

Master Specification

Part PC-SI1

Site Surveys

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Government of South Australia
Department for Infrastructure
and Transport

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PC-SI1 Site Surveys

1 General

- a) This Master Specification Part specifies the requirements for the management of the survey control network and the general survey duties necessary for the delivery of Works and Temporary Works, including:
 - i) the documentation requirements, as set out in section 2;
 - ii) the Surveyor requirements, as set out in section 3;
 - iii) the survey control network requirements, as set out in section 4;
 - iv) the survey equipment requirements, as set out in section 5;
 - v) the survey duties - general requirements, as set out in section 6;
 - vi) the verification certificates requirement, as set out in section 7;
 - vii) the survey using global navigation satellite system equipment requirements, as set out in section 8;
 - viii) the property boundary marking requirements, as set out in section 9;
 - ix) the provision of as-constructed information requirements, as set out in section 10;
 - x) the record requirements, as set out in section 11;
 - xi) the payment requirements, as set out in section 12; and
 - xii) the Hold Point requirements, as set out in section 13.
- b) The management of the survey control network and the general survey duties necessary for the delivery of Works and Temporary Works must comply with:
 - i) the Reference Documents, including Department Cadastral Survey Guidelines (available from: <https://dti.sa.gov.au/cadastral-surveying>); and
 - ii) all applicable Laws, including the *Survey Act 1992* (SA).

2 Documentation

2.1 Quality Management Records

In addition to the requirements of PC-QA1 “Quality Management Requirements” or PC-QA2 “Quality Management Requirements for Major Projects” (as applicable), the Quality Management Records must include:

- a) a final list of stations, as required by section 4b)iii);
- b) evidence of checks to ensure level equipment is calibrated and in tolerance, as required by section 5.3;
- c) the verification certificates for all set out points, in accordance with section 6.6;
- d) the bore log reports and digitised data for all underground boring, in accordance with section 6.10c);
- e) the information required by section 10; and
- f) evidence of compliance in accordance with section 11.

3 Surveyor

- a) The Contractor must engage a person (“Surveyor”) who:
 - i) is eligible for the grade of member of the Geospatial Council of Australia, or be eligible for membership of an allied professional organisation;
 - ii) is accredited by completion of a work zone traffic management course with a trainer approved by the Department; and
 - iii) has a minimum of 3 years’ experience as a survey party leader on major infrastructure work (appropriate for the Project) since gaining qualification.
- b) The Contractor must ensure that:
 - i) the Surveyor complies with the requirements of this Master Specification Part;
 - ii) the Surveyor personally carries out the duties specified herein or be on Site at all times during survey work; and
 - iii) all survey duties are undertaken in accordance with a certified quality assurance system that complies with the requirements of AS/NZS ISO 9001 Quality management systems - Requirements.

4 Survey control network

- a) The Principal will provide the survey control marks to the Contractor.
- b) The Contractor:
 - i) is responsible for the survey control marks and any additional marks that form the survey control network;
 - ii) must verify the integrity of the marks before commencing survey work; and
 - iii) must supply to the Principal, a final list of stations immediately prior to Completion as part of the Quality Management Records.

4.2 Verification

- a) Verification of the survey control must be conducted periodically (at intervals not exceeding 3 months) until Completion.
- b) If discrepancies are detected between apparently undisturbed adjacent control points, the Contractor must ensure that the Surveyor reports the discrepancies to the Principal who may direct further survey control verification to be carried out.

4.3 Horizontal control

For horizontal control only, survey stations numbered S001 to S799 must be used. The S300 series of survey stations are permanent survey marks registered with the Surveyor General.

4.4 Vertical control

- a) Where deep bench marks (prefixed BM) are provided by the Principal, these deep bench marks must be used for vertical control.
- b) If deep bench marks are not provided by the Principal, survey stations numbered S001 to S099 and S300 to S399 must be used for vertical control.

