the line of the existing road including requirements for retaining walls to accommodate widening of the existing A5 corridor where there are adjoining properties or alternatively requirements to demolish additional properties to accommodate the widened earthworks, particularly in the area of Victoria Bridge.

Reconstruction of the existing A5 would also be required in places to give an acceptable alignment, and temporary and permanent retaining structures would be required to allow these works to be undertaken.

There are a number of industrial and landfill sites on or close to the On-line Dual Carriageway which present potential geotechnical constraints, but which are avoided by the Proposed Scheme Route which runs across green field land. The On-line Dual Carriageway also crosses a number of localised areas of peat and lake alluvium which are also potential geotechnical constraints, for example at Victoria Bridge. These are largely avoided by the Proposed Scheme Route.

In the vicinity of Newtownstewart, the On-line Dual Carriageway is underlain by significant areas of Alluvium associated with the Mourne Strule which represent a substantial geotechnical constraint. The On-line Dual Carriageway is also constrained

by proximity to the Mourne River and by the land sloping steeply towards the river, and by the Pubble graveyard. Retaining walls could be required to address these constraints. These constraints are avoided by the Proposed Scheme Route which runs over predominantly glacial soils to the west of the town.

Both the On-line Dual Carriageway and Proposed Scheme would have to address construction of an earthwork on sidelong ground in the Strule valley between Newtownstewart and Mountjoy. Both dual carriageways would require substantial earthworks, but because of the proximity of the river and the associated soft ground and potential additional retaining structures, the On-line Dual Carriageway is the more adverse of the two.

Overall, it is considered that the On-line Dual Carriageway has substantial and significant additional geotechnical constraints compared with the Proposed Scheme Route for Section 2, particularly in the vicinity of Victoria Bridge and Newtownstewart.

Section 3

In comparison with the Proposed Scheme Route, the On-line Dual Carriageway has additional geotechnical constraints associated with construction adjacent to the line of the existing road including requirements for retaining walls to accommodate widening of the existing A5 corridor where there are adjoining properties or alternatively requirements to demolish additional properties to accommodate the widened earthworks.

Reconstruction of the existing A5 would also be required in places to give an acceptable alignment, and temporary and permanent retaining structures would be required to allow these works to be undertaken.

The On-line Dual Carriageway would encounter additional areas of peat and alluvium, for example between Tullyrush Road and Greenmount Road, and at the Star Bog on the south side of Garvaghy, which are avoided by the Proposed Scheme Route. However, at the northern end of the On-line Dual Carriageway route and between Garvaghy and Junction15, there is some reduction in the extent of soft ground compared with the Proposed Scheme Route.

There are also a number of infilled quarries and industrial sites adjoining the existing A5 which are potential geotechnical constraints to the On-line Dual Carriageway, but

which are largely avoided by the Proposed Scheme Route. The On-line Dual Carriageway also passes close to the Tullyvar landfill site.

The On-line Dual Carriageway avoids the substantial cuttings required on the Proposed Scheme Route at Tycanny and Errigal, but significant rock cuttings may nevertheless be required to accommodate widening and re-alignment of the existing A5, for example between the A4 junction at Ballygawley and Tullyvar and immediately south of Garvaghy..

The overall marginal advantages of the On-line Dual Carriageway are cancelled out by the difficulties posed by the Star Bog and the rock cutting south of Garvaghy. Therefore, in section 3, neither the On-line Dual Carriageway nor the Proposed Scheme Route have a geotechnical advantage and both have equal merits.

3.3 Drainage Strategy & Engineering Requirements

The drainage implications of the A5 On-line Route are considered from two perspectives, namely drainage infrastructure and flooding. These two aspects would be significantly affected in the dualling of existing A5, to include On-line Dual Carriageway and A5 Collector Road.

3.3.1 Drainage Infrastructure

The purpose of the road drainage design is to provide infrastructure for discharge of road related runoff to existing watercourses at specific locations. Along the Proposed Scheme Route, there are a number of mainline and side road outfalls

The existing A5 road has drainage associated with a single lane carriageway which in some instances has been upgraded to 2+1 or climbing lane at specific locations. It is considered unlikely that the existing drainage network could be utilised for the dual carriageway; new drainage would need to be provided for the On-line Dual Carriageway and the provision of any new lengths of A5 Collector Road.

Surface water channels would be utilised, in line with DMRB HD33/16, for the majority of mainline drainage networks. The surface water channels discharge to carrier drains, which in turn discharge to suitable watercourses.

The drainage system design would include an additional 20% allowance within rainfall intensity calculations to account for climate change.

Pre earthworks drainage (PED) would be provided as a network of predominantly open channel ditches discharging into existing watercourses along the length of the scheme. PED ditches would also pick up existing field drains in various locations. These drains would have sufficient capacity to transfer flows from the surrounding topography and proposed slopes to suitable watercourses/drains, assessed for the 75 year return period storm in accordance with HA 106/04. PED would be required;

- In areas of cutting to intercept flows from the surrounding natural topography and adjacent lands to prevent discharge into the Works.
- In areas of embankment to intercept flows from proposed embankment slopes and surrounding natural topography to prevent discharge from the Works onto adjacent lands and vice-versa.

Watercourses would generally be crossed by providing culverts with the size and shape of these being determined by watercourse characteristics. The installation of some culverts would require realignment or the diversion of existing watercourses. Where the watercourse is an existing land drainage feature, a culvert would be used to intercept the watercourse or the watercourse would be intercepted by per earthworks drainage. In addition to the many small watercourses crossings there are several larger water crossings requiring more complex bridge structures.

As with the Proposed Scheme Route, there would be the need to provide a number of attenuation and treatment ponds for the new carriageways. The new drainage infrastructure would also require new outlet pipes, headwalls, culverts and watercourse diversions, which would all require additional land to construct and maintain.

As noted above, existing road drainage infrastructure would be unlikely to be extensively utilised for provision of the On-line Dual Carriageway drainage due to anticipated impact on adjacent utilities, existing culvert characteristics and watercourse diversions associated with infrastructure requirements for the on-line route.

The cost in upgrading the existing drainage to current standards, and the provision of the utility diversions would severely impact on the economic benefits of utilising the existing A5 corridor.

3.3.2 Drainage and Flooding Mitigation

Mitigation measures would be included to reduce the impact of road drainage on the receiving watercourses and the wider environment.

Throughout the dual carriageway drainage network, the principles of Sustainable Drainage systems (SuDS) would be provided for each network/outfall. SuDS measures attenuate flow where required, controlling the rate of water release to the receiving watercourse in order to reduce the potential of downstream flooding. In order to manage Water Quality, appropriate SuDS measures would also be incorporated to reduce the pollutant loading within road runoff.

The DMRB (Para. 2.37 HD 45/09) stipulates that with regards to management of flood risk, the mandatory requirements state that transport infrastructure must:

- Remain operational and safe for users in times of flood;
- result in no net loss of floodplain storage;
- Not impede water flows;
- Not increase flood risk elsewhere.

Where development is required within a floodplain, additional works could be required to mitigate flood risk changes caused by the project. DMRB HD45/09 identifies some of the potential mitigation options available in relation to road schemes; these include design of road geometry, flood relief culverts, storage compensation and modifications to river channels and river structures.

The purpose of mitigation measures within a floodplain is to manage floodwater levels in a way that reduces the potential impact of flooding on the scheme itself and also elsewhere in the catchment.

Flood impacts would be mitigated using measures which include some, or all, of the following:

- Avoidance of floodplains as far as reasonably practicable and whilst considering multi-discipline engineering and non-engineering factors,
- Minimisation of road footprint as far as reasonably practicable and whilst considering multi-discipline engineering and non-engineering factors,
- Appropriately sized culverts
- Large span structures where feasible,

- Provision of floodplain connectivity structures to maintain floodplain conveyance where floodplains are bisected by the road alignment, and
- Provision of compensatory storage where volumetric floodplain encroachment remains.

Flood Compensatory Storage Areas (FCSAs) would be excavated and re-contoured with a series of terraces or steps to create the required volume for flood compensatory storage where appropriate and in agreement with Rivers Agency.

The lowest contour would typically be the existing watercourse top of bank level; the highest would be the predicted 1% Annual Event Probability (AEP) level. The level of the outer perimeter of the FCSA would therefore correspond to the predicted flood level for the 1% AEP event. The land would typically be lowered in terraces of approximately 200mm in height, with gentle slopes from one terrace to the next.

In general terms, flooding impacts associated with the On-line Dual Carriageway are considered to be broadly similar to the existing A5 carriageway. The additional land requirement for drainage infrastructure, flood compensatory areas, flood mitigation measures would have a significant impact on the built environment. This additional land would be defined at the Specimen Design Stage of the scheme, and have not been developed for this report.

To provide further insight into some of the associated issues incurred by the On-line Dual Carriageway, a series of key examples for each section are provided below. While not intended as definitive list, they serve to highlight relevant issues in accord with the general points made above.

3.3.3 Section 1

New culverts and potential watercourse diversions would be required at CH 4500 and CH 5250 for the dual carriageway and realigned private access roads where it crosses two existing watercourses.

Depending on the vertical alignment of the On-line Dual Carriageway, attenuation pond(s) could also be required at these locations for carriageway drainage outfalls. Between CH 5300 and CH 6500 the A5 Collector Road would require new drainage infrastructure and potential alteration to existing utility services.

The vertical alignment of the A5 Collector Road would determine if an attenuation pond at CH 6300 for a carriageway drainage outfall into the Gortin Hall Drain would be required. At CH 6300 the existing culvert on the Gortin Hall Drain would need to be lengthened with the potential requirement for a watercourse diversion. Subject to the vertical alignments for both the On-line Dual Carriageway and the A5 Collector Road, an attenuation pond(s) could be required at this watercourse for a carriageway drainage outfall.

New culverts and potential watercourse diversions would be required at CH 7050 and CH 7400 for the On-line Dual Carriageway and realigned private access road as they cross and undesignated watercourse and the Blackstone Burn. Depending on the vertical alignment of the On-line Dual Carriageway an attenuation pond(s) could be required at these watercourses for carriageway drainage outfalls.

At CH 7725 an existing culvert on an undesignated watercourse would need to be extended / altered for the realigned private access road. A new culvert and potential watercourse diversion would be required at CH7800 for the On-line Dual Carriageway as it crosses an undesignated watercourse, depending on the vertical alignment of the On-line Dual Carriageway an attenuation pond(s) could be required at this location for a carriageway drainage outfall.

Between CH 7900 and CH 8025 a diversion of the existing undesignated watercourse underneath the On-line Dual Carriageway would be required. Subject to the design of this watercourse diversion, a number of new culverts could be required along with an attenuation pond(s) for carriageway drainage outfalls.

A new culvert and watercourse diversion of an undesignated watercourse would be required at CH 9675 for the On-line Dual Carriageway. Depending on the vertical alignment of the On-line Dual Carriageway attenuation pond(s) could also be required at this location for a carriageway drainage outfall.

Between CH 9950 and CH 10625 the A5 Collector Road would require new drainage infrastructure and potential alteration to existing utility services. The vertical alignment of the A5 Collector Road would determine if an attenuation pond at CH 10675 for a carriageway drainage outfall into the undesignated watercourse would be required.

Some localised watercourse engineering works may be required at CH 10675 where the On-line Dual Carriageway interacts with an existing undesignated watercourse.

At CH 12225 the On-line Dual Carriageway, A5 Collector Road and realigned side road would require the extension of the existing culverts and likely a diversion of the undesignated watercourses. Depending on the vertical alignment of the On-line Dual Carriageway, A5 Collector Road and the realigned side road, there could be a requirement for an attenuation pond(s) in this area for a carriageway drainage outfall from the On-line Dual Carriageway and the A5 Collector Road, with the only available land located to the north of the dual carriageway.

Between CH 12150 and CH 13550 the A5 Collector Road would require new drainage infrastructure and potential alteration to existing utility services. A new bridge structure would be required where the dual carriageway crosses the Burn Dennet River at CH13900, an attenuation pond(s) would be required at this location for a carriageway drainage outfall.

Between CH 12900 to CH 13250, CH 14200 to CH 14600 and CH 15400 to CH 16250 the On-line Dual Carriageway would require upgrade to the existing drainage infrastructure and potential alteration to existing utility services.

Between CH 13950 and CH 16750 the A5 Collector Road would require new drainage infrastructure and potential alteration to existing utility services. Depending on the vertical alignment of the A5 Collector Road an attenuation pond(s) for carriageway drainage outfalls could be required at CH 13900 into the Burn Dennet River, CH 14900 into the Ballydonaghy Drain, CH 15200 into an undesignated watercourse and between CH 15700 and CH 16450 into any of the undesignated watercourses to the west of the A5 Collector Road.

A new bridge structure would be required where the On-line Dual Carriageway crosses the Glenmoran River at CH 17225, an attenuation pond(s) would be required at this location for a carriageway drainage outfall. A number of new culverts and a series of watercourse diversions would be required between CH 17300 and CH 18200 to facilitate the On-line Dual Carriageway crossing of the Ballymagorry Burn watercourse. The vertical alignment of the On-line Dual Carriageway would determine if there is a need for an attenuation pond(s) in this area for carriageway drainage

outfall. New bridge structures at CH 18700 and CH 18900 are required to cross existing watercourses and also to provide connectivity of flood plains along the Ballymagorry Burn.

An attenuation pond(s) would be required in this area for a carriageway outfall. The existing culverts at CH 18775 underneath the realigned Woodend Road and the A5 Collector Road roundabout with the potential requirement for watercourse diversions.

The A5 Collector Road realignment between CH 18600 and CH 18850 would require new drainage infrastructure and an attenuation pond(s) for a carriageway drainage outfall. Alteration to existing utility services could also be required. A structure would be required at CH 19200 where the proposed dual carriageway and realigned private access road crosses an existing undesignated watercourse. Depending on the vertical alignment of the dual carriageway an attenuation pond(s) could be required at this location for a carriageway drainage outfall.

New culverts and a series of potential watercourse diversions would be required at CH 193220, CH 19475, CH 19550, CH 19750, CH 19875, CH 20225 CH 20600 and CH 20650, where the On-line Dual Carriageway and realigned private access road crosses numerous existing watercourses. The vertical alignment of the dual carriageway would influence if an attenuation pond(s) would be required in this area for carriageway drainage outfalls.

The existing culverts at CH 20770 and CH 21160 would need to be extended and watercourse diversions incorporated. Depending on the vertical alignment of the On-line Dual Carriageway an attenuation pond(s) could be required at these locations for carriageway drainage outfalls. New culverts would be required at CH 21200 and CH 21400 for the realigned side road and at CH 21250 for the realigned private access road.

The existing culvert at CH 21500 would need realigned and lengthened with a potential watercourse diversion where the existing A5 and the proposed dual carriageway cross the Park Road Drain watercourse. The vertical alignment of the On-line Dual Carriageway would determine if an attenuation pond(s) would be required at this location for a carriageway outfall, with limited room available in this area.

Between CH 21575 and CH 21850 the proposed A5 Collector Road would require new drainage infrastructure and an attenuation pond for a carriageway drainage outfall into the Mourne River. There could also be alternation to existing services required.

A new bridge structure would be required where the On-line Dual Carriageway crosses the River Mourne at CH 21950. An attenuation pond(s) would be required at this location for a carriageway drainage outfall. The existing culvert at CH 22275 could need lengthened to accommodate the realigned side road. A new culvert and watercourse diversion would be required at CH 22250 where the On-line Dual Carriageway crosses an existing undesignated watercourse. An attenuation pond(s) could be required at this location for a carriageway drainage outfall.

Between CH 22700 and CH 23600 the On-line Dual Carriageway would require upgrade to the existing drainage infrastructure and potential alteration to existing services. The existing culvert at CH 22800 could need lengthened to accommodate the realigned side road.

Between CH 22900 and CH 23050 watercourse diversions and alteration to existing culverts and / or new culverts would be required where the existing A5 crosses Urney Road Drain. A new culvert and potential watercourse diversion would be required at CH23700 where the On-line Dual Carriageway crosses an undesignated watercourse.

The vertical alignment of the On-line Dual Carriageway would influence if an attenuation pond(s) would be required at this location for a carriageway drainage outfall. A new culvert would be required at CH 24750 where the On-line Dual Carriageway the Flushtown watercourse. An attenuation pond(s) could be required for a carriageway drainage outfall. A new culvert and watercourse diversion would be required at CH 25750 where the On-line Dual Carriageway crosses an existing undesignated watercourse.

Depending on the vertical alignment of the dual carriageway, an attenuation pond(s) could be required at this location. A5 Collector Road between CH 25650 and CH 25800 would require new drainage infrastructure and an attenuation pond(s) for a carriageway drainage outfall. Alteration to existing utility services may also be required.

3.3.4 Section 2

New culverts would be required along with possible watercourse diversions at CH 27350, CH 27800, CH 28700 and CH 29200 where the proposed dual carriageway crosses four undesignated watercourses. The vertical alignment of the proposed dual carriageway would determine if an attenuation pond(s) would be required at these locations for carriageway drainage outfalls.

Between CH 29300 and CH 30000 the A5 Collector Road would require new drainage infrastructure and possible alternation to existing utility services, an attenuation pond would be required for a carriageway drainage outfall, its location dependant on the vertical alignment of the A5 Collector Road. Between CH 29850 and CH 31900 the On-line Dual Carriageway would require an upgrade to the existing drainage infrastructure and possible alteration to existing services. Along this section of the On-line Dual Carriageway attenuation ponds would be required for carriageway drainage outfalls, these attenuation ponds could be required at CH 30530 and CH 31200. The existing culvert at CH 30530 would need lengthened and a watercourse diversion required where the dual carriageway crosses the undesignated watercourse.

A watercourse diversion would be required between CH 3110 and CH 31350. Between CH 30950 and CH 32925 the A5 Collector Road would require new drainage infrastructure and possible alternation to existing utility services along sections, an attenuation pond(s) would be required for a carriageway drainage outfall(s), the location(s) dependant on the vertical alignment of the A5 Collector Road. A new bridge structure would be required at CH 33500 where the dual carriageway crosses the River Derg. An attenuation pond(s) would be required at this location for a carriageway drainage outfall.

Between CH 35375 and CH 37050 the A5 Collector Road would require new drainage infrastructure and possible alternation to existing utility services, an attenuation pond(s) would be required for a carriageway drainage outfall(s), the location(s) dependant on the vertical alignment of the A5 Collector Road. Between CH 36000 and CH 42350 the On-line Dual Carriageway would require an upgrade to the existing drainage infrastructure and possible alteration to existing utility services.
Along this section of the On-line Dual Carriageway attenuation ponds would be required for carriageway drainage outfalls, depending on the vertical alignment these attenuation ponds could be required at CH 36650, CH 36800, CH 38100, CH 38200,

CH 39100, CH 40050, CH 40550, CH 40650, CH 41250, CH 41450 and CH 41950. The existing culverts at CH 37025, CH 39100, CH 40550, CH 41025, CH 41450 and CH 41950 would need to be lengthened and watercourse diversions incorporated where the dual carriageway crosses existing watercourses.

The A5 Collector Road would require new drainage infrastructure between CH 38450 and CH 42350. Attenuation ponds would be required for carriageway drainage outfalls, the vertical alignment of the A5 Collector Road would determine if these attenuation ponds would be required at CH 39125, CH 40050, CH 40550, CH 40650, CH 41000, CH 41450, CH 41950 and CH 42425. A new culvert would be required at CH 39125 where the A5 Collector Road crosses an existing watercourse. Culverts and a watercourse diversion would be required at CH 39125 where the private access road and realigned Grange road interact with the watercourse.

The existing culvert would need to be lengthened and the watercourse diverted at CH 42425 where the On-line Dual Carriageway and A5 Collector Road crosses an existing watercourse. New culverts and watercourse diversions would be required at CH 42625, CH 42750 and CH 42925 where the On-line Dual Carriageway crosses existing watercourses, depending on the vertical alignment of the dual carriageway attenuation pond(s) could be required at these locations for carriageway drainage outfalls.

A new culvert would be required at CH 42900 for the realigned private access road. New culverts and possible water diversions would be required at CH 43100, CH 43500 and CH 43700 where the dual carriageway crosses existing watercourses. The vertical alignment of the On-line Dual Carriageway would influence if an attenuation pond(s) would be required at these locations for a carriageway drainage outfall(s). Between CH 43850 and CH 46750 the On-line Dual Carriageway would require an upgrade to the existing drainage infrastructure and new drainage infrastructure along with possible alteration to existing utility services. Along this section of the On-line Dual Carriageway attenuation ponds would be required for carriageway drainage outfalls, depending on the vertical alignment these attenuation ponds may be required at CH 43850, CH 43975, CH 44600, CH 44750, CH 45125, CH 45925, CH 46300 and CH 46675.

The existing culverts at CH 43650, CH 43900, CH 44750, CH 45125, CH 45925, CH 46300 and CH 46650 would need to be lengthened and watercourse diversions incorporated where the On-line Dual Carriageway crosses existing watercourses.

The A5 Collector Road would require new drainage infrastructure between CH 43550 and CH 46750, with alteration to existing utility services. Attenuation ponds would be required for carriageway drainage outfalls, depending on the vertical alignment of the A5 Collector Road these attenuation ponds may be required at CH 43650, CH 43850, CH43975, CH 44400, CH 44650, CH 44950, CH 45900, CH 46300 and CH 46700.

The existing culverts at CH 43650, CH 43875, CH 43975, CH 44650, CH 44950, CH 45900 and CH 46650 would need to be extended and realigned with possible watercourse diversions where the A5 Collector Road crosses existing watercourses.

