DRAFT Technical Report

Bath Enterprise Area/Transport Strategy

S-Paramics Modelling

Prepared for

Bath and North East Somerset Council

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Appendices

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SECTION 1

Introduction

1.1 Background

Bath and North East Somerset Council (B&NES) are developing a Transport Strategy for the city of Bath to cater for planned growth in the future. The Draft Strategy has a vision for transport in Bath which is that: "*Bath will enhance its unique status by adopting measures that promote sustainable transport and reduce the intrusion of vehicles, particularly in the historic core. This will enable more economic activity and growth, while enhancing its special character and environment and improving the quality of life for local people*". A key aspiration is the re-development of areas along the river, notably within and to the west of the City Centre. This is defined as the Enterprise Area (EA).

The process of master-planning for the EA is at its early stages but discussions have taken place regarding its likely form and content. The planned EA includes a variety of land uses including office, retail and residential. Previous work done by Mott MacDonald on behalf of the Council considered the overall trip generation potential of two land use scenarios termed the 'Revised Land Use Schedule' and the 'Original Land Use Schedule'. Taking account of existing and proposed land uses on different sector sites within the EA this estimated the 'net' traffic generation associated with the full development of the EA as proposed in the two scenarios. In doing so, this made assumptions about how modal split might be expected to change with the induction of measures within the Strategy.

The work undertaken by Mott MacDonald did not explicitly assess the operational impact of the expected additional EA traffic on the Bath highway network. The 'net' traffic increase expected with the two EA land use scenarios was estimated for the weekday 8:00-9:00am and 5:00-6:00hrs only, as well as its expected routing distribution. Critically, the work previously undertaken made no quantitative estimate as to the amount of existing vehicle traffic which might be removed by Strategy measures to encourage the use of Park and Ride and rail, and increase walking and cycling.

To allow detailed S-Paramics micro-simulation modelling of future highway operating conditions with the EA and Strategy measures in place it has been necessary as part of this work to:

- Include all 'committed' highway schemes currently planned or in the process of implementation. A key example here is the A36 Rossiter Road scheme in the Widcombe area;
- Consider other highway changes proposed as part of the EA, but not necessarily 'fixed' in design terms;
- Expand the 'net' EA hourly vehicle matrices developed by Mott McDonald to the 7:00-10:00am and 3:00-7:00pm matrices required for input to the S-Paramics models; and
- Critically, to estimate the potential reduction in existing car driver trips achievable by expansion of Park and Ride capacity around Bath, growth in rail use linked to GWML improvements and Metro West and increases in walking and cycling. This work has been particularly important in making a reasoned case for reductions applied to the existing 2013 'base-line' matrices. With significant congestion affecting parts of the City Centre network now there is a realisation that the Transport Strategy will need to be successful in achieving a level of reduction which largely balances out the increased traffic effects of the EA. This is because previous modelling work with S-Paramics undertaken for the Bath Low Emission Zone (LEZ) study demonstrated that the existing network could tolerate very little traffic growth in the weekday peak periods without operating conditions becoming extremely unstable.

1.2 Existing S-Paramics Traffic Modelling

An S-Paramics model of the A36 corridor through Bath, Bathwick Street and the A4 London Road was developed in 2012, with comprehensive traffic count and Automatic Number Plate Recognition (ANPR)

surveys undertaken in May 2012 to build the vehicle matrices and calibrate models for the time periods 7:00-10:00am, 10:00-3:00pm and 3:00-7:00pm. This was done as part of the Bath LEZ study. Further count and ANPR surveys were done in November 2013 to facilitate the expansion of this model to include the whole of the City Centre and the remainder of the A4 corridor between Cleveland Place and the A36/A4 Twerton Fork junction. The Weston Road/Julian Road/Guinea Lane route to the north of the A4 was also added to the model network coverage, as well as the intervening north-south linkages provided by Combe Park, Park Lane, Marlborough Lane and Gay Street/Brock Street.

The calibration and validation of the 7:00-10:00am and 3:00-7:00pm 2013 'base' models used as the starting point for the EA and Transport Strategy scenario tests was completed in July 2014.

1.3 Structure of Report

Following this introductory chapter the remainder of the report content is structured as follows:

- Chapter 2: Highway network changes;
- Chapter 3: Estimation of EA traffic generation/distribution: Revised and original Lane Use Schedules;
- Chapter 4: Assumed effects of the Transport Strategy: Existing car driver trips;
- Chapter 5: EA land use variants: Place-Making Plan (PMP) options;
- Chapter 6: Scenario test results; and
- Chapter 7: Conclusions

Highway Network Changes

2.1 Under Construction/Committed Schemes

A series of highway schemes either currently under construction, completed since November 2013 or deemed 'committed' were added to the S-Paramics model network. These were as follows:

- Recently completed improvements to the A36/Windsor Bridge Road junction;
- The A36 Rossiter Road scheme: currently under construction;
- Recently completed changes to the lining and marking on St James Parade between Corn Street and Dorchester Street in January 2014, including signalling changes to the St James Parade/Dorchester Street junction. This includes the allied improvement to provide two lanes onto Churchill Bridge in the southbound direction from the City Centre. The eastbound bus gate restriction into Dorchester Street was not included;
- Proposed changes to the alignment of Green Park Road and allied changes to traffic circulation on Broad Quay, Corn Street and Avon Street; and
- Newbridge Park and Ride access improvements: currently under construction.

2.2 Bath Western Riverside

With Bath Western Riverside (BWR) fully built-out there will be three points of access to the main highway network as follows:

- A northern access to the A4 Upper Bristol Road via Midland Road, with the existing Destructor Bridge demolished and replaced with a new two way bridge. The existing A4/Midland Road junction is to be signalled. The new signal layout is being designed by Buro Happold and a drawing was made available on request;
- A new junction with the A36 to the west of the existing Midland Road junction. No details were available for the intended layout or control of this new junction. As such, it was assumed in the S-Paramics model that it would be signal controlled, with two approach lanes on the BWR arm running back at far as the internal junction proposed with the main east-west link road through the development site. It was also assumed that the layout of the westbound A36 approach to this new junction would incorporate a separate lane for right turning vehicles; and
- The existing BWR access onto the Pines Gate gyratory, which also serves the Sainburys petrol filling station and provides a secondary entrance to the Homebase car park at present.

In the initial Revised and Original Land Use Strategy tests it was assumed that BWR traffic would enter/leave the main highway network via these three points, but no specific modelling of any part of the internal road network within BWR was undertaken on the proviso that any use by non-access 'through' traffic would be actively discouraged. However, in later tests its was accepted that the length of the main BWR east-west spine road between the A36 junction and Pines Gate may be used by non-development traffic to avoid delays on the parallel section of the A36, particularly for access to the Green Park area. As such this link was added to the S-Paramics network, albeit with a low 20mph speed limit set to reflect its residential status and the presence of traffic calming features.

It is understood that north-south through routing between the A4 and the A36 via Midland Road and the east-west BWR link road will be prevented by a bus gate installed on Midland Road just north of the junction with the link road. As such, the availability of such a 'through' linkage which formerly existed along Midland road in the southbound direction before closure of the present Destructor Bridge was not modelled.

2.3 Pines Gate

As part of the EA proposals in the Green Park area there is an aspiration to remove the existing A36 Pines Way gyratory, expressly the northern link. This is to allow development land currently within the central island of the gyratory to be better integrated with master-plan proposals for land within the Green Park West area to the north. Proposals developed by consultants IMA as part of a planning application for a new replacement office building on the eastern part of the 'island' site were made available by B&NES, together with LINSIG model results. The proposed changes envisaged were as follows:

- Removal of the section of carriageway on the northern side of the gyratory between Stanier Road and Midland Road. The remaining length on the north side and the short western section of the current gyratory would be changed to two-way roads. These would provide local vehicle access to development within the Green Park West and Green Park East area. The existing BWR link road connection would remain, but the current junction with the gyratory altered to either a mini-roundabout or major-minor 'priority' junction; and
- New signalled all movement 'T' junctions on the A36 would be introduced at the existing west end of the gyratory (Pines Gate West) and with Midland Road (Pines Gate East). The existing one-way section of Midland Road on the east side of the gyratory would become two-way.

