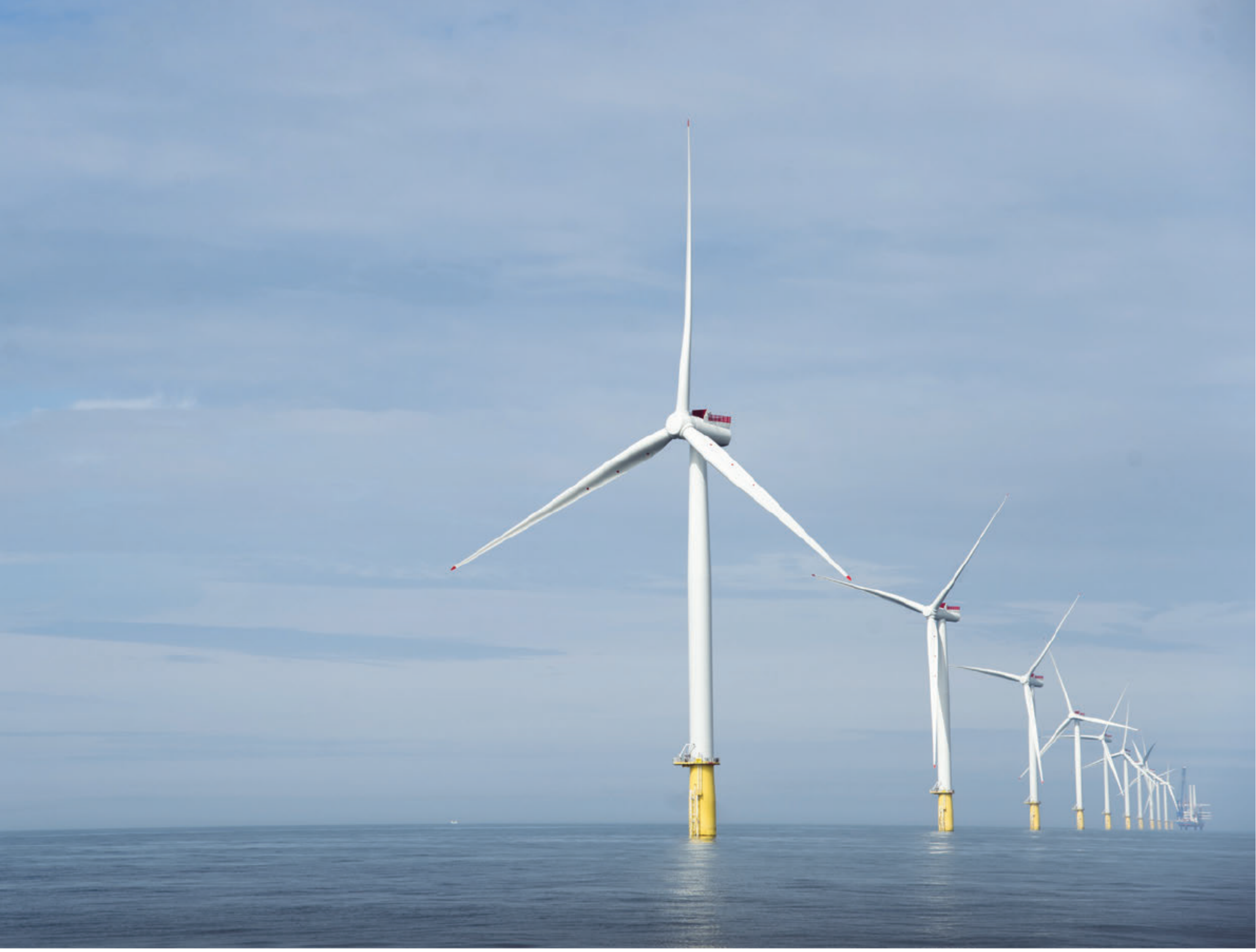

Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects

Environmental Statement

Volume 3

Appendix 24.1 - Transport Assessment

August 2022
Document Reference: 6.3.24.1
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Title:
Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects Appendix 24.1 Transport Assessment

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Glossary of Acronyms

AADT	Annual Average Daily Traffic
AAWT	Annual Average Weekday Traffic
ATC	Automatic Traffic Count
CBS	Cement Bound Sand
DCO	Development Consent Order
DEP	Dudgeon Offshore Wind Farm Extension Project
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
DoS	Degree of Saturation
EIA	Environmental Impact Assessment
ES	Environmental Statement
GEART	Guidelines for the Environmental Assessment of Road Traffic
HGV	Heavy Goods Vehicle
HP3	Hornsea Project Three
LV	Light Vehicle
MCTC	Manually Classified Turning Count
MMQ	Mean Max Queue
NCC	Norfolk County Council
NH	National Highways
NV	Norfolk Vanguard
OCTMP	Outline Construction Traffic Management Plan
PCU	Passenger Car Unit
PRC	Practical Reserve Capacity
RFC	Ratio of Flow of Capacity
SEP	Sheringham Shoal Offshore Wind Farm Extension Project
SRN	Strategic Road Network
TA	Transport Assessment
TEMPro	Trip End Model Presentation Programme
TTSA	Traffic and Transport Study Area
UK	United Kingdom

Glossary of Terms

Dudgeon Offshore Wind Farm Extension Project (DEP)	The Dudgeon Offshore Wind Farm Extension onshore and offshore sites including all onshore and offshore infrastructure.
Heavy Goods Vehicle (HGV)	HGV is the term for any vehicle with a Gross Weight over 3.5 tonnes. This is also used as a proxy for HGVs and buses / coaches recognising the similar size and environmental characteristics of the respective vehicle types.
Horizontal directional drilling (HDD) zones	The areas within the onshore cable route which would house HDD entry or exit points.
Landfall	The point at the coastline at which the offshore export cables are brought onshore, connecting to the onshore cables at the transition joint bay above mean high water
Light Vehicle	The term ‘Light Vehicles’ (LV) is used to refer to employee vehicle trips. The term LVs describes the range of vehicle types that could be used by construction employees (e.g. cars, vans, pick-ups, minibuses, etc.).
Links	A road or group of roads with similar traffic characteristics and composition.
Movements	A term used to describe a single trip (i.e. the arrival or departure from site) for the transfer of employees or goods.
Onshore cable corridor	The area between the landfall and the onshore substation sites, within which the onshore cable circuits will be installed along with other temporary works for construction.
Onshore export cables	The cables which would bring electricity from the landfall to the onshore substation. 220 – 230kV.
Onshore Substation	Compound containing electrical equipment to enable connection to the National Grid.
Traffic and Transport Study Area (TTSA)	Area where potential impacts from the project could occur, as defined for each individual EIA topic.
Sheringham Shoal Offshore Wind Farm Extension Project (SEP)	The Sheringham Shoal Offshore Wind Farm Extension onshore and offshore sites including all onshore and offshore infrastructure.
The Applicant	Equinor New Energy Limited.

Vehicle (HGV, Traffic) trips	A single trip (i.e. the arrival or departure from site) for the transfer of employees or goods. This term is interchangeable with the term movements. A two-way trip (i.e. the arrival and departure from site) for the transfer of employees or goods.

24.1 Transport Assessment

24.1.1 Introduction

1. This Transport Assessment is provided as an appendix (**Appendix 24.1**) to the Environmental Statement (ES) **Chapter 24 Traffic and Transport.**
2. Following the introductory sections, the TA is structured as follows:
   - **Section 24.1.2** provides a detail of the derivation of baseline and future year traffic flows;
   - **Section 24.1.3** provides the baseline road safety data;
   - **Section 24.1.4** provides details of the derivation of construction traffic demand and the assignment of this demand to the traffic and transport study area;
   - **Section 24.1.5** provides details of the proposed access strategy including the design of new temporary points of access to the highway network;
   - **Section 24.1.6** provides a detailed assessment of driver delays impacts; and
   - **Section 24.1.7** provides a summary.

24.1.1.1 Background

3. Equinor New Energy Limited (hereafter the Applicant) applied, on behalf of the partners in the operational Sheringham Shoal and Dudgeon Offshore Wind Farms, for an Agreement for Lease for the extension of these two wind farms.
4. The Applicant is leading on the development work for the proposed Sheringham Shoal Offshore Wind Farm Extension Project (SEP) and Dudgeon Offshore Wind Farm Extension Project (DEP).
5. Electricity will flow from the wind turbines via infield cables to offshore substation platform(s). Interlink cables will link the separate project areas. At the offshore substation(s), the generated power will be transformed to a higher alternating current voltage. The power will be exported via up to two export cables, in two separate trenches, to landfall west of Weybourne on the North Norfolk coast. At landfall, the offshore export cables will meet and be joined up with the onshore export cables in transition joint bays.
6. The onshore export cables travel approximately 60km inland to a high voltage alternating current onshore substation near to the existing Norwich Main substation. The onshore substation will be constructed to accommodate the connection of both SEP and DEP to the national transmission grid.
7. A full description of SEP and DEP is provided in the Environmental Statement (ES) **Chapter 4 Project Description.**

24.1.1.2 Transport Assessment Scope

8. It was agreed with Norfolk County Council (NCC) and National Highways (NH) (at a meeting on the 13 July 2021) that the TA would constitute an abridged document providing the technical inputs informing the ES. This includes establishing baseline traffic flows, baseline road safety data, the derivation and distribution of construction

traffic, assessment of junction capacity and the access strategy.

9. For the purpose of assessing the impact of SEP and DEP on the highway network, the relevant Planning Practice Guidance is 'Travel Plans, Transport Assessment and Statements' (the Transport PPG) (Department for Levelling Up, Housing and Communities. March 2014).

10. The Transport PPG key principles have shaped the development of the TA which has in turn, informed the impact assessment contained in the ES **Chapter 24 Traffic and Transport**. In this context, **Table 1** provides a summary of the requirements of the transport assessment process and where they are considered.

Table 1: Document Map

Transport Assessment Requirements	Where considered
Review of salient policy and guidance	ES **Section 24.4.1**
Review of baseline highway conditions	ES **Section 24.5**
Derivation of baseline traffic flows	TA **Section 24.1.2**
Derivation of future year traffic flows	TA **Section 24.1.2**
Derivation of construction traffic demand	TA **Section 24.1.4**
Distribution of construction traffic	TA **Section 24.1.4**
Access Strategy	TA **Section 24.1.5**
Impact Assessment: • Severance; • Amenity; • Pedestrian Delay; • Road Safety; • Driver Delay (highway constraints); • Driver Delay (road closures); and • Abnormal Loads.	ES **Section 24.6**
Assessment of Driver Delay ([redacted])	TA **Section 24.1.6** for the Strategic Road Network ES **Section 24.6** for the local highway network
Assessment of Cumulative Impacts	ES **Section 24.7**

11. ES **Chapter 4 Project Description** outlines that whilst SEP and DEP are the subject of a single Development Consent Order (DCO) application (with a combined Environmental Impact Assessment (EIA) process and associated submissions), the assessment considers both projects being developed in isolation, sequentially and concurrently, so that mitigation is specific to each development scenario.

12. The following influences were key considerations when developing traffic worst-case scenarios:

- SEP or DEP in isolation generates less traffic demand overall than a SEP and DEP concurrently scenario (due to the reduction in quantities). However, due to differences in activity scheduling for the respective projects it does not necessarily follow that SEP or DEP in isolation would generate less daily traffic on respective links. Therefore, it is necessary to consider the traffic impacts from both a SEP or DEP in isolation and a SEP and DEP concurrently as a worst-case scenario.
- A SEP and DEP sequential scenario would have the same activity schedule and in turn daily traffic demand, as a SEP or DEP in isolation scenario. The daily traffic demand would be replicated for each project.
- In the event that there is an overlap between SEP and DEP in the sequential built out scenario, the potential maximum impacts are assessed within the worst-case parameters identified for SEP and DEP concurrently built out scenario.

13. The two worst-case construction scenarios considered by the traffic and transport assessment are therefore:
    - Build SEP or build DEP in isolation; and
    - Build SEP and DEP concurrently.

14. The terms heavy goods vehicles (HGVs) and light vehicles (LVs) is used throughout this TA and are defined as follows:
    - HGV is the term for any vehicle with a Gross Weight over 3.5 tonnes, this TA also uses the term HGV as a proxy for HGVs and buses / coaches recognising the similar size and environmental characteristics of the respective vehicle types.
    - LV is used as a term to refer to employee vehicle trips for SEP and DEP and describes the range of vehicle types that could be used by construction employees (e.g. cars, vans, pick-ups, minibuses, etc).

