Specification for Geodetic Surveying Services for Highway Works Schemes

1.0 Introduction

This specification is for the use of geodetic survey firms engaged in work for Highways England on the South West network and adjacent third party land where detailed in each Scheme Task Order. Where this Specification requires options to be deleted or details to be added, these shall be explicitly identified in each Scheme Task Order.

2.0 Purpose and Scope

Surveys commissioned are for the purposes of facilitating detailed design of highway works the nature of which are further detailed in the Scheme Task Order. The highest achievable levels of accuracy are required both horizontally and vertically for key elements within the highway envelope. Section 5 lists the required accuracy levels for various items required to be recorded during the survey.
The location and extent of the survey shall be as identified in the drawing(s) accompanying the Scheme Task Order.

The survey scope shall be to review this specification and supplementary information provided in the Scheme Task Order to determine a programme and quotation for completion of site works - including requirements for Traffic Management. The provision of the presentation material as detailed in Section 6 shall be listed separately within the programme and quotation. Traffic Management will be arranged, provided and funded separately by Highways England but the type, phasing and duration shall be determined by the Survey Contractor to suit their method of working.

3.0 General Requirements

Project information shall be as detailed in the Scheme Task Order. This specification is not intended to be used for specialist surveys of structures such as bridges but basic level and positional information for structures shall be included as detailed in the Scheme Task Order.

3.1 Health and Safety at Work etc Act 1974

All activities performed during the course of work undertaken by the Survey Contractor on this Contract shall be in accordance with the requirements of the Health and Safety at Work etc Act 1974. Any operations or areas which involve safety considerations over and above those normally required during survey activities will be identified within the Scheme Task Order.

3.2 Landowners, Occupiers and Entry

Unless otherwise stated in the Scheme Task Order, owners and occupiers of all the land covered by the survey will have been notified of the period during which entry is likely to be required and their permission for entry secured by Highways England. Notwithstanding the above, the Survey Contractor shall, where possible, notify the landowner / occupiers upon arrival and agree with them all routes and means of access. Where access to the Survey Contractor is refused, the Survey Contractor shall immediately notify the Highways England contact who commissioned the survey.

3.3 Prior to undertaking survey

Within two weeks of award of the Contract, the Survey Contractor shall provide the Highways England Survey Coordinator with a detailed programme and method statement of the activities the Survey Contractor intends to carry out, in order to meet the Contract timetable and the Specification. The method statement shall include copies of calibration certificates for the survey equipment

4.0 Project Control

Planimetric and vertical control shall be made up of a framework to provide a suitable foundation for the production of a reliable survey and for future setting-out during construction.

4.1 Requirements

Planimetric and vertical control frameworks shall be established and tied into the Ordnance Survey National Grid and datumn.

A minimum of two primary points shall be established connected by direct measurement and located at a nominal distance of 250m on motorways and 100m on trunk roads. Where ever possible these should be located within the highway boundary in locations that are unlikely to be disturbed.

Secondary points tied into the primary points shall be utilised as required to provide adequate coverage of the survey area as defined by the task order but intervals shall not exceed those of the primary points.

Use of Minor control points may be employed where necessary to obtain full coverage within third party land.

4.2 Ground Markers

The primary and secondary control points shall be defined by permanent ground markers. Final positions of permanent ground markers shall be determined by terrain and intervisibility constraints. Minor control points need not be permanently marked.

Permanent Ground Markers shall be stable for a period of 5 years and shall be of a construction which conforms to the types illustrated in Appendix J of Manual of Contract Documents for Highway Works Volume 5 Section 1 Part 2 available online at:

http://www.dft.gov.uk/ha/standards/mchw/vol5/sect1/5_1_2.pdf.

4.3 Schedule of Permanent Control Stations

A Schedule of Permanent Control Stations shall be prepared incorporate the following information:

a. Station designation
b. Plan co-ordinates
c. Level value
d. Description
e. Ordnance Survey triangulation stations (if used)
f. Ground marker type

4.4 Framework Accuracy

The acceptance criteria specified below are in terms of internal rather than absolute accuracies and are given as permitted deviations for distances, angles and levels. Internal accuracies are more critical to the construction process than the absolute accuracy of points in a higher coordinate system.