A new culvert would be required at CH 46300 along with a possible watercourse diversion where the A5 Collector Road crosses the existing watercourse. Between CH 47000 and CH 47175 new culverts and a watercourse diversion would be required where the On-line Dual Carriageway crosses an existing watercourse. Depending on the vertical alignment of the dual carriageway there could be an attenuation pond(s) required for a carriageway drainage outfall.

The A5 Collector Road would require new drainage infrastructure between CH 47350 and CH 47925, with alteration to existing utility services. New culverts and watercourse diversions would be required between CH 49050 and CH 49500 where the On-line Dual Carriageway crosses the Tully Drain watercourse. The vertical alignment would decide if an attenuation pond(s) would be required at this location for a carriageway drainage outfall.

A new bridge structure over the Fairywater River would be required at CH 49900. An attenuation pond(s) for carriageway drainage outfall is required at this location. A watercourse diversion is required at CH 50000 where the On-line Dual Carriageway interacts with an existing watercourse. New culverts and possible watercourse diversions would be required at CH 51100 and CH 51450 where the dual carriageway crosses the Aghnamoyle Drain and an undesignated watercourse. Depending on the vertical alignment of the On-line Dual Carriageway an attenuation pond(s) may be required at these locations for a carriageway drainage outfall(s). Between CH 52950

and CH 53300 a watercourse diversion and culverts would be required where the On-line Dual Carriageway crosses an undesignated watercourse. Depending on the vertical alignment of the dual carriageway an attenuation pond(s) could be required at these locations for a carriageway drainage outfall.

New culverts and watercourse diversions would be required at CH 54650, CH 54825, CH 55150, CH 55400, CH 55625 and CH 56250 where the On-line Dual Carriageway crosses three undesignated watercourses, the Fireagh Lough Drain and two additional undesignated watercourses. Depending on the vertical alignment of the dual carriageway attenuation pond(s) could be required at these locations for a carriageway drainage outfall(s).

Between CH 56900 and CH 57400 a watercourse diversion and culvert(s) would be required where the On-line Dual Carriageway crosses the Loughmuck watercourse. Depending on the vertical alignment of the dual carriageway these may be a requirement for an attenuation pond at this location for a carriageway drainage outfall.

A new culvert and watercourse diversion would be required at CH 57450 where the realigned Ballynahatty side road crosses an existing watercourse. A new bridge structure would be required at CH 57625 where the On-line Dual Carriageway crosses the Drumragh Extension River. An attenuation pond(s) would be required at this location for a carriageway drainage outfall(s).

A new culvert and watercourse diversion would be required at CH 57800 where the On-line Dual Carriageway crosses the Freughmore Drain watercourse. Depending on the vertical alignment the proposed dual carriageway an attenuation pond may be required at this location for a carriageway drainage outfall.

3.3.5 Section 3

A new culvert and watercourse diversion would be required at CH 57000 and between CH 57700 to CH 58000 where the On-line Dual Carriageway crosses an undesignated watercourses. Depending on the vertical alignment of the dual carriageway an attenuation pond(s) could be required at these locations for a carriageway drainage outfall(s).

Between CH 57050 and CH 57400 the A5 Collector Road would require new drainage infrastructure and possible alteration to existing utility services. A new culvert and watercourse diversion would be required at CH 57250 where the realigned side road cross an undesignated watercourse.

Between CH 58500 and CH 60775 the On-line Dual Carriageway would require an upgrade to the existing drainage infrastructure and possible alteration to existing utility services. Along this section of the On-line Dual Carriageway attenuation ponds would be required for carriageway drainage outfalls at CH 59400, CH 59650, CH 59950 and CH 60250. The existing culverts at CH 59500 and CH 59650 would need lengthened and a watercourse diversion required where the dual carriageway crosses the undesignated watercourse.

Between CH 58500 and CH 60775 the A5 Collector Road would require new drainage infrastructure and possible alternation to existing utility services, an attenuation pond(s) would be required for a carriageway drainage outfall(s). A watercourse diversion would be required at CH 60250 where the A5 Collector Road interacts with an existing watercourse. A watercourse diversion would be required between CH 61500 and CH 61025 where the On-line Dual Carriageway interacts with an existing watercourse. Between CH 61800 and CH 63250 the On-line Dual Carriageway would require an upgrade to the existing drainage infrastructure and possible alteration to existing utility services.

An attenuation pond may be required for carriageway drainage outfalls at CH 62400. The existing culvert at CH 62425 would need realigned and a watercourse diversion required where On-line Dual Carriageway crosses the undesignated watercourse. A watercourse diversion would be required between CH 62975 and CH 63100 where the proposed On-line Dual Carriageway interacts with an existing watercourse.

Between CH 61700 and CH 63250 the A5 Collector Road would require new drainage infrastructure. Depending on the vertical alignment an attenuation pond may be required at CH 62400 for a carriageway drainage outfall. The A5 Collector Road between CH 63400 and CH 64350 would require new drainage infrastructure and possible alterations to existing utility services. Depending on the vertical alignment of the A5 Collector Road an attenuation pond could be required at CH 64250 for a carriageway drainage outfall.

A watercourse diversion would be required between CH 63350 and CH 63575 where the proposed dual carriageway crosses an existing watercourse. The existing culvert at CH 64275 would require realignment and a watercourse diversion where the On-line Dual Carriageway crosses the Letfern watercourse.

Between CH 64800 and CH 65250 modifications would be required to existing culverts with new culverts and watercourse diversions also required where the On-line Dual Carriageway crosses an existing undesignated watercourse. Depending on the vertical alignment of the dual carriageway an attenuation pond(s) could be required for a carriageway outfall at CH 65275 and CH 65700. A watercourse diversion would be required between CH 66150 and CH 6450 where the On-line Dual Carriageway interacts with an existing watercourse. A new culvert would be required at CH 66450 where the dual carriageway crosses an existing undesignated watercourse.

Between CH 67200 and CH 68600 the proposed On-line Dual Carriageway would require upgrades to the existing drainage infrastructure and possible alterations to existing utility services. Depending on the vertical alignment of the On-line Dual Carriageway an attenuation pond may be required at CH 67900 for a carriageway drainage outfall. The existing culvert at CH67900 would need to be lengthened where the dual carriageway and A5 Collector Road crosses the watercourse.

Between CH 67900 and CH 69700 watercourse diversions, new culverts and alteration of existing culverts would be required where the On-line Dual Carriageway interacts with an existing undesignated watercourse. The existing culverts at CH 7000 and 71050 would need to be lengthened where the dual carriageway crosses existing watercourses. Depending on the vertical alignment of the On-line Dual Carriageway an attenuation pond could be required for a carriageway drainage outfall.

Between CH 71325 and CH 72575 the A5 Collector Road would require new drainage infrastructure and possible alterations to existing services. The existing culvert at CH 71475 would need to be lengthened with a possible watercourse diversion where the On-line Dual Carriageway and A5 Collector Road cross an existing watercourse.

Between CH 72625 and CH 73350 a series of watercourse diversions would be required and existing culverts altered where the On-line Dual Carriageway crosses a number of existing watercourses. The vertical alignment of the On-line Dual

Carriageway would determine if an attenuation pond(s) may be required for a carriageway drainage outfall in this area.

Between CH 73000 and CH 75200 the A5 Collector road would require new drainage infrastructure and alteration to existing utility services. A series of watercourse diversions and alterations to existing culverts would be required along this section of the A5 Collector Road. Depending on the vertical alignment an attenuation pond(s) could be required for a carriageway outfall(s) where the road interacts with existing watercourses. Depending on the vertical alignment of the On-line Dual Carriageway attenuation ponds could be required at CH 72800, CH 75100 and CH 74500 for carriageway drainage outfalls.

Between CH 7650 and CH 76750 the existing culverts would need to be altered and a watercourse diversion incorporated. The existing culvert at CH 76900 would need to be realigned with a watercourse diversion where the On-line Dual Carriageway crosses an existing watercourse. Depending on the vertical alignment of the On-line Dual Carriageway an attenuation pond could be required for a carriageway drainage outfall at this location.

The On-line Dual Carriageway would require alterations to existing culverts and watercourse diversions at CH 77650 and between CH 78000 to CH 78150. The vertical alignment of the On-line Dual Carriageway would influence if an attenuation pond would be required for a carriageway drainage outfall(s) at these locations.

The On-line Dual Carriageway and A5 collector road would require alteration to the existing culverts and watercourse diversions at CH 79550, CH 80450, CH 81175, CH 81550, CH 81775, CH 82250, CH 82850 and CH 83150. Existing drainage infrastructure would need to be upgrades and alterations made the existing utility services. Depending on the vertical alignment of the On-line Dual Carriageway and A5 Collector Road attenuation pond(s) could be required for carriageway outfalls at CH 79550, CH 80450, CH 81175, CH 81550, CH 81775, CH 82250, CH 82850 and CH 83150.

New culverts would be required at CH 80200 and CH 81150 where the A5 Collector Road crosses numerous watercourses. Depending on the vertical alignment of the A5

Collector Road attenuation pond(s) could be required at CH 80200 and CH 81150 for carriageway outfalls.

New culverts and watercourse diversions would be required at CH 83500 (E), CH 83600 (E) to CH 83675 (E), CH84050, CH 84250 (E) to CH 84550 (E), CH 85100 (E) to CH 85300 (E) and CH 85650 (E). Where the On-line Dual Carriageway crosses a number of existing watercourses, attenuation ponds could be required for carriageway outfalls at these watercourses.

3.3.6 Summary

The A5WTC On-line Route and associated A5 Collector Road would require significant river engineering works across all three sections. Works would include realignment, lengthening and increasing the size of a significant number of existing culverts, the installation of new culverts and the creation of watercourse diversions ranging from minor to lengthy watercourse realignment.

Attenuation ponds to provide attenuation and treatment to carriageway runoff would be required along the entire length of the scheme. The location of these attenuation ponds would largely be driven by the vertical profile of the, the topography of the existing land and the availability of a suitable receiving watercourse. The current review has identified potential locations where attenuation ponds would be required at locations where there is limited land available, particularly adjacent to existing residential and commercial properties.

At locations where the On-line Dual Carriageway interrupts the natural catchment flows from surrounding lands, these would be intercepted by PED and transferred back into the receiving watercourse. Specific locations are likely to present significant engineering challenges in maintaining flows with their existing catchment due to the natural topography of the land.

In general terms, flooding impacts associated with the On-line Dual Carriageway are considered to be broadly similar to the existing A5 carriageway. The exception to this is where route traverses through floodplain to provide by-passes at specific locations. Detailed hydraulic modelling would be required to confirm this aspect.

3.4 Traffic Strategy & Engineering Requirements

The traffic implications of an On-line Dual Carriageway utilising the existing A5 Corridor compared to the previously identified Proposed Scheme may be considered from two perspectives, namely, local traffic and strategic traffic.

With regard to strategic traffic, the major traffic model previously prepared for the project was developed to consider the relative merits of the scheme options from the strategic perspective. That model has not been re-run for this exercise as conclusions could reasonably be drawn with regard to strategic traffic implications when the following considerations and assumptions are taken into account:-

a) Since the length of an on-line versus an off-line option would be similar, and if all junctions along the route are similar (and predominantly grade-separated), journey time savings, and hence accrued economic benefits would be similar for strategic traffic.

b) Given the duration of the construction period and the associated temporary traffic management measures that would be required to conduct works safely on and adjacent to the on-line sections to be dualled, there would be a negative impact on an on-line option compared to a predominantly off-line option with regard to economic benefits.

In light of the foregoing, if all other factors were equal, an assessment looking at strategic traffic would deliver a less favourable result for an On-line Dual Carriageway utilising the existing A5 Corridor compared to the previously identified Proposed Scheme.

Turning to local traffic issues, the differences between on-line and off-line would become more pronounced. It should be remembered that due to the high speed nature of the proposed dual carriageway and applicable current road safety guidance, the dual carriageway would require a central reserve with a continuous safety barrier running the length of the scheme. The following consequences would therefore arise with an on-line dual carriageway:-

i) Due to the central barrier, vehicles that currently access properties that would remain in situ along the length of the A5 would be unable to turn right into the properties and right out of the properties. Consequently, the properties would have to be accessed one of two ways. In possibly the less favourable option,

accesses could remain on and off the A5, but these could only operate on a left-in/left-out basis, with motorists having to travel to the next grade separated junction to allow them to access the opposite side of the carriageway. Such an approach would perhaps entail more junctions to keep travel distance to the next junction at an acceptable level, with associated land-take, environmental impact and associated costs. The alternative option would be to run collector roads parallel to the A5 to enable the dwellings and businesses adjacent to the A5 to leave at the closest junction rather than travelling in what may considered as the wrong direction to access properties. Again, these collector roads would have associated land-take, construction, environmental and cost implications over and above what the connotation of widening the A5 may initially suggest to some.

ii) Several sections of the existing A5 were previously developed and constructed as by-passes to alleviate existing adverse traffic conditions, for example, the A5 Newtownstewart Bypass. If these sections of the A5 were widened associated impacts would arise, with the potential for further construction works and associated impacts and mitigation requirements. If the previously proposed junction strategy were maintained, access to and from origins and destinations in, say, Newtownstewart, would be restricted. A proportion of the traffic that currently utilises this bypass would be obliged to once more use the local road network in and around Newtownstewart, since the direct access from and across the existing A5 would be lost. The alternative would be to provide additional grade-separated junctions either side of the by-passed settlement, again, with associated land-take, construction, environmental and cost implications.

iii) Furthermore, by-and-large, local motorists that use sections of the existing A5 repeatedly on any given day would be more inconvenienced during the construction phase of the project than more strategic travellers who may use the existing A5 more infrequently.

In summary, the consequences on the means of access to existing properties and settlements and associated patterns of movement would be substantially altered and adversely affected from the local perspective.

To provide further insight into some of the associated issues incurred by an on-line option, a series of key examples for each section are provided below. While not

intended as a definitive list, they serve to highlight relevant issues in accord with the general points made above.

3.4.1 Section 1

The following highlights some of the potential traffic issues which could occur in Section 1 with the On-line Dual Carriageway:

- CH 4300 – Junction 1 Bypass New Buildings. The existing traffic movements through the town are slow due to the existing traffic lights and junctions, which at peak times can cause long tail backs.
- This bypass reduces the traffic through the town and allows for the free movement of traffic in the town. The reduction of HGVs traveling in the town would improve safety, reduce noise and improve air quality.
- A number of landowners along the existing A5 in New Buildings would have improved access to their properties due to the reduction through traffic in the village.
- CH5750 – Junction 2 Link to existing A5. The junction links the existing A5 and dual carriageway, enabling traffic to join the dual carriageway without going through the New Buildings.
- This junction has been identified as a strategic junction to link to the A6, a link around the city of Derry.
- The utilisation of the existing A5 from CH5900 – CH6450, would cause traffic problems due to buildability of using the existing carriageway and traffic management problems.
- The utilisation of Great Northern Link would cause traffic issues for the local traffic. The existing roundabout at Bradley Way provides access to the existing through pass and town. However as the bypass is utilised for the dual carriageway, traffic is forced through the town.
- More traffic through the town would result in greater congestion, more noise and greater pollution, however it may also affect the dual carriageway as traffic may use this stretch as a ‘rat run’. Traffic would join the dual carriageway at junction 7 and leave at Junction 6, to avoid traffic in the town. This would cause traffic issues through the bypass round Strabane, and would affect the strategic traffic movements, which would increase journey times.
- The location of Junction 7 would result in a significantly large roundabout. This roundabout may result in a grade separated junction due to the volume of traffic

joining from the Strabane and Lifford areas. The grade separated junction would maintain journey times, and reduce waiting times at this junction. .

- In general utilising the existing A5 would cause traffic management problems, the On-line Dual Carriageway crosses the A5 Collector Road. This would increase journey times due to the temporary traffic signals and construction traffic on the existing A5.

3.4.2 Section 2

The following highlights some of the potential traffic issues which could occur in Section 2 with the On-line Dual Carriageway:

- CH29500 -CH31150 Victoria Bridge Bypass - utilising the existing A5 bypass of Victoria Bridge for the dual carriageway would force the local traffic through the town, this could cause increased noise and air pollution. Farm vehicles which are not allowed to use the dual carriageway would be forced thought the town.
- Due to the difficulty and suitable junction location, two junctions would be required, northbound and southbound junctions. The length of realigned A5 Collector Road would tie in to these junctions. The junctions would be grade separated at each location.
- The issue in providing a junction at either end of the village, it would cause traffic to travel through the town which wish to join the proposed dual carriageway, again the strategic traffic would be forced to travel through before heading north or south from the town. This perfect storm would result in significant delays and congestions for locals going about their daily business.
- CH36400 – CH39100 Newtownstewart Bypass - utilising the existing A5 bypass of Newtownstewart for the dual carriageway would force the local traffic through the town, this could cause increased noise and air pollution. Farm vehicles which are not allowed to use the dual carriageway would be forced thought the town.
- There are a number of traffic signals and narrow roads in the town. The additional traffic would cause congestion and parking issues in the town. The additional closure of Main Street junction with the existing A5 would increase journey times through the town.
- Due to the difficulty and suitable junction location, two junctions would be required, northbound and southbound junctions. The length of realigned A5 Collector Road would tie in to these junctions. The junctions would be grade separated at each

location. The issue in providing a junction at either end of the village, it would cause traffic to travel through the town which wish to join the dual carriageway, again the strategic traffic would be forced to travel through before heading north or south from the town. This perfect storm would result in significant delays and congestions for locals going about their daily business.

- There could be a call for additional junction locations along this dual carriageway due to tourist attractions such as the Ulster-American Folk Park. As the park attracts a significant number of visitors and is in close proximity to the dual carriageway there may be calls for an additional junction.
- The provision of junctions north, west and south of Omagh would reduce the traffic through the town and provide strategic junctions.

3.4.3 Section 3

The following highlights some of the potential traffic issues which could occur in Section 3 with the On-line Dual Carriageway:

- The provision of a junction South of Omagh allows for a connector road to the existing A5. This junction would be a grade separated junction, with an upgrade of the Seskinore Road to tie in with the dual carriageway slip road and new junction with the existing A5. The new A5 Collector Road provides the link for local traffic between the strategic junctions. A new strategic junction would be provided at Moylagh as an intermediate location for joining the dual carriageway.
- The On-line Dual Carriageway continues to utilise the existing A5 though the village of Garvaghy bypassing the Gaelic Athletic Association Tyrone Centre of Excellence. This centre attracts large number of vehicles and would continue to grow, there could be a call to provide a junction at this location for the centre and the village of Garvaghy and surrounding area. Too many junctions would result in the dual carriageway no longer being a strategic route and used as locals to move between junctions.
- The On-line Dual Carriageway utilises the climbing lane from the Ballygawley roundabout. This would result in the local traffic traveling through Ballygawley before reaching the existing roundabout junction. This could cause a number of traffic issues in the village such as noise and air pollution. The additional traffic could cause parking and safety issues within the town.
- In putting the traffic though the town there would be a push to provide an additional junction north of Ballygawley CH 77200, at the top of the existing climbing lane.

This would result in having two junctions within 1km of each other. These junctions would result in the dual carriageway being used as a 'rat run' around the village of Ballygawley.

Notwithstanding, it must be recognised that an on-line option would generate some benefits from the local perspective. For example, preventing right turns across the existing A5 would remove a potential hazard and source of delay on what is one of the Region's Key Transport Corridors, intended to facilitate the expeditious movement of goods, services and people across the Region. However, in general terms, an off-line option also generates similar benefits, since removing longer haul traffic from the existing A5 would reduce the potential source of conflict that can occur between local motorists trying to get on and off the A5 and those wishing to travel expeditiously along the same section of road, and, the overall reduction in traffic on the existing A5 would reduce delays thereon.

3.5 Utilities

Northern Ireland Electric (NIE), Northern Ireland Water (NI Water), British Telecom (BT) and other telecommunication operators (O2, Vodafone, Eir, Virgin Media, etc.) are the main service providers situated within the existing A5 corridor. These services are concentrated in development limits and utilise the existing A5 as a strategic corridor to transfer services from settlement to settlement.

Further surveys and investigations are required to determine the full extent of the impact on utilities. Each individual service provider would need to be contacted to develop an accurate account of the diversionary works required.

As the On-line Dual Carriageway is continuously on, or close to, the existing A5, public utilities are severely affected and a significant amount of services would require alterations or diversionary works. In addition to the permanent diversionary works, temporary works may be essential in order to maintain services during construction phases.

Significant lead in time is required for these diversionary works to be operational before permanent construction works can commence. New services are required to be running before the older services can be shut down and removed. The associated

works would add significant construction time to an on-line option compared to an off-line option.

The following highlights some service diversions which are required per section of the On-line Dual Carriageway.

3.5.1 Section 1

There is an extensive network of overhead and underground distribution apparatus for commercial and domestic electricity and potable water supplies between New Buildings and Sion Mills.

The On-line Dual Carriageway crosses 110kV overhead transmission lines once (CH18150).There are significant planning and costs involved in diverting 110kV overhead transmission, which may cause disruption to services.

The On-line Dual Carriageway crosses 33kV, 11kV and Medium Voltage (MV) overhead power lines 12 times, 21 times and 11 times respectively. The dual carriageway would require a total of approximately 62 sets of overhead supporting poles to be relocated or raised, if potential, to achieve sufficient safety clearance. This is the equivalent of providing a new pole approximately every 375m for the 23.2km of dual carriageway.