At the time of the S-Paramics model testing B&NES officers had a lot of outstanding comments on the proposed IMA highway layout and the allied LINSIG modelling of the Pines Gate West and Pines Gate East junctions. Therefore, as part of the work requested, CH2M Hill undertook a redesign of the proposed layout and revised the LINSIG modelling to provide suitable control and timing inputs for the S-Paramics models. The revised layout used for the basis of the S-Paramics scenario test with the Pines Gate scheme in place is shown in Drawing No 204269-024-001 Rev P1 in **Appendix A**.

A critical operational factor with the proposed scheme is the proximity of the Pines Gate West junction to the existing A36/Brougham Hayes junction. The latter currently has a two stage Method of Control and operates on a fairly low cycle time of 50-60 seconds, which is compatible in co-ordination terms with the signalled eastbound A36 entry junction with the Pines Way gyratory. Both junctions are within the same SCOOT region, with the low cycle time used at Brougham Hayes providing sufficient inter-green 'gaps' for what is a relatively high opposed right turn movement. With the proposed changes Pines Gate West will need to run with a three stage Method of Control, and LINSIG modelling suggested a higher cycle time of circa 80 seconds would be desirable for this 'node'. However this would force up the cycle time at the Brougham Hayes junction which would need to continue to operate within the same SCOOT region. Operating the Brougham Hayes junction at 80 seconds would noticeably reduce the number of inter-green periods used now to clear the opposed right turners. In view of this a revised three stage Method of Control was introduced at the A36/Brougham Hayes in S-Paramics to incorporate a right turn indicative arrow stage (RTIA).

The Pines Gate highway layout changes remain aspirational and the scheme as designed is not yet fixed. In view of this, land use scenarios were separately tested with this change in and out.

SECTION 3

EA Traffic Generation/Distribution

3.1 Introduction

The estimation of the 'net' traffic generation associated with the 'Revised' and 'Original' land use proposals for the EA was developed from work done by Mott MacDonald. As previously stated, the spreadsheet work made available only calculated the total trips by mode, including car driver, for the 8:00-9:00am and 5:00-6:00pm periods. It was thus necessary to expand this work to cover the other hours simulated in the S-Paramics models.

3.2 Methodology

3.2.1 Traffic Generation

The methodology used to estimate the 'net' EA vehicle trip generations for the other hours maintained the same assumptions/data sources used in the Mott MacDonald work. These key assumptions were as follows:

- The TRICS data used to estimate the hourly person trips for specific land uses was the same as that used for generating the 8:00-9:00am and 5:00-6:00pm predictions. In other words no ancillary TRICS work was done to confirm/check the trip rates obtained previously by Motts;
- The external/internal split (to Bath) for trips associated with the proposed residential and commercial/industrial/retail (employment) land uses was maintained. For the residential land uses this derived split was 35/65, so 65% of all trips were predicted to be internal to Bath. For the employment uses 44% of trip attractions were predicted to be from origins within the city; with the remaining 56% expected to travel from outside Bath; and
- Critically the same 'adjusted' modal splits estimated by Mott MacDonald for internal and external trips to/from the EA were used. These adjustments were applied to take account of the effect of Strategy measures, or to reflect model shift trends seen in the 2001-2011 Census data (Journey to Work). Slightly different mode splits were used for residential and employment trips, whilst these were also varied by EA Sector. However, within these Sectors the mode split applied to retail/industrial and commercial land uses was the same.

3.2.2 Traffic Distribution

Following dialogue between Mott MacDonald and B&NES officers the agreed distribution of external traffic to different approach routes was as follows:

- A4 East/A46: 23%;
- A4 West: 30%;
- A36: 10%;
- A367: 16%;
- Lansdown Road/Lansdown Lane: 13%; and
- A431: 3%.

This was duly adopted in the EA matrices developed for the S-Paramics models. For internal vehicular trips within Bath to/from the EA the following 'sector' split was used for distribution purposes. This was again based on census analyses done previously by Mott MacDonald:

- Central area: 14%;

- North Bath: 19%;
- West Bath: 33%;
- SE Bath: 3%; and
- SW Bath: 31%.

3.3 Revised Land Use Schedule

The proposed type and quantum of development in each EA Sector with the Revised Land Use Schedule (RLUS) is set out in Table 3.1 below. The estimated internal/external vehicle trip arrivals/departures for each sub-sector in each of the modelled hours are included in **Appendix B**.

Table 3.1 Enterprise Area: RLUS - Proposed Development by Sub-Sector/Zone

Revised Land Use Schedule					
Sub-Sector	**Site**	**GFA sqm**	**Dwellings No**	**Use Class**	**Use Description**
1a	Manvers Street	1456		A3	Restaurants and cafés
1a	Manvers Street	7077		B1	Offices
1a	Manvers Street	6480		C1	Hotels
1a	Manvers Street		74	C3(a)	Residential
1b	Cattle-market	1745		A3	Restaurants and cafés
1b	Cattle-market site	2080		C1	Hotels
1b	Cattle-market site		54	C3(a)	Residential
2a	Green Park Station West	7271		B1	Offices
2a	Green Park Station West	31786		A1	Shops
2a	Green Park Station West	405		A3	Restaurants and cafés
2a	Green Park Station West	1432		A1F	Supermarket
2a	Green Park Station West		446	C3(a)	Residential
2b	Green Park Station East	3152		A1	Shops
2b	Green Park Station East	12160		B1	Offices
2b	Green Park Station East	596		A3	Restaurants and cafés
2b	Green Park Station East		103	C3(a)	Residential
2c	North Quays	3935		B1	Offices
2c	North Quays	2036		A3	Restaurants and cafés
2c	North Quays	7762		C1	Hotels
2c	North Quays	3993		B1B	Innovation / workspace
2c	North Quays		70	C3(a)	Residential
3a	South Quays	427		A3	Restaurants and cafés
3a	South Quays	7625		B1	Offices
3a	South Quays	8985		B1B	Innovation / workspace
3b	South Bank	21752		B1	Offices
3b	South Bank	964		A3	Restaurants and cafés

3b	South Bank		61	C3(a)	Residential
5a	Bath Press	23659		B1B	Innovation/Workspace – Business Park
5a	Bath Press		88	C3(a)	Residential
5b	BWR Crest Phase 1 (secured)		240	C3(a)	Residential
5b	BWR Crest Phase 2 (un secured)		1982	C3(a)	Residential
7	Roseberry Place	681		A3	Restaurants and cafés
7	Roseberry Place	4207		A1	Shops
7	Roseberry Place		408	C3(a)	Residential

All residential development was defined as flats, with 65% privately owned and 35% rented.

The resultant mode splits for associated two-way trips in the 7:00-10:00am and 3:00-7:00pm weekday periods with the Mott MacDonald assumptions are shown in Table 3.2 below.

Table 3.2 Enterprise Area: RLUS - Mode Split of Two-Way Trips by Time Period

Mode	7:00-10:00am		3:00-7:00pm	
	Percent (%)	ABS	Percent (%)	ABS
Car Driver	21.1	2.392	22.3	4,641
Car Passenger	4.2	484	4.4	904
Walk	35.3	3,989	35.0	7,274
Rail	13.8	1,556	13.9	2,878
Bus	17.1	1.931	16.0	3.322
Cycle	7.1	804	7.2	1,485
Motorcycle	1.0	114	1.0	212
Other	0.2	27	0.3	55
TOTAL	100	11,297	100	20,771

The outcome of the work using the agreed Mott MacDonald person trip rates for the different development types and assumed mode splits for internal and external trips shows that 'car driver' is only expected to account for circa 20% of EA trips in both periods. By way of comparison the 2011 Census 'Journey to Work' data for trips to the City Centre from Wards within Bath showed that car driver trips equated to 20.8% then, down from 23.4% in 2001. Whilst what is predicted for the EA is thus similar it should be remembered that these figures account for all trips, both internal and external to Bath. As such, it might have been expected that the car driver mode share overall might be higher. However, it should be noted that any assumed 'Park and Ride' users are included within the 'bus' mode and not a car driver.

