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# The Norfolk County Council (Norwich Northern Distributor Road (A1067 to A47(T))) Order

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## 6.2 Environmental Statement: Volume II: Chapter 2. The Scheme

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Planning Act 2008

Infrastructure Planning

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*This document is submitted in relation to the application for a proposed development by Norfolk County Council to the Planning Inspectorate, under the Planning Act 2008.*

*The application is for the Norfolk County Council (Norwich Northern Distributor Road (A1067 to A47(T))) Order, to grant development consent for the construction of a new highway running west-east between the A1067 Fakenham Road and the A47 Trunk Road at Postwick, including improvements to the existing highway network to the north and north east of Norwich.*

*This document comprises part of the application documents and relates to Regulation 5(2)(a) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009.*

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A.1.1 Overleaf is the construction methodology for the proposed Scheme, as provided by Birse Civils.

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## **Norwich Northern Distributor Road (NDR)**

### **Construction Methodology**



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## Introduction

### 1.1 Purpose of this report

- 1.1.1 This report has been prepared by Birse Civils who have been appointed by Norfolk County Council (NCC) as main contractors for the Norwich Northern Distributor Road (NDR) project. Birse Civils, part of the Balfour Beatty group, has been appointed as contractor for Stage 1 to assist with the development of the project; appointment on this basis is known as Early Contractor Involvement (ECI). The Contractor will be appointed to Stage 2 to construct the proposed NDR only when the funding is in place, the Secretary of State has confirmed the DCO and a target cost has been agreed with the Contractor.
- 1.1.2 The report describes the Construction Methodology and programme for the delivery of the NDR. It has been developed during the 'Early Contractor Involvement' (ECI) phase of the project to support the Development Consent Order (DCO) application for the NDR. In particular, the Construction Methodology will be used to inform the Environmental Impact Assessment (EIA) of the likely significant environmental effects of the construction stage of the NDR project.
- 1.1.3 The EIA of the NDR is documented within the Environmental Statement (ES). This Construction Methodology is summarised at Chapter 2 of the ES and forms an appendix to that document.
- 1.1.4 The Construction Methodology (CM) should be read in conjunction with the Construction and Environmental Management Plan (CEMP), which describes the environmental good practice measures that will be adopted during the construction of the NDR. The CEMP has been produced and will be submitted as part of our DCO application.

### 1.2 Scope of this report

- 1.2.1 This CM describes the process and programme for the construction of the NDR.
- 1.2.2 The construction is programmed to be carried out between 2015 and 2017, with the road being opened in late 2017. This report presents the CM for all of the construction works associated with the project.
- 1.2.3 The adjacent infrastructure will be affected as a consequence of constructing the NDR. These encompass works to the existing roads, footpaths, cycleways, bridleways and private access tracks that are crossed by the NDR, including alterations to these as well as the provision of new facilities to link with the existing access network. The NDR will also necessitate the diversion of a number of existing private access tracks, in addition to the provision of new tracks in some locations along its route. These 'associated works' are described within this report and detailed in Schedule 8 of the Development Consent Order (DCO).
- 1.2.4 The NDR will require modifications to some local utilities and services where these cross the footprint of the development. Discussions are underway with the relevant service/utility providers in accordance with the New Roads and Streetworks Act (NRSWA). The final design of these diversion works has yet to be finalised and agreement also needs to be reached with each provider as to who will be responsible for carrying out the works. This report therefore describes typical construction methods for the utility works and these have been assessed in the ES.
- 1.2.5 Included within the scope of the NDR is the construction of a new interchange with the A47 at Postwick. Discussions with the Highways Agency have taken place to agree the format of the new bridge crossing the A47 and the redesign to the slip roads at the Interchange.



### **1.3 Contents of this report**

- 1.3.1 Section 2 of this report describes the works to be undertaken prior to construction to prepare the NDR site and enable the construction to proceed in a timely manner. These include pre-consent works, such as benchmark and baseline environmental surveys in the preparation of the design, the mitigation works and licence applications; mobilisation works; the establishment of construction compounds, accommodation facilities and construction site accesses; and the temporary and permanent closure of local roads and public rights of way.
- 1.3.2 Section 3 describes the construction of the NDR, including the structures involved, drainage, landscaping and mitigation. It also describes associated works that are a consequence of the NDR, such as works to side roads and alterations to/provision of footpaths, cycleways, bridleways and private access tracks.
- 1.3.3 Section 4 describes the construction logistics and support structure.
- 1.3.4 Section 5 describes the programme for the construction works, including the main assumptions made in its development.
- 1.3.5 Section 6 outlines the scope of the utility diversions required to allow the NDR to be constructed, including those that are required in advance of the construction works.

### **1.4 Construction Strategy**

- 1.4.1 Birse Civils has extensive experience of planning and delivering large highway schemes. We can also take advantage of support from our parent company, Balfour Beatty PLC, who are the largest construction company in the UK. We have the knowledge and experience to deliver the NDR:
  - within budget and to programme;
  - within the constraints of the existing highway infrastructure;
  - working closely with the local communities and other stakeholders;
  - safely, complying with all H&S legislation; and
  - observing the environmental strategies and working practices set out in the CEMP.
- 1.4.2 The strategies used for the development of this CM are outlined below.

#### **Construction Programme Strategy**

- 1.4.3 The construction programme is discussed in detail in Section 5 of this report. The key assumptions underlying preparation of the programme are described in paragraphs 1.4.4 – 1.4.15.
- 1.4.4 Mobilisation will commence in early 2015 to ensure that the office and compound facilities are available for the start of the works. This will of course be dependent on any environmental mitigation works required at each location.
- 1.4.5 Construction will commence in 2015 with site clearance activities, ecological mitigation and the diversion of the utilities affected by the scheme.
- 1.4.6 Some preparatory works will be required in advance of planning permission being granted where appropriate and within legal limits. Typical pre-consent works to be completed are described in Section 2.
- 1.4.7 All ecological and cultural heritage mitigation works will be carried out in accordance with the CEMP once the appropriate licences have been obtained. All ecological and cultural heritage works will be completed in advance of construction works in relevant areas under the supervision of suitably qualified specialists. Ecological receptor sites will be identified and prepared for the translocation of species and habitats as required. Archaeological field walking and trial trenching has been undertaken and any further surveys will



- be completed prior to the start of the construction works. The programme will take account of any watching brief or further excavation works required.
- 1.4.8 Land will only be released for construction once the ecological and cultural heritage works have been completed. This will follow the logic of the construction sequence within our works programme set out in Section 5. All areas of the site will be signed off by the relevant environmental or archaeological specialists prior to work commencing.
  - 1.4.9 The bulk earthworks are programmed to be carried out between March and October 2016. Visual and noise mitigation bunds will be constructed as soon as practicably possible to minimise local disturbance.
  - 1.4.10 Temporary drainage arrangements will be constructed where required, ahead of the works commencing to ensure that surface run-off will not directly enter any existing water courses. All private water supplies will be identified with landowners and clearly marked on the site and contract drawings.
  - 1.4.11 The surfacing works are planned to be carried out between July 2016 and July 2017.
  - 1.4.12 The new bridges and associated side roads will be constructed to ensure access is available to meet both the earthworks and surfacing programmes.
  - 1.4.13 Landscaping works will be undertaken as soon as practicable upon completion of the earthworks. The optimum amount of planting will be undertaken at the end of the first year of construction between November 2015 and March 2016. All landscaping works will be subject to a two year maintenance period.
  - 1.4.14 The site will be secured progressively, in accordance with the sequence of work as planned, with permanent fencing being erected (including any specified netting) wherever possible. Local roads will be maintained as far as is practicable and diversions will be completed prior to stopping up.
  - 1.4.15 The programme of construction works has been developed, as far as practicable, to avoid disruption to local communities and the environmental effects of construction.
  - 1.4.16 Working hours will reflect the need to complete the construction works as quickly and effectively as possible, whilst minimising the disturbance to local communities. Earthworks operations have been programmed between 07:00 and 19:00 Monday to Friday and 07:00 and 13:00 on Saturdays. Extended hours of working (e.g. Sundays and overnight works) will be limited to those required to construct tie-ins to side roads, those subject to the requirements of Network Rail at Rackheath and the construction of the new A47 overbridge. All working hours will be discussed and agreed with the Environmental Health Officer (EHO).

