SHEFFIELD CITY COUNCIL

TRAFFIC SIGNALS DESIGN GUIDE

Sheffield City Council

1. Design Objectives

The design objectives are as follows:

- All designs shall be produced to provide the optimum solution in terms of whole life costs
- All designs shall be produced to minimise the use of energy and thereby carbon production.
- All designs shall use LED signal aspects and Extra Low Voltage (ELV) street equipment.
- All designs shall eliminate, wherever possible, the reliance on inductive loops within the carriageway surfacing.

2. Reference Documents

All Designers need to familiarise themselves with the Contract Documents with particular reference to the following documents.

- Traffic Signals Specification - Appendix 12/5
- Factory Acceptance Test (FAT) form
- Site Acceptance Test (SAT) form
- Signals Configuration Test Sheet

3. Traffic Signal Design - Data Sources

Information that may be available about current traffic signals installations that can be used as part of the traffic signal design process include:-

- Existing as-built drawings, configuration documentation and UTC plan timings (from SCC)
- Sheffield City Council - Site Documentation/accident records
- Sheffield City Council - UTC Status database records
- And where the information is available, current traffic flows

4. Design Process

The table below details a summary of the design process to be followed.

Table 1 – Traffic Signal Design Process Summary		
No	**Stage**	**Description**
1	**Design**	Designs will be undertaken for each signal installation to meet the general requirements to current highway standards and will use ELV LED technology and nearside pedestrian signal equipment, where applicable, throughout the design. Emphasis will be placed on the use of alternative methods of vehicle detection in order to reduce the reliance on detector loops within the carriageway surfacing as much as is reasonably practicable. The use of above ground detection, including video, microwave and radar, in preference to inductive loops shall therefore be adopted where it is technically possible or expedient to do so. The designer shall seek clarification and confirmation from the SCC-UTC section on the following: a. the retention of existing Scoot and Count loop use and location, if applicable; b. controller staging & control strategy; c. UTC/CLF plan timings;
2	**Drawings – details to be included**	1. <u>Traffic Signals & Detection Details;</u> a. 1:200 layout showing traffic signal poles, heads, detection, push button units, pedestrian display units, loops, above ground detector symbols, photo electric cell (PEC), road markings (stop-lines, lane markings, hatching, arrows , etc), road names; b. Labels for pole numbers, phase letters, real/virtual loops, above ground detectors, controller, ancillary/termination cabinets, communications and servicing feeder pillars; c. Street Furniture Requirements table – listing against each pole number: i. Phase ii. Head or PBU type as given on the standard detail iii. TRO box sign iv. Brackets v. Extension Brackets vi. TRO sign

Table 1 – Traffic Signal Design Process Summary		
No	**Stage**	**Description**
		d. Pole Details table – listing against each pole number: i. Type (standard 4m, totem, swan necked, etc) ii. Offset from kerb to face of pole. e. External Inputs and Push Button Units table – listing by detector label, alphabetically: i. Distance from stop-line or Pole Number (for an above ground detector). f. Box out note indicating 'This is an ELV site' g. Box out note headed 'UTC Communications - showing: i. Communications type ii. Communications equipment required (e.g. iMesh router, iOUT, 3G router, 32 bit/64 bit Chameleon) h. North point i. Key for symbols used j. General notes. 2. <u>Ducting Civils & Road Markings;</u> a. 1:200 layout showing ducting, main cable chambers, pull/joint boxes, pole centres/retention socket, stop-lines, pedestrian crossing studs, road markings (may be split off into separate drawing for signing and road markings, but stop-lines, lane markings, arrows etc should be shown on this and the Traffic Signals & Detection Details drawing) ; b. Labels for pole numbers, cable box/pull box/joint box reference numbers, controller, ancillary/termination cabinets, communications and servicing feeder pillars; c. Pole Details table – listing against each pole number: i. Type (standard 4m, totem, swan necked, etc) ii. Offset from kerb to face of pole. d. Box out note indicating 'This is an ELV site' e. Setting out notes/details, f. Ducting notes (type, colour, etc) g. Road markings schedule (unless full road marking details are shown on a separate drawing, but see 2(a) above) h. North point i. Key for symbols used j. General notes

Table 1 – Traffic Signal Design Process Summary		
No	**Stage**	**Description**
		3. Site Clearance (required if an existing site is affected by the new works); a. 1:200 drawing of the existing traffic signal site depicting labels shown adjacent to Traffic Signal/Control and communications/power servicing items (and a corresponding list of these affected items) to be transferred (in the case of services), abandoned, or set aside for re-use, or removed to store/tip. b. North point 4. Residual Design Hazards; a. 1:200 drawing base with poles centres, road markings, depicting referenced symbols located at identified residual design hazards (– this information shall be collected from the Pre-construction Information and the CDM Hazard Management process to identify all significant high risk residual design hazards); b. North point; c. Key for symbols used. 5. Standard Details; a. Relevant standard details; b. Notes on any site specific requirements in applying these details. **Examples of drawings/drawing layout included in appendix A.**
3	**Issue**	The following documents will be created and issued for each traffic signal scheme: Drawings (.pdf): 1. Traffic Signals & Detection Details; 2. Ducting Civils & White Lining; 3. Site Clearance; 4. Residual Design hazards; 5. Standard Details; 6. Existing site records (if applicable) Drawings (.dwg): 1. Main Signals Drawing Model File with layout tabs, as above.