The assumed no of EA trips using either rail or 'Park and Ride' was an important consideration in determining the potential for these modes to reduce existing vehicle traffic in these periods in the future. In the work provided by Mott MacDonald it was assumed that 400 EA trips would use Park and Ride sites around the city in the 8:00-9:00am hour, and the same number between 5:00-6:00pm. The predicted vehicle generation profiles between 7:00-10:00am and 3:00-7:00pm were thus used to estimate the expected EA users in the other hours, as well as the observed arrival/profiles observed at

the existing Park and Ride sites at Newbridge, Odd Down and Lansdown. The resultant expanded estimates of EA 'Park and Ride' trips in the 7:00-10:00am and 3:00-7:00pm periods were 955 and 1,174 vehicles respectively. The assumed external trip distribution for the EA was used to assign these relative demands to the three existing sites and a new site to the 'East of Bath' proposed by the Transport Strategy.

3.4 Original Land Use Strategy

The proposed type and quantum of development in each EA Sector with the Original Land Use Schedule (OLUS) is set out in Table 3.3 below. Details of the expected hourly traffic generations are again provided in Appendix B.

Table 3.3 Enterprise Area: OLUS - Proposed Development by Sub-Sector/Zone

Revised Land Use Schedule					
Sub-Sector	**Site**	**GFA sqm**	**Dwellings No**	**Use Class**	**Use Description**
1a	Manvers Street Phase 1 (Council)	7000		B1	Offices
1a	Manvers Street Phase 2 (Police)	3000		B1	Offices
1a	Manvers Street Phase 3 (Royal Mail)	12000		B1	Offices
1a	Manvers Street Phase 3 (Royal Mail)		30	C3(a)	Residential
1b	Cattle-market	4200		A1	Shops
1b	Cattle-market	700		A3	Restaurants and cafés
1b	Cattle-market	9500		B1	Offices
1b	Cattle-market	2080		C1	Hotels
1b	Cattle-market		81	C3(a)	Residential
2a	Green Park Station Phase 2 North		97	C3(a)	Residential
2b	Green Park Station Phase 1 South Site	1100		B1	Offices
2b	Green Park Station Phase 1 South Site	7900		A1	Shops
2c	North Quays Phase 1 Car Park	17000		B1	Offices
2c	North Quays Phase 1 Car Park	3000		A3	Restaurants and cafés
2c	North Quays Phase 2 Coach Park	14000		B1	Offices
2c	North Quays Phase 1 Car Park		90	C3(a)	Residential

2c	North Quays Phase 2 Coach Park		60	C3(a)	Residential
3b	South Bank Phase 3 Eastern Site	4600		B1	Offices
3b	South Bank Phase 2 Central Site	8150		B1	Offices
3b	South Bank Phase 2 Central Site	1500		A3	Restaurants and cafés
3b	South Bank Phase 3 Eastern Site		65	C3(a)	Residential
3b	South Bank Phase 1 Western Site		150	C3(a)	Residential
3b	South Bank Phase 2 Central Site		65	C3(a)	Residential
5a	Bath Press	7400		B1	Offices
5a	Bath Press	6300		A1	Shops
5b	BWR Crest Phase 1 (secured)		240	C3(a)	Residential
5b	BWR Crest Phase 2 (un secured)		1982	C3(a)	Residential
5b	BWR East Phase 1 North Site		220	C3(a)	Residential
5b	BWR East Phase 2 South Site		350	C3(a)	Residential
5b	BWR East Phase 1 North Site	6000		A1F	Supermarket
5b	BWR East Phase 2 South Site	3500		B1	Offices
7	Stable Yard Phase 1 South Site	2000		B1	Offices
7	Stable Yard Phase 1 South Site	2200		A1	Shops
7	Stable Yard Phase 2 South Site		95	C3(a)	Residential
8	Herman Miller Building (south)	4600		A1F	Supermarket
9	Carrs Mill Phase 1 East Site		50	C3(a)	Residential
9	Carrs Mill Phase 2 Central Site		50	C3(a)	Residential

9	Carrs Mill Phase 2 Western Site		10	C3(a)	Residential

Tabl3 3.4 below sets out the overall mode split in the two modelled periods with the latest Mott MacDonald assumptions based on 2011 Census data and expected effects of the Transport Strategy.

Table 3.4 Enterprise Area: OLUS - Mode Split of Two-Way Trips by Time Period

Mode	7:00-10:00am		3:00-7:00pm	
	Percent (%)	ABS	Percent (%)	ABS
Car Driver	20.8	2.510	21.9	4643
Car Passenger	4.3	520	4.3	909
Walk	35.2	4,260	35.4	7503
Rail	13.8	1,674	13.8	2928
Bus	17.5	2,117	16.1	3423
Cycle	7.1	863	7.2	1523
Motorcycle	1.0	118	1.0	214
Other	0.2	28	0.3	56
TOTAL	100	12.090	100	21199

Whilst the overall number of person trips predicted is marginally higher than the RLUS, the number of car driver or vehicle trips is practically identical. Again, an overall car driver mode share of only circa 20% for all trips made to/from the EA developments is possibly optimistic, even allowing for the 'bus' component including Park and Ride trips which are arguably trips made as a car driver at origin.

SECTION 4

Transport Strategy Effects

4.1 Existing Car Trip Reductions

4.1.1 General

Given the existing peak period congestion which occurs in Bath it was considered highly probable that Strategy interventions would need to be successful in achieving a level of existing car trip reduction of similar magnitude to the expected net increase in traffic expected with the overall EA developments. Previous work using the S-Paramics models showed, not expectedly, that the network would not be able to cope with a large increase in traffic demand. In view of this the work undertaken to assess the potential existing car trip abstraction to other modes in the future formed a critical step of the S-Paramics modelling work. This section of the report explains the rationale used in estimating the 'reductions' applied to account for expected mode transfers to Park and Ride, rail and walking and cycling.

4.1.2 Park and Ride

Making greater provision for and encouraging the use of Park and Ride is a key objective of the Transport Strategy. In terms of enhanced capacity provision the following assumptions were made:

- The provision of a new Park and Ride to the 'East of bath' with a parking capacity of 1600 spaces;
- Further expansion of the Odd Down Park and Ride site beyond the recently completed Bath Transport Package (BTP) change. The BTP proposals increased the capacity of the site to 1,230 spaces. A further expansion of 300 spaces to 1530 was assumed in the analyses undertaken as part of this work;
- Further expansion of the Lansdown Park and Ride site beyond the recently completed Bath Transport Package (BTP) change. The BTP proposals increased the capacity of the site to 880 spaces. A further expansion of 300 spaces to 1180 was assumed in the analyses undertaken as part of this work;
- No change to the current proposed number of spaces with the BTP at the Newbridge Park and Ride site. When the BTP works are completed the capacity here will be 750 spaces. However the original proposal to create 1000 spaces at this site was blocked by a Village Green application which was upheld. In view of this the possibility of expanding the site further in the future was considered questionable and so this was not assumed.

The methodology used to estimate the potential increase in vehicle trips possible at each site in the 7:00-10:00am and 3:00-7:00pm period was as follows:

- Entry and exit count data for a 'typical' weekday was obtained for the existing Park and Ride sites at Odd Down, Lansdown and Newbridge. This was used to build up a parking accumulation profile for each of these existing sites. In all cases the maximum accumulation was less than the current maximum parking capacities;
- Assuming the 'same' profiles, factors were calculated to uplift the entry/exit flows at each site so that peak accumulation matched the parking capacity in each case, allowing for assumed expansions in capacities at current sites where applicable. In the case of the new 'East of Bath' site the profile observed at Odd Down was deemed to be a suitable proxy for estimating the hourly entry and exit flows here; and
- The changes in the entry and exit flows seen in the 7:00-10:00am and 3:00-7:00pm periods were used to estimate the maximum potential abstraction possible in the two periods at each site, and hence the car trips reductions possible on the different corridors served by each.