The On-line Dual Carriageway has a significant impact on NI Water distribution mains of various sizes. Approximately 1.04km of 100mm or smaller diameter pipes, 6.2km of 100 - 300mm diameter pipes and 50m of 300 – 450mm diameter pipes require diversions. The On-line Dual Carriageway would require approximately 230m of combined sewer pipes to be diverted, including 100m of 900 – 1350mm diameter piping which transports non-potable water from Strabane to the waste water treatment works on Park Road (CH20800m).

The requirement for nearly 8km of water network to be diverted would require significant time, cost and additional land. The associated costs with these works could be increased due to the condition of the existing network and change in design standards. It is difficult to quantify the condition of the existing network at this stage.

Current utility information indicates that there is no gas apparatus affected by the On-line Dual Carriageway.

The On-line Dual Carriageway utilises or is in close proximity to the existing A5, therefore telecommunication apparatus would be significantly affected. In utilising the existing A5 corridor fibre optic cables would be significantly affected. Fibre optic cables are expensive to move.

The On-line Dual Carriageway crosses BT trunk fibre optic and copper cables 10 times. Although the copper cables may be straight forward to move, the fibre optic cables diversions are more expensive to move. There would be approximately 5.1km of cable needing diverted and 101 joint boxes to be relocated to utilise 5.65km of the existing A5 for a dual carriageway. The diversions for the fibre optic cables may be significantly longer.

Other BT underground cables are crossed where the dual carriageway intersects existing side roads. BT overhead cables are crossed 17 times, which would directly affect 59 overhead supporting poles. These poles would need to be relocated or raised to achieve sufficient safety clearance.

EE (formerly Orange) currently have a mast located on Park Road (Ch21200m) which would need relocated. Atlas Communications (NI) (formerly Bytel), Eir (formerly Eircom) and Virgin Media could require 0.38km of trunk fibre optic cables to undergo diversionary works each.

Current utility information indicates that telecommunications apparatus owned by other utility providers are not affected by this On-line Dual Carriageway route.

3.5.2 Section 2

There is an extensive network of overhead and underground distribution apparatus for commercial and domestic electricity and potable water supplies between Sion Mills and the South of Omagh.

The On-line Dual Carriageway crosses 110kV overhead transmission lines 4 times. The On-line Dual Carriageway directly affects 1 overhead supporting tower (110kV). For an overhead supporting tower to be relocated, the adjacent towers would generally

undergo remedial works – resulting in a total of 3 towers affected. There would be significant planning and costs involved in diverting 110kV overhead transmission, which may cause disruption to services.

The On-line Dual Carriageway crosses 33kV and 11kv overhead power lines 5 times and 18 times respectively. MV lines are crossed twice, at Garden Road and Concess Road – both South of Sion Mills. A total of approximately 46 sets of overhead supporting poles would need to be relocated or raised to achieve sufficient safety clearance. This is the equivalent of providing a new pole approximately every 680m for the 31.3km of new on-line dual carriageway.

The dual carriageway has a significant impact on NI Water distribution mains of various sizes. Approximately 3.8km of 100mm or smaller diameter pipes, 7.8km of 100 – 300mm diameter pipes and 0.2km of 300 – 450mm diameter pipes are likely to require diversionary works. Around 0.7km of 300mm or smaller diameter combined sewer pipes would also need to be diverted.

The requirement of over 12km of water network to be diverted requires significant time, cost and additional land. The associated costs with these works may be increased due to the condition of the existing network and change in design standards. It is difficult to quantify the condition of the existing network at this stage, further investigations are required.

Current utility information indicates that there is no gas pipes affected by the On-line Dual Carriageway.

The On-line Dual Carriageway crosses BT trunk fibre optic and copper cables 17 times. Although the copper cables may be straight forward to move, the fibre optic cables diversions are more expensive to move. There is approximately 10.7km of cable needing diverted and 157 joint boxes to be relocated to utilise 11.5km of the existing A5 for a dual carriageway. The diversions for the fibre optic cables could be significantly longer.

Other BT underground cables are crossed where the dual carriageway intersects existing side roads. BT overhead cables are crossed 21 times, which would directly

affect 59 overhead supporting poles. These poles would need to be relocated or raised to achieve sufficient safety clearance.

Vodafone currently have a mast located near Bells Park Road (Ch28200m) which would need relocated. Atlas Communications (NI), Eir and Virgin Media each require 10.1km of trunk fibre optic cables to undergo diversionary works. The diversions for the fibre optic cables may be significantly longer, this would be determined at detailed design stage. When a complete route diversion is not potential, the ducts would be lowered and/or protected as appropriate.

Current utility data indicates that telecommunications apparatus owned by other utility providers are not affected by this dual carriageway.

3.5.3 Section 3

There is an extensive network of overhead and underground distribution apparatus for commercial and domestic electricity and potable water supplies between the South of Omagh and Aughnacloy.

The On-line Dual Carriageway crosses 33kV, 11kv and MV overhead power lines 9 times, 35 times and 9 times respectively. Current utility information indicates that 110kV power lines are not impacted along the dual carriageway. The On-line Dual Carriageway requires a total of approximately 90 sets of overhead supporting poles to be relocated or raised to achieve sufficient safety clearance. This is the equivalent of providing a new pole approximately every 340m for the 30.5km of new on-line dual carriageway.

The On-line Dual Carriageway has a high impact on NI Water distribution mains of various sizes. Approximately 5.3km of 100mm or smaller diameter pipes, 11.1km of 100 – 300mm diameter pipes and 0.05km of 300 – 450mm diameter pipes would be likely to require diversionary works.

The requirement of over 16km of water network to be diverted requires significant time, cost and additional land. The associated costs of these works may be increased due to the condition of the existing network and change in design standards. It is difficult to quantify the condition of the existing network at this stage, further investigations would be required.

Current utility information indicates that there is no gas pipes affected by the On-line Dual Carriageway.

As the On-line Dual Carriageway is close to the existing A5, telecommunication apparatus would be significantly affected. The dual carriageway crosses BT trunk fibre optic and copper cables 20 times, which would require approximately 17.8km of cable needing diverted and 207 joint boxes to be relocated.

The On-line Dual Carriageway crosses BT trunk fibre optic and copper cables 20 times. Although the copper cables could be straight forward to move, the fibre optic cables diversions are more expensive to move. There is approximately 17.8km of cable needing diverted and 207 joint boxes to be relocated to utilise 15.35km of the existing A5 for a dual carriageway. The diversions for the fibre optic cables could be significantly longer, this would be determined at detailed design stage.

Other BT underground cables are crossed where the dual carriageway intersects existing side roads. BT overhead cables are crossed 28 times, which would directly affect 166 sets of overhead supporting poles. These poles would need to be relocated or raised, if possible, to achieve sufficient safety clearance.

Eir and Virgin Media would require 12.4km of trunk fibre optic cables to undergo diversionary works each. Similarly, Bytel would also require 3.5km to be diverted. Vodafone (formerly Cable and Wireless) have apparatus located in Aughnacloy, of which 0.3km would require diversion. When a complete route diversion is not possible, the ducts would be lowered and/or protected as appropriate.

Current utility information indicates that telecommunications apparatus owned by other utility providers are not affected by this On-line Dual Carriageway Route.

There is a windfarm situated east of Garvaghy at Slieve Divena. It consists of 12 turbines, with an additional 8 proposed. The windfarm would not be affected by the On-line Dual Carriageway.

The table below summaries the main utilities which would be affected by the On-line Dual Carriageway.

Table 3-11 Utilities Affected by the On-line Dual Carriageway

Utilities Affected by the On-line Dual Carriageway				
Utility	**Utility Type**	**Section 1**	**Section 2**	**Section 3**
Northern Ireland Electric (NIE)	110kv	n/a	1 Tower in Buffer 7 Poles in Buffer	n/a
	33kv	22 Poles in Buffer	8 Poles in Buffer	6 Poles in Buffer
	11kv	26 Poles in Buffer	25 Poles in Buffer	53 Poles in Buffer
	MV	14 Poles in Buffer	6 Poles in Buffer	31 Poles in Buffer
Northern Ireland Water (NIW)	Mains <100mm Ø	Approx. 1.04km requires diversion	Approx. 3.8km requires diversion	Approx. 5.3km requires diversion
	Mains 100 - 300mm Ø	Approx. 6.2km requires diversion	Approx. 7.8km requires diversion	Approx. 11.1km requires diversion
	Mains 300 - 450mm Ø	Approx. 0.05km requires diversion	Approx. 0.2km requires diversion	Approx. 0.05km requires diversion
	Mains 450 - 600mm Ø	n/a	n/a	n/a
	Sewer Combined <300mm Ø	Approx. 0.07km requires diversion	Approx. 0.7km requires diversion	Approx. 0.1km requires diversion
	Sewer Combined 300 - 600mm Ø	Approx. 0.06km requires diversion	n/a	n/a
	Sewer Combined 600 - 900mm Ø	n/a	n/a	n/a
	Sewer Combined 900 - 1350mm Ø	Approx. 0.1km requires diversion	n/a	n/a
Telecommunications	3	n/a	n/a	n/a
	o2	n/a	n/a	n/a
	EE (formerly Orange)	1 Mast in Buffer	n/a	n/a
	EE (formerly T-Mobile)	n/a	n/a	n/a
	Vodafone	n/a	1 Mast in Buffer	n/a
	BT - Overhead	59 Poles in Buffer	59 Poles in Buffer	166 Poles in Buffer

Utilities Affected by the On-line Dual Carriageway				
Utility	**Utility Type**	**Section 1**	**Section 2**	**Section 3**
	BT - Underground	Approx. 5.1km requires diversion 101 Joint Boxes in Buffer	Approx. 10.7km requires diversion 157 Joint Boxes in Buffer	Approx. 17.8km requires diversion 207 Joint Boxes in Buffer
	Atlas Communications (NI) (formerly Bytel)	Approx. 0.38km requires diversion	Approx. 10.1km requires diversion	Approx. 3.5km requires diversion
	Eir (formerly Eircom)	Approx. 0.38km requires diversion	Approx. 10.1km requires diversion	Approx. 12.4km requires diversion
	Vodafone (formerly C&W Atkins)	n/a	n/a	Approx. 0.3km requires diversion
	Virgin Media	Approx. 0.38km requires diversion	Approx. 10.1km requires diversion	Approx. 12.4km requires diversion
Firmus	Gas	n/a	n/a	n/a

3.5.4 Conclusion

The On-line Dual Carriageway is continuously on, or close to, the existing A5, utilities are severely affected and a significant amount of services require alterations and / or permanent / temporary diversionary works.

There are significant costs involved in diverting utilities. The associated costs for the lengths of diversionary works can run in to hundreds of thousands of pounds. Diversions are more expensive when a service runs parallel to the dual-carriageway; as a significant length of pipe/cable/conductor would be generally required to move to ensure it does not fall within the extent of the dual-carriageway. Utilities crossing the On-line Dual Carriageway perpendicularly wouldpaid have a low conveyance impact on the works, as they can be lowered or raised accordingly.

In terms of electricity supply, NIE apparatus is significantly affected by the On-line Dual Carriageway. The On-line Dual Carriageway intercepts 110kV conductors a total of 5 times; directly affecting 1 overhead supporting tower and 7 overhead supporting poles.

Where the Proposed Scheme crosses 110kV conductors, diversionary works would be limited to line raising only.

Re-location of an overhead supporting pole / tower is considerably more expensive than altering existing supports. The On-line Dual Carriageway would require a total of 198 diversions to take place; the majority being overhead supporting pole relocations. This compares to the Proposed Scheme, where approximately a total of only 116 diversions are required; the majority being existing apparatus alterations (raising / lowering).

With regards to potable water supply and sewerage, NI Water apparatus is significantly affected by the On-line Dual Carriageway. There would be approximately 35.54km of pipes supplying potable water and over 1km of combined sewers requiring diversionary works as a result of the dual carriageway. Trunk water mains and sewers are affected in both, the Proposed Scheme and the On-line Dual Carriageway. However, the impact on this infrastructure is substantially greater along the On-line Dual Carriageway due to its continuous, close proximity to the existing A5.

BT, Virgin Media, Eir and Atlas Communications (NI) apparatus would be significantly affected by the On-line Dual Carriageway. As previously mentioned, diversionary works could be expensive and fibre optic cables are largely located within the existing A5. As the Proposed Scheme is mainly off-line from the existing A5, fibre optic cables are generally affected at tie in locations only. This compares to the On-line Dual Carriageway, which would require approximately 33.6km of BT trunk fibre optic cables to be diverted and 60.0km of other trunk fibre optic cables to be diverted (59.74km of which are located in a 4-way duct laid in a common trench). The diversions for the fibre optic cables could be significantly longer.

Both proposals would affect the EE mast located on Park Road, west of Strabane. One Vodafone mast needs relocated along the On-line Dual Carriageway. This relates to the Proposed Scheme, where a different Vodafone mast is in close proximity to the scheme at Killynure Road, but no diversionary works would be likely to be required to this mast.

The table below is a comparison of the Utilities affected by the Proposed Scheme and On-line Dual Carriageway.

Table 3-12 Utilities Affected On-line Dual Carriageway and Proposed Scheme Route Comparison

Utilities Affected by the On-line Dual Carriageway compared with Proposed Scheme Route		
Utility	**On-line Dual Carriageway**	**Proposed Scheme Route**
NIE Apparatus potential diversions	198	116
BT Overhead Cables Intersections	66	91
BT Fibre Optic Cables potential diversions	33.6 km	Tie in locations only
Other Fibre Optic Cables potential diversions	60.0 km	Tie in locations only
Telecommunications potential relocation	2 masts	1 mast

The On-line Dual Carriageway would have significant more Fibre Optic cable diversions than the A5WTC Proposed Scheme Route. Whilst this is not a definitive list of the diversions required, the costs associated with the Fibre Optic Cable diversions alone would be significant and have a negative impact on the economic benefits of the On-line Dual Carriageway.

4 Environmental Assessment

4.1 Methodology

Identification of environmental constraints has involved a combination of desk based review and analysis, consultations and site surveys and familiarisation.

This appraisal of environmental constraints has been undertaken in accordance with DMRB Volume 11 Section 3. The summary of key data provided is based on the detailed Stage 2 Environmental Assessment Report (EAR2) for the project.

4.2 Air Quality

4.2.1 Methodology

This section provides a comparison of the potential air quality constraints associated with the implementation of either the On-line Dual Carriageway or Proposed Scheme Route for the A5 Western Transport Corridor (WTC) Scheme.

The air quality constraints reported for the On-line Dual Carriageway and Proposed Scheme Route designs are based on:

- qualitative evaluation of the number of sensitive receptors, including Designated Sites, within 200 m of each node section associated with Section 1, 2 & 3 of the On-line Dual Carriageway and Proposed Scheme Route Design[1], which have the potential to be subjected to increased concentrations of traffic-related pollutants nitrogen dioxide (NO_2) and particulate matter with a mean aerodynamic diameter of less than 10 micrometres (PM_{10});
- review of the number of sensitive receptors (human health), based on detailed atmospheric dispersion modelling completed for a 2013 baseline year, that have the potential to approach or exceed the annual mean limit value concentration for NO_2 and/or PM_{10} (40 µg/m^3 for both pollutants), as per the European Union (EU) Ambient Air Quality Directive 2008 and Air Quality Standards Regulations (NI) 2010;

[1] Due to atmospheric mixing, vehicle emissions contributions to local pollution levels beyond 200 m is not significant

- review of air quality management areas (AQMAs) declared by a relevant local authority and Pollution Climate Mapping (PCM) links considered by Defra, within 200 m of each node section associated with each scheme option.

4.2.2 Section 1 - On-line Dual Carriageway and Proposed Scheme Route

A qualitative assessment of the number of sensitive receptors with the potential to experience an increase in annual mean concentrations of NO_2 and PM_{10} was undertaken, based on the distance of each receptor to the respective On-line Dual Carriageway and Proposed Scheme Route.

The number of receptors identified within 200 m of the On-line Dual Carriageway and Proposed Scheme Route are presented in below.

Table 4-1 Section 1- Number of sensitive receptors with potential for changes in annual mean NO_2 and PM_{10} levels

Scheme	Number of receptors within:	
	0 - 50m	0 - 200m
Proposed Scheme Route	14	504
On-line Dual Carriageway	16	1,015

Based on the mapping exercise summarised in Table 4-1, the number of receptors within 200 m of the On-line Dual Carriageway is approximately double the number located within 200 m of the Proposed Scheme Route. Therefore, vehicle emissions associated with the On-line Dual Carriageway have the potential to adversely impact local air quality at a relatively higher number of sensitive receptors.

Implementation of the Proposed Scheme Route would result in the transfer of a significant proportion of traffic from the existing A5, which largely adheres to the On-line Dual Carriageway. Therefore, this would reduce vehicle emissions contributions to local NO_2 and PM_{10} concentrations at receptors within 200 m of the On-line Dual Carriageway, resulting in potential air quality improvements at a significant number of receptors.

Based on the results of detailed air quality modelling completed for a 2013 baseline year, there are four receptors situated within 200 m of the On-line Dual Carriageway and Proposed Scheme Route at which annual mean NO_2 concentrations were predicted to be above 90% of the relative annual mean limit value. All four receptors

are located in proximity to each other in the south of New Buildings. Therefore, vehicle emissions associated with the operation of either the On-line Dual Carriageway and Proposed Scheme Route have the potential to contribute to annual mean NO_2 concentrations that approach and/or exceed the limit value at these four receptors.

All remaining sensitive receptors identified within 200 m of each scheme were predicted to remain below 90% of the annual mean NO_2 limit value in a 2013 baseline and would not be likely to exceed the limit value with both the On-line Dual Carriageway and Proposed Scheme Route in operation.

The baseline modelling results predicted that all sensitive receptors located within 200 m of both schemes were below 90% of the annual mean PM_{10} limit value. Therefore, the implementation of either scheme would not be likely to result in annual mean concentrations that approach or exceed the PM_{10} limit value.

Based on a review of local air quality, there is one AQMA designated within 200 m of both the On-line Dual Carriageway and Proposed Scheme Route:

- Strabane AQMA, declared for annual and 24-hour mean PM_{10} due to domestic heating sources.

Although the principal source for this declaration is domestic heating, the implementation of either scheme has the potential to contribute to levels of PM_{10} within the AQMA due to local increases in vehicle emissions.

There is one Designated Site – a *Special Area of Conservation (SAC) for the River Foyle and Tributaries* – that intersects both the On-line Dual Carriageway and Proposed Scheme Route in multiple locations, thus is considered potentially vulnerable to changes in air pollutant emissions associated with the operation of both schemes (e.g. vehicle emissions of oxides of nitrogen (NO_x)).

There is one Defra PCM link within 200 m of both the On-line Dual Carriageway and Proposed Scheme Route, which follows the existing A5 alignment through Strabane. The implementation of either scheme would impact vehicle emissions on this PCM link, with the potential to impact NO_2 and PM_{10} annual mean concentrations at receptors included within Defra's PCM model associated with this link.

Overall, implementation of the Section 1 On-line Dual Carriageway would be more likely to result in adverse local air quality impacts, given the relatively higher number of sensitive receptors located within 200 m, compared to the Proposed Scheme Route. The Proposed Scheme Route would result in the transfer of a significant proportion of traffic away from the existing A5, thus reducing vehicle emissions and potentially improving local air quality in proximity to a significant number of receptors.

Further atmospheric dispersion modelling and quantitative analysis would be required, based on operational traffic data for the On-line Scheme, to confirm the findings of the qualitative review.

4.2.3 Section 2 - On-line Dual Carriageway and Proposed Scheme Route

A qualitative assessment of the number of sensitive receptors with the potential to experience an increase in annual mean concentrations of NO_2 and PM_{10} was undertaken, based on the distance of each receptor to the respective On-line Dual Carriageway and Proposed Scheme Route.

The number of receptors identified within 200 m of the On-line Dual Carriageway and Proposed Scheme Route are presented below.

Table 4-2 Section 2- Number of sensitive receptors with potential for changes in annual mean NO_2 and PM_{10} levels

Scheme	Number of receptors within:	
	0 - 50m	0 - 200m
Proposed Scheme Route	10	234
On-line Dual Carriageway	31	360

Based on the mapping exercise summarised in Table 4-2, the On-line Dual Carriageway would include over 120 more sensitive receptors within 200 m of the alignment than the Proposed Scheme Route. The On-line Dual Carriageway has approximately three times the number of receptors within 50 m of the alignment, within which significant air quality impacts associated with changes to vehicle emissions are most likely to occur. Therefore, vehicle emissions associated with the On-line Dual Carriageway have the potential to adversely impact local air quality at a relatively higher number of sensitive receptors.

Implementation of the Proposed Scheme Route would result in the transfer of a significant proportion of traffic from the existing A5, which largely adheres to the On-

line Dual Carriageway. Therefore, this would reduce vehicle emissions contributions to local NO_2 and PM_{10} concentrations at receptors within 200m of the On-line Dual Carriageway, resulting in potential air quality improvements at a significant number of receptors.

Based on the results of detailed air quality modelling completed for a 2013 baseline year, there are no receptors situated within 200m of the On-line Dual Carriageway and Proposed Scheme Route at which annual mean NO_2 and PM_{10} concentrations were predicted to be above 90% of the relative annual mean limit value. Therefore, the implementation of either scheme would not be likely to result in annual mean concentrations that approach or exceed the respective annual mean limit values.

Based on a review of local air quality, there is one AQMA designated within 200m of the On-line Dual Carriageway, but not the Proposed Scheme Route Design:

- Newtownstewart AQMA, declared for annual and 24-hour mean PM_{10} due to domestic heating sources.

Although the principal source for this declaration is domestic heating, the implementation of the On-line Dual Carriageway has the potential to contribute to levels of PM_{10} within the AQMA due to local increases in vehicle emissions...