4.5 Bridge control

- a) Where the Works or Temporary Works include a bridge or major structure, the Contractor must nominate a minimum of 3 control stations for each bridge / major structure site. Where the bridge / major structure length exceeds 100 m, the distance between control stations must not

exceed 100 m. Only these stations or their approved replacements are to be used for alignment, level and coordinate origin for the bridge / major structure set out and construction.

- b) Where survey control for structures and bridgeworks is established, the Contractor must ensure the Surveyor uses ground distances (not grid distances) for all lines when calculating coordinates.

4.6 Re-establishment of control

If control survey stations have to be re-located or additional stations installed, these stations must be connected to the existing survey control network. Adjustment computations for new control points must be ancillary to the main control adjustment so that minor adjustments to the previously fixed stations are avoided. The Contractor is responsible for all costs associated with re-establishment of survey marks.

4.7 Principal supplied survey coordinate data

- a) All survey and design undertaken by the Principal is in planar project coordinate system.
- b) All design undertaken prior to any issue of survey datasets provided by the Principal will be undertaken in either:
 - i) GDA 2020 / SA Lambert (EPSG: 8059); or
 - ii) GDA 2020 / MGA zone 'XX', where 'XX' is the zone appropriate to the site location (for example: GDA 2020 / MGA zone 54 (EPSG: 7854)).
- c) The Contractor must be responsible for converting data to and from the preferred coordinate system as required, including for Utility Service Authorities designs and GIS data.

5 Survey equipment

The equipment used by the Contractor must be appropriate for the accuracy of work undertaken. The Contractor's procedures must address all errors introduced by survey methods and make due allowance for the effects of:

- a) survey equipment capability and adjustment;
- b) integrity of the survey control network;
- c) vertical refraction;
- d) the grid scale factor;
- e) the earth's curvature; and
- f) the geoid - ellipsoid separation.

5.2 Electronic distance measuring (EDM) equipment

- a) Electronic distance measuring equipment must have the following capabilities:
 - i) capability to measure distances to within 5 mm +5 ppm;
 - ii) for angular measurements, capability for both horizontal and vertical angles to be less than 3 seconds of arc;
 - iii) one second of arc minimum count;
 - iv) diametric vertical circle reading;
 - v) automatic tilt compensator; and
 - vi) capable to electronically record and store field data including horizontal and vertical angles, distances, point notation, target, and instrument heights.

- b) The Contractor must ensure that all electronic distance measuring equipment used for the Contractor's Activities has been tested within the last 12 months prior to initial use and subsequently every 12 months from the last test for the duration of the relevant Contractor's Activities.
- c) Electronic distance measuring equipment must be tested at the University of South Australia, Mawson Campus or a NATA accredited organisation.
- d) Prior to survey work commencing on Site, the Contractor must submit evidence to demonstrate compliance with sections 5.2b) and 5.2c) which will constitute a **Hold Point**. Survey work must not commence until this Hold Point has been released.
- e) Where re-testing is required to comply with section 5.2b), the Contractor must submit evidence of re-testing, which will constitute a **Hold Point**. Further survey work must not commence until this Hold Point has been released.

5.3 Verification of level equipment

Prior to commencement of any survey work, the Contractor must undertake sufficient checks to ensure the level equipment is calibrated and in tolerance. Evidence of calibration and within the required tolerances must be documented as part of the Quality Management Records and may be requested by the Principal at any time.