The existing and projected entry/exit flow profiles for the Odd Down, Lansdown and Newbridge Park and Ride sites are included in **Appendix C**, as is the predicted profile for the 'East of Bath' site assuming typical accumulation was to 'peak' at the assumed maximum parking capacity of 1600 spaces. The two-way trip growth potential of the four sites in the 7:00-10:00am and 3:00-7:00pm periods is summarised in Table 4.1 below.

Table 4.1 Park and Ride Spare Capacity: Assume Fill to MAX Accumulation

Park and Ride Site	Potential Two-Way Car Trip Growth - Abstraction		Spaces Assumed
	7:00-10:00am	3:00-7:00pm	
Odd Down	569	702	1530: 300 further spaces assumed beyond recent BTP Expansion
Newbridge	300	325	750: Proposed with BTP Expansion: No change with Strategy
Lansdown	515	713	1180: 300 further spaces assumed beyond recent BTP Expansion
'East of Bath'	1314	1621	1600 spaces as advised
TOTAL	**2698**	**3361**	

As mentioned previously, in determining the 'net' capacity available to abstract existing car traffic off the central area road network it was necessary to know how many EA trips were predicted to make use of Park and Ride and thus reduce this spare capacity. It is estimated EA usage would account for 955 arrivals in the 7:00-10:00am period and 1,174 departures over the 3:00-7:00pm period. Based on the above site capacities the potential for existing car trip reduction across all sites is 1,743 vehicles between 7:00-10:00am and 2,187 vehicles between 3:00-7:00pm. It should be noted that this assumes that typical maximum accumulation would reach capacity at all sites at some point, which existing profiles suggest would be late morning to early afternoon. As such, there would be in-built 'reserve' to cater for demand in busier periods such as the run up to Christmas. This is something B&NES may need to consider in determining the actual future capacities desirable at all sites.

4.1.3 Rail Patronage Growth

To estimate the effect that expected changes in rail patronage could have on existing car use boarding/alighting surveys carried out at Bath Spa and Oldfield Park in November 2013 were used as a starting point. Critically, this gave the number of passengers currently either boarding or alighting trains at the two Bath stations in the periods 7:00-10:00am and 3:00-10:00pm. The historic growth rate/annum at the 'Bath' stations combined over the period 2004/2005 to 2011/2012 has been +6.4%/annum. The growth rates per annum through to 2024 have been established in other rail study work being done for the Bristol authorities, and using +6.4% as the 2013 base-line gives the following growth figures:

- 2013: 6.4%;
- 2024: 5.7%;
- 2015: 5.0%;
- 2016: 4.4%;
- 2017: 3.7%;
- 2018: 3.0%;
- 2019: 3.0%;

- 2020: 2.9%;
- 2021: 2.7%;
- 2022: 2.5%;
- 2023: 2.3%; and
- 2024: 2.2%.

The latter assume electrification of the Great Western Main Line (GWML), and locally the completion of the Bristol Metro Phases 1 and 2. These rates have been applied to the 2013 data for Bath Spa and Oldfield Park to derive the compound growth in patronage expected. The calculated increases in boarding/alighting passengers at Bath Spa and Oldfield Park are shown in Table 4.2 below.

Table 4.2 Predicted Rail Patronage Changes: Bath Spa/Oldfield Park – 2013 to 2024

Station	7:00-10:00am		3:00-7:00pm	
	Boarding	Alighting	Boarding	Alighting
Bath Spa	701	1246	2036	1311
Oldfield Park	190	55	62	179
TOTAL	891	1301	2098	1490

Assuming all new rail trips are 'abstracted' from either existing car driver, car passenger or bus trips the potential former car driver component of new 'boarding' trips at the two stations would be circa 87%. This was based on Mott MacDonald 2011 mode share estimates of 67.4% car driver, 5.6% car passenger and 4.5% Bus for 'Live in Bath-Work External'. Similarly, for 'alighting' trips the former potential car driver component was estimated to be 83%. This was based on the Mott MacDonald 2011 mode share estimates of 73.1% car driver, 6.5% car passenger and 8.5% Bus for 'Work in Bath-Live External'. Using the above percentages the potential 'maximum' existing car trip reduction would be 1,855 trips between 7:00-10:00am and up to 3,061 trips between 3:00-7:00pm.

However, the above patronage increases needed to take account of rail demand expected with the EA. As such, predicted EA rail trips had to be deducted from the above before making any rail related reduction to the existing S-Paramics light vehicle (LV) matrices for the two periods. As an example, the RLUS is expected to result in a net increase of 1,556 rail trips between 7:00-10:00am and 2,878 additional rail trips between 3:00-7:00pm. Taking these into account it was found that the possible rail related reduction to the existing LV matrices was in fact quite small, despite the large expected change in patronage expected over the period 2013-2024. In short, the high rail mode share predicted for the EA will be effective in taking up most of the expected growth in patronage at Bath Spa and Oldfield Park over the period considered.

4.1.4 Walking and Cycling

2011 Census data for trips within Bath (INT) to the central area provided by B&NES was used to estimate how much increased walking and cycling could affect existing car-trips. Growth trends in 2001-2011 Census information additionally provided by Mott MacDonald was used to project forward 10 years to 2024. Looking at the data and trend over the last 10 years suggested that:

- By 2024 walking and cycling trips 'Journey to Work' trips from Bath INT to the centre can be expected to increase by 1140. The 2001 and 2011 census data revealed a proportional change of +37% and +16% in the cycling and walking mode shares, although the absolute changes in the overall share for these modes were +1.5% and +7.3%;
- The increases in walking/cycling seen in the last 10 years, and thus projected forward, were not associated with a drop in car driver use of anywhere near the same magnitude. The figures show

instead that local bus usage for internal trips has showed a decline (-24.4%) over the period 2001-2011, and trip making as a car passenger also reduced (-26.5%). In contract the car mode share over the same period reduced from 23.4% in 2001 to 20.8% in 2011, a proportional change of only -11.1%;

- Applying a car driver reduction to the existing LV matrices due to walking/cycling effects therefore justified removing about 300 trips from the 7:00-10:00am LV matrix (Inbound) and the same number outbound in the 3:00-7:00pm period.

The projected 2001-2011 data for Bath INT to 'Centre' work trips showed that 'car driver' would still be expected to account for around 18% of trips in 2024. In contrast the EA mode split used by Mott MacDonald for INT trips predicts a 'car driver/taxi' share of circa 9.5%.

4.2 Overview

The analyses suggest that the combined impact of rail patronage growth, Park and Ride changes and walking/cycling effects could reduce existing car driver trips by circa 2,400 over the 7:00-10:00am period and around 3,000 trips over the 3:00-7:00pm period by 2024. This is based on the reasoned calculations made for all mode shifts assumed, whilst allowing for the expected increased demand for Park and Ride and rail use generated by the proposed EA land uses. This in a sense sets a rough upper limit on the allowable 'net' increase in traffic which proposed land uses within the EA area might be expected to generate. To avoid a significant increase in highway operating problems within the area of interest the mode shift reductions to existing car trips achieved by the Transport Strategy would ideally balance the 'net' traffic increase expected with the EA development mix, or nearly so.

The estimated 'net' traffic increases predicted by the RLUS and OLUS in Chapter 3 suggests that this 'balance' is achievable in the weekday 7:00-10:00am, but that the expected traffic increase in the 3:00-7:00pm period is likely to out-weigh the mode shift reduction in existing car use possible. This is certainly the situation modelled in testing the RLUS and OLUS scenarios.

SECTION 5

EA - Place-Making Plan Option Variants

5.1 General

Further to the S-Paramics testing of the RLUS and OLUS options the Planning team at B&NES issued a further three Place-Making Plan (PMP) options for the EA. The Schedules supplied showing the new land uses and extant/existing uses removed is included in **Appendix D**. Specific commentary on the options and any differences in the applied S-Paramics modelling compared to the RLUS and OLUS tests is given in the following sections.

