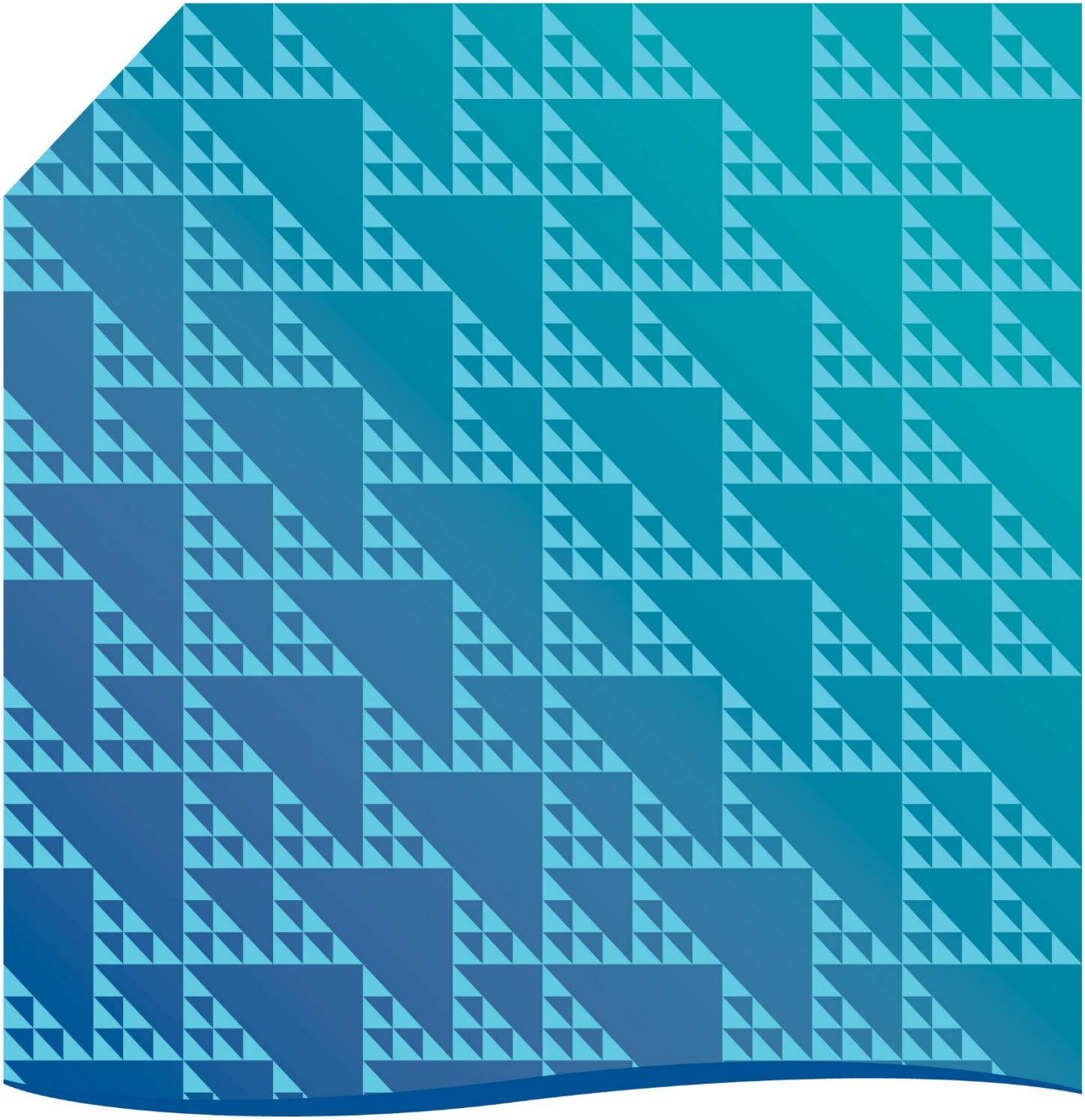
Professional Services
Specifications (PSS)

Last updated:
September 2020

T4 – Engineering Survey for Planning and Design ***INTERIM UPDATE***



Department of State Growth

Tasmanian Government

Contents

Revision History

Version No.	Date	Description of changes
1.1	September 2020	Interim version to prior to taking a detailed review. Template updated and references to "DIER" removed. Superseded documents/entities and links updated.

