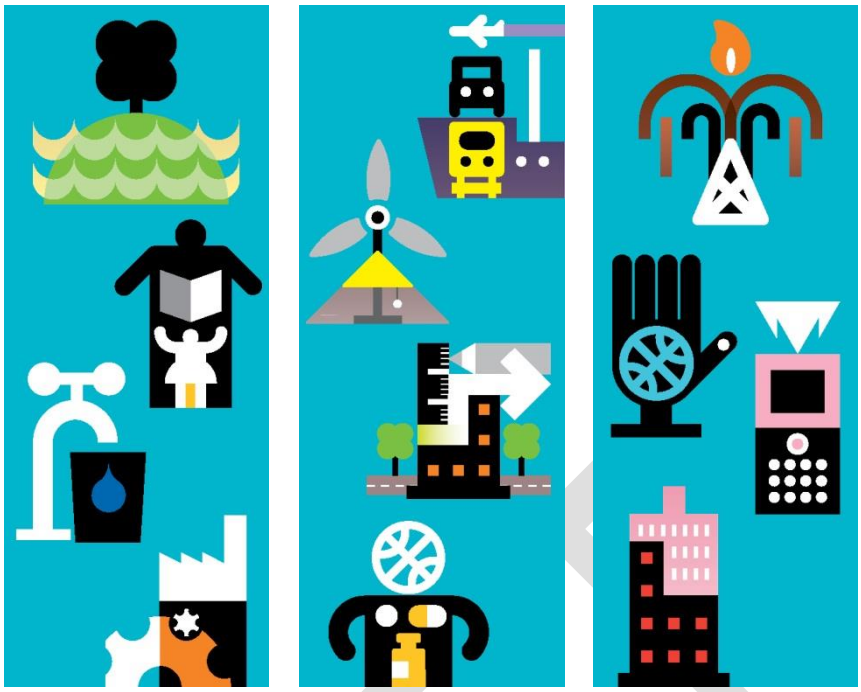

Longwater Link Road

Stage 1 Assessment

October 2015

Norfolk County Council

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Issue and revision record

Revision	Date	Originator	Checker	Approver	Description	Standard
1/A	18-10-2013	Graeme Corden Andrew Howes Mark Gipson Sanmita Palit	Mark Frith	Gerry Kelly	First Draft	
B	30-10-2015	Rob Holl Graeme Corden Mark Gipson	Sam Cliff	Mark Frith	Second Draft	

Contents

1 Introduction

1.1 General

This report has been prepared in response to a brief by Norfolk County Council (NCC)'s Economic Development and Strategy team.

The report provides details of a Stage 1 Assessment carried out in accordance with the Highways Agency standard TD37/93 'Scheme Assessment Reporting' to establish baseline conditions and key constraints associated with the development of a new link road between the A1074 Dereham Road and Ernest Gage Way (the Longwater Link Road), the route of the Link Road would cross through an existing landfill site.

Whilst the scope of a Stage 1 report is to identify the constraints associated with broadly defined improvement strategies, due to the complex design considerations involved in crossing a landfill site this report goes a step further, the report identifies six alternative route options and assesses the impact of those options on the landfill site and the likely landfill remediation works and costs.

The previous issue of this report (produced by Mott MacDonald in October 2013) explored two original options, this issue expands the options further, exploring six route options through the landfill site, the options have been developed in discussion with NCC's landfill team. This report includes assessment of the options provided by NCC's landfill team.

1.2 Structure of the Report

The structure of this report follows guidance given in the Design Manual for Road and Bridges (DMRB) TD 37/93 and incorporates the following chapters:

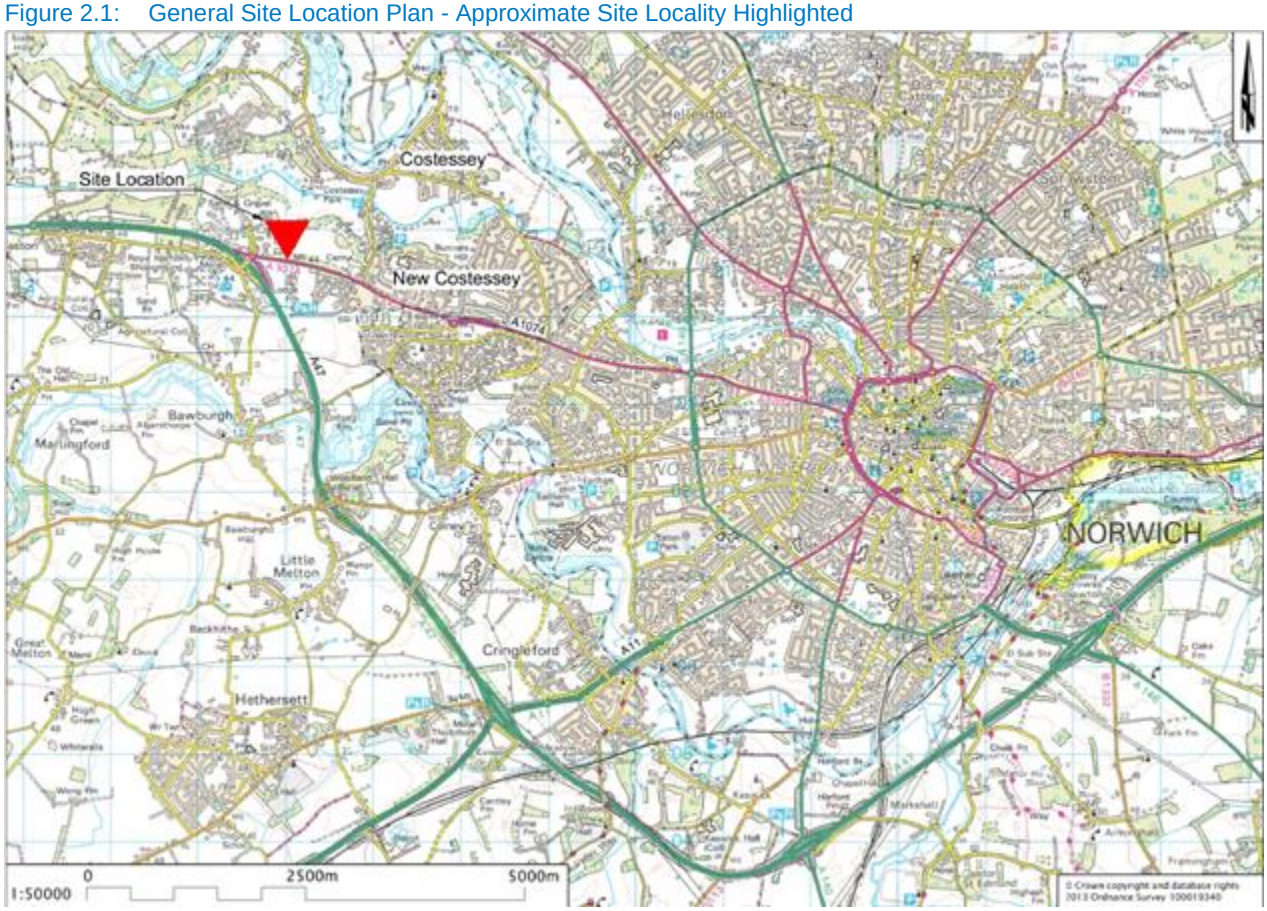
- **Background** – a description of the site's location, an overview of the existing situation on the local highway network and planned development in the Longwater – Easton area;
- **Outline Scheme Design** – a description of existing site constraints and the development of alternative highway alignments, including principal design assumptions, and preliminary scheme cost estimates;
- **Engineering Assessment** – a description of the sources of topographical data and land ownership information. Consideration of geology and geomorphology, focusing on issues associated with areas of historic landfill and the appraisal of alignment options leading to recommendations for further ground investigation, made with reference to a Preliminary Sources Study Report. A description of hydrological issues leading to recommendations on the principles to be followed in drainage design and the results of a C2 search to identify existing public utilities in the area;
- **Environmental Assessment** – a description of an appraisal of baseline environmental conditions and key constraints, leading to preliminary conclusions and consideration of the need for a full Environmental Impact Assessment. Environmental aspects considered are: ecology and nature conservation; landscape and visual impact; cultural heritage; water resources and drainage; geology, soils and contaminated land; air quality; noise and vibration; pedestrians, cyclists, equestrians and community effects; vehicle travellers; and land use.

Traffic and Economic Assessment – a description of existing peak hour traffic conditions and 5 year accident records, leading to forecasts of future traffic demands in 2026. An initial analysis has been made of the impact of a Link Road scheme and its potential economic benefits.

2 Background

2.1 Site Location

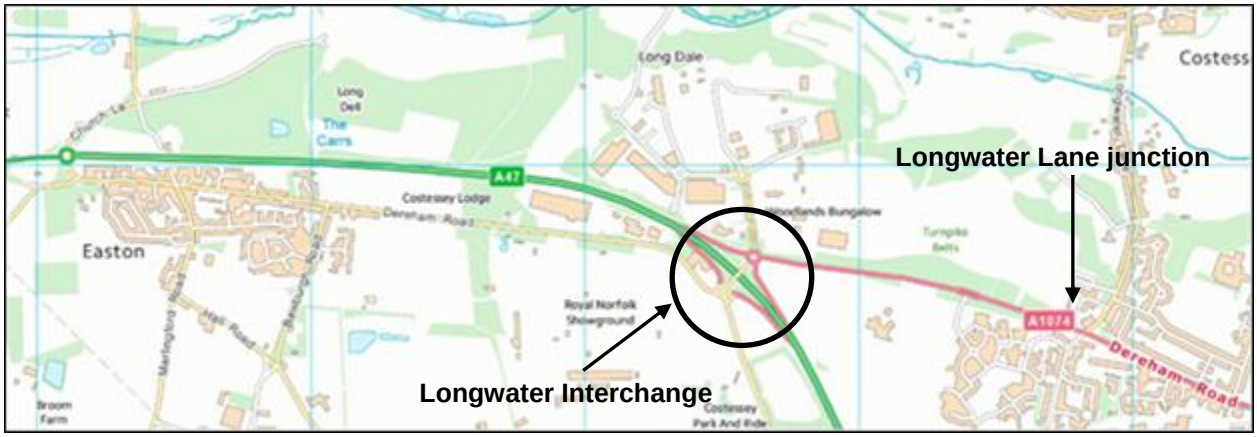
Figure 2.1: General Site Location Plan - Approximate Site Locality Highlighted



Source: Crown copyright and database rights 2013 Ordnance Survey 100019340

Longwater is located on the western fringe of Norwich, close to the suburb of Costessey (**see Figure 2.1**). It is an area where significant development is taking place, driven by access opportunities provided by the A47 Norwich Southern Bypass and its junction with the A1074 Dereham Road (the Longwater Interchange). **Figure 2.2** shows the layout of the area showing clearly the location of Longwater Interchange, which lies to the south of Longwater Employment Area. This report focuses on the proposal for a new link road that aims to help alleviate the congestion that has been generated as a result of the ongoing developments in the Longwater Employment Area. The link road will meet the A1074 Dereham Road between the Longwater Interchange and the Longwater Lane Junction.

Figure 2.2: Study Area



Source: Contains Ordnance Survey data © Crown copyright and database right [2014]

The proposed link road is located just to the east of Longwater Interchange and would provide a new connection northwards from the A1074 Dereham Road to Ernest Gage Way, an estate road serving industrial uses within the Longwater Employment Area, which can be seen on the map in **Figure 2.3**. It is important to note that during the preparation of this report a free flow left turn has been introduced between William Frost Way and the A1074 Dereham Road. The corridor that the proposed Link Road would follow is shown in **Figure 2.4**.

Figure 2.3: Road map of Longwater Employment Area

Source: Crown copyright and database rights 2015 Ordnance Survey 100019340

Figure 2.4: Link Road Corridor

Source: Crown copyright and database rights 2013 Ordnance Survey 100019340

2.2 Existing Situation

The corridor that is proposed for the Link Road passes through an area of brownfield land at the east end of Longwater Employment Area, a significant proportion of which is being used as landfill. The Link Road would provide an alternative route to William Frost Way, see **Figure 2.3**, which is currently the only access route into the Employment Area, in the form of a single carriageway. The main route through the Employment Area in turn provides a single point of access to Queens Hills, a large residential area to the north of the River Tud.

Longwater Interchange is a 'dumbell' grade-separated roundabout with a single overbridge crossing the A47 trunk road. The northern roundabout connects with the A1074 Dereham Road and William Frost Way, whilst the southern roundabout provides access to the villages of Easton and Bawburgh, as well as the Norfolk Showground.

The A47 provides a strategic east-west link through the heart of Norfolk, whilst the A1074 Dereham Road is a key radial route connecting western suburbs of Norwich with the City Centre. Around half a mile to the east of the proposed Link Road, there is a signalised junction on the A1074 Dereham Road, providing access to both the first phase of the Lodge Farm residential development and Costessey village centre along Longwater Lane.

At peak times the local network suffers from traffic congestion (described in detail in **Section 6**) and there are particular issues for vehicles approaching Longwater Interchange on William Frost Way, a particular issue as it is a major ambulance route. The aim of a new Link Road would be to provide relief to William Frost Way by providing a second access and egress to Longwater Employment Area.

2.3 Planned Development and Transport Strategy

Development plans within the Longwater – Easton area are outlined within the Joint Core Strategy (JCS) a long-term vision for the Greater Norwich area depicting work up to the year 2026. It identifies broad locations for new housing and employment growth. The JCS forms part of South Norfolk Council's Local Development Framework (LDF) which, within the Longwater – Easton area, incorporates some significant proposals including,

- completion of Queens Hills – 759 residential units,
- completion of Lodge Farm 1 – 121 residential units,
- 900 residential units to the south and east of Easton,
- 500 residential units at Lodge Farm 2 (currently under construction),
- 18 hectares of B1/B2/B8 uses in Longwater employment area, and
- a Norfolk Food Hub to the west of Easton.

Longwater Interchange has been identified as a major junction in the Greater Norwich area where the JCS will generate a significantly increased traffic demand. A separate study is underway with the aim of developing a Transport Strategy which will accommodate planned development in the Longwater – Easton area and address existing congestion. The proposed Longwater Link Road is one of a number of infrastructure improvement options being considered within this overall Strategy.

3 Description of Alternative Schemes

3.1 Highway Alignment and Cross-section

3.1.1 General

The corridor within which alternative outline designs for the proposed Link Road have been developed, shown in **Figure 2.4**, was subject to a site inspection on 17th June 2015. The area of interest and surrounding highways network are shown in more detail in **Figure 2.3** and **Drawing MMD-326109-C-DR-00-XX-0001** in **Appendix A.**

The site visit confirmed a number of features, including:

- an access from the northern arm of Ernest Gage Way which serves a scrapyard operated by European Metal Recycling Group (EMR), a Norfolk Cement compound and provides access to a footpath running along the northern boundary of the EMR scrapyard (see **Figures 3.1** and **3.2**),
- a Materials Recycling Facility operated by the Waste Recycling Group (WRG), served from the northern arm of Ernest Gage Way,
- the southern arm of Ernest Gage Way serves a Materials Recycling Facility operated by Norfolk Environmental Waste Services Ltd (NEWS), and
- the southern arm of Ernest Gage Way also provides access to the Costessey Landfill Site and Extension
- a tree belt to the north of A1074 Dereham Road (**see Figure 3.3**).

Figure 3.1: Ernest Gage Avenue and the access to EMR and Norfolk Cement

Source: Mott MacDonald

Figure 3.2: Costessey Landfill Site looking west towards the footpath running next to the EMR scrapyard

Source: Mott MacDonald

Figure 3.3: Costessey Landfill Site looking south towards the tree belt north of the A1074 Dereham Road

Source: Mott MacDonald

Information on existing ground levels within Costessey Landfill Site is based on a topographical survey produced by PRS Surveys Ltd in June 2012, whilst Ordnance Survey data and existing topographical survey information has been used to predict the road surface levels for A1047 Dereham Road and Ernest Gage Avenue. Other ground levels between the roads and Costessey Landfill Site are based on assumptions only. It should be noted that Phase 3 of the Costessey Landfill (Area shown in **Figure 3.3** above) has experienced higher than expected settlement, and so the topographical survey data from 2012 may have changed somewhat.

3.1.2 Route Options

Following discussion with NCC's landfill team six route options have been developed for the link road between Ernest Gage Avenue and A1074 Dereham Road. These routes are described in detail below and their preliminary layouts and vertical profiles may be found in **Appendix A**. The form of the proposed Link Road would be a 7.3m wide single carriageway subject to a 30mph speed limit.

3.1.2.1 Chosen Route Options

Norfolk County Council's (NCC) landfill team suggested three potential routes through or adjacent to the landfill, these routes were labelled Orange, Green and Blue routes. The routes were chosen with the aim of minimising the impact of a new link road on the existing landfill site. These three options were then developed into highway alignments, where possible the alignments follow the highway design parameters in section 3.1.3 below. The final route options included in this report comprise of the three main alignment routes Orange, Green and Blue, each with two options (e.g. Green Route Option 1 and Green Route Option 2).

3.1.2.2 Junction Design

The layout and form of junction where the link road meets the A1074 Dereham Road would be determined by traffic modelling in a Stage 2 Scheme Assessment Report. A crossing point for pedestrians would be provided at this junction, but the exact nature of any crossing would be dependent on the junction layout. The three main alignment routes join the A1074 Dereham Road at different locations due to the horizontal alignment though the landfill, section 6.3 provides an initial assessment on each junction location.

3.1.2.3 Comments from NCC's Landfill Team

Comments have been provided by NCC's Landfill Manager on each of the route options, the comments assess the impact of the route options on the individual phases of the landfill. The landfill phases are shown in the key of each of the associated route drawings in **Appendix A.**

3.1.3 Highway Design Parameters and assumptions

For a 30 mph single carriageway road the appropriate design speed is 60 kph as specified in the Design Manual for Road and Bridges (DMRB) TD9/93 table 2. TD9/93 table 3 of the DMRB specifies the following design parameters in accordance with a design speed of 60 kph:

Stopping sight distance

- Desirable minimum stopping sight distance (SSD) 90m;
- Desirable minimum SSD of 90m.

Horizontal Curvature

- Desirable minimum radius being 255m with 5% superelevation.

Vertical Curvature

- Desirable minimum crest K value 17.
- Sag curves absolute minimum K value 13.
- Desirable maximum gradient 6% (TD9/93 paragraph 4.1).

The vertical profile is based on limited topographical data and assumptions, a full survey would be required to confirm this alignment.

3.1.4 Scheme Option – Orange Route (Option 1)

A preliminary layout and vertical profile for Orange Route Option 1 is shown on **Drawings MMD-326109-C-DR-00-XX-1010 and 1011** in **Appendix A**.

The route forms a single carriageway running east from the northern arm of Ernest Gage Avenue, from a point near the access to the EMR scrapyard and Norfolk Cement, the route then turns in a south easterly direction towards NEWS Material Recycling Facility before turning south eastwards across the Costessey Landfill Site and then heading southwards to join the A1074 Dereham Road at a new junction.

3.1.4.1 Horizontal Alignment

For a highway with a design speed of 60kph (30mph), the desirable minimum radius of the horizontal alignment is 255m, with a 5% super-elevation, the proposed route meets this criteria. The proposed alignment aims to avoid acute existing level differences in the southeast of the Costessey Landfill Site. The alignment also avoids leachate sites and dewatering wells on the northwest corner.

The proposed alignment forms a junction with the A1074 Dereham Road about 100m to the east of the new Lodge Farm Phase 2 junction and 500m east of the existing Longwater roundabout.

3.1.4.2 Vertical Alignment

The proposed vertical profile meets the requirement for the minimum K values for a design speed of 60kph, with a low point at chainage 226m and gradients ranging from 0.53% to 4.5%. Details are shown on **Drawing MMD-326109-C-DR-00-XX-1011** in **Appendix A**.

3.1.4.3 Comments on impacts of Orange Route Option 1 from NCC Landfill Manager

Layout:

- The existing access to phase 3 can be maintained but new access is required to the rest of the site.
- A new site haul road will be necessary for phases 1A&B, 2A&B and dilute and disperse (D&D).
- The main compound can remain in place.
- Impact on contours of the site and its layout.
- Landfill site is split.

Waste Removal:

- Waste would need to be removed from the sidewalls of phases 1A&B, 2A&B and 3 and could be re-deposited in phase 3 and used for re-profiling.
- Excavated waste could be used to re-profile phases 1A&B, 2A&B and 3 to create a green bund. Alternatively only phase 3 could be re-profiled whilst phases 1A&B, 2A&B and D&D are mined freeing this land up for regeneration.
- Quality of inert soils in blue D&D area unknown – suitability risk.

Engineering:

- New liner and cap details required along south western boundary of Phases 2A&B and north eastern edge of Phase 3. These details would be in the Closed Landfill team's experience.

Site Security:

- A new fence line would be required on both sides of the new road.
- Visual barriers would be needed (e.g. high wooden fence) between the road and the compound as well as the gas compound for safety reasons
- As the road would isolate phases 1A&B, 2A&B and the D&D it could have an impact on site security with an increase in trespassing.

Leachate Infrastructure:
- Infrastructure for phases 1A&B, 2A&B and the D&D would need to cross the new road.
- Phase 3's connection to the current leachate tank can remain.

Gas Infrastructure:
- Gas compound can stay in current location.
- Gas monitoring points may have to be moved in the South and the West.
- Risk of explosive atmosphere on services along road need to be considered.

Drainage Systems:
- Soakaway in the compound would stay and take water from phase 3 as previously, but phases 1A&B and 2A&B will partly require a new drainage system. This would need to pass under the road in order to discharge into the existing soakaway.
- Foul water tank would be unaffected.

Other Services:
- Electricity cables to phases 1A&B, 2A&B and the D&D need to be ducked under the new road.
- Access to site for electricity, water and BT stays as they are.

Other Impacts:
- No impact on NEWS Waste Transfer Station.
- Would require Environmental Permit variation.
- There may be an impact on one groundwater monitoring points.

3.1.5 Scheme Option – Orange Route (Option 2)

A preliminary layout and vertical profile for Orange Route Option 2 is shown on **Drawings MMD-326109-C-DR-00-XX-1012 and 1013** in **Appendix A**. Option 2 follows a similar route through the centre of the Landfill site as Option 1, but the initial segment of the route follows Ernest Gage Way for an increased distance meaning that Norfolk Cement is mainly undisturbed and the route takes up less of the EMR scrapyard premises. The route has a number of increased radii curves and therefore reaches further east within the landfill site, the route does not pass as closely to the corner of the NEWS material recycling facility. The route continues to sweep southwards across the Costessey Landfill Site and joins the A1074 Dereham Road at a new junction.

3.1.5.1 Horizontal Alignment

As for Option 1 the route uses a number of curves with radii no less than 255m. The initial curve starting on Ernest Gage Avenue has a considerably larger radius in option 2 than option 1, 720m in comparison to 255m.

The proposed alignment forms a junction with the A1074 Dereham Road about 80m to the east of the new Lodge Farm phase 2 junction and 500m east of the existing Longwater roundabout.

3.1.5.2 Vertical Alignment

The proposed vertical profile for the carriageway incorporates gradients ranging from 0.53% to 4.29%, with a low point at chainage 228m and is shown on **Drawing MMD-326109-C-DR-00-XX-1013**.

3.1.5.3 Comments on impacts of Orange Route (Option 2) from NCC Landfill Manager

Layout:

- As it runs above the base, deep excavation is necessary and a new sidewall/bund would need to be installed.
- The remaining phases 1A&B and 2A&B would be very small.

Waste Removal:

- More than half of the waste in Phases 1A&B and 2A&B would need to be moved – this would be an estimated 300,000 to 400,000 m^3 of waste. This raises the question should all of the waste in Phases 1A&B and 2A&B be removed? There is not the scope on site to redeposit this quantity of waste, therefore full treatment or offsite removal would be required.

Engineering:

- Significant re-engineering of phase 1&2 is required or complete mining of entire phase.

Orange Option 1 is preferable to Orange Option 2 and therefore no further considerations have been assessed for this route.

3.1.6 Scheme Option – Green Route (Option 1)

A preliminary layout and vertical profile for Green Route Option 1 is shown on **Drawings MMD-326109-C-DR-00-XX-1020 and 1021** in **Appendix A**. The green route forms a single carriageway running eastward from the northern arm of Ernest Gage Avenue, from a point near the access to the EMR scrapyard and Norfolk Cement the route turns eastwards towards a proposed roundabout located on the northeast corner of the old scrap yard. The roundabout has been introduced to facilitate a change in direction which would otherwise be a departure/relaxation from standard. The roundabout will also potentially serve existing/new land uses to the east of the Link Road. From the roundabout the alignment heads in a south easterly direction and cuts the corner of the existing NEWS facility, this will require moving the weighbridge and realigning the existing infrastructure on the NEWS site. From this point the route runs along the western edge of the Costessey Landfill Site, adjacent to the NEWS site, continuing to join the A1074 Dereham Road at a new junction.

3.1.6.1 Horizontal Alignment

The western and southern arms of the new roundabout both use a straight section and a curve with a radius of 360m, therefore they meet the standards stated in the DMRB.

A roundabout with an Inscribed Circle Diameter (ICD) of 40m is proposed on the north east corner of the existing scrap yard. The ICD, number of entry lanes (single lane entry or multilane entries) and entry width are the key determinants of a roundabout's capacity and would need to be assessed with further traffic modelling in later design stages.

The proposed alignment forms a junction with the A1074 Dereham Road about 90m to the west of the new Lodge Farm phase 2 junction and 330m east of the existing Longwater roundabout.

3.1.6.2 Vertical Alignment

The proposed vertical profile for the carriageway, incorporates gradients ranging from 0.77% to 3.55%, and is shown on **Drawing MMD-326109-C-DR-00-XX-1021** in **Appendix A**. The roundabout is sited at the lowest point on the proposed Link Road.

3.1.6.3 Comment on impact of Green Route (Option 1) from NCC Landfill Manager

Layout:

- A new entrance to the landfill site and new haul roads to the main and gas compounds are required.

- The main compound does not need to be relocated.
- Minimal impact on overall layout and contours.

Waste Removal:
- Waste needs to be excavated from the sidewall of phases 1A&B, 2A&B and 3.
- Excavated waste could be used to re-profile Phase 3.
- Route does not inhibit the opportunity of mining the whole site.

Engineering:
- New liner and cap details required on south western corner of phases 2A&B and western edge of phase 3. These details would be within the Closed Landfill team's experience.

Site Security:
- Existing fence line in the West of the site needs to be moved.
- Visual barriers are required between the main compound and the road and between the road and NEWS for safety reasons.

Leachate Infrastructure:
- Existing leachate infrastructure will be unchanged.

Gas Infrastructure:
- Existing gas infrastructure will be unchanged.
- Gas compound can stay where it is.
- Gas monitoring points in the West of the site will need to be relocated.

Drainage Systems:
- Drainage systems as they are with exception of the western edge of phase 3. This will change as part of re-engineering the liner/cap detail.
- Foul water tank can stay as existing.

Other Services:
- Entrance point for water, electricity and BT need to be relocated so they enter under the new road.

Other Impacts:
- Would require Environmental Permit variation.
- Litter picking on the new road needs to be considered.
- Would require changes to NEWS' MRF operation at the entrance (road, drainage and car park) and weighbridge – probably a positive.
- Groundwater monitoring points may need to be moved.

3.1.7 Scheme Option – Green Route (Option 2)

A preliminary layout and vertical profile for Green Route Option 2 is shown on **Drawings MMD-326109-C-DR-00-XX-1022 and 1023** in **Appendix A**. Similarly to Green Route Option 1 this route heads east from the northern arm of Ernest Gage Way and runs through the EMR scrapyard site. However, this route does not make use of a roundabout, instead the road continues undisturbed and heads southwards using a number of radii, including one that is a relaxation below the desirable minimum value. The NEWS material recycling site is affected in the same way as for Option 1.

3.1.7.1 Horizontal Alignment

As mentioned the roundabout has been replaced with a continuous road. This road uses two desirable minimum curve radii of 255m, but it also uses a section with a radius of 90m for a length of 52.04m. This 90m radius is a relaxation of 3 steps below the desirable minimum radius with superelevation of 5% and therefore must use a superelevation of 7%.

The proposed alignment forms a junction with the A1074 Dereham Road about 90m to the west of the new Lodge Farm phase 2 junction and 330m east of the existing Longwater roundabout.

3.1.7.2 Vertical Alignment

The proposed vertical profile for the carriageway, incorporates gradients ranging from 0.93% to 3.24%, with a low point at chainage 214m and is shown on **Drawing MMD-326109-C-DR-00-XX-1023** in **Appendix A**.

3.1.7.3 Comment on impact of Green Route (Option 2) from NCC Landfill Manager

The same comments were made as above for Green Route (Option 1).

It was concluded that whilst option 1 had a larger impact on phases 1A&B and 2A&B but a smaller impact on phase 3, option 2 had a smaller impact on phases 1A&B and 2A&B but a larger impact on phase 3. Therefore both options were considered to have a similar overall impact on the landfill site.

3.1.8 Scheme Option– Blue Route (Option 1)

A preliminary layout and vertical profile for Blue Route Option 1 is shown on **Drawings MMD-326109-C-DR-00-XX-1030 and 1031** in **Appendix A**. The blue route forms a single carriageway running eastward from the northern arm of Ernest Gage Avenue, from a point near the access to the EMR scrapyard and Norfolk Cement. It continues to head eastwards as it enters the Costessey Landfill Site along the southern boundary of the adjacent golf course. The alignment then turns south eastwards in close proximity to the existing soakaway where it heads across the landfill site to join the A1074 Dereham Road at a new junction.

3.1.8.1 Horizontal Alignment

The alignment uses curves with radii greater than 255m. The curve that runs along the north of the site uses a radius of 720m for a length of 330m which allows the route to bypass the majority of landfill phases 1&2.

The route forms a junction with the A1074 Dereham Road about 170m east of the Lodge Farm Phase 2 junction and 600m east of the existing Longwater roundabout.

3.1.8.2 Vertical Alignment

The proposed vertical geometry incorporates gradients ranging from 0.50% to 3.75%, with a low point at chainage 474.1m. This is shown on **Drawing MMD-326109-D-DR-00-XX-1031** in **Appendix A**.

3.1.8.3 Comment on impact of Blue Route (Option 1) from NCC Landfill Manager

Layout:

- Main compound can stay where it is.
- Existing site entrance can remain but a new entrance to split D&D area would be required or remaining waste removed.
- Option of carrying out landfill mining or place excavated waste in phases 1A&B, 2A&B and 3.