The relation between the permitted deviation (PD) and root mean square error (rmse) is:

PD = 2.5 x rmse.

Where the control system forms a network, it shall be observed by measuring sufficient distances and angles to obtain a redundant number of observations, which shall then be adjusted by a least squares method.

When comparing measured distances and angles with those derived from the adjusted co-ordinates the differences shall not exceed the following permitted deviations:-

(a) Primary Points

Distances:- ± 0.5√L mm
Angles:- ± 0.035/√L degrees

As an offset:- ± 0.61√ L mm

(b) Secondary Points

Distances:- ± 0.75√L mm
Angles:- ± 0.045/√L degrees

As an offset:- ± 0.75√ L mm

(c) Minor Control

Distances:- ± 1.0√L mm
Angles:- ± 0.09/√L degrees.

As an offset:- ± 1.5√L

Where L is the distance in metres between the points concerned. In the case of angles, the shorter of the two distances defining the angle shall be used.

When using GPS the adjustment must pass the chi squared test on the control network.
Post adjustment relative errors for distances and bearings at the 95% confidence level should be calculated for each line to show compliance with the criteria above. In addition, compliance measurements should be observed between selected points in the network to confirm the validity of the adjustment positions on plan.

4.5 Accuracy Acceptance Criteria

When comparing measured height differences with those derived from the adjusted reduced levels, the differences shall not exceed the following permitted deviations:

a. Between bench marks, primary stations and other closed loops in the framework:
   ± 12√K mm where K is the distance levelled in km
b. Between adjacent secondary stations or minor control points less than 300 m ± 5 mm

4.6 Surveyed Features Accuracy

The required accuracy when surveying features has been identified using two categories, Max and Medium. These are defined below.

Max
This shall represent survey using a Total Station offering accuracy tolerance of +/- 5mm or better. Use of GPS survey techniques or other means not providing this level of accuracy shall not be permitted.

Medium
This shall represent items for which survey via total station is preferred but that use of GPS is not precluded. However, it is likely that use of GPS techniques will be limited to large areas of third party agricultural land or expansive highway verges.

Section 5 details the level of accuracy required for the various features required to be captured during a survey for each class of road unless explicitly varied by the Scheme Task Order.

5.0 Items to be surveyed

The primary information to be surveyed is that which determines the shape, alignment and make-up of the public highway envelope. This shall extend into the adjacent third party land where identified by the Scheme Task Order. Specific items that must be recorded are detailed below. This shall not be taken as a complete list and any features / items not specifically referenced shall also be recorded. The line or point to be surveyed on a feature shall be at the feature's intersection with the ground surface unless otherwise noted.

5.1 Roads, Tracks, Footways and Road Markings

Ref.	Features	Trunk Roads	Motorways	To be Included in Output drawings	Accuracy	3D feature type
5.1.1	All Road edges (where no kerbs) including side roads, laybys, private access's etc.	5m (2.5m on radii below ~12m)	10m	2D + 3D	Max	String
5.1.2	All Kerb lines at channels + Channel blocks including side roads, laybys, private access's and traffic islands	5m (2.5m on radii below ~12m)	10m	2D + 3D	Max	String
5.1.3	All Kerb tops including side roads, laybys, private access's and traffic islands	5m (2.5m on radii below ~12m)	10m	2D + 3D	Max	String
5.1.4	Location of drop kerbs and transition kerbs (each end)	All	All	2D + 3D	Max	Part of kerb strings
5.1.5	Tactile paving and colour	Footprint	N/A	2D	Medium	-
5.1.6	Footway (each edge)	5m (2.5m on radii below ~12m)	5m	2D + 3D	Max	String
5.1.7	Other paved areas (extents / material type and changes)	Footprint (max 5m)	Footprint (max 5m)	2D + 3D	Max	String
5.1.8	Zebra and signal controlled crossings	Position and extents	N/A	2D	Max	-
5.1.9	All Road and footway crown lines	5m	10m	2D + 3D	Max	String
5.1.10	Steps including construction type and railings if present.	Position, extents and height of each step	Position, extents and height of each step	2D + 3D	Max	Strings