T4.1 Scope

This Specification is in the process of being fully reviewed to incorporate specific requirements for information delivered using new technologies; such as mobile / terrestrial laser scanning, airborne LiDAR and Remote Piloted Aircraft Systems.

It intends to provide guidance / guidance on the provision of survey based on point cloud data to create terrain and feature models at specific stages of planning and design, what must be included and may be excluded at those stages, outline any re-processing that might be required at each specific stage and the meta data describing the limitations that must be provided at each stage of delivery to ensure that it is not used outside its limitations.

The review intends on providing guidance on the requirements of other types of terrestrial other data acceptable for planning activities, such as Photogrammetry or LiDAR and the limitations of where it can be used.

The review will to cross reference Construction Specifications to eliminate discrepancies that might exist between the tolerances required for construction and this specification.

The review will update / confirm qualifications required for components of survey work.

This interim version of the Specification contains minor updates only.

This specification sets out the requirements for the provision of engineering survey for planning and design activities, and for preparation of data and documentation required for construction, in particular:

- Survey Control, both Primary and Minor;
- Engineering Surveys;
- Preliminary Property Boundary Surveys;
- Property Surveys;
- Digital Data.

All work shall be carried out in an environmentally sensitive manner and shall not cause damage to property. Any claims for damage associated with the survey work will be the responsibility of the Consultant.

This Specification is part of the set of specifications comprising the Professional Services Specifications (PSS).

T4.2 Objective

The objectives of this specification are to ensure that all surveys meet the minimum standards, as defined in this specification, in order for State Roads projects to achieve the required construction tolerances.

Note: The Survey Control Network and the linkages from the initial engineering detail survey through to construction set-out are pivotal to the successful installation of the constructed infrastructure to the Department's requirements.

T4.3 References and Standards

All surveys shall be in accordance with this Specification, all other Professional Services, Construction Specifications, and the *Surveyors Act 2002*.

Note: The NSW RTA Guide NG71 has been identified as a relevant source of information on specific instrumentation and observing techniques used in engineering and construction surveying to achieve specified levels of measurement accuracy commensurate with the Department's construction tolerances.

This can be found at https://www.icsm.gov.au/publications under the *Transport Authorities Survey And Mapping Managers (TASAMM)* heading.

T4.4 Definitions

The following interpretations apply to terms used in this specification:

- Datum
    - "GDA94" – Geodetic Datum of Australia 1994
    - "GDA2020" – Geocentric Datum of Australia 2020
    - "MGA" – Map Grid of Australia
    - "AHD" – Australian Height Datum (Tasmania)
- "Department's Representative" – The officer who has engaged the Consultant, e.g. "Crown Representative" (Crown based General Conditions of Contract), "Principals Representative" (AS4122 General Conditions of Contract for Engagement of Consultants).
- "DYBD" – Dial Before You Dig. A free national referral service designed to assist in preventing damage and disruption to infrastructure networks. Referrals are provided to relevant utility owners registered with the service, who then provide information of the location of their utilities. Required to establish the location of underground utilities in particular.
- "GPS" - The satellite based Global Positioning System developed by the American military in the 1970's and now used extensively worldwide by civilian users. One of the position products available is the Real Time Kinematic (RTK) system which is capable of providing real time three dimensional measurements with a Local Uncertainty of around 30mm. GPS is the original and most common Global Navigation Satellite System (GNSS) – other systems (existing and proposed) include GLONASS (Russian), GALILEO (European) and COMPASS (Chinese). In this specification where GPS is used it is taken to represent any or all of the GNSS systems, individually or combined.
- "G71" and "Guide NG71" – In 2005 the NSW Roads and Traffic Authority (RTA) developed its *Quality Assurance Specifications for Road Construction Surveys (G71)* and an accompanying set of guidelines *Guide to G71, Quality Assurance Specifications for Road Construction Surveys (NG71)*. In 2007 ICSM *and* TASAMM (Transport Authorities Surveying and Mapping Managers) commenced a review of those documents to assess their compliance with ICSM's SP1 which was completed in November 2009. The documents are available at https://www.icsm.gov.au/publications under the *Transport Authorities Survey And Mapping Managers (TASAMM)* heading.
- "Height of sight lines" – when used in relation to survey procedures it refers to the minimum vertical distance from the sight line to the natural surface.