- Major change in contours.
- Landfill site may be split.

Waste Removal:
- Excavated waste could go into phases 1A&B, 2A&B and 3.
- Option of landfill mining of part of the D&D area.

Engineering:
- Would require a carefully designed solution along northern boundary of phase 1A&B.
- Uncertainty of ground conditions outside of lined cell phase 1A&B on the northern boundary.

Site Security:
- North fence line needs to be relocated and a new fence line in the East is required on both sides of the road.
- There could be a greater safety issue with trespassing in the D&D area.

Leachate Infrastructure:
- Leachate management system can stay as it is.

Gas Infrastructure:
- Gas compound can stay where it is.
- Gas management infrastructure from the split D&D area needs to go under the new road, in order to connect with the gas compound.
- Gas monitoring points on the northern side would need to be relocated and may require access of the other side of the road.
- Gas monitoring points would need to be moved.

Drainage Systems:
- Foul water tank can remain as it is.
- Soakaway lagoon in the North remains as it is. It could have a connection to the cut off D&D area.
- French drain in the north of the site as part of the surface water management system needs to be relocated. The water could go under the road into the existing Soakaway lagoon.

Other Services:
- Entrance points for water, electricity and BT can all stay as existing.

Other Impacts:
- Would require Environmental Permit variation.
- Groundwater boreholes on the northern side would need to be relocated and may require access of the other side of the road.
- No impact on the NEWS Waste Transfer Station.
- Impact on golf course.

3.1.9 Scheme Option – Blue Route – (Option 2)

A preliminary layout and vertical profile for Blue Route Option 2 is shown on **Drawings MMD-326109-D-DR-00-XX-1032 and 1033** in **Appendix A**. The route is very similar to Blue Route Option 1 with the exception of where the route heads south to meet the A1074 Dereham Road. The route does not head southwards until it meets the existing soakaway.

3.1.9.1 Horizontal Alignment

The initial alignment is very similar to Blue Route Option 1 but differs by heading southwards closer to the existing soakaway. This route uses a minimum curve radius of 207.197m which is less than the 255m desirable minimum radius. This reduced radius is a relaxation of one step below desirable minimum and requires a superelevation of 7%.

As for Blue Route Option 1 the route forms a junction with the A1074 Dereham Road about 170m east of the Lodge Farm Phase 2 junction and 600m east of the existing Longwater roundabout.

3.1.9.2 Vertical Alignment

The proposed vertical geometry incorporates gradients ranging from 0.56% to 2.73%, with a low point at chainage 474.1m. This is shown on **Drawing MMD-326109-D-DR-00-XX-1033** in **Appendix A**.

3.1.9.3 Comment on impact of Blue Route (Option 2) from NCC Landfill Manager

The same comments were made as above for Blue Route (Option 1) with the exception of the drainage.

Drainage:

- Foul water tank can remain as it is.
- Soakaway lagoon in the North would be removed so a new location must be found.
- French drain in the north of the site as part of the surface water management system needs to be relocated. The water could go under the road into the new Soakaway lagoon.

It was concluded that option 2 is the preferred option as it has a smaller impact on phases 1A&B and 2A&B in comparison to option 1.

3.1.10 Highway Cross-Section

For all six of the route options the proposed corridor would be a minimum of 12.3m wide. The cross-section would comprise a 7.3m carriageway, 3.0m shared use cycleway/footway on one side and a 1.0m wide verge on either side. In general the carriageway will have a central camber with a 2.5% crossfall towards each kerb, furthermore the shared use facility will also have a 2.5% crossfall but towards the road. However, where appropriate due to horizontal curvature, the carriageway would be super-elevated. The typical cross-section is shown on **Drawing MMD-326109-C-DR-00-XX-1008** in **Appendix A**.

For the proposed new roundabout, forming part of Green Route option 1, a crown line would be provided on the circulatory carriageway with a ratio of 2:1 (internal to external) to assist drainage.

3.1.10.1 Provision for Pedestrians/Cyclists

An existing footpath runs along the northern boundary of the EMR scrapyard, at a level which is approximately 3.0m lower than Ernest Gage Avenue. This results in a steep vegetated slope on the north side of the footpath, shown in **Figure 3.4**.

There is an existing shared use cycleway/footway along the north side of A1074 Dereham Road and it is proposed that a 3.0m wide shared use facility should be provided along a single side of the new Link Road. The facility would tie into the footway along the A1074, linking the adjacent track near the entrance to the Costessey Landfill Site. With the exception of the Green Route Option 1, the shared use facility is located on the eastern side of the carriageway as this is deemed to fit best with predicted cycle movements. Green route Option 1 shows an option to use the shared use facility as a break between the proposed carriageway and the adjacent NEWS internal road.

Figure 3.4: Footpath on the northern boundary of the EMR scrapyard

Source: Mott MacDonald

3.1.10.2 Further Considerations

Green Route (Option 1) would require additional amenities so pedestrians and cyclists can be safely routed around the roundabout. An uncontrolled pedestrian crossing has been proposed on the west arm of the roundabout, providing a link to the existing footway along Ernest Gage Avenue. A footway could be provided around the north side of the roundabout and continue eastwards towards a potential development area.

3.2 Highway Drainage Principles

Highway drainage along the proposed Link Road would be formed by a positive system of kerbs and gullies. A drainage survey has not been carried out at this stage but would be required, potentially with soakaway tests as part of a wider ground investigation, in order to carry out a detailed drainage design.

There is a combined drainage system with gullies along both sides of the Ernest Gage Avenue. Drainage at the north end of the Link Road could tie into the existing combined system.

At its junction with the A1074 Dereham Road, existing drainage system remains as free surface flow to the southern verge of the road.

3.3 Pavement Design

For all six route options the pavement design would be confirmed with the results of further ground investigation and any proposals for landfill remediation works. It is not recommended to place any new road across an existing landfill (without remediation works) as substantial, disparate, subsidence of the carriageway is highly likely.

3.4 Preliminary Cost Estimates

3.4.1 Three Preferred Cost Estimates

The feedback received from NCC Landfill Team on the route options and their potential impact on the landfill indicated a preferred option for the Orange and Blue Routes. Option 1 was preferred for the Orange Route and Option 2 was preferred for the Blue Route. For the Green Route the impact on the landfill varied slightly for each option but neither was considered to have a high impact, therefore the worst case scenario 'Green Route Merged' has been priced. Cost estimates for the three preferred options and can be found in **Table 3.1**.

Table 3.1: Preliminary Cost Estimates

Costs	Value	Orange Route Option 1 £	Green Route Merged £	Blue Route Option 2 £
Highway Construction				
At-grade roundabout on single carriageway	£615,000/unit	-	615,000	-
Single carriageway all-purpose road	£2,360/m	2,022,120	1,756,440	2,806,860
Cycleway	£162/m	133,460	115,925	185,253
Lighting to estate roads	£2500/unit	70,000	60,000	95,000
Traffic signals and new staggered junction at A1074	£250,000/unit	250,000	250,000	250,000
Utility diversions	£300,000/unit	300,000	300,000	300,000
Total Highway Construction	-	2,775,580	3,097,365	3,637,113
Landfill Construction				
Landfill Works	-	9,417,682	2,615,530	54,560,629
Land Costs	-	No Land costs have been included for the routes		
Changes to NEWS entrance (road, drainage, car park) and weighbridge	£250,000/unit	-	£250,000	-
Sub Total (Highway & Landfill)	-	12,193,262	5,962,895	58,197,742
Development and Supervision costs (10%)	10%	1,219,326	596,290	5,819,774
Total costs	-	13,412,588	6,559,185	64,017,516
Optimism Bias – Stage 1 (TAG 3.5.6) (44%)	44%	5,901,539	2,886,041	28,167,707
Grand total	-	19,314,127	9,445,226	92,185,223

Source: Mott MacDonald/NCC

Notes:

1. Costs for landfill remediation works received from NCC are based on the following assumptions:

- Depending on quantities, excavated waste is costed as either being redeposited on site or disposed of off-site at another landfill (using Blackborough End pricing). It has been assumed that this will attract landfill tax.
- Assumptions on approval by the Environment Agency (EA) for engineering solutions of containment systems have been made using the team's experience. However there is no guarantee that the EA will agree to these.
- No costs for gas and leachate control have been estimated at this stage.
- Fill material beneath the road is priced in accordance with Highways Specification to formation level or to existing level, depending on which is lower.

2. Remaining costs calculated by Mott MacDonald are based on the following assumptions:
    - Works for new single carriageway, single carriageway at-grade roundabout and cycleway are based on Franklin & Andrews 2010 pricings. A rate of inflation from 2010 to 2015 of 23% has been applied to these rates.
    - Lighting to estate roads is provided by Mott MacDonald lighting team based on previous experience.
    - Drainage, signage, fencing and earthworks are included within the single carriageway rate.
    - A nominal figure has been provided for the traffic signals and new staggered junction at A1074.
    - An indicative figure has been provided at this stage for the utility diversions.
    - A nominal figure has been provided for changes to NEWS entrance (road, drainage, car park) and weighbridge for the Green Route Merged.
    - No land costs have been included in the estimates.

3.4.2 Potential Cost Saving

During the assessment carried out by NCC's Landfill team, it was identified that the Green Route would have the smallest impact on the landfill site. It was also identified that the cost of this route could potentially be reduced with minor amendments to the road design, either by re-aligning the link road, reducing the width or removing the shared use facility.

By removing the shared use facility along the southern arm of the roundabout the impacts on landfill phase 3 would be considerably reduced and in turn reduces the associated costs. Based on the cost estimates in **Table 3.1** NCC's Landfill team have identified a potential cost saving in the region of £635k to the Merged Green Route if this modification was made. Furthermore if the road alignment was moved westwards of landfill phases 1 and 2 another significant saving on cost and time could potentially be made. These recommendations should be taken forward to subsequent assessment stages.

4 Engineering Assessment

4.1 Topography and Land Use

The engineering assessment has made reference to the following topographical information:

- Ordnance Survey, Landranger Map 133, North East Norfolk, Cromer & Wroxham, 1:50,000, 2004; and
- Full site topographical survey – updated June 2012, Costessey Landfill Site, PRS Surveys Ltd.

Land ownership within the area of interest is shown in **Drawing MMD-326109-C-DR-00-XX-0003** in **Appendix A**. Key features and requirements can be summarised as follows:

- About 1.6 hectare area of land, immediately to the east of the EMR scrapyard is in the ownership of NCC;
- The Costessey Landfill Site in the ownership of Tud Developments Ltd and NCC;
- NEWS Material Recycling Facility, the Green route would require changes to NEWS' MRF operation at the entrance (road, drainage and car park) and weighbridge;
- L J Technical Systems Ltd own land to the north of the study area (Costessey Park Golf Club) which will not be affected by the proposals;
- Access may be required to the EMR scrapyard (within the ownership of Thomson Bros. Inc.) for slope stabilisation work.
- The ownership of the eastern portion of Ernest Gage Avenue is unknown at present. An area of land in the vicinity of the access to EMR and Norfolk Cement would be required for realignment of kerbs and visibility improvements.

Legal services should be consulted at an early stage in development of the scheme to maximise the opportunity for agreements to be reached with landowners in respect of land purchase and any necessary accommodation works.

4.2 Geology and Geomorphology

Information on geology and geomorphology has been obtained from the following sources:

- England and Wales Sheet 161 Norwich, Solid and Drift Edition, 1:50,000, BGS, 2007[2];
- Geology of the country around Norwich, Memoir for 1:50,000 geological sheet 161 (England and Wales), 1989 [3];
- British Geological Survey, Geology of Britain viewer, http://mapapps.bgs.ac.uk/geologyofbritain/home.html[4];
- British Geological Survey, Borehole Scans Database, http://www.bgs.ac.uk/data/boreholescans/home.html[5];
- British Geological Survey, The BGS Lexicon of Names Rock Units, http://www.bgs.ac.uk/lexicon/ [6]; and,
- NCC Mapping Browser, http://nmb.norfolk.gov.uk/[7].

4.2.1 Anticipated Superficial Deposits

4.2.1.1 Topsoil

Topsoil was only encountered in two of the historical boreholes present, these were located on the northern edge of the Costessey Landfill Site. The topsoil is described as black sandy topsoil with occasional flint cobbles and was recorded as being 0.4m and 1.1m thick. Whilst a thickness of 0.4m is reasonable, a thickness of 1.1m suggests some form of earthworks had been undertaken. Due to the age of the exploratory hole records and the activities undertaken on site it could be that these observations are now obsolete.

4.2.1.2 Artificial Ground/Made Ground

Made Ground is known to exist on site due to the presence of the landfill site and the potentially backfilled gravel pits and ponds recorded to the immediate north and west of the proposed sites. However, despite knowing general information about the site little site specific data is currently available regarding the exact nature and makeup of the potential Made Ground present on site.

Historical boreholes logs record Artificial Ground as present to the north and west of site. Granular Made Ground was encountered in three exploratory holes to the immediate north and northwest of the landfill site, with a typical thickness ranging from 0.2m to 0.4m thick. It is described as brown, silty, fine sand with some fine-coarse gravel sized, flint, chalk, brick and chipboard. A thicker layer or pocket of Made Ground approximately 2.1m thick was encountered in one exploratory hole located close to the eastern boundary of the scrapyard. Due to the age of the exploratory hole records and the activities undertaken on site it could be that these observations are now obsolete.

4.2.1.3 Historic Landfill

Two aborted boreholes located immediately to the northwest of the site, record that waste was encountered at 2.7m and 1.5m below ground level respectively. No descriptions of the waste were provided in the logs. These boreholes were constructed before the landfill site therefore the waste encountered could be from another older historical landfill or waste pit. Due to the age of the exploratory hole records and the activities undertaken on site it could be that these observations are now obsolete.

Information provided by NCC identifies that different basal lining materials and waste capping materials have been used during different phases of the Costessey Landfill Site. Artificial materials involved are Bender Element System (BES) liner, Linear Low Density Polyethylene (LLDPE), High Density Polyethylene (HDPE) geomembrane, Geosynthetic Clay Liners (GCL), leachate drainage blanket and some other protective layers. Detail information about the locations of such materials can be found in the report, Costessey Landfill Site Closure Plan[8], produced by the NCC. However the exact nature and composition of the landfill site and the material itself remains unknown.

4.2.1.4 Glacial Deposits

Glacial Sand and Gravel is identified on the geological map as being present on site is attributed to the Happisburgh Glaciogenic Formation and Lowestoft Formation (Undifferentiated) – Sand and Gravel. All exploratory hole logs consulted identified the presence of Glacial Sand and Gravel and Glacial Till beneath the site. Most records indicated that Glacial Till is sandwiched between two layer of Glacial Sand and Gravel however, the glacial deposits are likely to be more complex than this forming a series of interfingered laterally discontinuous bands and lenses. The three main constituents are summarised below:

Upper Glacial Sands and Gravels

The Upper Glacial Sand and Gravel were recorded in a number of boreholes. It is typically described as (orangey) brown, silty fine (to medium) sand with some fine to medium flint and quartzite (chalk) gravel. Its thickness ranges from 0.4m to 12.8m.

Glacial Till

Seven boreholes record the presence of Glacial Till. It is generally described as a firm to very stiff, brown/brownish grey, slightly sandy, silty clay with some fine to medium chalk and flint gravel. In the deeper boreholes the unit was recorded as sandwiched by layers of Glacial Sand and Gravel with a thickness ranging from 1.6m to 4.7m. The thickness of the unit for the other shallower boreholes were not proven but was recorded as being greater than 2m.

Lower Glacial Sands and Gravels

The Glacial Sand and Gravel was recorded overlying the Chalk in the deeper borehole records. The unit is described as orangey brown, very clayey, silty (medium) sand with much fine to coarse flint gravel or orangey fine to coarse flint gravel with some clayey silty medium to coarse sand and soft to firm, very sandy, silty clay. Occasional flint cobbles were also encountered. Its thickness ranges from 2.2m to 4m.

4.2.2 Solid Geology

The Upper Chalk was only encountered in five boreholes. The top of formation was encountered at depths between 12.4m to 26.82m below ground level. The thickness of the unit was not proven but is recorded as being up to 34.14m thick.

The Chalk is described as white, fine to coarse well rounded to sub-angular Chalk gravel (fragments) with some flint cobbles.

4.2.3 Geological Constraints/Resources

The following table broadly summarise the main engineering considerations of each stratum likely to be encountered during the lifetime of the project and should be read in conjunction with the interpreted geology. It is assumed that topsoil (where present) will be removed prior to any site works commencing and where possible reused as part of the landscaping works, it has therefore been excluded from this section.

Geological Unit	Physiography	Materials	Constraints	Resources	Engineering Considerations	Potential Hazards
Made Ground/ Artificial Ground	Present on site and to the north and west of site	Ground to the north and west of site: <u>Granular:</u> Brown, silty, fine SAND with some fine-coarse gravel sized, flint, chalk, brick and chipboard <u>Cohesive:</u> Brown, silty fine CLAY with some large flint cobbles (Driller's description) Nature of Made Ground on site is **UNKNOWN.**	▪ Poor material for earthworks. ▪ Liable to be highly compressible. ▪ Low bearing capacities ▪ Variable founding, settlements conditions. ▪ High organic content ▪ Potentially contaminated	▪ There is limited resource potential. It is possible that fill from existing earthworks could be recycled.	▪ Various problems associated with excavations including instability and collapse. ▪ Unsuitable founding material for shallow foundations due to variability, low strength and high compressibility. ▪ Likely large long term settlements caused by consolidation and secondary compression ▪ There is a potential risk for concrete to be attacked by aggressive ground conditions. Sulphate resistant concrete may be necessary. ▪ Negative skin friction on piled foundations. ▪ Potential source of ground gas. ▪ Potentially contaminated. ▪ Potentially high groundwater levels/perched water.	▪ Inundation collapse. ▪ Collapse of excavations, and foundations due to low material strength ▪ Compressible soils resulting in settlements/ total and differential. ▪ There is potential for sulphate attack of concrete. ▪ Health Hazards depending on gas type. ▪ Health Hazards depending on presence of contamination. ▪ Potential Flooding (for Cohesive Made Ground)
Historic Landfills	Present on site (maybe to the north of site)	<u>Capping Materials</u>: BES Liner, HDPE geomembrane, GCL, Leachate drainage blanket, protective geotextile/layers <u>Waste:</u> **Unknown**	▪ Highly contaminated. ▪ Poor material for earthworks. ▪ Liable to be highly compressible. ▪ Low bearing capacities ▪ Variable founding, settlements	▪ Non-recyclable	▪ Land and water contamination, land remediation is required. ▪ Sources of toxic gas and chemicals. ▪ Very likely that concrete would be attacked by aggressive ground	▪ Health Hazards depending on gas type. ▪ Health Hazards depending on presence of contamination. ▪ High potential of concrete attack/damage.

Geological Unit	Physiography	Materials	Constraints	Resources	Engineering Considerations	Potential Hazards
		Basal Lining: BES, LLDPE, GCL	conditions. ▪ Potential organic content		conditions. Special concrete design is necessary. ▪ Various problems associated with excavations including instability and collapse. ▪ Unsuitable founding material for shallow foundations due to variability, low strength and high compressibility. ▪ Likely large long term settlements caused by consolidation and secondary compression ▪ Negative skin friction on piled foundations. ▪ Potential source of ground gas. ▪ Potentially high groundwater levels	▪ Inundation collapse. ▪ Collapse of excavations and foundations due to low material strength ▪ Compressible soils resulting in settlements/ total and differential.
Glacial Deposits: Upper and Lower Glacial Sand and Gravel	Present on site and within 250m of site. The Glacial Sand and Gravel, in most of the cases, forms two units, one at the top of the sequence of glacial deposits, the second present at the bottom of the glacial deposits. Upper Glacial Sand and Gravel has thickness ranging from 0.4m to 12.8m. Lower Glacial Sand	Upper Glacial Sand and Gravel: (Orangey) brown, silty fine (to medium) SAND with some fine to medium flint and quartzite (chalk) gravel. Lower Glacial Sand and Gravel: Orangey brown, very clayey, silty (medium) SAND with much fine to coarse flint gravel or orangey fine to	▪ Perched water tables, particularly where underlain by low permeability formations. ▪ Variable founding conditions depending on grading. ▪ High variability in density, allowable bearing pressures, compressibility and permeability. ▪ May have been locally extracted and backfilled with uncontrolled landfill.	▪ Cuttings and excavations may provide some materials for earthworks and aggregates.	▪ Local instability and seepages into cutting and excavations. ▪ Potentially suitable for Shallow foundations (with waste completely removed) or piled foundations. ▪ Presence of silt and clay elements may reduce founding potential. ▪ The ground assumed to be weak and capable of sustaining only low	▪ Pathways for contamination. ▪ Seepages into excavation and cuttings from perched water systems may destabilise slopes and excavations and bring contamination into system. ▪ If loose to medium dense, the deposit may be vulnerable to vibration induced settlement. ▪ There is potential for piping.

Geological Unit	Physiography	Materials	Constraints	Resources	Engineering Considerations	Potential Hazards
	and Gravel has thickness ranging from 2.2m to 4m. The entire glacial unit ranges in thickness from >6m to 26.82m.	coarse flint GRAVEL with some clayey silty medium to coarse sand and soft to firm, very sandy, silty clay. Occasional flint cobbles were also encountered.	▪ Potentially contaminated.		bearing pressure without inducing excessive ground movement. ▪ Pumping may result in soil migration and potential settlement. ▪ Settlement may occur if materials are loose to medium dense. May be vulnerable to vibration induced settlement. ▪ There is a low potential risk for concrete to be attacked by aggressive ground conditions. Sulphate resistant concrete may be necessary. ▪ Secondary A Aquifer ▪ Potentially contaminated.	
Glacial Deposits: Glacial Till	Present to the west of site. The Glacial Till sandwiches between Glacial Sand and Gravel, and ranges in thickness from >0.80m to 8.54m. The entire glacial unit ranges in thickness from >6.00m to 26.82m.	Generally described as a firm to very stiff, brown/brownish grey, slightly sandy, silty CLAY with some fine to medium chalk and flint gravel or Orangey brown, clayey, sandy SILT.	▪ Potentially soft low strength material ▪ Potentially compressible. ▪ Low bearing capacities ▪ Variable founding, settlements conditions. ▪ Potentially an unproductive strata, highly impermeable with intermediate plasticity. ▪ Deposit could be over consolidated. ▪ Sensitive to moisture content variations.	▪ There is limited resource potential, possibly reuse as general fill or landscaping material.	▪ Soft material may cause excavation instability ▪ Potential for shallow (with waste completely removed) & pile foundations. But, localized weakness in clay and silt layers. Settlement may cause negative skin friction. ▪ Potential for long term consolidation settlement. ▪ Because it is likely to be classified as unproductive strata,	▪ Swelling / heave potential in excavations and below foundations. ▪ Seepages into excavation and cuttings from perched water systems may destabilise slopes and excavations and bring contamination into system. ▪ Variability in material strength and make up resulting in differential settlement. ▪ Could contain boulders that may be wrongly interpreted as

Geological Unit	Physiography	Materials	Constraints	Resources	Engineering Considerations	Potential Hazards
			▪ High silt content.		the unit is unlikely to be suitable for conventional soakaways. ▪ Potential risk for concrete to be attacked by aggressive ground conditions. Sulphate resistant concrete may be necessary. ▪ High silt content could lead to potential susceptibility to frost.	rockhead. ▪ There is potential for sulphate attack of concrete. ▪ Potentially susceptible to frost should any shallow foundations be required.
Upper Chalk	The top of formation was encountered at depths between 12.4m to 26.82m below existing ground level. The thickness of the unit was not proven.	Described as white, fine-coarse well rounded flint and sub-angular reworked chalk gravels with some flint cobbles. Much reworked silt sized, chalk fragments. One borehole identified the Chalk as Grade VI.	▪ Varying weathering grade thickness. ▪ Potential development of local dissolution erosion features. ▪ Potential buried channels present. Local presence of flint bands. ▪ Where any excavations required for cutting then excavatability would need to be addressed. ▪ Abandoned chalk pits may have been backfilled with variable and contaminated materials. The chalk pits may be liable to collapse. ▪ Principal Aquifer.	▪ Excavations might provide materials suitable be reuse in embankments. ▪ Source of water.	▪ Acceptability of material excavated from any chalk cutting could be too soft for reuse as engineering material. ▪ General founding characteristics should be suitable for most structures. ▪ Variable weathering profile needs careful logging. ▪ Variable rock head profile may be encountered due to dissolution features. Face should stand up in a short-term.	▪ Potential presence of dissolution erosion features and variable rockhead and weathering levels. ▪ Infill materials of variable type and nature. ▪ Chalk is a regionally important aquifer. All engineering works need careful control to avoid pollution of the aquifer. Discussions with the Environment Agency will be required.

4.2.4 Geotechnical and Geo-environmental Appraisal of the Options

4.2.4.1 Scheme Option – Orange Route (Option 1)

The alignment of orange route (option 1) dissects a disused pit and the Costessey Landfill Site from north to south before turning westwards and dissecting the EMR scrapyard to join with the northern arm of Ernest Gage Avenue close to the EMR and Norfolk Cement.

The beginning of the route (chainage 190m to chainage 280m) crosses a scrapyard which could lead to geo-environmental issues from possible contamination associated with on-site processes. Geotechnical risks could be presented by possible Made Ground on site whilst natural deposits in this area could provide relatively minor hazards such as consolidation settlement of infrastructure constructed on Glacial Till. A separate risk exists due to the potential level changes in this area with the potential for a section of embankment being required.

The geotechnical and geo-environmental issues for the second section of the route (chainage 350 to chainage 650m) are quite extensive and include that possible landfill waste is present directly underneath 300m of the proposed route. Whilst this is clearly a major geo-environmental risk it is also a major geotechnical risk. Constructing a carriageway and associated services on this material is likely to result in significant differential settlement which will only be remedied by a robust foundation solution such as piles for all elements. Alternatively a significant programme of maintenance works over the lifetime of the scheme coupled with a design that will accommodate reasonable amounts of movement could be employed. Whilst the piling could be a viable option the fact that the landfill site overlies a principle aquifer which is in hydraulic continuity with the superficial deposits it is likely that the Environment Agency will oppose this approach especially if the areas of landfill to be traversed are lined. A separate risk exists due to the potential level changes in this area with the potential for a section of embankment being required.

The third section of the route (chainage 650m to chainage 750m) dissects a disused pit, which has potentially been backfilled, and area labelled as “dilute and disperse”. The backfilled pit may compose of placed fill (a non-engineered back fill) and possible contamination associated with on-site processes could lead to geo-environmental issues. Geotechnical risks could be presented by possible Made Ground / placed fill of variable strength and compressibility on site whilst natural deposits in this area could provide relatively minor hazards such as consolidation settlement of infrastructure constructed on Glacial Till. A separate risk exists due to the potential level changes in this area with the potential for a section of embankment being required.

It is likely that due to the number of issues affecting this proposal that constructing this option will prove prohibitive either in terms of cost or permissions.

4.2.4.2 Scheme Option – Orange Route (Option 2)

The alignment of orange route (option 2) dissects a disused pit and the Costessey Landfill Site from north to south before turning westwards and dissecting the EMR scrapyard to join with the northern arm of Ernest Gage Avenue close to the EMR and Norfolk Cement. The route is very similar to orange route (option 1); however it dissects the scrapyard across the north eastern corner instead of the centre of the site.

The beginning of the route (chainage 250m to chainage 400m) crosses a scrapyard and has the same associated risks as the orange route (option 1).

The geotechnical and geo-environmental issues for the second section of the route (chainage 380 to chainage 700m) are quite extensive and include that possible landfill waste is present directly underneath 320m of the proposed route. If landfill is present this clearly is a major geo-environmental and geotechnical risk and will carry the same problems as described for option 1.

The third section of the route (chainage 700m to chainage 750m) dissects a disused pit, which has potentially been backfilled and has the same associated risks as option 1.

It is likely that due to the number of issues affecting this proposal that constructing this option will prove prohibitive either in terms of cost or permissions.

4.2.4.3 Scheme Option – Green Route (Option 1)

The alignment of green route (option 1) skirts the existing boundary of Costessey Landfill Site on its western side, following the access road to the NEWS material Recycling Facility from north to south, before traversing a section of the landfill site and EMR scrapyard to a proposed roundabout. It then turns west traversing the EMR scrapyard to join with the existing Ernest Gage Avenue close to the access to EMR and Norfolk Cement.

The beginning of the route (chainage 200m to chainage 300m to the west of the proposed roundabout, the proposed roundabout and chainage 409m to chainage 380m) crosses a scrapyard which could lead to geo-environmental issues from possible contamination associated with on-site processes. Geotechnical risks could be presented by possible Made Ground on site whilst natural deposits in this area could provide relatively minor hazards such as consolidation settlement of infrastructure constructed on Glacial Till. A separate risk exists due to the potential level changes in this area with the potential for a section of embankment being required on the southern arm of the roundabout.

The geotechnical and geo-environmental issues for the second section of the route (chainage 350 to chainage 0m) could be extensive and are dependent on whether landfill waste is present directly underneath. If landfill is present this clearly is a major geo-environmental and geotechnical risk. Constructing a carriageway and associated services on this material is likely to result in significant differential settlement which will only be remedied by a robust foundation solution such as piles for all elements. Alternatively a significant programme of maintenance works over the lifetime of the scheme

coupled with a design that will accommodate reasonable amounts of movement could be employed. Whilst the piling could be a viable option the fact that the landfill site overlies a principle aquifer which is in hydraulic continuity with the superficial deposits it is likely that the Environment Agency will oppose this approach especially if the areas of landfill to be traversed are lined.

Should landfill waste not be present then this section passes close to the landfill site and NEWS Material Recycling Facility which could lead to geo-environmental issues from possible contamination associated with on-site processes. Geotechnical risks could be presented by possible Made Ground of variable strength and compressibility on site whilst natural deposits in this area could provide relatively minor hazards such as consolidation settlement of infrastructure constructed on Glacial Till. A separate risk exists due to the possible level changes in this area with the potential for a section of embankment being required due to level changes between the edge of the landfill site and the existing access road to the NEWS Material Recycling Facility.

4.2.4.4 Scheme Option – Green Route (Option 2)

The alignment of green route (option 2) skirts the existing boundary of Costessey Landfill Site on its western side, following the access road to the NEWS material Recycling Facility from north to south, before traversing a section of the landfill site and the EMR scrapyard. It then turns west traversing the EMR scrapyard to join with the existing Ernest Gage Avenue close to the access to EMR and Norfolk Cement.