24.1.1.3 Consultation

15. Consultation with regard to traffic and transport has been undertaken in accordance with the general process described in ES **Chapter 5 EIA Methodology** and the **Consultation Report** (document reference 5.1). The key elements have included scoping, the ongoing Evidence Plan Process (EPP) via the traffic and transport Expert Topic Group (ETG), Public Information Days and the Section 42 consultation on the Preliminary Environmental Information Report (PEIR).
16. The feedback received throughout this process has been considered in preparing this TA and ES **Chapter 24 Traffic and Transport**.
17. **Table 24.1** of ES **Chapter 24 Traffic and Transport** provides a summary of the scoping and ETG consultation responses received to date relevant to traffic and transport, and details of how the Project team has had regard to the comment and

how these have been addressed within the ES and TA.

24.1.2 Baseline Traffic Flows

24.1.2.1 Baseline Traffic Data Collection

24.1.2.1.1 Highway Links

18. ES **Chapter 24: Traffic and Transport** is underpinned by the Guidelines for the Environmental Assessment of Road Traffic (GEART) for establishing the potential impacts associated with changes in traffic from SEP and DEP. GEART sets out broad thresholds for where changes in total daily traffic flows and HGVs may be considered significant, for the effects of:
    - Severance;
    - Amenity;
    - Pedestrian delay;
    - Road Safety;
    - Driver delay (highway constraints); and
    - Driver delay (road closures).
19. In the context of these thresholds, it is necessary to establish the following baseline traffic flows for all links within the traffic and transport study area (TTSA):
    - Annual average daily traffic flows (AADT) (including HGV component);
    - Annual average weekday traffic flows (AAWT) (including HGV component); and
    - Peak hour traffic flows (including HGV component).
20. The extent of the TTSA is defined within **Figure 24.1** of ES **Chapter 24 Traffic and Transport**.
21. Traffic flow data has been captured for all 140 links from the TTSA. The datasets that are used in the assessment are summarised in **Table 2** and are presented graphically in **Figure 24.1.1** of this TA.

Table 2: Traffic Flow Data Sources

Data set	Spatial coverage	Dates	Notes
Classified* Automatic Traffic Counts (ATC)	7, 8, 10, 12, 15, 38, 39, 50, 57, 58, 60-69, 71, 74, 75, 77, 81-85, 93, 99, 101-103, 109-113,115-119, 144, 146-150, and 153.	2020	Traffic counts commissioned by the Applicant which provide classified hourly and daily count and speed data. Undertaken during Covid19 pandemic. Copies of these ATC surveys are provided as **Annex 1** of this TA.
Classified* AADT	1-6, 9, 16-35, 40-43, 45-49, 54, 56, 72, 73, 76, 78-80, 86-89, 94-97, 100, 104, 105, 108, 114,	2018/2019	Data sourced from the DfT which provides classified AADT traffic count data.

Data set	Spatial coverage	Dates	Notes
	121, 122, 125, 126, 128, 129, 131, 138, 139, 141, 143 and 152.		
Classified* ATCs	14, 37, 51 and 52.	2017	Data sourced from the Norfolk Vanguard (NV) DCO application documents (Vattenfall, 2019) which provide classified hourly and daily traffic count data.
Classified* ATCs	11, 13, 44, 53, 59 and 123.	2017	Data sourced from Annex 7.3 of the Hornsea Project Three (HP3) DCO application documents (Orsted, 2019) which provide classified daily traffic data.
Classified* ATCs	90, 98, 106, 107, 127, 132, 133, 136 and 137.	2019	Data sourced from the HP3 DCO Examination documents (Orsted, 2019) which provide classified hourly and daily traffic count data.

24.1.2.1.2 Junctions

22. NH have identified 11 junctions that they consider to be sensitive to increases in daily traffic flow. These 11 junctions are shown within **Figure 24.2** of ES **Chapter 24 Traffic and Transport**.

23. To understand the baseline traffic flows through these 11 junctions, manual classified turning counts (MCTCs) were undertaken.

24. To comply with the Transport PPG, traffic surveys informing the transport assessment process should be representative of typical neutral conditions (e.g. outside of school holidays).

25. The MCTCs were therefore undertaken on a neutral weekday (Tuesday 16 November 2021) and captured flows and queue lengths between 06:30 – 09:30 and 16:00 and 19:00. A copy of the MCTC and queue length data is provided as **Annex 2** of this TA.

26. For the purpose of junction modelling, the data is expressed in terms of total vehicles and percentage HGVs. For the purpose of modelling traffic signal-controlled junctions, the data has been converted to Passenger Car Units (PCUs). A passenger car unit is a method of converting vehicles of different lengths into a standard unit, e.g. a car is typically one PCU, whilst a HGV is two PCUs.

24.1.2.2 Standardisation of Baseline Data

24.1.2.2.1 Highways Links

27. Of the 140 links within the TTSA, flows on 52 links were sourced from ATCs undertaken during the Covid-19 pandemic in October 2020.

28. Since the peak of the pandemic 'lockdown' restrictions, which came into force during March 2020, traffic volumes have been slowly recovering, however, traffic levels had not returned to pre Covid-19 at the time of undertaking the aforementioned 52 ATC surveys. Thus, traffic flows recorded by the 52 ATC surveys were considered to be lower than 'typical neutral' periods for the TTSA. To reconcile, it was agreed with NCC during consultation (18 September 2020) to undertake five 'control' ATCs.

29. The five control ATCs were installed upon roads where the most recent ATC surveys were undertaken pre Covid-19 for the submitted DCO applications of the consented NV and HP3 offshore wind farm schemes.

30. The traffic flows from the proposed control ATC surveys have been compared to the historic NV and HP3 wind farm projects ATC surveys, allowing 'uplift' factors to be derived for light vehicles and HGVs. The resultant uplift factors have then been applied to the Applicant's 52 ATC surveys providing consolidation to pre-pandemic traffic levels.

31. **Annex 3** provides a summary of the recorded 2020 ATC traffic flows and calculated 'uplift' factors per Control ATC. The resultant final uplifted 2020 reference baseline traffic flows that form the basis of the assessment are also presented in **Annex 3**.

32. To account for geographical variations in traffic flows over the extensive TTSA, the 'control' ATC surveys were undertaken at a range of different geographical locations where existing NV and HP3 wind farm ATC surveys were available. **Table 3** sets out the location of the control surveys, their source and the links that have been subject to an uplift factor. The graphical location of these ATC surveys can be found in **Figure 24.1.1** of this TA.

33. The validity of the baseline traffic flows (presented within **Annex 3**) have been agreed with NCC (at a meeting on the 31 March 2022). However, at the request of NCC, the outline Construction Traffic Management Plan (OCTMP) (document reference 9.16) contains a clause that permits further assessment of network capacity constraints at identified sensitive junctions if NCC evidence baseline traffic conditions have changed materially from those of the DCO application post consent.

Table 3: Control ATCs and Links Uplifted

Link ID	Road	Existing Control ATC Source	Links uplifted Utilising Control ATCs
11	A149 from Weybourne to Weybourne Road	HP3	7, 8, 10, 12, 15 and 102.
37	A149 from A1151 to B1159	NV	38 and 39.
52	B1148 from B1149 to A140	NV	50, 67-69, 71, 74, 75, 77, 81-85, 93, 147 – 150, and 153.

Link ID	Road	Existing Control ATC Source	Links uplifted Utilising Control ATCs
59	B1149 from A148 to B1354	HP3	57, 58, and 60-66.
106	B1172 from Kettering Lane to A47	HP3	99, 101, 103, 109-113, 115-119, 144 and 146.

24.1.2.2.2 Junctions

34. Traffic volumes have been slowly recovering since the peak of the pandemic lockdown restrictions; however, it is not possible to forecast if traffic will return to pre-Covid conditions or will settle at a new normal (e.g. reflecting a greater propensity for home working).

35. Prior to undertaking the MCTS at the 11 junctions, it was agreed with NH (at a meeting 13 July 2021) that surveys undertaken after September 2021 would be accepted as being representative of future baseline conditions. The MCTCs were therefore undertaken during November 2021.

36. Subsequent to undertaking the surveys, NH requested (at a meeting on the 5 April 2022) that further analysis was required to understand if the surveys undertaken in November 2021 were representative of typical conditions. In response, a review of opensource data for six locations along the A47 close to Norwich has been undertaken to understand how traffic conditions have changed between September 2021 and March 2022 (the latest period available at the time of drafting).

37. This review (presented in **Annex 4**) highlights that between September 2021 and March 2022, traffic flows were 2.3% higher in November 2021 than the average across the seven months considered, and 5.1% lower than the peak in March 2022. It is noteworthy that the differences outlined are within 'rule of thumb' day to day fluctuations in traffic (typically plus or minus 10%).

38. It is therefore considered that the traffic data captured by the Applicant is representative of highway network baseline conditions.

24.1.2.3 Future Year Traffic Flows

39. It is currently estimated that the earliest date that construction could commence would be 2025.

40. In order to consider a worst-case, a reference year for background traffic of 2025 has been agreed with NCC and NH (at a meeting on the 23 March 2020). The rationale for this is later years could result in potentially higher background traffic flows and therefore a lesser magnitude of change.

41. To take account of sub-regional growth in housing and employment, a proportionate approach to forecasting future traffic growth for the 2025 reference year has been agreed with NCC and NH (at a meeting on the 23 March 2020).

42. The baseline flows have been factored to the future year baseline traffic demand (year 2025) using the Trip End Model Presentation Programme (known as TEMPro) Version 7.2c with data set 72 for the Norfolk and Suffolk Area and factoring the growth rate using the National Traffic Model Dataset AF15 all areas (a combination of urban and rural area types).

43. Details of the growth factors that have been applied are provided within **Annex 5** of this TA.

24.1.2.4 Summary of Baseline Traffic Flows

24.1.2.4.1 Highway Links

44. **Annex 6** provides a summary of the forecast future year 2025 traffic flows (including HGV component) for each of the links within the TTSA.

24.1.2.4.2 Junctions

45. **Annex 7** provides a summary of the forecast 2025, peak hour traffic flows, percentage of HGVs and PCUs for each of the 11 junctions links with the TTSA.

24.1.3 Baseline Road Safety Data

46. To assess whether SEP and DEP will have an adverse road safety impact it is necessary to establish a road safety baseline and identify any inherent road safety issues within the TTSA.

47. Recognising the large extent of the TTSA, a two-stage approach to defining the road safety baseline has been adopted and agreed with NCC and NH (18 September 2020).

48. The first stage involves a high-level search of the TTSA utilising open source data (www.crashmap.co.uk) to identify collision clusters, utilising the following definition:

- Five personal injury collisions occurring within a three-year period for roads managed by NCC in a 50m radius for built up areas and a 100m radius in non-built up areas; and
- Five personal injury collisions occurring within a five-year period for roads managed by NH in a 50m radius for built up areas and a 100m radius in non-built up areas.

49. In addition, NH requested that the A11/Station Lane junction should be assessed irrespective of an identified collision cluster at the junction (at a meeting on the 18 September 2020). A review of the junction identified that there were no collisions recorded within the adopted five-year study period and therefore this location has subsequently been discounted.

50. The initial search of open source data identified 37 identified collision clusters within the TTSA. A summary of the locations and numbers of collisions occurring at each of the 37 identified collision cluster locations is provided in **Table 4** and shown graphically in **Figure 24.3** of **Chapter 24: Traffic and Transport**.

