

Arbury Camp.  
Proposed changes to the Highway.  
Stage 2 Safety Audit Report.  
Jan-Feb 2004

**Note:**

**Given the extent of the proposals around Arbury Camp the report has been split into areas 1,2,4,5 and 6. These areas coincide with those on the WSP sheet layout drawing no. 134.**

**Appendix 1 shows the approximate extents of these areas.**

**(Note: there is no report 3 as there are no works proposed in this area)**

## **Contents**

Page 2	Introduction
Page 5	Report on Area 1: Histon interchange and slip roads.
Page 9	Report on Area 2: Kings Hedges Road, Cambridge Road area.
Page 14	Report on Area 3: Histon Road: No longer part the proposals.
Page 15	Report on Area 4: Kings Hedges Road, western end. Including Arbury Road junction.
Page 22	Report on Area 5: Kings Hedges Road, east of Arbury Road.
Page 26	Report on Area 6: Kings Hedges Road, eastern end of the site.
Page 30	Report section 7: Items relevant to all areas.
Page 32	Signed Audit team statement.

### **Appendices:**

Appendix 1: Location plan for areas 1 to 6 as referred to above.

Appendix 2: Drawing issue sheets, detailing plan information issued for audit.

# **CAMBRIDGESHIRE COUNTY COUNCIL**

## **ACCIDENT INVESTIGATION TEAM**

### **SAFETY AUDIT STAGE 2**

**SCHEME:**                    **Highway Works Arbury Camp  
Improvement of existing highway and  
installation of new signalised junctions.**

#### **Introduction**

The Audit was carried out at the request of Jeremy Smith, Senior transport officer, Transport Development and Assessment.

The terms of reference of the audit are as described in HD 19/03. The audit has examined and reported only on the road safety implications of the scheme as presented and has not examined or verified the compliance of the designs to any other criteria or design standards. Design standards are quoted only where those standards have road safety implications.

All comments and recommendations are referenced to the detailed design drawings specified above.

Note: any dissemination of this report is strictly prohibited unless otherwise expressly agreed in writing. Information from it should not be released unless by prior agreement between the author and the requester.

**Date of Report:**            **7<sup>th</sup> January 2004**

**Audit Team:**                **Malcolm Mugridge (Team Leader)  
Amanda Mays  
Russell de Ville  
Drew Wallace and Malcolm Witham (Signals)**

**Daytime site visits:**

8.30am 8<sup>th</sup> January 2004

Attending:...Amanda Mays, Malcolm Mugridge.

Conditions at visit:

Weather: Cold and rainy.

Traffic: Morning Peak, traffic queued onto A14 from slip road.

11.00am 28<sup>th</sup> January 2004

Attending:...Amanda Mays

Conditions at visit:

Weather: Cold with around 2 inches of snow. Road surface gritted/wet.

Traffic: Free flowing steady traffic..

### **Information Supplied:**

Drawings:

WSP Project no. 11110588/IF1

Drawings supplied as per **appendix 2** (drawing and report issue and schedule sheets.)

Additional Information:

Transport Assessment Reports for the Junctions off Kings Hedges Road (13<sup>th</sup> December 2001) and revised analysis report (11<sup>th</sup> February 2003).

**The information supplied is substantially complete. However there are still a few noticeable drawing errors and some basic concept issues to be resolved. (e.g. whether the right turn into Arbury Camp will be permitted at the Arbury road crossroads.)**

**Therefore we would not consider this report to be complete and final until the designer's response has been received and assessed.**

### **Technical audit.**

As stated above this audit reflects only on the safety issues raised by the submitted design. The Cambridgeshire County Council (CCC) signals team will produce a technical audit of the signals design.

The phasing and staging of the signals will play an important part in the safe operation of the junctions. There fore this report should be taken in conjunction with the technical report.

### **Notified Departures from Standard**

None notified

### **Scheme outline: Whole Site**

This report refers to the Highway works appertaining to the development of Arbury Camp. The roads affected are Kings Hedges Road from Northfield Avenue to the junction with Cambridge Road, Cambridge Road up to the A14 Interchange, and the westbound slip road from the A14.

The main proposals are:

Widening of the A14 slip road and Cambridge Road to allow for additional lanes. Improvements to the signal operation and pedestrian facilities around the A14 Interchange, the junction of Cambridge Road and Kings Hedges Road and Arbury Road and Kings Hedges Road.

2 new signalised junctions and a bus only access will be constructed into the site off Kings Hedges Road.

Pelican crossings are proposed across Kings Hedges Road near Howgate Road, and Buchan Street.

The most prominent features of the proposals are the installation of new traffic signals and the alteration of existing signal controlled junction.

**The county policy regarding new signals installation is as follows:**

*New installations must be designed in accordance with current British Standards, Advice Notes and regulations. New installations shall incorporate pedestrian and cycle facilities as far as is practical.*

### **Items Raised at Stage 1 Audit**

Stage 1 audits were carried out on the initial concepts of the proposals in February/March 2003. The design has been moved on significantly since these reports. Therefore no issues will be formally carried forward from those audits, where similar issues arise these will be dealt with in the stage 2 audit reports.

## Items Raised from this Audit:

### **B1. Area 1 (coincident with are shown on WSP sheet 1)**

Area 1: Encompasses the A14/ Histon Road interchange, the westbound A14 slip road and the northernmost section of Histon Road.

Area 1: The main proposals are widening of A14 exit slip road, and Histon Road Southbound. Physical and signal changes to signalised roundabout (Histon Interchange).

The speed limit on Histon Road is to be reduced to 40mph, the circulatory carriageway and slip road will remain derestricted.

#### **Existing Injury Accident Details in Area 1:**

The roundabout is identified on the 2003 county accident site list.

There have been 25 personal injury accidents since January 1998.

Rear end shunts are the most common type of accident (13 of the 25 are shunts). Since high friction surfacing was installed on the county road in the summer of 2001 the number of shunt type accidents has been greatly reduced.

3 of the accidents have involved cyclists, and 2 motorcyclists, which is just below the county average for occurrence of these types of incident.

Incidences of accidents in the dark, wet, and involving skidding are also all below the county averages.