The beginning of the route (chainage 250m to chainage 400m) crosses a scrapyard which could lead to geo-environmental issues from possible contamination associated with on-site processes. Geotechnical risks could be presented by possible Made Ground on site whilst natural deposits in this area could provide relatively minor hazards such as consolidation settlement of infrastructure constructed on Glacial Till. A separate risk exists due to the potential level changes in this area with the potential for a section of embankment being required.

The geotechnical and geo-environmental issues for the second section of the route (chainage 400 to chainage 781m) are the same as green route (option 1) and has the same risks.

4.2.4.5 Scheme Option - Blue Route (Option 1)

The alignment of blue route (option 1) dissects a disused pit and a sand and gravel pit from north to south before turning west across the northern extent of the Costessey Landfill Site and dissecting a further gravel pit. It then runs along the northern boundary of the EMR scrapyard to join the existing Ernest Gage Avenue close to EMR and Norfolk Cement.

The beginning of the route (chainage 200m to chainage 400m) passes close to a scrapyard which could lead to geo-environmental issues from possible contamination associated with on-site processes. Geotechnical risks could be presented by possible Made Ground on site whilst natural deposits in this area could provide relatively minor hazards such as consolidation settlement of infrastructure constructed on Glacial Till. A separate risk exists due to the potential level changes in this area with the potential for a section of embankment being required.

The geotechnical and geo-environmental issues for the second section of the route (chainage 350 to chainage 700m) are quite extensive and include that possible landfill waste is present directly underneath 350m of the proposed route. Whilst this is clearly a major geo-environmental risk it is also a major geotechnical risk. Constructing a carriageway and associated services on this material is likely to result in significant differential settlement which will only be remedied by a robust foundation solution such as piles for all elements. Alternatively a significant programme of maintenance works over the lifetime of the scheme coupled with a design that will accommodate reasonable amounts of movement could be employed. Whilst the piling could be a viable option the fact that the landfill site overlies a principle aquifer which is in hydraulic continuity with the superficial deposits it is likely that the Environment Agency will oppose this approach especially if the areas of landfill to be traversed are lined. A separate risk exists due to the potential level changes in this area with the potential for a section of embankment being required.

The third section of the route (chainage 650m to chainage 1000m) dissects a sand and gravel pit as well as a disused pit, which has potentially been backfilled, and area labelled as “dilute and disperse”. The backfilled pit may be composed of placed fill (a non-engineered back fill) and possible contamination associated with on-site processes could lead to geo-environmental issues. Geotechnical risks could be presented by possible Made Ground / placed fill of variable strength and compressibility on site whilst natural deposits in this area could provide relatively minor hazards such as consolidation settlement of infrastructure constructed on Glacial Till. A separate risk exists due to the potential level changes in this area with the potential for a section of embankment being required.

It is likely that due to the number of issues affecting this proposal that constructing this option will prove prohibitive either in terms of cost or permissions.

4.2.4.6 Scheme Option - Blue Route (Option 2)

The alignment of blue route (option 2) dissects a disused pit and sand and gravel pit from north to south before turning west across the northern extent of Costessey Landfill Site and dissecting a further gravel pit. It then runs along the northern boundary of the EMR scrapyard to join the existing Ernest Gage Avenue close to EMR and Norfolk Cement. The route is very similar to blue route (option 1) however it also dissects an existing soakaway to the immediate north east of the landfill site.

The beginning of the route (chainage 200m to chainage 400m) passes close to a scrapyard and has the same associated risks as discussed in blue route, option 1.

The geotechnical and geo-environmental issues for the second section of the route (chainage 350 to chainage 700m) are quite extensive and include that possible landfill waste is present directly underneath 350m of the proposed route. The associated risks are the same as discussed in option 1.

The third section of the route (chainage 650m to chainage 1050m) dissects a sand and gravel pit as well as a disused pit, which has potentially been backfilled. The associated risks are the same as discussed in option 1.

It is likely that due to the number of issues affecting this proposal that constructing this option will prove prohibitive either in terms of cost or permissions.

4.2.5 Ground Investigation Recommendations

Based on the information summarised above a phased site investigation will be necessary in order to determine the ground conditions along the route and within the areas of worked ground. The objectives of the ground investigation (GI) should allow the following tasks to be undertaken:

- Assessment of the Landfill, Made Ground, Glacial Sand and Gravel and Glacial Till as a bearing stratum;
- Assessment of the suitability of the Made Ground, Glacial Sand and Gravel and Glacial Till for reuse on site;
- Assessment of the groundwater levels below site and the effect this may have on the proposed development;
- Assessment of the potential for sulphate attack on buried concrete from existing ground and groundwater conditions; and,
- Assessment of the risk from contaminated land, groundwater and ground gases to human and environmental receptors.

The results from the GI should allow the preliminary contamination risk assessment, preliminary engineering assessment and geotechnical risk register presented in Section 5, 7 and 9 of the PSSR[11] to be updated. It should also allow the engineering issues at the site to be addressed, be suitable to allow the undertaking of a quantitative risk assessment and permit identification of any contamination remediation requirements and expected remediation costs.

With the limited information available, it is best practice to follow a staged approach to ground investigations, to avoid any unnecessary risks associated with the unknown waste, to allow time for development plans to evolve and to allow hazards at the site to be investigated in increasing detail as information on the ground risks for the development become clearer. The phasing should allow better and more effective targeting of the investigations, and has the advantage of spreading capital expenditure over time.

The planning of this GI is subject to change and is dependent on whether more information would be made available before its commencement. An initial GI proposal is presented in Section 10 of the PSSR[11]. The design principles are outlined in the following sections.

4.3 Hydrology Drainage

Information on hydrology has been obtained from the Envirocheck Report for New Costessey Norfolk[9] and the Environment Agency website[10].

4.3.1 Surface Water

The nearest surface water feature is approximately 46m to the north of site and is a drain running along the public pathway to the north of the EMR scrapyard that discharges water to an area beyond the northern boundary of Costessey Landfill Site. A pond is present approximately 350m to the northeast, located just south of River Tud which is approximately 400m to the northeast. The River Tud flows southeast where it joins River Wensum approximately 4km downstream.

The site and within 250m orientation of site are free from flooding. The area along River Tud is vulnerable to extreme flooding (Zone 2). There are no areas benefiting from flood defences and no water storage areas within the study locality or the surrounding area.

4.3.2 Groundwater

The regional hydrogeology has been assessed using the Environment Agency Groundwater Vulnerability map for the area which indicates that the bedrock beneath the site has been classified as a Principal Aquifer. These are *"layers of rock or drift deposits that have high intergranular and/or fracture permeability – meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale."*

The superficial deposits comprising Glacial Sand and Gravel that are present within site are classified as Secondary A Aquifer. These are *"permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers".*

The superficial deposits comprising Lowestoft Till that are present approximately 600m to the southwest of site are classified as Unproductive Strata. These are *"rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow".*

The Groundwater Vulnerability map East Norfolk, Sheet 26 (scale 1:100,000) indicates that the soils within the site footprint have three different soil classifications. The northern section of site is classified as *"High Leaching Potential (U) – Soil information for restored mineral workings and urban areas is based on fewer observations than elsewhere. A worst case vulnerability classification (H) assumed, until proved otherwise"*. The middle section of site is classified as *"High Leaching Potential (H3) – Coarse textured or moderately shallow soils which readily transmit non-absorbed pollutants and liquid discharges but which have some ability to attenuate absorbed pollutants because of their large clay or organic matter contents".* The southern end of the site is classified as *""High Leaching Potential (H2) – Deep, permeable, coarse textured soils which readily transmit a wide range of pollutants because of their rapid drainage and low attenuation potential".*

A Source Protection Zone (SPZ) III (Total Catchment) is shown present approximately 500m southeast and 1km northwest of site. A SPZ II is also present approximately 1km northwest.

4.3.3 Drainage Design Considerations

Consideration will need to be given when choosing drainage solutions so as to minimise the vertical and horizontal migration of contamination within or close to Costessey Landfill Site. The use of swales, or soakaways should not be considered due to the potential for it to promote the migration of contaminates.

At this stage it is recommended that a completely contained drainage system, piping surface and foul water away from the proposed scheme to a controlled system is used to prevent migration of contaminates. Furthermore it is recommended that the infrastructure for this system are not embedded in a granular medium but are completely encased in concrete to prevent contaminates such as landfill leachate and ground gas using these zones as conduits.

4.4 Public Utilities

A C2 utility search has been undertaken for the whole site extents. A plan combining all the research findings has been produced and is shown on **Drawing MMD-326109-C-DR-00-XX-0002** in **Appendix A**.

4.4.1 Existing Utilities

Existing Virgin Media ducts and BT cables are present along the northern side of the A1074 Dereham Road. Intermediate pressure gas mains, high voltage cables, BT cables and water pipes are shown on the southern side of A1074. Trial holes will be required to identify the depths of the apparatus and potential need for diversions at the location of a new junction

In Costessey Landfill, electricity and BT overhead cables are crossing the field. A large amount of rigid gas pipes feeding to the CHP plant are present throughout the site.

On Ernest Gage Avenue there are underground BT cables crossing and along the road. As kerb realignment works are required at this area, diversions may be necessary depending on the results from trial holes.

4.4.2 Provision of New Utilities

If any public utilities and ducts for street lighting are needed for potential developments in the vicinity, these could be installed in utility corridors under the proposed footways.

There is a risk of ground settlement within Costessey Landfill Site, as discussed earlier in this chapter. Further consideration will be required in the course of detailed design and specific mitigation measures may be required e.g. mains/ducts to be fitted with concrete protection.

5 Environmental Assessment

5.1 Introduction

This chapter describes an initial appraisal to establish environmental baseline conditions and key constraints associated with the proposed Link Road. As such, it describes the existing environment, within the study area (the Site), the potential impacts during construction and operation stages and identifies the main differences between the two alignment options.

In the context of the proposed development, a range of potential environmental and planning issues have been identified, which are discussed below. The following environmental aspects are considered within this report:

- Ecology and nature conservation;
- Landscape and visual impact;
- Cultural heritage;
- Water resources and drainage;
- Geology, soils and contaminated land;
- Air quality;
- Noise and vibration;
- Pedestrians, cyclists, equestrians and community effects;
- Vehicle travellers: and
- Land use.

The information to identify the potential constraints has been gathered from online and other readily available sources including the following:

- Multi Agency Geographic Information for the Countryside (MAGIC) website;
- Natural England website;
- English Heritage; and
- Environment Agency website

This level of assessment will give only a broad indication of likely effects, as it takes no account of detailed alignments or mitigation measures. This report is intended to provide sufficient information to identify potential environmental constraints for the proposed Link Road. As the six route options are so close to each other in geographical terms it has been possible to simply describe the site as encompassing all of

these, and provide general descriptions of constraints and impacts as applicable to all. In the small number of cases where this has not been possible, then the differences are highlighted and explained.

At this stage it is not possible to conform directly to any of the prescribed stages of environmental assessment in the DMRB Volume 11: Environmental Assessment. Whilst it is acknowledged that this stage of the scheme would lend itself to the Scoping stage of assessment, other components of the overall Transport Strategy have not yet been confirmed to allow this to happen. For example no detailed traffic model output is currently available, therefore the requirements in terms of air quality and noise and vibration cannot be fulfilled. However, more qualitative, indicative impacts have been described, and the differences between the options highlighted.

5.2 Air Quality

In considering the likely impacts on air quality of a road scheme, DMRB states that:

"Road transport sources account for a large proportion of the emissions of several air pollutants, although most of the pollutants emitted by road vehicles are also produced by a wide range of industrial, commercial and domestic processes. The vehicle-derived pollutants of concern, and the environmental effects to which they contribute, are summarised in Annex A. The pollutants of most concern near roads are nitrogen dioxide (NO2) and particles (PM10) in relation to human health and oxides of nitrogen (NOx) in relation to vegetation and ecosystems."

And that:

"Clean air is an essential ingredient for a good quality of life. The Government is committed to meeting health based air quality criteria for human health and for the protection of vegetation and ecosystems."

Air quality is directly, inextricably linked to traffic volumes and patterns. Even at the Scoping stage, the earliest stage of scheme assessment, it is usually necessary to use traffic model data to be able to assess the air quality scenarios for Do Something and Do Nothing, at base year, opening year and a future year, usually taken as the worst year (in air quality terms) in the first fifteen years after opening. Whilst some estimates of potential changes to traffic are available, the budget does not allow quantitative assessment on multiple routes at this stage, and so qualitative input is given here instead.

5.2.1 Baseline Conditions

The study area is not covered by an Air Quality Management Area (AQMA), the nearest being that declared for central Norwich. However, there are four non-automatic air quality monitoring points within 1.5km from the link road at the following locations.

Table 5-1: Non-Automatic Monitoring Sites Results of Nitrogen Dioxide Diffusion Tubes

Site Name	OS grid Reference	Unadjusted 2010	2010 (µg/m3) Adjusted for bias
Longwater Lane (top), Costessey	▪ X616890 ▪ Y310429	▪ 24.32	▪ 22.38
West End, Costessey	▪ X616879 ▪ Y311554	▪ 27.38	▪ 25.19
Longwater Lane (Bridge), Costessey	▪ X616955 ▪ Y311242	▪ 30.17	▪ 27.76
Dereham Road, Costessey	▪ X618896 ▪ Y309758	▪ 25.69	▪ 23.63

Source: 2011 Air Quality Progress Report for South Norfolk District Council, South Norfolk Council

When assessing the 2010 annual mean NO^2 concentrations, measured using diffusion tubes, (bias adjusted using national factor) against the AQS Objective of 40 µg/m^3, there were no exceedances evident at any of the diffusion tube monitoring sites.

There is additional air quality monitoring points in the vicinity of the link road. These are monitored by the Environment Agency and are located on mineral extraction and waste treatment sites. All of these monitoring points have been recorded as achieving 'very good' compliance rating scares for relevant pollutants in accordance with the licences issued to these businesses.

The main source of air pollution is likely to be attributable to the traffic on the A47 and adjoining main roads.

When considering local air quality, all those properties within 200 metres of any affected roads should be considered. Affected roads are those that meet any of the following criteria:

- Road alignment will change by 5 m or more; or
- Daily traffic flows will change by 1,000 AADT or more; or
- Heavy Duty Vehicle (HDV) flows will change by 200 AADT or more; or
- Daily average speed will change by 10 km/hr or more; or
- Peak hour speed will change by 20 km/hr or more.

This is likely to include the Link Road, some or all of the arms of the Longwater Interchange and the new housing development at Lodge Farm (south of the A1074 Dereham Road), as shown on **Drawing MMD-326109-C-DR-00-XX-0017** in **Appendix A**.

5.2.2 Impact identification

No Designated Sites are located close enough to be affected by potential changes in air quality associated with this scheme.

There is sufficient distance from the Norwich AQMA that all the route options are unlikely to have any effect on this designation, either adversely or positively.

During construction operations there is potential for a range of impacts on air quality to arise as a result of the proposed development. These include elevated gaseous emissions arising from construction machinery and related traffic, and elevated dust production during excavation works. Most significantly, there is the potential for the release of landfill gases such as carbon dioxide (CO_2) and methane (CH_4) as well as airborne contaminated dusts from Costessey Landfill Site if disturbed.

During the operational phase, the proposed development will reduce traffic congestion within the Longwater Interchange which has been identified as one of a number of major junctions in the Greater Norwich area where the JCS will result in significantly increased traffic demand in the area and thus there is potential for improvement in the air quality in the area.

5.2.3 Route Comparison

There are no significant differences identified between the road options that would differentiate them from each other in regard to the potential to cause impacts upon air quality with respect to potential sources of construction dust, combustion related emissions and operation related vehicular emissions.

5.3 Cultural Heritage

The site for the proposed development is on land which had been historically used for quarrying and then at least in part for landfill (Costessey Landfill Site).

The proposed site does not lie within a Conservation Area or an Area of Archaeological Potential. There are no Scheduled Monuments within 1 km of the site. The closest scheduled monument is the Bawburgh Bridge just over 1 km to the south west. There are eight listed buildings within one kilometre of the link road, as shown on **Drawing MMD-326109-C-DR-00-XX-0013** in **Appendix A**.

In addition to designated Scheduled Monuments and listed buildings, a range of other non-designated heritage features can be identified in the study area. These features are known to the Norfolk Historic Environment Service and include archaeological find spots, earthworks, and various historic buildings both within the site and the wider study area.

5.3.1 Impact Identification

Direct impacts on scheduled monuments are not anticipated.

Archaeological assets are likely to have been removed by the extraction process during the middle to late part of the twentieth century. This extraction would have caused significant ground works at the Site and the likely removal of any archaeological deposits.

In light of the mineral extraction undertaken on the Site during the twentieth century, it is considered that the construction and operation of the proposed development is unlikely to encounter any heritage assets for the majority of the site, or affect those within a close proximity to the Site.

5.3.2 Route Comparison

It is considered that it is not possible to differentiate between the routes on the grounds of cultural heritage alone.

A further detailed desk-based assessment of the National Heritage List and NCC Historic Environment Records (NCCHER) data is recommended to be carried out along the northern section of the Link Road and surrounding areas to identify any additional constraints. However, it is considered that the development and operation of the proposed development is unlikely to encounter any heritage assets on the site or affect those within a close proximity to the site.

5.4 Ecology and Nature Conservation

DMRB defines ecology as *"the scientific study of living organisms, and their relationship both with each other and their environment (e.g. soils, climate, topography)".* It also states that nature conservation is *"concerned with maintaining a viable population of the country's characteristic fauna and flora and the communities they comprise".*

Conservation of wildlife species and their habitats is important both for human inspiration, enjoyment and general well-being and to sustain the value of the natural environment for future generations as an asset for recreation, education and direct economic benefit including genetic resources.

5.4.1 Baseline Conditions

This section provides a summary of the key ecological receptors identified within the study area. The Site is located within an established built-up area in an urban fringe environment and the proposed development involves construction on a capped landfill site (Costessey Landfill Site), so in ecological terms it is, to all intents and purposes an existing brownfield site.

Designated Sites

There are no statutory designated sites that would be directly impacted by the proposed development.

The nearest designated site is the River Wensum Site of Special Scientific Interest (SSSI) and Special Area of Conservation (SAC) situated approximately 1 km to the north of the proposed route, as shown on **Drawing No. MMD-326109-C-DR-00-XX-0012** (**see Appendix A**). This river is a prime example of an enriched calcareous lowland river and supports a great diversity of flora and fauna including white-clawed crayfish (*Austropotamobius pallipes*) and various species of *Ranunculus* vegetation.

Non-Statutory designations

Of local importance and approximately 450 m to the northwest of the proposed link road lies the Long Dale County Wildlife Site (CWS), as shown on **Drawing MMD-326109-C-DR-00-XX-0012** in **Appendix A**.

Within two kilometres of the proposed scheme are the River Tud (500 m north) and River Yare (2 km south) which, together with the River Wensum, are part of The Broads Environmentally Sensitive Area (ESA), *"a network of wetland that is unique in Europe in terms of both ecology and landscape, forming one of the few remaining large areas of lowland floodplain grassland in Britain".* Farming operations in this area that have followed conservation-orientated management practices have been rewarded via farm payment initiatives and grants. However, all such schemes are due to be phased out by 2014 and are being replaced with Environmental Stewardship Agreements, of which there are many within 2 km of the route and outside the historical boundary of The Broads ESA. The nearest site registered for an Environmental Stewardship Agreement is to the immediate south of the proposed development, beyond the A1074 Dereham Road. This farm is part of the Entry Level plus Higher Level Stewardship scheme.

5.4.2 Habitats, plant communities and flora

5.4.2.1 Woodland

The proposed development would cross the deciduous Broadleaved Woodland 'Turnpike Belts' (Norfolk Biodiversity Action Plan (BAP) priority habitat) along the northern verge of the A1074 Dereham Road.

5.4.2.2 Grassland

The main habitat to be lost to the proposed development would be the semi-improved grassland on Costessey Landfill Site. It is likely to be an artificially seeded area, with a mixture of locally native species of grasses and other herb species.

5.4.3 Protected Species

5.4.3.1 Great Crested Newts

There is potential for impacts on populations of great crested newts present along the six route options. Records indicate known great crested newt ponds within the study area.

Great crested newts are a European protected species and as such are fully protected under the Wildlife and Countryside Act 1981 (as amended) and the Conservation of Habitats and Species Regulations 2010 (as amended).

5.4.3.2 Nesting Birds

The areas of scrub and trees in the Site provide abundant habitat for breeding birds within hedgerows, trees and mown rough grassland. Ground nesting birds in particular may be served by areas of scrubland and ground vegetation.

5.4.3.3 Reptiles

There are no records extant for reptiles within the Site. However, there is potential for reptiles in the shrub, field corners, road verges and grassland habitat within the Site. Common lizard and slow worm are the species most likely to be found.

5.4.3.4 Badgers

There is a potential for badger setts to occur in the vicinity of hedgerows and within the woodland along the A47. Further assessment would be required to identify the potential presence of badgers within the study area and associated construction area.

5.4.3.5 Bats

There is a high likelihood for bat roots within the many suitable mature trees located within the Site. The study area also provides extensive bat foraging and commuting habitat, including linear hedgerow boundaries, tree lined streams, water bodies and grassland areas.

5.4.4 Impact identification

The impacts of a road scheme on ecological assets can be many and varied, over a wide area or locally, short term, long term or permanent. In the case of this scheme, a significant road network is already in place, with additions proposed, so the focus of this section is directed towards impacts additional to those already in existence.

The proposed development will not directly impact upon any ecology and nature conservation statutory designated sites.

The potential impacts of the proposed options are summarised as below:

- Direct impacts on protected species such as bats, badgers, reptiles and birds through habitat loss and disturbance or injury to wildlife through construction;
- Disturbance or injury to wildlife during construction, through noise, visual disturbance and pollution of soil and water, or through vegetation clearance (e.g. reptiles and great crested newts); and
- Longer term impacts may occur if established best practice measures to avoid and prevent impacts are not implemented. More extensive habitat restoration works might therefore be required to re-establish areas of the habitat lost.

The Site is located within derelict ground that has become rough grassland. The proposed development will cause the loss of some or all habitat on the Site, and has the potential to cause impacts on nearby wildlife through dust, noise and habitat severance.

A preliminary ecological assessment will need to be carried out to identify any potential ecological constraints at the Site and in the surrounding areas including potential for protected species. There may be some bat potential in the building because it contains roof cavities. Further ecological works will be determined on the basis of the survey and if necessary relevant mitigation measures identified and licences sought.

5.4.5 Route Comparison

There is very little difference between the route options. All options would require the loss of an area of broadleaved woodland belt of low conservation value.

5.5 Landscape and Visual Impact

There are no statutory or non-statutory designated landscape protection areas or any landscape areas classed as sensitive that affect the site.

5.5.1 Regional Landscape Character

The proposed development and the surrounding areas are within an industrial estate on the urban fringes of Norwich, which also includes a complex of historic and operational landfill sites. As such, the immediate landscape is dominated by industrial and landfill units segmented by access roads, with mature woodland screening. Street and site lighting units are common and suspended electricity cabling and a communications tower are visible. To the west, northwest and north the industrial estate extends further. In the wider area, the site is bound by the Costessey Park Golf Club to the northeast, and to the east by open farmland. To the south the proposed route will join the A1074, a road from which the site is currently screened by mature woodland. Beyond this road lies the open farmland of Lodge Farm. To the west is the Longwater Interchange.

Natural England's Countryside Character Map divides England's countryside into 159 distinctive National Character Areas (NCAs) based on their unique combinations of landscape, biodiversity, geodiversity, culture and economic activity. The proposed development is located within NCA 78 Central North Norfolk whose key characteristics are low-lying, gently undulating ground predominantly influenced by intensive arable agriculture interspersed with pockets of woodland and wetland areas.

The landscape character of the study area is also described within the South Norfolk District Landscape Character Assessment produced in June 2001. The proposed development is located within the Fringe Farmland Landscape character area. The boundary of this area is distinguished by the woodlands at the periphery of the Tud Valley to the north of the area and the Yare Rural River Valley to the south. This landscape is underlain by sand and gravel drift deposits.

This area has a history of mineral extraction, particularly sand and gravels workings, resulting in scarred and reclaimed areas.

5.5.2 Visual Amenity

The A47 dual carriageway is a major feature of the study area. There is also a significant level of settlement including the Norwich suburb of New Costessey and the linear settlement of Easton. The study area is predominantly characterised by urban fringe uses, including a park and ride scheme, retail

warehouses, industrial units, closed and operational landfill sites, a golf course and the Royal Norfolk showground. High voltage electricity pylons dissect the study area from the southeast to the northwest, skirting the village of Easton to the south via Easton College.

The landscape around the site is a mixture of agricultural (both arable farmland and pastoral cattle grazed landscapes) and industrial landscapes. The site has a history of mineral extraction for sand and gravel, which has given rise to scarred and reclaimed areas.

5.5.3 Impact Identification

Potential impacts and effects on landscape character and visual amenity during construction include:

- Presence of construction traffic, construction plant and equipment, removal of trees disturbance of the ground;
- Elevated noise affecting enjoyment of the Costessey Park Golf Club; and
- Introduction of temporary built structures.

The proposed development will impose a new linear feature that will be visible from the immediately surrounding countryside and nearby settlements. Associated changes in land use such as the conversion of woodland to highway will also alter the character of specific areas within the study area landscape. However, it is considered that the scheme will interact with already relatively developed areas.

5.5.4 Route Comparison

When considering the potential route options, the landscape impacts for the options are considered to likely be similar.

The potential impacts upon visual amenity of the options are also considered to be similar as the visual receptors for the routes are likely to be the same.

5.6 Land Use

This section will consider the effects of the Link Road on a number of aspects, including:

- Demolition of private property;
- Loss of community land;
- Effects on development land; and
- Effects on agricultural land and Environmentally Sensitive Areas.

5.6.1 Demolition of Private Properties

No direct impacts on private buildings are anticipated, so no demolition would be required.

5.6.2 Loss of Community Land

No community land would be affected by the Link Road options.

5.6.3 Effects on Development Land

The area comes within the South Norfolk Council administrative area. Their currently adopted plans are in the Local Development Framework (LDF), previously known as the Local Plan. The LDF is due to be superseded by a new document, on which South Norfolk Council are currently consulting. This will also be called the Local Plan.

The route options lie within the Costessey Parish. The land to the east of the A47 is also designated as Southern Bypass Landscape Protection Zone.

The upcoming Local Plan, which has yet to be adopted, does not include for any development land that would be affected by the proposed Link Road. The Longwater Employment Area to the east of the proposed Link Road is an established site for development of class B1, B2 and B8 employment uses.

5.6.4 Effects on Agricultural Land

No Agricultural land would be directly affected by the Link Road options.

No Environmentally Sensitive Areas would be affected by the Link Road options.

5.6.5 Route Comparison

In this section it is not possible to differentiate between the route options as they will have similar, if not the same effects.

5.7 Noise and Vibration

When considering noise and vibration, DMRB states that:

'Traffic noise is a general term used to define the noise from traffic using the road network'.

'A road project has the potential to cause both increases and decreases in traffic noise on an existing road by altering the traffic composition. In the case of a new road, for example a bypass, a completely new noise source can be created'.

As with the air quality assessment described in a previous section, noise and vibration are directly linked to traffic volumes and characteristics. No traffic model is available, so no detailed input can be given in terms of noise impacts

5.7.1 Baseline Conditions

The land use of the surrounding area is a mixture of commercial, cultural, leisure, community and residential areas. The site is bounded by the A47 and the A1074 and the Longwater Interchange which means there is already significant traffic and background noise in the vicinity of the Site. The other major sources of noise are the commercial industrial units along Ernest Gage Avenue including the EMR scrapyard to the south of the proposed Link Road and the NEWS Material Recycling Facility to the west of the Site.

The nearest residential dwellings are located at the new Lodge Farm housing estate, approximately 200m south east of the proposed development and the Caravan Site approximately 550m east.

5.7.2 Impact identification

During construction it is expected that there will be a temporary increase in local noise associated with the construction activities and increased related traffic movements that may impact noise sensitive receptors. There is also potential for vibration from demolition activities.

During the operational phase, the proposed development will reduce traffic congestion within the Longwater Interchange and thus there is potential for reduction in noise levels within the area.

Lodge Farm along the A47 is most likely to be affected, due to the proximity of the Link Road and the potential change in noise levels, a detailed assessment of the impacts here will be required.

As with the Air Quality section above, there may be effects on the commercial and industrial properties in the vicinity of the Longwater Interchange so further assessment is likely to be required, once traffic details are available.

5.7.3 Route Comparison

Overall there is little else to differentiate between the route options in regard to the potential noise impacts to nearby sensitive receptors.

It is recommended, when an option is selected, further assessment on the potential noise effects should be undertaken.

5.8 Pedestrians, Cyclists, Equestrians and Community Effects

The main transportation route in the study area is the A47 which, with the A1074, connects Norwich to Easton and King's Lynn and other towns beyond the study area to the West. Settlements to the north or south of the A47 within the study area are served by a network of B and C roads which connect to the A47 at the Easton roundabout or the Longwater Interchange. A park and ride scheme at the Longwater Interchange also connects this area to Norwich and its fringe settlements. There are no rail routes, major

Public Rights of Way (PROWs) or regional trails within the study area, although the Rivers Wensum and Yare serve as recreational waterways.

5.8.1 Impact Identification

At peak times the local network suffers from traffic congestion (see **Chapter 6**) and there are particular issues for vehicles approaching Longwater Interchange on William Frost Way. The aim of the proposed Link Road would be to provide relief to William Frost Way by providing a second access to Longwater Employment Area.

5.8.2 Route Comparison

There is little to differentiate the route options been considered as they run along very similar routes, both connecting the A1074 Dereham Road to Ernest Gage Avenue to the north.

5.9 Vehicle Travellers

Assessment of the impacts on vehicle travellers is made in terms of both the view from the road and driver stress. As with the above section, it is not necessary to consider the effects and impacts of the six route options individually.

The view from the Link Road would, as a function of its required height, be positive, as wider views would be afforded. Conversely, the view from the road of a user of the A47 and other, nearby minor roads, would not be affected.

On the assumption that the proposed scheme achieved its aims and freed up congestion for at least some movements at the Longwater Interchange, then the impact on driver stress should generally be positive. Aside from the construction period, when congestion would likely get worse temporarily, the smoother running traffic should result in higher average speeds and quicker journeys through the junction, reducing the stress that comes with congestion, low speeds, driver uncertainty etc.