Table 4: Identified Collision Clusters in the TTSA

Link	Collision Cluster Ref.	Description	No. of collisions	Collision severity		
				Fatal	Serious[1]	Slight[2]
23/24	1	A140/Fuller's Hill Roundabout	13	0	1	12
25	2	A47/Breydon Bridge	12	0	3	9
25/26	3	A47/William Adams Way Roundabout	14	0	2	12
26	4	A47/Lowestoft Road Roundabout	7	0	1	6
26/27	5	A47/B1385 Roundabout	5	0	3	2
29	6	A12/Carlton Road Junction	11	0	3	8
29	7	A12/A1145 Roundabout	9	0	1	8
30/31/129	8	A47/A146	29	0	3	26

Link	Collision Cluster Ref.	Description	No. of collisions	Collision severity		
				Fatal	Serious[1]	Slight[2]
		Junction				
32/33	9	A47/Cucumber Lane Roundabout	23	0	3	20
33	10	A47, within proximity of the Plantation Road slip road.	9	0	2	7
33	11	A47, within proximity of Main Road	7	0	1	6
34	12	A47	13	0	3	10
35/36/40	13	A1270/A1151 Roundabout	13	0	1	12
36	14	A1042/A1151 Roundabout	12	0	1	11
42	15	A140/A1402 Junction	15	0	2	13
76	16	A1067/Hospital Lane Junction	10	0	2	8
76	17	A140/A1067 Junction	16	0	3	13
86	18	A47 – Hockering	8	0	2	6
86	19	A47 – Necton	10	0	4	6
89/90/91/94	20	A47/Bind Lane/Taverham Road Junction	10	0	3	9
93/94/95	21	A47/Church Lane Roundabout	12	0	1	11
96	22	A1074/Longwater Lane Junction	6	0	1	5
96	23	A1074/Norwich Road Junction	15	0	1	14
96	24	A140/A1074 Junction	20	0	2	18
105/106/114/121/122	25	Thickthorn Interchange	26	0	1	25
122/127/129	26	A47, south of Thickthorn Interchange	5	0	1	4
125	27	A47/A146 Roundabout	8	0	0	8
33	28	A47/B1140	7	0	2	5
34	29	A47 – Acle Straight	7	1	0	6
34	30	A47/Branch	9	0	0	9

Link	Collision Cluster Ref.	Description	No. of collisions	Collision severity		
				Fatal	Serious [1]	Slight [2]
		Road				
24/25/34	31	A47/A149	9	0	0	9
25	32	A47/Gapton Hall Roundabout	18	0	1	17
87	33	A47 – Constitution Hill	6	3	0	3
87	34	A47 – Chalk Farm	6	0	4	2
86	35	A47/B1146	8	1	4	3
85/86/89	36	A47/Berrys Lane/Wood Lane	12	0	2	10
127	37	A140	5	0	3	2

Notes:

1. An injury for which a person is detained in hospital as an "in-patient", or any of the following injuries whether or not they are detained in hospital: fractures, concussion, internal injuries, crushing, burns (excluding friction burns), severe cuts, severe general shock requiring medical treatment and injuries causing death 30 or more days after the accident.
2. An injury of a minor character such as a sprain (including neck whiplash injury), bruise or cut which are not judged to be severe, or slight shock requiring roadside attention. This definition includes injuries not requiring medical treatment.

51. The second stage of defining a road safety baseline involves a more detailed review of the types, location and patterns to the collision clusters. This review uses STATS19[1] obtained for the identified clusters from NCC and Suffolk County Council for the five-year period, 1st January 2015 to 31st December 2019. These periods exclude data from 2020 onwards where traffic flows would be impacted by lockdowns associated with Covid-19. This review is presented **Annex 8**.

52. An assessment of the impacts of SEP and DEP traffic upon these 37 clusters is provided within **Section 24.6.1.5** of ES **Chapter 24 Traffic and Transport**.

[1] Accidents on the public highway that are reported to the police and which involve injury or death are recorded by the police on a STATS19 form. The form collects a wide variety of information about the accident (such as time, date, location, road conditions).

24.1.4 Trip Generation and Assignment

24.1.4.1 Introduction

53. A realistic worst-case traffic demand scenario has been developed by examining:
- The likely minimum construction programme (and therefore maximum activity intensity);
- Peak demand for materials and personnel;
- Likely mode share; and
- The assignment of traffic.

54. The assumptions that underpin the worst-case scenario are discussed below and have been developed with the input from construction contractors J Murphy and Sons Ltd (JMS) and the Applicant's engineering team.

55. JMS and the Applicant's engineering team have experience gained through the construction of previous projects of a similar scope and scale.

24.1.4.2 Material and Personal Demand

56. The traffic generation that will inform the assessment of traffic and transport impacts has been derived and undertaken by way of a 'first principles' approach. The first principles approach generates traffic volumes from an understanding of material quantities and employee numbers required for SEP and DEP and converts these metrics into vehicle trips.

57. **Annex 9** and **Annex 10** detail the derivation of HGVs and LVs that could be expected for each of the construction activities for SEP or DEP in Isolation and SEP and DEP respectively.

58. To ensure that any minor omissions or design changes can be accommodated within the assessed traffic flows the following approach has been applied:
- An appropriate level of contingency (reflecting the uncertainties in the design) has been applied to all material quantities and associated HGV movements. Full details are contained within **Annex 9** and **Annex 10**.
- LV movements contained within **Annex 9** and **Annex 10** have been based upon one employee to one vehicle, whereas, in reality many construction employees may car-share, or travel in contractor provided minibuses. The OCTMP (document reference 9.16) contains a range of measures to encourage and promote a reduction in single occupancy vehicle trips amongst construction employees.

59. The total HGVs and LVs (detailed within **Annex 9** and **Annex 10**) have then been divided by the forecast number of working days for each activity to derive daily vehicles. **Table 5** provides a summary of the number of daily HGVs and LVs per activity.

Table 5: Peak Daily Vehicle Trips Per Activity

Activity	Peak daily vehicles per activity (SEP or DEP in Isolation)		Peak daily vehicles per activity (SEP and DEP concurrent)	
	HGVs	LVs	HGVs	LVs
Compound mobilisation	12	10	13	10
Installation of access	2	9	2	9
Right of Way diversions	2	13	2	13
Installation of temporary drainage	8	8	9	8
Stripping of topsoil	0.3	11	0.3	11
Installation of the temporary haul road	27	9	27	9
Installation of trenchless crossings	6	12	5	12
Installation of ducting	20	24	20	24
Construction of joint bays	3	9	1	9
Installation of cable	2	9	2	9
Jointing of cables	1	6	1	6
Landfall	3	18	2	18
Onshore substation groundworks	11	10	15	10
Aboveground onshore substation infrastructure works	42	65	84	131
Testing	0.1	9	4	9
Demobilisation *	0.5	9	0.5	9
Additional Traffic to and from compound locations				
Daily vehicles to six secondary compounds	5	8	5	8
Daily vehicles to two secondary compounds with Cement Bound Sand (CBS) batching	10	20	10	20
Daily vehicles to the main compound	25	80	25	80
Daily vehicles to the onshore substation compound	8	15	8	15
Notes ** Numbers quoted for the installations of compounds, haul roads, accesses etc apply equally to the demobilisation phase. In addition, the demobilisation activity includes a general allowance for the demobilisation activities including welfare and signage removal, etc.*				

60. Having established the number of daily HGVs and LVs that could be expected per activity, these numbers have been assigned to a construction programme to show the overlap of activities per onshore cable route section (the onshore cable route has been divided into 48 sections).

61. The assignment of HGV and LV trips per section is outlined in **Annex 11** for SEP or DEP in Isolation and **Annex 12** SEP and DEP concurrently.

62. **Annex 9** to **12** utilise data provided by JMS and uses the term 'movements' to refer to a single vehicle trip, i.e. the arrival or departure from site. Trips are calculated later (**Annex 13** and **Annex 14**) by doubling the flows presented in **Annex 9** and **10**.

63. It can be noted from **Annex 11** and **Annex 12** that the demand per section fluctuates significantly according to the intensity of activities occurring per month. **Annex 13** for SEP or DEP in Isolation and **Annex 14** for SEP and DEP concurrently provide a summary of the peak and average HGV and LV trips per section throughout the construction phases.

64. Average flows are derived by considering the mean of each section (by dividing the total number of trips for each section by the number of days during which deliveries occur.

24.1.4.3 Construction Traffic Assignment

65. At the time of DCO submission, the supply chain for materials and workforce cannot be informed by early contractor involvement as the procurement process has not commenced. Therefore, for the purpose of the assessment, traffic distribution is based upon worst-case assumptions for HGV distribution and refined socio-economics data for employees.

24.1.4.4 HGV Assignment

66. To identify how the peak HGV trips per section will assign to the TTSA, traffic trips per section have first been distributed equally per access as shown in **Annex 15** for SEP or DEP in Isolation and **Annex 16** for SEP and DEP concurrently. For example (considering DEP and SEP concurrently), **Annex 16** identifies that the peak number of HGV trips to section 2 is 54, there are two accesses (access ACC02 and ACC03) serving this section, therefore 27 HGV trips have been assigned to each access.

67. The assignment of peak HGV trips per section to their respective access are detailed within **Annex 15** for SEP or DEP in Isolation and **Annex 16** for SEP and DEP concurrently.

68. Having established the assignment of the peak HGV trips to an access point (destination), the HGV trips have then been assigned to a corresponding origin.

69. Bulk materials such as concrete and stone aggregate would make up the majority of the total HGV trips for SEP and/or DEP. A review of the potential supply chain within the TTSA area (and advice from JMS) indicates that while there are a number of local suppliers that may meet some of SEP and/or DEP demand, they are unlikely to meet the substantive material demands required of SEP and/or DEP.

70. A viable source for bulk materials would be the ports local to the project. King's Lynn Port to the west and Lowestoft/Great Yarmouth Ports to the east are considered to be the most likely source for all materials and, as such, it is assumed that all HGV trips would have an origin and destination in these regions (noting that in practice that some of the demand could be met by the local supply chain, taking up existing demand on the network).

71. It has been agreed with NCC and NH (at a meeting on the 23 March 2020) that trips from any local suppliers (such as quarries) within the TTSA would be captured within the existing permissions and therefore do not need to be assessed.

72. A single port could have the capacity to provide all required materials for SEP and DEP, however, it is unlikely that hauliers would travel long distances to service the furthest onshore infrastructure site from a single port as the economics would be a 'distance deterrent'.

73. It was agreed with NCC and NH (at a meeting on the 23 March 2020) that a gravity model approach would be utilised to assign the traffic to the ports.

74. The gravity model (provided in **Annex 17**) uses journey time derived from the Google maps journey planner based on a neutral weekday (Wednesday, during the peak period of 7am to 8am). Journey time for SEP and DEPs various accesses to the port has been calculated based on the percentage of deliveries that could come from the respective ports. For example, from access ACC01, it is an approximate 75 minutes to Great Yarmouth Port and 65 minutes to King's Lynn Port. Therefore, applying the gravity model, it is calculated that 53.6% would come from the direction of Great Yarmouth Port or Lowestoft and 46.4% would come from the direction of King's Lynn Port. In contrast, access ACC64 is approximately 40 minutes from Great Yarmouth Port and 70 minutes to King's Lynn Port, equivalent to a split of 36.4% and 63.6% respectively.

75. The assignment of peak HGV trips per access from their respective origin to the agreed destinations (King's Lynn Port to the west and Lowestoft/Great Yarmouth Ports) is detailed within **Annex 18** for SEP or DEP in Isolation and **Annex 19** for SEP and DEP concurrently.

24.1.4.5 LV Assignment

76. To identify how the peak LV trips per section will assign to the TTSA, traffic trips per section have first been distributed equally per access as shown in **Annex 15** for SEP or DEP in Isolation and **Annex 16** SEP and DEP concurrently. For example (considering SEP and DEP in Isolation), **Annex 15** identifies that the peak number of LV trips to section 3 is 24, there are two accesses (accesses ACC04 and ACC05) serving section therefore 12 LV trips have been assigned to access ACC04 and ACC05.

77. The assignment of peak LV trips per section to their respective access are detailed within **Annex 15** for SEP or DEP in Isolation and **Annex 16** for SEP and DEP concurrently.

78. Having established the assignment of the peak LV trips to an access point (destination), the LV trips have then been assigned to a corresponding origin.

79. To inform the potential origin and distribution of construction LV trips, the availability of local labour and rented accommodation has been reviewed.

80. The types of specialist skills required for projects such as SEP and/or DEP means that construction personnel often have to be drawn from across the country and not necessarily from local labour sources. The socio-economic assessment for SEP and DEP has estimated that 30% of the workforce would be drawn from the local area (known as 'resident' labour). The remaining 70% of the workforce would be sourced from a distance beyond a reasonable daily commute (referred to as 'in-migrant' labour). This is detailed in ES **Chapter 27 Socio-Economics and Tourism**.