5.4 Global Navigation Satellite System (GNSS) equipment

- a) This section 5.4 applies to Global Navigation Satellite System (GNSS) hardware and software systems designed for geodetic survey applications operated in differential mode where carrier phase and pseudo-range observations are recorded by the receivers.
- b) At a minimum, GNSS equipment must:
 - i) include receivers capable of recording carrier waves;
 - ii) be authorised for frequency to operate a two-way radio from the ACMA for GNSS operations; and
 - iii) incorporate braced support for the receiver pole.
- c) GNSS must not be used as the sole method of measuring length in contractor surveys.
- d) Where the Contractor uses GNSS for contract verification purposes, it must adhere to the requirements of the Surveyor General.
- e) The Contractor must ensure that all GNSS equipment used for the Contractor's Activities has been tested within the last 12 months prior to initial use and subsequently at the frequencies set out in section 5.4f). This requirement is specific to utilising GNSS in a quality assurance system.
- f) GNSS systems must be tested on a calibration network at least once per year, including immediately after any repair, and after a system upgrade (hardware or firmware).
- g) Prior to commencement of survey work using GNSS equipment, the Contractor must submit evidence to demonstrate compliance with section 5.4e), which will constitute a **Hold Point**. Survey work using GNSS equipment must not occur until the Hold Point has been released.
- h) Where subsequent re-testing is required to comply with section 5.4f), the Contractor must submit evidence of re-testing, which will constitute a **Hold Point**. Further survey work using GNSS equipment must not occur until the Hold Point has been released.

6 Survey duties - general

6.1 Permanent survey marks

- a) Permanent survey marks must be protected in accordance with the *Survey Act 1992 (SA)*, including section 52 - Interface with Survey Marks.

- b) Prior to construction commencing, the Contractor must:
 - i) obtain location details of all permanent survey marks registered with the Surveyor General within the construction area;
 - ii) give the Surveyor General a minimum of 10 Business Days' notice in writing (via email to dti.surveyoperations@sa.gov.au) of the following:
 - A. the commencement date of construction activities; and
 - B. the possible destruction of a permanent survey mark registered with the Surveyor General.
- c) A copy of all notifications provided to the Surveyor General in section 6.1b)ii) must be provided to the Principal within 24 hours of such notification.
- d) The Contractor must submit a document that includes:
 - i) the details of any correspondence with the Surveyor General; and
 - ii) evidence that the Surveyor General has responded and provided its requirements to protect survey marks under the *Survey Act 1992* (SA),which will constitute a **Hold Point**. The Contractor must not commence any relevant Works or Temporary Works (including demolition) until this Hold Point has been released.

6.2 Re-instatement and placement of permanent survey marks

- a) In the event of damage, disturbance or removal of any permanent survey mark, the Contractor must:
 - i) re-install or replace the permanent survey mark;
 - ii) liaise with a representative from the Surveyor General's office when undertaking these activities;
 - iii) ensure this work is certified by the Surveyor; and
 - iv) submit to the Surveyor General field observations, coordinates, locality sketches and other information as requested.
- b) Details for placement of permanent survey marks are outlined in the Department Cadastral Survey Guidelines.
- c) Details for the requirements for the coordination of permanent survey marks are outlined in the Department Cadastral Survey Guidelines.

6.3 Review of data

- a) The Contractor must:
 - i) prepare and set out data from IFC Design Documentation and digital design prior to and during construction;
 - ii) provide a certificate verifying the survey coordinate information supplied by the Principal, which will constitute a **Hold Point**. The Contractor must not submit Design Documentation until this Hold Point has been released;
 - iii) seek direction from the Principal if any survey stations are missing or disturbed; and
 - iv) detect any design discrepancies or ambiguities.
- b) Where there is disagreement with any co-ordinates or levels provided by the Principal, the Contractor and the Principal must agree on the values to be adopted before any setting out is commenced. The Contractor must submit a request to the Principal outlining the proposed values to be adopted, which will constitute a **Hold Point**. Setting out must not commence until this Hold Point has been released.