5.10 Water Resources and Drainage

This section considers four specific aspects of the water environment, and how the proposed alternatives may affect it. At this stage it is not necessary to differentiate between the four alternatives. It assesses:

- Effects of Routine Runoff on Surface Waters;
- Effects of Routine Runoff on Groundwater;
- Pollution Impacts from Spillages; and
- Flood Impacts

The impacts of pollution are a significant factor for consideration. DMRB acknowledges that

"Pollution from road drainage can arise from a variety of sources including: collisions, general vehicle and road degradation, incomplete fuel combustion, leaks of oil, fuel or other pollutants, fires and atmospheric deposition."

It describes four types of pollution event, namely:

- Diffuse pollution, whereby ongoing low levels of contaminants/pollutants occur over a large area, or from a number of point sources. Road runoff is generally considered as diffuse pollution;
- Acute pollution, associated with specific events such as traffic accidents where fuel enters the water system, or spikes in salt loading, for example during periods of very cold weather;
- Chronic pollution, which is the result of ongoing low levels of pollutants resulting in non-lethal pollution. Effects are likely to include reduced feeding rates and fecundity of organisms in affected water; and
- Routine runoff, the normal runoff from roads that may include the contaminants washed off the surface in a rainfall event and can result in either acute or chronic impacts. It excludes the effect of spillages and major leaks which usually result in acute impacts.

All of the above types of pollution have the potential to adversely affect both surface water and ground water.

5.10.1 Baseline Conditions

5.10.1.1 Hydrology

The nearest surface water feature is approximately 46 m to the north of site and is a drain running along the public pathway to the north of the scrapyard that discharges water to an area beyond the northern boundary of Costessey Landfill Site. A pond is present approximately 350 m to the northeast, located just south of River Tud at approximately 400 m to the northeast. The River Tud flows to the southeast where it joins River Wensum approximately 4 km downstream, as shown on **Drawing MMD-326109-C-DR-00-XX-0014** in **Appendix A**.

5.10.1.2 Hydrogeology

The regional hydrogeology has been assessed using the Environment Agency Groundwater Vulnerability map for the area which indicates that the Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation (Undifferentiated) bedrock beneath the site has been classified as a Principal Aquifer. These are *"layers of rock or drift deposits that have high intergranular and/or fracture permeability – meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale."*

The superficial deposits comprising Glacial Sand and Gravel that are present within site are classified as Secondary Aquifer. These are *"permeable layers capable of supporting water supplies at a local rather*

than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers".

The superficial deposits comprising Lowestoft Till that are present approximately 600m to the southwest of site are classified as Unproductive Strata.

The Groundwater Vulnerability map East Norfolk, Sheet 26 (scale 1:100,000) indicates that the soils within the site footprint have three different soil classifications. The northern section of site is classified as *"High Leaching Potential (U) – Soil information for restored mineral workings and urban areas is based on fewer observations than elsewhere. A worst case vulnerability classification (H) assumed, until proved otherwise".* The middle section of site is classified as *"High Leaching Potential (H3) – Coarse textured or moderately shallow soils which readily transmit non-absorbed pollutants and liquid discharges but which have some ability to attenuate absorbed pollutants because of their large clay or organic matter contents".* The southern end of the site is classified as *""High Leaching Potential (H2) – Deep, permeable, coarse textured soils which readily transmit a wide range of pollutants because of their rapid drainage and low attenuation potential".*

Source Protection and Zone III (Total Catchment) are shown present approximately 500m southeast and 1km northwest of site.

5.10.1.3 Flood Risk

The Site falls within Flood Zone 1 which is defined as the areas with low probability of flooding from river or sea. There is no record of historical flooding for the Site.

The site and surrounding areas within 250m of site are free from flooding. The area along the River Tud is vulnerable to extreme flooding (Zone 2), as shown on **Drawing MMD-326109-C-DR-00-XX-0014** in **Appendix A**. There are no areas benefiting from flood defences and no water storage areas within the study locality or the surrounding area.

5.10.2 Impact Identification

Potential impacts on water resources resulting from the construction of the proposed options include:

- Physical alteration to land drainage networks following the construction of new roads or the widening of existing roads may increase flood risk by increasing surface runoff; and
- Soil disturbance within the vicinity of Costessey Landfill Site may mobilise pollutants leading to the contamination of surface waters and groundwater protection zones with detrimental consequences for water quality and aquatic ecology both locally and off-site.

The proposed development has the potential to have adverse effects on water resources including groundwater as it crosses areas of high leaching potential soils and unconfined main aquifers, and are

within close proximity of private abstraction sites. Further details are provided in **paragraph 5.11** and **Chapter 4**.

During operation there is a potential risk of contaminated material being mobilised by the runoff from the road and being released to the water environment.

Best practice in terms of road drainage design, coupled with the many and numerous pieces of legislation relating to water quality and quantity (for example the Water Framework Directive, and the upcoming establishment of the SuDS approvals Board), mean that the majority of the impacts associated with the above issues will be considered as the detailed design progresses.

Consultation with the Environment Agency will be required as the scheme progresses, and input from water quality and drainage specialists sought early on in the design and assessment process.

5.10.3 Route Comparison

In consideration of potential effects and impacts related to water resources there are no significant differences between the route options that would differentiate them from each other.

5.11 Geology, Soils and Contaminated Land

5.11.1 Baseline Conditions

The land area of the proposed scheme is underlain by Turonian to Campanian aged white chalk which is the dominant solid geological substratum for much of the land to the west of Norwich. Overlying this substratum are the superficial deposits of the Happisburgh Glacigenic Formation and the Lowestoft Formation, both of which consist of sands, gravels and tills and extend to variable depths of approximately 20 and 60 m respectively. The Site will not over lay any features of special or protected geological interest.

The vast majority of the proposed route will be based on “brownfield” land and will dissect the Costessey Landfill Site, which covers 15 ha in total. These sites were in operation between 1986 and 2007 and can thus exhibit a range of engineering styles which were employed during the burial of 2,100,000 tonnes of waste. Since their closure, these sites have experienced long-standing issues with gas migration along their eastern boundary and these issues have yet to be resolved despite various interventions. Following treatment, leachate volumes are now in line with compliance and there are plans to improve drainage in order to reduce surface water ingress. Within 250m of the proposed route there is another landfill site, the Longwater Pits. This latter site is still in operation and has gas control measures in place.

5.11.2 Impact identification

Contaminated land is a particular issue during the construction stage, when ground is disturbed and relocated causing potential remobilisation and spread of contamination and/or creation of new pollution pathways. There is a high potential for disturbing contaminated land, namely Costessey Landfill Site. The disturbance of such landforms during construction operations may result in the mobilisation of pollutants

with the potential to contaminate nearby soils and water courses, groundwater aquifers, and the above-ground atmosphere. Such contamination has the potential to affect ecological and human receptors beyond the scheme boundary, for example via windblown contaminated dusts generated during excavation works. The potential impacts of disturbing these sites in relation to watercourses have been discussed above (see **Section 5.4**).

5.11.3 Route Comparison

In consideration of potential effects and impacts related to geological, soils and potential contaminated land factors it is considered that the Green Routes are considered to have significantly smaller potential for disturbing contaminated land at the Costessey Landfill Site in comparison to the Blue or Orange Routes.

5.12 Conclusions and Mitigation

During the development phase the requirement for an Environmental Impact Assessment (EIA) and the requirement for the preparation of an Environmental Statement for the Project will be considered once the details of the proposed Link Road have been confirmed.

The Town and Country Planning (Environmental Impact Assessment) Regulations 2011 (the 'EIA Regulations') and the Highways Act 1980 require an EIA to be carried out for two broad categories of projects given in Schedules 1 and 2. For Schedule 1 projects, an EIA is required in every case. A Schedule 2 project requires an EIA if it is deemed 'likely to give rise to significant environmental effects'.

The above process will determine if an EIA is required, At this point a full Scoping Report to DMRB guidelines will be produced. Alternatively, as the scheme extents are fairly confined and optioneering will have already taken place, it may be that it is deemed more appropriate to instead move directly to a Simple Environmental Impact Assessment. This report would need to closely follow the DMRB guidelines and requirements, at the same time incorporating and expanding on the contents of this report.

Overall, in consideration of the differences in the routes, the Green Routes are considered to have the least potential for environmental impacts to occur as they are routed at the edge of Costessey Landfill Site thus minimising the disturbance to contaminated land as compared to the Orange and Blue Routes.

The disturbance of contaminated land during strategy construction operations may result in the mobilisation of pollutants with the potential to contaminate nearby soils and water courses, groundwater aquifers, and the above-ground atmosphere. Such contamination has the potential to affect ecological and human receptors beyond the scheme boundary and will need to be mitigated. Close consultation will be required with the Environment Agency from an early stage. The extensive, serious contaminated land aspects of the scheme, unavoidably associated with the landfill, are likely to require extensive mitigation and construction methodologies, far beyond those for a standard road construction, with a corresponding increase in construction costs.

The proposed development has the potential to have a visual impact. The scale of the impact will be dependent on the final location, road alignments, nearby receptors and the potential for the retention of provision of natural screening. There may be temporary construction adverse and permanent adverse

impacts on the landscape through damage or removal of local vegetation and woodland, and visual impacts from the use of tall plant.

The presence and location of protected species within the strategy area is unknown at this stage. It is recommended that a Preliminary Ecological Appraisal based on the outcome of the Stage 2 Assessment is carried out for individual developments within the strategy area once the final options have been identifies. Following this survey further botanical or protected surveys will be recommended and will also inform further environmental assessments.

A Flood Risk Assessment may be required to accompany the planning submission for the final options. This assessment needs to conform to the guidance in PPS25 which is designed to ensure that the level of flood risk is acceptable and that the development will not adversely affect the wider flood zone. Early consultation with the Environment Agency is recommended during the design process so that any constraints on design are taken into account.

Landscape mitigation proposals are likely to be required to support the planning applications. This could include planting areas, planting types, and specification and maintenance requirements. Most landscape schemes require a five year maintenance period as part of the planning conditions and the client should make allowances for this in their budgeting.

There are seasonal constraints for surveys and mitigation for each protected species and this constraint needs to be included in the programme under planning and environmental impact assessment, and should be considered against the overall design and construction timeframe.

6 Traffic and Economic Assessment

6.1 Existing Conditions

6.1.1 Traffic Demand

The Longwater Interchange is a strategically important junction, with relatively high volumes on three of the five roads that converge at the Interchange:

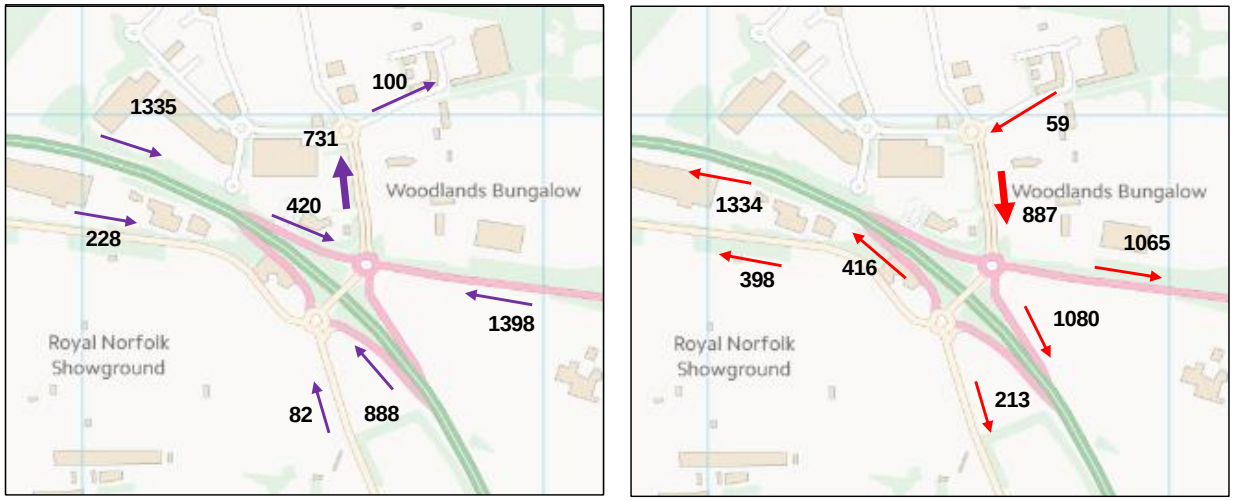
- A47 (via the eastbound and westbound off-slip roads);
- A1074 Dereham Road to/from Norwich city centre to the east; and
- William Frost Way to/from the retail, housing and employment areas to the north.

The other two roads mainly serve local destinations:

- Long Lane to/from the Costessey Park & Ride site and village of Bawburgh to the south; and
- Dereham Road to/from the village of Easton to the west.

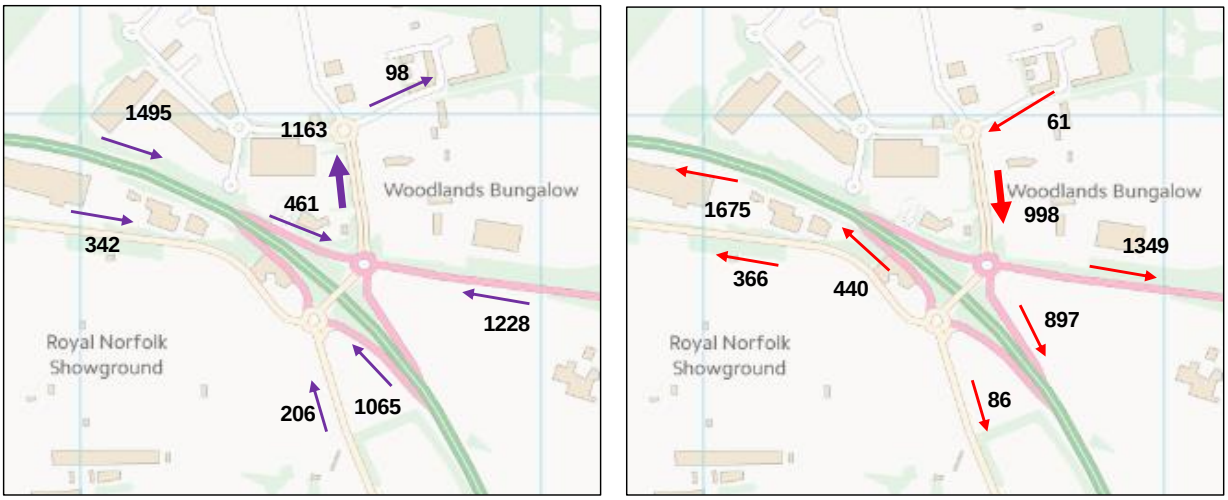
Figure 6.1 and **Figure 6.2** show the traffic volumes entering and exiting the Longwater Interchange for the morning and evening peak hours (08:00-09:00 and 17:00-18:00 respectively). Turning movement volumes at the Interchange northern roundabout are detailed in Table 6-1.

Figure 6.1: 2013 AM Peak Hour traffic volumes (PCUs/hour)



Source: Traffic count 30 April 2013

Figure 6.2: 2013 PM Peak Hour traffic volumes (pcus/hour)



Source: Traffic count 30 April 2013

Table 6-1: 2013 Northern Roundabout Peak Hour turning movements (PCUs/hour)

0800-0900

From / To	A	B	C	D	E	
A - A47 Off-slip	0	134	267	0	20	420
B - William Frost Way	0	2	340	398	146	887
C - A1074	0	349	8	591	450	1398
D - A47 On-slip	0	0	0	0	0	0
E - Overbridge	0	247	450	91	0	787
	0	731	1065	1080	616	3492

1700-1800

A - A47 Off-slip	0	158	297	0	6	461
B - William Frost Way	0	1	457	354	186	998
C - A1074	0	564	0	382	282	1228
D - A47 On-slip	0	0	0	0	0	0
E - Overbridge	0	439	596	162	0	1196
	0	1163	1349	897	474	3883

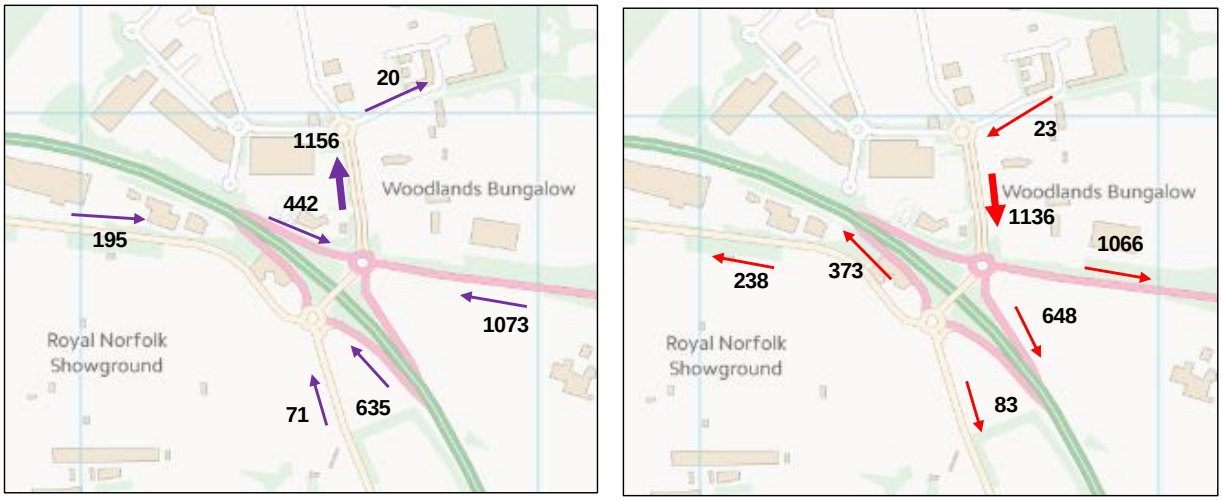
Source: Traffic count 30 April 2013

Ernest Gage Avenue is currently solely an access road serving industrial units from the roundabout on William Frost Way, as such its traffic demand is relatively low at around 100 PCUs/hour or less, even during the peak periods.

The above traffic data were collected on Tuesday 30 April 2013 which was considered a typical weekday in a neutral month. As such, the data are considered to be representative of existing conditions and suitable for use as baseline traffic demand.

The Interchange is also busy at weekends, associated with the retail development accessed via William Frost Way. Traffic counts are also available covering the Saturday lunch time period on 8 June 2013, with the highest volumes from 12:15-13:15, as shown in **Figure 6.3.**

Figure 6.3: 2013 Saturday Peak Hour traffic volumes (PCUs/hour)



Source: Traffic count 8 June 2013

Whilst there are automatic traffic counters on the A47 that could be used to illustrate daily and seasonal variations in traffic demand, these sites are unlikely to be representative of demand at Longwater as the A47 is a strategic route. It is understood that there is not a long term automatic traffic count site available on the A1074 or A47 slip roads that would be more appropriate.

6.1.2 Traffic Congestion

The Longwater Interchange currently experiences limited traffic congestion and generally congestion only occurs during the peak hours. Queue surveys were undertaken at the same time as the traffic count and showed minimal queuing in the AM peak period. During the PM peak period there was consistently a queue of up to 60m on the A47 eastbound off-slip. The introduction of a free-flow left turn slip road from William Frost Way southbound onto Dereham Road eastbound has reduced queueing on William Frost Way considerably (**Figure 6.4** and **Figure 6.5**).

From observations on site, under 'normal' operation there is limited queuing on the approach roads. However, congestion and slow-moving traffic on the eastbound A1074 **(Figure 6.6**) often presents a constraint to traffic exiting the Interchange in this direction. When this occurs, long queues can then develop on the eastbound A47 off-slip (**Figure 6.7**).

Figure 6.4: William Frost Way before introduction of free flow left turn

Source: Mott MacDonald

Figure 6.5: William Frost Way after introduction of free flow left turn

Source: Mott MacDonald

Figure 6.6: Queuing on Eastbound A1074 obstructing movements at Longwater Interchange

Source: Mott MacDonald

Figure 6.7: Queuing on A47 Off-slip

Source: Mott MacDonald

At the southern roundabout of the Interchange, queuing occurs on the westbound A47 off-slip during the PM peak period. The volume of traffic circulating past this arm is relatively low but the queuing is a result of the majority of traffic on the slip road wanting to travel to the north of the Interchange and only using one lane of the slip road **(Figure 6.8**). This is despite the layout being changed recently to encourage use of the two lanes on the slip road for this movement.

Minimal queuing occurs on the Dereham Road entry to the southern roundabout in both peak periods and queuing only occurs on Long Lane for short periods after a bus has dropped off drivers at the Park & Ride site in the evening peak period **(Figure 6.9**).

Figure 6.8: Queuing on A47 Westbound Off-Slip

Source: Mott MacDonald

Figure 6.9: Queuing on Long Lane due to traffic exiting the Park & Ride site

Source: Mott MacDonald

During weekday inter-peak and off-peak periods, it is understood that congestion and queuing at the Interchange is not significant, other than under abnormal conditions, such as an event at the nearby Norfolk Showground. However, limited queuing also occurs during the peak periods on Saturday.

6.1.3 Road Safety

Figure 6.10 shows all of the personal injury accidents (PIAs) that have occurred in the study area over a five year period (1 September 2008 – 31 August 2013). There have been a total of 3 PIAs resulting in serious injury (shown as blue squares) and 31 PIAs with slight injury (green circles); no fatal accidents have occurred in the five year period.

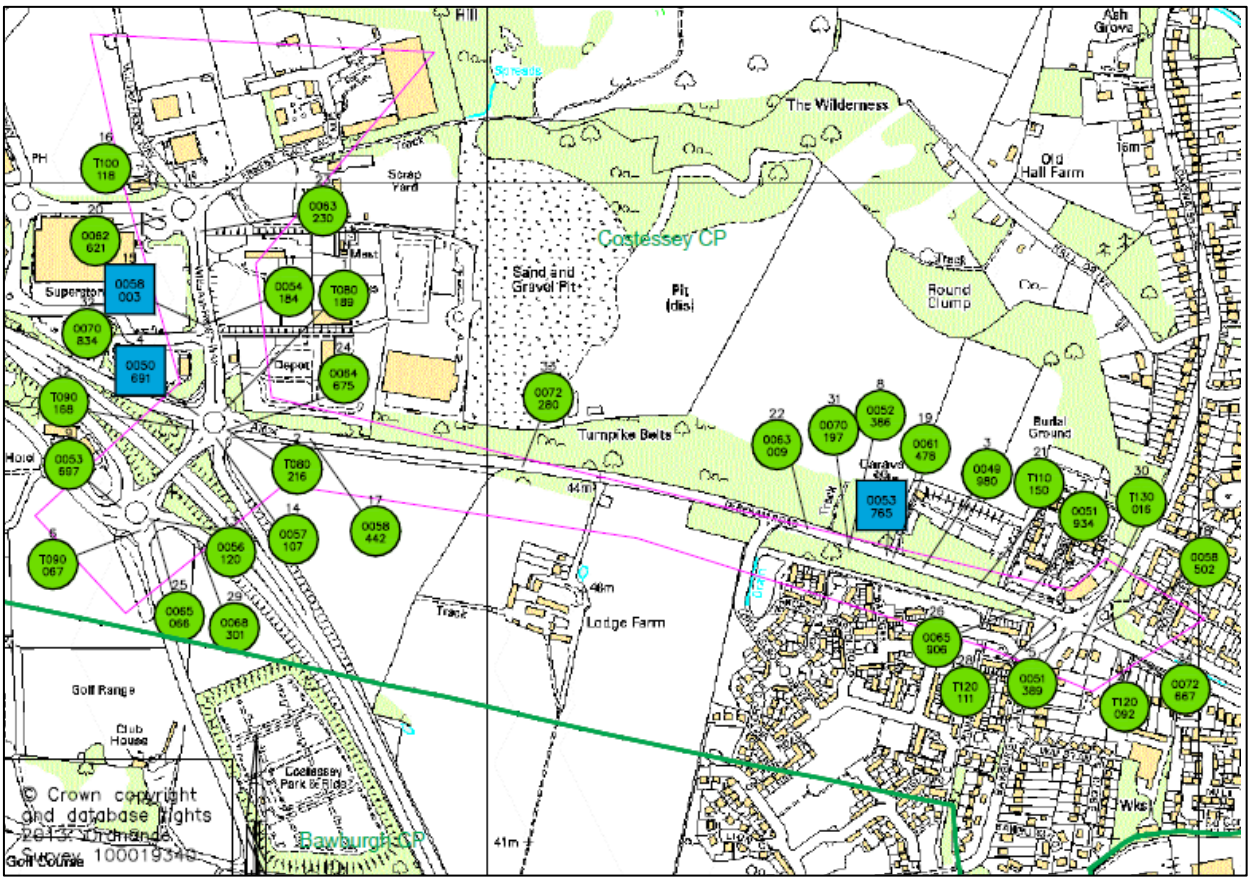
Table 6-2 summarises the location and severity of the PIAs:

Table 6-2: Location and Severity of Personal Injury Accidents (1 Sept 2008-31 Aug 2013)

Location	Serious injury	Slight injury	Total
Longwater Interchange Northern roundabout	1	5	6
Longwater Interchange Southern roundabout	0	5	5
William Frost Way and Ernest Gage roundabout	1	5	6
Longwater Lane signalised junction	0	8	8
A1074 between the junctions	1	8	9
Total	3	31	34

Source: Mott MacDonald analysis of data provided by Norfolk County Council

Figure 6.10: Location of Personal Injury Accidents (1 Sept 2008-31 Aug 2013)



Source: Norfolk County Council

An improvement scheme was completed in 2013 at the Longwater Interchange, primarily comprising changes to road markings to address road safety issues associated with the lanes used for particular turning movements and lane discipline. The scheme also introduced a free-flow left turn lane from William Frost Way onto the eastbound carriageway of Dereham Road. It is too early to assess if the scheme has been successful in reducing accidents. It is understood that no other road safety improvement schemes are planned in the study area.

6.2 Future Conditions

6.2.1 2013 Forecast

The original forecast for the future traffic demand in the study area was carried out in 2013, using a 'first principles' approach. Traffic demand was estimated for 2026, in line with the end of the plan period for the

JCS. The trip generation of potential new developments in the area was calculated using trip rates from the TRICS database for the following sites that either already had planning permission or were allocated in the JCS:

- Lodge Farm housing - Phase 1 (completion) and Phase 2 (allocated);
- Queens Hill housing (completion);
- South and east of Easton housing (allocated); and
- Longwater Employment Area (allocated).

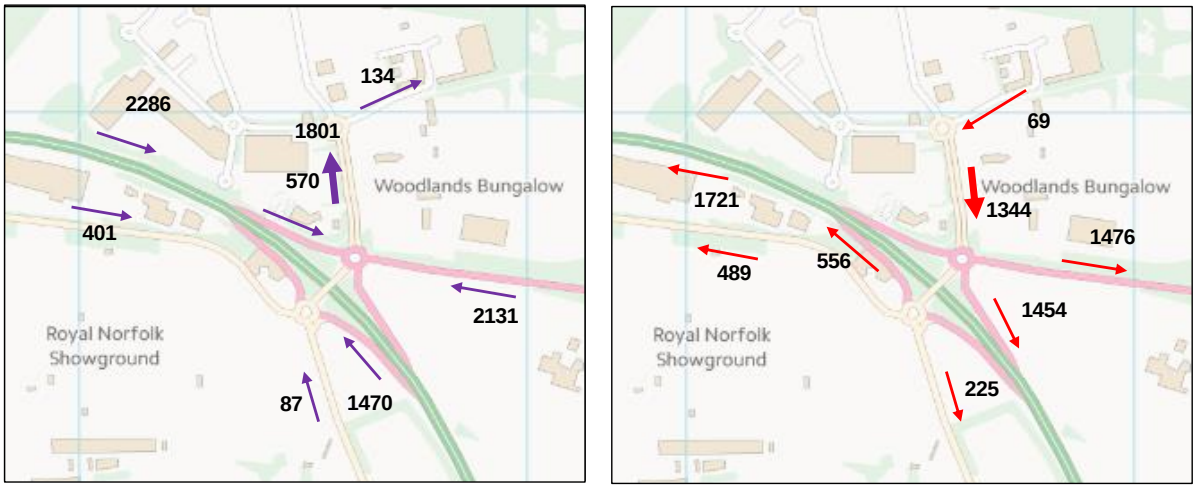
Allowance was also made for a new retail development in Longwater, the re-occupation of a former industrial site east of Easton and a potential 'Food Hub' development to the west of Easton (on a scale in line with the JCS).

As the trips from all potential development in the area had already been added, TEMPRO data was only used for traffic growth due to higher levels of car ownership and relative fuel costs. The 'alternative development' scenario within TEMPRO with the increase in housing and jobs set to zero allowed the background growth for the Rural South Norfolk area for Urban Principal Roads to be estimated.

The distribution of new development trips onto the road network around Longwater was estimated using separate data sources for the housing and the employment trips. Travel to work data from the 2001 Census was used (2011 data had not yet published) to estimate the home origin of trips to the proposed employment area. The distribution of new housing trips was based on a recent survey of existing residents of the Lodge Farm Phase 1 development.