- "ICSM" - The Inter-Governmental Committee on Surveying and Mapping (ICSM) is the body responsible for coordinating Commonwealth and State agencies who contribute to surveying and mapping at a national level to ensure continued cooperation and technical standards. Its role includes developing survey standards and specifications.
- "Local Uncertainty" – is the universally accepted measure of the quality of measurement by quoting a confidence interval about derived measurements. The ICSM defines Local Uncertainty in SP1 as: "the average measure, in metres at the 95% confidence level, of the relative uncertainty of the coordinates, or height, of a point(s), with respect to the survey connections to adjacent points in the defined frame".
- Models
    - "DTM" – Digital Terrain Model of the ground surface generated from a survey
    - "MX" – CADD Software, previously known as MOSS (Bentley Systems)
    - "Open Roads" – CADD Software (Bentley Systems)
    - "12d"– CADD Software (12d Solutions)
    - "Civil 3D" – CADD Software (Autodesk)
    - "AutoCAD" – CADD Software (Autodesk)
    - "Microstation" – CADD Software (Bentley Systems)
    - "GENIO" (GENeral Input Output) – text file imported to CADD Software to create a model,
    - "12da" – text file imported to CADD Software to create a model
    - "12daz" – compressed 12da file (7-zip)
    - "dwg" – Autodesk file format for 2D / 3D drawings and models
    - "dgn" – Microstation file format for 2D / 3D drawings and models
- "Minor Survey Control (MSC)" - MSC points are established as a stable point of reference for all operational survey aspects i.e. the acquisition of ground feature or cadastral boundary information, or the construction set-out survey. It is accepted that MSC points may be destroyed during the construction process.
- "Permanent Survey Mark" – a permanently monumented survey control mark with horizontal coordinates and/or height of known accuracy adopted as a permanent mark under Section 14 of the Survey Coordination Act 1944 (Tasmanian Act) and included in the online register (SuRCoM) maintained by the Tasmanian Office of the Surveyor General (https://surcom.dpipwe.tas.gov.au/surcom/jsp/login).
- "Primary Survey Control (PSC)" – is a substantial survey control mark that is intended to survive, undisturbed, the entire life of the project– from design to construction, including all necessary compliance and audit surveys. It will either be an existing Permanent Survey Mark or a mark of an approved form described in ***Clause T4.9 Survey Control***.
- "Sight distance" – when used in relation to survey procedures refers to the length of the sight line
- "SP1" – ICSM Special Publication 1 *Standard for the Australian Survey Control Network* (current version 2.1, October 2014), under the Standard for the Australian Survey Control Network heading available at https://www.icsm.gov.au/publications.
- "Standard Permanent Mark (SPM)" – A common prefix used in the name of many Standard Permanent Marks in SuRCoM. In this report the abbreviation SPM is used to generically refer to all of the Permanent Survey Mark types.

- "Survey Control" – a survey peg, bench mark, reference mark, or any other mark used or intended to be used for the purpose of measuring, setting out, or checking the actual or design surface.
- "Survey procedures" – methods to control parameters that affect the accuracy of survey techniques, such as a radiation procedure or height determination procedure.

T4.5 Access to Property Not Owned by the Department of State Growth

The rights to enter property not under the ownership of State Growth, and the process / communication required prior to entering these properties, to conduct survey activities are being reviewed within the Department of Stare Growth.

This process will supersede or update the following information and will outline requirements for advance notice to property owners and property occupiers, providing notice at the time property is being entered and determine if other conditions are required on the property (for example, where poppies are being grown personnel may need to be accompanied).

Access to property not owned/managed by the Department of State Growth is to be under the following Legislation:

- *Surveyors Act 2002*
- *Land Acquisition Act 1993*
- *Roads and Jetties Act 1935*.

The Consultant will be required to have written authorisation from the Department's representative prior to entering onto land not owned/managed by the Department.

The Consultant shall, more than four (4) days before the date on which the Consultant enters land, notify the relevant owner and/or occupier of:

- The consultants intention to enter on to the land;
- The purpose of the entry;
- The nature of the activity (including any potential disturbances);
- The planned duration of the entry.

Initial notification is to be in writing, with details of phone calls / personal exchanges with land owners and occupiers provided in a record of all communications as per T4.7.3 - Consultancy Records. Where practicable, contacting the owner / occupier when entering the land should be made before commencement of the required activities.

Entry onto adjacent land shall also be in accordance with Standard Specification PM4 PERMITS with regard to environmental and other statutory requirements.