The resultant 'net' traffic generation with each option by hour over the 7:00-10:00am and 3:00-7:00pm periods is included in **Appendix E.**

5.2 Option 1a

The Option 1a schedule provided is described as the "*Enterprise Area Master-plan and optimistic about Sainsbury's intentions at Green Park*". A key difference with this land use scenario compared to the RLUS and OLUS is the treatment of the existing Sainsbury's food store on the existing Green Park East site. The Schedule indicates that:

- Green Park East 'losses' show the removal of 4,960sqm of food retail, which although not specifically stated was assumed to be the existing Sainsbury's free standing unit; and
- Green Park West includes 12,000sqm of food retail. Whilst some of this may be small unit it was assumed that this was largely associated with a considerably expanded free standing store operated by Sainsburys. We are aware of a past aspiration by Sainsburys to relocate to a new store on the existing Homebase site.

In the 2013 base-line S-Paramics model the Stanier Road access to the Pines Way gyratory is specifically represented by Zone 10. The current traffic assigned to this zone and counted in the May 2012 surveys would have been predominantly existing food store users, but it was recognised this could also include access traffic to Homebase, the small industrial estate on the south side of Stanier Road and other drivers making use of the Sainburys car park for short duration trips into the City Centre. The 'losses' shown for Green Park West suggest that the Homebase store and the existing industrial estate are included, so with the removal of the present food-store as well it would have been possible to simply remove all the current traffic assigned to Zone 10 to reflect this. However to do and this and use Mott MacDonald person trip rates for a new food store of this size was considered the wrong approach, namely because the subsequent model split assumptions universally applied to the new commercial/retail uses would have resulted in a very low car driver share for this food-store. As such, it was elected to 'adjust' Zone 10 using separate TRICS assessments to get suitable 'vehicle' trip rates. Table 5.1 shows the comparative traffic generation for a 4,960sqm and 12,000sqm food-store.

Table 5.1 Green Park - Expanded Food Store Traffic Generation: Comparison

Time Period	VEH Trip Rate/100sqm GFA		Existing Food-Store: 4,960sqm		New Food-Store: 12,000sqm	
	IN	OUT	IN	OUT	IN	OUT
7:00-8:00am	1.306	0.796	65	40	157	96
8:00-9:00am	2.297	1.782	114	89	276	214
9:00-10:00am	4.514	2.539	224	126	542	305
TOTAL: 7:00-10:00am	**8.117**	**5.117**	**403**	**254**	**974**	**614**
3:00-4:00pm	4.353	4.643	216	231	522	557

4:00-5:00pm	4.418	4.493	219	223	530	539
5:00-6:00pm	4.514	4.734	224	235	542	568
6:00-7:00pm	4.390	4.508	218	224	527	541
TOTAL: 3:00-7:00pm	**17.675**	**18.378**	**878**	**913**	**2,121**	**2,205**

The table shows that the expected two way trip generation with the existing store would be 657 two-way vehicle trips between 7:00-10:00am and 1,791 trips between 3:00-7:00pm. The actual two-way trip totals for Stanier Road (Zone 10) in the 'Base' 2013 S-Paramics models were 1,150 and 2,848 in the two periods. As expected both counts were higher than the generation expected with the food-store alone. As the other 'attractors' generating most of the additional traffic in the count would also be lost under Option 1a, the Zone 10 arrival and departure totals were simply adjusted to reflect that associated with an expanded 12,000sqm food-store. In the 7:00-10:00am the predicted net change was an increase of only 438 two-way vehicle movements, but in the 3:00-7:00pm period the expected change modelled was a two-way increase of circa 1,500 trips.

When examining the impact of a new food-store the expected trip generation would normally undergo a further stage of analysis to estimate pass-by, diverted and new vehicle trips on the highway network. In the case of the work undertaken with Option 1a no allowance was made for any pass-by component in the additional traffic attracted by the larger food-store. With regard to 'diverted' trips the net effect on the highway network considered in the S-Paramics model would depend on the location of the competing stores where customers were formerly shopping. A retail impact study would generally be used to estimate the 'pull' from existing food-stores, and so in this case could be used to identify those vehicle trips already present within the S-Paramics model matrices, and those currently routing wholly outside the area. In the absence of this information a 'worst case' assumption was made in that no compensating reductions were made to trips to Waitrose and Morrison's to account for diversion from these stores.

Other differences in the application of the S-Paramics modelling to Option 1a were as follows:

- Adjustments were made to certain zones within the City Centre to account for identified development changes outside the EA sectors identified in the RLUS and OLUS work. An example is the 10,000sqm, 177 bedroom hotel proposed on the existing Kingsmead House site, and the associated loss of 4,500sqm of current office space. Another is the identified 107 bedroom Premier Inn and the allied loss of 1,250sqm of retail floor-space; and
- Identified development changes in South Bank were not included in the S-Paramics model as the Schedule notes state that *"South Bank is assumed to come forward beyond 2029 so its totals need to be deleted for Plan period data purposes"*.

Other than the modelling of the much larger food-store on Green Park West, the person trip rates for different land use types and the assumed mode splits for internal/external trips used the same values derived by Mott MacDonald in the RLUS and OLUS scenario testing. The quantum of development on the BWR site was also deemed to be the same as that in the RLUS and OLUS scenarios. This was included within EA Sector 5 in the latter scenarios, but is excluded from the Option 1a schedule.

5.3 Option 2a

The Option 2a schedule provided is described as "*Compact and Continuous Primary Shopping Area & less optimistic about Green Park East and West*". With this scenario there is no proposed change to the location of the existing Sainsburys food-store in Green Park East, so the required changes to the trip generation methodology adopted for the RLUS and OLUS tests to specifically assess Option 1a was not required.

The key differences from Option 1a are the developments proposed on the Green Park West and Green Park East sites. With regard to the former there is little change in the overall 'net' floor-space, with the Sainburys food store remaining in its current location and a 2,000sqm loss in office space offset by a small extension to the size of the food store (800sqm) and 34 new residential units (3,000sqm). By far the biggest changes are on the Green Park West site with 'net' floor-space proposed to increase by 61,800sqm. Whilst similar in quantum to Option 1a it includes in this case 27,500sqm of new office accommodation, but no food-store on this site and a lower volume of complimentary retail.

As before, the same Mott MacDonald person trips rates and subsequent modal split assumptions were used to generate the net 7:00-10:00am and 3:00-7:00pm vehicle traffic matrices and hourly profiles.

5.4 Option 3a

Option 3a results is an overall 'net' floor-space change in the EA which lies between Options 1a and 2a. It is described as a "*Balanced approach and still less optimistic about Green Park East and West*". Like Option 2a it assumes no change in the location of the existing Sainburys food-store, but a modest extension of the facility as before. In overall terms there is a net reduction in development on the Green Park East site.

The development on the Green Park West site is in this case more mixed, with a lower quantum of office development than Option 2a but an increased amount of complementary and A3 retail. The number of residential dwellings proposed on this land remains similar to that envisaged with both Options 1a and 2a.

SECTION 6

Scenario Testing and Results

6.1 Scenario Tests

The following scenario tests were undertaken with references as follows:

- Scenario 2024 EA1: Do Minimum network with 'committed' highway improvements but the Pines Gate changes excluded as well as specific modelling of the BWR East-West link road. Revised Land Use Schedule (RLUS) proposals and 'net' traffic generation modelled.
- Scenario 2024 EA2: Do Minimum network with 'committed' highway improvements and the Pines Gate changes. Specific modelling of the BWR East-West link road excluded. Revised Land Use Schedule (RLUS) proposals and 'net' traffic generation modelled;
- Scenario 2024 EA3: Do Minimum network with 'committed' highway improvements but the Pines Gate changes excluded as well as specific modelling of the BWR East-West link road. Original Land Use Schedule (OLUS) proposals and 'net' traffic generation modelled;
- Scenario 2024 EA4: Do Minimum network with 'committed' highway improvements and the Pines Gate changes. Specific modelling of the BWR East-West link road excluded. Original Land Use Schedule (OLUS) proposals and 'net' traffic generation modelled;
- Scenario 2024 EA5: Do Minimum network with 'committed' highway improvements including specific modelling of the BWR East-West link road, but the Pines Gate changes excluded. Revised Land Use Schedule (RLUS) proposals and 'net' traffic generation modelled;
- Scenario 2024 EA6: Do Minimum network with 'committed' highway improvements including specific modelling of the BWR East-West link road and the Pines Gate changes. Revised Land Use Schedule (RLUS) proposals and 'net' traffic generation modelled;
- Scenario 2024 EA7: Do Minimum network with 'committed' highway improvements including specific modelling of the BWR East-West link road, but the Pines Gate changes excluded. PMP Option 1a land use proposals and 'net' traffic generation modelled;
- Scenario 2024 EA8: Do Minimum network with 'committed' highway improvements including specific modelling of the BWR East-West link road and the Pines Gate changes. PMP Option 1a land use proposals and 'net' traffic generation modelled;
- Scenario 2024 EA9: Do Minimum network with 'committed' highway improvements including specific modelling of the BWR East-West link road, but the Pines Gate changes excluded. PMP Option 2a land use proposals and 'net' traffic generation modelled;
- Scenario 2024 EA10: Do Minimum network with 'committed' highway improvements including specific modelling of the BWR East-West link road and the Pines Gate changes. PMP Option 2a land use proposals and 'net' traffic generation modelled
- Scenario 2024 EA11: Do Minimum network with 'committed' highway improvements including specific modelling of the BWR East-West link road, but the Pines Gate changes excluded. PMP Option 3a land use proposals and 'net' traffic generation modelled; and
- Scenario 2024 EA12: Do Minimum network with 'committed' highway improvements including specific modelling of the BWR East-West link road and the Pines Gate changes. PMP Option 3a land use proposals and 'net' traffic generation modelled