The proportion of serious and fatal incidents is currently around half the county average, with only 2 of the 25 accidents resulting in serious injuries.

There is also group of 5 accidents on the start of the slip road on the A14. 3 of these are Shunt type accidents, with one single vehicle loss of control and one due to changing lanes suddenly.

### **Road Signs and Markings**

#### **B1.1 PROBLEM (area1)**

The schedule indicates that sign AD-2-1 is to be mounted on 1 post and 1 lamp column. This may exceed the recommended wind loading for a lamp column, increasing the risk of damage to the sign and column.

#### **RECOMMENDATION**

Ensure wind loading is not exceeded and use an additional post if required.

#### **B1.2 PROBLEM (area1)**

Approach speeds up the slip road from the A14 will be relatively high in clear conditions and vehicles may obscure the direction arrows when traffic is queuing.

Clear advance signing about lane discipline is essential to help drivers make early choices and reduce weaving.

**RECOMMENDATION**

Install additional signing at the start of the slip road showing the correct lane choices and destinations, with directional arrow markings to reinforce the message.

Additionally 'Get in lane' signs could be used.

**B1.3 PROBLEM (area1)**

The existing road markings around the roundabout are simple lane markings. These do not help right turning vehicles to 'move out' from the inner lane to the outer one, and some interesting weaving manoeuvres have been seen. The short sides of the circulatory carriageway in particular give very little distance to move across safely.

**RECOMMENDATION**

Spiral or partial spiral markings might be used to help drivers make the manoeuvre in the appropriate location.

**Lighting and Signals**

**B1.4 PROBLEM (area1)**

The junction is already signalised although it does not currently have 'MOVA' optimisation. It generally operates quite well for most of the day. However the morning peak often sees queues down the slip road onto the A14. Only a few of the injury accidents occur in the morning peak as vehicles speeds are low, damage only accidents are reportedly common at these times.

**RECOMMENDATION**

Changes to signals should aim to reduce uneven queuing, especially back onto the Main A14 carriageway.

A good PSV aggregate should be used in the surface course to provide adequate skidding resistance, with antiskid surfacing on the immediate approach to all the stop lines.

**B1.5 PROBLEM (area1)**

There have been accidents involving cyclists at the top of the slip roads here, both on the carriageway and at the off road crossings. The relatively short intergreen times are a likely contributory factor in these incidents.

**RECOMMENDATION**

A slight increase in the all red phase would reduce the risk of cyclists crossing the top of the slip road being hit by the starting traffic. The benefit will be to both cyclists on the circulatory carriageway and those crossing the slip road from the off road cycletrack.

The feasibility of this recommendation should be discussed with the CCC signals team. A short term trial could be used to assess the impact on the operation of the junction.

**B1.6 COMMENT (area1)**

Currently the signals operate on a part time basis (12hr) but this is to be increased to 24hr operation.

Investigations of the accident records have indicated that 24hr operation might help to reduce accident numbers/severity here. The report recommends red reversion when the signals are full time.

**B1.7 PROBLEM (area1)**

The lighting and safety barrier are shown on separate drawings. This makes it difficult to ascertain the exact relative positions.

**RECOMMENDATION**

Ensure that no lamp columns are installed in front of safety barrier.

**Facilities for Vulnerable Road Users**

**B1.8 PROBLEM (area1)**

The footway/cycleway will be between the carriageway and the safety barrier. If a vehicle were to lose control in this area, it might prevent the vehicle going down the embankment, however it would direct the vehicle along the footway at speed. The potential injury if any cyclists and pedestrians happened to be using the route could be very serious. It will also direct the driver into any signs or posts between the barrier and the carriageway. This increases the risk of injury for the vehicle occupants and could put debris on the carriageway.

**RECOMMENDATION**

The safest solution would be to install the safety barrier between the carriageway and the cycle track, with a bund, fence or other barrier between the embankment and the cycleway. However it is noted that checks on visibility and feasibility would need to be carried out.

Whatever solution is used, there must be no signposts or lamp columns in front of the safety barrier.

**B1.9 PROBLEM (area1)**

New dropped kerbs with tactile blister are shown at the cycleway crossings across the westbound exit and entry slip roads.

**RECOMMENDATION**

Dropped kerbs at all such crossing points should be flush with no more than 6mm upstand.

**B1.10 COMMENT (area1)**

Where pedestrian crossings have dropped kerbs and tactile 'blister' paving, the standard throughout the city is to install white ballotini blocks between the kerb and the blister slabs.

This increases the conspicuity at night and also for the partially sighted. Using this detail here would give consistency of design with the rest of the city.

**Landscaping**

**B1.11 PROBLEM (area1)**

There appears to be a half metre strip between the carriageway and the cycleway. There is no annotation showing what surface is to be used. Grass verge has been suggested in other recent schemes submitted for audit. This would be difficult to maintain (especially alongside the signalised roundabout and would leave a soft strip alongside the cycleway.

**RECOMMENDATION**

Avoid narrow strips of verge. If possible separate the cycleway from the carriageway as recommended in B1.8

Alternatively the 0.5m separation strip could be simply delineated using a broken line or hatching in white thermoplastic. 50mm wide broken lines have been used at other sites in the county to highlight cycle ways. This method also gives improved perception of the edges of the path at night.

## **B2 Area 2 (coincident with are shown on WSP sheet 2)**

Scheme outline:

Area 2: Encompasses Histon Road south of the A14 interchange, the signalised junction of Kings Hedges Road with Histon Road, and the reopened gated access to the west of Histon Road. This section of Histon road is subject to a 40mph limit, and 30mph in Kings Hedges Road.

Area 2: Main proposals are: Widening of Histon Road Southbound, and changes to layout and signals at Histon Road / Kings Hedges Road Junction (referenced junction 2). Also changes to the existing gated access south west of the junction.

### **Existing Injury Accident Details (Where applicable):**

The junction identified on the 2003 county accident site list.

There have been 11 personal injury accidents since 1<sup>st</sup> January 1998. 10 of these were slight injury, with only 1 resulting in serious injury.

Two wheeled vehicles feature highly in the statistics:

4 (36%) have involved pedal cycles and 3 (27%) motorcycles, this is double the county average for pedal cycles and three times that for motorcycles.