There are two Designated Sites within 200 m of the On-line Dual Carriageway, one of which is located within 200 m of the Proposed Scheme Route. These sites are considered potentially vulnerable to changes in air pollutant emissions associated with the operation of both schemes (e.g. vehicle emissions of NO_x):

- *SAC - River Foyle and Tributaries*; both the On-line Dual Carriageway and Proposed Scheme Route within 200m
- *Area of Special Scientific Interest (ASSI) – Grange Wood*; only the On-line Dual Carriageway alignment within 200m.

There are no Defra PCM links within 200m of either the On-line Dual Carriageway or Proposed Scheme Route.

Overall, implementation of the Section 2 On-line Dual Carriageway would be more likely to result in adverse local air quality impacts, given the relatively higher number of sensitive receptors located within 200m, compared to the Proposed Scheme Route. The Proposed Scheme Route would result in the transfer of a significant proportion of

traffic away from the existing A5, thus reducing vehicle emissions and potentially improving local air quality in proximity to a significant number of receptors.

Further atmospheric dispersion modelling and quantitative analysis would be required, based on operational traffic data for the On-line Dual Carriageway, to confirm the findings of the qualitative review.

4.2.3 Section 3 - On-line Dual Carriageway and Proposed Scheme Route

A qualitative assessment of the number of sensitive receptors with the potential to experience an increase in annual mean concentrations of NO_2 and PM_{10} was undertaken, based on the distance of each receptor to the respective On-line Dual Carriageway and Proposed Scheme Route.

The number of receptors identified within 200m of the On-line Dual Carriageway and Proposed Scheme Route are presented in **Table 4-3.**

Table 4-3 Section 3- Number of sensitive receptors with potential for changes in annual mean NO_2 and PM_{10} levels

Scheme	Number of receptors within:	
	0 - 50m	0 - 200m
Proposed Scheme Route	7	148
On-line Dual Carriageway	39	252

Based on the mapping exercise summarised in Table 4-3, the On-line Dual Carriageway would include over 100 more sensitive receptors within 200m of the alignment than the Proposed Scheme Route. The On-line Dual Carriageway has over five times the number of receptors within 50m of the alignment, within which significant air quality impacts associated with changes to vehicle emissions are most likely to occur. Therefore, vehicle emissions associated with the On-line Dual Carriageway could have the potential to adversely impact local air quality at a relatively higher number of sensitive receptors.

Implementation of the Proposed Scheme Route would result in the transfer of a significant proportion of traffic from the existing A5, which largely adheres to the On-line Dual Carriageway. Therefore, this would reduce vehicle emissions contributions to local NO_2 and PM_{10} concentrations at receptors within 200m of the On-line Dual

Carriageway, resulting in potential air quality improvements at a significant number of receptors.

Based on the results of detailed air quality modelling completed for a 2013 baseline year, there are no receptors situated within 200m of the On-line Dual Carriageway and Proposed Scheme Route at which annual mean NO_2 and PM_{10} concentrations were predicted to be above 90% of the relative annual mean limit value. Therefore, the implementation of either scheme would not be likely to result in annual mean concentrations that approach or exceed the respective annual mean limit values.

There are no AQMAs, Designated Sites, or Defra PCM links within 200m of either the On-line Dual Carriageway or the Proposed Scheme Route.

Overall, implementation of the Section 3 On-line Dual Carriageway would be more likely to result in adverse local air quality impacts, given the relatively higher number of sensitive receptors located within 200m, compared to the Proposed Scheme Route. The Proposed Scheme Route would result in the transfer of a significant proportion of traffic away from the existing A5, thus reducing vehicle emissions and potentially improving local air quality in proximity to a significant number of receptors.

Further atmospheric dispersion modelling and quantitative analysis would be required, based on operational traffic data for the On-line Dual Carriageway, to confirm the findings of the qualitative review.

4.3 Cultural Heritage

4.3.1 Methodology

The assessment of the On-line Dual Carriageway and Proposed Scheme Route relative to assets and resources associated with Cultural Heritage has been focused on:

- Direct impacts on recorded sites and resources including Designated Assets, Undesignated Assets and State Care Monuments:
- Impacts on the setting, and in the case of State Care Monuments, the amenity value of recorded sites and features:
- Direct impacts and impacts on the setting of historic buildings: and
- Impacts on areas of distinct historic landscape.

4.3.2 Section 1 - On-line Dual Carriageway and Proposed Scheme Route

On-line Dual Carriageway

Within Section 1 of the On-line Dual Carriageway there would be an impact upon 27 cultural heritage assets. These 27 sites consist of 1 Scheduled Monument, 3 Listed Buildings, 16 Industrial Heritage Record sites (IHR), 2 Sites and Monuments Record sites (SMR), 2 Monuments and Buildings Record sites (MBR), 2 sites located during walkover surveys and an excavation site. There could also potential for previously unrecorded heritage assets to be impacted by the On-line Dual Carriageway.

The known designated heritage assets include a Scheduled section of the Strabane Canal, St Mary's RC Church, Red House and the Gate Lodge. Undesignated assets consist of a circular enclosure site, an Abbey with associated graveyard, a holy well site, the site of an excavation which uncovered Neolithic activity and a Bronze Age round barrow, a standing stone and a number of Industrial Heritage sites which consist of mills, quarries, a kiln and railway infrastructure.

Within this section, the on-line dual carriageway would cross over a scheduled section of the Strabane Canal, this may result in destruction of some elements of the surviving buried structure of the canal walls and base, the impact upon this feature is rated as Major Adverse. Scheduled Monument Consent would be required before any works can take place at this site. The dual carriageway would also run between the two listed buildings, Red House and Gate Lodge at Carricklee. This would sever the contact between these two buildings and their wider relationship to the rest of the estate. For this reason the impacts upon these buildings are assessed as slight/moderate adverse in relation to the Red House and moderate adverse in relation to the Gate House.

There would be high potential for unknown archaeological remains to be discovered at the site of an Abbey at Rossnagalliagh which is supposed to contain the remains of a church building and associated graveyard, although no remains are visible above ground.

Proposed Scheme

Within Section 1 of the Proposed Scheme there would be an impact upon 21 cultural heritage assets. These sites consist of 1 Scheduled Monument, 5 listed buildings, 4 IHR sites, 2 MBR sites, 4 sites identified during a walkover survey and 5 sites

discovered during site evaluation works. There is also potential for previously unrecorded heritage assets to be impacted by the Proposed Scheme Route.

The known designated heritage assets include a Scheduled section of the Strabane Canal, Bready Reformed Presbyterian Church, Woodend Cottage, Red House, the Gate Lodge and Castletown House. Undesignated assets consist of a circular enclosure site, a plantation village and a number of Industrial Heritage sites which consist of mills, a slate quarry and a brickfield.

Within this section, the Proposed Scheme Route would cross over a scheduled section of the Strabane Canal, this may result in destruction of some elements of the surviving buried structure of the canal walls and base, the impact upon this feature is rated as Major Adverse. Scheduled Monument Consent would be required before any works can take place at this site. The Proposed Scheme Route would also run between the two listed buildings, Red House and Gate Lodge at Carricklee. This would sever the contact between these two buildings and their wider relationship to the rest of the estate. For this reason the impacts upon these buildings are assessed as slight/moderate adverse in relation to the Red House and moderate adverse in relation to the Gate House.

One designated site would be totally removed by the Proposed Scheme. This is Castletown House (a listed building). The impact upon this feature has been assessed as large adverse.

There are a number of sites in this section which have been identified via trial trenching which took place in 2013. These sites would be impacted by the Proposed Scheme Route and would require full excavation prior to construction.

Summary

While both the On-line and Proposed Scheme would result in similar impacts to cultural heritage remains, the Proposed Scheme would result in an adverse impact to less known cultural heritage assets. For this reason, it is considered that for Section 1 the Proposed Scheme would be preferable.

4.3.3 Section 2 - On-line Dual Carriageway and Proposed Scheme Route

On-line Dual Carriageway

Within Section 2 of the On-line Dual Carriageway there would be an impact upon 17 cultural heritage assets. These sites consist of 1 Scheduled Monument, 12 IHR sites, 3 SMR sites and 1 site which was located during a walkover survey. There is also potential for previously unrecorded heritage assets to be impacted by the On-line Dual Carriageway.

The designated site consists of the site of a Neolithic Court Tomb at Cloghogle, Undesignated assets consist of the site of a Franciscan Friary and Graveyard, a Holy Well and a number of Industrial Heritage sites which consist of a mill pond, a flax mill, a mile post and railway infrastructure.

The Scheduled Court tomb is unlikely to be directly impacted by the on-line dual carriageway, however, there would be an adverse impact upon its setting. The impact to this site has been assessed as Moderate Adverse. A number of industrial heritage sites of low value may be affected by the proposals along with the site of a Flax Mill, a milepost and a Holy Well site which would be entirely removed. The majority of the sites which would be removed are of low value, with no visible remains visible on the ground.

The site of the Franciscan Friary (Pubble Friary) and Graveyard would also be directly impacted significantly. This is related to the unknown number of burials within the walls of the graveyard as well as the possibility that burials may have occurred outside the graveyard wall. An archaeological evaluation carried out to the south of the graveyard did not uncover remains of archaeological significance.

Proposed Scheme

Within Section 2 of the Proposed Scheme there would be an impact upon 19 cultural heritage assets. These sites consist of 2 scheduled monuments, 1 MBR site, 1 SMR site, 4 IHR sites and 11 sites identified during walkover sites. There is also potential for previously unrecorded heritage assets to be impacted by the Proposed Scheme Route.

The two designated sites consist of a Wedge Tomb and a Court Tomb. Undesignated assets consist of an enclosure, a Holy Well and a number of Industrial Heritage sites which consist of bridges and a railway crossing. The walkover sites consisted of dwellings, a trackway and a possible cairn. The majority of the walkover sites are in a ruinous state and are of low value.

The scheduled sites are unlikely to be directly impacted by the Proposed Scheme, however there may be an adverse impact upon its setting. The impact to these sites has been assessed as Moderate Adverse. A number of industrial heritage and walkover sites of low value would also be affected by the proposals, the majority of these sites would be completely destroyed by the construction of the road. The impact upon these sites has been assessed as Neutral to Slight Adverse.

Summary

Again, for Section 2 both the On-line and Proposed Scheme would result in similar impacts to cultural heritage remains. However, while the Proposed Scheme Route would result in impacts to a greater number of cultural heritage assets, the values assigned to the majority of these assets are low. The On-line option would have the potential to impact more assets of a slightly higher value and therefore it is suggested that the Proposed Scheme would be preferable for this section.

4.3.4 Section 3 - On-line Dual Carriageway and Proposed Scheme Route

On-line Dual Carriageway

Within Section 3 of the On-line Dual Carriageway there would be an impact upon 13 cultural heritage assets. These sites consist of 1 Scheduled Monument, 7 IHR sites and 5 SMR sites. There would also potential for previously unrecorded heritage assets to be impacted by the Proposed Scheme Route.

The designated site consists of the site of a scheduled Bronze Age mound. Undesignated sites consist of a hanging fort enclosure, a Bronze Age urn burial, a Platform Rath, an enclosure, and a number of Industrial Heritage sites which consist of a creamery, a quarry and railway infrastructure.

The On-line Dual Carriageway would result in the total loss of the Scheduled Bronze Age mound site (which would require Scheduled Monument Consent). The loss of this site is assess as Major Adverse.

A number of other sites would also be directly affected by the On-line Dual Carriageway. These include the Hanging Fort enclosure, the Bronze Age urn burial site and the platform rath. All of these sites would be totally removed, and as well as the known archaeological remains which would be lost, there is also potential for all of these sites to be associated with currently unknown but contemporary remains. The loss of these sites is assessed as Moderate Adverse.

Proposed Scheme

Within Section 3 of the Proposed Scheme there is be an impact upon 15 cultural heritage assets. These consist of 1 State Care Monument, 1 Scheduled Monument, 1 Listed Building, 6 MBR sites, 1 IHR site, 3 sites which were identified during a walkover survey and 2 sites which were identified during site evaluations in 2013. There is also potential for previously unrecorded heritage assets to be impacted by the Proposed Scheme Route.

The designated sites consist of the State Care monument Errigal Keerogue, a Scheduled Platform Rath and a listed manse. Undesignated sites consist of enclosures, a holy well, a rath, a house and a brick kiln.

The Scheduled Platform Rath may be directly impacted, while the State Care Monument and Listed Building may be subject to an adverse impact upon their setting. The impacts upon the designated sites have been assessed as Moderate to large Adverse.

A number of sites of low value would also be physically impacted or totally removed by the Proposed Scheme. The impacts upon these assets are assessed as Slight adverse.

There are a number of sites in this section which have been identified via trial trenching which took place in 2013. These sites would be impacted by the Proposed Scheme Route and would require full excavation prior to construction.

Summary

Again, for Section 3 both the On-line and Proposed Scheme would result in similar impacts to cultural heritage remains. The On-line Dual Carriageway would result in the total loss of a scheduled site, whereas the Proposed Scheme is adversely impact upon 3 designated sites. For this reason, for Section 3, the On-line Dual Carriageway is slightly more preferable.

4.4 Ecology and Nature Conservation

4.4.1 Methodology

The comparison of On-line Dual Carriageway and Proposed Scheme Route relative to assets and resources associated with Nature Conservation has been focused on:

- Potential impacts on statutory designated sites;
- Potential impacts on habitats of nature conservation value (Priority Habitats); and
- Potential impacts on protected species.

Potential impacts identified include habitat loss, degradation, fragmentation and pollution at river crossings and consequent impacts on fauna. Many of the impacts can be mitigated by the implementation of appropriately designed drainage systems and pollution prevention measures, working practises during construction, habitat planting and adoption of appropriate designs for structures such as open span bridges over sensitive watercourses. Allowance has accordingly been made for mitigation potential during the assessment of identified impacts associated with both the On-line Dual Carriageway and Proposed Scheme Route. The findings relating to each are outlined below.

4.4.2 Section 1 - On-line Dual Carriageway and Proposed Scheme Route

Between New Buildings and Junction 2 both the On-line Dual Carriageway and Proposed Scheme Routes are close to the River Foyle & Tributaries Special Area of Conservation (SAC), crossing through several species poor hedgerows. There would be no discernible difference in potential impacts of these options at this location.

From Junction 2 to Magheramason, the On-line Option is slightly further from the Foyle SAC than the Proposed Scheme, and both options pass through similar habitats with

a similar level of severance and habitat loss. There is no discernible difference in potential impacts of these options at this location.

Through the Magheramason Bypass there is no discernible difference in potential impacts between the options, with both in approximately the same proximity to the Foyle SAC, and both options severing species poor and species rich hedgerows.

As the dual carriageway passes from the Magheramason Bypass southward to Bready, the On-line Dual Carriageway would predominantly follow the line of the existing A5, reducing habitat severance and loss when compared to the Proposed Scheme. At this location, the On-line Dual Carriageway would have a lower impact on ecological resources.

Through the Bready Bypass and southward to Cloghor, both the On-line Dual Carriageway and Proposed Scheme Routes sever a number of species poor hedgerows, and require a crossing of the Burn Dennet. While the On-line Dual Carriageway follows the line of the existing A5 for part of this route, there is no discernible difference in potential impacts on ecological resources.

From Cloghor to the Ballymagorry Bypass, both options pass through similar habitats, with severance of hedgerows, crossing of the Glenmornan and other small watercourses as the main impacts. Whilst the Proposed Scheme passes closer to McKean's Moss Area of Special Scientific Interest (ASSI), there are no predicted impacts on the ASSI from the Proposed Scheme, so no higher impact is perceived for the site. Therefore, there is no discernible difference in potential impacts on ecological resources at this location.

Through the Ballymagorry Bypass and southward to Junction 3, the On-line Dual Carriageway and Proposed Scheme Routes follow broadly similar lines, and therefore there is no discernible difference in potential impacts on ecological resources at this location.

Between Junction 3 and Junction 6 the On-line Dual Carriageway and Proposed Scheme Routes follow broadly similar lines, and therefore there is no discernible difference in potential impacts on ecological resources at this location.

From Junction 6 to Junction 7, the On-line Dual Carriageway passes through the urban area of Strabane, moving it further from the Foyle SAC. Whilst there is limited

difference between the two options, there is sufficient reduction in habitat severance, and risk to the SAC, such that the On-line Dual Carriageway has a lower potential impact on ecological resources at this location.

Between Junctions 7 and 8, the On-line Dual Carriageway and Proposed Scheme Route follow broadly similar lines, and therefore there is no discernible difference in potential impacts on ecological resources at this location.

The proposed link between the A5 corridor and Donegal passes through similar habitats, with a similar potential for severance and habitat loss. Whilst the Proposed Scheme has a shorter link in comparison to the On-line Dual Carriageway, the difference is not considered to be significant in ecological terms. Therefore there is no discernible difference in potential impacts on ecological resources at this location.

As the dual carriageway passes south and round Sion Mills, the On-line Dual Carriageway and Proposed Scheme Route pass through similar habitats with similar potential impacts on ecological resources, and therefore there is no discernible difference in potential impacts on ecological resources at this location.

In terms of protected species, both options would have the potential to cause habitat loss and severance, such that impacts on species such as Irish hare, badger, bats and aquatic species, such as Atlantic salmon and otter, are similar, with the exception of the section between Junction 6 and 7, where the On-line Dual Carriageway passes through the urban area of Strabane, reducing the potential impact at this location.

4.4.3 Section 2 - On-line Dual Carriageway and Proposed Scheme Route

As the On-line Dual Carriageway passes from Sion Mills, south toward Victoria Bridge, the On-line Dual Carriageway is significantly closer to the Mourne River, therefore the Proposed Scheme Route would be considered to have a lower potential impact on ecological resources at this location.

Through the Victoria Bridge Bypass the On-line Dual Carriageway is again closer to the Mourne River, however, at this location the existing A5 and built area of Victoria Bridge stand between the On-line Dual Carriageway and the watercourse. Therefore, there would be no discernible difference in potential impacts on ecological resources at this location.

Between Victoria Bridge and the River Derg, the Proposed Scheme Route passes through areas of broadleaved woodland which comprise Priority Habitat, as well as severing species rich hedgerows. At this location the On-line Dual Carriageway is predominantly along the line of the existing A5, therefore, it is considered that the On-line Dual Carriageway has a lower potential impact on ecological resources at this location.

From the River Derg, south toward Newtownstewart, the situation above is repeated, with the On-line Dual Carriageway being predominantly along the line of the existing A5. Therefore, it is considered that the On-line Dual Carriageway has a lower potential impact on ecological resources at this location.

The Newtownstewart Bypass is a very different matter, with the Proposed Scheme Route avoiding a crossing or the Mourne, and the On-line Dual Carriageway crossing the river twice, bringing a much higher potential impact at this location to the On-line Dual Carriageway.

Between Newtownstewart and the north of Omagh, the routes follow differing lines, however, the potential impacts of the On-line Dual Carriageway, passing much closer to the major watercourse, and potentially requiring loss of habitat from the Grange Wood ASSI, balance the potential impacts of the Proposed Scheme Route which requires some minor loss of Priority Habitat woodland and bog habitat. Both options pass close to Tully Bog SAC, and though the Proposed Scheme Route is closer, no significant impact on the site is predicted from either option. It is considered that there is no discernible difference in level of potential impact on ecological resources at this location.

Around the Omagh Bypass and southward to Junction 13 the On-line Dual Carriageway and Proposed Scheme Routes follow broadly similar lines, and therefore there is no discernible difference in potential impacts on ecological resources at this location.

In terms of protected species, both options have the potential to cause habitat loss and severance, such that impacts on species such as Irish hare, badger, bats and aquatic species, such as Atlantic salmon and otter, are similar, with the exception of those areas where the On-line Dual Carriageway follows the existing A5, where this reduces the potential impact on most species, and those areas where the On-line Dual

Carriageway is significantly closer to, or crosses the major watercourses, where the potential impact on aquatic species such as otter and Atlantic salmon is greatly increased. Overall, there is no discernible difference in the potential impact on protected species through Section 2.

4.4.4 Section 3 - On-line Dual Carriageway and Proposed Scheme Route

Between Junction 13 and Ballynassagart Road, the On-line Dual Carriageway follows the line of the existing A5, thus in comparison to the Proposed Scheme Route, which impacts on bog habitat, hedgerows and broadleaved woodland, the On-line Dual Carriageway has a lower potential to impact on the ecological resources of Section 3 down to this point.

From Ballynassagart Road to Junction 15, the Proposed Scheme Route passes through species poor hedgerows and grassland habitats, while the On-line Dual Carriageway requires loss of hedgerows and woodland areas, therefore it is considered that there is no discernible difference in potential impacts on ecological resources at this location.

From Junction 15 to Junction 16, the On-line Dual Carriageway again predominantly follows the existing A5, reducing habitat severance and loss in comparison with the Proposed Scheme Route. Therefore, the On-line Dual Carriageway would be considered to have a lower potential for impact on the ecological resources of this location.

From Junction 16, round the Aughnacloy Bypass to the scheme end both options follow the same routing, and therefore have no discernible difference in potential impacts on ecological resources at this location.

In terms of protected species, the On-line Dual Carriageway through Section 3 follows largely along the line of the existing A5, and therefore would have a lower potential for impacts on protected species.

4.5 Landscape and Visual Impact

4.5.1 Methodology

The comparison of the On-line Dual Carriageway and Proposed Scheme Route relative to assets and resources associated with Landscape and Visual Impact has been focused on:

- impacts on the composition and quality of the existing landscape associated with the preferred corridor based on an analysis of distinctive local landscape character zones; and

- Evaluation of the number of visual receptors who would be subject to potentially significant visual impact as a result of the introduction of route options into the existing landscape.