81. For the purpose of a proportional assessment, a single centroid has been assumed in the centre of the onshore cable corridor, which is located approximately 14km northwest of Norwich (close to the village of Swannington).

82. Those personnel who are not local (in-migrant labour) i.e. beyond a reasonable daily commute (up to a 90-minute drive of the centroid), are likely to base themselves within temporary local accommodation.

83. The distribution of local hotel accommodation per post code cluster is outlined within **Annex 20**. The distribution of hotel bed spaces per postcode cluster has been factored using a gravity model, whereby the number of bed spaces is divided by the journey time from the centroid (taken from the google maps route planner during a neutral 7am to 8am neutral weekday).

84. **Annex 20** also assigns each postcode cluster a point of entry onto the highway network to inform the distribution of employees.

85. The distribution of residents within the local area with the relevant skill sets has been examined. The number of residents working in the construction sector per postcode within the region has been informed by Table LC6602EW (Industry by economic activity) derived from the 2011 Census (ONS, 2019). The distribution of local employees per postcode cluster is outlined within **Annex 21**. This has been factored using a gravity model, whereby the number of employees is divided by the journey time from the centre of the postcode cluster to the centroid. **Annex 21** also shows the assignment of each postcode cluster to a point of entry on to the TTSA to inform the distribution of local employees.

86. The assignment of peak LV trips per access from their respective origin point of entry to the TTSA is detailed within **Annex 22** for SEP or DEP in Isolation and **Annex 23** for SEP and DEP concurrently.

24.1.4.6 HGV and LV Demand Optimisation

87. The assignment of the peak HGV (**Annex 18** and **Annex 19**) and LV trips (**Annex 22** and **Annex 23**), adopts a worst-case whereby the peak trips per section are assumed to occur at the same time. Within the respective assignments, to ensure that the assessment considers a realistic worst-case for all roads, a process of applying demand optimisation to peak trips has been applied.

88. The demand optimisation approach allows for the consideration of worst-case trips along local roads, which may only serve one access. However, for 'collector' roads (typically main A roads) where traffic from multiple accesses converge, prevents over estimation of HGV and LV trips.

89. A two-stage demand optimisation approach has been applied as follows:

- **Stage 1:** A review has been undertaken to identify for each link, which sections will utilise that link to travel between the origin and destination, this appraisal is presented in **Annex 24** for HGVs and **Annex 25** for LVs. For example, it can be noted from **Annex 24** that link 6 accommodates HGV traffic from sections 1 to 8.
- Stage 2: Having identified the sections that overlap for a discrete link, the optimised activity programme supplied by JMS (**Annex 9**, for SEP or DEP in Isolation, **Annex 10** for SEP and DEP concurrently) has been interrogated to extrapolate the maximum HGV and LV cumulative demand for the sections in question, therefore allowing the derivation of the forecast optimum demand on the collector roads. These 'optimum activity' forecasts are presented in **Annex 26** for SEP or DEP in Isolation and **Annex 27** for SEP and DEP concurrently.

90. **Worked example summary:** Stage 1 identifies that link 6 accommodates traffic from sections 1 to 8 (**Annex 24**). Stage 2 forecast peak daily demand from the optimum activity programme overlap of these sections for SEP or DEP in Isolation on collector roads is 123 HGV trips per day (**Annex 26**). This contrasts to the initial worst-case estimate (which applied all sections overlapping at peak activity) of 213 HGV trips per day within **Annex 18**.

91. The same approach has been adopted for the additional ancillary compound movements (presented in **Table 5**) for both SEP or DEP in Isolation and SEP and DEP concurrently.

24.1.4.7 Trip Generation and Assignment Summary

92. **Annex 28** (for SEP or DEP in Isolation) and **Annex 29** (for SEP and DEP concurrently) provides a summary of the forecast worst-case peak daily HGV and LV trips on each of the 140 links within the TTSA.

24.1.5 Access Strategy

93. There could be up to 67 points of access from the public highway, the locations of which are shown on **Figure 24.6** of ES **Chapter 24 Traffic and Transport**.

94. Following the completion of the PEIR, there have been a number of refinements to the access locations. Consequently, there has been an approximate net reduction in the number of accesses by 20.

95. In order to allow cross referencing between the PEIR and the ES, accesses have not been renumbered and consequently access numbering is not always sequential.

96. These access locations would allow construction traffic to access and egress from the public highway. Furthermore, where accesses are located opposite each other, they would allow construction traffic to cross from one side of the public highway to the other, i.e. to traverse along the haul road.

97. In addition to the 67 points of access, 24 haul road crossings have been established across the public highway. These haul road crossings would allow construction traffic to cross the public highway (but not take direct access), thereby allowing access to be taken from a more suitable location.

98. All accesses and crossings identified for construction are temporary and following completion of construction works would be reinstated to their former state unless otherwise agreed with the highway authorities and the relevant landowner. The exception to this would be the access to the onshore substation which would remain in-situ for operation and maintenance of the onshore substation.

99. Figure 24.6 of ES **Chapter 24 Traffic and Transport** (document reference 6.1.24)) shows three potential options to access the onshore substation. These are:

- Access ACC73 Mangreen Lane - this provides access to the existing National Grid substation, in addition to providing a potential route to the onshore substation;
- Access ACC74 – an existing quarry access from the A140; and
- Access ACC76 - a new temporary access from Mangreen Lane.

100. During the construction of SEP and/or DEP, it will be necessary to avoid the potential for conflict with National Grid traffic on National Grid's existing access from Mangreen Lane (access ACC73).

101. To achieve this, one of the following traffic management strategies would be implemented:

- A one-way system with access/egress via ACC76 and/or ACC73;
- Access and egress via ACC73 or ACC76; or
- Access and egress via ACC74.

102. At the time of drafting, it is unclear if access from the quarry ACC74 would be possible as there maybe ongoing restoration works which could conflict. However, should the restoration works at the quarry be complete, SEP and/or DEP construction traffic could potentially use access ACC74.

103. Upon completion of the construction works, operational access to the onshore substation would be via existing National Grid access (ACC73).

104. During a meeting with NCC and NH (13 July 2021) it was agreed with NCC and NH that outline designs should be developed for five locations:

- Secondary compound to the south of the A148 near Bodham (ACC10);
- Secondary compound to the north of the B1149 near Oulton (ACC25);
- Works area off the A47 (ACC47);
- Main compound off the A1067/Old Fakenham Road near to Attlebridge (ACC33); and
- The onshore substation off the A140/Mangreen Lane (access ACC73).

105. Outline designs for access ACC10, ACC25, ACC33 and ACC73 have been developed and shared with NCC and agreed in principle (at a meeting on the 31 March 2022). These layouts are presented in **Annex 30**.

106. For access ACC10 (from the A148 near Bodham), NCC indicated that the works may have to be scheduled to avoid the school holiday season due to highway capacity concerns. To understand if traffic associated with SEP and DEP would have a material impact upon capacity at this location, junction modelling has been undertaken with the use of 'Junctions 9' software[2]. The results of this modelling are provided within **Annex 31**. It can be noted (from **Annex 31**) that the A148 would not experience significant queuing or delay during peak construction, on this basis, restrictions on seasonal working are not considered necessary.

107. Access ACC47 is provided as an option to access the works area between the River Tudd and the A47 and to facilitate the trenchless installation of SEP and DEP cables under the A47. The access would only be used in the event that improvements works to the A47 (known as, the A47 North Tuddenham to Easton Improvement scheme) have not been completed prior to the commencement of SEP and DEP (construction of the proposed improvements is projected to be complete by the start of SEP and DEP' construction programme in 2025). If the A47 North Tuddenham to Easton Improvement scheme is complete access would instead be taken from access ACC46.

108. An outline access concept for the potential A47 access (access ACC47) is provided in **Annex 30**.

109. A range of outline access design concepts for the remaining 70 access locations and 38 haul road crossings have been developed, these include:

- Type A access: a fully standard compliant, Design Manual for Roads and Bridges (DMRB) major/minor road junction. Intended for use on A and major B roads;
- Type B and C access: a reduced footprint access suitable for small B roads, minor and unclassified roads; and
- Type D access**:** to facilitate the haul road crossing the public highway only.

[2] Junctions 9 is the industry standard software for modelling priority and roundabout junctions.

110. Outline access designs for these four access types are provided within **Annex 30** of this TA.

111. Any future design changes are anticipated to be minor in nature and would not materially alter the assessment presented within ES **Chapter 24 Traffic and Transport**. The visibility splay requirements for each access and crossing would be determined based upon measured speeds and provided in accordance with the requirements of the DMRB. Where the visibility splay requirements could not be fully achieved or may have significant adverse environmental impacts (e.g. extensive tree/hedgerow removal) a reduction in the visibility requirement (through temporary speed limit reductions) would be discussed and agreed with NCC.

112. Prior to the commencement of the relevant parts of the construction works, the technical approvals for the access and crossing designs will be submitted to and agreed with the highway authorities under Section 278 of the Highways Act (1980) or equivalent provisions under the DCO (i.e. DCO Requirement 17 Schedule 2 Part 1). The technical approval process will include submission of finalised drawings, showing full details of access and crossing improvements, including drainage, lighting, signing, and standard construction details.

113. The technical approval documentation will also include Stage 1 and 2 Road Safety Audit and a Road Safety Audit Response Report (on behalf of the designers).

114. It has also been agreed with NH (at a meeting on the 5 April 2022) that if access is required from the A47 (access ACC47), the technical approvals documentation should include a Safety Risk Assessment (known as a GG104).

24.1.6 Driver Delay (Capacity)

24.1.6.1 Introduction

115. NH and NCC and been engaged to identify which parts of the highway network within the TTSA have the potential to exhibit significant Driver Delay impacts when the construction traffic demand is introduced.

116. NH and NCC have adopted a different approach to identifying sensitive parts of the highway network recognising the different operation characteristics of the strategic road network (SRN) to the local highway network.

117. NCC, applying their statutory duties, have identified routes (links) that are sensitive to increases in traffic during defined peak periods. An assessment of the increase in traffic through these links is presented in ES **Chapter 24 Traffic and Transport**.

118. NH have identified 11 junctions that they consider to be sensitive to increases in daily traffic flow and these junctions are considered further within this TA. It has been agreed with NH (at a meeting on the 5 April 2022) that a representative worst-case scenario for assessing sensitive junctions would be during the period immediately preceding the morning network peak and immediately following evening network peaks, (known as shoulder peaks). These shoulder peak periods are identified as:

- 06:30 – 07:30; and
- 17:25 – 18:25.

119. The rationale for these worst-case scenarios is that it is considered representative of the time when the peak SEP and/or DEP traffic demand associated with employee trips (LVs) could manifest if there was any divergence in the working hours of 07:00 to 19:00 (e.g. administration staff arriving later or earlier shift finishes to accommodate onward travel to home). The shoulder peak periods would also contain the hourly SEP and/or DEP HGV demand as delivery to and from site would have commenced.

120. Peak hour flows have been derived from daily traffic flows presented in **Annex 28** and **Annex 29**, adopting the following worst-case scenario parameters:

- LV trips are calculated by dividing daily LV trips by two, i.e. assuming all employees arrive and depart within a single hour am and pm;
- LV trips assume one LV trip per employee, i.e. no allowance has been made for employees to car-share or using other suitable transport modes, e.g. walking, cycling, bus, etc.
- Hourly HGV trips calculated by profiling HGV trips across a 10 hour delivery window, rather than the proposed 12 hour (07:00 – 19:00) window.
- Demand optimisation (as described in **section 24.1.4.6**) has not been applied.

121. Modelling has been undertaken utilising the following industry standard software, as agreed with NH (at a meeting on the 13 July 2021):

- Modelling of priority and roundabout junctions has been undertaken with the use of Junctions 9 software; and

- Modelling of traffic signal-controlled junctions has been undertaken with the use of LinSig Version 3.2 software.

122. When assessing priority and roundabout junction capacity, reference has been made to the Ratio of Flow to Capacity (RFC). RFC is the standard recognised threshold for priority and roundabout junctions in the UK and is typically reported by junction approach arm. When values for RFC are above 0.85 a junction is considered to be operating beyond its desirable capacity and mitigation measures may be required.