All the incidents have occurred between 6am and 6pm, with 5 (45.5%) between 8am and 9am (morning peak).

### **General**

#### **B2.1 PROBLEM(area2)**

The left only lane on the southbound approach to junction 2 develops over quite a distance. Cyclists, mopeds and other small slow vehicles wanting to go straight on are at greater risk in this area as there is no clear correct line marked for them, and drivers may be moving across towards the left or right without indication.

It is noted that the off road facilities being provided will reduce the number of cyclists using the carriageway though the junction. However, fast and confident cyclists may still choose to stay on road.

#### **RECOMMENDATION**

Keeping the 'weaving' section as short as possible reduces the length of time exposed to the higher risk. The correct route for cycles going straight ahead could also be highlighted using an advisory cycle lane with direction arrows.

### **Junctions**

#### **B2.2 PROBLEM(area2)**

The proposed widening near the junction leading to Old Cambridge Road will give an extremely wide carriageway area.

It scales at roughly 17.6m. Approximate arrangement west to east: 1.2m cycle lane, 4.8m northbound lane, 4.2m RTF, 2x 3m southbound lanes, 1.2m cycle lane

The northbound lane is starting to develop into 3 lanes and the 2 southbound lanes are merging into a single lane. The arrangement is very wide and quite confusing. The diverging and converging movements may lead to more aggressive drivers using the ghost island right turn facility to overtake.

This side road is currently gated and accesses a very small number of properties. It is unclear why the right turn facility is needed at all, and also why it appears to be around 20% wider than standard.

#### RECOMMENDATION

Revisit the layout of this junction and determine whether the Right turn facility is required or whether other changes could be made to reduce the width and complexity.

### Road Signs and Markings

#### B2.3 PROBLEM(area2)

There are no cycle reservoir/ advance stop lines shown at any of the signalised junctions. At junction 2 this could be especially problematic for cyclists due to the huge area of the junction. If a cyclist is still crossing the junction when the next stage goes to green they are at great risk.

It is noted that the off road facilities being provided will reduce the number of cyclists using the carriageway through the junction. However, fast and confident cyclists may still choose to stay on road.

#### RECOMMENDATION

If possible install advance reservoirs, as this will help cyclists to get across the junction area within the signal cycle. This may not be appropriate at all arms of every junction, discuss the details with CCC signals team.

### Lighting and Signals

#### B2.4 PROBLEM(area2)

The stop line for northbound traffic at junction 2 is set around 20m back from the end of the splitter island. One effect will be to increase the time taken for vehicles to cross the junction from the stop line (increasing inter-green time and therefore driver frustration).

Other possible effects could be that drivers will deliberately ignore the stop line and wait in the area ahead of the stop line or in heavy traffic when queues may move forward slowly, drivers may find themselves stranded in this area. These 2 situations are likely to be relatively minor safety issues unless the secondary signal head at the north end of the island is not working. However once a driver is past the stop line they are technically no longer subject to signal control. This could lead to a small minority of drivers proceeding into the junction when they perceive a gap, given the size and complexity of the layout an error in judgement could easily be made.

#### RECOMMENDATION

The simplest solution would be to move the stop line forward. However there may be other appropriate solutions, and any changes should be discussed with the CCC signals team.

**B2.5 PROBLEM(area2)**

The lighting and bridge parapet/safety barrier are shown on separate drawings. This makes it difficult to ascertain the exact relative positions. Note: although the junction will slow traffic to some extent this section of road is subject to a 40mph limit.

**RECOMMENDATION**

Ensure that no lamp columns are installed in front of safety barrier. This may difficult where the parapet wall is concerned, but any signs and lamp columns should be located away from sections where vehicles may be guided towards impact with them.

**B2.6 PROBLEM(area2)**

The extended splitter islands at the northern and eastern arms of junction 2 leave a relatively small gap for traffic turning right into Kings Hedges Road. As the westbound side of the side road is 3 lanes wide there is a risk of vehicles mistakenly turning into the westbound lane.

**RECOMMENDATION**

Make the correct route very clear. Marking a line through the junction to guide traffic into the correct route would do this quite simply. Installing no entry signs or additional flag type signs could also be used to guide drivers, but adding 'sign clutter' to the junction could increase confusion and would provide more items to collide with in the event of a vehicle mounting the island.

**B2.7 PROBLEM(area2)**

There are a number of overhead electricity cables over the junction of Kings Hedges Road and Cambridge Road. The layout changes will lead to the relocation or replacement of existing, and installation of additional columns and signal poles.

It can be difficult to judge the height of cables from the ground and at high voltages arcing can occur across a significant distance (up to 7.5m in certain conditions.).

**RECOMMENDATION**

The design must ensure that no tall items intrude into the 'safety zone' as recommended by EDF Energy. Safe installation and maintenance must also be considered.

**Facilities for Vulnerable Road Users**

**B2.8 (area2)COMMENT**

Where pedestrian crossings have dropped kerbs and tactile 'blister' paving, the standard throughout the city is to install white ballotini blocks between the kerb and the blister slabs.

This increases the conspicuity at night and also for the partially sighted.

**B2.9 PROBLEM(area2)**

The 3 stage pedestrian crossing route across Cambridge Road is staggered to ensure that pedestrians face the traffic at the most important points. However those crossing the dedicated left turn lane from west to east will have their back to the approaching vehicles. Given the complexity of the 3 separate stages there is a risk, especially in the early weeks before people get used to the change, of people failing to look behind and/or assuming priority over both streams of southbound traffic.

**RECOMMENDATION**

Installing a 'LOOK LEFT' marking on the carriageway along the dropped kerb at this point would highlight the need to be aware of oncoming traffic from this direction.

Additionally nearside 'green man' displays could be used, and 'wait for the green man' signs could be installed to ensure pedestrians are aware that this lane is separately controlled.

**B2.10 PROBLEM (area2)**

Junction 2 has shared use cycle facilities on all sides.

'Cyclists Dismount' signs are widely ignored by cyclists in Cambridge, so it is likely that many people will simply cycle across regardless.

**RECOMMENDATION**

Toucan crossings might be more appropriate here than pedestrian only, as the 2 cycle facilities are split by the road.. This option should be discussed with the CCC Signals Team.