Please see Appendix *G-1 Environment Landscape Baseline* for a summary of the baseline environment.

4.5.2 Section 1 - On-line Dual Carriageway and Proposed Scheme Route

On-line Dual Carriageway

The On-line Dual Carriageway runs south of New Buildings and to the west of the existing A5, where there would be an impact on the Area of High Scenic Value which takes in the western and eastern margins of the River Foyle. The road would briefly be a new and visible element on the margin of the river, with consequent erosion of the quality of the landscape setting on the southern approach into Londonderry.

In bypassing Magheramason, the influence of a second road corridor within the wider landscape of the River Foyle would be contained by the slopes of Gortmonly Hill to the east and the wide meander of the river to the west. The removal of strategic traffic from the existing road through Magheramason would improve the ambience of the settlement itself.

There would be a marked impact on the lower hill slopes of Gortmonly Hill near Bready, where the dual carriageway would divert from the existing A5 alignment via a deep cutting to the east of the settlement before returning to the existing corridor. While there would not be a fundamental change in the character of the valley landscape, there would be a marked erosion of the inherent qualities and value of this part of the lower valley in the vicinity of Gortmonly Hill.

From the crossing of the Burn Dennet at Cloghcor and south toward Ballymagorry, the On-line Dual Carriageway would occupy the existing A5 corridor alignment and accordingly there would be limited impact on the Foyle floodplain to the west and on the tributary valley of the Burn Dennet to the east. At Ballymagorry, the dual

carriageway would divert into the floodplain on extended embankment to bypass the settlement, with a consequent erosion of the river valley context on the approach to Strabane.

The On-line Dual Carriageway through Strabane would run broadly parallel with the existing A5 corridor, extending the influence of vehicular traffic and emphasising the sense of separation between the town and river context, although without any fundamental change to the existing landscape character and townscape of Strabane. A new bridge crossing over the Mourne River would be in parallel with the existing crossing, before the dual carriageway would return to occupy the existing A5 alignment through the residential areas to the south of the town. Here there would be some degree of townscape alteration, although the character of the setting would not be unduly compromised.

An On-line Dual Carriageway to the south of Strabane, comprising two road junctions would be largely contained by the semi-industrial landscape on the fringes of the town, with limited impact on the progressively rural aspects to the west. There would be some loss of distinction between Strabane and the neighbouring settlement of Sion Mills, although the historic context of the latter would not be compromised by virtue of the dual carriageway bypassing the town to its west.

The visual assessment for the On-line Dual Carriageway has identified **1751** receptors which would be potentially subject to adverse impact, **600** of which would be subject to moderate, large or very large adverse impacts.

Proposed Scheme Route

Where the Proposed Scheme Route runs between New Buildings and Bready to the west of the existing A5 and Magheramason, there would be an impact on the Area of High Scenic Value which takes in the western and eastern margins of the River Foyle. The road would be a new and visible element on the margin of the river setting between New Buildings and Magheramason, with a consequent erosion of the quality of the landscape on the southern approach into Londonderry.

In bypassing Magheramason, the influence of a second road corridor within the wider landscape of the River Foyle would be contained by the slopes of Gortmonly Hill to the east and the wide meander of the river to the west. The removal of strategic traffic

from the existing road through Magheramason would improve the ambience of the settlement itself.

There would be a marked impact on the lower hill slopes of Gortmonly Hill near Bready, where the Proposed Scheme Route would cross the existing A5 alignment on embankment and through deep cutting to the east of the settlement. While there would not be a fundamental change in the character of the valley landscape, there would be a marked erosion of the inherent qualities and value of this part of the lower valley in the vicinity of Gortmonly Hill.

Between Grange Foyle and the Glenmornan River, the Proposed Scheme Route would be predominantly on embankment and west of the existing A5 corridor, extending into the floodplain landscape at the river crossings, while in close proximity to the A5 at McKean's Moss. The Proposed Scheme Route would be initially exposed and perceived as a new focus in the landscape, defining the transition from the tributary valley of the Burn Dennet and Glenmornan Rivers to the broader floodplain of the River Foyle.

The Proposed Scheme Route through Strabane would run broadly parallel with the existing A5 corridor, extending the influence of vehicular traffic and emphasising the sense of separation between the town and river context, although without any fundamental change to the existing landscape character and townscape of Strabane. A new bridge crossing over the Mourne River would be in parallel with the existing crossing.

There would be a localised and significant impact where the existing relationship of housing alongside the Finn River would be severed by the Proposed Scheme Route, which would run along the immediate river margin towards the proposed N7 river crossing. A deep cutting to the south of the proposed cutting would be locally evident, but otherwise well concealed.

The dual carriageway and proposed road junction to the south of Strabane would be largely contained by the semi-industrial landscape on the fringes of the town, with limited impact on the progressively rural aspects to the west. There would be some loss of distinction between Strabane and the neighbouring settlement of Sion Mills, although the historic context of the latter would not be compromised by virtue of the Proposed Scheme Route bypassing the town to its west.

The visual assessment for the Proposed Scheme Route has identified **1759** receptors which would be potentially subject to adverse impact, **643** of which would be subject to moderate, large or very large adverse impacts.

4.5.3 Section 2 - On-line Dual Carriageway and Proposed Scheme Route

On-line Dual Carriageway

On bypassing Sion Mills to the immediate west of the town, the On-line Dual Carriageway would cross within the lower slopes of the Mourne valley to meet with the existing A5 corridor on its approach to Victoria Bridge. The On-line Dual Carriageway would occupy the existing A5, in close proximity to residential properties and with a material impact on its townscape quality.

Between the settlements of Victoria Bridge and Newtownstewart, the On-line Dual Carriageway would either occupy, or run parallel with, the existing A5 alignment. The consequent impact on the valley landscape would be limited to the modification and widening of the existing transport corridor and its immediate context. At Newtownstewart, the line of the existing by-pass would be retained and modified, which again would limit the impact upon the local townscape setting, the surrounding river floodplain and local hills.

To the south of Newtownstewart, the On-line Dual Carriageway would enter the Strule Valley on broadly the same alignment as the existing A5 corridor, diverting briefly to a higher alignment along the eastern slopes of Bessy Bell, before re-joining the existing corridor towards Mountjoy. The diversion would have a material effect on the perception of the landscape at this western limit of the Sperrin AONB, visible above the existing A5 which runs within the AONB at a lower and more contained location within the Strule valley. The dual carriageway, over a limited length, would be visually exposed to the wider context of the AONB from Mary Gray and Deers Leap, where the views would be across the Strule Valley against a backdrop of wind turbines on the upper slopes of Bessy Bell.

The On-line Dual Carriageway would emerge from the Strule Valley along the existing A5 alignment, entering drumlin farmland north of Omagh towards the crossing of the Fairy Water. Impacts on the landscape would be limited due to the use of the existing transport corridor and the associated drumlin terrain.

The On-line Dual Carriageway would trace a new route through elevated drumlin farmland to the west of Omagh, to form a bypass to the town. There would be associated loss of hedgerow, hedgerow trees and some small established woodland copses where the On-line Dual Carriageway would sever moderately sized pastoral fields, although the dual carriageway itself would be reasonably concealed and accommodated within the drumlin terrain. There would however be encroachment within the greenbelt designation that surrounds Omagh.

The visual assessment for the On-line Dual Carriageway has identified **702** receptors which would be potentially subject to adverse impact, **232** of which would be subject to moderate or large adverse impacts.

Proposed Scheme Route

On bypassing Sion Mills to the immediate west of the town, the Proposed Scheme Route would follow the lower western slopes of the Mourne Valley above Victoria Bridge, running between deep to moderate cutting and high to moderate embankment as it crosses several minor tributary valleys that descend the lower slopes of Whisker Hill and Clady Hill. Although there are occasional woodland areas on these hill slopes, they would not substantially break the initial impact of the extended lengths of embankment across the valley recesses.

The dual carriageway would continue to run in parallel and above the line of the existing A5, along the western flank of the Mourne valley and consequently a more conspicuous built feature in the wider landscape. Towards its crossing of the Derg valley at the north-western limit of the floodplain, there is a transition from the river valley setting to the higher ground of the Baronscourt Estate and hill slopes above Newtownstewart. The dual carriageway and its associated traffic would be open to view from the east, although it would be seen in a similar context to that of the existing A5. The effect would be a perceived widening and increase in the influence of the strategic road corridor as part of the wider landscape.

Towards Newtownstewart, the Proposed Scheme Route would have an impact on the historic landscape where the dual carriageway crosses agricultural land on low embankment at Deerpark, beyond the proposed junction at Baronscourt Road and immediately south of Harry Avery's Castle in deep cutting. The severance of the

landscape and introduction of a modern road in this context would have a potentially large adverse impact.

The Proposed Scheme Route would maintain a higher alignment on the slopes of Bessy Bell above Newtownstewart and into the Strule Valley. This would have a material effect on the quality of the landscape at this western limit of the Sperrin AONB. It would be seen above the existing A5, which also runs within the AONB at a lower and more contained location within the Strule valley. The road would be visually exposed to the wider context of the AONB from Mary Gray and Deers Leap, where the views would be across the Strule Valley against a backdrop of wind turbines on the upper slopes of Bessy Bell.

The Proposed Scheme Route would emerge from the Strule Valley along the existing A5 alignment, entering drumlin farmland north of Omagh towards the crossing of the Fairy Water. Impacts on the landscape would be limited due to the use of the existing transport corridor and the associated drumlin terrain.

The road would trace a new route through elevated drumlin farmland to the west of Omagh, to form a bypass to the town. There would be associated loss of hedgerow, hedgerow trees and some small established woodland copses where the dual carriageway would sever moderately sized pastoral fields, although the dual carriageway itself would be reasonably concealed and accommodated within the drumlin terrain. There would however be encroachment within the greenbelt designation that surrounds Omagh.

The visual assessment for the Proposed Scheme Route has identified **572** receptors which would be potentially subject to adverse impact, **207** of which would be subject to moderate or large adverse impacts.

4.5.4 Section 3 - On-line Dual Carriageway and Proposed Scheme Route

On-line Dual Carriageway

The dual carriageway would pass through drumlin farmland beyond Omagh, with a grade separated junction to the south of the town defining the limit of the new bypass and a return to the existing A5 corridor alignment towards Doogary Road. There would be impacts on properties currently screened by landform to views of surrounding development.

The dual carriageway, by virtue of it occupying the same corridor as the existing A5 and in combination with the very much local character definition associated with the drumlin terrain, would not have any significant effects on the wider landscape between Omagh and Garvaghy. Impact would be limited to localised areas within the visual context of the route, where the corridor is locally widened to accommodate both the dual carriageway and collector roads.

The landform of Curr Mountain, a low but prominent hill form adjacent to the A5 at Gortaclare signifies a transition from the drumlin landscapes to the hill slopes of the Brougher/Slievemore ridge line. Diversions to accommodate the mainline would result in large side cutting and embankment in the vicinity of Curr Mountain, with the On-line Dual Carriageway then rising above and to the east of the existing A5 towards Garvaghy. This exposure would have a material effect on the local valley form, although wider impacts on landscape would be limited by landform and enclosure.

Large sections of cut and embankment would be necessary in order for the On-line Dual Carriageway to negotiate the ridge crest approaching Ballymackilroy, although the dual carriageway maintains the existing general alignment of the A5 across the ridge top. The settlement would be locally impacted upon, although mitigation measures could be introduced to reduce the effect. The junction of the On-line Dual Carriageway with the A4 at Ballygawley would utilise the existing junction arrangement, with limited impact on landscape character and visual impacts to properties in the vicinity of the proposed junction.

South of the A4, the On-line Dual Carriageway would re-enter a drumlin farmland landscape, following the existing A5 corridor to Aughnacloy before diverting to by-pass the town around its eastern margin. The widening of the corridor would be subject to local character impacts within the drumlin setting, while the bypassing of Aughnacloy would not unduly impact upon the character of the town itself. However a new road construction through a rural drumlin landscape such as this would bring about localised impacts on landscape character quality and an erosion of the tranquil green space that surrounds the town. The junction with the A28 would create a noticeable change of character to traffic entering the town from the south.

The visual assessment for the On-line Dual Carriageway has identified **557** receptors which would be potentially subject to adverse impact, **195** of which would be subject to moderate or large adverse impacts.

Proposed Scheme Route

The Proposed Scheme Route passes through drumlin farmland beyond Omagh, with a grade separated junction to the south of the town defining the limit of the new bypass and a return towards the existing A5 corridor alignment at Doogary Road. There would be impacts on properties currently screened by landform to views of surrounding development.

South of Doogary, the dual carriageway diverges from the existing A5 to become a visually distinct and separate road corridor. There would be lengths of road running either at or close to existing ground levels, interrupted by occasional large cuttings or embankments. A number of side roads would cross the Proposed Scheme throughout the sub-zone, either elevated on embankment and bridged over the dual carriageway or passing beneath the dual carriageway. Impacts on the landscape would be highly localised, due to the nature of the drumlin terrain.

The Proposed Scheme Route passes close to Moylagh, a compact village set within an enclosed river recess and with open prospects to the southwest. There would be a potentially large impact on its setting where it crosses immediately west of the settlement, both by virtue of its proximity at a grade separated junction and with adjacent deep and wide cuttings that would substantially modify local landform to the north and south of the village.

South of Moylagh marks a transition from the drumlin farmlands of Omagh to the hill slopes of the Brougher/Slievemore ridge line. The Proposed Scheme Route would run south between Newtownsaville and the rise of Tycanny Hill, along the western margin of Tullanafoile Hill on low embankment and in occasional shallow sidelong cutting. Its potential impact would be partially mitigated by the proximity of areas of wet birch woodland and scrub on the valley floor at Newtownsaville Bog.

The alignment of the Proposed Scheme through this attractive and secluded ridge landscape of distinctive hills and woodland between Tycanny Hill and Errigal would be kept low within the local landscape, as a means of reducing its potential prominence on the ridge skyline. There would however be substantial modification to landform, with major cuttings at Tycanny Hill and below Errigal church and graveyard. The cuttings through both hills would have significant impact on the landscape both in a local context and from the Clogher Valley to the south.

The approach to Ballygawley and the junction with the A4 would maintain a distinct and separate alignment from the existing A5 corridor, requiring the creation of a new junction roundabout to the west of the town. Beyond the A4 and towards Aughnacloy, the Proposed Scheme Route would negotiate a drumlin landscape before diverting to by-pass the town around its eastern margin. The new corridor would be subject to local character impacts within the drumlin setting, while the bypassing of Aughnacloy would not unduly impact upon the character of the town itself.

However a new road construction through a rural drumlin landscape such as this would bring about localised impacts on landscape character quality and an erosion of the tranquil green space that surrounds the town. The junction with the A28 would create a noticeable change of character to traffic entering the town from the south.

The visual assessment for the Proposed Scheme Route has identified **415** receptors which would be potentially subject to adverse impact, **269** of which would be subject to moderate or large adverse impacts.

4.6 Noise and Vibration

4.6.1 Methodology

To assess the likely noise impact of the On-line Dual Carriageway, compared with the Proposed Scheme Route, receptor counts were undertaken. The number of receptors within distance bands up to 600m from the centreline of the existing A5, A5WTC Proposed Scheme Route, and On-line Dual Carriageway were counted in GIS software.

4.6.2 Section 1 - On-line Dual Carriageway and Proposed Scheme Route

Table 4-4 Route option property counts for Section 1

Option	Number of Receptors				
	0 – 100m	100 – 200m	200 – 300m	300 – 600m	Total
Existing A5	1010	1150	967	1985	5112
Proposed Scheme Route	83	339	654	2089	3165
On-line Dual Carriageway	310	727	865	2405	4307

Although the On-line Dual Carriageway has fewer receptors within 600m than the existing A5 in Section 1, there are significantly more receptors than for the Proposed Scheme Route.

It is likely that noise impacts associated with the On-line Dual Carriageway would be greater than those associated with the Proposed Scheme Route, for Section 1 of the scheme.

4.6.3 Section 2 - On-line Dual Carriageway and Proposed Scheme Route

Table 4-5 Route option property counts for Section 2

Option	Number of Receptors				
	0 – 100m	100 – 200m	200 – 300m	300 – 600m	Total
Existing A5	861	982	724	1859	4426
Proposed Scheme Route	31	167	203	1058	1459
On-line Dual Carriageway	151	201	263	1587	2202

Within Section 2, the On-line Dual Carriageway has fewer receptors within 600m than the existing A5, however, there are significantly more receptors than for the Proposed Scheme Route.

It is likely that noise impacts associated with the On-line Dual Carriageway would be greater than those associated with the Proposed Scheme Route, for Section 2 of the scheme.

4.6.4 Section 3 - On-line Dual Carriageway and Proposed Scheme Route

Table 4-6 Route option property counts for Section 3

Option	Number of Receptors				
	0 – 100m	100 – 200m	200 – 300m	300 – 600m	Total
Existing A5	378	184	171	410	1143
Proposed Scheme Route	18	91	106	293	508
On-line Dual Carriageway	128	99	121	454	802

The On-line Dual Carriageway has fewer receptors within 600m than the existing A5 in Section 3, however, there are more receptors than for the Proposed Scheme Route.

It is likely that noise impacts associated with the On-line Dual Carriageway would be greater than those associated with the Proposed Scheme Route, for Section 3 of the scheme.

4.7 Community and Private Assets

4.7.1 Methodology

The comparison of the On-line Dual Carriageway and Proposed Scheme Route relative to Community and Private Assets has focused on:

- Potential severance between communities and/or severance of communities from important community facilities;
- Loss of community, residential and commercial property; and
- An evaluation of the extent of Best and most Versatile Agricultural Land that would be lost.

The findings relating On-line Dual Carriageway and Proposed Scheme Route are outlined below. Supporting Drawings are in Appendix E and F.

4.7.2 Section 1 - On-line Dual Carriageway and Proposed Scheme Route

Community Severances

The On-line Dual Carriageway and Proposed Scheme Route avoid the main settlement areas (New Buildings, Magheramason, Bready, Cloghor and Ballymagorry) therefore offering some relief from severance cause by the existing A5. At Strabane the Proposed Scheme Route avoids the main settlement areas providing similar relief. The On-line Dual Carriageway at Strabane would result in the upgrade of the Great Northern Link resulting and increase in severance between communities and facilities east and west of the dual carriageway.

Loss of community, residential and commercial property

The precise land take requirements for the On-line assessment has yet to be determined so the quoted asset counts are indicative.

Pointer address layer data has been interrogated and 30 properties would require demolition for the On-line Dual Carriageway in Section 1, In addition, 109 dwellings

would be majorly impacted and a further 351 may potentially be affected by land take. For the Proposed Scheme Route 3 properties and a halting site would be demolished and 9 properties affected by the dual carriageway. The impact of the On-line Dual Carriageway land take would be significantly greater on residential properties.

In Section 1 the On-line Dual Carriageway would demolish 9, majorly impact 4 and impact a further 41 commercial properties interrogation. The On-line Dual Carriageway would demolish 1, majorly impact 1 and impact a further 12 community properties interrogation. The Proposed Scheme Route would not demolish commercial or community facilities however it would impact on 4 commercial properties and 2 community facilities.

4.7.3 Section 2 - On-line Dual Carriageway and Proposed Scheme Route

Community Severance

The On-line Dual Carriageway and Proposed Scheme Route both avoid the main settlement areas (Sion Mills, Victoria Bridge, Newtownstewart, Mount Joy, and Omagh) therefore, offering some relief from severance cause by the existing A5. The impact of the On-line Dual Carriageway and Proposed Scheme Route in this section are similar in terms of community severance.

Loss of community, residential and commercial property

The precise land take requirements for the On-line assessment has yet to be determined so the quoted asset counts are indicative.

Pointer address layer data has been interrogated and 36 properties would require demolition for the On-line Dual Carriageway in section 2, in addition, 82 dwellings are majorly impacted and a further 212 may potentially be affected by land take. For the Proposed Scheme Route 2 properties would be demolished and 19 properties affected by the route. The impact of the On-line Dual Carriageway land take would be significantly greater on residential properties.

In Section 2 the On-line Dual Carriageway would demolish 4, majorly impact 7 and impact a further 30 commercial properties interrogation. The On-line Dual Carriageway would demolish 1 and impact a further 8 community properties interrogation. The

Proposed Scheme Route would affect 2 commercial properties and 1 community assets.

4.7.4 Section 3 - On-line Dual Carriageway and Proposed Scheme Route

Community Severance

The On-line Dual Carriageway and Proposed Scheme Route both avoid the main settlement areas (Moylagh, Garvaghy, Ballygawley and Aughnacloy), therefore offering some relief from severance cause by the existing A5. The impact of the On-line Dual Carriageway and Proposed Scheme Route in this section are similar in terms of community severance.

Loss of community, residential and commercial property

The precise land take requirements for the On-line assessment has yet to be determined so the quoted asset counts are indicative.

Pointer address layer data has been interrogated and 41 properties would require demolition for the On-line Dual Carriageway in Section 3, In addition, 51 dwellings would be majorly impacted and a further 254 may potentially be affected by land take. For the Proposed Scheme Route 1 property would be demolished and 13 properties affected by the route. The impact of the On-line Dual Carriageway land take would be significantly greater on residential properties.

In Section 3 the On-line Dual Carriageway would demolish 3, majorly impact 15 and impact a further 54 commercial properties interrogation. The On-line Dual Carriageway would demolish 1, majorly impact 1 and impact a further 12 community properties interrogation. The Proposed Scheme Route would affect 1 commercial property.