6.4 Existing survey marks

- a) The Contractor must maintain a site list of all existing survey marks within the Site, listing coordinates and status.
- b) Prior to Completion, the Contractor must supply to the Principal a certificate of the site stations list, in Microsoft Excel (.xlsx) format detailing:
 - i) the survey stations supplied by the Department that are intact;
 - ii) the survey stations supplied by the Department that have been destroyed or disturbed;
 - iii) a sorted station listing by label detailing the coordinates, the type of ground mark and the witness mark, of all additional survey marks placed by the Contractor;
 - iv) permanent survey marks registered with the Surveyor General that are intact; and
 - v) permanent survey marks registered with the Surveyor General that have been destroyed or disturbed.
- c) Provision of the certificate required in section 6.4b) will constitute a **Hold Point**, which is a condition precedent to Completion.

6.5 Survey dataset

Where the Contractor undertakes any design subsequent to the issue of the survey dataset by the Principal (including any updated survey dataset), it must be undertaken in accordance with the horizontal and vertical grid consistent with the issued dataset.

6.6 Setout

The Contractor must set out all necessary design information needed to achieve the required construction tolerances relevant for the Works and Temporary Works. Verification certificates must be provided for all points, as part of the Quality Management Records.

6.7 Survey checks for pavement layers

When undertaking pavement verification:

- a) the Contractor must utilise the same point on all pavement layers, from subgrade to wearing course inclusive, for the purpose of determining total pavement thickness; and
- b) for concrete pavements, refer to RD-PV-D3 "Concrete Road Pavements" for additional surveying requirements.

6.8 Survey checks for rail layers

The Contractor must provide survey data for the following:

- a) turnout crossovers, including 'K' and 'V' crossings;
- b) rail signals and associated infrastructure (such as tuning units, axle counters etc.);
- c) new or altered rail furniture, including whistle boards, speed signs, etc.;
- d) structural clearance verification; and
- e) rail weights / locations.

6.9 Additional potholing of existing Utility Services

- a) The Contractor must survey locations of all deepened and constructed Utility Services including location of and top of service, as stated in PC-SI5 "Engineering Survey".
- b) For newly constructed Utility Services, actual positions (not offsets) of the Utility Service prior to any backfilling must be recorded.

- c) The Contractor must provide supporting information for each Utility Service, including:
 - i) details of Utility Service information where possible (such as diameter, material, number and configuration of conduits, condition);
 - ii) for sewers, both the invert and obvert level of the pipe and size / diameter of the manhole / IP;
 - iii) for drainage structures, invert and pipe diameter for all pipes penetrating the structure, and a notation for ingress or egress of the pipes;
 - iv) for water mains at valve covers, where possible record the main, otherwise record the top of the spindle and estimate a height above the main (in comments); and
 - v) any other relevant information (e.g. blocked, broken, plugged, etc.).
- d) Where multiple conduits (banks) are observed, the Contractor must:
 - i) expose all conduits in the top layer and excavate the sides of the bank until the conduits on the outsides of the lowest layer are exposed; and
 - ii) survey the top of each conduit in the upper layer of the bank and the underside of the outer conduits in the lowest layer, and record the configuration of the bank, (e.g. 4 X 4, 5 X 3).

6.10 Installation of new Utility Services

- a) The Contractor must ensure that the Surveyor:
 - i) sets out the proposed alignment of any new Utility Service, including the location of any adjoining infrastructure that may impact on the placement of the new Utility Service; and
 - ii) records the position of any new Utility Services or conduit(s), and makes measurements at all changes of direction, or grade, and at regular intervals of length, (e.g. 10 m).
- b) The Contractor must ensure that the Surveyor has access to undertake the measurements required in section 6.10a)ii) prior to any backfill of a Utility Services trench.
- c) The Contractor must provide bore log reports and digitised data for all underground boring as part of the Quality Management Records. Bore logs must clearly define the entry and exit points and show regular incremental measurements, generally at each bore rod length, represented in the planar project coordinate system (x,y,z).
- d) The minimum survey requirements for new Utility Services are specified in Appendix 1: Minimum survey requirements for new Utility Services.