**B2.11 PROBLEM(area2)**

The off road cycle lane on the south side of Kings Hedges Road ends just before the junction. Cyclists heading south down Cambridge (Histon) Road are being asked to rejoin the main carriageway and cycle with the left turning traffic.

It is noted that the left hand lane will be bus lane right up to the stop line, which will mean vehicle numbers are likely to be low, but they may be quite large with limited turning circles. Also the left hand lane around the corner in Cambridge Road is not a dedicated bus lane.

Some cyclists will chose to continue around the corner on the footway, either to avoid the conflict point or to miss the red light signal. This path does not appear to be wide enough for safe shared use.

**RECOMMENDATION**

Extend the cycleway round the corner a little way, so that it rejoins the main on carriageway cycle lane away from the turning vehicles. Give way markings should be installed at the dropped kerb where the path rejoins as there may be southbound cycles using the on road cycle lane.

### **Protective Aids**

#### **B2.12 PROBLEM(area2)**

There are no guardrails shown at the staggered crossing points.

#### **RECOMMENDATION**

Install guardrail to current guidelines. If there is a risk of reduced visibility between drivers and pedestrians, use 'Visirail' or similar.

### **Surface Characteristics**

#### **B2.13 PROBLEM(area2)**

The B1049 Approaches to Junction2 currently have high friction surfacing. The construction details' drawing does not show any antiskid on the approaches. This item will be especially important as pedestrian facilities are to be provided in the new layout.

#### **RECOMMENDATION**

Install high friction surfacing on all approaches. This should extend to the stop line where there is no pedestrian provision and to the stud line where they are provided.

**B3 Area 3 (coincident with are shown on WSP sheet 2)**

This area no longer required.

**B4. Area 4 (coincident with are shown on WSP sheet 4)**

**Scheme Outline**

Area 4: Encompasses the western end of Kings Hedges Road, covering the new entry access into Arbury Camp and the signalised crossroads at Arbury Road. This section of Kings Hedges Road is subject to a 30mph limit.

Area 4: Main proposals are: A westbound bus lane/priority measures. Pelican Crossing across Kings Hedges Road, an entry only 'bus?' lane into Arbury camp (referenced junction 3). The existing T junction at Arbury road will become a crossroads, this junction will be fully signalised with traffic islands to split and channel traffic (referenced junction 4).

**Existing Injury Accident Details (Where applicable):**

The Arbury Road Junction is identified on the 2003 county accident site list. There have been 7 injury accidents at the junction since January 1998 (6 slight and 1 serious injury).

The incidents have generally been shunts (3 out of 7) or drivers disobeying the signals (2 out of 7).

The only other outstanding factor is that almost 60% (4 out of 7) have occurred in the wet compared to the county average of 37%.

**General**

**B4.1 PROBLEM (area4)**

Short stretches of Bus Lane, especially where there are left turns are often abused by other drivers.

Right turns into the side roads may also bring traffic into conflict with moving buses and cycles when traffic is queuing in the main running lane. (e.g. Howgate Road)

**RECOMMENDATION**

Do not use short lengths of bus lane, and where possible avoid bus lanes altogether on the immediate nearside approach to junctions.

**B4.2 PROBLEM (area4)**

The island in Arbury Road protrudes quite a way into the junction. Drivers who purposefully or in error find themselves in the left lane wishing to go straight on, or simply driving around vehicles waiting to turn right into Arbury Camp risk collision with the island.

**RECOMMENDATION**

If the right turn is to be permitted clearly indicate using road markings where vehicles turning right into Arbury camp should wait, so that they do not obstruct the vehicles behind wishing to go straight ahead.

The island could be shortened to minimise the risk of collision. However this could increase the number of drivers deliberately using the left hand lane to pass other vehicles before the one lane section. Ensure the island has good visibility especially from the eastern side, using illuminated bollards and retro reflective material.

## Junctions

### B4.3 PROBLEM (area4)

Between Junction 3 and the pelican crossing there is a short gap of around 60m between the central reserve islands. There do not appear to be any markings or signs to indicate that drivers should not overtake or turn right at this point.

#### RECOMMENDATION

Investigate whether the gap could be closed physically.

As a minimum install signs or markings to clarify the situation.

There are a range of features that could be used: e.g. Solid white lines, sweep arrows, hatching, red infill, no right turn signs et al. The choice will depend on expected flows bus activity etc.

### B4.4 PROBLEM (area4)

Just to the east of junction 3 there is a similar situation to that noted in B4.2. There do not appear to be any markings or signs to indicate that drivers should not overtake or turn right at this point.

It is noted that ultimately this is the point proposed for the Rapid Transit System buses to transfer between the Guideway and the Highway. However in the short term the problems noted in B4.2 will apply.

#### RECOMMENDATION

Investigate whether a temporary physical separation could be used.

As a minimum install signs or markings to clarify the situation.

There are a range of features that could be used: e.g. Solid white lines, sweep arrows, hatching, red infill, no right turn signs et al. The choice will depend on expected flows bus activity etc.

## Road Signs and Markings

### B4.5 PROBLEM(area4)

The hatched tapers on the approaches to some of the islands lead into the kerb rather than past them. Extending the lines around the island would lead the drivers eye past the kerbs reducing the risk of clipping them with a wheel. It also serves to visually reduce the width of carriageway.

#### RECOMMENDATION

Take the lines around the islands, especially on the approach side.

### B4.6 PROBLEM (area4)

The sign mounting height for signs such as AD-3-2 over the cycleway is given as 2.150m; this is lower than the recommended minimum over cycleways.

The posts also appear to restrict the width of the path.

#### RECOMMENDATION

The recommended mounting height over cycle ways is 2.7m. Where this cannot be achieved 2.4m is considered the minimum.

Ideally posts should be installed outside the line of the cycletrack.

B4.7 PROBLEM (area4)

Sign RS-3-7 appears to have the wrong sign face. It is shown as dia. 962. this indicates a bus lane at the junction ahead.

RECOMMENDATION

Install the correct sign. This is likely to be dia. 958 Bus (or bus/cycle) lane ahead.