Best and Most Versatile Land

The Proposed Scheme Route land take is based on the Vesting Order 2016 and the indicative fence line between Ballygawley and Aughnacloy. The expected landtake for the On-line Dual Carriageway is unknown and so has been indicatively based on a 50m buffers from the centreline.

The On-line Dual Carriageway would affect approximately 99.3ha of Grade 2 and 324.86ha of Grade 3A agricultural land which is considered the higher value and most versatile agricultural land. The Proposed Scheme Route would impact approximately

143ha Grade 2 and 555ha of Grade 3A agricultural land. The On-line Dual Carriageway is considered to have a lower impact on agricultural land resource.

4.8 Effects on all Travellers

4.8.1 Methodology

The comparison of On-line Dual Carriageway and the Proposed Scheme Route relative to effects on all travellers has focused on:

- potential severance of recognised long-distance footpaths and cycle ways; and
- potential impacts on side roads.

The findings relating to each of the On-line Dual Carriageway and the Proposed Scheme Route are outlined below.

Issues associated with driver stress have not been considered during the comparison of the On-line Dual Carriageway and the Proposed Scheme Route, it being a principal that the detailed design for any of the options would be in accordance with relevant standards for a strategic dual carriageway and that access onto the road would be limited to key junctions.

Benefits related to relief of driver stress would be addressed as part of the detailed assessment for the Proposed Route.

4.8.2 Section 1 - On-line Dual Carriageway and Proposed Scheme Route

Long Distance Footpaths and Cycle Routes

National Cycle Route (NCR) 92, Lifford Road. Both the Proposed Scheme Route and the On-line Dual Carriageway cross this route at the same location and maintain suitable crossing. The impact of both options would be slight adverse.

The Derg Valley Cycle Route, Bellspark Road. Both the Proposed Scheme Route and the On-line Dual Carriageway cross this route at the same location and maintain suitable crossing. The impact of both options would be slight adverse.

Side Roads

Both the On-line Dual Carriageway and the Proposed Scheme Route would intersect a number of side roads along their length. At the majority of these locations access

across the route via a localised diversion or an overpass/ underpass would be provided. The predicted impact of On-line Dual Carriageway and Proposed Scheme Route on side roads is concluded to be similar is scale.

4.8.3 Section 2 - On-line Dual Carriageway and Proposed Scheme Route

Long Distance Footpaths and Cycle Routes

NCR 92, 95 and the Derg Cycle Route at Newtownstewart. The Proposed Scheme Route runs to the west of the Newtownstewart and intersects NCR 95 and the Derg Valley Cycle Route along Oldcastle Road. Suitable access is maintained by the realigned side road and a slight adverse impact is anticipated.

The On-line Dual Carriageway runs to the east of Newtownstewart and intersects NCR 92 and NCR 95 along Douglas Road and Strahulter Road. Suitable access is maintained by the realigned side road and a slight adverse impact is anticipated.

Side Roads

Both the On-line Dual Carriageway and the Proposed Scheme Route would intersect a number of side roads along their length. At the majority of these locations access across the dual carriageway via a localised diversion or an overpass/ underpass would be provided. The predicted impact of both routes on side roads is concluded to be similar is scale.

4.8.4 Section 3 - On-line Dual Carriageway and Proposed Scheme Route

Long Distance Footpaths and Cycle Routes

Ulster Way Castletown Road (Section 2) and south east of Aughnacloy (Section 3). Both the Proposed Scheme Route and the On-line Dual Carriageway cross this route at the same location and maintain suitable crossing. Southeast of Aughnacloy. The impact of both options would be slight adverse

Side Roads

Both On-line Dual Carriageway and Proposed Scheme Route would intersect a number of side roads along their length. At the majority of these locations access across the route via a localised diversion or an overpass/ underpass would be

provided. The predicted impact of both routes on side roads is concluded to be similar is scale.

4.9 The Water Environment

4.9.1 Methodology

The comparison of potential impacts upon the water environment associated with both the Proposed Scheme Route and the On-line Dual Carriageway have been based upon water environmental data currently held. Potential impacts considered include:

- the crossing of watercourses and standing water bodies with consideration to their Water Framework Directive (WFD) classification;
- the crossing of designated areas;
- the crossing of areas identified as featuring peat; and,
- the crossing of areas identified as having groundwater vulnerability (GWV) status classified as Class 5 (most vulnerable).

The comparison has been made between the On-line and Proposed Schemes at a point at which the On-line Dual Carriageway option is only partially complete and therefore it has been noted that this presents the potential for error in summarising impacts.

The On-line Dual Carriageway and the Proposed Scheme Route have been compared based on sections defined by the Engineering Team. Numbers and lengths of potential impacts were summarised for On-line Dual Carriageway and Proposed Scheme Route by the defined sections based on the constraints outlined above. A decision was then made based on these summaries along with professional judgement, where necessary, as to which section of each option was indicative of a better option from a Water Environment perspective.

4.9.2 Section 1 - On-line Dual Carriageway and Proposed Scheme Route

Based on the criteria outlined above, for Section 1 the overall indicative better route was the On-line Dual Carriageway Option.

Table 4-7 Section 1-On-line Dual Carriageway interactions against Proposed Scheme Route Interactions

Location	Indicative Better Option	On-line Dual Carriageway Interactions	Proposed Scheme Route Interactions
New Buildings to Junction 2	On-line Dual Carriageway	Crosses 2 non-WFD classified watercourses	Crosses 2 non-WFD classified watercourses; Crosses 30m of GWV Class 5
Junction 2 to Maghermason	On-line Dual Carriageway	Crosses 2 non-WFD classified watercourses	Crosses 2 non-WFD classified watercourses; Crosses 10m of GWV Class 5
Maghermason Bypass	Proposed Scheme	Crosses 4 non-WFD classified watercourses	Crosses 3 non-WFD classified watercourses
Maghermason Bypass to Bready	Proposed Scheme	Crosses 1 non-WFD classified watercourse; Crosses 390m of GWV Class 5	Crosses 1 non-WFD classified watercourse; crosses 40m of GWV Class 5
Bready Bypass to Cloghcor	On-line Dual Carriageway	Crosses 3 non-WFD classified watercourses; Crosses 140m GWV Class 5	Crosses 1 non-WFD classified watercourse; Crosses 570m GWV Class 5
Cloghcor to Ballymagorry Bypass	On-line Dual Carriageway	Crosses 1 WFD 'Good ' classified watercourse; Crosses 1 WFD 'Moderate ' classified watercourse	Crosses 1 WFD 'Good ' classified watercourse; Crosses 1 WFD 'Moderate ' classified watercourse; Crosses 1 non-WFD classified watercourse
Ballymagorry Bypass to Junction 3	Proposed Scheme	Crosses 3 non-WFD classified watercourses	No interactions
Junction 3 to Junction 6	None	Crosses 6 non-WFD classified watercourses	Crosses 6 non-WFD classified watercourses

Location	Indicative Better Option	On-line Dual Carriageway Interactions	Proposed Scheme Route Interactions
Junction 6 to Junction 7	On-line Dual Carriageway	Crosses 1 WFD 'Moderate Ecological Potential' classified watercourse; Crosses 2 non-WFD classified watercourses; Crosses 80m of designated area	Crosses 1 WFD 'Moderate Ecological Potential' classified watercourse; Crosses 3 non-WFD classified watercourses; Crosses 83m of designated area
Junction 7 to Junction 8	On-line Dual Carriageway	Crosses 1 non-WFD classified watercourse	Crosses 2 non-WFD classified watercourses; Crosses 1 non-WFD classified standing water body
Donegal link	Proposed Scheme	Crosses 1 WFD 'Poor' classified watercourse; Crosses 1 non-WFD classified watercourse; Crosses 1 non-WFD classified standing water body; Crosses 30m of designated area	Crosses 1 non-WFD classified watercourse
Sion Mills Bypass	None	Crosses 1 non-WFD classified watercourse	Crosses 1 non-WFD classified watercourse

4.9.3 Section 2 - On-line Dual Carriageway and Proposed Scheme Route

Based on the criteria outlined above, for Section 2 the overall indicative better route was the Proposed Scheme Route.

Table 4-8 Section 2 On-line Dual Carriageway interactions against Proposed Scheme Route Interactions

Location	Indicative Better Option	On-line Dual Carriageway Interactions	Proposed Scheme Route Interactions
Sion Mills Bypass	Proposed Scheme	Crosses 2 non-WFD classified watercourses; Crosses 1 non-WFD classified standing water body	Crosses 2 non-WFD classified watercourses
Sion Mills to Victoria Bridge	Proposed Scheme	Crosses 3 non-WFD classified watercourses; Crosses 67m of designated area	Crosses 1 non-WFD classified watercourse
Victoria Bridge Bypass	None	Crosses 2 non-WFD classified watercourses	Crosses 2 non-WFD classified watercourses
Victoria Bridge to Derg River	None	No interactions	No interactions
Derg River to Newtownstewart	Proposed Scheme	Crosses 1 WFD 'Moderate' classified watercourse; Crosses 100m of designated area	Crosses 1 WFD 'Moderate' classified watercourse; Crosses 90m of designated area
Newtownstewart Bypass	Proposed Scheme	Crosses 1 WFD 'Moderate Ecological Potential' classified watercourse; Crosses 1 non-WFD classified watercourse;	No interactions

Location	Indicative Better Option	On-line Dual Carriageway Interactions	Proposed Scheme Route Interactions
		Crosses 370m of designated area	
Newtownstewart to Hamilton's Rd	Proposed Scheme	Crosses 2 WFD 'Moderate' classified watercourses; Crosses 1 WFD 'Moderate Ecological Potential' classified watercourse; Crosses 10 non-WFD classified watercourses; Crosses 510m of designated area	Crosses 1 WFD 'Good' classified watercourse; Crosses 11 non-WFD classified watercourses
Hamilton's Rd to Mountjoy	Proposed Scheme	Crosses 9 non-WFD classified watercourses; Crosses 580m of peat	Crosses 6 non-WFD classified watercourses
Mountjoy Bypass	Proposed Scheme	Crosses 3 non-WFD classified watercourse; Crosses approximately 490m of peat	Crosses 5 non-WFD classified watercourses
Mountjoy to North of Omagh	Proposed Scheme	Crosses 1 non-WFD classified watercourse; Crosses 280m of peat	Crosses 2 non-WFD classified watercourses
Omagh Bypass	Proposed Scheme	Crosses 1 WFD 'Moderate' classified watercourse; Crosses 7 non-WFD classified watercourses;	Crosses 1 WFD 'Moderate' classified watercourse; Crosses 4 non-WFD classified watercourses

Location	Indicative Better Option	On-line Dual Carriageway Interactions	Proposed Scheme Route Interactions
		Crosses approximately 270m of peat	
South of Omagh to Junction 13	Proposed Scheme	Crosses 1 WFD 'Moderate' classified watercourse; Crosses 8 non-WFD classified watercourses; Crosses 160m of GWV Class 5; Crosses approximately 960m of peat	Crosses 1 WFD 'Moderate' classified watercourse; Crosses 10 non-WFD classified watercourses; Crosses 418m of GWV Class 5; Avoiding crossing peat was a deciding factor in this case.

4.9.4 Section 3 - On-line Dual Carriageway and Proposed Scheme Route

Based on the criteria outlined above, for Section 3 the overall indicative better route was the Proposed Scheme Route.

Table 4-9 Section 3 On-line Dual Carriageway interactions against Proposed Scheme Route Interactions

Location	Indicative Better Option	On-line Dual Carriageway Interactions	Proposed Scheme Route Interactions
Junction 13 to Tullyrush Rd	Proposed Scheme	Crosses 6 non-WFD classified watercourses; Crosses 210m of peat	Crosses 5 non-WFD classified watercourses

Location	Indicative Better Option	On-line Dual Carriageway Interactions	Proposed Scheme Route Interactions
Tullyrush Rd to Moylagh Rd (J14)	Proposed Scheme	Crosses 4 non-WFD classified watercourses; Crosses 230m of GWV Class 5; Crosses 1100m of peat	Crosses 5 non-WFD classified watercourses
Moylagh Rd (J14) to Greenmount Rd	On-line Dual Carriageway	Crosses 6 non-WFD classified watercourses; Crosses 160m of GWV Class 5	Crosses 1 WFD 'Moderate' watercourse; Crosses 5 non-WFD classified watercourses
Greenmount Rd to Garvaghy	Proposed Scheme	Crosses 1 WFD 'Moderate' classified watercourse; Crosses 4 non-WFD classified watercourses; Crosses 770m of GWV Class 5	Crosses 5 non-WFD classified watercourses; Crosses 135m of GWV Class 5
Garvaghy to Ballynasaggart Rd	Proposed Scheme	Crosses 5 non-WFD classified watercourses; Crosses 590m of GWV Class 5; Crosses 870m of peat	Crosses 3 non-WFD classified watercourses; Crosses 1500m of GWV Class 5; Avoiding crossing peat was the deciding factor in this case.

Location	Indicative Better Option	On-line Dual Carriageway Interactions	Proposed Scheme Route Interactions
Ballynasaggart Rd to Old Omagh Rd (North of Ballygawley)	None	Crosses 2 non-WFD classified watercourses	Crosses 1 non-WFD classified watercourse; Crosses 120m of GWV Class 5
Ballygawley Bypass to Junction 15	On-line Dual Carriageway	Crosses 5 non-WFD classified watercourses	Crosses 7 non-WFD classified watercourses; Crosses 1135m of GWV Class 5
Junction 15 to Junction 16	On-line Dual Carriageway	Crosses 1 WFD 'Poor' classified watercourse; Crosses 13 non-WFD classified watercourses; Crosses 830m of GWV Class 5	Crosses 2 WFD 'Poor' classified watercourses; Crosses 12 non-WFD classified watercourses; Crosses 950m of GWV Class 5
Junction 16 to Aughnacloy Bypass	Proposed Scheme	Crosses 1 WFD 'Moderate' classified watercourse; Crosses 1 WFD 'Poor' classified watercourse; Crosses 6 non-WFD classified watercourses	Crosses 1 WFD 'Poor' classified watercourse; Crosses 7 non-WFD classified watercourses; Crosses 350m of GWV Class 5

4.9.5 Limitations

There have been several limitations to the assessment of potential impacts associated with the On-line Dual Carriageway and Proposed Scheme Route which have been summarised, as follows:

WFD classification of water bodies

WFD classifications as recent as the time of the re-submission of the Environmental Statement (WFD 2013 classifications) have been included in this assessment; however, it is noted that 'Cycle 2' of the NIEA River Basin Management Plan (2015) has now been published and there have been several updates to WFD catchment boundaries and water body classification results.

Water resources

Water resources have not been included in this assessment due to water supplies data held not covering the geographic extent of the On-line Dual Carriageway.

Peatlands

Some of the peatland data held does not define the extent of geographical area covered. This presents inaccuracies in comparing lengths of road crossing peatlands.

4.10 Geology and Soils

4.10.1 Methodology

Information relating to the existing status and constraints associated with geology, topography, ground conditions including contaminated ground within the environmental study area is provided in Chapter 3.3 of this report. This chapter outlines the status relating to soils. Data sources reviewed and consultees contacted during the constraints study relating to soils comprise:

- Department of Agriculture for Northern Ireland Soils Maps,
- Department of Agriculture and Rural Development – Land Classification map.

4.10.2 Section 1 - On-line Dual Carriageway and Proposed Scheme Route

New Buildings to Junction 2

From CH 4400- CH 5650 the On-line Dual Carriageway and the Proposed Scheme Route would follow the same general route to the west of the existing A5 and is generally across agricultural land with no significant constraints noted. Ground conditions are expected to include glacial till over shallow bedrock of Psammite and Pelite rock of the Ballykelly Formation.

There is no preference to the dual carriageway options at this point.

Junction 2 to Maghermason

From CH 5700- CH7200 both the On-line Dual Carriageway and Proposed Scheme Route would generally be constructed over areas of glacial till overlying bedrock of Psammite and Semi-Pelite rock of the Claudy Formation. The On-line Dual Carriageway incorporates the existing A5 from CH 5950- CH6500. Soft ground may be associated with the 2 small watercourses at Taghnarina Road at CH 6300 and CH 7025.

The Proposed Scheme Route would also crosses the small watercourses west of Taghnarina Road at CH 6375 before converging with the On-line Dual Carriageway at around CH 7025. It passes close to a waste water treatment plant at CH 7000

On-line Dual Carriageway would be considered marginally the best option at this point as is further away from any potential contamination from the waste water treatment plant.

Maghermason Bypass

Both the On-line and the Proposed Route would then pass off-line to the west of the village of Magheramason generally over glacial till with alluvium associated with the Blackstone Burn at CH 7350 and overlying bedrock of Psammite and Semi-Pelite rock of the Claudy Formation.

Soft ground may be associated with alluvium around the Blackstone Burn which may have to be realigned for 75-100m. Additionally soft areas may be associated with 3 small watercourses south of Dunnalong Road at CH 7950, CH 8025 and CH 8400.

No preference to dual carriageway options at this point.

Maghermason Bypass to Bready

Immediately south of Magheramason the On-line Dual Carriageway would be constructed by widening the northbound carriageway of the existing A5 from CH 8450- CH 9500 before diverging to the west between From CH 9550- CH 9950. It would be constructed over areas with rock close to the surface with bedrock of Psammite and Semi-Pelite rock of the Claudy Formation. Soft ground may be associated with watercourse south of Ballybeeny Road at CH 9750.

The Proposed Scheme Route would generally be constructed across agricultural land further west. Again it would be constructed over glacial tills and rock close to the surface with limited soft ground around CH 9750 associated with the water course.

South of Tamnabrady Road, the On-line and Proposed Scheme Route would cross to the east of the A5 and rise up on an off-line route east of Bready. Earthworks would be constructed on glacial till or shallow bedrock.

A backfilled quarry and disused waste water treatment plant are located to the west of the existing A5 immediately north of Bready at CH 10600 and CH 11000. These may affect the A5 access local access road.

The On-line Dual Carriageway would likely be marginally favourable due to rock close to the surface.

Bready Bypass to Cloghcor/ Cloghcor to Ballymagorry Bypass

Between Bready and Cloghcor the On-line Dual Carriageway would follow the existing A5.

Contamination may be associated with reclaimed area found at CH 10400 and quarry with fly tipping at CH 11200 in the rock cutting behind Bready

Alluvium would be expected to be encountered from CH 11200- CH 11350 south of Bready.

From CH 11700-CH 13700 the Proposed Scheme Route would be expected to be constructed adjacent to the existing carriageway widened to the east and west along

different sections. No significant constraints noted. Glaciofluvial sands and gravels are indicated along the length of this section.

From CH 13700-CH 15400 the dual carriageway continues along the existing A5. Some ground instability was noted just south of Cloghcor Road to the east of the dual carriageway at CH 15100. River alluvium is present at CH13800-CH14000 and CH14400-CH14450. Maps indicate that glaciofluvial sands and gravels predominate in that area with areas of alluvium associated with the Burn Dennet River.

The Proposed Scheme Route would be carried further west generally over glaciofluvial sands, gravels and alluvium associated with the Burn Dennet River from CH 14300-CH 14600. It would generally be constructed over alluvial material from CH 14950 at Ballydonaghey Road to CH 17200 as it avoids McKeans Moss ASSI. A brickfield would also be encountered from CH 16100-CH 16300.

The On-line Dual Carriageway would be preferred through this section. It is generally to the east of the A5 and avoids the more extensive areas of peat further west and crossing more significant areas of glacial sands and gravels. There is also less risk to McKeans Moss ASSI.

Ballymagorry Bypass to Junction 3

The On-line Dual Carriageway would continue along the existing A5 to immediately north of Ballymagorry and then sweeps off-line to the west of Ballymagorry. It would follow a similar route to the Proposed Scheme Route however it is the Proposed Scheme Route which makes better use of the gravel ridges west of Ballymagorry. Earthworks would be constructed over glaciofluvial sands and gravels and alluvium expected to be up to 8m deep.

The Proposed Scheme Route option is considered the best option at this section as it makes better use of the gravel ridges west of Ballymagorry.

Junction 3 to Junction 6

At this point the Proposed Scheme Route and On-line Dual Carriageway follow the same route.South of Ballymagorry the Proposed Scheme Route would continue off-line to the west over alluvial material.

From CH 18500-CH 20100 alluvium is expected along much of this section up to 8m deep associated with the floodplain of the Foyle River between Ballymagorry and north of Strabane. Maps indicate that alluvium associated with the Foyle floodplain predominate in that area with smaller areas of glaciofluvial gravels.

From CH 20100-CH 21800 alluvium is again expected along much of this section up to 8m deep associated with the floodplain of the Foyle River.

The dual carriageway would be impacted by a former landfill site from CH 21000 and CH 21400. Risk assessments and remediation strategies would have to be incorporated in the detailed design.

Contamination and unstable ground would be expected from the former and now infilled Strabane Canal from CH 20750- CH 20950 and from industrial buildings associated with the former railway at CH 21550.

Both Proposed Scheme and On-line Dual Carriageways are the same so there is no preference.

Junction 6 to Junction 7 (Junction with N2)

The On-line Dual Carriageway would follow the existing A5 along the Strabane by-pass. From CH 21800-CH 23450 river alluvium is evident at CH 21800-CH 22500 Made ground indicated to the east of the existing A5 at CH 23400. Maps indicate that alluvium and glaciofluvial sands and gravels extend throughout the section.

The Proposed Scheme Route would be constrained between the town of Strabane and the river Finn crossing hummocky morraines and alluvium.

It is considered that the On-line Dual Carriageway is the Proposed Scheme as there is potentially less alluvium encountered.