Using the above distributions, the predicted trips generated by the future developments were assigned onto the existing road network. With the addition of background traffic growth applied to existing trips, this resulted in the predicted 2026 volumes shown in **Figure 6.11** and **Figure 6.12**

Figure 6.11: 2026 AM Peak Hour Traffic Volumes (PCUs/hour)



Source: Mott MacDonald analysis

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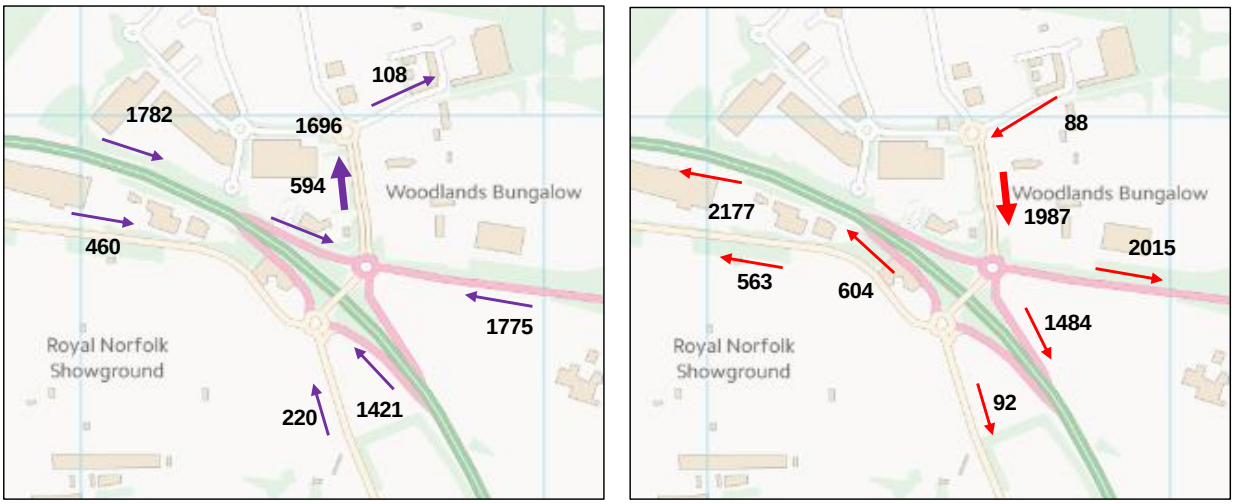
Figure 6.12: 2026 PM Peak Hour Traffic Volumes (PCUs/hour)



Source: Mott MacDonald analysis

It is recognised that the assumptions used for the forecasting will have a large effect on the pattern of trips over the wider area. Changes to the distribution of trips could occur for a number of reasons eg a proportion of traffic to/from the city centre could switch onto the A47 due to congestion along the whole length of the A1074 corridor. As such, a sensitivity test was used to give a range of predicted demand on the Link Road, based on a shift of 10% in overall percentage from A1074 to A47, as detailed in **Table 6.3** .

Table 6.3: Predicted Traffic Demand for the Link Road (PCUs/hour)

Trip	Original distribution assumptions	Sensitivity Test with less traffic using A1074
AM Peak westbound	550	510
AM Peak eastbound	830	730
PM Peak westbound	900	800
PM Peak eastbound	840	800

Source: Mott MacDonald analysis

6.2.2 2015 Forecasts

The impact of the Link Road as part of a package of improvements to the Interchange was analysed in the report 'Longwater Easton Transport Strategy – Further Assessment', dated August 2015. This reviewed the impact of the Link Road considered together with a double 'tear drop' at the Interchange roundabouts using the latest SATURN traffic model that was developed and used for the assessment of the Norwich Northern Distributor Road. For the purpose of this assessment, the matrices from the recent Norwich City Centre Measures study were used for running the model.

In carrying out this work, the SATURN coding of the Longwater Interchange, the two signalised junctions to the east and one signalised junction to the west of this junction were fined-tuned with the geometric parameters extracted from the latest engineering drawings. The signal timings were then optimised for all of these junctions during the morning peak, evening peak and inter peak periods.

A Do Nothing scenario was prepared based on a network which contains the Northern Distributor Road together with the series of Norwich City Centre Measures described in the 'NATS City Centre Measures Report', dated April 2015. This was then developed into a Do Minimum scenario by adding:

- Free-flow left turn from William Frost Way to eastbound Dereham Road;
- Longwater Lane Traffic Signals improvement;
- Free-flow left turn from Dereham Road to A47 eastbound on-slip;
- Longwater 'Tear drop' at South roundabout;
- A1074 Dereham Road widening (west section);
- A47 eastbound off-slip 2 lanes to Dereham Road; and
- Improvements to Easton Roundabout.

A Do Something scenario has then been created through adding an alternative access to the Longwater Employment Area, in the form of a Longwater Link Road, and a double 'tear drop' arrangement at Longwater Interchange itself.

The predicted traffic demand on the Link Road is shown in **Table 6.4**. This differs from the predictions made in the initial forecast due to differences in the assumptions, particularly in the nature of development at the Longwater Employment Area (change from B1 office to less intensive B1/B2/B8 use).

Table 6.4: Revised Predicted Traffic Demand for the Link Road in 2032

Direction	AM Peak (PCUs/hour)	PM Peak (PCUs/hour)	AADT (vehicles)
Westbound	308	271	5,500
Eastbound	254	266	

Source: Mott MacDonald analysis

6.3 Effect of Options

The updated forecast shows that the Link Road will provide a convenient route for traffic travelling between the Longwater / Queens Hill area and A1074 to the east. It is likely to remove 250-300 PCUs/hour in each direction at peak times from the Longwater Interchange and carry a total of 5,500 vehicles per day. This will result in a significant reduction in traffic congestion.

Testing in LINSIG has shown that taken together with the double 'tear drop' arrangement at Longwater Interchange, the package as a whole would result in the Interchange operating at ratios of flow to capacity of 83% and 81% in the AM and PM peak hours respectively. These are below the maximum acceptable RFC value of 90%. This contrasts with Do-Minimum forecast ratios of flow to capacity of 100% and 111% respectively by 2032, reaching and exceeding capacity.

Given the scale of increase in traffic volumes anticipated, there is the risk that congestion at the Longwater Interchange could result in blocking back from the A47 slip roads onto the main carriageway. This would clearly lead to increased delays for many more drivers and a significant road safety problem, placing more importance on solving the congestion problems.

If the congestion problem cannot be solved, the issue of allowing major new developments in the area to go ahead is brought into question. Without these developments, the economy of the city and county as a whole is likely to be affected.

In terms of the difference between the alignment routes presented for the Link Road itself, for traffic flow and congestion, this relates to the location of its junction with the A1074 Dereham Road:

Orange would provide staggered signalised junctions each with three arms. The Link Road junction would be approximately 80-100m to the east of the Lodge Farm 2 residential access road, creating a right/left stagger between the minor roads.

Green would provide staggered signalised junctions each with three arms. The Link Road junction would be approximately 90m to the west of the Lodge Farm 2 residential access road, creating a left/right stagger between the minor roads.

Blue would provide staggered signalised junctions each with three arms. The Link Road junction would be approximately 170m to the east of the Lodge Farm 2 residential access road, creating a right/left stagger between the minor roads.

At this stage, no change in overall traffic patterns between the three options can be estimated. In traffic terms, the main difference is in the relative positions of the joining minor roads. The Green Route options

place the junction west of the junction with Lodge Farm 2, resulting in traffic between the Link Road and Lodge Farm turning left onto the main road and then right (in both directions). The Design Manual for Roads and Bridges, Volume 6, Section 2, Part 3, clause 5.24 notes that "a left/right stagger will usually have difficult traffic conflicts which could have an adverse effect upon safety". In contrast, the Orange and Blue Routes place the junction with Dereham Road to the east of the Lodge Farm 2 junction, creating a right/left stagger.

Therefore, purely on safety grounds, the preferred options are the Orange Route and the Blue Route, whilst the Green Route is ranked lowest.

6.4 Economics

The main benefits of the Link Road will be to reduce junction delays at the Longwater Interchange and on the A1074. Whilst it is not possible to quantify the effect on journey times at this stage, it is clear that traffic using the Link Road will benefit. It is also clear that the level of reduction in traffic demand through the Interchange will also provide significant benefit to all other trips passing through the Interchange.

The Link Road may also provide accident savings by removing traffic from the very busy northern roundabout of the Longwater Interchange and from William Frost Way, which have had 12 personal injury accidents between them over the last 5 years.

Benefits to the economy of the area are likely to result if the Link Road forms part of an overall strategy to tackle traffic congestion which allows the proposed employment and housing developments to go ahead.

Given that it is an offline route, any delays to traffic using the A1074 and Longwater Interchange during construction of a Link Road are likely to be minimal, other than its tie in with the A1074.

7 Conclusions

This report documents a Stage 1 Assessment that has been carried out, in accordance with the Highways Agency standard TD37/93 'Scheme Assessment Reporting', to establish baseline conditions and key constraints associated with the development of a potential Longwater Link Road. This scheme would provide a new single carriageway link between the A1074 Dereham Road and Ernest Gage Way in the Longwater Employment Area.

7.1 Outline Scheme Development

Six route options have been developed for the Longwater Link Road and they all take the form of a single carriageway. The route options were studied by NCC's Landfill team and 3 were eliminated leaving the following:

- Orange route option 1 runs east from the northern arm of Ernest Gage Avenue, from a point near the access to the EMR scrapyard and Norfolk Cement, the route then turns in a south easterly direction towards NEWS Material Recycling Facility before turning south eastwards across the Costessey Landfill Site and then heading southwards to join the A1074 Dereham Road.
- Green route option 1 runs eastward from the northern arm of Ernest Gage Avenue, from a point near the access to the EMR scrapyard and Norfolk Cement the route turns eastwards towards a proposed roundabout located on the northeast corner of the old scrap yard. From the roundabout the alignment heads in a south easterly direction and cuts the corner of the existing NEWS facility, this will require moving the weighbridge and realigning the existing infrastructure on the NEWS site. From this point the route runs along the western edge of the Costessey Landfill Site, adjacent to the NEWS site, continuing to join the A1074 Dereham Road.
- Blue route option 2 runs eastward from the northern arm of Ernest Gage Avenue, from a point near the access to the EMR scrapyard and Norfolk Cement. It continues to head eastwards until it meets the existing soakaway where it turns south eastwards across the landfill site to join the A1074 Dereham Road at a new junction.

Preliminary cost estimates for these route options have been provided and are displayed in **Table 3.1**. The costs come in at approximately £19.3M for orange route option 1, £9.5M for the green route merged (worst case scenario) and £92.2M for the blue route option 2. These values exclude the cost of land purchases and costs for gas and leachate control.

It can be seen that the merged green route provides significant cost savings over the orange and blue routes. It was also identified that the cost of this route could potentially be reduced further with minor amendments. By removing the shared use facility along the southern arm of the roundabout the impacts on landfill phase 3 would be considerably reduced and in turn reduces the associated costs. Based on the cost estimates in **Table 3.1** NCC's Landfill team have identified a potential cost saving in the region of £635k to the Merged Green Route if this modification was made. Furthermore if the road alignment was moved westwards of landfill phases 1 and 2 another significant saving on cost and time could potentially be made. These recommendations should be taken forward to subsequent assessment stages.

7.2 Ground Conditions

A phased site investigation will be necessary in order to determine the ground conditions along the route and within the areas of worked ground. The objectives of the GI should allow the following tasks to be undertaken:

- Assessment of the Landfill, Made Ground, Glacial Sand and Gravel and Glacial Till as a bearing stratum;
- Assessment of the suitability of the Made Ground, Glacial Sand and Gravel and Glacial Till for reuse on site;
- Assessment of the groundwater levels below site and the effect this may have on the proposed development;
- Assessment of the potential for sulphate attack on buried concrete from existing ground and groundwater conditions; and,
- Assessment of the risk from contaminated land, groundwater and ground gases to human and environmental receptors.

The results from the GI should allow the preliminary contamination risk assessment, preliminary engineering assessment and geotechnical risk register presented in Section 5, 7 and 9 of the PSSR[11] to be updated. It should also allow the engineering issues at the site to be addressed, be suitable to allow the undertaking of a quantitative risk assessment and permit identification of any contamination remediation requirements and expected remediation costs.

With the limited information available, it is best practice to follow a staged approach to ground investigations, to avoid any unnecessary risks associated with the unknown waste, to allow time for development plans to evolve and to allow hazards at the site to be investigated in increasing detail as information on the ground risks for the development become clearer. The phasing should allow better and more effective targeting of the investigations, and has the advantage of spreading capital expenditure over time.

The planning of this GI is subject to change and is dependent on whether more information would be made available before its commencement. An initial GI proposal is presented in Section 10 of the PSSR[12].

7.3 Drainage Design

Consideration will need to be given when choosing drainage solutions so as to minimise the vertical and horizontal migration of contamination within or close to the Costessey Landfill Site. The use of swales, or soakaways should not be considered due to the potential for it to promote the migration of contaminates.

At this stage it is recommended that a completely contained drainage system, piping surface and foul water away from the proposed scheme to a controlled system is used to prevent migration of

contaminates. Furthermore it is recommended that the infrastructure for this system are not embedded in a granular medium but are completely encased in concrete to prevent contaminates such as landfill leachate and ground gas using these zones as conduits.

7.4 Environmental

The requirement for an Environmental Impact Assessment and preparation of an Environmental Statement would be considered once details of the proposed Link Road have been confirmed and it has been established whether it falls within Schedule 1 or 2 of the EIA Regulations.

At this point a full Scoping Report to DMRB guidelines would be produced. Alternatively, as the scheme extents are fairly confined and optioneering would have already taken place, it may be more appropriate to instead move directly to a Simple Environmental Impact Assessment. This report would need to closely follow the DMRB guidelines and requirements, at the same time incorporating and expanding on the contents of the Stage 1 Assessment.

The green routes are considered to have the least potential for environmental impacts to occur as it is routed at the edge of the Costessey Landfill Site thus minimising the disturbance to contaminated land, in comparison with orange and blue routes which would pass through the centre of the landfill.

The disturbance of contaminated land during strategy construction operations may result in the mobilisation of pollutants with the potential to contaminate nearby soils and water courses, groundwater aquifers, and the above-ground atmosphere. Such contamination has the potential to affect ecological and human receptors beyond the scheme boundary and will need to be mitigated. Close consultation will be required with the Environment Agency from an early stage. The extensive, serious contaminated land aspects of the scheme, unavoidably associated with landfill, are likely to require extensive mitigation and construction methodologies, far beyond those for a standard road construction, with a corresponding increase in construction costs.

The proposed development has the potential to have a visual impact. The scale of the impact will be dependent on the final location, road alignments, nearby receptors and the potential for the retention of provision of natural screening. There may be temporary construction adverse and permanent adverse impacts on the landscape through damage or removal of local vegetation and woodland, and visual impacts from the use of tall plant.

The presence and location of protected species within the strategy area is unknown at this stage. It is recommended that a Preliminary Ecological Appraisal based on the outcome of the Stage 2 Assessment is carried out for individual developments within the strategy area once the final options have been identifies. Following this survey further botanical or protected surveys will be recommended and will also inform further environmental assessments.

A Flood Risk Assessment may be required to accompany the planning submission for the final options. This assessment needs to conform to the guidance in PPS25 which is designed to ensure that the level of flood risk is acceptable and that the development will not adversely affect the wider flood zone. Early consultation with the Environment Agency is recommended during the design process so that any constraints on design are taken into account.

Landscape mitigation proposals are likely to be required to support the planning applications. This could include planting areas, planting types, and specification and maintenance requirements. Most landscape schemes require a five year maintenance period as part of the planning conditions and the client should make allowances for this in their budgeting.

There are seasonal constraints for surveys and mitigation for each protected species and this constraint needs to be included in the programme under planning and environmental impact assessment, and should be considered against the overall design and construction timeframe.

7.5 Traffic and Economics

A Longwater Link Road is forecast to remove between 250 and 300 pcus/hour in each direction at peak times from the Longwater Interchange, resulting in a significant reduction in traffic congestion.

However, the Link Road is one element of an overall Transport Strategy that is being developed to address traffic congestion that is anticipated to occur at the Longwater Interchange and on A1074 Dereham Road as a result of increased traffic associated with proposed employment and housing developments in the area. The addition of the Link Road may mean that the scale and cost of improvements otherwise needed for Longwater Interchange can be significantly reduced. The overall conclusion is that the Link Road should have a significant positive impact on reducing congestion, either on its own or as part of other improvements in the Longwater area

In terms of the difference between the three alignment options developed for the Link Road, the main difference is in the relative positions of the joining minor roads. A right/left stagger is inherently safer than a left/right stagger due to the difficult traffic conflicts resulting from the latter configuration. Therefore, purely on safety grounds, the preferred options are the Orange Route and the Blue Route, whilst the Green Route is ranked lowest.

The main benefits of the Link Road will be to reduce junction delays at the Longwater Interchange and on the A1074. Whilst it is not possible to quantify the effect on journey times at this stage, it is clear that traffic using the Link Road will benefit greatly from reduced journey times. It is also clear that the reduction in traffic demand through the Interchange will also provide journey time benefits to all other trips that pass through the Interchange.

There are potential accident savings to be made by the Link Road removing traffic from the very busy northern roundabout of the Longwater Interchange and from William Frost Way, which have had 12 personal injury accidents between them over the last 5 years.

Benefits to the economy of the area are likely to result if the Link Road forms part of an overall strategy to tackle traffic congestion which allows the proposed employment and housing developments to go ahead. Any delays to traffic during construction of a Link Road are likely to be minimal, other than at the tie in with the A1074, as it is an offline route.

References

1. NCC's Standard Detail SD/700/3

2. England and Wales Sheet 161 Norwich, Solid and Drift Edition, 1:50,000, BGS, 2007.

3. Geology of the country around Norwich, Memoir for 1:50,000 geological sheet 161 (England and Wales), BGS, 1989.

4. Geology of Britain viewer, http://mapapps.bgs.ac.uk/geologyofbritain/home.html, BGS, accessed 13/06/13.

5. Borehole Scans Database, http://www.bgs.ac.uk/data/boreholescans/home.html, BGS, accessed 13/06/13.

6. The BGS Lexicon of Names Rock Units, http://www.bgs.ac.uk/lexicon/, BGS, accessed 13/06/13.

7. NCC Mapping Browser, http://nmb.norfolk.gov.uk/, accessed 19/08/13.

8. Costessey Landfill Site Closure Plan Third issued, Document No. 4112/01, NCC, August 2010.

9. Envirocheck Report for New Costessey, Norfolk, Report reference 46894687_1_1, Landmark Information Group, 14th June 2013.

10. Environment Agency website, www.environment-agency.gov.uk, accessed 13/06/13.

11. Longwater Link Road - Preliminary Sources Study Report, 326109BA03/BSE/NOR/001/A, September 2013.

Appendix A. Assessment Drawings

KEY

SITE LOCATION

Costessey Park (Golf Course)

Costessey Park

Community Centre

Recreation Ground

Long Dale

Builders Merchant

Reservoir Hill

Waste Transfer Sta

Weighbridge

Eastern Court

Ambulance Station

Scrap Yard

Scrap Yard

Sand and Gravel Pit

Sand and Gravel Pit

Pit (disused)

Waste Transfer Station

The Wilderness

Old Hall Farm

Round Clump

River View Nurseries

Edgewood

WILLIAM FROST WAY

Ernest Gage Av

A 47

Factory

Garage

Turnpike Bells

A 1074

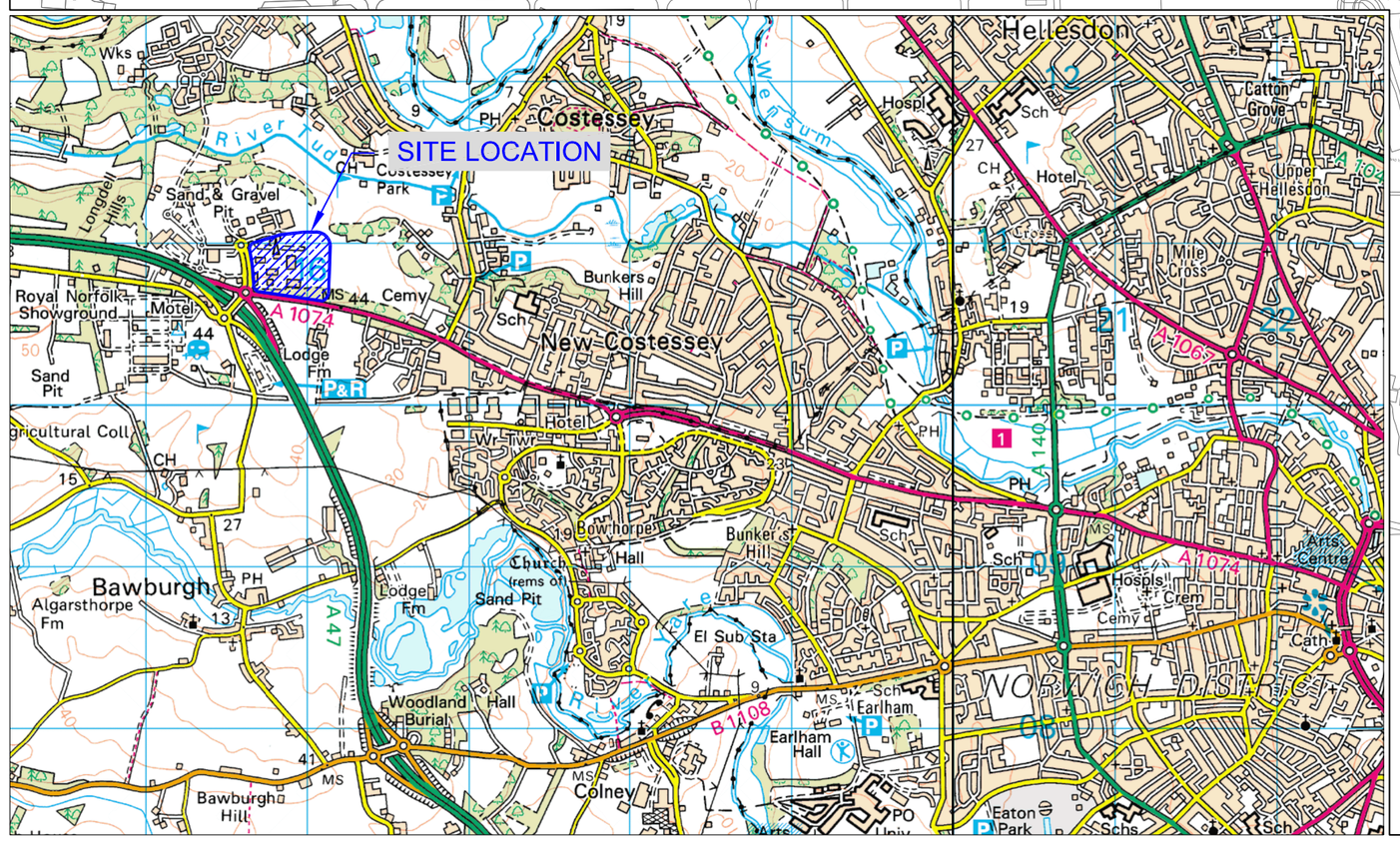
DEREHAM ROAD

Caravan Site

LONGWATER LANE

Costessey Park and Ride

Long Lane



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No further copies may be made.

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DRAWING TITLE

Site Location Plan

REV.	DESCRIPTION	CHECKED	DATE

	INIT.	DATE
DESIGNED BY	JR	07/13
DRAWN BY	JR	07/13
CHECKED BY	AH	08/13
APPROVED BY	MMG	08/13

DRAWING No.
MMD-326109-C-DR-00-XX-0001

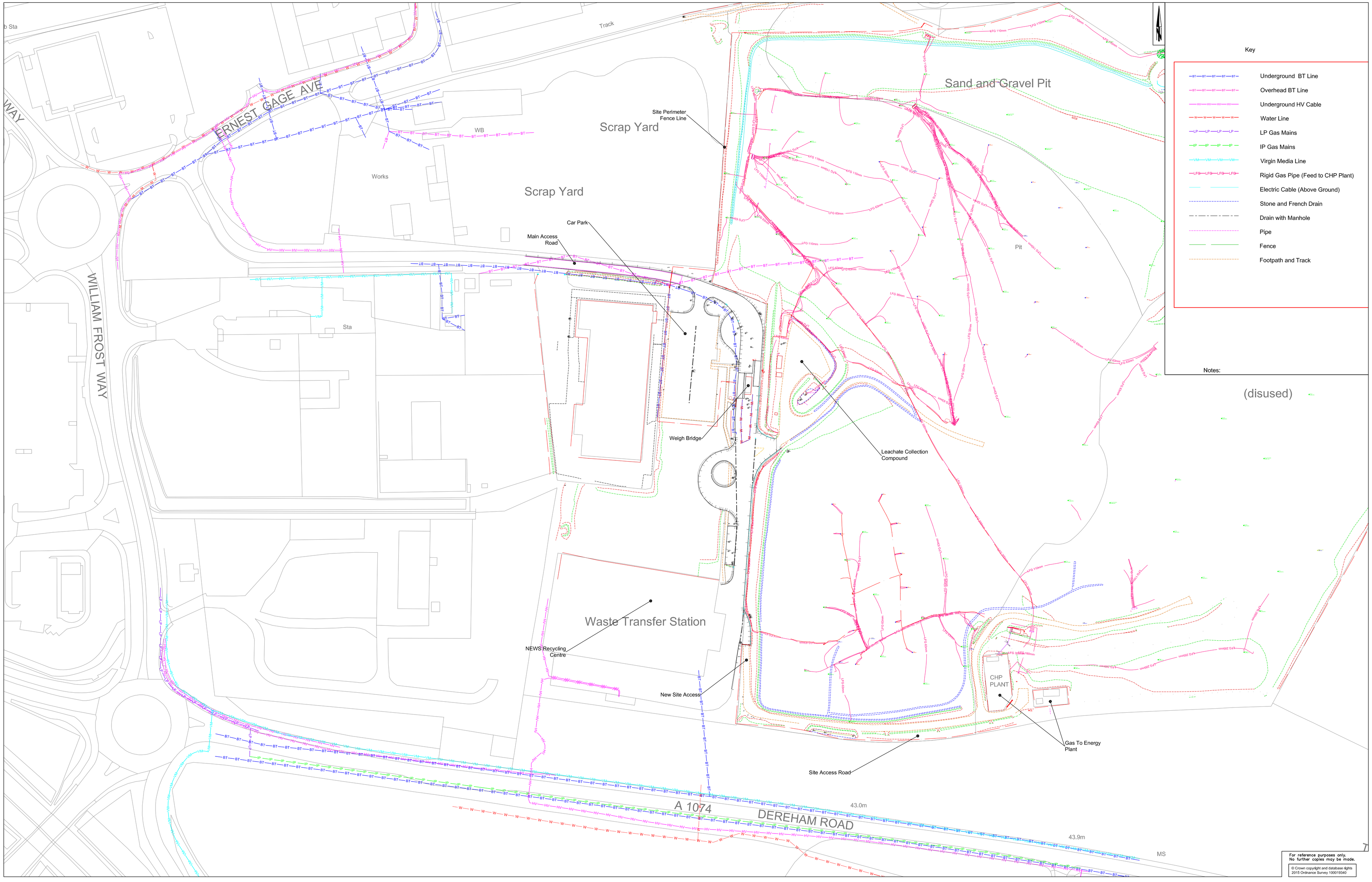
PROJECT TITLE
Longwater Link Road
Stage 1 Engineering Assessment

SCALE AT A2
1:5000

FILE No.
326109

ORIGINAL SIZE: A2

30/06/2009



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DRAWING TITLE

Utility Constraints Plan

REV.	DESCRIPTION	CHECKED	DATE

	INIT.	DATE
DESIGNED BY	JR	07/13
DRAWN BY	ZL	07/13
CHECKED BY	AH	08/13
APPROVED BY	MMG	08/13

DRAWING No.
MMD-326109-C-DR-00-XX-0002

PROJECT TITLE
Longwater Link Road
Stage 1 Engineering Assessment

SCALE AT A1
1:1000

FILE No.
326109

ORIGINAL SIZE: A1

30/06/2009

KEY

- NK205759 L J Technical Systems Ltd
- Nk120072 Tud Developments
- NK104395 Tud Developments
- NK175700 Tud Developments
- NK215856 NEWS MRF
- NK 335251 MRF and landfill access road
- NCC Owned
- NEWS Owned
- Thomson Bros. Land
- NEWS Proposed Development Area

SITE LOCATION

Costessey Park (Golf Course)
Costessey Park
Community Centre
Recreation Ground
Reservoir Hill
Waste Transfer Site
Weighbridge
Eastern Coprl
Sand and Gravel Pit
Scrap Yard
The Wilderness
Waste Transfer Station
Turnpike Belts
Round Clump
Caravan Site
Old Hall Farm
Edgewood
River View Nurseries
Long Dale
WILLIAM FROST WAY
DEREHAM ROAD
LONGWATER LANE
A 1074
A47
WORWICH DISTRICT

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DRAWING TITLE
Land Ownership Plan

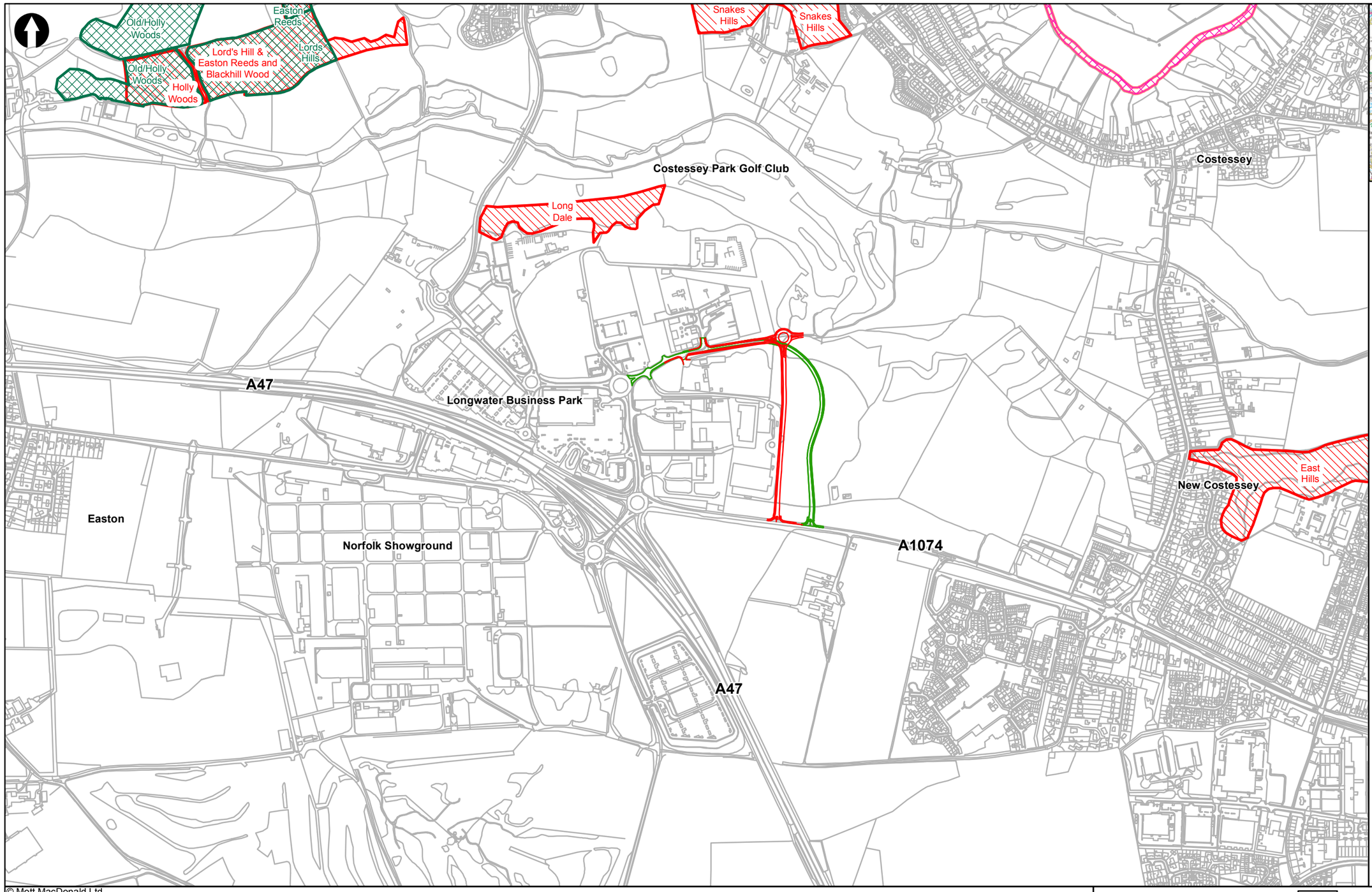
REV.	DESCRIPTION	CHECKED	DATE

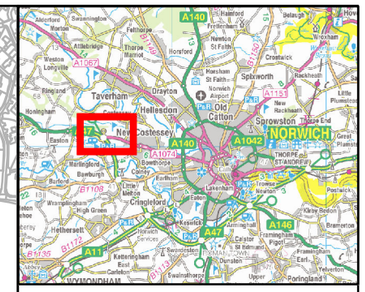
	INIT.	DATE
DESIGNED BY	JCR	07/13
DRAWN BY	JCR	07/13
CHECKED BY	AH	09/13
APPROVED BY	MMG	09/13

DRAWING No. MMD-326109-C-DR-00-XX-0003
PROJECT TITLE Longwater Link Road Stage 1 Engineering Assessment
SCALE AT A2 1:5000
FILE No. 326109

ORIGINAL SIZE: A2

30/06/2009





Legend

- Route Alignment Option A
- Route Alignment Option B
- SSSI
- Country Wildlife Site
- Ancient Woodland

This drawing shows options A & B, these have now been superseeded by revised route options orange, green and blue shown in drawings MMD-326109-D-DR-00-XX-1010,1012,1020, 1022,1030 &1032.