B4.8 PROBLEM (area4)

Around junction 3 the signs and markings drawing does not show any hatch markings in the tapers and between the central islands. This is likely to be a drawing error, but there is a risk that if left unamended it could be installed incorrectly.

RECOMMENDATION

Add hatching as appropriate to drawing 11110588/1204.

B4.9 PROBLEM (area4)

There is no indication of how vehicles will be prevented from entering the one-way section (junction 3) from the development end.

RECOMMENDATION

No entry signs, markings and/or physical barriers must be used at the end of the one-way section.

B4.10 PROBLEM (area4)

The splitter islands and 2 lane approaches to junction 4 give a large layout that could be confusing for some drivers.

The directional and no entry signs appear to direct the driver quite well, and additional sign clutter may simply lead to more confusion.

The greatest problem appears to be for drivers turning right from the north arm to the west arm. Unfamiliar drivers may take a line towards one of the oncoming lanes, this may lead to sudden steering as they realise their error. At worst they may try to exit along the eastbound lane.

RECOMMENDATION

Installing a guide line indicating the correct path from the north to the west would help drivers to take the correct line through the junction.

This solution should only be applied to one route, as too many lines would simply add to the confusion.

B4.11 PROBLEM (area4)

At junction 4, the right hand lane on the exit from Arbury Camp shows an ahead and right arrow at the approach to the stop line, then a right turn only arrow at the mouth of the junction. This is confusing and could lead to lane changing between the stop line and the junction (approx 30m).

RECOMMENDATION

Match the 2 sets of markings to give a consistent message. Making both show right turn only would be safer as the signalised junction of St Catharine's Road is only around 30m from junction 4, and 2 lanes of straight ahead traffic would increase lane changing on this approach.

**B4.12 PROBLEM (area4)**

The location for Sign AD-4-2 is shown only around 45m from the stop lines. The 4 lanes of traffic have already started to develop which gives drivers very little time to react, choose the correct lane, indicate and manoeuvre safely, even when forward visibility to the sign is good.

**RECOMMENDATION**

Install the ADS and lane discipline sign in advance of the start of the dedicated lanes.

**Lighting and Signals**

**B4.13 PROBLEM (area4)**

The lighting arrangement around the crossing as shown on the drawings does not appear to provide suitable illumination for safe use by pedestrians at night, as the columns are both on one side, giving uneven illumination.

BS5489 recommends normal lighting levels around crossings. However the columns should be sited symmetrically on each exit side of the crossing to provide uniform lighting levels beyond the crossing. In this location where there will be approaching headlights and other extraneous lighting the levels given in BS5489 may not be sufficient for safety.

**RECOMMENDATION**

There is no single solution to the lighting of a pedestrian crossing as exact positioning depends upon all the site parameters. A street lighting engineer should carry out an assessment of the site to produce a safe and suitable design for this location.

**B4.14 PROBLEM (area4)**

The cycleway crosses the Bus access (junction 4) immediately after the 90° bend in the road. The stop line appears to be located about 15m from the crossing point on the approach to the bend, with signals facing along the line of the main road.

It looks like these signals may be visible to drivers on the main road.

This could lead to rear end shunts if drivers unexpectedly stop on the main road.

Note: Ultimately there are likely to be signals on the main road to allow the guided bus priority over the road traffic. This could end up looking like a forest of signals, which would be very confusing for drivers.

**RECOMMENDATION**

Given the simple one-way junction and the relatively low number of vehicles likely to be using the junction evaluate whether signals are

required here. In the short term until the busway is operational normal priority may be sufficient.

If signals are the preferred option:

The location and angle of the heads should be designed carefully to ensure they will be seen clearly in advance, and also whilst waiting at the stop line. If there is any risk they may confuse drivers on the main road louvres or hoods may be required.

Ideally the stop line should be more closely associated with the crossing point.

Whatever layout is chosen, the verge areas especially the area on the inside of the 90° bend should be kept clear of obstructions to give good visibility between the bus access and the cycle/footway.

#### B4.15 PROBLEM (area4)

The westbound approach to junction 3 shows an ahead and right arrow on the road. The signal head appears to be full green only with no unopposed right turn signal. This will leave right turning vehicles waiting for a gap in the eastbound traffic.

This has raises safety issues:

The right turning vehicle is likely to wait opposite the Arbury Road splitter island which will leave insufficient room for the vehicles behind to pass.

The 4 lanes of traffic and splitter islands make judgement of the gaps difficult.

With the multi lane approaches and many islands, some drivers may find it difficult to judge the correct road position to wait for the right turn.

This could place them in the path of oncoming vehicles.

#### RECOMMENDATION

Gap acceptance must not be used for this right turn manoeuvre.

The safest option would be to prohibit right turns. Given that there are 2 junctions to the east where this manoeuvre is permitted this should not be impossible.

### **Facilities for Vulnerable Road Users**

#### B4.16 COMMENT (area4)

Where pedestrian crossings have dropped kerbs and tactile 'blister' paving, the standard throughout the city is to install white ballotini blocks between the kerb and the blister slabs.

This increases the conspicuity at night and also for the partially sighted.

#### B4.17 PROBLEM (area4)

The bus lane on the approach to the pelican crossing gives a 2 lane approach to the crossing. One of these lanes will be relatively free flowing, as it should only carry buses and cycles (possibly taxis). This could be a problem when vehicles are stopped to allow pedestrians to cross. Vehicles and cyclists in the bus lane, approaching the crossing on a flashing amber signal may do so at some speed, as they may not see a pedestrian still on the crossing.

Pedestrian accidents where there is a two lane approach to crossings has been a problem at other sites in the city.

**RECOMMENDATION**

Develop the second lane downstream of the crossing, leaving a single lane approach.

**B4.18 PROBLEM (area4)**

The drawings show a pelican crossing to the east of Howgate Road. The county standard for pedestrian crossings is the puffin crossing. However given that this crossing links 2 off road cycle tracks a toucan might be more appropriate in this location.

From observation, Cyclists Dismount signs are regularly ignored in the City, and cyclists will cycle across regardless. Therefore it would be safer to use a design that acknowledges this.

A similar problem exists with the pedestrian element at the Junction itself.