Ref.	Features	Trunk Roads	Motorways	To be Included in Output drawings	Accuracy	3D feature type
5.1.11	Road markings – edge of carriageway / rib line, lane markings, give way markings and stop lines and directional arrows and text	5m	10m	2D	Max	-
5.1.12	Extents of High Friction Surfacing and colour surfacing including 'gateway features'	Footprint / extents	Footprint / extents	2D	Medium	-
5.1.13	Subways / underpasses / bridges including piers.	Footprint / extents	Footprint / extents	2D	Max	-
5.1.14	Bridge piers at 2m above ground level.	Cross section	Cross section	2D	Max	-
5.1.15	Bridge / structures expansion joints	Footprint / extents	Footprint / extents	2D	Max	-

Additional notes:

1. Quadrant radii kerbs to have start, middle and end points picked up.
2. Bus kerbs shall be picked up in the same manner as drop kerbs.
3. For road markings the centre of the lines shall be recorded.

5.2 Verges, earthworks and other soft landscaping and vegetation

Ref.	Feature	Trunk Roads	Motorways	To be Included in Output drawings	Accuracy	3D Feature type
5.2.1	Cuttings and embankments – crest and toe lines	5m	10m	2D + 3D	Medium	String
5.2.2	Retaining Walls or other level change without a slope such as raised planting beds.	Footprint (max 5m) Levels at top and bottom	Footprint (max 5m) Levels at top and bottom	2D + 3D	Max	String
5.2.3	Localised changes of level such as mounds and swales.	Footprint (max 5m) Enough levels to illustrate form / shape	Footprint (max 5m) Enough levels to illustrate form / shape	2D + 3D	Medium	Strings and points as required
5.2.4	Drainage ditches and all other waterways. Footprint including embankments and bed plus levels of each element including water.	5m or less if required to accurately capture shape	10m or less if required to accurately capture shape	2D + 3D	Medium	String

Ref.	Feature	Trunk Roads	Motorways	To be Included in Output drawings	Accuracy	3D Feature type
5.2.5	Drainage headwalls / outfalls to include pipe size and soffit level	Footprint, levels at ditch bed, water, and top of walls	Footprint, levels at ditch bed, water, and top of walls	2D + 3D	Max	Strings and points as required
5.2.6	Waterbodies such as ponds and lakes including water level	Footprint including any embankment	Footprint including any embankment	2D + 3D	Max	String
5.2.7	Line of filter / French drains	5m along run to both sides	10m along run to both sides	2D + 3D	Medium	String
5.2.8	Line and height of Safety barriers including terminals, guard railings or parapets *1	5m along run and changes of beam type / height	10m along run and changes of beam type / height	2D	Max	-
5.2.9	Open fields / soft verge	10m centres / grid pattern	10m centres / grid pattern	2D + 3D	Medium	Spots as blocks or points
5.2.10	Trees – Canopy extents, height and trunk where latter is greater than 0.5m diameter 1m above ground	All	All	2D	Medium	-
5.2.11	Small trees / Bushes / scrub / brambles etc. Extents and height	All areas	All areas	2D	Medium	-
5.2.12		Areas of overgrown vegetation		Where critical these will have been cleared prior to survey but where they remain every effort should be made to record ground level information around the full extent of inaccessible area to provide as reliable a representation of the ground levels as possible		

Additional notes:

1. Street furniture shall only be included in the 3D CAD file where it has a direct effect on the topography / levels in the immediate vicinity. If included it shall be represented as a block or string in accordance with Section 6.

5.5 Within third party land

Where the survey extents extend into third party land this will be highlighted in the Scheme Task Order and the necessary permissions to enter the land obtained by Highways England in advance. Further requirements are detailed in Section 3.2.