123. When assessing traffic signal-controlled junction capacity, reference has been made to the Degree of Saturation (DoS) and Practical Reserve Capacity (PRC). DoS and PRC are the standard recognised thresholds for signalised junctions in the UK, with DoS typically reported by junction approach arm and PRC for the whole junction. When values for DoS are above 90% and when PRC is less than 0% a junction is considered to be operating beyond desirable capacity and mitigation measures may be required.

124. When considering queuing, reference has been made to mean max queues (MMQ). A MMQ is the standard recognised way of expressing queue lengths and represents the maximum queue within a typical cycle averaged over all the cycles within a modelled time period. MMQs are expressed in vehicles (veh) for priority junctions and PCUs for signalised junctions (where one PCU is equivalent to a length of approximately 5.75m).

125. Within the tables below a dash (-) has been used to show where an arm of a junction is unopposed and therefore no queuing or delay would be expected.

126. The following section provides a summary of the modelled impacts for the peak construction of SEP or DEP in Isolation when compared to background traffic flows.

127. Full modelling outputs, including flow diagrams for each junction are provided within **Annex 32**.

24.1.6.1.1 Junction 1

128. Junction 1 forms the staggered junction of the A47, B1535 and Berrys Lane to the East of Hockering/West of Honingham.

129. **Table 6** and **Table 7** summarise the modelled RFC, queuing and delay for junction 1 for the forecast year of 2025 with and without SEP or DEP for the morning and evening shoulder peak hours respectively.

Table 6: Junction 1 Modelling Results Summary SEP or DEP In Isolation (06:30 – 07:30)

Arm	2025 Forecast Background Flows (06:30 – 07:30)			2025 Forecast Background Flows + Construction Flows (06:30 – 07:30)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
Berry's Lane to A47 (West)	0.05	0.1	7.18	0.0 6	0.1	7.94
Berry's Lane to A47 (East)	0.12	0.1	25.64	0.21	0.3	49.22
A47 (East) to B1535	0.31	0.4	12.89	0.47	0.9	19.02
B1535 to A47 (East)	0.48	0.9	20.01	2.71	59.5	2394.52
B1535 to A47 (West)	0.42	0.7	66.16	2.64	14.4	26917.23
A47 (West) to Berry's Lane	0.12	0.1	7.39	0.12	0.1	8.01

Table 7: Junction 1 Modelling Results Summary SEP or DEP In Isolation (17:25 – 18:25)

Arm	2025 Forecast Background Flows (17:25 – 18:25)			2025 Forecast Background Flows + Construction Flows (17:25 – 18:25)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
Berry's Lane to A47 (West)	0.11	0.1	8.52	0.13	0.1	10.41
Berry's Lane to A47 (East)	0.08	0.1	25.04	0.16	0.2	53.42
A47 (East) to A47 (West)	0.25	0.3	8.92	0.31	0.4	10.27
B1535 to A47 (East)	0.30	0.4	10.53	1.33	26.3	426.45
B1535 to Berry's Lane	0.40	0.7	43.19	1.31	14.7	482.79
A47 (West) to A47 (East)	0.07	0.1	7.88	0.08	0.1	9.35

130. **Table 6** and **Table 7** show that for the am and pm shoulder peak periods the existing junction operates with spare capacity and queues of no more than one vehicle. With the addition of the SEP or DEP traffic the B1535 arm of the junction would operate over capacity and significant queuing and delay would be noted.

131. NH are however proposing to remove junction 1 as part of the A47 North Tuddenham to Easton improvement scheme. This scheme would remove this junction providing new grade separated junctions on the A47. The improvement works are proposed to be complete by 2024/2025 and should therefore be in place prior to the commencement of SEP and DEP (scheduled to start in 2025 at the earliest).

132. Should the improvement works not be implemented prior to the commencement of construction of SEP and DEP, the OCTMP (document reference 9.16) sets out a range of potential mitigation measures to ensure impacts are not significant. These would comprise of demand management measures such as, car-sharing, spreading of arrival/finish times, etc.

24.1.6.1.2 Junction 2

133. Junction 2 forms the priority junction of the A47 (East and West), Taverham Road and Blind Lane. During a meeting with NH (3 July 2021), NH requested that if improvements to the A47 are not completed prior to the commencement of SEP and DEP, that road safety improvements to the junction of the A47, Blind Lane and Taverham Road proposed by HP3 should be retained/re-introduced for the construction of SEP and DEP.

134. These amendments include the closure of Blind Lane and creation of a left in left out only junction at Taverham Road and are detailed further within the OCTMP (document reference 9.16).

135. The modelling of junction 2 therefore assumes that Blind Lane is closed and that Taverham Road operates as a left in left out arrangement.

136. **Table 8** and **Table 9** summarise the modelled RFC, queuing and delay for junction 2 for the forecast year of 2025 with and without SEP or DEP for the morning and evening shoulder peak hours respectively.

Table 8: Junction 2 Modelling Results Summary SEP or DEP In Isolation (06:30 – 07:30)

Arm	2025 Forecast Background Flows (06:30 – 07:30)			2025 Forecast Background Flows + Construction Flows (06:30 – 07:30)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
Taverham Road to A47 West	0.02	0	10.39	0.05	0.0	14.53
A47 East to Taverham Road	-	-	-	-	-	-

Table 9: Junction 2 Modelling Results Summary SEP or DEP In Isolation (17:25 – 18:25)

Arm	2025 Forecast Background Flows (17:25 – 18:25)			2025 Forecast Background Flows + Construction Flows (17:25 – 18:25)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
Taverham Road to A47 West	0.02	0	8.07	0.22	0.3	14.93
A47 East to Taverham Road	-	-	-	-	-	-

137. **Table 8** and **Table 9** show that for the am and pm shoulder peak periods the existing junction operates with spare capacity and queues of no more than one vehicle. With the addition of the SEP or DEP traffic the junction would continue to operate with spare capacity and would experience minimal changes in queuing and delay.

24.1.6.1.3 Junction 3

138. Junction 3 forms the roundabout junction of the A47 (East & West), Church Lane and Dereham Road to the West of Easton.

139. **Table 10** and **Table 11** summarise the modelled RFC, queuing and delay for junction 3 for the forecast year of 2025 with and without development for the morning and evening shoulder peak hours respectively.

Table 10: Junction 3 Modelling Results Summary SEP or DEP In Isolation (06:30 – 07:30)

Arm	2025 Forecast Background Flows (06:30 – 07:30)			2025 Forecast Background Flows + Construction Flows (06:30 – 07:30)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
A47 East	0.39	0.6	2.10	0.45	0.8	2.39
Dereham Road	0.07	0.1	4.08	0.08	0.1	4.48
A47 West	0.57	1.3	3.68	0.63	1.7	4.37
Church Lane	0.27	0.4	7.52	0.31	0.4	8.93

Table 11: Junction 3 Modelling Results Summary SEP or DEP In Isolation (17:25 – 18:25)

Arm	2025 Forecast Background Flows (17:25 – 18:25)			2025 Forecast Background Flows + Construction Flows (17:25 – 18:25)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
A47 East	0.45	0.8	2.23	0.49	0.9	2.45
Dereham Road	0.15	0.2	4.98	0.25	0.3	6.54
A47 West	0.45	0.8	2.72	0.51	1.0	3.15
Church Lane	0.13	0.2	5.06	0.15	0.2	5.72

140. **Table 10** and **Table 11** show that for the am and pm shoulder peak periods the existing junction operates with spare capacity and queues of no more than two vehicles. With the addition of the SEP or DEP traffic the junction would continue to operate with spare capacity and would experience minimal changes in queuing and delay.

24.1.6.1.4 Junction 4

141. Junction 4 forms the priority junction of the A11 (East & West) and Station Lane to the North of Norfolk County Council Highway Depot (South)/North of East Carleton.

142. **Table 12** and **Table 13** summarise the modelled RFC, queuing and delay for junction 4 for the forecast year of 2025 with and without development for the morning and evening shoulder peak hours respectively.

Table 12: Junction 4 Modelling Results Summary SEP or DEP In Isolation (06:30 – 07:30)

Arm	2025 Forecast Background Flows (06:30 – 07:30)			2025 Forecast Background Flows + Construction Flows (06:30 – 07:30)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
Station Lane to A11 West	0.11	0.1	14.48	0.14	0.2	15.37
A11 West to A11 East	-	-	-	-	-	-

Table 13: Junction 4 Modelling Results Summary SEP or DEP In Isolation (17:25 – 18:25)

Arm	2025 Forecast Background Flows (17:25 – 18:25)			2025 Forecast Background Flows + Construction Flows (17:25 – 18:25)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
Station Lane to A11 West	0.02	0	7.58	0.20	0.3	8.90
A11 West to A11 East	-	-	-	-	-	-

143. **Table 12** and **Table 13** show that for the am and pm shoulder peak periods the existing junction operates with spare capacity and queues of no more than one vehicle. With the addition of the SEP or DEP traffic the junction would continue to operate with spare capacity and would experience minimal changes in queuing and delay.

24.1.6.1.5 Junction 5

144. Junction 5 forms the roundabout junction of the A11 (East & West), A47 (Northbound and Southbound – Off ramp), B1172 and Newmarket Road to the North West of Cringleford.

145. **Table 14** and **Table 15** summarise the modelled DOS, MMQ and average delay per PCU for junction 5 for the forecast year of 2025 with and without development for the morning and evening shoulder peak hours respectively.

Table 14: Junction 5 Modelling Results Summary SEP or DEP In Isolation (06:30 – 07:30)

Arm	2025 Forecast Background Flows (06:30 – 07:30)			2025 Forecast Background Flows + Construction Flows (06:30 – 07:30)		
	DoS (%)	MMQ (PCUs)	Average delay per PCU (s/pcu)	DoS (%)	MMQ (PCUs)	Average delay per PCU (s/pcu)
Unnamed Road (Left)	0.3	0.0	3.1	0.3	0.0	3.3
A11 East (Left/Ahead)	48.9	8.9	27.8	65.4	11.7	40.8
A11 East (Ahead)	48.0	7.6	26.5	54.2	9.1	30.6
A47 Northbound Off Ramp (Left)	71.5	11.5	25.3	74.6	12.1	26.8
A47 Northbound Off Ramp (Ahead)	60.7	14.7	27.0	63.4	15.2	28.4

Arm	2025 Forecast Background Flows (06:30 – 07:30)			2025 Forecast Background Flows + Construction Flows (06:30 – 07:30)		
	DoS (%)	MMQ (PCUs)	Average delay per PCU (s/pcu)	DoS (%)	MMQ (PCUs)	Average delay per PCU (s/pcu)
A11 West (Left/Ahead)	44.4	9.6	18.8	50.2	11.3	19.1
A11 West (Ahead)	27.6	5.2	16.2	27.4	5.2	15.6
A11 West (Ahead)	28.4	5.2	16.3	27.8	5.3	15.7
A11 West (Ahead)	51.3	11.4	19.9	51.1	11.7	19.3
B1172 (Left/Ahead)	35.5	4.7	27.5	36.4	4.7	27.5
B1172 (Ahead)	71.0	11.1	45.5	73.1	11.2	47.9
A47 Southbound Off Ramp (Ahead/Left)	16.9	3.0	23.4	34.2	2.8	20.8
A47 Southbound Off Ramp (Ahead)	70.2	17.1	35.0	73.9	19.0	33.7
Practical Reserve Capacity over all lanes	25.9%			20.6%		

Table 15: Junction 5 Modelling Results Summary SEP or DEP In Isolation (17:25 – 18:25)

Arm	2025 Forecast Background Flows (17:25 – 18:25)			2025 Forecast Background Flows + Construction Flows (17:25 – 18:25)		
	DoS (%)	MMQ (PCUs)	Average delay per PCU (s/pcu)	DoS (%)	MMQ (PCUs)	Average delay per PCU (s/pcu)
Unnamed Road (Left)	1.0	0.0	58.9	1.7	0.0	77.6
A11 East (Left/Ahead)	60.1	9.7	29.1	71.7	15.8	28.3
A11 East (Ahead)	54.3	9.2	26.1	50.0	8.6	22.8
A47 Northbound Off Ramp (Left)	53.6	8.4	30.0	53.0	7.3	24.3

Arm	2025 Forecast Background Flows (17:25 – 18:25)			2025 Forecast Background Flows + Construction Flows (17:25 – 18:25)		
	DoS (%)	MMQ (PCUs)	Average delay per PCU (s/pcu)	DoS (%)	MMQ (PCUs)	Average delay per PCU (s/pcu)
A47 Northbound Off Ramp (Ahead)	53.4	12.4	34.0	51.4	11.1	27.3
A11 West (Left/Ahead)	49.1	11.5	28.4	58.8	13.4	28.4
A11 West (Ahead)	47.8	8.3	25.9	39.9	8.0	24.4
A11 West (Ahead)	38.2	8.1	25.8	39.4	7.9	24.3
A11 West (Ahead)	60.9	15.5	31.9	66.4	16.0	30.7
B1172 (Left/Ahead)	27.3	4.1	16.9	31.3	4.3	18.3
B1172 (Ahead)	60.4	11.6	33.7	71.8	12.9	38.6
A47 Southbound Off Ramp (Ahead/Left)	27.3	4.5	29.4	26.0	4.5	28.6
A47 Southbound Off Ramp (Ahead)	60.2	13.7	38.2	72.4	16.2	40.4
Practical Reserve Capacity over all lanes	47.7%			24.2.0%		

146. **Table 14** and **Table 15** show that for the am and pm shoulder peak periods the existing junction operates with spare capacity and queues of up to 17 PCUs. With the addition of the SEP or DEP traffic the junction would continue to operate with spare capacity and would experience minimal changes in queuing and delay.