### **Materials and Waste Strategy**

- 1.4.17 A cut to fill balance will be achieved for the earthworks associated with the NDR. Excavated material will be used to form the structural embankments, landscape areas and bunds and granular material will be used to form sub-base for the main carriageway, where it will be stabilised with cement.
- 1.4.18 The road surfacing will be constructed with hydraulically bound material (HBM) batched on site and bituminous material delivered from Lafarge Tarmac's coating plant in both Norfolk and Suffolk. Low noise surfacing will be used throughout the project. The delivery of this material will be made by road vehicles. The use of existing hard material from within the site will be used as subbase for the side road and footpath construction.
- 1.4.19 Materials storage areas will be identified at the main construction compound adjacent to Norwich Airport (identified in Section 4.4) and within the planning application site boundary adjacent to the bridge locations. Materials will be transported around the site by road vehicles.



- 1.4.20 A Site Waste Management Plan (SWMP) will be developed to identify and record measures to optimise re-use of materials on site, maximise resource use and minimise the amount of waste produced and disposed in land fill off site.

#### **Labour Strategy**

- 1.4.21 It is Birse's intention to sublet the NDR works in packages that can be effectively carried out by our supply chain. Only attendance labour for the administration of our compounds and site offices will be employed directly from within the Norwich area.
- 1.14.22 In conjunction with NCC, Birse will produce a Procurement Schedule of capable suppliers for each of the works packages. This will include as many local suppliers from East Anglia as practicably possible.
- 1.14.23 Early subcontractor involvement has already commenced with Lancaster being awarded the earthworks package, Lafarge Tarmac the surfacing package and Roadservices the Traffic Management package.
- 1.14.24 All construction workforce support facilities will be provided within the planning application site boundary. Birse Civils staff will have accommodation provided if required within the main site compound adjacent to Norwich Airport.

#### **1.5 Consultation**

- 1.5.1 Consultation meetings were held with NCC Planning, Environment Agency, Natural England and English Heritage during the development phase of the project. The comments received have been incorporated within this document and the CEMP, as will any agreement reached with the EHO.



## **Pre-construction Works**

### **2.1 Introduction**

- 2.1.1 There are a series of activities that must be completed before the construction works for the NDR can commence. Some of these can be completed prior to the Secretary of State's decision and will be done at risk to allow the NDR construction works to commence as programmed in March 2015. These are described as pre-consent works.
- 2.1.2 Some pre-construction works can only be completed once consent has been granted. These are the activities that depend on the decision to implement them and ensure the measures to prevent, reduce, offset, or enhance the effects of the development are completed in accordance with the relevant legislation. In addition these activities are required as preparation to the construction activities. These activities are described as mobilisation and site establishment works.

### **2.2 Pre-consent Works**

- 2.2.1 Some work will be completed in advance of planning consent being granted, such that the works that are dependent on consent can commence as soon after the Secretary of State's decision as possible. Works to be completed prior to the decision being made include:
- Benchmark and baseline monitoring
  - Preparation of licence applications for the ecological translocation works and any cultural heritage works required
  - Negotiations with statutory utility companies regarding the diversion of key services including the HP gas main and the oil pipeline.

### **2.3 Mobilisation and Site Establishment**

- 2.3.1 There will be an 8 week mobilisation period allowed within the NDR programme. This will enable the following activities to be completed prior to construction commencing:
- Establishment of main office compound at Norwich Airport and satellite compounds at Drayton lane, Buxton Road, Plumstead Road and Postwick.
  - Obtain final consents and necessary licenses for commencing ecological and archaeological mitigation works in accordance with the programme
  - Completion and approval of our construction phase Health and Safety plan.
  - Completion of our Quality Plan and Waste Management Plans
  - Completion and agreement from all parties on the CEMP
  - Update our Procurement Schedule and set up Orders with subcontractors and suppliers required for the early construction activities
  - Update all stakeholders on the work being undertaken in the first three months by newsletter
  - Organise local exhibitions to promote the scheme and advise stakeholders of the scope and programme for the scheme.
  - Commence the diversion of utility affected by the works



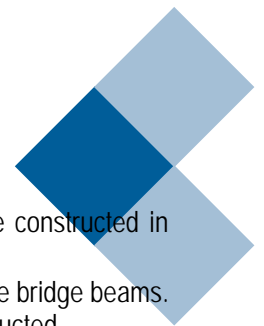
- Apply for Temporary Traffic Regulation Orders (TTRO's) to NCC
- Apply to stop up or divert Public Rights of Way (PROW's) to NCC

## 2.4 Facilities for Pre-construction Works

- 2.4.1 Facilities for all pre-construction works will be available at the Project ECI office at Gazebo Farm, Newman Road, Rackheath. This building has been purchased by Birse Civils and planning permission received for change of use from a dwelling to an office. The facility includes an open plan office with two meeting rooms and full welfare facilities.
- 2.4.2 This facility will remain available throughout the construction and maintenance period for senior staff from both Birse and NCC.

## 2.5 Stopping Up and Diversions to Roads and Public Rights of Way

- 2.5.1 The stopping up and diversion of side roads required to deliver the NDR scheme is fully described below. It is always our intention to minimise any disruption for road users and local residents. Our construction programme has been developed to take cognisance of this. The effect of the NDR on the local road network is described below and indicated on the drawings supporting the planning application.
- The NDR commences with the construction of a new roundabout on the A1067 Fakenham Road. The new road then heads east as a dual two lane carriageway.
  - A new roundabout will be constructed where the NDR crosses Fir Covert Road.
  - A temporary diversion of Marriott's Way will be established for the period required to construct the new bridge and approach embankments.
  - Breck Farm Way will remain open until the new Marriott's Way structure is completed. It is then our intention to apply for a short term closure to allow all of the tie-ins to be completed and carry out the diversion of Breck Farm Lane.
  - A new roundabout is created where the NDR crosses Reepham Road. This will be constructed in phases using traffic signals to control the traffic.
  - The Private Access track at Ch3750 will be closed.
  - To construct the overbridge and side road improvements to Bell Farm we will require either a temporary closure or the construction of a temporary diversion outwith the footprint of the new construction.
  - A new roundabout is created where the NDR crosses Drayton Lane. This will be constructed in phases using traffic signals to control the traffic.
  - The construction of the new roundabout on Holt Road will be constructed in phases using traffic signals. This will be constructed after the permanent diversion of Drayton Lane is completed.
  - A new interchange is created where the NDR crosses Cromer Road. This will be constructed in multiple phases using traffic signals to control the traffic. As part of these works Holt Road, Hall Lane (Holly Lane) and New Home Lane will all be stopped up at the interchange. No closure will be applied for on this important county road.
  - The construction of the tie-ins at Buxton Road will be undertaken in phases using traffic signals to control the traffic.
  - A new roundabout is created where the NDR crosses North Walsham Road. This will be constructed in phases using traffic signals to control the traffic.
  - The existing access to Beeston Farm is stopped up and replaced with a private means of access along the north fence line.
  - A new roundabout is created where the NDR crosses Wroxham Road. This will be constructed in phases using traffic signals to control the traffic.
  - The Private Access track at Ch14800 will be stopped up.
  - At Newman Road access to the park will be maintained at all times necessitating the use of traffic signals to construct the tie-ins.