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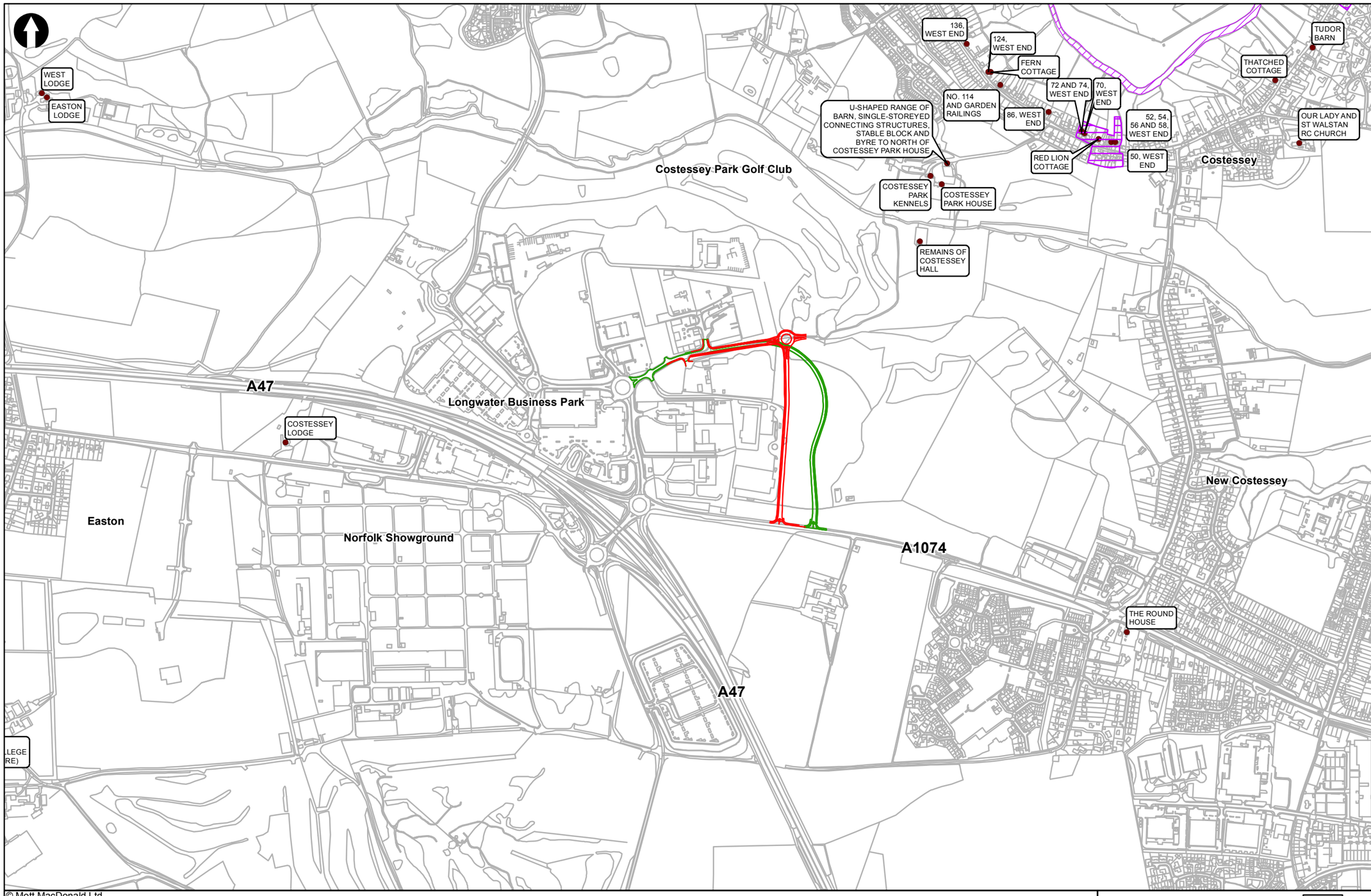
Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	10/10/2013	LP	For Information	SA	MF

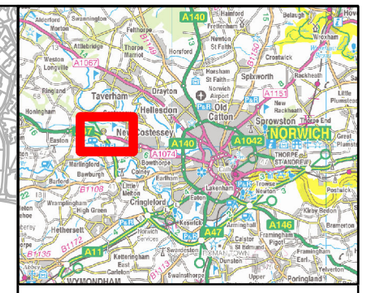
Title: Longwater Link Road
Ecological statutory designated and Non statutory designated sites

Drawn	LP
Checked	SA
Approved	MF
Scale at A3	1:10,000

Drawing No. MMD-326109-C-DR-00-XX-0012

Status: INF
Rev: P1





Legend

- Route Alignment Option A
- Route Alignment Option B
- Listed Buildings
- Conservation Areas

This drawing shows options A & B, these have now been superseeded by revised route options orange, green and blue shown in drawings MMD-326109-D-DR-00-XX-1010,1012,1020, 1022,1030 &1032.

Note:
Conservation areas and listed buildings within 1km of the scheme extents have been labelled.

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Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	10/10/2013	LP	For Information	SA	MF

Title
Longwater Link Road
Historic Environment
Listed Buildings

Drawn	LP
Checked	SA
Approved	MF
Scale at A3	1:10,000

Drawing No.
MMD-326109-C-DR-00-XX-0013

Status	Rev
INF	P1

River Tud

River Wensum

Wensum

Costessey Park Golf Club

Costessey

River Tud

A47

Longwater Business Park

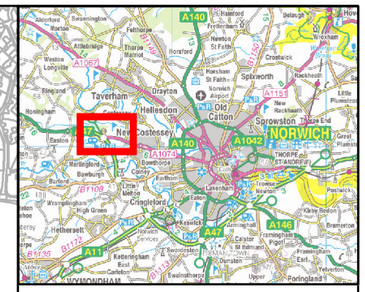
Easton

Norfolk Showground

A1074

New Costessey

A47



Legend

- Route Alignment Option A
- Route Alignment Option B
- Main Rivers
- Flood Zone 3
- Flood Zone 2

This drawing shows options A & B, these have now been superseeded by revised route options orange, green and blue shown in drawings MMD-326109-D-DR-00-XX-1010,1012,1020, 1022,1030 &1032.

Meters 0 100 200 300 400

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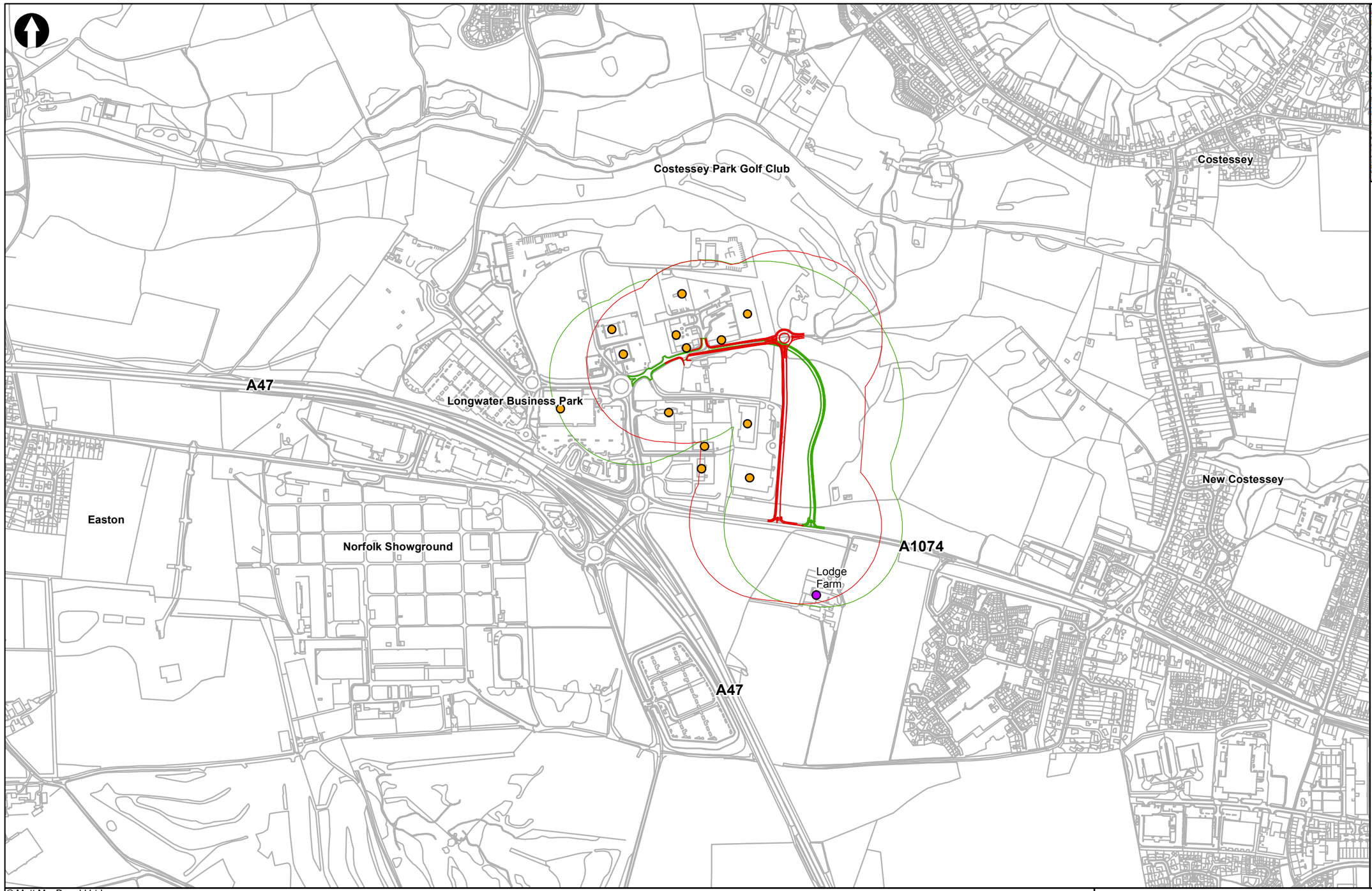
Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	10/10/2013	LP	For Information	SA	MF

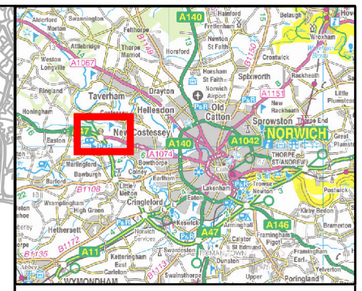
Title
Longwater Link Road
Environment Agency Flood Zone

Drawn	LP
Checked	SA
Approved	MF
Scale at A3	1:10,000

Drawing No.
MMD-326109-C-DR-00-XX-0014

Status	Rev
INF	P1





Legend

- Route Alignment Option B
- Route Alignment Option A
- Route Option B 200m Buffer
- Route Option A 200m Buffer
- Commercial property
- Residential property

This drawing shows options A & B, these have now been superseeded by revised route options orange, green and blue shown in drawings MMD-326109-D-DR-00-XX-1010,1012,1020, 1022,1030 &1032.

0 100 200 300 400 Meters

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Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	15/10/2013	LP	For Information	SA	MF

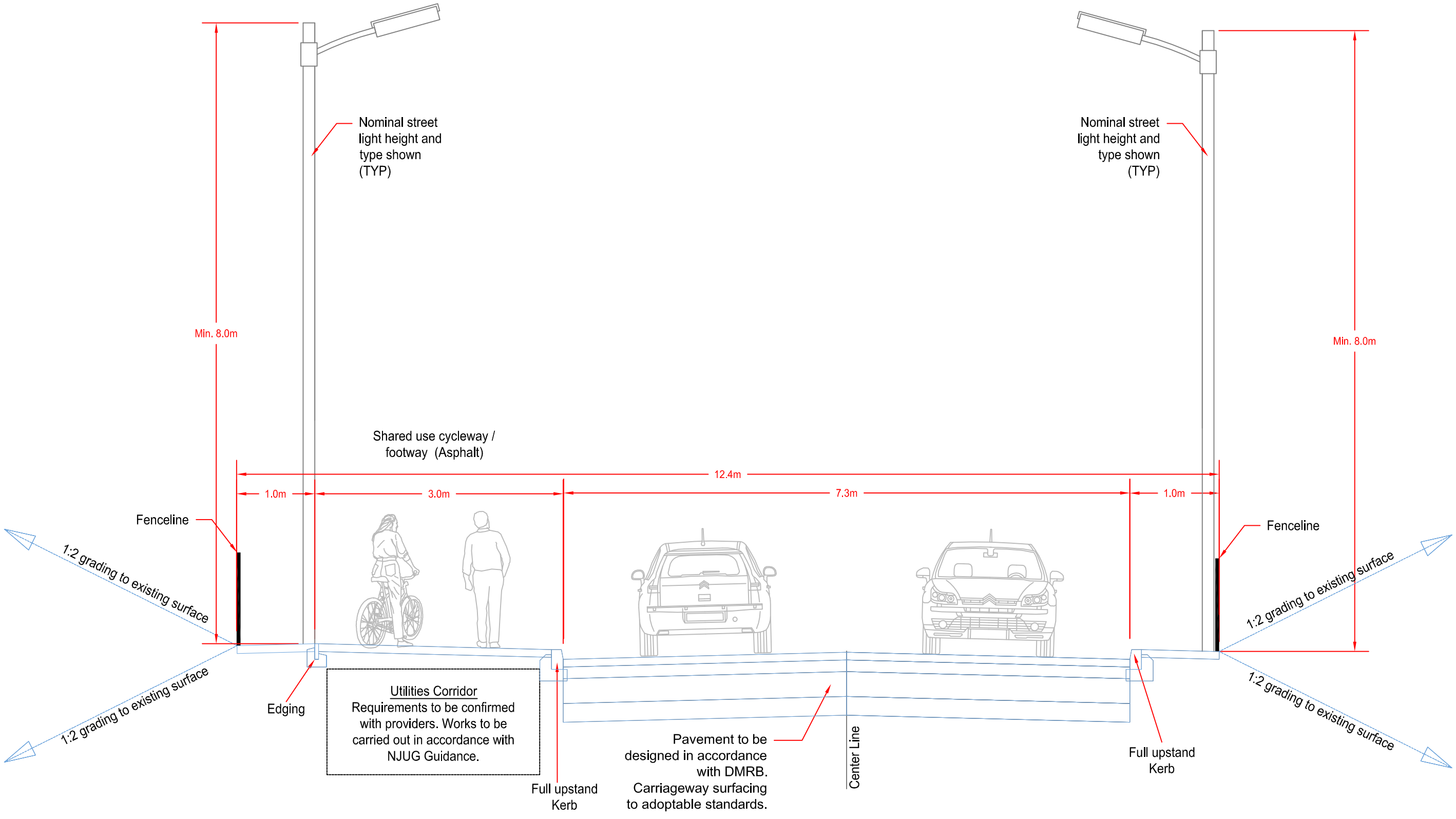
Title
Longwater Link Road
Air quality sensitive receptor

Drawn	LP
Checked	SA
Approved	MF
Scale at A3	1:10,000

Drawing No.
MMD-326109-C-DR-00-XX-0017

Status	Rev
INF	P1

MMD-326109-C-DR-00-XX-0017 Oct 15, 2013 - 10:13AM pic54635



Typical Section (Indicative Only)
12.3m Corridor Width

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Client
Norfolk County Council

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	21/07/15	RH	For discussion with client	SC	MF

Title
Longwater Link Road
Stage 1 Assessment
Typical Cross Section

Drawn	RH
Checked	SC
Approved	MF
Scale at A3	1:50

Drawing Number
MMD-326109-D-DR-00-XX-1008

Rev	Status
PRE	P1

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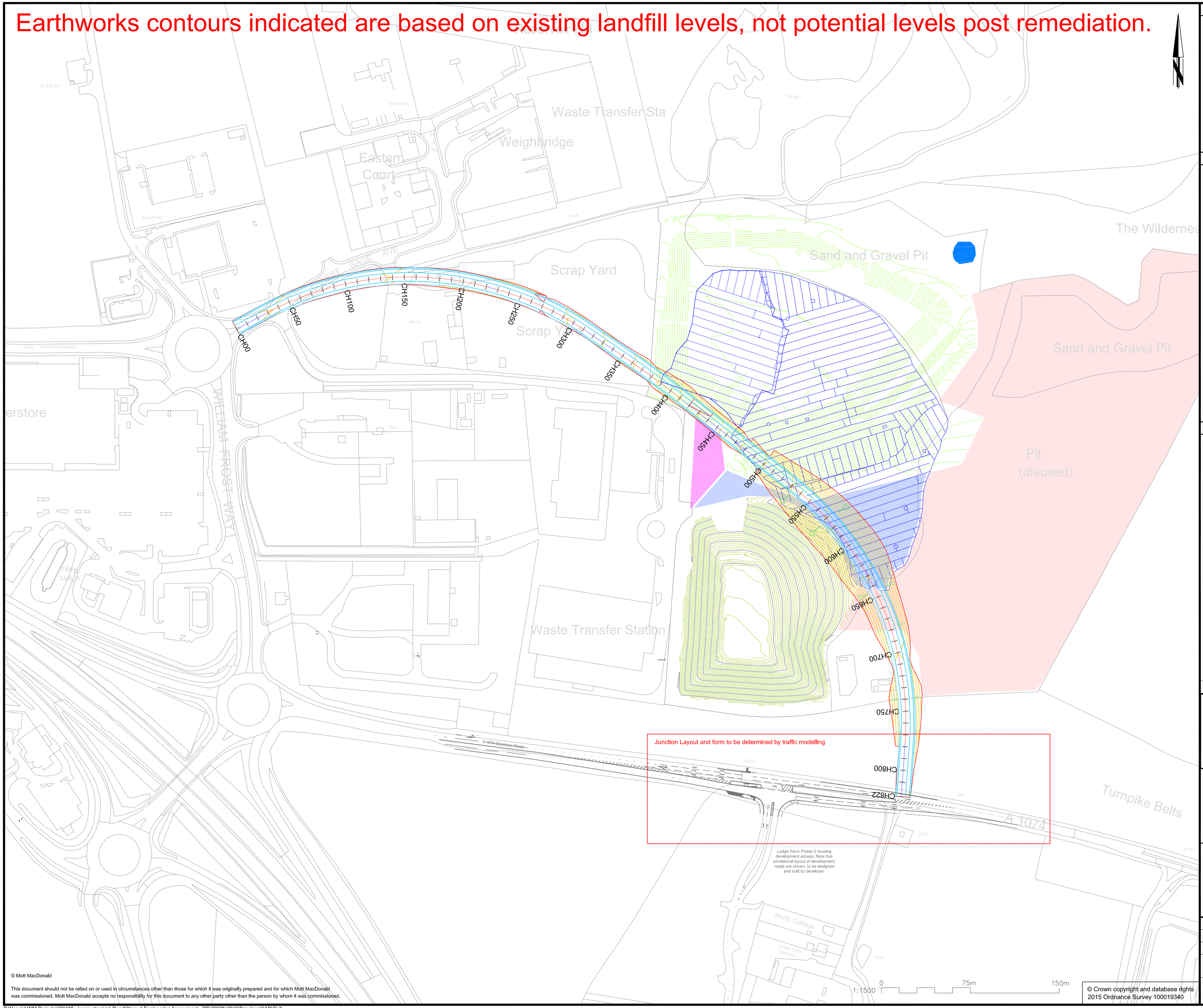
Earthworks contours indicated are based on existing landfill levels, not potential levels post remediation.



P:\Norwich\MM Projects\326109 - Longwater Link Road\Stage 1 Engineering Assessment - REVISION 2015\Drawings\CAD\Civil
3D\MMD-326109-D-DR-00-XX-1010 & 1011 Orange Route - Option 1.dwg Jul 21, 2015 - 3:05PM hof71608

Notes

1) Existing level information is based on a variety of sources. A full topographic survey will need to be carried out prior to detailed design.

Key to symbols

- OS base map
- Proposed centre line & chainage
- Highway corridor
- Extent of earthworks
- Earthworks grading. Contours at 1m intervals

Existing conditions

- Inert
- Dilute & disperse
- Landfill Phase 1 & 2
- Landfill Phase 3
- Capping
- Compound
- Soakaway

Reference drawings

MMD-326109-D-DR-00-XX-1011

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	21/07/15	RH	Issue for discussion with client	SC	MF

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Client: Norfolk County Council

Title
Longwater Link Road
Stage 1 Assessment 2015
Orange Route - Option 1
Plan

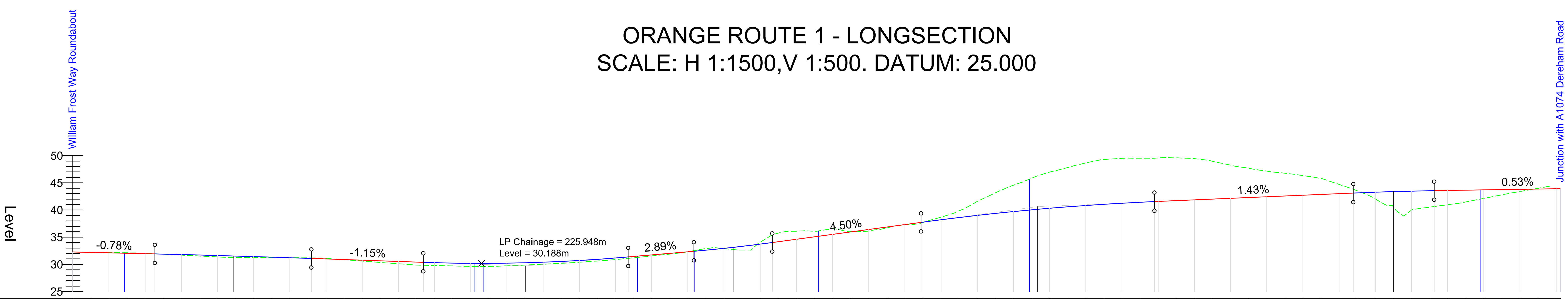
Designed	RH	07/15	Eng check	SC	07/15
Drawn	RH	07/15	Coordination	RH	07/15
Dwg check	PB	07/15	Approved	MF	07/15

Scale at A1: 1:1500
Status: PRE
Rev: P1

Drawing Number: MMD-326109-D-DR-00-XX-1010

Earthworks contours indicated are based on existing landfill levels, not potential levels post remediation.

ORANGE ROUTE 1 - LONGSECTION
SCALE: H 1:1500,V 1:500. DATUM: 25.000



Chainage	Existing Levels	Proposed Levels	Level Difference
00.000	32.272	32.272	0.000
10.000	32.223	32.194	-0.029
20.000	32.174	32.116	-0.058
30.000	32.125	32.038	-0.087
40.000	32.029	31.960	-0.069
50.000	31.865	31.882	0.017
60.000	31.701	31.799	0.099
70.000	31.537	31.713	0.176
80.000	31.375	31.622	0.248
90.000	31.252	31.528	0.276
100.000	31.265	31.428	0.163
110.000	31.252	31.325	0.073
120.000	31.226	31.217	-0.008
130.000	31.187	31.105	-0.082
140.000	31.096	30.991	-0.105
150.000	30.856	30.876	0.020
160.000	30.606	30.761	0.155
170.000	30.345	30.646	0.301
180.000	30.107	30.531	0.425
190.000	29.865	30.416	0.552
200.000	29.787	30.308	0.522
210.000	29.711	30.234	0.523
220.000	29.622	30.194	0.573
230.000	29.621	30.191	0.570
240.000	29.722	30.223	0.501
250.000	29.865	30.291	0.426
260.000	30.023	30.395	0.373
270.000	30.193	30.535	0.341
280.000	30.389	30.710	0.321
290.000	30.616	30.921	0.305
300.000	30.880	31.167	0.287
310.000	31.206	31.448	0.242
320.000	31.549	31.738	0.189
330.000	31.896	32.027	0.131
340.000	32.316	32.317	0.000
350.000	32.891	32.614	-0.276
360.000	32.892	32.947	0.055
370.000	32.638	33.316	0.678
380.000	34.085	33.723	-0.362
390.000	35.752	34.165	-1.587
400.000	36.094	34.615	-1.479
410.000	36.096	35.065	-1.031
420.000	36.549	35.515	-1.034
430.000	36.082	35.965	-0.117
440.000	36.132	36.415	0.283
450.000	36.711	36.865	0.154
460.000	37.295	37.315	0.020
470.000	37.703	37.765	0.062
480.000	38.687	38.200	-0.487
490.000	39.860	38.612	-1.248
500.000	41.571	39.000	-2.571
510.000	43.145	39.364	-3.781
520.000	44.562	39.704	-4.857
530.000	45.835	40.021	-5.814
540.000	46.966	40.313	-6.652
550.000	47.812	40.582	-7.229
560.000	48.665	40.827	-7.838
570.000	49.304	41.049	-8.255
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590.000	49.519	41.420	-8.100
600.000	49.578	41.570	-8.008
610.000	49.584	41.713	-7.871
620.000	49.451	41.856	-7.595
630.000	48.962	41.998	-6.963
640.000	48.237	42.141	-6.096
650.000	47.682	42.284	-5.398
660.000	47.157	42.427	-4.730
670.000	46.761	42.570	-4.191
680.000	46.334	42.712	-3.621
690.000	45.796	42.855	-2.941
700.000	44.709	42.998	-1.712
710.000	43.527	43.140	-0.387
720.000	42.063	43.269	1.205
730.000	40.603	43.377	2.774
740.000	39.959	43.466	3.506
750.000	40.519	43.534	3.015
760.000	40.967	43.588	2.621
770.000	41.474	43.641	2.168
780.000	42.132	43.694	1.563
790.000	42.790	43.748	0.957
800.000	43.401	43.801	0.400
810.000	43.993	43.854	-0.139
822.400		43.920	
820.000		43.907	

Horizontal Geometry: L =28.516 · R: 255.000 L: 193.767 · L =4.953 · R: 255.000 L: 84.995 · L =31.266 · R: 998.974 L: 68.833 · L =116.494 · R: 255.000 L: 249.182 · L =44.393

Vertical Geometry: G =-0.780% L =45.389 · R =23500.000 K =235.000 L =86.519 · G =-1.149% L =61.881 · R =2800.000 K =28.000 L =113.213 · G =2.895% L =36.353 · R =2700.000 K =27.000 L =43.342 · G =4.500% L =82.230 · R =4200.000 K =42.000 L =129.027 · G =1.428% L =109.875 · R =5000.000 K =50.000 L =44.770 · G =0.533% L =92.354

Notes

Key to symbols
- Existing surface
- Proposed surface

Reference drawings
MMD-326109-D-DR-00-XX-1010

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	21/07/15	RH	Issue for discussion with client	SC	MF

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Client
Norfolk County Council

Title
Longwater Link Road
Stage 1 Assessment 2015
Orange Route - Option 1
Long Section

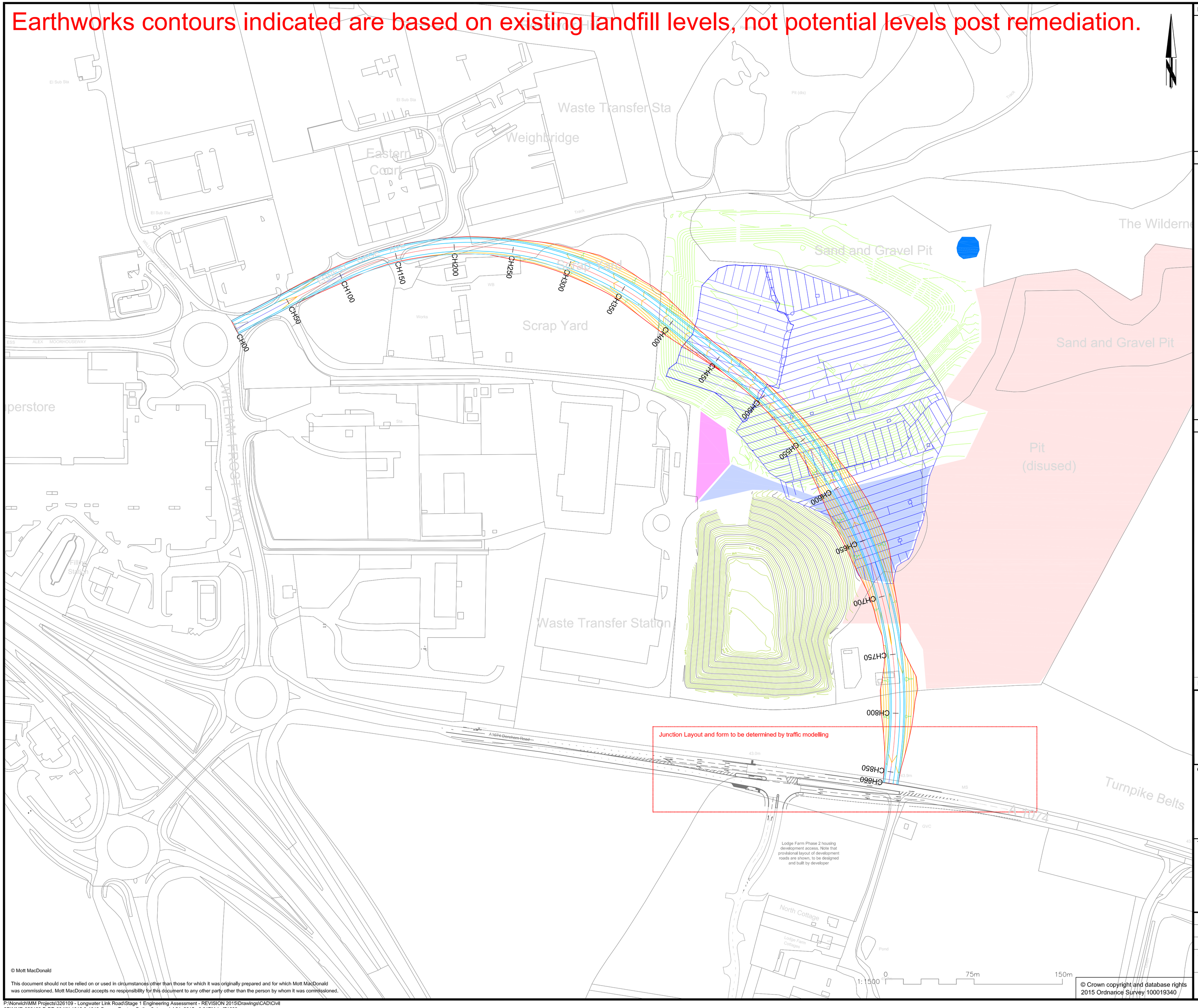
Designed	RH	07/15	Eng check	SC	07/15
Drawn	RH	07/15	Coordination	RH	07/15
Dwg check	PB	07/15	Approved	RH	07/15

Scale at A1: 1:1500 · Status: PRE · Rev: P1

Drawing Number: MMD-326109-D-DR-00-XX-1011

P:\Norwich\MM Projects\326109 - Longwater Link Road\Stage 1 Engineering Assessment - REVISION 2015\Drawings\CAD\Civil 3D\MMD-326109-D-DR-00-XX-1010 & 1011 Orange Route - Option 1.dwg Jul 21, 2015 - 3:04PM hol71608

Earthworks contours indicated are based on existing landfill levels, not potential levels post remediation.