24.1.6.1.6 Junction 6

147. Junction 6 forms the roundabout junction of the A47 (Eastbound and Westbound - Offramp), A140 (North and South), Markshall Farm Road and Harford Park and Ride Road to the North of Dunston.

148. **Table 16** and **Table 17** summarise the modelled RFC, queuing and delay for junction 6 for the forecast year of 2025 with and without development for the morning and evening shoulder peak hours respectively.

Table 16: Junction 6 Modelling Results Summary SEP or DEP In Isolation (06:30 – 07:30)

Arm	2025 Forecast Background Flows (06:30 – 07:30)			2025 Forecast Background Flows + Construction Flows (06:30 – 07:30)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
A47 Westbound	0.24	0.3	2.70	0.29	0.4	3.03
Markshall Farm Road	0.11	0.1	4.36	0.12	0.1	4.86
A140 South	0.41	0.7	2.71	0.44	0.8	2.87
A47 Eastbound	0.28	0.4	3.05	0.31	0.4	3.24
Unnamed Road	0.00	0.0	0.00	0.00	0.0	0.00
A140 North	0.33	0.5	2.98	0.38	0.6	3.25

Table 17: Junction 6 Modelling Results Summary SEP or DEP In Isolation (17:25 – 18:25)

Arm	2025 Forecast Background Flows (17:25 – 18:25)			2025 Forecast Background Flows + Construction Flows (17:25 – 18:25)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
A47 Westbound	0.27	0.4	3.36	0.29	0.4	3.59
Markshall Farm Road	0.14	0.2	5.52	0.14	0.2	5.81
A140 South	0.43	0.7	2.80	0.49	1.0	3.23
A47 Eastbound	0.37	0.6	3.39	0.42	0.7	3.93
Unnamed Road	0.04	0.0	3.39	0.05	0.0	3.73
A140 North	0.59	1.4	4.88	0.62	1.6	5.56

149. **Table 16** and **Table 17** show that for the am and pm shoulder peak periods the existing junction operates with spare capacity and queues of no more than two vehicles. With the addition of the SEP or DEP traffic the junction would continue to operate with spare capacity and would experience minimal changes in queuing and delay.

24.1.6.1.7 Junction 7

150. Junction 7 forms the roundabout junction of the A47 (East and West) and Norwich Road to the East of Honingham.

151. **Table 18** and **Table 19** summarise the modelled RFC, queuing and delay for junction 7 for the forecast year of 2025 with and without development for the morning and evening shoulder peak hours respectively.

Table 18: Junction 7 Modelling Results Summary SEP or DEP In Isolation (06:30 – 07:30)

Arm	2025 Forecast Background Flows (06:30 – 07:30)			2025 Forecast Background Flows + Construction Flows (06:30 – 07:30)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
A47 East	0.85	5.2	19.03	0.94	11.3	39.96
Norwich Road	0.27	0.4	7.62	0.30	0.4	8.60
A47 West	1.09	62.6	173.02	1.27	173	567.85

Table 19: Junction 7 Modelling Results Summary SEP or DEP In Isolation (17:25 – 18:25)

Arm	2025 Forecast Background Flows (17:25 – 18:25)			2025 Forecast Background Flows + Construction Flows (17:25 – 18:25)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
A47 East	1.02	33.70	91.04	1.18	123.9	350.79
Norwich Road	0.22	0.3	7.79	0.23	0.3	8.08
A47 West	0.82	4.4	16.69	0.91	8.5	31.32

152. **Table 18** and **Table 19** show that for the am and pm shoulder peak periods the existing junction operates over capacity with significant queuing. With the addition of the SEP or DEP traffic junction would continue to operate over capacity users would experience an increase in queuing and delays.

153. NH are however proposing to remove junction 7 as part of the A47 North Tuddenham to Easton improvement scheme. This scheme would remove this junction providing new grade separated junctions on the A47. The improvement works are proposed to be complete by 2024/2025 and should therefore be in place prior to the commencement of SEP and DEP (scheduled to start in 2025 at the earliest).

154. Should the improvement works not be implemented prior to the commencement of construction of SEP and DEP, the OCTMP (document reference 9.16) sets out a range of potential mitigation measures to ensure impacts are not significant. These would comprise of demand management measures such as, car-sharing, spreading of arrival/finish times, etc.

24.1.6.1.8 Junction 8

155. Junction 8 forms the roundabout junction of the A1074, Unnamed Road, A47 North and William Frost Way at Longwater.

156. **Table 20** and **Table 21** summarise the modelled RFC, queuing and delay for junction 8 for the forecast year of 2025 with and without development for the morning and evening shoulder peak hours respectively.

Table 20: Junction 8 Modelling Results Summary SEP or DEP In Isolation (06:30 – 07:30)

Arm	2025 Forecast Background Flows (06:30 – 07:30)			2025 Forecast Background Flows + Construction Flows (06:30 – 07:30)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
A1074	0.50	1.0	3.21	0.51	1.0	3.30
Unnamed Road	0.29	0.4	2.67	0.29	0.4	2.67
A47 North	0.25	0.3	3.15	0.25	0.3	3.15
William Frost Way	0.41	0.7	3.54	0.41	0.7	3.54

Table 21: Junction 8 Modelling Results Summary SEP or DEP In Isolation (17:25 – 18:25)

Arm	2025 Forecast Background Flows (17:25 – 18:25)			2025 Forecast Background Flows + Construction Flows (17:25 – 18:25)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
A1074	0.68	2.1	5.37	0.67	2.1	5.32
Unnamed Road	0.71	2.4	7.00	0.72	2.5	7.19
A47 North	0.54	1.2	9.98	0.58	1.3	10.89
William Frost Way	0.70	2.3	6.78	0.71	2.4	7.11

157. **Table 20** and **Table 21** show that for the am and pm shoulder peak periods the existing junction operates with spare capacity and queues of no more than three vehicles. With the addition of the SEP or DEP traffic the junction would continue to operate with spare capacity and would experience minimal changes in queuing and delay.

24.1.6.1.9 Junction 9

158. Junction 9 forms the roundabout junction of the A47 (North & South), Dereham Road and Long Lane to the South of Longwater.

159. **Table 22** and **Table 23** summarise the modelled RFC, queuing and delay for junction 9 for the forecast year of 2025 with and without development for the morning and evening shoulder peak hours respectively.

Table 22: Junction 9 Modelling Results Summary SEP or DEP In Isolation (06:30 – 07:30)

Arm	2025 Forecast Background Flows (06:30 – 07:30)			2025 Forecast Background Flows + Construction Flows (06:30 – 07:30)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
Unnamed Road	0.44	0.8	5.31	0.45	0.8	5.49
A47 South	0.27	0.4	2.61	0.27	0.4	2.64
Long Lane	0.04	0.0	6.45	0.04	0.0	6.56
A47 North	0.12	0.1	3.55	0.12	0.1	3.60

Table 23: Junction 9 Modelling Results Summary SEP or DEP In Isolation (17:25 – 18:25)

Arm	2025 Forecast Background Flows (17:25 – 18:25)			2025 Forecast Background Flows + Construction Flows (17:25 – 18:25)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
Unnamed Road	0.54	1.2	6.26	0.54	1.2	6.26
A47 South	0.46	0.9	3.42	0.47	0.9	3.45
Long Lane	0.65	1.8	23.26	0.66	1.8	24.20
A47 North	0.32	0.5	6.77	0.32	0.5	6.87

160. **Table 22** and **Table 23** show that for the am and pm shoulder peak periods the existing junction operates with spare capacity and queues of no more than two vehicles. With the addition of the SEP or DEP traffic the junction would continue to operate with spare capacity and would experience minimal changes in queuing and delay.

24.1.6.1.10 Junction 10

161. Junction 10 forms the roundabout junction of the A47 (North), B1108 (East & West), Unnamed Road and Green Access to the South-West of Three Score.

162. **Table 24** and **Table 25** summarise the modelled RFC, queuing and delay for junction 10 for the forecast year of 2025 with and without development for the morning and evening shoulder peak hours respectively.

Table 24: Junction 10 Modelling Results Summary SEP or DEP In Isolation (06:30 – 07:30)

Arm	2025 Forecast Background Flows (06:30 – 07:30)			2025 Forecast Background Flows + Construction Flows (06:30 – 07:30)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
Unnamed Road	-	-	-	-	-	-
Green Access	-	-	-	-	-	-
B1108 East	0.20	0.2	2.04	0.20	0.2	2.05
B1108 West	0.32	0.5	3.55	0.33	0.5	3.60
A47 North	0.22	0.3	2.34	0.23	0.3	2.37

Table 25: Junction 10 Modelling Results Summary SEP or DEP In Isolation (17:25 – 18:25)

Arm	2025 Forecast Background Flows (17:25 – 18:25)			2025 Forecast Background Flows + Construction Flows (17:25 – 18:25)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
Unnamed Road	-	-	-	-	-	-
Green Access	-	-	-	-	-	-
B1108 East	0.39	0.6	2.70	0.40	0.7	2.80
B1108 West	0.41	0.7	3.98	0.45	0.8	4.32
A47 North	0.17	0.2	2.31	0.18	0.2	2.39

163. **Table 24** and **Table 25** show that for the am and pm shoulder peak periods the existing junction operates with spare capacity and queues of no more than one vehicle. With the addition of the SEP or DEP traffic the junction would continue to operate with spare capacity and would experience minimal changes in queuing and delay.

24.1.6.1.11 Junction 11

164. Junction 11 forms the roundabout junction of the B1108 (East & West) and A47 South to the South-East of Bawburgh.

165. **Table 26** and **Table 27** summarise the modelled RFC, queuing and delay for junction 11 for the forecast year of 2025 with and without development for the morning and evening shoulder peak hours respectively.

Table 26: Junction 11 Modelling Results Summary SEP or DEP In Isolation (06:30 – 07:30)

Arm	2025 Forecast Background Flows (06:30 – 07:30)			2025 Forecast Background Flows + Construction Flows (06:30 – 07:30)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
B1108 (East)	0.23	0.3	3.28	0.24	0.3	3.32
A47 South	0.15	0.2	2.13	0.19	0.2	2.24
B1108 (West)	0.29	0.4	4.18	0.30	0.4	4.30

Table 27: Junction 11 Modelling Results Summary SEP or DEP In Isolation (17:25 – 18:25)

Arm	2025 Forecast Background Flows (17:25 – 18:25)			2025 Forecast Background Flows + Construction Flows (17:25 – 18:25)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
B1108 (East)	0.43	0.8	4.34	0.44	0.8	4.37
A47 South	0.31	0.4	2.86	0.31	0.5	2.90
B1108 (West)	0.36	0.6	5.22	0.44	0.8	5.97

166. **Table 26** and **Table 27** show that for the am and pm shoulder peak periods the existing junction operates with spare capacity and queues of no more than one vehicle. With the addition of the SEP or DEP traffic the junction would continue to operate with spare capacity and would experience minimal changes in queuing and delay.