- A new roundabout is created where the NDR crosses Salhouse Road. This will be constructed in phases using traffic signals to control the traffic in order to construct the tie-ins.
- Plumstead Road will only be closed off peak to facilitate the delivery and placing of the bridge beams. At other times traffic will be controlled with signals to allow the abutments to be constructed.
- Middle Lane will be closed to allow the bridge and new side road to be constructed. After this new road is opened both Low Road and Smee Lane will be permanently closed.
- A new Interchange is to be constructed at Postwick. This includes the construction of a new bridge across the A47, new westbound diverge and merge slip roads, refurbishment of the existing A47 overbridge, a new signalised junction at the entrance to the Park and Ride Site and new access arrangements to the NDR from Peachman Way roundabout and the new Postwick North East roundabout.

2.5.2 At locations where closures will not be permitted we have indicated additional land on the red line drawings that may be required to facilitate the tie-ins. These areas are most likely to be required on side roads with full depth construction tie-ins and not overlay.

## **2.6 Site Access for Construction Activities**

2.6.1 Access to the site is covered in Section 4.5, where we have indicated the public roads we will require access along to service the site. This includes the side roads where we propose to install plant crossings to allow safe access for both construction plant and the travelling public.





### **3 Construction of NDR**

#### **3.1 Introduction**

3.1.1 This section describes our proposals for the major construction activities associated with delivering the NDR.

3.1.2 Our construction programme has been developed on the basis that site clearance operations are completed throughout 2015, depending on the constraints of the ecological calendar. To provide continuity, the earthworks are carried out wholly in the 2016 season. We have identified all of the areas required for both temporary storage and permanent disposal within the site boundary to enable a cut to fill balance to be achieved. The granular material west of Cromer road has been identified as being the best source of aggregates for the cement bound materials, which will be used as the subbase and base for the NDR. The construction of the new bridges is programmed to commence in May 2015 and the programme has been developed to allow continuity of the earthworks and optimised paving operations. As each bridge is completed the corresponding side road activities will be undertaken to allow traffic to be diverted over or under the NDR. The drainage activities are programmed to be undertaken as follows:

- Cut off drainage and ditches, along with culverts will be constructed in advance of the earthworks activities;
- Piped carriageway drainage activities and outfalls will be completed after the earthworks activities;
- Swales and bituminous drainage channel will be constructed as part of the finishing activities.

The balancing ponds will be excavated to provide earthworks or landscape fill. Surfacing operations are programmed to commence in July 2016. The HBM material will be batched on site at dedicated areas within our compounds. Our intention is that once cured we will use this carriageway for access through the works. The bituminous surfacing will follow the progression of the HBM base materials. One carriageway will be completed at a time to allow unrestricted access through the site.

3.1.3 Production rates for all activities are based on those previously achieved on similar projects and have been discussed in detail with both our earthworks and surfacing subcontractors. Our outline programme is attached in Section 5 of this report.

#### **3.2 Site Clearance**

3.2.1 Our strategy for site clearance is to carry out the majority of the work outwith the bird nesting season which is between March to September inclusive. Other statutory ecological restrictions that apply to bat roosts, badgers, reptiles and amphibians on specific parts of the site will also be completed after securing the appropriate licenses from Natural England.

3.2.2 All site clearance activities will be supervised by Middlemarch, our environmental advisors, to ensure we consistently comply with the statutory regulations and that best practice is used during the translocation of the protected species.

#### **3.3 Earthworks**



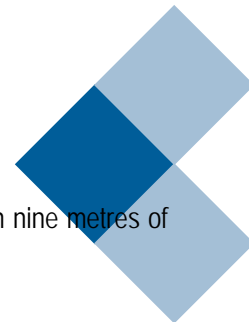
- 3.3.1 The overall earthworks strategy has been based on a cut to fill balance with excavated material from the cuttings, structures, balancing ponds and drainage arisings being utilised to satisfy all of the fill areas, bunds, landscape areas and also provide the aggregate for the CBGM A subbase. All material will be hauled through the site within the red line footprint. Plant crossings will be utilised to cross the public roads. Their location and construction is discussed further in Section 4.5.
- 3.3.2 All topsoil strip activities will be undertaken to take account of the results of the completed archaeological surveys. Our construction programme will take account of any watching brief requirements required. Any contaminated material encountered during the works will either be disposed off site in designated disposal facilities or if possible remediated to be used within the works.
- 3.3.3 A detailed Soil Management Plan will be produced to ensure that where possible the reinstatement of topsoil will match the quality of that originally excavated. Where topsoil is stripped in compounds and batching plants the soil will be bunded around the perimeter to achieve both noise and visual attenuation.
- 3.3.4 The bulk quantities taken from the fixed MX model are:

Material	Excavation Quantity
Topsoil	455,000 cm
Excavation	1,477,000 cm
Embankment Fill	752,000 cm
Landscape Fill	763,000 cm
Resoil	382,000 cm

- 3.3.5 The earthworks season has been programmed from mid March to mid October, which is 30 weeks long taking account of Easter. The average output per earthworks team is 1,500 cm per day, which requires up to 5 teams being available to meet the construction programme.
- 3.3.6 The earthworks have been divided into the two separate seasons. During 2016 it is our intention to complete the following earthworks operations:
- Cromer Road to North Walsham Road
  - Rackheath Rail bridge approach embankments
  - Rackheath Rail bridge to North Walsham Road.
  - Postwick Interchange
- During 2017 the key earthworks activities are:
- Cromer Road to Fakenham Road
  - Rackheath Rail Bridge to Postwick
- 3.3.7 It is our intention whenever possible to deposit excavated material in its final location. However temporary soil storage will be required. These areas are indicated on the drawings, and have been derived to minimise the haul lengths and maximise the use of land already taken for the scheme. All storage locations are within the red line boundary.