7 Verification certificates

7.1 General

- a) Prior to Completion or within any other timeframe specified in the Contract Documents, the Contractor must ensure that the Surveyor provides verification certificates demonstrating that the Contractor's work complies with the tolerances specified in the Contract Documents. Verification certificates must:
 - i) identify the instrument used;
 - ii) be provided electronically in Microsoft Excel (.xlsx) format;
 - iii) include tables which display the information in a clear and logical format;
 - iv) for each design dimension / position / level, display:
 - A. the design value;
 - B. the actual value;

- C. the difference between actual value and design value; and
 - D. display the allowable tolerances in accordance with the Contract Documents; and
 - v) for pavement layers, the individual layer and total pavement thicknesses.
- b) The Contractor must submit the verification certificates required by section 7.1a) to the Principal, which will constitute a **Hold Point**. Release of this Hold Point is a condition precedent to Completion. The verification certificates must be included in the Quality Management Records.
- c) Where the work described in sections 7.2 to 7.8 forms part of the Contractor's Activities, at a minimum, the verification certificates required in section 7.1a) must confirm compliance with those requirements.

7.2 Roadworks

For roadworks, the verification certificates required in section 7.1a), must provide confirmation of compliance with Table PC-SI1 7-1.

Table PC-SI1 7-1 Roadworks compliance

Roadworks element	String label chainage at interval of reference string	Offset from reference string	Design level	Actual level	Difference between actual and design levels	Displacement from horizontal position
Stripping topsoil	Yes	Yes	-	-	-	-
Cuts / fills	Yes	Yes	-	-	-	Yes
Subgrade	Yes	Yes	Yes	Yes	Yes	-
Pavement layers including asphalt pavement treatments	Yes	Yes	Yes	Yes	Yes	Yes
Earth drains	Yes	Yes	Yes	Yes	Yes	Yes
Kerb and gutter (including bus guideway system)	Yes	Yes	Yes	Yes	Yes	Yes
Median kerb type 2, 3, 4, 4A	Yes	Yes	Yes	Yes	Yes	Yes
Median kerb type 1, 5, 6, 7, 8	Yes	Yes	-	-	-	Yes
Drainage culverts	-	-	Yes	Yes	Yes	Yes
Drainage structures	-	-	Yes	Yes	Yes	Yes
Lighting and traffic signal footings	Yes	Yes	Yes	Yes	Yes	Yes
Steel beam and wire rope safety barrier	Yes	Yes	-	-	-	Yes
Settlement monitoring	Yes	Yes	Yes	Yes	Yes	Yes

7.3 Cuts / fills

- a) For cut / fills, the verification certificates required in section 7.1a), must provide confirmation that that fills are located within the horizontal tolerances specified in accordance with the chainages set out in the geometric details applicable to:
- i) the reference string;
 - ii) top of batter; and
 - iii) batter interface string.
- b) Where the length of batter exceeds 15 m additional data must be obtained at the batter mid-point.

7.4 Subgrade and pavement layers including asphalt pavement treatments

- a) For subgrade and pavement layers including asphalt pavement treatments, the verification certificates required in section 7.1a), must provide:
 - i) confirmation that pavement layers are located within the horizontal tolerances specified in accordance with the chainages set out in the geometric details, including:
 - A. edge of pavement strings for subgrade and granular (bound or unbound) pavement layers;
 - B. edge of bitumen strings / gutter lip / face of median kerb for new asphalt works; and
 - C. edge of treatment strings / gutter lip / face of median kerb for plane and reinstate asphalt works; and
 - ii) confirmation of the pavement thickness in comparison with the design thickness for:
 - A. subbase layers;
 - B. asphalt levelling courses;
 - C. asphalt wearing course;
 - D. total asphalt thickness; and
 - E. total pavement thickness.
- b) For concrete pavements, refer to RD-PV-D3 “Concrete Road Pavements” for additional verification requirements.

7.5 Earth drains

For earth drains, the verification certificates required in section 7.1a), must provide confirmation of drainage string for earth drains every 10 m and at horizontal and vertical tangent points.