In all cases reductions to the existing (2013) light vehicle matrices were made to account for increased use of Park and Ride, expected growth in rail patronage and increases in walking and cycling. As explained earlier in this report, the expected effect of the EA itself on rail patronage growth and

increased use of Park and Ride was taken into account in determining the degree to which these modes could contribute to reducing existing car driver trips in the future.

6.2 Comparisons Made

In order to assess the relative highway network impact of each of the EA land use options a series of comparisons have been made using the extensive outputs produced by S-Paramics. For each option test 30 'seed' runs or iterations were undertaken for the two model periods, and results from these averaged. The results obtained are included in **Appendices F to H** as follows:

6.2.1 Global Network Statistics

Global network statistics for the entire 7:00-10:00am and 3:00-7:00pm simulated time periods are shown in **Appendix F** for each of the EA scenario tests. The comparative information provided in the tables for the two periods show:

- Mean network delay and speed. The delay value is the mean delay per vehicle in seconds over the whole simulation period at the end of the simulation, whilst the speed given is the cumulative mean speed in miles per hour for all vehicles at the end of the simulation period;
- The total cumulative distance travelled;
- The number of vehicles 'entering' the S-Paramics network over the course of each period, the number of vehicles completing journeys through the network and, critically, the number of vehicles still present in the network at the end of the period. The latter will always include some vehicles in transit but, where substantial change is seen, this will be due to increased congestion resulting in additional queuing traffic unable to clear the network;
- The network demand, which in the total vehicle demand in the 7:00-10:00am or 3:00-7:00pm matrices for a given scenario. Changes relative to the 2013 base in each case show the degree to which existing traffic reductions made to account to Transport Strategy measures are likely to be effective in balancing out the 'net' traffic increase expected with different EA land use mixes. In addition a comparison of this figure with the number of vehicles entering the network in the same scenario gives an indication of 'unsatisfied demand'. A noticeable difference indicates queuing out of the network or within internal zones; and
- No of 'lock-Ups'. This was assessed by looking at the numbers of vehicles in the network over time for all 30 'seed' runs. Under normal 'peak' operation this shows a typical peak profile, with the number of vehicles rising with congestion and then falling. In contrast, a continuous cumulative rise in the number of vehicles occupying the network will be seen where 'grid-lock' occurs preventing exit.

6.2.2 Journey Times on Selected Routes and Sections

Appendix G contains **c**omparative mean journey times on selected journey time routes through the model area in seconds between 8:00-9:00am and 5:00-6:00pm. The specific routes used for assessment were as follows:

- Route 1: A36 Eastbound - A4/36 Twerton Fork to Warminster Road;
- Route 2: A36 Westbound - Warminster Road to A4/A36 Twerton Fork;
- Route 3: A4 Eastbound - A4/36 Twerton Fork to A46 Interchange;
- Route 4: A4 Westbound – A46 Interchange to A4/A36 Twerton Fork;
- Route 5: 'Cross City Centre Northbound' A367 Wellsway to Monmouth Street; via Green Park Road;
- Route 6: 'Cross City Centre Southbound' Monmouth Street to A367 Wellsway; via Green Park Road;

- Route 7: 'Cross City Centre Eastbound' Midland Bridge Road to North Parade; via Green Park Road and Dorchester Street;
- Route 8: 'Cross City Centre Westbound' North Parade to Midland Bridge Road, via Dorchester Street and Green Park Road;
- Route 9: Bathwick Street northbound - Sydney Place to London Road; and
- Route 10: Bathwick Street southbound - London Road to Sydney Place.

These were the same routes used for validating the 2013 'base' models to the same time periods.

6.2.3 Mean Speed Plots

These plots are provided for each scenario including the 2013 'base' for the periods 8:00-9:00am and 5:00-6:00pm in **Appendix H**. These show all links where the mean speed over the periods considered are <15mph. As the mean speeds tend to near zero the band widths shown are larger and the associated colour redder. For mean speeds on links closer to 15mph the band widths will be narrow with the intensity of colour diminishing to a pale yellow. The plots provide a useful graphical way of identifying the congestion 'hotspots' expected on the network in the two 'peak' hours, and also the extent of congestion expected.

6.3 Analysis of Results

6.3.1 Revised Land Use Schedule

The commentary here is confined to the RLUS scenario tests with the BWR East-West link road in place, but with the Pines Way gyratory either retained or the Pine Gate changes made (EA5 and EA6). As indicated in Table 3.2 earlier and Appendix B, the expected 'net' traffic increase of the EA alone is expected to be 2,392 vehicles between 7:00-10:00am and 4,641 vehicles over the period 3:00-7:00pm. The global network statistics in Appendix F show the effect of the Transport Strategy reductions in 'balancing out' this increase, with the overall change for the 2013 'base' predicted to be negligible in the 7:00-10:00am period but +1,727 vehicles between 3:00-7:00pm. So, as previously indicated the maximum possible reduction of existing car trips considered possible in the critical 3:00-7:00pm period is circa 3,000, or in this case 2,914 vehicle trips. In consequence the effect of the RLUS would result in net traffic growth of 4.1% in the 3:00-7:00pm weekday period.

Not unexpectedly the overall global network statistics for the RLUS show very little difference from the 2013 base in the 7:00-10:00am period. This is because, although distribution patterns will have altered slightly, the overall volume of traffic which the network is required to accommodate is unchanged. In other words, it is probable that existing traffic reductions possible with increased use of Park and Ride in particular could be effective in 'cancelling' out any 'net' traffic generation increase associated with the RLUS.

In the 3:00-7:00pm period the global network statistics again show that the overall network would be able to cope, despite the addition of 1,727 two-way vehicle trips over this four hour period. The number of vehicles still present on the network at 7:00pm is similar to be 2013 'base', with the number of journeys completed in the scenarios with and without the Pines Gate changes (EA5 and EA6) rising by about 1700-1800 trips. The latter is roughly equivalent to the additional demand, showing that the network would be able to pass this level of additional vehicular traffic over the period considered.