- 3.3.8 The re-soil of completed slopes, verges, bunds and other landscape areas will be carried out immediately after the earthworks has been trimmed to final line and level. This will allow the seeding and planting works to be optimised at the end of 2016.
- 3.3.9 In landscape areas the existing topsoil will not be removed prior to fill being placed due to the large surplus available.
- 3.3.10 At the Rackheath approach embankments there is a requirement for ground stabilisation prior to commencing fill operations. The detailed design for this element of the works is not yet completed but any starter layer required will utilise the as excavated granular material.
- 3.3.11 In cuttings founded on clay having a CBR<2%, the subgrade will be cement stabilised insitu to a depth of 250mm. On embankments the top metre of fill will be formed with granular material to ensure the CBR is acceptable for our proposed pavement construction.
- 3.3.12 The earthmoving plant used will comprise off road articulated dump trucks, tracked excavators and dozers and both towed and self propelled rollers. A list of indicative plant and equipment is included in Section 4.3.
- 3.3.13 The CEMP includes measures for avoiding dust nuisance during dry spells of weather. All haul roads will be regularly maintained by a motor grader to ensure that plant can pass safely through the site.
- 3.3.14 Where plant has to cross underneath overhead cables or above buried live services we will ensure that adequate risk assessments have been carried out for each location and that adequate safety measures are in place and maintained to avoid any damage.
- 3.3.15 Excavated topsoil will either be placed directly into landscape areas or attenuation bunds or stored for re-use in designated areas indicated on the planning drawings. These have been allocated to ensure that the height of the stockpiles do not exceed two metres. All surplus material will be disposed within the red line boundary. The permanent bunds will be constructed early within the construction period to maximise the visual and noise screening to the local communities.
- 3.4 Drainage**
  - 3.4.1 Surface water run-off from the NDR and associated side roads will drain to permanent balancing ponds indicated on the scheme drawings. These ponds have been designed as infiltration ponds, which will drain into the underlying ground.
  - 3.4.2 The drainage system proposed for the NDR is Sustainable Drainage System (SuDS) based on run off from the carriageway being intercepted by grass swales which will percolate to collection catch pits before draining to the balancing ponds. Where the carriageway drains to the centre reserve the runoff will be collected in a bituminous drainage channel, which will be collected into a piped drainage system and outfall to the verge drainage system. The subgrade to the carriageway will be drained by narrow filter drains on the low side of each carriageway which will discharge into the carriageway drainage catch pits.
  - 3.4.3 The drainage at roundabouts, side roads and Postwick Interchange will be with either kerb drains or traditional road gullies. The discharge will feed into a network of carrier drains, which will feed to the balancing ponds.
  - 3.4.4 All of the balancing ponds will be monitored during the construction phase at the point of discharge to ensure that contaminants from the construction works are not entering the pond. The CEMP will document the monitoring requirements which will be agreed with NCC.
  - 3.4.5 Existing road drainage will not be impeded at any time during construction.



- 3.4.6 Flow will be maintained during the culvert relocation along Dobbs Beck. Any works within nine metres of an existing watercourse will obtain EA consent.

### 3.5 Pavement/ Surfacing

- 3.5.1 The pavement design for the NDR is currently based on a 40 year designed life. For the main carriageway between roundabouts this will consist of a hydraulically bound material (HBM) base, bituminous binder and surface course founded on a CBGM A subbase. A low noise surface course will be used throughout.
- 3.5.2 The CBGM A subbase will be formed by insitu stabilisation of the excavated granular material. The HBM base layer will be batched on site at specific locations within our compounds. The cement content will be based on trials using the excavated granular materials but it is envisaged that approximately 5% of cement will need to be added to the excavated material. The cement will be delivered to site by tankers and stored in silos. Approximately 86,000 cm of granular material will be required. 3.5.3 Tarmac has been appointed as our surfacing contractor for the NDR scheme. The bituminous material for the project will be batched and delivered by road wagons from their plants at Bittering and Ipswich. Access to the site is discussed in detail within Section 4.5. It is anticipated that approximately 1000 tonnes/ day will be delivered between July 2016 and July 2017.
- 3.5.3 The pavement design for the roundabouts and their approaches, Postwick Interchange and all side roads is bituminous base, binder and low noise surface course founded on granular Type 1 subbase. Where possible we will substitute the requirement to import Type 1 subbase by utilising crushed concrete or road planings from the works or other local contracts.
- 3.5.4 All works will be undertaken within the normal working hours for the site as discussed in detail in Section 4.2. However to maximise efficiency some of the side road tie-ins and paving operations at Postwick Interchange may be carried out either overnight or on Sundays, when traffic management restrictions will be relaxed by the Highway Authority.

### 3.6 Structures

- 3.6.1 There are 9 new bridges to construct on the NDR scheme, as well as 7 bat bridges and 1 bat tunnel. The logic of the construction sequence is dependent on the programme for the earthworks and surfacing. The table below indicates the type of construction currently being considered for each of the bridges and the period it is programmed to be constructed in.

Bridge	Location	Bridge Form	Green Bridge
Marriott's Way	Ch 2450	Two span precast concrete deck with reinforced earth abutments	Yes
Bell Farm	Ch 3990	Two span precast concrete deck with reinforced earth abutments	No
Cromer Road	Ch 6800	Two span precast concrete deck with reinforced earth abutments	No
Buxton Road	Ch 10900	Two span precast concrete deck with reinforced earth abutments	No
Newman Road	Ch 15500	Two span precast concrete deck with reinforced earth abutments	No
Rackheath Rail	Ch 16900	Three span composite deck with steel beams with insitu concrete abutments	No
Rackheath Road	Ch 17000	Single span precast concrete deck with reinforced earth abutments	No
Middle Road	Ch 18060	Two span precast concrete deck with reinforced earth abutments	Yes
A47 Postwick Overbridge	Ch 20250	Three span composite deck with steel beams with insitu concrete abutments	No

Rackheath Bat Underpass	Ch 14805	Precast box culvert	No
Bat Gantry 1	Ch 750	Multi Wire	No
Bat Gantry 2	Ch 5800	Multi Wire	No
Bat Gantry 3	Ch10050	Multi Wire	No
Bat Gantry 4	Ch 12600	Multi Wire	No
Bat Gantry 5	Ch 13200	Multi Wire	No
Bat Gantry 6	Ch17700	Multi Wire	No
Bat Gantry 7	Ch 19000	Multi Wire	No

3.6.2 A small compound will be established at each of the major bridge sites to store materials and to provide welfare facilities for the staff and operatives involved with the construction. Refer to Section 4.4 for more detail.

3.6.3 The Rackheath Rail Bridge crosses the Norwich to Cromer line. Discussions will be held with Network Rail to agree the construction methods appropriate for the construction and the possessions required based on the Rules of the Route in place for this line. It is anticipated that overnight possessions will be available during the week with longer periods being available at weekends. We will ensure that adequate noise mitigation measures are in place during these periods. Our sister company Balfour Beatty Rail will provide assistance to our team in negotiating access and agreeing methodology with Network Rail.

### 3.7 Associated Accommodation Works

3.7.1 The boundary fencing will be programmed to be the first physical activity carried out on the NDR. The type of fencing required will be agreed in advance with each of the adjacent landowners and detailed accordingly on the fencing drawings.

3.7.2 For boundaries where permanent fencing has not been requested we will install temporary fencing for the duration of the contract works to avoid the risk of trespass on land outwith the scheme.

3.7.3 Fencing to side roads and adjacent to structures will be completed once the bridge has been completed and the tie-in completed. Again temporary fencing will be erected where necessary to avoid trespass.

3.7.4 A schedule of accommodation works will be agreed with each land owner in order that access to their land is maintained as a result of the NDR being constructed. These works will include access tracks, water supplies and field entry points and gates. These will be programmed to ensure uninterrupted access is maintained at all time to adjacent land and properties.