7.6 Structural works

For structural works, the verification certificates required in section 7.1a), must provide confirmation of the following:

- a) alignment and spacing of piles prior to placement of concrete (insitu piles);
- b) alignment and spacing of piles following placement of concrete (insitu piles);
- c) alignment and spacing of piles, founding reduced level on completion of driving (driven piles);
- d) location and level of pile caps after placing concrete;
- e) location and level of abutment sills after placing concrete;
- f) span lengths and location and levels of bearing pedestals or bearings;
- g) dimensions of precast girders;
- h) alignment and levels of placed girders;
- i) alignment and levels of deck after placing concrete;
- j) alignment and levels of kerb and gutter after placing of concrete;
- k) alignment and levels of barriers after installation; and
- l) alignment and position of reinforced soil structures.

7.7 Rail works

For rail works, the verification certificates required in section 7.1a), must provide confirmation of the following:

- a) setting out of all 'K' and 'V' crossings;
- b) setting out of all rail gauge face including check rails;
- c) setting out of all signal infrastructure;
- d) verification of structural clearance envelope;
- e) setting out and levels of piers prior to placing concrete;
- f) setting out and levels of abutment sill prior to placing concrete;
- g) setting out and levels of deck prior to placing of concrete; and
- h) setting out of reinforced earth walls.

7.8 Motorway operating systems

For motorway operating systems, the verification certificates required in section 7.1a), must provide confirmation of the following:

- a) clearance height of overhead motorway operating systems fitted above lane;
- b) clearance height of motorway operating system structures above lanes;
- c) over-height vehicle critical detection height at all points across the carriageway; and
- d) over-height vehicle enforcement detection height at all points across the carriageway.

8 Survey using global navigation satellite system (GNSS) equipment

- a) This section 8 applies where GNSS equipment is used.
- b) The Contractor must,
 - i) ensure that for each construction activity the instrument's threshold suitably meets the specified construction tolerances outlined in the Contract Documents;
 - ii) validate equipment and survey by occupying established survey control stations and comparing coordinates;
 - iii) prior to undertaking any observations or set out, localise onto the planar project coordinate system by observing survey control stations and document the results;
 - iv) verify a sample of set out by traditional survey methods; and
 - v) document and validate the methodology for modelling the geoid and its effects on heights.
- c) Real time kinematic GNSS may be used for horizontal set out for clearing lines, batter lines, bulk earthwork quantities and initial set out of earthworks.
- d) Real time kinematic GNSS must not be used for horizontal set out for any feature placed on or above the pavement course such as kerb-lines, medians, side entry pits, drainage manholes, structures such as culverts and bridges.

9 Property boundary marking

Where the Project requires construction activity within 500 mm of a property boundary, the property line must be determined using the most current cadastral information supplied by the Principal or

Land Services SA (as applicable). The survey must be carried out by or under the direct supervision of a licensed surveyor in accordance with the *Survey Act (1992) SA*.

10 Provision of as-constructed information

- a) The Contractor must provide:
 - i) an electronic copy of the combined verification certificates required in section 7.1a), including 3D model in either 12d ascii, MX Genio or AutoCad dwg format containing the following as specified by the Principal:
 - A. final pavement layer;
 - B. kerbs;
 - C. light poles;
 - D. side entry pits;
 - E. structural elements;
 - F. rail infrastructure;
 - G. all newly placed Utility Services;
 - H. all existing Utility Services retained or redundant and left in place; and
 - I. any other elements as outlined in the Contract Documents;
 - ii) all new survey control placed and used for this Project; and
 - iii) a consolidated set out report of all design information used for the construction works as an electronic Microsoft Excel (.xlsx) spreadsheet.
- b) The model data must comply with the Principal's survey codes and model naming convention in an "As-Constructed" model in accordance with PC-SI5 "Engineering Survey".
- c) The information required by this section 10 must be submitted as a single deliverable, prior to Completion, which will constitute a **Hold Point**. The release of this Hold Point is a condition precedent to Completion.