5.5.1 Agricultural land and public open spaces

The same requirements as identified above shall apply except the accuracy level may be reduced to medium.

5.5.2 Private and commercial / industrial properties
Where included within the survey extents these shall be treated as identified above with the same frequency and accuracy as that required on trunk roads regardless of the class of the adjacent highway.

Particular attention should be paid to the building footprint, line of roadways, drives and paths as well as boundary information.
Further requirements will be detailed in the Scheme Task Order.

6.0 Presentation

The Survey Contractor shall provide two CAD files in AutoCAD 2017 dwg or dxf format one to be 2D and the other 3D for use with AutoCAD Civil 3D. Any additional file requirements (such as MX GENIO files) will be noted on the Scheme Task Order if required.
The presentation scale for the survey output drawings shall be 1:250 on trunk roads and 1:500 on motorways unless otherwise stated in the Scheme Task Order.
Drawings shall contain the Survey Contractors title block and contact details and a table detailing the control stations created / used as detailed in Section 4.3. Additional a legend of all symbol types used shall be incorporated.

6.1 Basic settings

The following settings shall be used:

- Text style shall be RomanS
- Point styles shall be in absolute units appropriate to the presentation scale
- Drawing base units to be set to 'Unitless'.
- No information shall be placed on layer 0

6.2 Use of layers

The drawing layer name convention shall reflect the items listed in Section 5 and named in such a way as to minimise ambiguity as to the information contained within it. The colour definition for each layer may be at the discretion of the surveyor but shall used in such a way as to aid in the visual clarity of the survey. Line type definition for each layer shall be continuous except for road markings and fence lines. Individual road markings shall be presented in a line type that reflects the marking surveyed. A library of such line types is available on request.

6.3 Use of blocks

Use of pre-defined blocks to represent surveyed features is permissible provided that this provides an accurate representation of the feature's extents and levels. Where blocks are used the insertion / base point shall reflect the part of the feature that was surveyed. The block orientation and size shall reflect and match the additional points surveyed for the feature. Where the shape and / or level information for an element cannot be adequately represented by a block then strings shall be used. For all block definitions line colour and type shall be defined as 'by block'.

6.4 Requirements specific to 2D files

2D files shall include contours represented at regular intervals across the survey extents. The required interval for contours will vary between sites and as such should be determined in a manner that provides sufficient indication of the general topography of the site without undue 'clutter'. Broadly the interval shall not be less than 100mm on flat sites or greater than 500mm on sites with significant level range. Major contours at each fifth interval shall be shown differently (weight or line type) so as to aid reading and shall be labelled with its level.

The 2D output file shall contain spot level information for all key features along with heights of features such as walls, fences and overhead cables. Additional information on type, size and nature of features surveyed shall also be included.

6.5 Requirements specific to 3D files

No string lines shall cross any other string or block entity as this causes errors when creating a surface with AutoCAD Civil 3D. Contours shall not be included in the 3D file.
No feature or item within the 3D file shall have a zero level.

7.0 Quality Control

7.1 Collection of data on site

The Survey Contractor shall employ a suitable methodology to ensure that the requirements of this specification are met and that all relevant features are recorded.

7.2 Presentation data

The survey contractor shall undertake a review of both 2D and 3D output files for compliance to this specification prior to issue to Highways England. For the 3D file particular attention should be paid to ensuring there are no level anomalies that produce an inaccurate representation of the site topography.

7.3 Record keeping

All source survey information shall be safely held by the Survey Contractor for a period of five years from the date of completion of the Survey Contract.

7.4 Sub-standard surveys

Omission of multiple items or of items of significant size / obvious nature particularly where these have a bearing on the proposed works will be considered sub-standard.
In such circumstances Highways England will review the impacts of the omission(s) and any mitigating circumstances offered for the omission. In exceptional circumstances Highways England reserve the right to instruct a return to site for collection of the missing data at the surveyors own expense, including TM costs if deemed appropriate.