Junction 7 to Junction 8

The On-line Dual Carriageway crosses and area of peat from CH 24650- 24900. Contamination associated with Orchard Road Landfill site at CH 24500 and associated with reclaimed ground from CH 24775 and CH 24825 Glacial Till and Peat predominate in this area.

From CH24900-CH26450 no significant constraints noted, the route would be constructed over glacial till and glaciofluvial sand and gravels.

The Proposed Scheme Route crosses mainly glacial till. However it crosses an area of peat and reclaimed ground from CH 24100- CH 24700.

It is considered that the Proposed Scheme would be better as it avoids any contamination associated with Orchard Road Landfill.

Donegal Link

The connection to the Finn crossing bridge would generally be constructed over hummocky glacial moraine and glacial till. Alluvium is associated with the river Finn. The Proposed Scheme Route would pass close but avoids the Urney Road landfill site.

4.10.3 Section 2 - On-line Dual Carriageway and Proposed Scheme Route

Sion Mills Bypass

The On-line Dual Carriageway would be constructed off-line between Sion Mills and Glebe before re-joining the existing A5 at Victoria Bridge at CH 29450. Directly North of Garden road at CH 27200 there is a former reservoir which may be backfilled with unknown materials. South of garden road there is landfill site just outside the buffer zone at CH 27250. Parallel to Bellspark road there is another landfill and a possible fuel storage tank which pose a contamination risk.

The earthworks would generally be constructed over firm to stiff glacial tills, hummocky glacial moraines and glacial sands and gravels.

The Proposed Scheme Route would be constructed slightly further west and would also be constructed over hummocky glacial moraines and glacial sands and gravels. It would generally be constructed across green field sites and would avoid the possible contamination associated with the sites around Sion Mills.

The Proposed Scheme Route is thus considered better at this point as it avoids many of the possible contamination sites around Sion Mills.

Sion Mills to Victoria Bridge

Along the On-line Dual Carriageway, lake alluvium is expected to be encountered west of Bellspark Road from CH 28425- CH 28875. There would be a potential low to medium risk of contamination from the farm buildings immediately west of Bellspark road. Alluvium is associated with the Mourne River and may be impacted close to Victoria Bridge.

The Proposed Scheme Route would be constructed across greenfield sites further west mainly across glacial tills. Lake alluvium would be encountered from CH 29000- CH 29250.

It is considered that the Proposed Scheme would be the best option for this section as it avoids the alluvium with the Mourne and potential sources of contamination.

Victoria Bridge Bypass

The On-line Dual Carriageway would be widened along the existing A5 from CH 29450- CH 29750 where it would be constructed to the west of the existing A5 to CH 31150. There are a number of Industrial sites and waste water treatment sites around Victoria Bridge. Soft ground would be expected with the alluvium at Liscreevaghan Burn from CH 30400- CH 30550. Peat may be encountered west of Victoria Bridge at CH 30950- CH 31150.

The Proposed Scheme Route would be constructed further west across glacial till and hummocky morraines. It is generally constructed across greenfield sites.

The Proposed Scheme Route would be considered the best option at this point as it avoids the impact from the industrial areas around Victoria Bridge.

Victoria Bridge to Derg River

From CH 32900- CH 36050 the On-line Dual Carriageway would be constructed parallel to the east of the existing A5.

From CH32450-CH32700 there is an active quarry. Contamination and instability may be associated with any workings or reclamation of this quarry.

Soft ground is expected with the alluvium at the Derg River from CH 33400- CH 33550. Maps indicate a mineral occurrence (Gold) associated with the Derg.

The Proposed Scheme Route would generally be constructed across glacial till and hummocky morraines. The route passes between and avoids two quarries between CH 32450- CH 32500.

The Proposed Scheme would be considered preferable at this point as it avoids the instability or contamination possibly associated with the quarries.

Derg River to Newtownstewart

The dual carriageway would generally avoids the gravel pits at Deerpark but a gravel pit is indicated to the east of the A5 at CH 34700. The dual carriageway would generally be constructed over glaciofluvial sands and gravels with smaller areas of alluvium.

The dual carriageway would intersect gravel pits from CH 33850- CH33950 and CH 35000- CH 35150 and a possible former gravel pit at CH 35950. It is unknown what materials the pits are backfilled be with and ground treatment may be required in this area. The dual carriageway would be constructed over glaciofluvial sands and gravels.

From CH 35350- CH 36050 earthworks would be constructed over glaciofluvial sands and gravels on the approach to the widened Strule Bridge. A small historic gravel pit would be encountered at CH 35950. The nature of the backfilling is unknown. Any contaminated material may be required to be excavated and disposed offsite.

The Proposed Scheme Route crosses glacial sands and gravels further west of the A5. It crosses a quarry at CH 35900. With the exception of the quarry it is generally across greenfield sites.

The Proposed Scheme Route is considered the better option at this point as it general crosses greenfield sites and less quarries.

Newtownstewart Bypass

Around Newtownstewart the majority of the earthworks would be constructed over alluvium associated with the River Strule. The alluvium associated with the Strule is expected to be up to 11m deep.

A number of low to medium risk industrial sites are located close to the dual carriageway at CH 37600 and CH 37825. Any contamination associated with the industrial sites may need to be excavated and disposed of offsite.

The Proposed Scheme Route is generally constructed across hummocky glacial morraines across green field sites.

The Proposed Scheme Route is considered best at this point as it avoids the alluvium associated with the Strule and any potential impact from the industrial sites around Newtownstewart.

Newtownstewart to Hamilton's Rd

From CH 38600- CH 39050 the Proposed Scheme Route would be constructed over alluvium associated with the River Strule and glaciofluvial sands and gravels. From CH 39050- CH 40000 the dual carriageway would be constructed by widening the existing A5 to the west mainly at grade. The dual carriageway at this section is expected to be carried over hummocky glacial moraines.

The local access A5 south of Newtownstewart would be constructed over hummocky glacial moraines.

From CH 39725- CH 41375 the site is constrained by the river Strule to the east with land falling towards it and significant steep slopes rising towards the west. Alluvium would be expected to be encountered running along the eastern extents. Possible made ground and infilling at CH 41450 and medium risk of contamination at CH 42550.

The Proposed Scheme Route would be generally constructed higher up away from the Strule River across hummocky glacial morraines.

The Proposed Scheme Route would be considered the better option at this point as it avoids the areas of alluvium and potential impact from the quarries.

Hamilton's Rd to Mountjoy

The On-line Dual Carriageway generally follows the existing A5 across glacial till and glacial sand and gravels.

The Proposed Scheme is proposed further west across hummocky glacial tills.

There is no preference to dual carriageway options at this point.

Mountjoy Bypass

Peat is expected to be encountered from CH 47675- CH 49900 which may need to be excavated before construction.

The Proposed Scheme Route may be constructed further west. It would be expected to encounter lake alluvium over shallow bedrock from CH 46800- CH47500.

The Proposed Scheme would be considered to be better at this point as there is less peat on this route.

Mountjoy to North of Omagh

The On-line Dual Carriageway could be constructed across, glacial sands and gravels, rock close to the surface, glacial till, peat and alluvium. Peat is expected to be encountered in association with the Tully drain and Tully Bog SAC from CH 49400- CH 49600. Alluvium would be associated with the Fairywater. Contamination could be encountered from the former Nestle site situated immediately adjacent and east of the buffer zone at CH 49750. Soft ground and contaminated areas could need to be excavated before construction.

The Proposed Scheme Route could be constructed across glacial sands and gravels, rock close to the surface, glacial till, peat and alluvium. It would intersect with the edge of a peat area from CH 48000- CH 4850 and a smaller area of peat at CH 49450- CH 49500. At the Fairywater it would follow the same alignment as the On-line Dual Carriageway.

The Proposed Scheme Route would be preferred as there is less potential impact on Tully Bog SAC and less impact from the contamination associated with the former Nestle factory.

The alignment would follow the Proposed Scheme Route west of Omagh from the Fairywater to Seskinore Road and has therefore not been assessed as part of this review.

4.10.4 Section 3 - On-line Dual Carriageway and Proposed Scheme Route

Junction 13 to Tullyrush Rd

The On-line Dual Carriageway would encounter peat from CH 57350- CH 58000 between Seskinore Road and Tattykeel Road to 7m. The ground could have to be surcharged prior to construction in this area.

From CH 58500- CH 60100 peat is present to the west of the existing A5 from CH 58700- CH 59450 to 3m BGL. The peat would likely be excavated prior to construction, or embankments constructed by staged construction.

Peat is also indicated on mapping to the east of the A5 from CH 59800- CH 60100 There is infilling with unknown materials from CH 58950- CH51950 to the west of the A5. Raised peat is indicated on mapping to the east of A5 from CH 60100- CH 60500. Raised peat indicated on mapping to the east of the A5 from CH 60450- CH 61650. Fly-tipping of unknown materials at CH 61050 east of the A5 was identified during the site walkovers. A former mill pond is indicated at CH 59525- CH 59575 backfilled with unknown materials.

The Proposed Scheme Route would also cross the areas of peat at Tattykeel and Doogary. From CH 58500- CH 58950 moves further into the peat area at Doogary. It diverges from the On-line Dual Carriageway at CH58550 and crosses areas of glacial till and rock close to the surface.

The On-line Dual Carriageway would be considered preferable at this point as it would be expected to encounter shallower areas of peat at Doogary.

Tullyrush Rd to Moylagh Rd (J14)

Along the On-line Dual Carriageway soft ground and raised peat would be encountered to 2.5m below ground level from CH 61650- CH 62300. An infilled quarry would be impacted at CH 62000. The nature of infilling of the quarry is unclear. Raised peat is expected between CH 62850- CH 63250.

The Proposed Scheme Route is generally proposed across greenfield sites over glacial tills and rock close to the surface with a backfilled quarry at Moylagh Road at CH 4250.

The Proposed Scheme is considered most appropriate at this point as it avoids areas of peat.

Moylagh Rd (J14) to Greenmount Rd

Soft ground and alluvium from CH 64150- CH64275 and CH 64625- CH 64875.

The On-line Dual Carriageway would be constructed to the southwest of the existing A5 from CH 64350- CH 67400. The dual carriageway would likely be carried on embankment over areas of glacial till and rock close to surface with smaller isolated areas of alluvium and peat.

A watercourse diversion would be required from CH 65200- CH 65350 and CH 65600- CH 65750 and soft ground is likely in these areas.

A petrol station is noted at CH 64900 and CH 67500 which could be a potential source of contamination. A backfilled quarry is identified at CH 67550.

The Proposed Scheme would be constructed over greenfield sites generally over till and rock close to the surface. There are isolated pockets of alluvium identified in the interdrumlin areas such as at CH 63950- CH 64000, CH 65200- CH 65250 and CH 65550-65600.

The Proposed Scheme Route is considered better at this point as it avoids contamination possibly associated with the petrol stations and the quarries.

Greenmount Rd to Garvaghy

Along the On-line Dual Carriageway there is possible soft ground from CH 66600- CH 66750. Alluvium associated with the Routing Burn Extension from CH67750- CH 68150. Soft ground and alluvium indicated both sides of the existing A5 between CH 68150- CH 69800. Soft ground and alluvium from CH 69800- CH69950. Contamination may be associated with the former lime kiln at CH70100 near Roscavy Road, the Petrol Station at Garvaghey and backfilled quarry to the east of the A5 at CH 71150.

The Proposed Scheme Route would generally be constructed over shallow glacial tills with rock close to the surface. Peat and alluvium around is noted around Cormore Road. Some contamination noted with peat area.

The Proposed Scheme Route is considered better at this point as it avoids the soft ground associated with the Routing Burn Extension and potential contamination associated with the petrol station.

Garvaghy to Ballynasaggart Rd

From CH 70700- CH 71780 the dual carriageway is likely to incorporate the existing A5 and be carried on embankment over glacial till glaciofluvial sand and gravel, peat and alluvium. Rock is indicated to be close to the surface from CH 71400-CH 71780.

Possible contamination associated with the backfilled quarries and lime kilns at CH 71150, CH 72000, CH 73150, CH 73375, CH 74400 and CH 75075.

Alluvium may be encountered from CH 71500- CH 71625 and peat from CH 71850-CH 71875, CH 71100- CH71200 and CH 72400-CH 73200.

The Proposed Scheme Route would generally be constructed over glacial tills and rock close to the surface with isolated areas of alluvium and more extensive areas of alluvium associate with the Roughan Stream.

The Proposed Scheme Route is considered more favourable at this point as there is less potential for impact from backfilled quarries.

Ballynasaggart Rd to Old Omagh Rd (North of Ballygawley)

Along the On-line Dual Carriageway soft ground and alluvium is expected from CH 75175- CH 75225. Possible contamination associated with a disused quarry at CH 75100 to the west of the existing A5.

Along the Proposed Scheme Route significant Areas of Alluvium associated with Roughan stream between Glenhoy Road and Feddan Road.

The On-line Dual Carriageway would be considered to be better at this point as there is less soft ground to be crossed.

Ballygawley Bypass to Junction 15

Along the On-line Dual Carriageway soft ground and alluvium associated with the Ballygawley water from CH 77900- CH 78150. Alluvium associated with the

Ballygawley water from CH 78150-CH 78450, CH79100- CH 78800 and 79600-CH79650.

The Proposed Scheme Route generally crosses glacial till and rock close to the surface. It does however cross significant areas of alluvium where the link road is upgraded between the Proposed Scheme Route and the A4. A quarry is noted at Feddan Road.

It is considered that the On-line Dual Carriageway would be better at this point as there is significant soft ground to be crossed associated with the upgrade of the link road between the Proposed Scheme Route and the A4.

Junction 15 to Junction 16

Along the On-line Dual Carriageway soft ground and alluvium would be encountered just west of the A5 at CH81150-CH81200. Contamination may be associated with backfilled quarries at CH 81250 and CH 82050, and CH 83150.

River alluvium is encountered along the existing A5 at chainage CH82100-CH82250, CH82400-CH82500 and CH82950-CH83050.

The Tullyvar active landfill site is located at CH81600-CH81800. Contamination may be associated with a small backfilled limestone quarry at CH81750 and a backfilled gravel pit and quarry located at CH8320.

Along the Proposed Scheme Route alluvium associated with the Tullyvar Stream, Ravella Stream and Old Chapel Road. Infilling and contamination around Old Chapel Road.

It is considered that particularly with the contamination potential from Tullyvar landfill that the Proposed Scheme Route is the more favourable option.

The alignment to around Aughnacloy is the same as the Proposed Scheme Route and therefore has not been assessed in this report.

5 Proposed Scheme Route v On-line Dual Carriageway

5.1 Properties Affected

Construction of the Proposed Scheme Route and On-line Dual Carriageway results in a number of buildings being demolished as the land on which they are situated would be required for construction of the scheme.

For the Proposed Scheme Route they are as follows:

- Section 1
  - 1 Agricultural Property
  - 3 Residential Properties
  - 1 Commercial Property - Castletown House (listed building)
- Section 2
  - 2 Residential Properties
- Section 3
  - 1 Residential Property

There are a total of 8 properties demolished for the entire length of the Proposed Scheme Route, which is the equivalent to demolishing a property approximately every 10.6km of dual carriageway.

A similar review was carried out for the On-line Dual Carriageway to identify the demolished. They are as follows:

- Section 1
  - 15 Agricultural Properties
  - 9 Commercial Properties
  - 1 Community Property
  - 30 Residential Properties
- Section 2
  - 15 Agricultural Properties
  - 4 Commercial Properties
  - 1 Community Property
  - 36 Residential Properties
- Section 3
  - 23 Agricultural Properties

- 3 Commercial Properties
- 41 Residential Properties

Table 5-1 Comparison of Properties Demolished

	Proposed Scheme Route			On-line Dual Carriageway		
Section	**1**	**2**	**3**	**1**	**2**	**3**
Agricultural Properties	1	0	0	15	15	23
Commercial Properties	1	0	0	9	4	3
Community Properties	0	0	0	1	1	0
Residential Properties	3	2	1	30	36	41
Total Properties	5	2	1	55	56	67
Total	**8**			**178**		

There are a total of 178 properties demolished for the entire length of the On-line Dual Carriageway, which is equivalent to demolishing a property approximately every 0.5km of dual carriageway.

Table 5-2 Properties Demolished per Km

	Proposed Scheme Route	On-line Dual Carriageway
Total Properties Demolished	8	178
Km per property demolished	10.6km	0.5km

There are nearly 23 times as many properties demolished for the On-line Dual Carriageway as there are on the A5WTC Proposed Scheme Route.

In addition to the 178 demolished properties for the On-line Dual Carriageway there are over 350 properties which are majorly impacted. Supporting Drawings are in Appendix B, C and E.

5.2 A5 Collector Road

The existing A5 acts as the A5 Collector road for local traffic on the Proposed Scheme Route, and for that reason there is no need to construct an additional local road. As previously discussed in utilising the existing A5 for a dual carriageway, a new collector road is required. See table below.

Table 5-3 Length of Road Construction

	On-line Dual Carriageway	Proposed Scheme Route
Dual Carriageway	85.0km	85.0km
A5 Collector Road	35.0km	0.0km
Side Road*	37.5km	42.5km
Total	**157.5km**	**127.5km**

*Please note the side road diversions for the On-line may be longer due to the lack of specimen design carried out.

There is approximately 35.0km of new A5 Collector Road required for the On-line Dual Carriageway. This compares with 0.0km of additional collector road for the Proposed Scheme Route. This road would have a direct impact on side roads, accesses and properties (See Appendix C).

There are a 175 side roads which intersect with the existing A5 along the limits of the scheme, of which 135 are directly affected by the A5 Collector Road or On-line Dual Carriageway. This is in comparison to 100 side roads directly affected by the Proposed Scheme Route.

The 35km of new A5 Collector Road for the On-line Dual Carriageway would approximately cost an additional £79m to construct in comparison to the Proposed Scheme Route which has no construction costs for the A5 Collector Road.

Whilst a full specimen design has not been carried out for the entire length of the On-line Dual Carriageway, the specific specimen design areas show the impact the addition of the new A5 Collector Road.

The list of drawings below show the impact the new A5 Collector Road has on the landtake, side roads and properties (See Appendix D);

- 718736-S1-0800-1432-1435 OA Magheramason SD
- 718736-S1-0800-1436-1438 OA Ballymagorry 2+1 SD

- 718736-S2-0800-1439-1443A OA Victoria Bridge SD
- 718736-S2-0800-1444-1448A OA Newtownstewart SD
- 718736-S3-0800-1439-1445 OA Greenmount Rd & Garvaghy SD

The impact the new A5 Collector Road can be seen to have a significant impact on landtake, side roads and properties. The Proposed Scheme Route has no impact on the existing A5, apart from junction tie in locations, therefore there is no impact on landtake, side roads and properties from A5 Collector Road for the Proposed Scheme Route.

5.3 Side Roads and Accommodation Works

Construction of the Proposed Scheme Route and On-line Dual Carriageway affect a number of Side Roads, property accesses and field accesses. These side roads allow for the connectivity of the local community to remain, whilst trying to reduce community severance.

The Proposed Scheme would affect approximately 100 roads on the network. Some of the major side roads affected are:

- Section 1
  - B49 Woodend Road
  - A38 Lifford Road
  - B85 Urney Road
- Section 2
  - B165 Bells Park Road
  - B72 Fyfin Road
  - B164 Barsoncourt Road
  - B50 Gillygooley Road
  - A32 Clanabogan Road
- Section 3
  - B83 Seskinore Road
  - B46 Moylagh Road
  - A4 Annaghilla Road
  - B35 Carnteel Road
  - B128 Rehaghy Road
  - A28 Caledon Road

Thirty-two side roads (7 No. in Section 1; 10 No. in Section 2 and 15 No. in Section 3) would be stopped-up with the remainder being substantially unaltered or diverted to alternative routes via the local road network. In such a situation it is recognised that there would be additional short lengths of existing side roads that would be stopped up.

The On-line Dual Carriageway affects a number of Side Roads. An exercise has not been carried out to determine which of the side roads affected by the On-line Dual Carriageway would be closed or realigned, however there are approximately 135 side roads directly affected. That is an additional 35% of the Side Roads affected in the Proposed Scheme, with the potential of an additional 35 structures required to keep these side roads open.

Whilst the On-line Dual Carriageway uses the existing A5, it also affects a number of major side roads, which are listed below;

- Section 1
  - B49 Woodend Road
  - A38 Lifford Road
  - B85 Urney Road
- Section 2
  - B165 Bells Park Road
  - B164 Barsoncourt Road
  - B50 Gillygooley Road
  - A32 Clanabogan Road
- Section 3
  - B83 Seskinore Road
  - B46 Moylagh Road
  - A4 Annaghilla Road
  - B35 Carnteel Road
  - B128 Rehaghy Road
  - A28 Caledon Road

Similar to the Proposed Scheme, these roads would be kept open with either structure or junctions at the intersection location with the On-line Dual Carriageway. However, the On-line crosses the A5 Collector Road 8 times requiring 8 skewed structures. The Proposed Scheme crossed over the A5 Collector Road (existing A5) requiring 2

skewed structures. These 6 additional structures would add significant costs to the construction of the On-line Dual Carriageway.

There are over 1000 accesses along the existing A5. These accesses include side roads private accesses and field accesses. Private access include, accesses to domestic properties and farm properties. Field accesses are accesses directly in to fields only.

`Both the On-line Dual Carriageway and the Proposed Scheme Route have significant impact on landowners and existing accesses. The On-line Dual Carriageway has a direct impact on the existing field gate, and accesses which directly access the existing A5.