11 Records

The Quality Management Records must provide objective evidence that the Surveyor has completed all survey work in compliance with the requirements of this Master Specification Part and that all surveys comply with the specified tolerances.

12 Payment

Unless a separate payment item or amount for an activity pursuant to this Master Specification Part is included in the "schedule of rates" or "schedule of prices" (or equivalent), separate payment will not be made for survey work. Payment for survey work for which there is no separate payment item or amount is deemed to be included in other rates and amounts generally.

13 Hold Points

Table PC-SI1 13-1 details the review period or notification period, and type (documentation or construction quality) for each Hold Point referred to in this Master Specification Part.

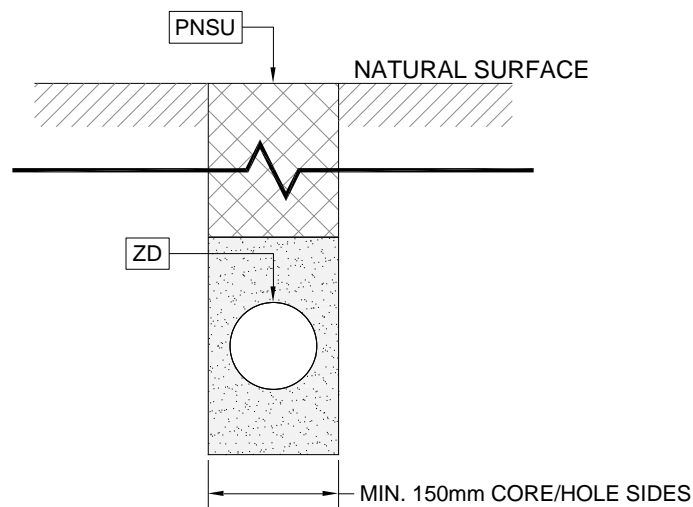
Table PC-SI1 13-1 Hold Points

Section reference	Hold Point	Documentation or construction quality	Review period or notification period
5.2d)	Evidence of initial EDM testing	Documentation	10 Business Days review
5.2e)	Evidence of EDM re-testing	Documentation	5 Business Days review
5.4g)	Evidence of initial GNSS equipment testing	Documentation	10 Business Days review
5.4h)	Evidence of GNSS re-testing	Documentation	5 Business Days review
6.1d)	Correspondence with the Surveyor General	Documentation	5 Business Days review
6.3a)ii)	Certificate verifying the survey coordinate information supplied by the Principal	Documentation	5 Business Days review
6.3b)	Request outlining the proposed co-ordinates values or levels	Documentation	5 Business Days review
6.4c)	Existing survey marks certificate	Documentation	5 Business Days review
7.1b)	Verification certificates	Documentation	5 Business Days review
10c)	Provision of as-constructed information	Documentation	5 Business Days review

14 Appendix 1: Minimum survey requirements for new Utility Services

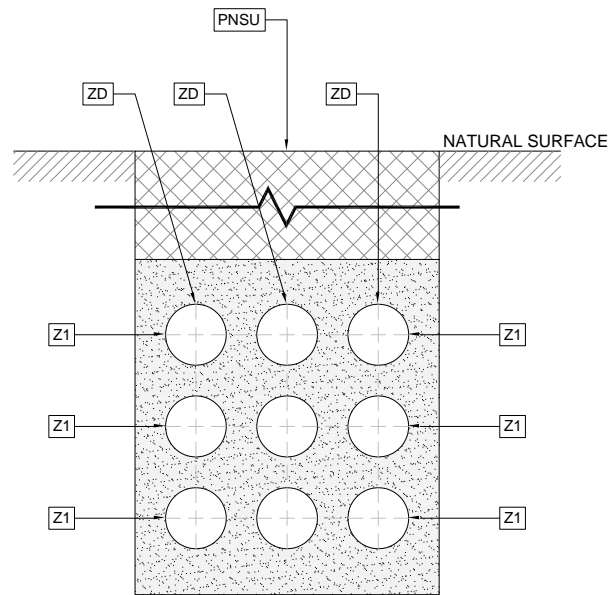
- a) Example notation and requirements for a cross section of a hole by the verified method is shown in Figure PC-SI1 14-1, where:
- i) ZD - Z = denotes top of service;
 - ii) D = 100 m dia (letter varies depending on service diameter);
 - iii) PNSS - denotes natural surface RL at the hole; and
 - iv) labelling must be in accordance with the Department Survey String Identifiers.