Notwithstanding the global network figures examination of the mean speed plots and route journey times for the EA5 and EA6 scenarios does show some change from the 2013 base. The principal differences are as follows:

- In the 8:00-9:00am period the westbound congestion on the A4 London Road is reduced, which is reflected in a reduced journey time on Route 4 'A4 - A46 to Twerton Fork'. This is due to traffic reductions applied to allow for the effect of the new 'East of Bath' Park and Ride site. In this time period the 'reduction' effect of the new Park and Ride facility on inbound traffic outweighs the effect

of any additional westbound traffic generated by the EA on this section of the A4. In contrast to this the westbound congestion here worsens in the weekday 5:00-:00pm period. This is because the effect of increased EA traffic is greater than the reduction effect of the new Park and Ride on inbound traffic at this time of day. As such, the predicted Route 4 journey time is noticeably higher than the existing, with the plots showing congestion leading to mean speeds <15mph extending back to the A46 interchange;

- In the 8:00-9:00am period the RLUS leads to increased congestion on the A367 Wellsway and Brougham Hayes approaches to the A36 with the Pines Way gyratory unchanged. With the Pines Gate changes in place this queuing and delay is brought back to base-line levels, but it is noticeable that there is a greater degree of congestion along the length of the A36 between the Windsor Bridge Road and Midland Bridge Road junctions;
- In the weekday 5:00-6:00pm period the northbound congestion on Bathwick Street is considerably reduced, with the predicted journey time on this route section showing a considerable delay saving with both scenarios EA5 an EA6. This again reflects the potential impact of the 'East of Bath' park and ride site, which in this period will serve to draw more outbound traffic off the London Road corridor than the EA is expected to generate; and
- In both peak hours there is predicted congestion along the BWR East-West link route between the junction with the A36 west of Midland Road and the existing connection to Pines Way. This is discussed in more depth in discussing PMP Option 1a, as more detailed turning flow analyses done to inform the Pines Gate proposals (IMA) have been undertaken for this variant. However, the key finding is the high likelihood of 'rat-running' along this residential route by non-residential traffic accessing the Green Park West and East areas.

6.4 Original Land Use Schedule

The detailed findings with the Original Land Use Schedule (Scenarios EA3 and EA4) are little different to the above. The overall net change in network traffic is practically identical to the RLUS in both time periods, with the increased traffic effect of the OLUS effectively cancelled out by expected existing vehicle trip reductions in the 7:00-10:00am period, but circa 1,770 higher in the 3:00-7:00pm period. As can be seen from the global network outputs, the effects show no marked deterioration in conditions relative to the 2013 base. As the OLUS represents in effect a base-line set of land-use assumptions which have now been largely super-ceded by the RLUS and PMP variants no further discussion/interpretation of the results is made in this report.

6.5 Place-Making Plan: Option 1a

The global outputs statistics for Option 1a (Scenarios EA7 and EA8) and the mean speed 'network congestion' plots give some cause for concern over the potential highway operating impact of these land use proposals. As explained earlier in this report the key difference with this option is the very large 12,000sqm GFA food-store envisaged on the Green Park West site. Although the existing Sainsburys food-store on the Green Park East site is deemed 'removed, an 'effective' free-standing food-store expansion of this magnitude will have a noticeable 'local' traffic impact on the whole of the Pines Gate area and surrounding roads. The TRICS work done to estimate the additional vehicle generation effect of a 12,000sqm GFA facility suggests this could be 1,500 two-ways trips in the 3:00-7:00pm period as explained earlier.

The effect of this is seen in the EA vehicle matrices for Option 1a in Appendix E, and the overall increase in demand seen in the global outputs. The latter shows the overall 'net' traffic demand increase in the 7:00-10:00am and 3:00-7:00pm periods rising to 300 and 3,189 vehicles respectively. As expected, it is the latter period where highway network operating conditions are expected to break down. This equates to traffic growth of circa 7.5% over this period.

The global statistics for the 3:00-7:00pm scenario with Option 1a provide a number of indicators which show that an unacceptable impact on the highway network would be created. These are as follows:

- The number of vehicles still 'in transit' on the network at the close of the simulation (7:00pm) is 2,267 vehicles (EA7) and 2,004 vehicles (E8), when compared with 1,282 vehicles in the 2013 base. Whilst there is higher demand with EA7 and EA8 the difference in the flow entering the network in the final minute of the simulation would not be materially different, so the fact that there is a 700-1000 increase in the number of vehicles still 'in transit' is a very clear indication of a lot of additional congestion and delay;
- A comparison of the 'demand' with the total number of vehicles entering the S-Paramics network over the modelled period shows a shortfall of nearly 1000 vehicles in scenario EA7 with the Pines way gyratory retained, but still nearly 600 with the replacement Pines Gate changes in place (EA8). The measure of total vehicles entering is generally recorded at the start of the final minute of the simulation, so some difference with demand would be expected. However, differences of this magnitude point to traffic queuing off the network either at external entries to the network or within 'internal' zones;
- A number of 'lock-up' runs occurred, testifying to the instability of the network in this period with the level of 'excess' demand created with Option 1a.

Examination of the 5:00-6:00pm mean speed plots for scenarios EA7 and EA8 show how much worse the network congestion gets in terms of 'hot spots' and general extent, particularly with Scenario EA7.

6.6 Place Making Plan: Option 2a

Option 2a produces 'net' traffic increases of -563 and +513 vehicles on the highway in the 7:00-10:00am and 3:00-7:00pm, so much lower than PMP Option 1a and indeed lower than both the RLUS and OLUS EA options. Appendix E shows that the expected 'net' traffic demand with this EA variant is 1,964 vehicles between 7:00-10:00am and 3,819 vehicles between 3:00-7:00pm, this using the same Mott MacDonald person trip rate for different land uses and subsequently applied mode splits. The 'net' changes overall show that applied reductions to existing traffic to account for Park and Ride, rail and walking/cycling transfers accounted for 2,527 car trips between 7:00-10:00am and 3,306 car trips between 3:00-7:00pm. Note that these are higher than the RLUS for example, as the EA takes up less of the expected rail patronage growth.

The global output statistics show that the EA9 and EA10 scenario tests with PMP Option 2a reveal the same level of network performance as the 2013 base. In other words, there is not predicted to be any material worsening of highway operating conditions. In terms of changes in congestion in the 8:00-9:00am and 5:00-6:00pm periods the mean speed plots for scenarios EA9 and EA10 show similar patterns to those previously described for the RLUS. As before, changes along Bathwick Street and the A4 London Road are more related to the 'reduction' effects in existing traffic possible with a proposed 'East of Bath' park and ride site in place, as opposed to any differential effects of this PMP land use option for the EA.

6.7 Place Making Plan: Option 3a

Option 3a produces 'net' traffic increases of -379 and +1,028 vehicles on the highway in the 7:00-10:00am and 3:00-7:00pm, so again much lower than PMP Option 1a and still lower than both the RLUS and OLUS EA options. Appendix E shows that the expected 'net' traffic demand with this EA variant is 2,063 vehicles between 7:00-10:00am and 3,934 vehicles between 3:00-7:00pm. Not unexpectedly, the global network statistics for scenarios EA11 and EA12 do not reveal any adverse operational highway impacts when compared with the respective 2013 base results for each time period. As with the RLUS, OLUS and PMP Option 2a tests the mean speed plots show that the additional 'hot spot' congestion will be local to the A36 between Windsor Bridge Road and Churchill Bridge gyratory, notably the A367 Wellsway and Brougham Hayes approaches in scenario EA11.

SECTION 7

Summary and Conclusions

7.1 Summary

This report has described the testing of various proposed land use mix scenarios being examined for the Enterprise Area (EA) in Bath. These scenarios have included options entitled the 'Revised Land Use Schedule' (RLUS), the 'Original Land Use Schedule' (OLUS) and three latter options terms Place-Making Plan (PMP) options 1a, 2a and 3a. The person trip rates for various land uses and applied mode splits are based on the work undertaken by Mott MacDonald for B&NES. The only deviation from this approach has been in the vehicle trip generation for the large food-store proposed on the Green Park West site in PMP Option 1a.

The S-Paramics network used for assessment includes a number of 'committed' highway improvements, or schemes completed since November 2013, which is the date of the current base model calibration/ validation. In addition to this, aspirational highway changes taking out the existing A36 Pines Way gyratory have been included as a 'sensitivity test' with all the EA land use variants considered. The potential operating impacts on the BWR east-west link road through the site have also been considered in testing, insofar as this could act as a 'rat-run for 'through' or non-residential access traffic seeking to avoid congestion on the parallel length of the A36 Lower Bristol Road. The high concentration of development aspired to on the Green Park West and Green Park Easts within the EA area makes this an extremely likely outcome.