Where the Proposed Scheme would involve land take on the boundary of private properties, boundaries would be reinstated as part of the accommodation works for the Proposed Scheme. Where existing access to properties or land would be severed, the proposals allow for new access.

Due to the impact the On-line Dual Carriageway has on the existing side road network, new domestic and field accesses would need to be constructed. The location of the new accesses would have an impact on the landowners, and while access is maintained, there are significant lengths of accommodation tracks and structures resulting in significant detours. Accommodation works would be provided to maintain access (where economically viable). These works would be agreed with the individual landowners prior to the construction phase. Similarly, access to severed land would be maintained during the construction phase. While the Proposed Scheme is off-line from the existing A5, it has less impact on these private accesses and field accesses.

5.4 Utilities

There are significantly more Utilities affected by the On-line Dual Carriageway compared to the Proposed Scheme Route. As the On-line Dual Carriageway is continuously on, or close to, the existing A5, utilities would be severely affected and a significant amount of services require alterations and / or permanent / temporary diversionary works.

These services are concentrated in development limits and utilise the existing A5 as a strategic corridor to transfer services from settlement to settlement. The Proposed

Scheme Route avoids development limits and does not utilise the existing A5. As the junctions for the Proposed Scheme connect to the existing A5, services would be affected at these locations.

The diversionary work for fibre optic cables are extremely expensive. The On-Line Dual Carriageway would require approximately 33km of BT fibre optic diversionary works and approximately 60km of diversionary works for other service providers, whilst the Proposed Scheme would only require local diversions at the junction locations. Whilst an in-depth design has not been carried out to fully establish the full length of the diversionary works required, the On-line Dual Carriageway has a significantly greater impact on the service providers with fibre optic cables than the Proposed Scheme Route. The cost and disruption to the service providers would be significant, and which would greatly reduce the economic benefits of the On-line Dual Carriageway in comparison with the Proposed Scheme Route.

Similar to BT, NIE apparatus would require more diversionary works from the On-line Dual Carriageway in comparison to the Proposed Scheme Route. NIE apparatus utilise the existing A5 Road corridor to provide services between the settlements.

The On-line Dual Carriageway would require a total of 198 diversions to take place; the majority being overhead supporting pole relocations. This compares to the Proposed Scheme, where approximately a total of only 116 diversions are required; the majority being existing apparatus alterations (raising / lowering).

The On-line Dual Carriageway would directly affect 110kV tower which could require the provision of two new 110kV towers for the diversionary works, in contrast the Proposed Scheme Route limits the works to raising of cables.

In summary, the extent of existing utilities along the existing A5 corridor results in significantly more service diversions for the On-line Dual Carriageway than the Proposed Scheme Route. These additional diversionary works and provision of new infrastructure would result in the On-line Dual Carriageway becoming a significantly more expensive route than the Proposed Scheme Route.

5.5 Buildability

There would be a number of construction issues when utilising the existing A5 for the On-line Dual Carriageway, some of them are;

- Traffic Management
- Construction of Access Roads
- Construction Traffic
- Worker Safety
- Maintaining access
- Travel Disruption
- Service Diversions
- Construction Time

One of the main issues of utilising the existing A5 for the On-line Dual Carriageway is the traffic management on the existing A5. During the works to upgrade the existing A5, traffic flows must be maintained, allowing traffic to travel between the settlements. The construction of the Collector Road would be necessary before using the existing A5 as the dual carriageway. This would cause significant disruption to public using the existing A5 or who live along it.

During the construction of the new A5 Collector Road, there would be the issue of using traffic signalling, which would increase journey times and cause driver frustration.

As the Proposed Scheme Route is off-line there is no requirement for traffic management along the length of the dual carriageway. There would be limited traffic management requirements during the construction of the junction tie-in locations.

The construction traffic for the On-line Dual Carriageway would use the existing A5 as a haulage route. This would cause traffic issues on the existing A5 for strategic traffic, with dirt, dust noise on the A5. The significant flow of haulage vehicles on the existing road network would cause travel disruption and driver frustration. The additional slow moving vehicles would increase journey times.

Construction work alongside a live carriageway can be dangerous for both road users and construction workers. The On-line Dual Carriageway would require a reduction in the speed limit on the existing A5 to allow for the safety of construction workers. There

would be heavy plant moving along the road, with access and egress locations along the road. At certain locations there would be significant cuttings/ embankments alongside the live carriageway which would have health and safety implications for construction workers and road users.

The Proposed Scheme Route would also have an implication on local road users, however, as this route does not utilise the existing A5, the impact on strategic traffic would be minimal.

During the construction of the On-line Dual Carriageway, access would need to be maintained for side roads, domestic accesses and farm accesses throughout the works. There are over 1000 accesses along the existing A5. Whilst all 1000 are not directly affect by the On-line Dual Carriageway, the issues of maintaining domestic and farm accesses to the A5 Collector Road during the works would cause significant difficulties. These accommodation works would need to be completed before the closing of accesses.

Whilst the Proposed Scheme Route would also have a direct impact on domestic and farm accesses, this impact would have less impact on the accesses than the On-line Dual Carriageway.

It is anticipated that the time for completion of the scheme would increase significantly due to these buildability issues.

6 Costs

6.1 Cost Estimate

The design team developed the On-line Dual Carriageway for consideration and cost evaluation. A methodology was developed to assess the comparative cost of the On-line Dual Carriageway without the benefit of detailed design and measured quantities. The major factors identified are:

- Length of Mainline Carriageway
- Length of A5 Collector Road
- Land take
- Properties directly affected
- Number and type of structures; river crossings, overbridges, underbridges

The purpose of the cost estimate is to determine the potential cost of an On-line Dual Carriageway in terms of scheme economics and not to set the scheme budget.

The cost estimates are based on Q1 2015 Prices and are based on a combination of unit rates and measured quantities. The majority of the pricing information was obtained from analysis of costs from previous and current dual carriageway motorway road projects. Current market prices were obtained for the surfacing works.

A rate per Kilometre was established for the On-line Dual Carriageway (dual carriageway), A5 Collector Road and Side Roads thus giving an overall cost for the road construction costs. The estimated costs were –

- Dual Carriageway (A5WTC) - £6.10m per kilometre (Q2 2012)
- A5 Collector Road - £2.25m per kilometre (Q1 2015)
- Side Road - £2.01m per kilometre (Q1 2015)

6.2 Design Information

The following information was utilised:

- Road Construction Details
- Landtake Area
- Assumed Horizontal and Vertical alignments – ’50m Buffer Zone’
- Assumed drainage and geotechnical area requirements
- Assumed side road lengths

This led to a comparison between the Proposed Scheme Route and the On-line Dual Carriageway Option and the associated costs between each dual carriageway.

6.3 Road Construction Costs

The costs of the road construction for each Section of the On-line Dual Carriageway are detailed in below. The table details the total estimated cost for each section. The values have been rounded to the nearest million.

Table 6-1 Section 1 On-line Dual Carriageway Cost

Section 1 On-line Dual Carriageway			
	Length (km)	Cost (£)	Total
Dual Carriageway	23.2	6.10m	£141.52m
A5 Collector Rd	7.5	2.25m	£16.88m
Total Cost			**£158.40m**

Table 6-2 Section 2 On-line Dual Carriageway Cost

Section 2 On-line Dual Carriageway			
	Length (km)	Cost (£)	Total
Dual Carriageway	31.3	6.10m	£190.93m
A5 Collector Rd	12.1	2.25m	£27.23m
Total Cost			**£218.16m**

Table 6-3 Section 3 On-line Dual Carriageway Cost

Section 3 On-line Dual Carriageway			
	Length (km)	Cost (£)	Total
Dual Carriageway	30.5	6.10m	£186.05m
A5 Collector Rd	15.4	2.25m	£34.65m
Total Cost			**£220.70m**

Total road construction costs for the On-line Dual Carriageway would be ***£597.26m*** which includes ***£78.76m*** for the A5 Collector Road. There is an additional ***£75.37m*** for the realignment of the side roads along the length of the scheme.

The total road construction costs for the On-line Dual Carriageway would be ***£672.64m***.

Based upon the costs rates above, the total road construction costs for the Proposed Scheme Route would be **£604.32m.**

The road construction costs for the On-line Dual Carriageway are approximately **£68m** more expensive than the Proposed Scheme Route.

6.4 Utility Diversion Costs

There are significantly more Utilities affected by the On-line Dual Carriageway compared to the Proposed Scheme Route. As the On-line Dual Carriageway is continuously on, or close to, the existing A5, utilities would be severely affected and a significant amount of services would require alterations.

There are significant costs involved in diverting utilities; such as fibre optic cables, water mains and overhead electric cables. The associated costs for individual diversionary works can run into hundreds of thousands of pounds

The On-line Dual Carriageway would have significantly more Fibre Optic cable diversions than the Proposed Scheme.

Table 6-4 Utilities Affected Comparison

Utilities Affected by the On-line Dual Carriageway compared with Proposed Scheme Route		
Utility	**On-line Dual Carriageway**	**Proposed Scheme Route**
NIE Apparatus potential diversions	198	116
BT Overhead Cables Intersections	66	91
BT Fibre Optic Cables potential diversions	33.6 km	Tie in locations only
Other Fibre Optic Cables potential diversions	60.0 km	Tie in locations only
Telecommunications potential relocation	2 masts	1 mast

Whilst this is not a definitive list of the diversions required, the costs associated with the Fibre Optic Cable diversions alone would be significant and have a negative impact on the economic benefits of the On-line Dual Carriageway.

6.5 Land Requirements

An assessment was carried out on the potential land requirements for the On-line Dual Carriageway. The land requirements were based on the footprint required to construct the Dual Carriageway, A5 Collector Road, Junctions and Side Roads.

The ‘Buffer Zones’ were used to establish an approximate landtake for the road construction. See table below for break down

Table 6-5 On-line Dual Carriageway Road Landtake

Road Type	Buffer Width (m)	Area in hectares
Local Access A5	5	23.23
Mainline	33	563.66
Side Roads	10	65.71
Slip Roads	10	5.96
Total		***658.56***

The total land required for roads construction is **658.56 ha**. Additional land is required for road drainage, drainage ponds, environmental mitigation etc. It can be assumed that this additional land is approximately **548.77 ha**. This is based upon 83% of the road construction land. This is the same ratio for the road construction land / engineering land as the Proposed Scheme Route. This gives a total area for the On-line Dual Carriageway of **1207.33 ha.**

The land required for the construction of the Proposed Scheme Route is **1154.91ha** which is only **52.42 ha** less than the land required for the construction of the On-line Dual Carriageway. Whilst this is an estimated value, it can be seen that there are no significant savings in landtake in using the On-line Dual Carriageway. It is anticipated after further design the landtake for the On-line Dual Carriageway would increase significantly.

As illustrated in Table 5.5 below, the assessment shows that even though the main development areas are bypassed, there are still significantly more properties along the existing A5 that would be lost by an On-line Dual Carriageway as opposed to the Proposed Scheme Route, i.e. 178 No. as opposed to 8 No.

Table 6-6 Impact on Properties

	Residential		Agricultural		Commercial		Community		Total	
	Proposed Scheme	On-line Dual Carriageway	Proposed Scheme	On-line Dual Carriageway	Proposed Scheme	On-line Dual Carriageway	Proposed Scheme	On-line Dual Carriageway	Proposed Scheme	On-line Dual Carriageway
Section 1	3	30	1	15	1	9	0	1	5	**55**
Section 2	2	36	0	15	0	4	0	1	2	**56**
Section 3	1	41	0	23	0	3	0	0	1	**67**
Total	**6**	**107**	**1**	**53**	**1**	**16**	**0**	**2**	**8**	**178**

Whilst the land take for the On-line Dual Carriageway and Proposed Scheme Route are comparable, the number of properties demolished for the On-line Dual Carriageway is significantly greater than the Proposed Scheme Route. This difference would mean the total cost for the On-line Dual Carriageway would be significantly higher than the Proposed Scheme Route.

6.6 Comparative Costs

A comparative cost exercise using pro-rata rates applied to the Proposed Scheme and the On-line Dual Carriageway indicates that an On-line Dual Carriageway would conservatively cost £68m more to construct than the Proposed Scheme. This does not take account of other factors that would make the rates for an On-line Dual Carriageway higher than the Proposed Scheme, i.e.:-

- The additional cost of the additional properties that would be lost or adversely affected by an on-line dual carriageway;
- additional construction costs due to temporary works for working beside live carriageways;
- temporary diversions of traffic including construction of temporary roads;
- protection/diversion of buried utilities under/beside the existing A5, etc.

In taking the above into account an On-line Dual Carriageway in total would cost in excess of **£100m** more compared to the Proposed Scheme.

7 Conclusions

7.1 Conclusions

The outcome of the assessment demonstrates the On-line Dual Carriageway has significantly more impact on the public and the built environment than the Proposed Scheme Route. The assessment process highlights the difficulties of creating a Dual Carriageway utilising the existing A5 corridor. The issues raised included:

- Significant number of properties demolished
- Length of new A5 Collector Road
- Land-take
- Length of Existing A5 Utilised
- Environmental Impact
- Cost Comparison

7.2 Significant number of properties demolished

Whilst the Proposed Scheme does have an impact on a number of properties, the On-line Dual Carriageway has a significantly greater impact on properties.

The table below shows the comparison of properties demolished between the On-line Dual Carriageway and Proposed Scheme Route.

Table 7-1 Comparison of Properties Demolished

	Residential	Agricultural	Commercial	Community	Totals
Section 1	3 v *30*	1 v *15*	1 v *9*	0 v *1*	5 v *55*
Section 2	2 v *36*	0 v *15*	0 v *4*	0 v *1*	2 v *56*
Section 3	1 v *41*	0 v *23*	0 v *3*	0 v *0*	1 v *67*
Total	**6 v *107***	**1 v *53***	**1 v *16***	**0 v *2***	**8 v *178***

Proposed Scheme Route Figures in **Red.** On-line Dual Carriageway figures in **Blue**. Although the main development areas are bypassed, 178 properties along the existing A5 would be lost with the On-line Dual Carriageway of which 107 are residential properties. This is in comparison with 6 residential properties demolished for the Proposed Scheme.

7.3 Length of new A5 Collector Road

On-line Dual Carriageway would require a significant length, 35km, of A5 Collector Road to be constructed. The table below shows the comparison of lengths of new road construction between the On-line Dual Carriageway and Proposed Scheme Route.

Table 7-2 Length of Road Construction

	Proposed Scheme Route	*On-line Dual Carriageway*
Dual Carriageway	85.0km	*85.0km*
A5 Collector Road	0.0km	*35.0km*
Side Roads	42.5km	*37.5km*
Total	**127.5km**	***157.5km***

Whilst the dual carriageway lengths for both the On-line Dual Carriageway and Proposed Scheme are the same, the additional length of A5 Collector Road means that over 150km of new road construction is required for an On-line Dual Carriageway.

The On-line Dual Carriageway has more road construction than the Proposed Scheme to be constructed. The additional length of road would primarily be used to facilitate access to and from properties and side roads that currently access the existing A5.

7.4 Land-take

A comparative land exercise using pro-rata proportions for the Proposed Scheme applied to the On-line Dual Carriageway indicates that the landtake for both would be of the same order: 1,155 hectares for the Proposed Scheme Route compared to 1,207 hectares for the On-line Dual Carriageway.

It was anticipated before this assessment was carried out that the On-line Dual Carriageway would require less landtake than the Proposed Scheme. However, it can be seem that the landtake is comparable, due to the requirement of additional 70% more local road construction of which 35km would be for an A5 Collector Road. It is anticipated the On-line Dual Carriageway would require approximately 50 hectares more land than the Proposed Scheme.

7.5 Length of Existing A5 Utilised

This assessment reviewed the potential for using the existing A5 corridor for a dual carriageway. When reviewed only 40% of the existing A5 could be used for a dual carriageway. The table below shows the utilisation of the existing A5 corridor for the dual carriageway.

Table 7-3 Existing A5 Utilised for Dual Carriageway

	Length of Existing A5	*Length of Existing A5 Utilised for On-line Dual Carriageway*	*Percentage of Existing A5 Utilised for On-line Dual Carriageway*
Section 1	22,950m	*5,650m*	*25%*
Section 2	29,400m	*11,500m*	*39%*
Section 3	29,650m	*15,350m*	*52%*
Total	**82,000m**	***32,500m***	***40%***

It is concluded that the greater proportion, 60%, of an *on-line* A5 dual carriageway would actually be *off-line* due to the need to avoid adverse significant impacts through settlements and at sensitive locations.

The table below shows the length the On-line Dual Carriageway utilises the Proposed Scheme Route.

Table 7-4 Percentage On-line Dual Carriageway utilising Proposed Scheme Route

	Length of Existing A5 (m)	Utilised Length of Proposed Route for On-line Dual Carriageway (m)	*Percentage of Proposed Route Utilised for On-line Dual Carriageway*
Section 1	23200	*7080*	*30%*
Section 2	31300	*9819*	*31%*
Section 3	30500	*6037*	*18%*
Total	**85000**	***22936***	***26%***

Although the On-line Dual Carriageway has been designed to utilise the existing A5 corridor as much as possible, it uses 26% of the Proposed Scheme Route from New Buildings to Aughnacloy.

7.6 Environmental Impact

The Environmental Impact of the On-line Dual Carriageway and Proposed Scheme Route was compared based on the following criteria;

- Air Quality
- Cultural
- Landscape and Visual
- Ecology & Nature
- Effects on Travellers
- Community and Private Assets
- Water Environment
- Geology & Soils

Table 7-5 identifies the route with least Environmental Impact.

Table 7-5 Identification of Option with least Environmental Impact

	Section 1	Section 2	Section 3
Air Quality	PSR	PSR	PSR
Cultural	PSR	PSR	PSR
Landscape	*On-line*	*On-line*	*On-line*
Visual	*On-line*	*On-line*	*On-line*
Ecology & Nature	Neutral	Neutral	*On-line*
Noise	PSR	PSR	PSR
Effects on Travellers	Neutral	Neutral	Neutral
Community and Private Assets	PSR	PSR	PSR
Water Environment	PSR	PSR	PSR
Geology & Soils	PSR	PSR	PSR

PSR = Proposed Scheme Route; On-line = On-line Dual Carriageway; Neutral – same level of effect/impact for both

In terms of landscape and visual, the On-line Dual Carriageway would have the least impact as it utilises the existing road infrastructure rather than greenfield.

Prior to the assessment being carried out, it could have been perceived that an On-line Dual Carriageway would have the least impact on the environment. However, the Proposed Scheme Route would have the least impact on the, cultural, air quality, noise, community & private assets, water environment and geology & soils.

From the environmental perspective, overall the Proposed Scheme Route has the least impact.

7.7 Drainage Infrastructure

As with the Proposed Scheme Route, there would be a need to provide attenuation and treatment ponds to capture stormwater run-off from the On-line Dual Carriageway and A5 Collector Road. The new drainage infrastructure would also require new outlet pipes, headwalls, culverts and watercourse diversions, which would all require additional land to construct and provide maintenance access.

The existing road drainage infrastructure would be unlikely to be extensively utilised for provision of the On-line Dual Carriageway drainage. This is due to anticipated impact on adjacent utilities, existing culvert characteristics and watercourse diversions associated with infrastructure requirements for the dual carriageway.

The cost in upgrading the existing drainage to current standards, and the provision of the utility diversions would severely impact on the economic benefits of utilising the existing A5 corridor.

7.8 Summary

The detailed On-Line Assessment Report has confirmed the decision reached early in the scheme development process that progression of an on-line dual carriageway improvement of the A5 is not a scheme the Department would wish to take forward, primarily for the following reasons:

- Impact on the environment;
- Impact on cost;
- Requirement for extensive Drainage Works and Utility Diversions
- Difficulties with construction, with greater delays and inconvenience to existing road users; and
- The requirement for the demolition of over 170 properties, of which 107 would be residential.

Appendix A

1. Online Assessment Typical Cross Sections

Appendix B

1. **On-line Assessment Section 1 70m Buffer Zone Drawings**
2. **On-line Assessment Section 2 70m Buffer Zone Drawings**
3. **On-line Assessment Section 3 70m Buffer Zone Drawings**

Appendix C

1. On-line Assessment Section 1 50m Key Plan
2. On-line Assessment Section 1 50m Buffer Zone Drawings
3. On-line Assessment Section 2 50m Key Plan
4. On-line Assessment Section 2 50m Buffer Zone Drawings
5. On-line Assessment Section 3 50m Key Plan
6. On-line Assessment Section 3 50m Buffer Zone Drawings

Appendix D

1. On-line Assessment Section 1 Specimen Design Key Plan
2. On-line Assessment Section 1 Maghermason Specimen Design
3. On-line Assessment Section 1 Ballymagorry 2+1 Specimen Design
4. On-line Assessment Section 2 Specimen Design Key Plan
5. On-line Assessment Section 2 Victoria Bridge Specimen Design
6. On-line Assessment Section 2 Newtownstewart Specimen Design
7. On-line Assessment Section 3 Specimen Design Key Plan
8. On-line Assessment Section 3 Greenmount Road & Garvaghy Specimen Design

Appendix E

1. **On-line Assessment Section 1 Buffer Drawings**
2. **On-line Assessment Section 2 Buffer Drawings**
3. **On-line Assessment Section 3 Buffer Drawings**

Appendix F

1. **On-line Assessment Section 1 Connectivity & Severance Overview Drawings**

2. **On-line Assessment Section 2 Connectivity & Severance Overview Drawings**

3. **On-line Assessment Section 3 Connectivity & Severance Overview Drawings**

Appendix G

1. Environment Landscape Baseline