### 3.8 Lighting and Signage

#### Street Lighting

3.8.1 Street lighting will only be provided at the Postwick Interchange between the new and existing roundabouts.

3.8.2 All columns will be constructed from galvanised tubular steel. Flat glass lenses will be provided to ensure there is minimal light leakage.

3.8.3 Lighting columns that are erected behind safety fencing must be positioned outwith the working width of the safety fence. If this requirement cannot be met then the column must be of a type that is passively safe.

3.8.4 Arrangements will be made with UKPN to agree the location and size of all Feeder Pillars required to provide power for the new lighting required. They will also be contacted to agree any electrical disconnections required and to programme the energising of the new lighting.

3.8.5 All service cables supplying the new lighting system will be installed in continuous uPVC ducting.



### **Road Signs**

3.8.6 The location of all signs will be set out and agreed on site prior to any excavation commencing to ensure sight lines are not affected and the correct type of posts have been specified.

3.8.7 Lit signs will be fed from the nearest lighting column or directly from a feeder pillar if this is not practicable

### **3.9 Landscaping**

3.9.1 There are predominantly three types of landscaping works to be carried out on the NDR scheme; the grass seeding of the re-soiled earthworks slopes, the planting of trees and shrubs and the planting of hedgerows.

3.9.2 The seeding works will be undertaken between April to May and September to October when there is more moisture in the soil and enough warmth to propagate growth. Once the sward of grass has been established a high level cut will be undertaken to encourage growth. Areas that fail to germinate will be reseeded in the next available season.

3.9.3 The planting of all shrubs, trees and hedge plants will be undertaken between October and March. There are areas of offsite planting that will be undertaken during 2015 in order that they can become established prior to the road opening. Similarly those areas available for planting at the end of 2016 will also be maximised leaving the minimum amount possible to be completed at the end of the project in 2017.

3.9.4 Maintenance of all plants will be undertaken for two years after the scheme has been completed, before the responsibility is transferred to NCC.

### **3.10 Mitigation**

3.10.1 Emergency response procedures will be developed and implemented that will cover any incidents that might lead to release of pollutants to the aquatic environment or the existing ground.

3.10.2 Storage of potentially polluting materials, plant and equipment, fuel and wheel washes will always be located more than ten metres from any watercourse.

3.10.3 A full environment emergency plan will be included within our CEMP and will comply with EA Pollution Prevention Guidelines PPG05 and PPG23 and CIRIA C648.



## **4. Construction Logistics**

### **4.1 Introduction**

- 4.1.1 This section summarises the different logistics required to deliver the NDR scheme. Indicative resource levels have been given based on the current project scope and programme based on our experience of delivering similar large highway schemes.

### **4.2 Working Hours**

- 4.2.1 Normal working hours will be from 07.00 – 19.00 Monday to Friday and 07.00 – 13.00 Saturday.
- 4.2.2 Working hours will reflect the need to complete the construction works as economically and efficiently as possible, whilst avoiding undue disturbance to local residents and businesses. Approval will be obtained from the relevant Environmental Health Officer, should we require permission outwith these hours.
- 4.2.3 It is proposed that working hours will have to be extended for some works as follows:
- Works within a Rail Possession at Rackheath Rail Bridge to comply with Network Rail's rules
  - Placing beams to the Cromer Road and A47 bridges
  - Deck construction to the A47 bridge
  - Construction of tie-ins at side road locations
  - Maintenance works in our site compounds

### **4.3 Labour and Plant**

- 4.3.1 This section summarises the estimated workforce (staff and operatives) and major items of plant required to deliver the NDR scheme.
- 4.3.2 A procurement strategy has been developed in conjunction with NCC to optimise the use of local labour from companies based in East Anglia. Birse Civils strategy is to procure works through subletting work packages to subcontractors on their approved supplier database. The following key subcontract packages have already been awarded based on specific scheme mini bids:
- Earthworks package to Lancasters (Newmarket based)
  - Surfacing package to Lafarge Tarmac (Norfolk and Suffolk based)
  - Traffic Management to Roadservices (Peterborough based)

With respect to the other trades a shortlist of three contractors will be agreed. We will invite these to tender for the associated works to suit our construction programme.

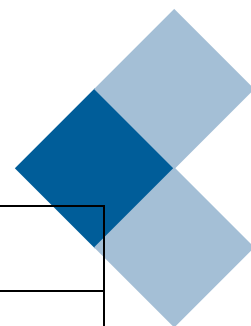
- 4.3.3 At peak periods in the summer months (April to September) of 2016 and 2017 we will have approximately 42 and 55 staff respectively and 120 operatives employed on the NDR scheme. Most of the Birse staff will be existing employees but we do envisage having to employ some local agency staff.
- 4.3.4 Accommodation for our staff who are not local to the scheme will be provided at our main Airport compound. There will be no provision made for operatives who predominantly will travel daily to the project. Car parking will be provided at all site compounds as indicated on the drawings.



4.3.5 The major plant items on the project will be associated with the earthmoving, drainage, surfacing and structures operations. The table below schedules the average number likely to be on site at any time along with their associated noise levels.

Earthworks	Item of Plant	Number	Noise level @ 8m (db)
	Cat 330 Excavator	1	87
	Cat 320 Excavator	1	83
	Volvo 460 Excavator	1	88
	Volvo 290 Excavator	1	86
	Volvo A30 Dumptruck	12	70
	Volvo A25 Dumptruck	10	67
	Cat D6 Dozer	4	90
	Cat CP76 Roller	3	91
	Kleeman Mr122 Crusher	1	92
	Cat 996 Loading Shovel	1	90
	Chieftain 2100 Power Screen	1	92
<b>Drainage</b>	15 Tonne Excavator	4	
	12 Tonne Excavator	2	
	4 tonne Mini Excavator	4	
	4 Tonne Dumper	6	
	Bomag 120 Roller	6	
	Hiab lorry	1	
<b>Surfacing</b>	Master Paver	2	





	Bomag 161 Roller	2	
	Bomag 138 Roller	2	
	8 Tonne Dead Wight Roller	2	
	Tack Coat Sprayer	2	
<b>Structures</b>	NCK 40 tonne Crawler Crane	3	
	40 Tonne Mobile Crane	2	
	CFA Piling Plant		
	Hiab lorry	1	
	Telehandler Forklift	2	

#### 4.4 Site Compound and Facilities

- 4.4.1 The main site compound will be located on the Airport land north of the NDR. Access will be from Cromer Road along the line of the future private means of access adjacent to the eastbound on slip road. This compound will have full welfare facilities and adequate parking for both staff and operatives. There will also be provision for accommodation for our travelling staff. Co-located offices will be provided for Birse, NCC and Mott MacDonald staff as well as key supply chain partners. A plant storage and maintenance compound will also be provided at this location as well as a recycling yard for storing recycled materials. Mains services will be provided in advance to ensure the offices are fully operational in advance of the commencement of construction.
- 4.4.2 The facilities at Gazebo Farm will be maintained as a high level administrative office for the overall project and future works.
- 4.4.3 Satellite compounds will also be constructed to provide office, parking and plant storage facilities at Drayton Lane, Buxton Road, Plumstead Road and Postwick. We will also batch the HBM materials at these locations.
- 4.4.4 Smaller compounds will also be established at each of the bridge sites to provide welfare facilities, parking and material storage associated with their construction. These will be reinstated after the bridge construction is completed.