24.1.6.2 Driver Delay Impacts (SEP and DEP Concurrently)

167. The following section provides a summary of the modelled impacts for the peak construction of SEP and DEP when compared to background traffic flows.

168. Full modelling outputs, including flow diagrams for each junction are also provided within **Annex 32**.

24.1.6.2.1 Junction 1

169. Junction 1 forms the staggered junction of the A47, B1535 and Berrys Lane to the East of Hockering/West of Honingham.

170. **Table 28** and **Table 29** summarise the modelled RFC, queuing and delay for junction 1 for the forecast year of 2022 with and without development for the morning and evening shoulder peak hours respectively.

Table 28: Junction 1 Modelling Results Summary SEP and DEP Concurrently (06:30 – 07:30)

Arm	2025 Forecast Background Flows (06:30 – 07:30)			2025 Forecast Background Flows + Construction Flows (06:30 – 07:30)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
Berry's Lane to A47 (West)	0.05	0.1	7.18	0.06	0.1	8.11
Berry's Lane to A47 (East)	0.12	0.1	25.64	0.25	0.3	59.81
A47 (East) to A47 (West)	0.31	0.4	12.89	0.55	1.2	23.61
B1535 to A47 (East)	0.48	0.9	20.01	99999.0	100.4	1685.37
B1535 to Berry's Lane	0.42	0.7	66.16	99999.0	22.0	1085.57
A47 (West) to A47 (East)	0.12	0.1	7.39	0.13	0.1	8.10

Table 29: Junction 1 Modelling Results Summary SEP and DEP Concurrently (17:25 – 18:25)

Arm	2025 Forecast Background Flows (17:25 – 18:25)			2025 Forecast Background Flows + Construction Flows (17:25 – 18:25)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
Berry's Lane to A47 (West)	0.11	0.1	8.52	0.14	0.2	11.24
Berry's Lane to A47 (East)	0.08	0.1	25.04	0.21	0.3	73.72
A47 (East) to A47 (West)	0.25	0.3	8.92	0.34	0.5	10.89
B1535 to A47 (East)	0.30	0.4	10.53	1.77	46.6	731.49
B1535 to Berry's Lane	0.40	0.7	43.19	1.72	26.0	756.45
A47 (West) to A47 (East)	0.07	0.1	7.88	0.09	0.1	9.91

171. **Table 28** and **Table 29** show that for the am and pm shoulder peak periods the existing junction operates with spare capacity and queues of no more than one vehicle. With the addition of the SEP and DEP traffic, the B1535 arm of the junction would operate over capacity and significant queuing and delay would be noted.

172. NH are however proposing to remove junction 1 as part of the A47 North Tuddenham to Easton improvement scheme. This scheme would remove this

junction providing new grade separated junctions on the A47. The improvement works are proposed to be complete by 2024/2025 and should therefore be in place prior to the commencement of SEP and DEP (scheduled to start in 2025 at the earliest).

173. Should the improvement works not be implemented prior to the commencement of construction of SEP and DEP, the OCTMP (document reference 9.16) sets out a range of potential mitigation measures to ensure impacts are not significant. These would comprise of demand management measures such as, car-sharing, spreading of arrival/finish times, etc.

24.1.6.2.2 Junction 2

174. Junction 2 forms the priority junction of the A47 (East and West) and Taverham Road.

175. **Table 30** and **Table 31** summarise the modelled RFC, queuing and delay for junction 1 for the forecast year of 2022 with and without development for the morning and evening shoulder peak hours respectively.

Table 30: Junction 2 Modelling Results Summary SEP and DEP Concurrently (06:30 – 07:30)

Arm	2025 Forecast Background Flows (06:30 – 07:30)			2025 Forecast Background Flows + Construction Flows (06:30 – 07:30)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
Taverham Road to A47 West	0.02	0	10.39	0.07	0.1	18.25
A47 East to Taverham Road	-	-	-	-	-	-

Table 31: Junction 2 Modelling Results Summary SEP and DEP Concurrently (17:25 – 18:25)

Arm	2025 Forecast Background Flows (17:25 – 18:25)			2025 Forecast Background Flows + Construction Flows (17:25 – 18:25)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
Taverham Road to A47 West	0.02	0	8.07	0.21	0.3	9.63
A47 East to Taverham Road	-	-	-	-	-	-

176. **Table 30** and **Table 31** show that for the am and pm shoulder peak periods the existing junction operates with spare capacity and queues of no more than one vehicle. With the addition of the SEP and DEP traffic the junction would continue to operate with spare capacity and would experience minimal changes in queuing and delay.

24.1.6.2.3 Junction 3

177. Junction 3 forms the roundabout junction of the A47 (East & West), Church Lane and Dereham Road to the West of Easton.

178. **Table 32** and **Table 33** summarise the modelled RFC, queuing and delay for junction 3 for the forecast year of 2025 with and without development for the morning and evening shoulder peak hours respectively.

Table 32: Junction 3 Modelling Results Summary SEP and DEP Concurrently (06:30 – 07:30)

Arm	2025 Forecast Background Flows (06:30 – 07:30)			2025 Forecast Background Flows + Construction Flows (06:30 – 07:30)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
A47 East	0.39	0.6	2.10	0.47	0.9	2.49
Dereham Road	0.07	0.1	4.08	0.13	0.2	6.02
A47 West	0.57	1.3	3.68	0.65	1.9	4.60
Church Lane	0.27	0.4	7.52	0.32	0.5	9.52

Table 33: Junction 3 Modelling Results Summary SEP and DEP Concurrently (17:25 – 18:25)

Arm	2025 Forecast Background Flows (17:25 – 18:25)			2025 Forecast Background Flows + Construction Flows (17:25 – 18:25)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
A47 East	0.45	0.8	2.23	0.51	1.0	2.58
Dereham Road	0.15	0.2	4.98	0.27	0.4	7.11
A47 West	0.45	0.8	2.72	0.54	1.2	3.43
Church Lane	0.13	0.2	5.06	0.16	0.2	6.18

179. **Table 32** and **Table 33** show that for the am and pm shoulder peak periods the existing junction operates with spare capacity and queues of no more than two vehicles. With the addition of the SEP and DEP traffic the junction would continue to operate with spare capacity and would experience minimal changes in queuing and delay.

24.1.6.2.4 Junction 4

180. Junction 4 forms the priority junction of the A11 (East & West) and Station Lane to the North of Norfolk County Council Highway Depot (South)/North of East Carleton.

181. **Table 34** and **Table 35** summarise the modelled RFC, queuing and delay for junction 4 for the forecast year of 2025 with and without development for the morning and evening shoulder peak hours respectively.

Table 34: Junction 4 Modelling Results Summary SEP and DEP Concurrently (06:30 – 07:30)

Arm	2025 Forecast Background Flows (06:30 – 07:30)			2025 Forecast Background Flows + Construction Flows (06:30 – 07:30)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
Station Lane to A11 West	0.11	0.1	14.48	0.17	0.2	16.44
A11 West to A11 East	-	-	-	-	-	-

Table 35: Junction 4 Modelling Results Summary SEP and DEP Concurrently (17:25 – 18:25)

Arm	2025 Forecast Background Flows (17:25 – 18:25)			2025 Forecast Background Flows + Construction Flows (17:25 – 18:25)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
Station Lane to A11 West	0.02	0	7.58	0.34	0.5	11.00
A11 West to A11 East	-	-	-	-	-	-

182. **Table 34** and **Table 35** show that for the am and pm shoulder peak periods the existing junction operates with spare capacity and queues of no more than one vehicle. With the addition of the SEP and DEP traffic the junction would continue to operate with spare capacity and would experience minimal changes in queuing and delay.

24.1.6.2.5 Junction 5

183. Junction 5 forms the roundabout junction of the A11 (East & West), A47 (Northbound and Southbound – Off ramp), B1172 and Newmarket Road to the Northwest of Cringleford.

184. **Table 36** and **Table 37** summarise the modelled DOS, MMQ and average delay per PCU for junction 5 for the forecast year of 2025 with and without development for the morning and evening shoulder peak hours respectively.

Table 36: Junction 5 Modelling Results Summary SEP and DEP Concurrently (06:30 – 07:30)

Arm	2025 Forecast Background Flows (06:30 – 07:30)			2025 Forecast Background Flows + Construction Flows (06:30 – 07:30)		
	DoS (%)	MMQ (PCUs)	Average delay per PCU (s/pcu)	DoS (%)	MMQ (PCUs)	Average delay per PCU (s/pcu)
Unnamed Road (Left)	0.3	0.0	3.1	0.3	0.0	3.3
A11 East (Left/Ahead)	48.9	8.9	27.8	68.8	11.7	42.6
A11 East (Ahead)	48.0	7.6	26.5	52.0	8.5	37.1
A47 Northbound Off Ramp (Left)	71.5	11.5	25.3	78.5	14.9	29.0
A47 Northbound Off Ramp (Ahead)	60.7	14.7	27.0	66.1	16.1	30.0
A11 West (Left/Ahead)	44.4	9.6	18.8	50.8	11.6	18.7
A11 West (Ahead)	27.6	5.2	16.2	27.3	5.2	15.1
A11 West (Ahead)	28.4	5.2	16.3	27.1	5.1	15.1
A11 West (Ahead)	51.3	11.4	19.9	52.3	12.0	18.9
B1172 (Left/Ahead)	35.5	4.7	27.5	38.5	4.9	29.4
B1172 (Ahead)	71.0	11.1	45.5	77.9	12.0	53.7
A47 Southbound Off Ramp (Ahead/Left)	16.9	3.0	23.4	15.4	2.7	20.2
A47 Southbound Off Ramp (Ahead)	70.2	17.1	35.0	78.1	21.3	35.2
Practical Reserve Capacity over all lanes	25.9%			14.6%		

Table 37: Junction 5 Modelling Results Summary SEP and DEP Concurrently (17:25 – 18:25)

Arm	2025 Forecast Background Flows (17:25 – 18:25)			2025 Forecast Background Flows + Construction Flows (17:25 – 18:25)		
	DoS (%)	MMQ (PCUs)	Average delay per PCU (s/pcu)	DoS (%)	MMQ (PCUs)	Average delay per PCU (s/pcu)
Unnamed Road (Left)	1.0	0.0	58.9	1.6	0.0	73.2
A11 East (Left/Ahead)	60.1	9.7	29.1	62.9	10.7	29.1
A11 East (Ahead)	54.3	9.2	26.1	59.0	10.3	28.2
A47 Northbound Off Ramp (Left)	53.6	8.4	30.0	57.6	8.2	27.7
A47 Northbound Off Ramp (Ahead)	53.4	12.4	34.0	55.9	11.9	31.0
A11 West (Left/Ahead)	49.1	11.5	28.4	64.6	15.2	31.5
A11 West (Ahead)	47.8	8.3	25.9	40.9	8.1	25.8
A11 West (Ahead)	38.2	8.1	25.8	41.3	8.3	25.9
A11 West (Ahead)	60.9	15.5	31.9	72.2	17.9	34.4
B1172 (Left/Ahead)	27.3	4.1	16.9	30.5	4.2	17.4
B1172 (Ahead)	60.4	11.6	33.7	72.1	13.2	37.8
A47 Southbound Off Ramp (Ahead/Left)	27.3	4.5	29.4	24.9	4.3	27.1
A47 Southbound Off Ramp (Ahead)	60.2	13.7	38.2	71.2	16.2	38.3
Practical Reserve Capacity over all lanes	47.7%			24.7%		

185. **Table 36** and **Table 37** show that for the am and pm shoulder peak periods the existing junction operates with spare capacity and queues of up to 17 PCUs. With the addition of the SEP and DEP traffic the junction would continue to operate with spare capacity and would experience minimal changes in queuing and delay.

24.1.6.2.6 Junction 6

186. Junction 6 forms the roundabout junction of the A47 (Eastbound and Westbound - Offramp), A140 (North and South), Markshall Farm Road and Harford Park and Ride Road to the North of Dunston.

187. **Table 38** and **Table 39** summarise the modelled RFC, queuing and delay for junction 6 for the forecast year of 2025 with and without development for the morning and evening shoulder peak hours respectively.