The modelling undertaken using S-Paramics has also needed to consider what impact the Bath Transport Strategy could have in reducing existing car traffic in the central area and along the principal A4 and A36 corridors through Bath; or indeed what it will 'need' to achieve to accommodate the EA developments. Previous work using the S-Paramics models has shown, not expectedly, that the network would not be able to cope with a large increase in traffic demand. In view of this the work undertaken to assess the potential existing car trip abstraction to other modes in the future formed a critical step of the S-Paramics modelling work. This work has included consideration of expanded Park and Ride provision around Bath, the effect of expected rail patronage growth and the likely effect of further increases in walking and cycling. In estimating the potential reductions in existing car trips achievable with enhanced rail and park and ride provision it was also necessary to take into account expected use of these modes by people travelling to or from the EA developments. As such, capacity estimated as 'surplus' was adjusted down as necessary to account for EA user take-up. The following assumptions/method was used in assessing the possible 'reduction' effect of the different non-car modes:

- Park and Ride: Existing and 'maximum' accumulation and entry/exit profiles were used to assess the capacity for additional traffic abstraction between 7:00-10:00am and 3:00-7:00pm. The analyses assumed the provision of a new 'East of Bath' site with a parking capacity of 1600 spaces. In addition, the capacities at the existing Odd Down and Lansdown were assumed to be further expanded by a further 300 spaces over the recent BTP improvements. No change at Newbridge beyond the 750 space provision with the BTP changes was assumed;
- Rail: November 2013 boarding/alighting counts at Bath Spa and Oldfield Park were used to obtain existing patronage in the 7:00-10:00am and 3:00-7:00pm periods. Growth estimates based on historic trends over the period 2004/5 to 2011/12 and projections done for the Bristol Metro were used to forecast patronage changes expected by 2024. The growth forecasts used assumed electrification of the GWML and the completion of Phases 1 and 2 of the Bristol Metro; and
- Walking/Cycling: 2011 Census data for trips within Bath (INT) to the central area provided by B&NES was used to estimate how much increased walking and cycling could affect existing car-trips. Growth trends in 2001-2011 Census information additionally provided by Mott MacDonald was used to project forward 10 years to 2024. Although both modes showed a good proportional increase over the period 2001-2011 the absolute change in the mode share for each has been more modest.

Furthermore, the associated reductions in mode share over this period have been more to 'car passenger' and 'bus user' rather than 'car driver'. The latter fell from 23.4% in 2001 to 20.8% in 2011. Note that the latter is roughly double what the assumed driver mode share is assumed to be for 'internal to Bath' trips to/from the EA developments.

A series of outputs have been used to evaluate the potential highway impact of the various EA land use scenarios. The global outputs statistics provide a good 'at a glance' measure of operating performance relative to the base-line, which for comparison has been the validated and calibrated 2013 base models for the weekday 7:00-10:00am and 3:00-7:00pm periods. Plots showing all links where the mean speed is <15mph between 8:00-9:00am and 5:00-6:00pm have additionally been used to identify any changes in 'hot spits', or worsened extent of congestion. As previously stated, the 'net' traffic generation for the EA development mix in each case in based on trip rates and mode split assumptions arising from previous work done by Mott MacDonald for B&NES. We have not sought to change or challenge any of the assumptions made or rates applied in undertaking the detailed S-Paramics model analyses. However, we would draw attention to the circa 20% car driver mode share predicted for all external/internal trips to the EA. This seems quite optimistic when the 2011 Census shows that 'car driver' journey to work trips from within Bath to the central area account for this level of share alone.

7.2 Conclusions

The analyses show very clearly that the level of existing car trips reduction achieved by the Bath Transport Strategy will need to balance or cancel out any expected 'net' increase in traffic generated by the proposed developments or 'nearly so'. The existing network within Bath is congested now in the weekday 7:00-10:00am and 3:00-7:00pm periods, and whilst some 'committed' or 'currently under construction' highway schemes are included in the EA tests none of these will radically alter the network capacity. As the EA is expected to take up a large proportion of the expected rail patronage change projected, it is clear that enhanced park and ride around the city will be an absolutely essential requirement which the Transport Strategy will need to deliver.

Whilst modest expansions assumed to the existing capacities at the Odd Down and Lansdown sites will clearly contribute, the largest potential for car trip abstraction will be a site to the 'East of Bath'. In all the EA tests undertaken the potential reductions to existing traffic achievable on the A4 London Road and Bathwick Street with this proposed facility in places give positive decongestion benefits to this part of the network. This is because the existing traffic reduction effect is likely to outweigh any increased traffic impact on this corridor due to the EA developments. The results suggest that the operation of the highway network is likely to be severely compromised if development in the EA proceeds apace, but the implementation of a new park and ride site on the east site of Bath is unavoidably delayed due to continuing uncertainty over the actual location, or as a result of this not built at all. In master-planning terms the 'ideal' would be to restrict and phase development in the EA to align with the programmed delivery of the Transport Strategy initiatives necessary to achieve the parallel reduction in existing car traffic. However, the absence of a confirmed site for the 'East of Bath' park and ride, and thus delivery programme, would make it difficult to constrain the EA developments in this way. Furthermore, it is noted that a high number of trips to the EA developments are predicted to use rail, but the rail capacity enhancements necessary to achieve this are outside the direct control of B&NES

The expected 'net' traffic increases of the various EA development options in the two periods are shown in Table 7.1 below, together with the overall network effect with the existing traffic 'reductions' applied to account for car driver mode shift to park and ride, rail, walking and cycling.

Table 7.1 Overall Changes in Predicted Traffic with EA Scenarios/Transport Strategy Measures

EA Land Use Mix	7:00-10:00am		3:00-7:00pm	
	EA 'Net' Traffic Generation	Overall Network Change with Existing Car Trip Reductions	EA 'Net' Traffic Generation	Overall Network Change with Existing Car Trip Reductions
RLUS	+2,392	-15	+4,641	+1,727
OLUS	+2,510	+168	+4,643	+1,767
PMP Option 1a	+2,772	+314	+6,358	+3,188
PMP Option 2a	+1,964	-563	+3,819	+513
PMP Option 3a	+2,063	-379	+3,934	+1,028

The results show that the weekday 3:00-7:00pm period will be the critical one in determining what level of development is acceptable in the EA. All the land use scenarios are expected to create an overall increase in the volume of traffic using the highway network in this period, irrespective of the effect of Transport Strategy measures in reducing existing car traffic. However, the results discussed in Chapter 6 show clearly that the magnitude of the expected increase with PMP Option 1a would not be operationally acceptable in highway terms; which would in effect create a 7.5% increase in the overall traffic volume over this period. In contrast, the results obtained with the RLUS and OLUS scenarios show that existing operating conditions could largely be maintained at current levels. Although the EA developments and the reductions achievable to existing trips with strategy measures can be expected to change the overall routing patterns within the area, the results do not reveal markedly worsened congestion. Indeed, the effect of the 'East of Bath' park and ride is predicted to result in improved westbound operating conditions on the A4 London Road between 8:00-9:00am and noticeably reduced delays on Bathwick Street between 5:00-6:00pm irrespective of the EA development mix.

The RLUS results in overall traffic growth of circa 4% between 3:00-7:00pm, so it very clear from the work undertaken that there is a very fine balance to be achieved in limiting the overall change in the volume of traffic using the network in this period.

Provided this overall increase is limited, more detailed examination of the S-Paramics model runs suggests that highway operation is not overly sensitive to discrete changes in the assumed development mix within the different EA plots. The exception to this, however, is the very large food-store within the Green Park West site in PMP Option 1a. However, the mean speed plots done for the 8:00-9:00am and 5:00-6:00pm periods consistently show that the length of the A36 between Windsor Bridge Road and the Churchill gyratory will be busier, with the Brougham Hayes junction a particular 'hot spot'. More detailed examination of the peak hour traffic flows obtained with Option 1a to inform the work on the Pines Gate changes strongly suggests that the east-west link road through the BWR site will be used by drivers as a through route to access the Green Park West and Green Park East areas from the A36 (W). With the Pines Gate changes as currently proposed the main access is via the Pine Gate West junction, which is predicted to experience congestion/delay on the access arm in particular. As a result, the east-west link road through the BWR site will tend to be used as a route to avoid this.