Figure PC-SI1 14-1 Cross section of a hole



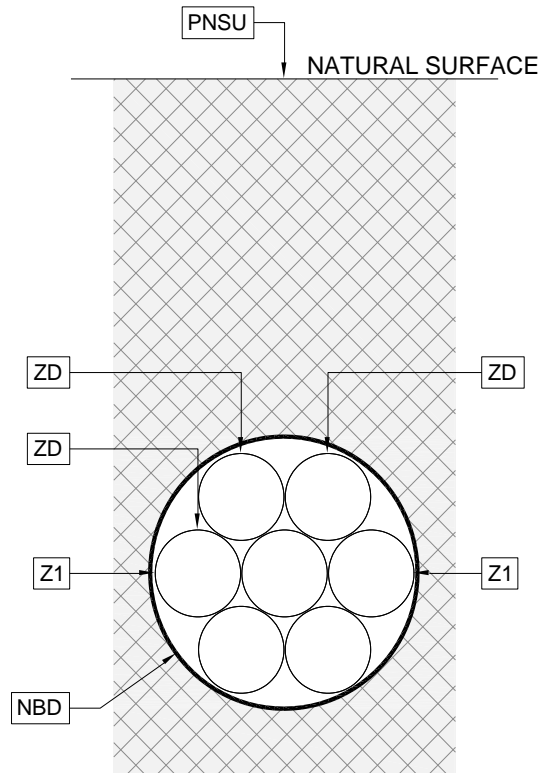
- b) Example notation and requirements for a cross section of a trench by the verified method is shown in Figure PC-SI1 14-2, where:
- i) Z1 - denotes pipe bundle edge;
 - ii) ZD - Z= denotes top of service; D = 100 m dia (letter varies depending on service diameter) PNSS- denotes natural surface RL at the trench / slot; and
 - iii) labelling must be in accordance with the Department Survey String Identifiers.

Figure PC-SI1 14-2 Cross section of a 'trenched multi conduit run' or 'trench / slot'



- c) Example notation and requirements for a bore of bundled conduits by the verified method is shown in Figure PC-SI1 14-3, where:
- i) Z1 - denotes pipe bundle edge located using verified method (refer to Figure PC-SI1 14-1);
 - ii) ZD - Z = denotes top of service;
 - iii) D = 100 m dia (letter varies depending on service diameter);
 - iv) PNSS - denotes natural surface RL, at 10 m intervals above bore;
 - v) NBD - denotes Nominal Bore Diameter (to be recorded on 'Service Deepthing Record' in under the 'Other Comments' column; and
 - vi) labelling must be in accordance with the Department Survey String Identifiers.

Figure PC-SI1 14-3 Cross section of a bore of bundled conduits



A. Example notation and requirements for an under bore using the verified and passive method is shown in

vii) Figure PC-SI1 14-4, where:

- A. PNSU - denotes natural surface RL, at 10 m intervals above bore;
- B. PUTT - denotes top of conduit bundle, at 10 m intervals, either potholed (verified method) or through bore logs (passive method); and
- C. labelling must be in accordance with the Department Survey String Identifiers.

Figure PC-SI1 14-4 Long section of an under bore