Table 1 – Traffic Signal Design Process Summary		
No	**Stage**	**Description**
		Documents: a. RSA 1-2 (Closed Out) b. Hazard Checklist; c. Hazard Management Schedule; d. Pre-Construction Information; e. MCH1827B controller configuration data (for junction controllers, Puffins, Toucans, etc.); f. MOVA dataset (if applicable); g. OTU interface sheet; h. Sheffield Special UTC Options document i. Details of Statutory Undertakers apparatus. j. Details of any environmental mitigation measures.
4	**Testing/ Commissioning**	The designer will attend the Factory Acceptance Test (FAT) to witness the test, carried out by the traffic signal contractor's configuration engineer and SCC's designated representatives. The designer will attend the Site Acceptance Test (SAT) to carry out the test and commissioning in conjunction with the traffic signal installation contractor's installation engineer, configuration engineer and SCC's designated representatives. Completed FAT and SAT test sheets shall be supplied on completion to SCC and/or SCC's designated representatives.
5	**As Constructed Drawings**	As-constructed drawings will be produced for certification purposes (utilising information supplied by the installation contractor(s) and designers) for the following: 1. Traffic Signals & Detection Details; 2. Ducting Civils & White Lining;

5. Detailed Design Specification

A. Existing MDPE Ducting and Chambers

All designs shall have a fully ducted system of MDPE ducting and brick or modular polyethylene chambers and joint/pull boxes. Earthenware ducting and PVC ducting shall not be considered for new or for re-use/retention in the works and shall be completely replaced with a fully ducted system design.

In order to meet the requirements of the Specification - Appendix 12/5 (no daisy-chaining of cables, possibility of up to 1 no. 20 core + 1 no. 16 core cable per pole) and the IEEE Regulations 17th Edition (40% usage within underground ducts), sufficient overall duct capacity shall be provided to accommodate the anticipated cabling needs for the installation. Where any existing 90mm O/D MDPE ducting has been retained (through alteration to an existing installation, for example), additional ducting (100mm I/D) shall be provided to meet this requirement, if necessary. Alternatively, the consideration shall be given to the use of termination pillars/cabinets to avoid additional carriageway ducting works.

B. Traffic Signal Cabling – Termination Pillars/Cabinets

The designer shall consider adopting the use of a termination pillar/cabinet at a suitable safe location remote from the controller to enable the use of main multi-core traffic signal feeder cables between controller and termination pillar on larger sites. Individual cables shall then feed directly to the individual poles.

C. Traffic Signal Cabling – Electrical

Electrical cable design for traffic signal installations and core allocation within cables shall generally be the responsibility of the traffic signal contractor. However, in order to be able to assess the duct requirement needs in the design process the following assumptions have been made to aid design:

- A limit of 1 no. 20 core and 1 no. 16 core armoured cable shall be used as the maximum requirement at any one pole;
- Maximum usable (40%) cross sectional area cable capacity for a single existing 90 mm O/D MDPE duct shall be taken as 1890 $mm^{2;}$
- Maximum usable (40%) cross sectional area cable capacity for a single new 100 mm I/D MDPE duct shall be taken as 3140 $mm^{2;}$
- Nominal cross sectional areas for multicore signal cables (1.5 mm^2 core size) to be used:

Table 3 - Multicore Signal Cables - Cross Sectional Areas (1.5 mm2 core)

Cable	Nominal Diameter (mm)	Armoured	CSA (mm^2)
20-core	21.5	Yes	363
16-core	19.8	Yes	308
12-core	18.1	Yes	257
8-core	15.2	Yes	181
4-core	12.7	Yes	127
2-core	11.3	Yes	100
4-core	9.1	No	65
2-core	7.9	No	49

D. Basic Cable Core Allocation

The following basic cable core allocation shall be used as a guide to determining the cable usage within ducting and the capacity available for above ground detection at a pole. The allocation is based on the worse case requirement dictated by a 2-pole Puffin crossing.