**RECOMMENDATION**

Use a Toucan crossing layouts.

**B4.19 PROBLEM (area4)**

There are no cycle reservoir/ advance stop lines shown at any of the signalised junctions. At junction 2 this could be especially problematic for cyclists due to the huge area of the junction. If a cyclist is still crossing the junction when the next stage goes to green they are at great risk.

It is noted that the off road facilities being provided will reduce the number of cyclists using the carriageway through the junction. However, fast and confident cyclists may still choose to stay on road.

**RECOMMENDATION**

If possible install advance reservoirs, as this will help cyclists to get across the junction area within the signal cycle. This may not be appropriate at all arms of every junction, discuss the details with CCC signals team.

**B4.20 PROBLEM (area4)**

The end of cycleway on Arbury Road discharges on the main carriageway just short of the school entrance. There are no on road facilities here and no give way marking to encourage cyclists to join the carriageway with due caution.

**RECOMMENDATION**

Ideally extend the cycleway to reduce the risk of conflict for children cycling to the school.

Wherever the cycleway rejoins the carriageway a give way triangle would highlight the change of conditions.

**B4.21 PROBLEM (area4)**

Just to the west of the Arbury Road Crossroads, the road is visually narrowed using solid white lines and hatch markings. This means that any cyclists who chose to stay on the road have to share the 3.5m running lane with all other vehicles, unless they cross the solid white line and ride over the thermoplastic hatching.

Running lanes in the range between 3.1m and 3.9m give an increased risk of conflict between cycles and vehicles as some drivers may try to overtake where there is no sufficient room to do so safely.

#### RECOMMENDATION

If the hatching on the offside is reduced to 800mm, a 1.2m cycle lane could be installed on the nearside.

This would give the equivalent visual narrowing whilst providing safe passage for cyclists.

#### B4.22 PROBLEM (area4)

There are no pedestrian/cycle crossing facilities across Arbury Road at junction 4/St Catharine's Road.

#### RECOMMENDATION

It is noted that queuing space for southbound traffic is very limited here, and it may be difficult to design safe and suitable crossing facilities.

Assess the pedestrian demand for such facilities, and the safety implications for all road users.

#### **Protective Aids**

#### B4.22 PROBLEM (area4)

There are no guardrails shown at the staggered crossing points.

#### RECOMMENDATION

Install guardrail to current guidelines. If there is a risk of reduced visibility between drivers and pedestrians use 'Visirail' or similar.

#### **Surface Characteristics**

#### B4.23 PROBLEM (area4)

The construction detail drawing 11110588/704 does not clearly show high friction surfacing on any of the signals approaches to the signals.

#### RECOMMENDATION

Install high friction surfacing up to the studs at all pedestrian facilities and the stop line at any high-speed approaches.

**B5. Area 5 (coincident with are shown on WSP sheet 5)**

Scheme Outline

Area 5: Encompasses area of Kings Hedges road to the east of Arbury Road Junction. Including the junction of Buchan Street and the proposed new signal controlled access into the site.

Area 5: Main proposals are: Installing a new signal controlled junction to access the new development. A pelican crossing to the west of the Buchan Street Junction.

**Existing Injury Accident Details (Where applicable):**

There has only been on injury accident in this section of Kings Hedges Road since January 1998. This was a light goods vehicle turning right out of Buchan Street into the path of a vehicle overtaking left turning traffic.

**General**

**B5.1 COMMENT**

The drawing (11110588/1214) supplied to show the signals layout for junctions 5 and 6 is quite inaccurate in showing the location of the signals poles.

Most of the misalignment is quite minor. However one serious error is that the toucan crossing appears to be shown at the busway rather than the cycle track.

**RECOMMENDATION**

Amend the drawing to give more accurate location.

Lack of comment in this report should not be taken to imply the layout is safe.

**Road Signs and Markings**

**B5.2 PROBLEM (area5)**

There is no lane discipline signage on the westbound approach to junction 5. Given that the arrangement of the islands would make it dangerous to attempt to go straight ahead from the right hand lane it is important to show the lane discipline clearly.

**RECOMMENDATION**

Install advance sign similar to AD-5-1 on the westbound approach. Additional road markings could also be used.

**B5.3 PROBLEM (area5)**

The advance direction signs are located relatively close to the junction. (Approx 45m from the stop lines on the main road, only 12m on the side road.) This could lead to late lane changes, with poor indication.

**RECOMMENDATION**

Place the signs a little further from the junction to enable drivers to make early decisions.

**B5.4 PROBLEM (area5)**

The splitter islands at junction 6 give a layout that could be confusing for some drivers.

The greatest problem appears to be for drivers turning right from the north arm to the west arm. Unfamiliar drivers may take a line towards one of the oncoming lanes, this may lead to sudden steering as they realise their error. At worst they may try to exit along the eastbound lane.

**RECOMMENDATION**

Installing a guide line indicating the correct path from the north to the west would help drivers to take the correct line through the junction.

This solution should only be applied to one route, as too many lines would simply add to the confusion.

**Lighting and Signals**

**B5.5 PROBLEM (area5)**

The lighting arrangement around the crossing as shown on the drawings does not appear to provide suitable illumination for safe use by pedestrians at night, as the columns are both on one side.

BS5489 recommends normal lighting levels around crossings. However the columns should be sited symmetrically on each exit side of the crossing to provide uniform lighting levels beyond the crossing. In this location where there will be approaching headlights and other extraneous lighting (i.e. shop fronts) the levels given in BS5489 may not be sufficient for safety.

**RECOMMENDATION**

There is no single solution to the lighting of a pedestrian crossing as exact positioning depends upon all the site parameters. A street lighting engineer should carry out an assessment of the site to produce a safe and suitable design for this location.

**Facilities for Vulnerable Road Users**

**B5.6 PROBLEM (area5)**

The drawings show a pelican crossing to the east of Howgate Road.

The county standard for pedestrian crossings is the puffin crossing. However given that this crossing links 2 off road cycle tracks a toucan might be more appropriate in this location.

From observation, Cyclists Dismount signs are regularly ignored in the City, and cyclists will cycle across regardless. Therefore it would be safer to use a design that acknowledges this.