#### 4.5 Materials Delivery and Management

- 4.5.1 The philosophy developed for the delivery of materials to the NDR scheme and the subsequent movement throughout the site has been developed based on the logistics of the site and discussion with NCC on the suitability of the County Roads for delivery vehicles. At several locations we have indicated the requirement for plant crossings, either temporary (concrete crossing points) or permanent (signal



controlled) that are required for transporting earthworks and other materials along the route. At several locations we have envisaged these only being approved during off peak periods.

- 4.5.2 Wheel washing facilities will be provided at all major access points and road sweeping equipment will also be provided to keep the roads clean and free from any mud and debris. All access points and haul road crossings will comprise of reinforced concrete slabs wide enough for two way traffic.
- 4.5.3 All access arrangements required are indicated on the planning drawings and are summarised in the table below.

County Road	Access Requirements	Plant Crossing
Fakenham Road	Eastbound access from existing highway	No
Marriott's and Breck Farm Way	None	Temporary crossing point
Reepham Road	Eastbound and westbound access	Yes (off peak)
Bell Farm	None	Temporary crossing point
Drayton Lane	Eastbound and westbound access	Yes
Holt Road	Eastbound and westbound access	Yes
Cromer Road	Eastbound access to Main Compound	Yes (off peak after Holt Road is closed)
Old Norwich Road	None	Temporary crossing point
Northern Airport access	None	Temporary crossing point
Quaker Road	None	Temporary crossing point
Buxton Road	Eastbound and westbound access	Yes
North Walsham Road	Eastbound and westbound access	Yes (off peak)
Beeston Farm	None	Temporary crossing point
Wroxham Road	Eastbound and westbound access	Yes (off peak)
Newman Road	To offices and bridge site only	Temporary crossing point



Salhouse Road	Eastbound and westbound access	Yes
Plumstead Road	Access to compounds and bridge sites	No
Middle Road	None	No
Low Road	Eastbound and westbound access	Yes
Smee Lane	None	Yes
Postwick	Access from Yarmouth Road and Broadland Way	No

- 4.5.4 Access through the site will be by either the westbound or eastbound carriageway depending on the current programmed activities. Apart from material deliveries access will be predominantly for earthworks plant transporting material from the cuttings to the fill areas, bunds, landscape areas and HBM batching sites.
- 4.5.5 The majority of offsite deliveries will comprise of drainage aggregates, concrete, temporary materials for constructing the bridges and bituminous materials. Cement will be delivered to silos at each of the three batching sites to suit the HBM programme.
- 4.5.6 Recycled materials comprising crushed concrete and planings will be stockpiled at the main compound for reuse as subbase on the side roads and roundabouts.
- 4.5.7 Waste material will be stored in accordance with our SWMP at each of our compounds and removed off site in the appropriate skips as required.
- 4.5.8 During peak periods it is envisaged that there will be up to 75 deliveries per day predominantly in 20 tonne eight wheeled wagons. This of course is in addition to staff and workforce transport. We will endeavour to restrict any deliveries until after 07:00.

#### **4.6 Construction Energy**

- 4.6.1 The site power requirements cover the office set up at the main compound at the airport and the satellite compounds at Drayton Lane, Buxton Road, Plumstead Road and Postwick. The batching plants are mobile units and will be powered by generators. This will also be the case for the temporary compounds at each bridge site.
- 4.6.2 Consumption energy requirements at the three sites are estimated as follows:
- Main Airport Compound – 1500kW
  - Satellite Compounds – 1000kW

#### **4.7 Construction Water Requirements**

- 4.7.1 During the construction phase of the project water will be required for the following activities:
- Dust suppression during the earthworks activities. The quantity required will be approximately 120 cm/day during dry periods. This can be from a non potable source and our intention is to collect water in the drainage ponds during the construction period to satisfy this demand.



- HBM production will require a potable water source to be available at each of the three batching sites described in Section 3.5. There is a requirement to batch 86,000 cm of granular material with an approximate 5% cement content. This will require 5,500 cm of potable water, which we intend to obtain from Anglian Water metered mains supplies.
- Water usage for the office compounds will be from Anglian Water metered supplies. At the bridge site compounds water will be supplied in containers for use by the operatives working at these locations. Using an output of 130 l/ person/ day for the contract period equates to an overall demand of 15,000 cm between March 2015 and August 2017.

#### **4.8 Construction Waste**

4.8.1 A SWMP will be developed for the NDR scheme detailing how we will deal with all waste on the scheme. Where possible all waste materials will be sorted at the site compounds. Segregated waste will be stored prior to disposal off site by an authorised waste management contractor for reuse or recycling.

4.8.2 Waste on the scheme can be defined as follows:

- Excavated waste
- Waste associated with site compounds
- New build waste

##### Excavated Waste

4.8.3 The NDR scheme has been designed with a cut to fill balance such that all excavated material will be transported to fills, bunds, landscape areas or for use in the manufacture of CBGM A subbase and HDM base materials. Therefore no excavated material will need to be disposed of offsite. Any contaminated material encountered will be reviewed as to whether it can be incorporated in attenuation bunds or landscape areas.

4.8.4 All existing concrete will be broken up and stored in our main compound prior to crushing for reuse as subbase on the side roads or roundabouts. Similarly all existing paved areas within the works will be planed out for similar reuse.

4.8.5 It has been agreed with NCC that we will provide storage facilities at our main compound to take delivery of further road planings from other highway schemes within the county if available.

##### Waste associated with site compounds

4.8.6 The site compounds will generate:

- Foul drainage waste, which will discharge directly to public sewers or to closed septic tanks. Any septic tank used will be emptied on a regular basis.
- Office waste, primarily paper and ink cartridges, which will be recycled.
- Catering waste, which will be composted for reuse

##### New build waste

4.8.7 This can be defined as follows:

- Vegetation waste which will be shredded and mulched for reuse in the resoiling operation
- Concrete waste, which will be collected for crushing as discussed in 4.5.6.
- Timber and steel waste, which again will be collected and disposed of off site for reuse/ recycling in the appropriate skips.

#### **4.9 Temporary Drainage and Discharges**



- 4.9.1 Temporary foul drainage from the compound areas will be required for the site compounds if permanent connections to the foul sewers cannot be made. Surface run off from the roofs of buildings or paved areas will be collected for reuse. Other sanitary provisions at the bridge sites, batching plants or elsewhere will be by portaloo facilities powered by solar panels.
- 4.9.2 Temporary surface water drainage systems will be constructed where required as early as possible in the earthworks programme to prevent silt runoff from site operations. Similar measures will be implemented to control the discharge of surface water runoff from the construction compounds.
- 4.9.3 Prior to the construction of the drainage lagoons it may be necessary to dewater excavations at bridge sites or elsewhere. Approval will be received for all proposed temporary outfalls from both NCC and the Environment Agency prior to being used. No discharge will take place from within fifty metres of private drinking water supplies. Any dewatering that could affect private water supplies will only be undertaken after agreement with the potentially affected parties has been reached on appropriate mitigation measures if their supplies are adversely affected.
- 4.10 Site Security and Safety**
  - 4.10.1 A site security programme will be developed to prevent unauthorised access onto the NDR scheme. All of the staff and workforce will attend a mandatory project specific site induction prior to gaining access for the first time. All who work on the scheme must comply with the requirements of Birse Civils management procedures for Health and Safety, Quality and Environment.
  - 4.10.2 The site will operate the Birse Civils "Take Care" behavioural safety programme as well as other safety training and tool box talks to maximise safety performance in accordance with our Zero Harm safety and sustainability agendas.
  - 4.10.3 All of our compounds will be protected by static security guards during non working hours and at weekends and holiday periods. The bridge sites will be monitored using CCTV facilities monitored from the main compound.