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Notes

1) Existing level information is based on a variety of sources. A full topographic survey will need to be carried out prior to detailed design.

Key to symbols

- OS base map
- Proposed centre line & chainage
- Highway corridor
- Extent of earthworks
- Earthworks grading. Contours at 1m intervals

Existing conditions

- Inert
- Dilute & disperse
- Landfill Phase 1 & 2
- Landfill Phase 3
- Capping
- Compound
- Soakaway

Reference drawings

MMD-326109-D-DR-00-XX-1013

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	21/07/15	RH	Issue for discussion with client	SC	MF

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Client

Norfolk County Council

Title

Longwater Link Road
Stage 1 Assessment 2015
Orange Route - Option 2
Plan

Designed	RH	07/15	Eng check	SC	07/15
Drawn	RH	07/15	Coordination	RH	07/15
Dwg check	PB	07/15	Approved	MF	07/15

Scale at A1	Status	Rev
1:1500	PRE	P1

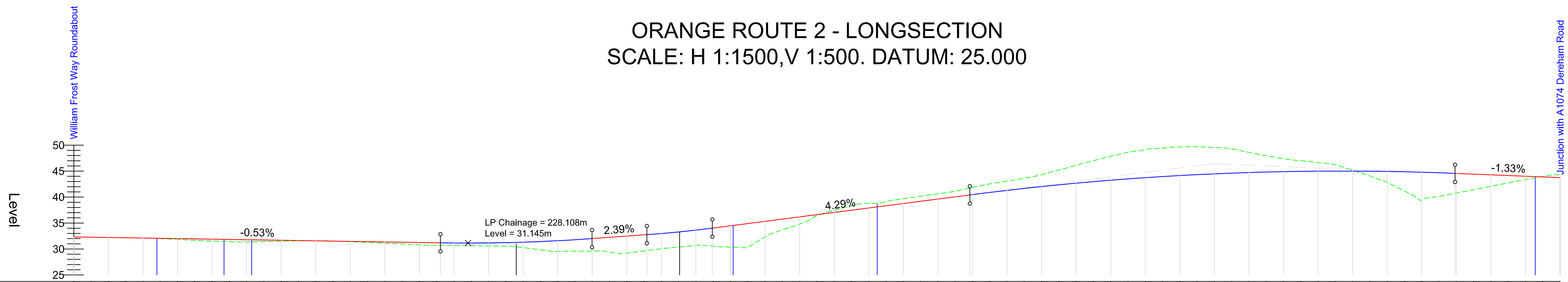
Drawing Number

MMD-326109-D-DR-00-XX-1012

P:\Norwich\MM Projects\326109 - Longwater Link Road\Stage 1 Engineering Assessment - REVISION 2015\Drawings\CAD\Civil 3D\MMD-326109-D-DR-00-XX-1012 & 1013 Orange Route - Option 2.dwg Jul 21, 2015 - 3:01PM hol71608

Earthworks contours indicated are based on existing landfill levels, not potential levels post remediation.

ORANGE ROUTE 2 - LONGSECTION
SCALE: H 1:1500,V 1:500. DATUM: 25.000



Chainage	Existing Levels	Proposed Levels	Level Difference
00.000	32.316	32.316	0.000
10.000	32.267	32.263	-0.005
20.000	32.219	32.209	-0.009
30.000	32.170	32.156	-0.014
40.000	32.122	32.103	-0.018
50.000	32.006	32.050	0.044
60.000	31.842	31.997	0.155
70.000	31.678	31.944	0.265
80.000	31.514	31.890	0.376
90.000	31.392	31.837	0.445
100.000	31.320	31.784	0.464
110.000	31.413	31.731	0.318
120.000	31.501	31.678	0.177
130.000	31.559	31.624	0.065
140.000	31.581	31.571	-0.009
150.000	31.532	31.518	-0.014
160.000	31.385	31.465	0.079
170.000	31.255	31.412	0.156
180.000	31.110	31.358	0.249
190.000	30.949	31.305	0.356
200.000	30.774	31.252	0.478
210.000	30.698	31.199	0.500
220.000	30.671	31.156	0.485
230.000	30.630	31.146	0.516
240.000	30.586	31.169	0.583
250.000	30.534	31.225	0.691
260.000	30.257	31.315	1.058
270.000	29.841	31.438	1.596
280.000	29.544	31.594	2.050
290.000	29.572	31.783	2.211
300.000	29.601	32.006	2.405
310.000	29.400	32.246	2.846
320.000	29.210	32.485	3.275
330.000	29.624	32.724	3.100
340.000	30.059	32.981	2.922
350.000	30.373	33.287	2.914
360.000	30.704	33.643	2.940
370.000	30.552	34.050	3.497
380.000	30.361	34.478	4.117
390.000	30.321	34.907	4.586
400.000	32.333	35.336	3.002
410.000	33.693	35.764	2.071
420.000	34.794	36.193	1.399
430.000	36.404	36.622	0.218
440.000	37.484	37.050	-0.433
450.000	38.345	37.479	-0.866
460.000	38.757	37.908	-0.850
470.000	39.115	38.336	-0.779
480.000	39.682	38.765	-0.916
490.000	40.155	39.194	-0.961
500.000	40.615	39.623	-0.993
510.000	41.116	40.051	-1.065
520.000	41.888	40.480	-1.408
530.000	42.529	40.895	-1.634
540.000	43.075	41.291	-1.784
550.000	43.625	41.667	-1.958
560.000	44.313	42.022	-2.291
570.000	45.214	42.358	-2.856
580.000	46.139	42.674	-3.465
590.000	47.018	42.970	-4.048
600.000	47.877	43.245	-4.631
610.000	48.621	43.501	-5.120
620.000	49.152	43.737	-5.415
630.000	49.443	43.952	-5.491
640.000	49.653	44.148	-5.505
650.000	49.676	44.324	-5.353
660.000	49.552	44.479	-5.073
670.000	49.274	44.615	-4.659
680.000	48.618	44.731	-3.887
690.000	47.999	44.826	-3.172
700.000	47.404	44.902	-2.502
710.000	47.001	44.958	-2.043
720.000	46.647	44.993	-1.654
730.000	46.229	45.009	-1.220
740.000	45.174	45.005	-0.169
750.000	44.050	44.981	0.931
760.000	42.832	44.936	2.104
770.000	41.169	44.872	3.703
780.000	39.438	44.788	5.350
790.000	40.127	44.683	4.556
800.000	40.769	44.559	3.790
810.000	41.426	44.426	3.000
820.000	42.084	44.293	2.209
830.000	42.743	44.160	1.417
840.000	43.368	44.028	0.660
850.000	43.961	43.895	-0.066
860.019		43.762	
860.000		43.762	

Horizontal Geometry

L =48.059 | R: 720.000 L: 38.835 | L =16.048 | R: 255.000 L: 278.626 | L =83.309 | R: 360.000 L: 380.788 | L =14.354

Vertical Geometry

G =-0.532% L =212.151 | R =3000.000 K =30.000 L =87.730 | G =2.392% L =31.727 | R =2000.000 K =20.000 L =37.890 | G =4.287% L =149.001 | R =5000.000 K =50.000 L =280.764 | G =-1.328% L =61.326

Notes

Key to symbols

Existing surface

Proposed surface

Reference drawings

MMD-326109-D-DR-00-XX-1012

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	21/07/15	RH	Issue for discussion with client	SC	MF

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Client

Norfolk County Council

Title

Longwater Link Road
Stage 1 Assessment 2015
Orange Route - Option 2
Long Section

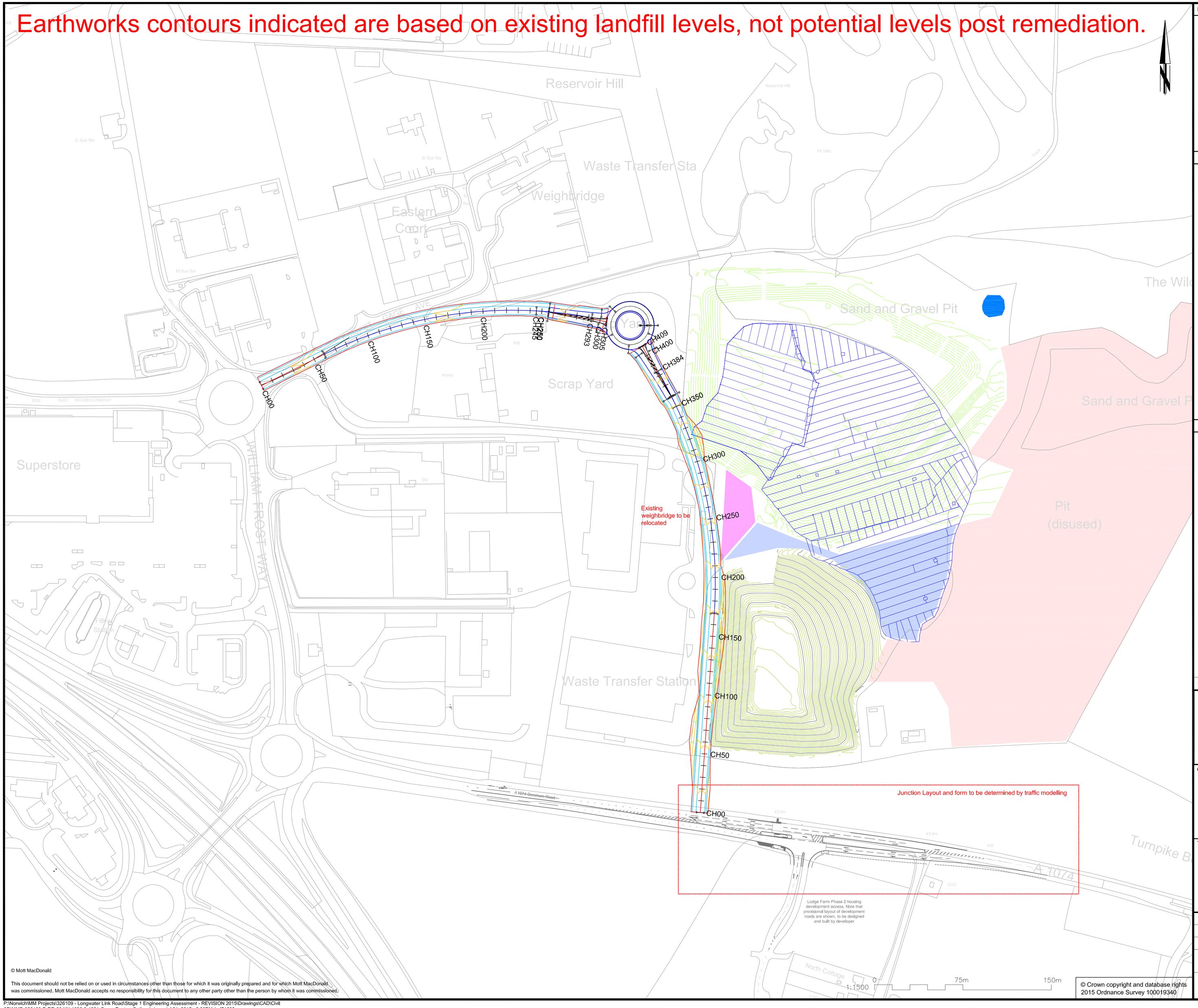
Designed	RH	07/15	Eng check	SC	07/15
Drawn	RH	07/15	Coordination	RH	07/15
Dwg check	PB	07/15	Approved	MF	07/15

Scale at A1: 1:1500 | Status: PRE | Rev: P1

Drawing Number: MMD-326109-D-DR-00-XX-1013

P:\Norwich\MM Projects\326109 - Longwater Link Road\Stage 1 Engineering Assessment - REVISION 2015\Drawings\CAD\Civil 3D\MMD-326109-D-DR-00-XX-1012 & 1013 Orange Route - Option 2.dwg Jul 21, 2015 - 2:56PM hol71608

Earthworks contours indicated are based on existing landfill levels, not potential levels post remediation.



P:\Norwich\MM Projects\326109 - Longwater Link Road\Stage 1 Engineering Assessment - REVISION 2015\Drawings\CAD\Civil 3D\MMD-326109-D-DR-00-XX-1020 & 1021 Green Route - Option 1.dwg Jul 21, 2015 - 2:30PM hol71608

Notes

1) Existing level information is based on a variety of sources. A full topographic survey will need to be carried out prior to detailed design.

Key to symbols

- OS base map
- Proposed centre line & chainage
- Highway corridor
- Extent of earthworks
- Earthworks grading. Contours at 1m intervals

Existing conditions

- Inert
- Dilute & disperse
- Landfill Phase 1 & 2
- Landfill Phase 3
- Capping
- Compound
- Soakaway

Reference drawings

MMD-326109-D-DR-00-XX-1021

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	21/07/15	RH	Issue for discussion with client	SC	MF

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Client

Norfolk County Council

Title

Longwater Link Road
Stage 1 Assessment 2015
Green Route - Option 1
Plan

Designed	RH	07/15	Eng check	SC	07/15
Drawn	RH	07/15	Coordination	RH	07/15
Dwg check	PB	07/15	Approved	MF	07/15

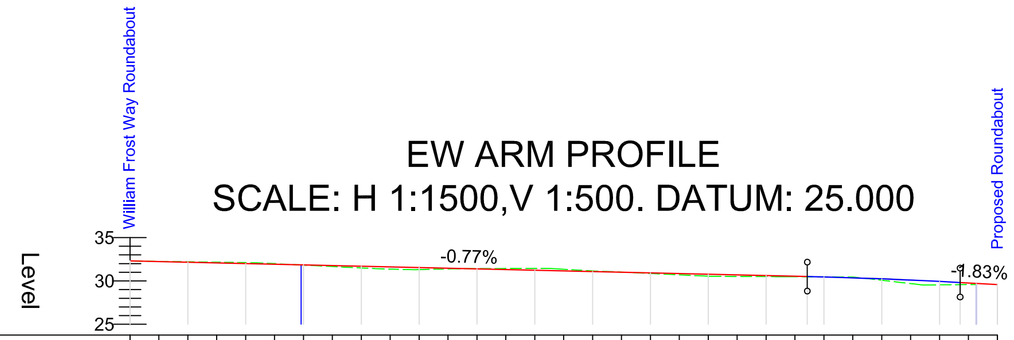
Scale at A1	Status	Rev
1:1500	PRE	P1

Drawing Number

MMD-326109-D-DR-00-XX-1020

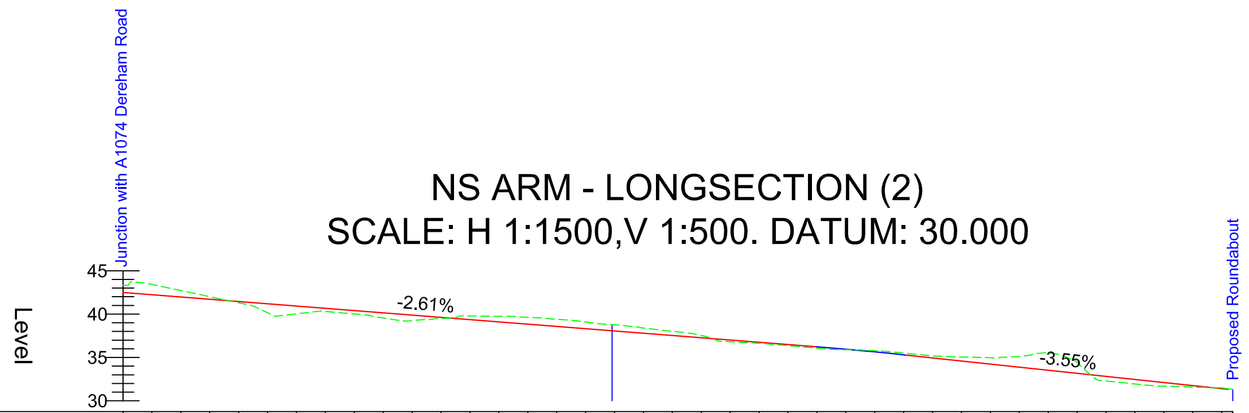
Earthworks contours indicated are based on existing landfill levels, not potential levels post remediation.

EW ARM PROFILE
SCALE: H 1:1500,V 1:500. DATUM: 25.000



Chainage	00.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000	100.000	110.000	120.000	130.000	140.000	150.000	160.000	170.000	180.000	190.000	200.000	210.000	220.000	230.000	240.000	250.000	260.000	270.000	280.000	290.000	300.000
Existing Levels	32.314	32.257	32.210	32.163	32.116	31.990	31.826	31.662	31.498	31.363	31.307	31.389	31.419	31.432	31.436	31.347	31.156	31.017	30.867	30.737	30.536	30.519	30.504	30.484	30.466	30.438	30.083	29.694	29.551	29.576	
Proposed Levels	32.314	32.236	32.159	32.082	32.004	31.927	31.850	31.772	31.695	31.618	31.540	31.463	31.386	31.308	31.231	31.154	31.076	30.999	30.922	30.844	30.767	30.690	30.612	30.535	30.454	30.356	30.237	30.098	29.939	29.761	29.576
Level Difference	0.000	-0.021	-0.051	-0.081	-0.111	-0.063	0.024	0.110	0.197	0.255	0.233	0.074	-0.033	-0.124	-0.205	-0.193	-0.080	-0.018	0.054	0.107	0.231	0.171	0.108	0.051	-0.011	-0.082	0.154	0.404	0.388	0.185	
Horizontal Geometry		L =59.171										R: 360.000 L: 233.553																			
Vertical Geometry												G =-0.773% L =234.265										R =5000.000 K =50.000 L =52.880			G =-1.831% L =12.855							

NS ARM - LONGSECTION (2)
SCALE: H 1:1500,V 1:500. DATUM: 30.000



Chainage	00.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000	100.000	110.000	120.000	130.000	140.000	150.000	160.000	170.000	180.000	190.000	200.000	210.000	220.000	230.000	240.000	250.000	260.000	270.000	280.000	290.000	300.000	310.000	320.000	330.000	340.000	350.000	360.000	370.000	380.000	383.000
Existing Levels	43.321	43.429	42.721	42.012	41.304	40.158	40.030	40.299	40.024	39.556	39.244	39.490	39.781	39.742	39.631	39.403	39.103	38.777	38.395	38.017	37.654	36.811	36.654	36.372	36.072	35.893	35.766	35.500	35.185	35.051	34.970	35.113	35.517	34.413	32.948	31.648	31.692	31.585	31.481	31.481
Proposed Levels	42.506	42.244	41.983	41.721	41.460	41.199	40.937	40.676	40.415	40.153	39.892	39.631	39.369	39.108	38.846	38.585	38.324	38.062	37.801	37.540	37.278	37.017	36.755	36.494	36.233	35.956	35.648	35.310	34.955	34.600	34.245	33.889	33.534	33.179	32.824	32.469	32.113	31.758	31.403	
Level Difference	-0.815	-1.185	-0.738	-0.291	0.156	1.041	0.908	0.377	0.390	0.597	0.648	0.141	-0.412	-0.634	-0.785	-0.818	-0.779	-0.714	-0.594	-0.478	-0.376	0.206	0.101	0.122	0.161	0.062	-0.118	-0.190	-0.230	-0.451	-0.726	-1.223	-1.982	-1.234	0.520	0.821	0.421	0.173	-0.083	
Horizontal Geometry		L =169.185															R: 360.000 L: 214.658																									
Vertical Geometry							G =-2.614% L =271.136															R =3263.919 K =32.639 L =30.632			G =-3.552% L =111.710																

P:\Norwich\MM Projects\326109 - Longwater Link Road\Stage 1 Engineering Assessment - REVISION 2015\Drawings\CAD\Civil 3D\MMD-326109-D-DR-00-XX-1020 & 1021 Green Route - Option 1.dwg Jul 21, 2015 - 2:31PM hol71608

Notes

Key to symbols

Existing surface

Proposed surface

Reference drawings

MMD-326109-D-DR-00-XX-1020

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	21/07/15	RH	Issue for discussion with client	SC	MF

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Client

Norfolk County Council

Title

Longwater Link Road
Stage 1 Assessment 2015
Green Route - Option 1
Long Section

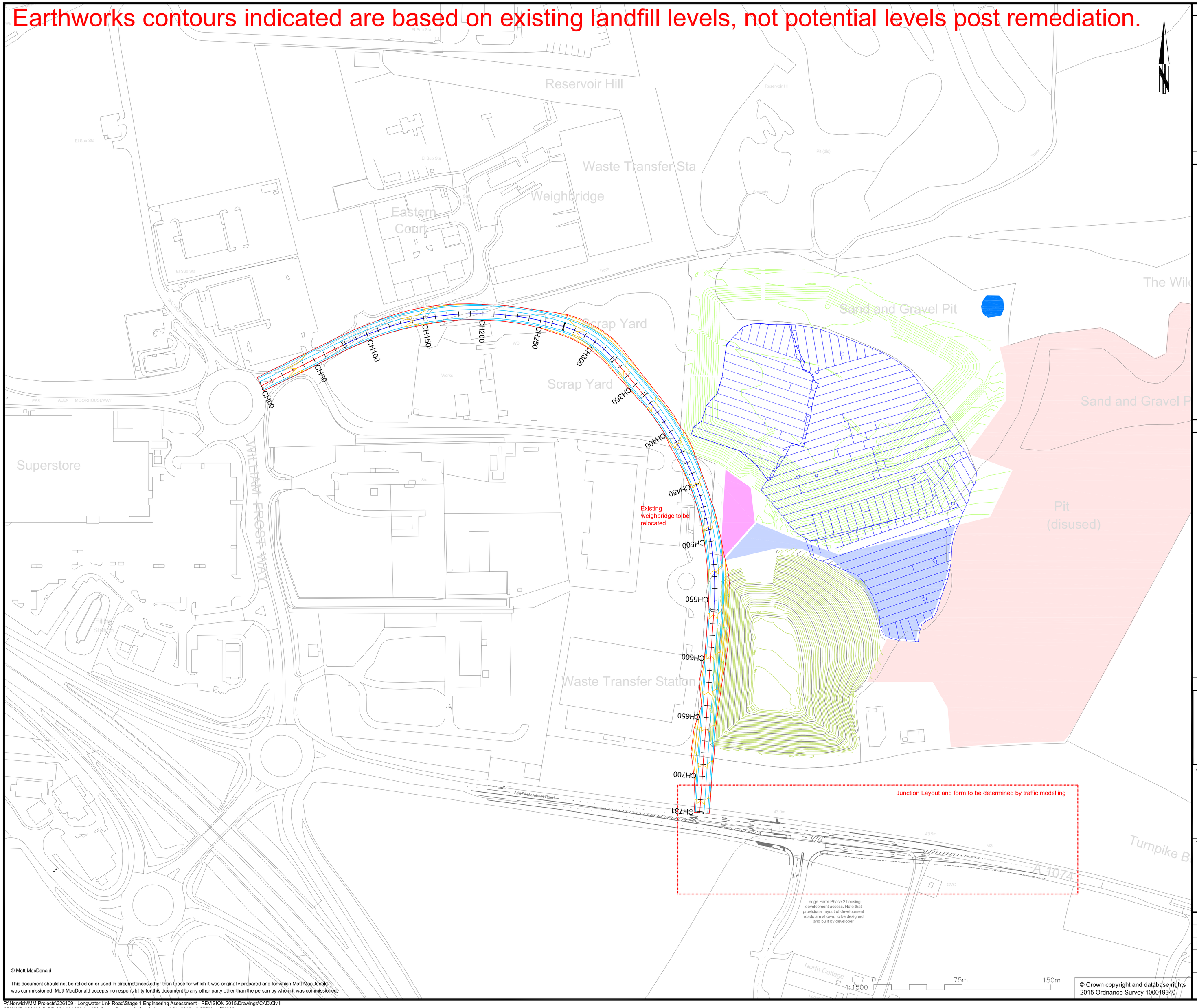
Designed	RH	07/15	Eng check	SC	07/15
Drawn	RH	07/15	Coordination	RH	07/15
Dwg check	PB	07/15	Approved	MF	07/15

Scale at A1	Status	Rev
1:1500	PRE	P1

Drawing Number

MMD-326109-D-DR-00-XX-1021

Earthworks contours indicated are based on existing landfill levels, not potential levels post remediation.



Notes

1) Existing level information is based on a variety of sources. A full topographic survey will need to be carried out prior to detailed design.

Key to symbols

- OS base map
- Proposed centre line & chainage
- Highway corridor
- Extent of earthworks
- Earthworks grading. Contours at 1m intervals

Existing conditions

- Inert
- Dilute & disperse
- Landfill Phase 1 & 2
- Landfill Phase 3
- Capping
- Compound
- Soakaway

Reference drawings

MMD-326109-D-DR-00-XX-1023

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	21/07/15	RH	Issue for discussion with client	SC	MF

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Client

Norfolk County Council

Title

Longwater Link Road
Stage 1 Assessment 2015
Green Route - Option 2
Plan

Designed	RH	07/15	Eng check	SC	07/15
Drawn	RH	07/15	Coordination	RH	07/15
Dwg check	PB	07/15	Approved	MF	07/15

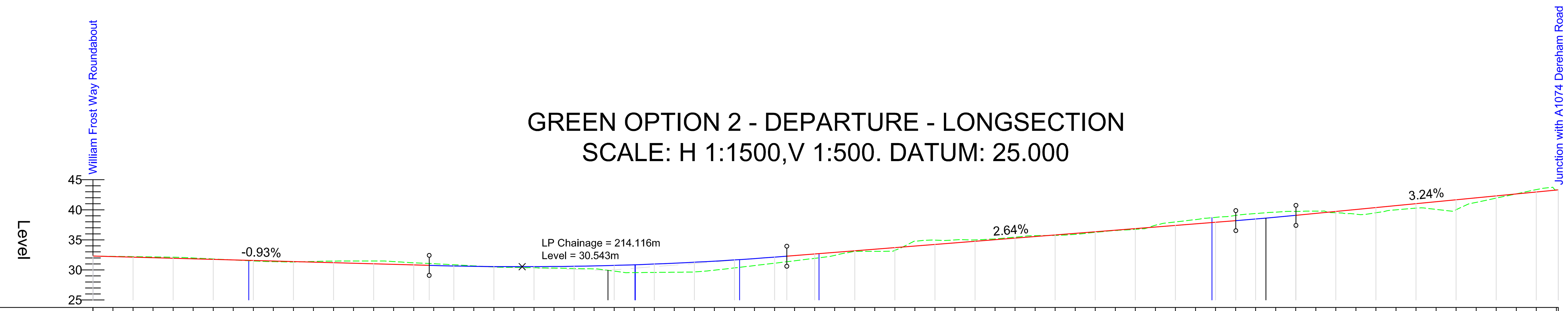
Scale at A1	Status	Rev
1:1500	PRE	P1

Drawing Number

MMD-326109-D-DR-00-XX-1022

Earthworks contours indicated are based on existing landfill levels, not potential levels post remediation.