**RECOMMENDATION**

Use a Toucan crossing layout.

B5.7 COMMENT (area5)

Where pedestrian crossings have dropped kerbs and tactile 'blister' paving, the standard throughout the city is to install white ballotini blocks between the kerb and the blister slabs.

This increases conspicuity at night and also for the partially sighted.

B5.8 PROBLEM (area5)

There are no cycle reservoir/ advance stop lines shown at any of the signalised junctions.

The carriageway width between the islands at this junction ranges from 3.3m to 3.65m, which lies in the range that have been found to lead to problems with conflict between cars and cycles. It would be difficult to install an advance cycle reservoir with a stub lane in this location.

It is noted that the off road facilities being provided will reduce the number of cyclists using the carriageway through the junction. However, fast and confident cyclists may still choose to stay on road.

RECOMMENDATION

If possible install advance reservoirs, as this will help cyclists to get across the junction area within the signal cycle. This may not be appropriate at all arms of every junction, discuss the details with CCC signals team.

B5.9 PROBLEM (area5)

Proposed Pelican: Non-staggered islands are not recommended (LTN 2/95). However there will be quite a good carriageway space in the location shown, the suggested island width will be 3m. This would provide a relatively safe waiting point, without the barrier, which could reduce the visibility to the west from Buchan Street.

There are several crossings with similar layouts operating quite successfully around the city.

One negative issue are the running lanes (shown as 3.65m), this width can cause problems if vehicles attempt to overtake cycles at this point.

RECOMMENDATION

The staggered layout with pedestrian guardrail is generally considered safer than the straight across island. However location, type of user and other parameters must be taken into consideration to make a true comparison.

The straight across layout does appear to be intrinsically unsafe in this location. So long as there are push button controls on the island (as indicated on your drawing 1110588/1212 rev A) to ensure that no pedestrians are 'trapped' here.

Details should be discussed with the CCC signals team.

B5.10 PROBLEM (area5)

The link between the cycleway and the pelican crossing is shown as a square junction with no increase in width to facilitate the turning movement.

It is noted that ultimately the rapid transit system guideway will run close to the track at this point, and may limit the options here, but this is some years from construction.

#### RECOMMENDATION

The horizontal alignment should have a radius or splay to provide adequate space for turning. The desirable minimum radius for a local access cycleway is 15m (20m on commuter routes).

#### B5.11 PROBLEM (area5)

There are no pedestrian facilities at the signalised junction.

Given the proximity of the residential development there will be some pedestrian movements around the junction. The current proposals will leave these people walking in the carriageway with vehicles. Those wishing to cross Kings Hedges Road will have to walk with traffic.

Full details of footways within the development plots are not yet available. However the plots will have access onto the shared use track along the north side of the road, which passes through junction 5 and 6.

#### RECOMMENDATION

Provide suitable pedestrian facilities at this junction.

#### **Protective Aids**

#### B5.12 PROBLEM (area5)

There are no guardrails shown at the staggered crossing points.

#### RECOMMENDATION

Install guardrail to current guidelines. If there is a risk of reduced visibility between drivers and pedestrians use 'Visirail' or similar.

#### **Surface Characteristics**

#### B5.13 PROBLEM (area5)

From the survey levels the area around the proposed pelican crossing looks quite flat. This may lead to ponding and potential ice around the crossing point.

#### RECOMMENDATION

Ensure there are adequate falls and gullies to keep the area free of standing water.

**B6. Area 6 (coincident with are shown on WSP sheet 6)**

Scheme Outline

Area 4: Encompasses area of Kings Hedges road to the west of Northfield Avenue.

Area 4: Main proposals are: Installing a new easternmost signal controlled junction to access the new development.

**Existing Injury Accident Details (Where applicable):**

There have been no injury accidents in this section of Kings Hedges Road since January 1998.

Note: the signal-controlled junction on the eastern edge of area 6 has had 6 slight injury accidents since January 1998.

**General**

**B6.1 COMMENT**

The drawing (11110588/1214) supplied to show the signals layout for junctions 5 and 6 is quite inaccurate in showing the location of the signals poles.

Most of the misalignment is quite minor. However one serious error is that the toucan crossing appears to be shown at the busway rather than the cycle track.

**RECOMMENDATION**

Amend the drawing to give more accurate locations.

**Junctions**

No comment at present

**Road Signs and Markings**

**B6.3 PROBLEM (area6)**

There is no lane discipline signage on the westbound approach to junction 5. Given that the arrangement of the islands would make it dangerous to attempt to go straight ahead from the right hand lane it is important to show the lane discipline clearly.

**RECOMMENDATION**

Install advance sign similar to AD-6-1 on the westbound approach. Additional road markings could also be used.

**B6.4 PROBLEM (area6)**

The advance direction signs are located relatively close to the junction. (Approx 45m from the stop lines on the main road, only 12m on the side road.) This could lead to late lane changes, with poor indication.

**RECOMMENDATION**

Place the signs a little further from the junction to enable drivers to make early decisions.

**B6.5 PROBLEM (area6)**

The splitter islands at junction 6 give a layout that could be confusing for some drivers.

The greatest problem appears to be for drivers turning right from the north arm to the west arm. Unfamiliar drivers may take a line towards one of the oncoming lanes, this may lead to sudden steering as they realise their error. At worst they may try to exit along the eastbound lane.

**RECOMMENDATION**

Installing a guide line indicating the correct path from the north to the west would help drivers to take the correct line through the junction.

This solution should only be applied to one route, as too many lines would simply add to the confusion.

**Lighting and Signals**

**B6.6 PROBLEM (area6)**

There are overhead electricity cables over the proposed junction 6. The signal-controlled junction will mean the installation of lighting columns and signal poles.

It can be difficult to judge the height of cables from the ground and at high voltages arcing can occur across a significant distance (up to 7.5m in certain conditions.).

**RECOMMENDATION**

The design must ensure that no tall items intrude into the 'safety zone' as recommended by EDF Energy.

Safe installation and maintenance must also be considered.

**Facilities for Vulnerable Road Users**

**B6.7 COMMENT (area6)**

Where pedestrian crossings have dropped kerbs and tactile 'blister' paving, the standard throughout the city is to install white ballotini blocks between the kerb and the blister slabs.