## **5 Construction Programme**

### **5.1 Introduction**

- 5.1.1 The programme reflects the construction strategy that is outlined in Section 1.4.
- 5.1.2 The programme is referenced by month numbers with the earliest start for construction of the Project commencing in May 2015 following an 8 week mobilisation period from March 2015.
- 5.1.3 The summary construction programme is attached.

### **5.2 Programme Assumptions**

- 5.2.1 The outline construction programme assumes that the whole site is available for preparatory and construction activities on the dates within the programme.
- 5.2.2 The critical path runs through the ecological works, the statutory authorities' diversion works, the earthworks, Marriott Way Overbridge and the road construction between Fir Covert Roundabout and the A1067. This may change subject to detailed design.
- 5.2.3 The cultural heritage programme will require a watching brief over the excavation of top soil in certain locations along the project. Areas of significant archaeology identified during baseline surveys will be excavated and finds recorded. In the event of important remains being found, the affected area will need to be excavated and all finds documented.
- 5.2.4 The ecological programme requires the preparation and establishment of suitable receptor sites and the availability of such areas in the appropriate season for completing translocation works. The programme has been developed taking into account the baseline surveys and the translocation seasonal windows and will need to be reviewed prior to commencement of construction to ensure that the relevant location of species and habitats are included. Temporary delays to works in some areas of the site may occur, for example caused by nesting birds or wildlife which have re-colonised cleared areas.
- 5.2.5 Critical activities within the programme include:
  - Cultural heritage and ecology measures which are related to the progress of site clearance, fencing and earthworks.
  - Providing advance drainage measures to control run-off from the site during construction which might affect watercourses, particularly in the Wensum Valley and around Dobbs Beck
  - Agreeing mitigation measures for any works which might affect private water supplies
  - Completing the diversions of statutory undertakers apparatus,
  - Earthworks activities
  - Construction of all structures
  - Construction of the road.

### **5.3 Maintenance**

- 5.3.1 Works beyond the completion of the road construction will continue between August 2017 and January 2018 to complete the landscaping works
- 5.3.2 Maintenance of the landscaping areas will be undertaken between January 2018 and January 2020.



5.3.3 Routine maintenance operations involving grass cutting, swabbing and cleaning/ clearing of gully pots and outfalls may be required immediately after construction, particularly where rainfall on newly landscaped areas may cause sediment rich runoff.

## **6 Utilities**

### **6.1 Introduction**

6.1.1 This section summarises our discussions with all of the utility companies regarding their individual services that may be affected due to the proposed route of the NDR and also the provision of both permanent and temporary services required to service the scheme.

6.1.2 A series of trial holes has been undertaken between October and November 2013 to locate all of the underground services and determine the height of all overhead cables crossing the scheme.

6.1.3 An initial workshop will be held with representatives from each of the Utilities to update them on the route of the scheme and to understand from each provider the scope of their works that would be affected. Revised quotations will also be requested and ongoing discussions will continue to determine the final scope and the associated costs of the diversions.

### **6.2 Scope of Diversions**

6.2.1 From our discussions with the utility companies the works required for the NDR scheme can be split into three categories:

- Protection of existing services
- Diversion of services prior to work being undertaken
- Diversion of services after civils works have been undertaken

It has been agreed with several of the utility companies that Birse can undertake the civils works involved.

6.2.2 A spreadsheet of the works required to be undertaken has been developed indicating the scope involved, the location and who will undertake the works. The current budget costs are also indicated. These are in accordance with the NRSWA procedures and will become more certain as the detail design develops.

6.2.3 The current estimated scope of the utility works is indicated in the table below:

Utility Company	Number of Diversions
UK Power Networks	28
Government Pipelines	1
National Grid Gas	9
National Grid Gas (High P)	1
British Telecom	18
Anglian Water (Potable)	18



Anglian Water (Sewers)	7
Virgin Media	2
Cable and Wireless	1



## **B. Construction Programme**

### **B.1 Introduction**

- B.1.1 Overleaf are the construction programmes for the proposed Scheme, and the currently proposed programme for the Postwick junction scheme, as provided by Birse Civils.
- B.1.2 There remains the possibility that construction could begin on the Postwick junction in Spring 2014. However, if the Secretary of State does not confirm Side and Slip Road Orders in relation to the Postwick junction scheme then this programme would be put back by 12 months.

Construction

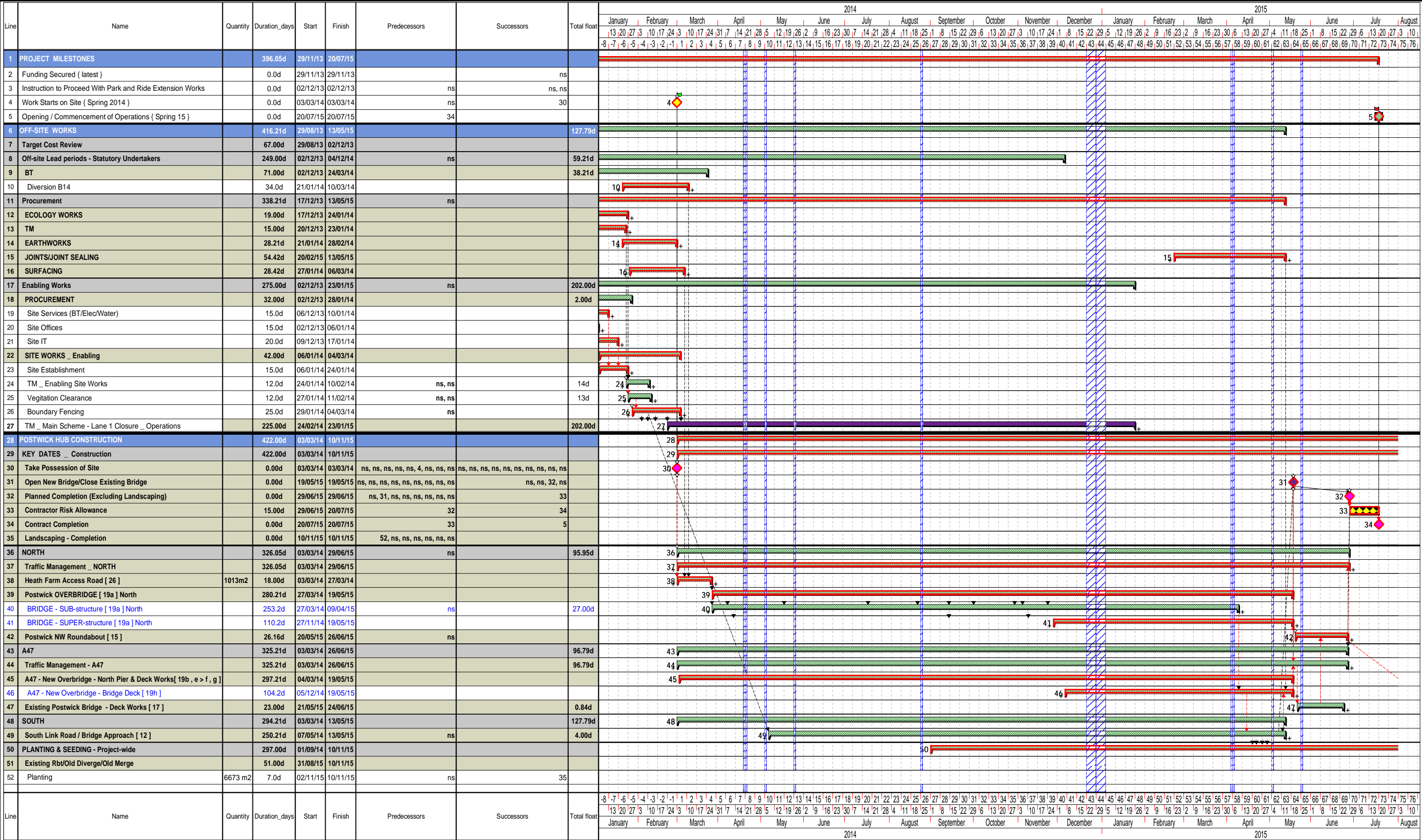
Project Management Approvals Topsoil Strip Ecology Site Clearance Milestones Contractor's Float Summary Tasks