GREEN OPTION 2 - DEPARTURE - LONGSECTION
SCALE: H 1:1500,V 1:500. DATUM: 25.000



Chainage	Existing Levels	Proposed Levels	Level Difference
00.000	32.314	32.314	0.000
10.000	32.257	32.221	-0.036
20.000	32.210	32.128	-0.082
30.000	32.163	32.036	-0.128
40.000	32.116	31.943	-0.173
50.000	31.990	31.850	-0.140
60.000	31.826	31.757	-0.069
70.000	31.662	31.665	0.003
80.000	31.498	31.572	0.074
90.000	31.382	31.479	0.097
100.000	31.323	31.386	0.063
110.000	31.408	31.294	-0.114
120.000	31.470	31.201	-0.269
130.000	31.482	31.108	-0.374
140.000	31.482	31.015	-0.467
150.000	31.389	30.923	-0.467
160.000	31.192	30.830	-0.362
170.000	31.035	30.738	-0.297
180.000	30.863	30.659	-0.203
190.000	30.676	30.601	-0.075
200.000	30.475	30.563	0.088
210.000	30.419	30.545	0.126
220.000	30.367	30.546	0.180
230.000	30.313	30.568	0.256
240.000	30.250	30.610	0.360
250.000	30.175	30.672	0.497
260.000	29.800	30.754	0.954
270.000	29.558	30.855	1.298
280.000	29.587	30.977	1.390
290.000	29.619	31.119	1.500
300.000	29.662	31.281	1.618
310.000	29.958	31.462	1.504
320.000	30.334	31.664	1.330
330.000	30.725	31.886	1.161
340.000	31.117	32.128	1.011
350.000	31.523	32.388	0.865
360.000	31.928	32.652	0.724
370.000	32.423	32.916	0.493
380.000	33.104	33.180	0.076
390.000	33.095	33.444	0.349
400.000	33.260	33.708	0.448
410.000	34.787	33.972	-0.815
420.000	34.956	34.236	-0.720
430.000	34.994	34.500	-0.494
440.000	34.994	34.764	-0.230
450.000	35.163	35.028	-0.135
460.000	35.453	35.292	-0.161
470.000	35.699	35.556	-0.143
480.000	35.753	35.820	0.067
490.000	35.922	36.084	0.163
500.000	36.253	36.348	0.095
510.000	36.556	36.612	0.057
520.000	36.763	36.876	0.113
530.000	37.443	37.140	-0.302
540.000	37.985	37.404	-0.581
550.000	38.370	37.668	-0.702
560.000	38.748	37.932	-0.816
570.000	39.061	38.196	-0.864
580.000	39.380	38.470	-0.910
590.000	39.615	38.764	-0.851
600.000	39.742	39.078	-0.665
610.000	39.780	39.402	-0.378
620.000	39.502	39.726	0.223
630.000	39.276	40.050	0.774
640.000	39.508	40.374	0.866
650.000	39.997	40.698	0.700
660.000	40.277	41.022	0.745
670.000	40.067	41.346	1.279
680.000	40.009	41.670	1.660
690.000	41.236	41.994	0.758
700.000	41.945	42.318	0.373
710.000	42.653	42.642	-0.011
720.000	43.362	42.966	-0.396
730.954	43.321	43.321	0.000
730.000	43.315	43.290	-0.025

Horizontal Geometry: L =77.747 | R: 255.000 L: 192.625 | L =0.180 | R: 90.000 L: 52.035 | L =39.614 | R: 255.000 L: 196.010 | L =172.742

Vertical Geometry: G =-0.927% L =167.743 | R =5000.000 K =50.000 L =178.380 | G =2.640% L =223.972 | R =5000.000 K =50.000 L =29.994 | G =3.240% L =130.865

Notes

Key to symbols

Existing surface
Proposed surface

Reference drawings

MMD-326109-D-DR-00-XX-1022

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	21/07/15	RH	Issue for discussion with client	SC	MF

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Client

Norfolk County Council

Title

Longwater Link Road
Stage 1 Assessment 2015
Green Route - Option 2
Long Section

Designed	RH	07/15	Eng check	SC	07/15
Drawn	RH	07/15	Coordination	RH	07/15
Dwg check	PB	07/15	Approved	MF	07/15

Scale at A1: 1:1500
Status: PRE
Rev: P1

Drawing Number: MMD-326109-D-DR-00-XX-1023

Earthworks contours indicated are based on existing landfill levels, not potential levels post remediation.

Junction Layout and form to be determined by traffic modelling

Lodge Farm Phase 2 housing development access. Note that provisional layout of development roads are shown, to be designed and built by developer

Reservoir Hill
Waste Transfer Sta
Weighbridge
Eastern Court
Scrap Yard
Sand and Gravel Pit
The Wilderness
Turnpike Belts
Waste Transfer Station
FROST WAY
WILLIAM FROST WAY
A1074 Dereham Road
North Cottage

CH00 CH50 CH100 CH150 CH200 CH250 CH300 CH350 CH400 CH450 CH500 CH550 CH600 CH650 CH700 CH750 CH800 CH850 CH900 CH950 CH1000 CH1050 CH1102

1:1500 0 75m 150m

Notes

1) Existing level information is based on a variety of sources. A full topographic survey will need to be carried out prior to detailed design.

Key to symbols

- OS base map
- Proposed centre line & chainage
- Highway corridor
- Extent of earthworks
- Earthworks grading. Contours at 1m intervals

Existing conditions

- Inert
- Dilute & disperse
- Landfill Phase 1 & 2
- Landfill Phase 3
- Capping
- Compound
- Soakaway

Reference drawings

MMD-326109-D-DR-00-XX-1031

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	21/07/15	RH	Issue for discussion with client	SC	MF

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Client: Norfolk County Council

Title
Longwater Link Road
Stage 1 Assessment 2015
Blue Route - Option 1
Plan

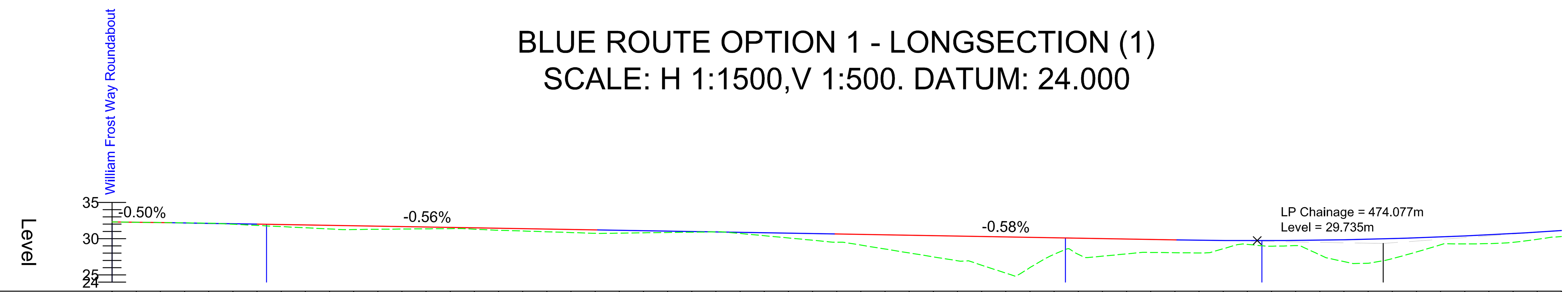
Designed	RH	07/15	Eng check	SC	07/15
Drawn	RH	07/15	Coordination	RH	07/15
Dwg check	PB	07/15	Approved	MF	07/15

Scale at A1: 1:1500
Status: PRE
Rev: P1

Drawing Number: MMD-326109-D-DR-00-XX-1030

Earthworks contours indicated are based on existing landfill levels, not potential levels post remediation.

BLUE ROUTE OPTION 1 - LONGSECTION (1)
SCALE: H 1:1500,V 1:500. DATUM: 24.000

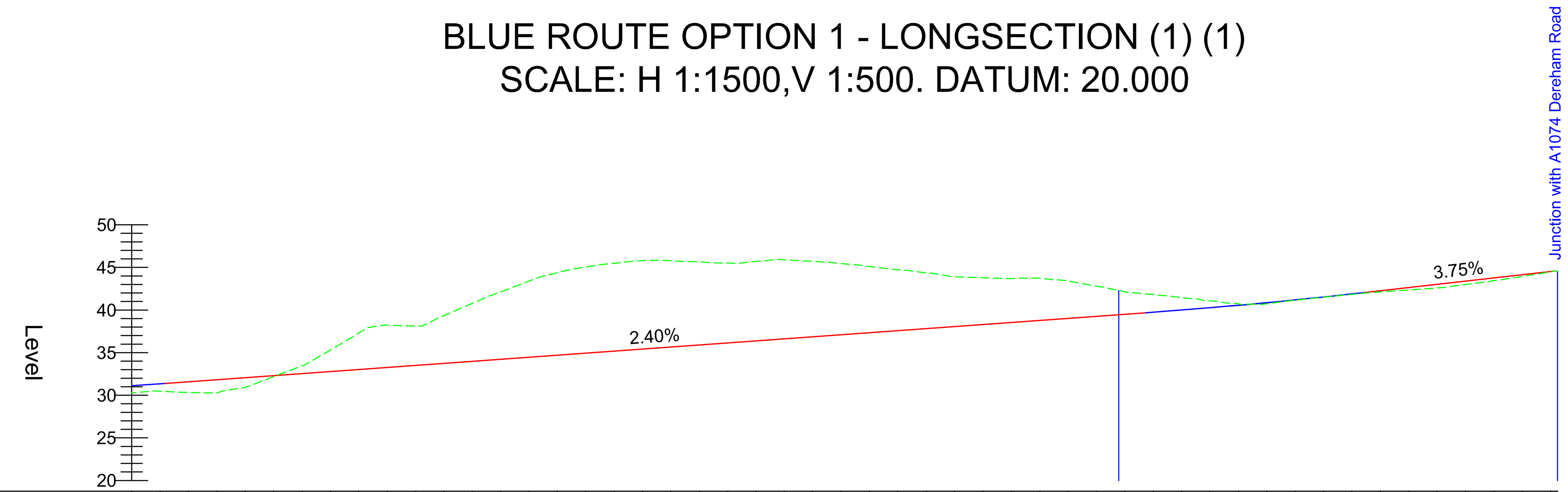


Chainage	Existing Levels	Proposed Levels	Level Difference
00.000	32.313	32.313	0.000
10.000	32.262	32.263	0.001
20.000	32.217	32.213	-0.004
30.000	32.173	32.163	-0.010
40.000	32.128	32.111	-0.017
50.000	31.991	32.058	0.067
60.000	31.827	32.002	0.175
70.000	31.663	31.946	0.283
80.000	31.499	31.890	0.391
90.000	31.336	31.834	0.499
100.000	31.257	31.778	0.522
110.000	31.294	31.722	0.428
120.000	31.328	31.666	0.339
130.000	31.357	31.610	0.254
140.000	31.381	31.554	0.173
150.000	31.308	31.498	0.191
160.000	31.149	31.442	0.293
170.000	31.053	31.386	0.334
180.000	30.950	31.330	0.381
190.000	30.842	31.274	0.433
200.000	30.728	31.218	0.490
210.000	30.761	31.162	0.401
220.000	30.809	31.106	0.297
230.000	30.853	31.050	0.197
240.000	30.891	30.993	0.102
250.000	30.937	30.936	-0.001
260.000	30.710	30.879	0.169
270.000	30.406	30.822	0.416
280.000	30.096	30.764	0.668
290.000	29.781	30.706	0.925
300.000	29.514	30.648	1.134
310.000	29.112	30.590	1.479
320.000	28.572	30.532	1.961
330.000	28.031	30.474	2.443
340.000	27.492	30.416	2.925
350.000	26.952	30.358	3.407
360.000	26.341	30.300	3.960
370.000	25.244	30.242	4.999
380.000	26.012	30.184	4.173
390.000	27.848	30.126	2.278
400.000	27.836	30.068	2.232
410.000	27.585	30.010	2.425
420.000	27.903	29.952	2.049
430.000	28.099	29.894	1.795
440.000	28.065	29.836	1.772
450.000	28.032	29.786	1.754
460.000	28.608	29.753	1.145
470.000	29.211	29.737	0.525
480.000	28.960	29.738	0.778
490.000	29.040	29.757	0.718
500.000	27.767	29.794	2.027
510.000	26.835	29.848	3.013
520.000	26.614	29.919	3.306
530.000	27.249	30.008	2.759
540.000	28.157	30.114	1.957
550.000	29.157	30.238	1.081
560.000	29.274	30.379	1.106
570.000	29.320	30.538	1.218
580.000	29.497	30.714	1.217
590.000	29.907	30.907	1.000
600.000	30.289	31.118	0.829

Horizontal Geometry: L =63.959 | R: 720.000 L: 330.719 | L =81.322 | R: 255.000 L: 471.800

Vertical Geometry: G =-0.500% L =24.674 | R =58592.662 K =585.927 L =35.156 | G =-0.560% L =141.198 | R =489717.755 K =4897.178 L =97.944 | G =-0.580% L =141.860 | R =5731.878 K =57.319 L =170.810

BLUE ROUTE OPTION 1 - LONGSECTION (1) (1)
SCALE: H 1:1500,V 1:500. DATUM: 20.000



Chainage	Existing Levels	Proposed Levels	Level Difference
600.000	30.289	31.118	0.829
610.000	30.479	31.347	0.868
620.000	30.328	31.587	1.259
630.000	30.273	31.827	1.554
640.000	30.925	32.067	1.141
650.000	32.182	32.307	0.124
660.000	33.441	32.547	-0.894
670.000	35.296	32.787	-2.509
680.000	37.293	33.027	-4.266
690.000	38.215	33.267	-4.948
700.000	38.128	33.507	-4.621
710.000	39.348	33.747	-5.601
720.000	40.778	33.987	-6.792
730.000	42.120	34.227	-7.893
740.000	43.390	34.467	-8.923
750.000	44.375	34.707	-9.669
760.000	45.045	34.947	-10.099
770.000	45.489	35.187	-10.302
780.000	45.793	35.427	-10.366
790.000	45.781	35.667	-10.115
800.000	45.649	35.907	-9.742
810.000	45.526	36.147	-9.380
820.000	45.709	36.387	-9.322
830.000	45.896	36.627	-9.269
840.000	45.714	36.867	-8.847
850.000	45.454	37.107	-8.348
860.000	45.105	37.347	-7.759
870.000	44.738	37.587	-7.152
880.000	44.377	37.827	-6.550
890.000	43.910	38.067	-5.844
900.000	43.799	38.307	-5.492
910.000	43.694	38.547	-5.148
920.000	43.726	38.787	-4.939
930.000	43.416	39.027	-4.389
940.000	42.790	39.267	-3.524
950.000	42.142	39.507	-2.636
960.000	41.811	39.747	-2.063
970.000	41.458	40.001	-1.457
980.000	41.076	40.272	-0.804
990.000	40.741	40.560	-0.180
1000.000	40.736	40.867	0.131
1010.000	41.155	41.190	0.035
1020.000	41.496	41.532	0.036
1030.000	41.837	41.890	0.054
1040.000	42.124	42.264	0.140
1050.000	42.359	42.639	0.280
1060.000	42.594	43.014	0.420
1070.000	42.992	43.389	0.397
1080.000	43.433	43.764	0.331
1090.000	43.946	44.139	0.193
1100.000	44.484	44.514	0.030
1102.415	44.981		

Horizontal Geometry: R: 255.000 L: 471.800 | L =154.615

Vertical Geometry: R =5731.878 K =57.319 L =170.810 | G =2.400% L =345.674 | R =5694.529 K =56.945 L =76.899 | G =3.750% L =67.540

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Notes

Key to symbols

Existing surface
Proposed surface

Reference drawings

MMD-326109-D-DR-00-XX-1030

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	21/07/15	RH	Issue for discussion with client	SC	MF

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Client

Norfolk County Council

Title

Longwater Link Road
Stage 1 Assessment 2015
Blue Route - Option 1
Long Section

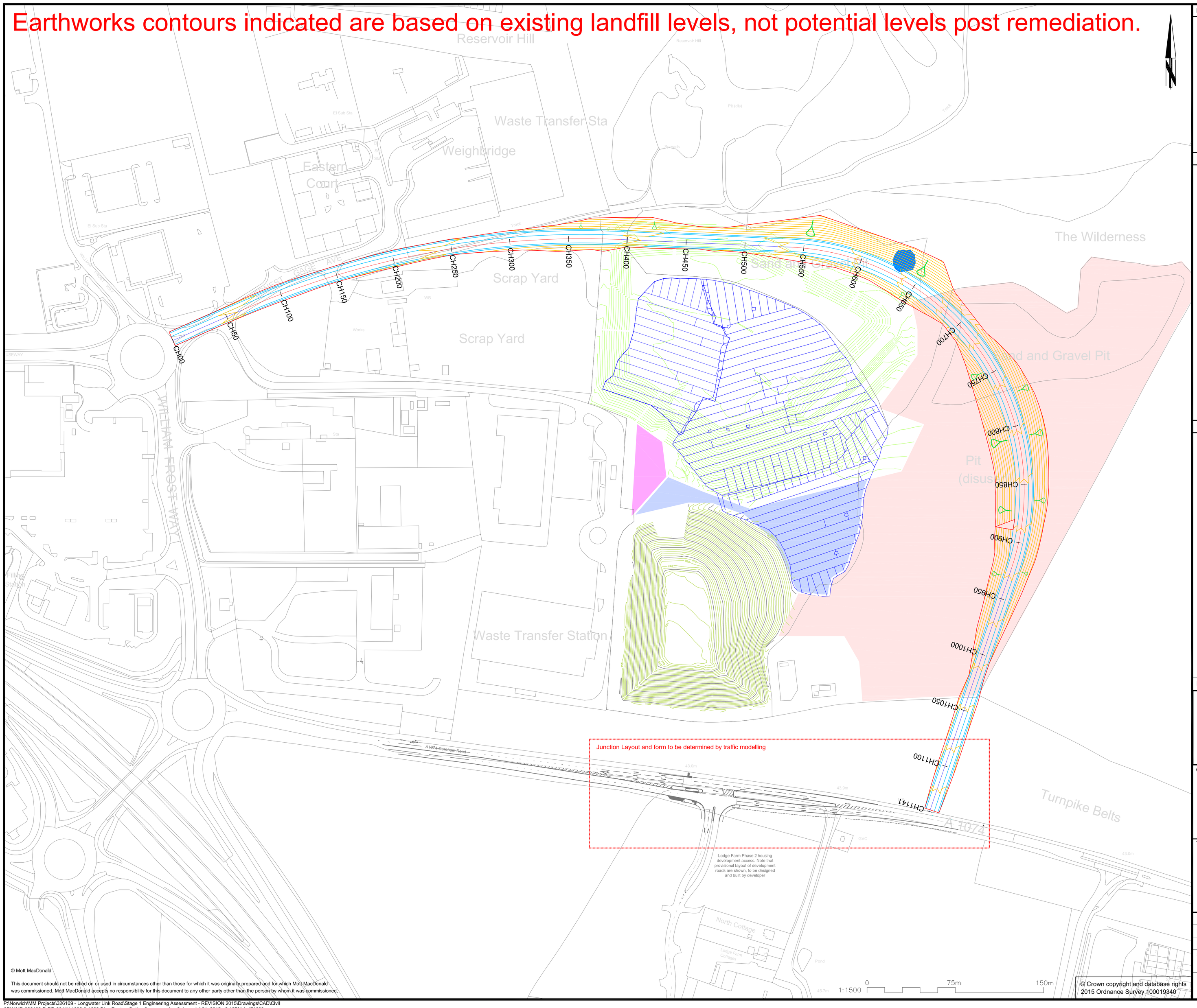
Designed	RH	07/15	Eng check	SC	07/15
Drawn	RH	07/15	Coordination	RH	07/15
Dwg check	PB	07/15	Approved	MF	07/15

Scale at A1: 1:1500 | Status: PRE | Rev: P1

Drawing Number

MMD-326109-D-DR-00-XX-1031

Earthworks contours indicated are based on existing landfill levels, not potential levels post remediation.



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Notes

1) Existing level information is based on a variety of sources. A full topographic survey will need to be carried out prior to detailed design.

Key to symbols

- OS base map
- Proposed centre line & chainage
- Highway corridor
- Extent of earthworks
- Earthworks grading. Contours at 1m intervals

Existing conditions

- Inert
- Dilute & disperse
- Landfill Phase 1 & 2
- Landfill Phase 3
- Capping
- Compound
- Soakaway

Reference drawings

MMD-326109-D-DR-00-XX-1033

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	21/07/15	RH	Issue for discussion with client	SC	MF

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Client

Norfolk County Council

Title

Longwater Link Road
Stage 1 Assessment 2015
Blue Route - Option 2
Plan

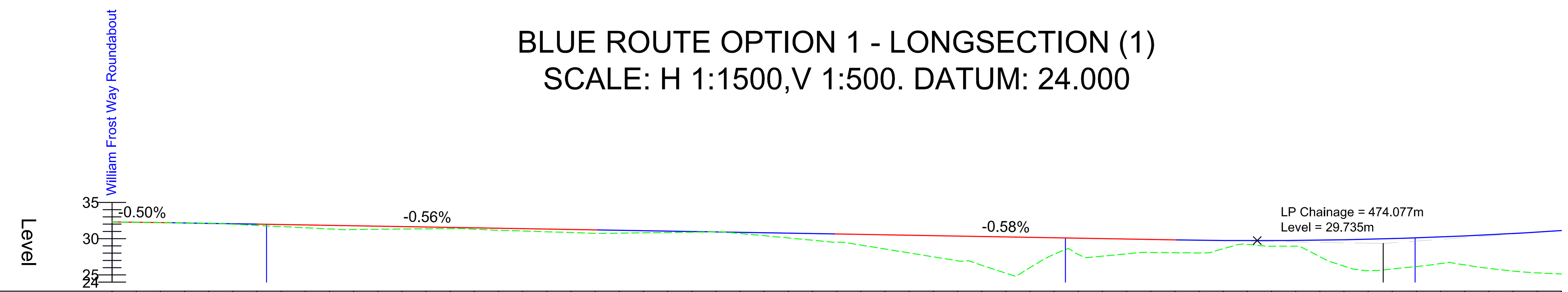
Designed	RH	07/15	Eng check	SC	07/15
Drawn	RH	07/15	Coordination	RH	07/15
Dwg check	PB	07/15	Approved	MF	07/15

Scale at A1: 1:1500
Status: PRE
Rev: P1

Drawing Number: MMD-326109-D-DR-00-XX-1032

Earthworks contours indicated are based on existing landfill levels, not potential levels post remediation.

BLUE ROUTE OPTION 1 - LONGSECTION (1)
SCALE: H 1:1500,V 1:500. DATUM: 24.000

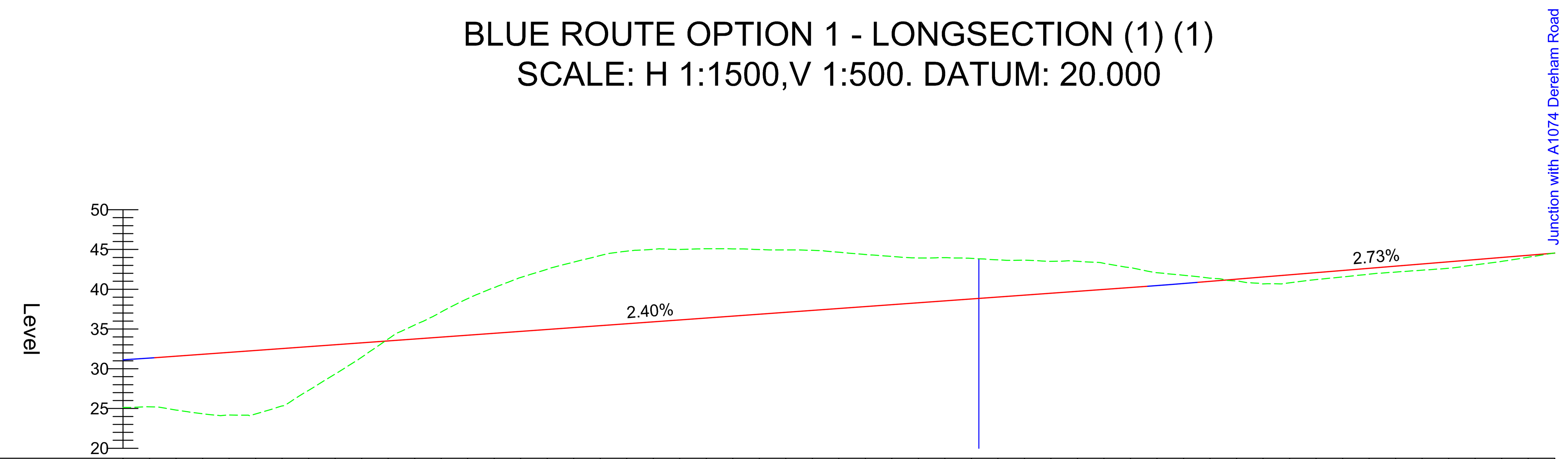


Chainage	Existing Levels	Proposed Levels	Level Difference
00.000	32.313	32.313	0.000
10.000	32.262	32.263	0.001
20.000	32.217	32.213	-0.004
30.000	32.173	32.163	-0.010
40.000	32.128	32.111	-0.017
50.000	31.991	32.058	0.067
60.000	31.827	32.002	0.175
70.000	31.663	31.946	0.283
80.000	31.499	31.890	0.391
90.000	31.336	31.834	0.499
100.000	31.257	31.778	0.522
110.000	31.294	31.722	0.428
120.000	31.328	31.666	0.339
130.000	31.357	31.610	0.254
140.000	31.381	31.554	0.173
150.000	31.308	31.498	0.191
160.000	31.149	31.442	0.293
170.000	31.053	31.386	0.334
180.000	30.950	31.330	0.381
190.000	30.842	31.274	0.433
200.000	30.728	31.218	0.490
210.000	30.761	31.162	0.401
220.000	30.809	31.106	0.297
230.000	30.853	31.050	0.197
240.000	30.891	30.993	0.102
250.000	30.937	30.936	-0.001
260.000	30.710	30.879	0.169
270.000	30.406	30.822	0.416
280.000	30.096	30.764	0.668
290.000	29.781	30.706	0.925
300.000	29.514	30.648	1.134
310.000	29.112	30.590	1.479
320.000	28.572	30.532	1.961
330.000	28.031	30.474	2.443
340.000	27.492	30.416	2.925
350.000	26.952	30.358	3.407
360.000	26.341	30.300	3.960
370.000	25.244	30.242	4.999
380.000	26.012	30.184	4.173
390.000	27.848	30.126	2.278
400.000	27.836	30.068	2.232
410.000	27.585	30.010	2.425
420.000	27.903	29.952	2.049
430.000	28.099	29.894	1.795
440.000	28.065	29.836	1.772
450.000	28.032	29.786	1.754
460.000	28.608	29.753	1.145
470.000	29.211	29.737	0.525
480.000	28.953	29.738	0.785
490.000	28.967	29.757	0.790
500.000	27.522	29.794	2.272
510.000	26.214	29.848	3.634
520.000	25.587	29.919	4.332
530.000	25.820	30.008	4.188
540.000	26.156	30.114	3.958
550.000	26.559	30.238	3.679
560.000	26.369	30.379	4.011
570.000	25.896	30.538	4.642
580.000	25.531	30.714	5.183
590.000	25.280	30.907	5.627
600.000	25.137	31.118	5.981

Horizontal Geometry: L =63.959 | R: 720.000 L: 330.719 | L =144.768 | R: 207.197 L: 383.355

Vertical Geometry: G =-0.500% L =24.674 | R =58592.662 K =585.927 L =35.156 | G =-0.560% L =141.198 | R =489717.755 K =4897.178 L =97.944 | G =-0.580% L =141.860 | R =5731.878 K =57.319 L =170.810

BLUE ROUTE OPTION 1 - LONGSECTION (1) (1)
SCALE: H 1:1500,V 1:500. DATUM: 20.000



Chainage	Existing Levels	Proposed Levels	Level Difference
600.000	25.137	31.118	5.981
610.000	25.215	31.347	6.131
620.000	24.808	31.587	6.778
630.000	24.345	31.827	7.482
640.000	24.176	32.067	7.890
650.000	24.304	32.307	8.003
660.000	25.308	32.547	7.238
670.000	27.284	32.787	5.502
680.000	29.334	33.027	3.692
690.000	31.449	33.267	1.818
700.000	33.744	33.507	-0.238
710.000	35.509	33.747	-1.762
720.000	37.129	33.987	-3.142
730.000	38.815	34.227	-4.589
740.000	40.208	34.467	-5.741
750.000	41.486	34.707	-6.779
760.000	42.522	34.947	-7.575
770.000	43.419	35.187	-8.233
780.000	44.231	35.427	-8.804
790.000	44.784	35.667	-9.117
800.000	45.027	35.907	-9.120
810.000	45.012	36.147	-8.865
820.000	45.087	36.387	-8.701
830.000	45.079	36.627	-8.453
840.000	44.995	36.867	-8.128
850.000	44.945	37.107	-7.838
860.000	44.888	37.347	-7.542
870.000	44.651	37.587	-7.064
880.000	44.370	37.827	-6.543
890.000	44.123	38.067	-6.057
900.000	43.937	38.307	-5.631
910.000	43.971	38.547	-5.425
920.000	43.878	38.787	-5.091
930.000	43.692	39.027	-4.665
940.000	43.652	39.267	-4.386
950.000	43.505	39.507	-3.998
960.000	43.510	39.747	-3.763
970.000	43.254	39.987	-3.267
980.000	42.708	40.227	-2.482
990.000	42.075	40.468	-1.607
1000.000	41.760	40.723	-1.037
1010.000	41.390	40.993	-0.397
1020.000	41.044	41.266	0.222
1030.000	40.664	41.538	0.875
1040.000	40.802	41.811	1.009
1050.000	41.208	42.084	0.876
1060.000	41.549	42.356	0.808
1070.000	41.890	42.629	0.739
1080.000	42.161	42.902	0.741
1090.000	42.396	43.174	0.779
1100.000	42.631	43.447	0.816
1110.000	43.061	43.720	0.659
1120.000	43.502	43.992	0.490
1130.000	44.029	44.265	0.236
1140.000	44.569	44.538	-0.031

Horizontal Geometry: R: 207.197 L: 383.355 | L =218.062

Vertical Geometry: R =5731.878 K =57.319 L =170.810 | G =2.400% L =374.826 | R =5694.529 K =56.945 L =18.595 | G =2.727% L =135.801

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Notes

Key to symbols

- Existing surface
- Proposed surface

Reference drawings

MMD-326109-D-DR-00-XX-1032

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	21/07/15	RH	Issue for discussion with client	SC	MF

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Client

Norfolk County Council

Title

Longwater Link Road
Stage 1 Assessment 2015
Blue Route - Option 2
Long Section

Designed	RH	07/15	Eng check	SC	07/15
Drawn	RH	07/15	Coordination	RH	07/15
Dwg check	PB	07/15	Approved	MF	07/15

Scale at A1: 1:1500 | Status: PRE | Rev: P1

Drawing Number: MMD-326109-D-DR-00-XX-1033