Table 4 - Basic Cable Core Allocation

Comments	Lamp Supply 20 Core	Core No.	Detection 16 Core	Comments
phase 1 RED	**R_1**	**1**	**24V+**	agd power supply
phase 1 AMBER	**A_1**	**2**	**24V-**	agd power supply
phase 1 GREEN	**G_1**	**3**	**MVD**	microwave vehicle detector
phase 2 RED	**R_2**	**4**	**PBU**	push button input
phase 2 AMBER	**A_2**	**5**	**KSD**	kerb-side detector
phase 2 GREEN	**G_2**	**6**	**OCD**	on-crossing detector
phase 3 RED	**R_3**	**7**	**SLD**	stop-line (a/g) detector
phase 3 AMBER	**A_3**	**8**	**Common**	agd/pbu common
phase 3 GREEN	**G_3**	**9**	**Bleeper**	bleeper driver
photocell	**PEC**	**10**	**Bleeper 0 Volts**	bleeper 0 volts
regulatory box sign supply 48 V+	**Reg. Sign +**	**11**	**$Spare_1$**	spare core 1
regulatory box sign supply 48 V-	**Reg. Sign -**	**12**	**$Spare_2$**	spare core 2
lamp neutral	**Neutral**	**13**	**$Spare_3$**	spare core 3
spare core 1	**$Spare_1$**	**14**	**$Spare_4$**	spare core 4
spare core 2	**$Spare_2$**	**15**	**$Test_1$**	test core
spare core 3	**$Spare_3$**	**16**	**$Test_2$**	test core
spare core 4	**$Spare_4$**	**17**		
spare core 5	**$Spare_5$**	**18**		
test core	**$Test_1$**	**19**		
test core	**$Test_2$**	**20**		

E. Kerbside & On-Crossing Detection Provision

The following initial rules for kerbside and on-crossing detection provision shall be used as a starting point in design discussions and initial arrangements:

Kerbside Detection:

- Puffins/Toucans – always provide;
- Junctions – provide for remote crossings, omit for walk-with traffic crossings;

On-crossing Detection:

- Puffins/Toucans – always provide where crossing carriageway width is greater than 4 metres;
- Junctions – always provide where crossing carriageway width is greater than 4 metres.

F. Electricity Supply Feeder Pillar

The following procedure shall be adopted when considering the presence or not of an existing electricity supply feeder pillar:

- No existing feeder pillar - transfer to new feeder pillar, capable of housing a meter.
- Existing unmetered feeder pillar - replace with new feeder pillar, capable of housing a meter.
- Existing metered feeder pillar - replace with new metered feeder pillar, like-for-like.

G. Detector Loops

Wherever reasonably practicable, conventional detector loops shall be designed out through the adoption of suitable above ground video, microwave, infrared, radar, or thermal detector units in the replacement design programme.

Where above ground detection cannot offer a viable or reliable solution then the use of a below ground detector may be adopted.

J. UTC Communications

The requirements for UTC communications at both new and existing modified sites shall be agreed with SCC.

K. Passively Safe Equipment

The designer shall ensure that all sites are subject to a designer's risk assessment. This shall include an assessment of the requirements for passively safe poles/structures in accordance with:

- TD 89/08 – The Use of Passively Safe Sign Posts, Lighting Columns and Traffic Signal Posts to BS EN 12767:2007
- BS EN 12767:2007 – Passive safety of support structures for road equipment – Requirements, classification and test methods.. If the designer's risk assessment indicates a beneficial impact on the overall safety of the site through the use of passively safe signal poles/structures.

The designer shall ensure that the approach to passive safety is in accordance with the guidance contained in the following:

- Passive Safety UK Guidelines for Specification and Use of Passively Safe Street Furniture on the UK Road Network (published by Passive Safety UK in association with Traffic Engineering and Control, April 2010).

L. Traffic Signal Controllers

Extra Low Voltage (ELV) traffic signal controllers shall be utilised on all new scheme designs.

Where an existing site is modified due to the new development's works additions then, in general, this site shall be upgraded to ELV in its entirety, unless agreed otherwise with SCC.

Appendix A

Examples of Traffic Signal Design drawings

Puffin Crossing

- TS-055-001-1 Traffic Signals & Detection
- TS-055-001-2 Setting Out & Ducting
- TS-055-001-3 Site Clearance and Residual Design Hazards
- TS-055-01 Standard Details
- TS-055-001-1-AC As Constructed

Signalised Junction with Pedestrian Facilities

- TS-201-001-1-B Traffic Signal & Detection
- TS-201-001-2-B Setting Out & Ducting
- TS-201-001-3-A Site Clearance
- TS-201-001-4 Residual Design Hazards
- TS-SD-201-01 Standard Details
- TS-201-001-1-AC As Constructed
- TS-201-001-2-AC Ducting As Constructed