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# Postwick Junction \_ Norwich A47

## TARGET COST SUBMISSION PROGRAMME



Construction  
 Summary Tasks  
 Approvals  
 TM  
 Project Management  
 Contractor's Float  
 Landscaping

### Birse Civils Limited

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Customer: Norfolk County Council  
Planner: M Franklin > G Clarke

Programme No: C2432\_FTC\_01  
Revision Date: 15/10/2013  
Revision Comment: TARGET COST PROGRAMME  
Page 1 of 1

## C. Summary of Transport Assessment

### C.1 Summary

C.1.1 The transport modelling and appraisal work has demonstrated that the Do Minimum network would be inadequate to accommodate traffic generation produced by the high levels of employment and residential growth planned for greater Norwich and lead to a substantial deterioration in operational performance, transport journey times and reliability, thus reducing the economic competitiveness of the City. This would occur with a further deterioration in traffic conditions on inappropriate routes, reductions in operational performance for bus services and worsening conditions for walking and cycling. There would be an increasing risk of worsening road safety as traffic would continue to grow on inappropriate routes and queues may extend onto the high speed A47(T) dual carriageway.

C.1.2 The following junctions were assessed in detail in this TA:

- All 14 on-line junctions along the NDR;
- Six other junctions with NDR at Postwick; and
- Five off-line junctions: A47(T) Trowse, A146 / Martineau Lane, Bracondale / King Street, Crostwick Junction (North Walsham Road / Crostwick Lane / Rackheath Lane), Rackheath Junction (Wroxham Road / Green Lane West)

C.1.3 The policy chapter concludes that the NDR scheme is considered complementary to the relevant key policies and guidance and is aligned with national and local policy.

C.1.4 The conclusions on sustainable transport are as follows:

- Bus: the NDR and its associated complementary measures are predicted to reduce congestion on the core network, thereby reducing bus journey times as demonstrated in this report. The complementary measures in the City Centre include road closures therefore giving priority to buses. These should lead to more reliable public transport and encourage greater usage.
- 18 of the current bus services would cross the route of the proposed NDR. The majority of these would be unaffected by the scheme with any minor impacts being mitigated against by benefitting from reduced traffic levels on radial routes and the Outer Ring Road.

- Park & Ride: the six Park & Ride sites and their bus services are likely to benefit from reductions in congestion along key corridors by the introduction of the NDR. Furthermore, the introduction of signals at the Postwick Park & Ride junction allows prioritisation of Park & Ride bus services.
  - Rail: rail services will not be directly affected by the NDR. The NDR is likely to however have a beneficial impact on journey times to and from the main rail station.
  - Non-motorised users (NMU): one of the main aims of the NDR is to enable the removal of through traffic from the city centre and the introduction of walking and cycling improvements.
  - There are a number of rights of way that are affected by the NDR. Detailed mitigation measures are set out for each of them.
  - The NDR scheme also includes approximately 25km of new pedestrian / cycle links along the route within the landscape strip. These would link to existing facilities and enhance the walking and cycling networks.
- C.1.5 The junction assessments presented in this TA demonstrate that the NDR approach arms have capacity levels below the desirable maximum level of 85% capacity in 2017 except for the southbound approach to the Postwick NE roundabout and the New Link Bridge approaching the Park & Ride signalised junction. In 2032, a number of the approaches show capacity levels that are above the 85% level but below their theoretical maximum threshold of 100% except for the southbound approach to the Postwick NE roundabout and the New Link Bridge approaching the Park & Ride signalised junction. There is a small number of side roads and links at Postwick junctions other than NDR approaches that are above the desirable level in 2017 and above the theoretical level in 2032. The resulting queues are deemed to be acceptable.
- C.1.6 The results presented in this TA are based on a number of iterations, with detailed junction modelling being carried out and the results then fed back into the strategic model with traffic being re-assigned. The testing has shown that with increasing capacity provided at the NDR junctions, the demand along the NDR also grew. Therefore, it is apparent that a careful balance needs to be struck between providing sufficient capacity to meet the objectives of the scheme without encouraging unnecessary or longer motorised journeys.
- C.1.7 The junction layouts presented in this TA are considered to be the best possible balance between relieving the existing network whilst ensuring acceptable conditions on this new part of the network. It does however mean

that there are likely to be some very limited queues and delays on some approaches to a small number of the on-line junctions during the morning and evening peak periods in 2017 when the road would be opened to traffic.

- C.1.8 The existing Postwick Park & Ride roundabout junction is forecast to experience substantial queues and delays on Yarmouth Road in both peak periods in both 2017 and 2032. With NDR and the signal junction improvement, the theoretical capacity limit is exceeded in 2032 PM peak, but the queues and delays on Yarmouth Road reduce significantly in the DS scenario with the introduction of signals. Furthermore, the proposed signal junction allows Park & Ride bus services being prioritised via dedicated signal control.
- C.1.9 Theoretical capacity is also exceeded at Martineau Lane / A146 and Bracondale / King Street junctions. The results demonstrate that this is not due to the NDR but background traffic growth with over-capacity levels similar in the DM and DS scenarios. Thus the NDR scheme itself does not significantly affect these junctions.
- C.1.10 The wider effects of the NDR are considered. The results demonstrate that the NDR reduces traffic levels and congestion on orbital roads, the Outer Ring Road and the radial routes in the north and northeast of Norwich. Journey times along key highway and public transport routes would be significantly reduced through the introduction of NDR. City Centre through traffic would be reduced by the NDR and its complementary measures, leading to lower traffic levels inside the Inner Ring Road than in the 2012 base.
- C.1.11 The high level safety review that was undertaken demonstrates that 62 (70%) out of the identified 89 accident cluster sites are predicted to experience lower flows due to NDR, which is considered likely to have an overall beneficial effect given the established relationship between traffic flow levels and accident risk.
- C.1.12 Construction impacts are unlikely to be severe and a range of mitigation measures will assist in reducing any temporary impacts to acceptable levels.
- C.1.13 Overall, the NDR scheme would deliver benefits in terms of materially improving highway conditions in Norwich overall and meet the relevant policy objectives without creating any unacceptable effects. In this regard it is considered that the NDR DCO should and can be granted consent.