Table 38: Junction 6 Modelling Results Summary SEP and DEP Concurrently (06:30 – 07:30)

Arm	2025 Forecast Background Flows (06:30 – 07:30)			2025 Forecast Background Flows + Construction Flows (06:30 – 07:30)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
A47 Westbound	0.24	0.3	2.70	0.32	0.5	3.30
Markshall Farm Road	0.11	0.1	4.36	0.13	0.1	5.27
A140 South	0.41	0.7	2.71	0.45	0.8	2.99
A47 Eastbound	0.28	0.4	3.05	0.33	0.5	3.44
Unnamed Road	-	-	-	-	-	-
A140 North	0.33	0.5	2.98	0.41	0.7	3.50

Table 39: Junction 6 Modelling Results Summary SEP and DEP Concurrently (17:25 – 18:25)

Arm	2025 Forecast Background Flows (17:25 – 18:25)			2025 Forecast Background Flows + Construction Flows (17:25 – 18:25)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
A47 Westbound	0.27	0.4	3.36	0.30	0.4	3.76
Markshall Farm Road	0.14	0.2	5.52	0.15	0.2	6.03
A140 South	0.43	0.7	2.80	0.54	1.2	3.61
A47 Eastbound	0.37	0.6	3.39	0.46	0.8	4.45
Unnamed Road	0.04	0.0	3.39	0.05	0.1	4.00
A140 North	0.59	1.4	4.88	0.65	1.8	6.13

Arm	2025 Forecast Background Flows (17:25 – 18:25)			2025 Forecast Background Flows + Construction Flows (17:25 – 18:25)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)

188. **Table 38** and **Table 39** show that for the am and pm shoulder peak periods the existing junction operates with spare capacity and queues of no more than two vehicles. With the addition of the SEP and DEP traffic the junction would continue to operate with spare capacity and would experience minimal changes in queuing and delay.

24.1.6.2.7 Junction 7

189. Junction 7 forms the roundabout junction of the A47 (East and West) and Norwich Road to the East of Honingham.

190. **Table 40** and **Table 41** summarise the modelled RFC, queuing and delay for junction 7 for the forecast year of 2025 with and without development for the morning and evening shoulder peak hours respectively.

Table 40: Junction 7 Modelling Results Summary SEP and DEP Concurrently (06:30 – 07:30)

Arm	2025 Forecast Background Flows (06:30 – 07:30)			2025 Forecast Background Flows + Construction Flows (06:30 – 07:30)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
A47 East	0.85	5.2	19.03	0.94	11.3	39.74
Norwich Road	0.27	0.4	7.62	0.30	0.4	8.60
A47 West	1.09	62.6	173.02	1.32	214.8	685.64

Table 41: Junction 7 Modelling Results Summary SEP and DEP Concurrently (17:25 – 18:25)

Arm	2025 Forecast Background Flows (17:25 – 18:25)			2025 Forecast Background Flows + Construction Flows (17:25 – 18:25)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
A47 East	1.02	33.7	91.04	1.23	158.1	465.01
Norwich Road	0.22	0.3	7.79	0.23	0.3	8.13

Arm	2025 Forecast Background Flows (17:25 – 18:25)			2025 Forecast Background Flows + Construction Flows (17:25 – 18:25)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
A47 West	0.82	4.4	16.69	0.91	8.8	0.91

191. **Table 40** and **Table 41** show that for the am and pm shoulder peak periods the existing junction operates over capacity with significant queuing. With the addition of the SEP and DEP traffic junction would continue to operate over capacity users would experience an increase in queuing and delays.

192. NH are however proposing to remove junction 7 as part of the A47 North Tuddenham to Easton improvement scheme. This scheme would remove this junction providing new grade separated junctions on the A47. The improvement works are proposed to be complete by 2024/2025 and should therefore be in place prior to the commencement of SEP and DEP (scheduled to start in 2025 at the earliest).

193. Should the improvement works not be implemented prior to the commencement of construction of SEP and DEP, the OCTMP (document reference 9.16) sets out a range of potential mitigation measures to ensure impacts are not significant. These would comprise of demand management measures such as, car-sharing, spreading of arrival/finish times, etc.

24.1.6.2.8 Junction 8

194. Junction 8 forms the roundabout junction of the A1074, Unnamed Road, A47 North and William Frost Way at Longwater.

195. **Table 42** and **Table 43** summarise the modelled RFC, queuing and delay for junction 8 for the forecast year of 2025 with and without development for the morning and evening shoulder peak hours respectively.

Table 42: Junction 8 Modelling Results Summary SEP and DEP Concurrently (06:30 – 07:30)

Arm	2025 Forecast Background Flows (06:30 – 07:30)			2025 Forecast Background Flows + Construction Flows (06:30 – 07:30)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
A1074	0.50	1.0	3.21	0.52	1.1	3.32
Unnamed Road	0.29	0.4	2.67	0.29	0.4	2.68
A47 North	0.25	0.3	3.15	0.25	0.3	3.15
William Frost Way	0.41	0.7	3.54	0.41	0.7	3.54

Table 43: Junction 8 Modelling Results Summary SEP and DEP Concurrently (17:25 – 18:25)

Arm	2025 Forecast Background Flows (17:25 – 18:25)			2025 Forecast Background Flows + Construction Flows (17:25 – 18:25)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
A1074	0.68	2.1	5.37	0.68	2.1	5.33
Unnamed Road	0.71	2.4	7.00	0.72	2.5	7.28
A47 North	0.54	1.2	9.98	0.58	1.4	11.11
William Frost Way	0.70	2.3	6.78	0.71	2.4	7.22

196. **Table 42** and **Table 43** show that for the am and pm shoulder peak periods the existing junction operates with spare capacity and queues of no more than three vehicles. With the addition of the SEP and DEP traffic the junction would continue to operate with spare capacity and would experience minimal changes in queuing and delay.

24.1.6.2.9 Junction 9

197. Junction 9 forms the roundabout junction of the A47 (North & South), Dereham Road and Long Lane to the South of Longwater.

198. **Table 44** and **Table 45** summarise the modelled RFC, queuing and delay for junction 9 for the forecast year of 2025 with and without development for the morning and evening shoulder peak hours respectively.

Table 44: Junction 9 Modelling Results Summary SEP and DEP Concurrently (06:30 – 07:30)

Arm	2025 Forecast Background Flows (06:30 – 07:30)			2025 Forecast Background Flows + Construction Flows (06:30 – 07:30)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
Unnamed Road	0.44	0.8	5.31	0.45	0.8	5.49
A47 South	0.27	0.4	2.61	0.27	0.4	2.64
Long Lane	0.04	0.0	6.45	0.04	0.0	6.56
A47 North	0.12	0.1	3.55	0.12	0.1	3.60

Table 45: Junction 9 Modelling Results Summary SEP and DEP Concurrently (17:25 – 18:25)

Arm	2025 Forecast Background Flows (17:25 – 18:25)			2025 Forecast Background Flows + Construction Flows (17:25 – 18:25)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
Unnamed Road	0.54	1.2	6.26	0.54	1.2	6.26
A47 South	0.46	0.9	3.42	0.47	0.9	3.48
Long Lane	0.65	1.8	23.26	0.67	1.9	24.79
A47 North	0.32	0.5	6.77	0.32	0.5	6.93

199. **Table 44** and **Table 45** show that for the am and pm shoulder peak periods the existing junction operates with spare capacity and queues of no more than two vehicles. With the addition of the SEP and DEP traffic the junction would continue to operate with spare capacity and would experience minimal changes in queuing and delay.

24.1.6.2.10 Junction 10

200. Junction 10 forms the roundabout junction of the A47 (North), B1108 (East & West), Unnamed Road and Green Access to the South-West of Three Score.

201. **Table 46** and **Table 47** summarise the modelled RFC, queuing and delay for junction 10 for the forecast year of 2025 with and without development for the morning and evening shoulder peak hours respectively.

Table 46: Junction 10 Modelling Results Summary SEP and DEP Concurrently (06:30 – 07:30)

Arm	2025 Forecast Background Flows (06:30 – 07:30)			2025 Forecast Background Flows + Construction Flows (06:30 – 07:30)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
Unnamed Road	-	-	-	-	-	-
Green Access	-	-	-	-	-	-
B1108 East	0.20	0.2	2.04	0.20	0.2	2.06
B1108 West	0.32	0.5	3.55	0.33	0.5	3.61
A47 North	0.22	0.3	2.34	0.23	0.3	2.36

Table 47: Junction 10 Modelling Results Summary SEP and DEP Concurrently (17:25 – 18:25)

Arm	2025 Forecast Background Flows (17:25 – 18:25)			2025 Forecast Background Flows + Construction Flows (17:25 – 18:25)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
Unnamed Road	-	-	-	-	-	-
Green Access	-	-	-	-	-	-
B1108 East	0.39	0.6	2.70	0.40	0.7	2.84
B1108 West	0.41	0.7	3.98	0.47	0.9	4.45
A47 North	0.17	0.2	2.31	0.18	0.2	2.42

202. **Table 46** and **Table 47** show that for the am and pm shoulder peak periods the existing junction operates with spare capacity and queues of no more than one vehicle. With the addition of the SEP and DEP traffic the junction would continue to operate with spare capacity and would experience minimal changes in queuing and delay.

24.1.6.2.11 Junction 11

203. Junction 11 forms the roundabout junction of the B1108 (East & West) and A47 South to the South-East of Bawburgh.

204. **Table 48** and **Table 49** summarise the modelled RFC, queuing and delay for junction 11 for the forecast year of 2025 with and without development for the morning and evening shoulder peak hours respectively.

Table 48: Junction 11 Modelling Results Summary SEP and DEP Concurrently (06:30 – 07:30)

Arm	2025 Forecast Background Flows (06:30 – 07:30)			2025 Forecast Background Flows + Construction Flows (06:30 – 07:30)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
B1108 (East)	0.23	0.3	3.28	0.24	0.3	3.32
A47 South	0.15	0.2	2.13	0.20	0.2	2.26
B1108 (West)	0.29	0.4	4.18	0.30	0.4	4.30

Table 49: Junction 11 Modelling Results Summary SEP and DEP Concurrently (17:25 – 18:25)

Arm	2025 Forecast Background Flows (17:25 – 18:25)			2025 Forecast Background Flows + Construction Flows (17:25 – 18:25)		
	RFC	Queue (Veh)	Average delay per veh (s)	RFC	Queue (Veh)	Average delay per veh (s)
B1108 (East)	0.43	0.8	4.34	0.44	0.8	4.37
A47 South	0.31	0.4	2.86	0.31	0.5	2.91
B1108 (West)	0.36	0.6	5.22	0.46	0.8	6.24

205. **Table 48** and **Table 49** show that for the am and pm shoulder peak periods the existing junction operates with spare capacity and queues of no more than one vehicle. With the addition of the SEP and DEP traffic the junction would continue to operate with spare capacity and would experience minimal changes in queuing and delay.

24.1.7 Summary

206. This TA is provided as an appendix (**Appendix 24.1**) to the ES **Chapter 24 Traffic and Transport**.

207. As agreed with NCC and NH, this TA constitutes an abridged document providing the technical inputs that would inform the ES. This TA therefore presents details of the:

- Derivation background and future year traffic flows;
- Analysis of baseline road safety conditions;
- Derivation and distribution of construction traffic;
- Proposed access strategy; and
- Assessment of driver delay (capacity) for the Strategic Road Network.

208. The ES **Chapter 24 Traffic and Transport**, with the exception of the assessment of capacity impacts on the strategic road network, the ES contains the assessment of all other scoped in traffic and transport effects, namely:

- Severance;
- Amenity;
- Pedestrian Delay;
- Road Safety;
- Driver Delay (highway constraints);
- Driver Delay (road closures);
- Driver Delay (capacity) on the local road network; and
- Abnormal Loads.

209. The findings of the assessment of driver delay (capacity) presented within this TA are that, of the 11 junctions identified as potentially sensitive to increases in traffic, all but two would continue to operate with spare capacity and minimal queuing and delay (and therefore would not experience significant driver delay impacts).

210. Potentially significant driver delay impacts were identified at two junctions (junctions 1 and 7). These junctions are proposed to be removed and replaced as part of planned works by NH. In the event that these works do not proceed or are delayed (prior to the start of SEP and DEP) a range of potential demand management mitigation measures are included within the OCTMP document reference 9.16) to ensure that no significant driver delay impacts are experienced.

References

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