This increases the conspicuity at night and also for the partially sighted.

**B6.8 PROBLEM (area6)**

Around 100m east of junction 6 the cycleway turns to the north with no apparent path for cyclists who wish to continue along Kings Hedges Road. There are businesses, schools and a college in this direction so there is likely to be some demand for this manoeuvre.

Cyclists usually take the most direct route. Once familiar with the route they are likely to rejoin the carriageway at junction 6 although there are no on road cycle facilities at this junction. The primary signal head will probably be behind the cycleway, so the already common disregard for

red signals observed in cyclists around Cambridge may be even more prevalent.

Note: The issues above will be greater problems when the guided bus way is in operation.

#### RECOMMENDATION

Installing facilities for this manoeuvre within the signalised junction would be difficult, costly and likely to increase clutter with additional signal heads.

A better solution may be to encourage cyclists to stay off the carriageway for a little longer. Where the main path deviates to the north provide a 'fork' in the path leading them to the kerb edge of Kings Hedges Road around 100m to the east of the junction. The layout at this point is much simpler, just 2 opposing lanes of traffic separated by centre hatching, and the visibility is good. (Note: this will entail crossing the busway, as at the other 2 crossing points the cycleway must cross the channel at right angles.)

Whatever solution is chosen clear directional signing for the cycleway should be provided.

#### B6.9 PROBLEM (area6)

There are no cycle reservoir/ advance stop lines shown at any of the signalised junctions.

The carriageway width between the islands at this junction ranges from 3.3m to 3.65m, which lies in the range that can lead to problems with conflict between cars and cycles. It would be difficult to install an advance cycle reservoir with a stub lane in this location.

It is noted that the off road facilities being provided will reduce the number of cyclists using the carriageway through the junction. However, fast and confident cyclists may still choose to stay on road.

#### RECOMMENDATION

If possible install advance reservoirs, as this will help cyclists to get across the junction area within the signal cycle. This may not be appropriate at all arms of every junction, discuss the details with CCC signals team.

#### B6.10 PROBLEM (area6)

There are no pedestrian facilities at the signalised junction.

Given the proximity of the residential development there will be some pedestrian movements around the junction. The current proposals will leave these people walking in the carriageway with vehicles. Those wishing to cross Kings Hedges Road will have to walk with traffic.

Full details of footways within the development plots are not yet available. However the plots will have access onto the shared use track along the north side of the road, which passes through junction 5 and 6.

#### RECOMMENDATION

Provide suitable pedestrian facilities at this junction.

## **B7. Whole site.**

These broad issues are relevant to several or all of the areas, to avoid excessive repetition these may not be duplicated in the individual sections 1 to 6 unless there are detail points specific to one area.

### **General**

#### **B7.1 PROBLEM (whole site)**

Some of the carriageway widths between islands and at junctions fall into the range (3.1m to 3.9m) that can lead to problems of cars attempting to over take cyclists where there is not really enough room. Where widths are less than 3.1m drivers are unlikely to attempt overtaking, as there is clearly not enough width. Where widths are greater than 3.9m there should be sufficient room to complete the manoeuvre safely.

#### **RECOMMENDATION**

Wherever possible kerb-to-kerb widths in this range should be avoided.

### **Junctions**

#### **B7.2 COMMENT (whole site)**

The addition of 2 new signalised junctions, 2 signalised crossings and the signalised bus access point along with the significant changes planned at the existing signalised junctions will dramatically affect traffic conditions in this area. This combined with the changes to traffic flows as a result of the development means that assessment of the overall impact should be a key element of the design process.

Facilities should be installed to allow use of SCOOT or similar system to ensure that the potential traffic problems can be minimised.

### **Lighting and Signals**

#### **B7.3 PROBLEM (area7)**

The side roads into the development will all be crossed by the proposed rapid transit system guideway.

This leaves all the stop lines on this side of Kings Hedges Road set 20 to 30m back from the junction.

This will necessitate very long intergreen times for this leg, as Cycles and other slow moving vehicles will take much longer to clear the junction from the inset stop lines. At peak times this will increase queuing along the main road. Driver frustration can lead to more than average red light jumping and once drivers get to know the phasing includes such a long intergreen they may be even more likely to take risks.

#### **RECOMMENDATION**

Ensure that the signal phasing allows for the right turn to be carried out safely, by all road users. The operation of the signals should be

monitored after installation and adjustments made as required to achieve the best balance.

### **Facilities for Vulnerable Road Users**

#### **B7.4 COMMENT (area7)**

Where pedestrian crossings have dropped kerbs and tactile 'blister' paving, the standard throughout the city is to install white ballotini blocks between the kerb and the blister slabs.

This increases the conspicuity at night and also for the partially sighted.

#### **B7.5 PROBLEM(area7)**

The signing relating to the cycleway does not appear to be complete. E.G.

a) There are very few directional signs for cyclists,

b) VERY few repeaters of dia. 956 on the north side of Kings hedges road. Even at the crossing points at junctions 5 & 6.

c) Pelican crossings are not authorised for Cyclists, but there are no 'cyclists dismount' or 'end of cycleway' signs to indicate this.

#### **RECOMMENDATION**

Review the cycle signing generally and provide signage to meet the guidelines for shared use tracks.

#### **B7.6 COMMENT (area 7)**

At all the junctions there are diverging lanes where traffic will be changing lane. These areas can be dangerous for cyclists, especially where there is a diverging left lane, and cyclists wishing to go straight ahead.

At junction 2 where speeds are higher and the divergence is longer this has been raised as a problem. However the other junctions might also benefit from clear markings to show the correct path for cyclists and highlighting to drivers the presence of cycles. At junction 5 and 6 there are no off road facilities on the south side so the number of westbound cyclists may be higher than the junctions further west.

Audit Team Statement

We certify that we have examined the drawings and documents listed at the commencement of this report. The examination has been carried out with the sole purpose of identifying any features of the design that could be removed or modified in order to improve the safety of the scheme. The problems identified have been noted in this report together with associated safety improvement suggestions which we recommend should be studied for implementation. No one in the Audit Team has been involved with the scheme design.

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Signed

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