T4.6 Consultancy Management Plan

The Consultant's Consultancy Management Plan shall include:

- Details of personnel including qualifications, equipment, work procedures and verification surveys to be used;
- All elements as listed in Professional Services Specification PM2 Project Management, in particular
    - Liaison with Service Authorities or Asset Locators to locate and expose underground services;
    - Liaison with Property Owners to inform them when work is being performed on their property and the nature of that work (ref ***Clause T4.5 Access to Property Not Owned by the Department of State Growth*** above);
- Traffic Management Plans in accordance with State Growths **Traffic Control for Works on Roads: Tasmanian Guide** and **Austroads Guide to Temporary Traffic Management.**

T4.7 Evidence of Compliance

T4.7.1 General

Evidence of compliance shall be included in a Survey Report for each activity undertaken in the Consultancy, i.e. Survey Control both Primary and Minor, Engineering Surveys, Preliminary Boundary Models and Property Surveys.

Evidence of compliance shall be submitted at each hold point.

The Consultants / Sub-Consultants survey work will be considered complete when all errors, ambiguities and deficiencies have been resolved in accordance with this Specification to the satisfaction of the Department's representative.

T4.7.2 Verification Surveys

For Engineering Surveys, independent verification surveys of the DTM **shall** be undertaken. That is, after completion of the DTM, additional site visits and new instrument set-ups are to be made to take actual (**manual**) measurements to check the DTM surface. The results of the surface verification survey are to be included with the submitted detail survey information.

T4.7.3 Consultancy Records

All survey information and records generated during the consultancy shall be the property of the Principal and shall be included in the consultancy records.

As a minimum the following shall be provided:

- A record of all communications with the owners and occupiers of property not owned/managed by the Department;
- Field notes of survey to establish and extend survey control networks. If field observations are by electronic means, copies of the raw and adjusted data in electronic format.

- Adjustment of survey control network with verification of Class of survey and an estimate of the Order of survey, in accordance with SP1;
- Electronic copy of raw (field) and reduced survey data generated during collection of feature strings;
- Summary table of all redundant observations, with comparisons, for the control survey to verify the accuracy of the surveys;
- Details of the validation of the ground survey model and certification that the survey conforms with this specification;
- Survey control sheets and survey drawings in accordance with ***Clause T4.12 Presentation of Information***.

T4.8 Survey Requirements

T4.8.1 General

The general requirements for the various surveys are:

Survey Type	Requirement
All Survey	Survey Control
Engineering Survey	Feature survey (including the location of utilities) Digital Terrain Model (DTM) (Triangulation) Contours of DTM Verification Survey
Preliminary Property Boundary Survey	Cadastral drawing or model with separate land areas identified by title reference and owner.
Property Acquisition Survey	Survey diagrams suitable for registration with the Land Titles Office, Tasmania

Each survey type shall be a separate model as either:

i) GENIO or 12da text files
ii) 3D AutoCAD Drawing
iii) 2D AutoCAD Drawing (Property Boundary Survey)

Survey feature string labels and / or layer names in CAD software shall be in accordance with ***Standard Professional Services Specification T13 CADD MANUAL.***

In undertaking all work the Consultant shall ensure that any test pits or excavations required are made and kept safe at all times, backfilled and the finished surface repaired appropriately.

T4.8.2 Qualification of Surveyors

All surveys shall be the responsibility of a qualified surveyor as listed in ***Table T4.8.2.1 Qualifications of Surveyors***. All surveyors are to be able to demonstrate competence in carrying out the required surveying tasks.

T4.8.2.1. Qualifications of Surveyors

Survey Element	**Qualification**
Survey Control	A person who holds a Diploma in Surveying, or a recognised equivalent, from a recognised tertiary institution and possess at least three (3) years practical experience as a survey party leader on major roadworks and/or bridgeworks as appropriate.
Engineering Survey	A person who holds a Diploma in Surveying, or a recognised equivalent, from a recognised tertiary institution and possess at least three (3) years practical experience as a survey party leader on major roadworks and/or bridgeworks as appropriate.
Preliminary Property Boundary Survey	Registered Land Surveyor under the (Tasmanian) Surveyors Act
Property Acquisition Survey	Registered Land Surveyor under the (Tasmanian) Surveyors Act

T4.8.3 Survey Standards

The technical survey standards applying to the *CLASS* of all horizontal and vertical control required under this specification are contained in *ICSM SP1*.

T4.8.4 Location of Utilities

The Consultant shall be responsible for proving the actual locations and level of all utilities prior to undertaking any work which may affect the utilities.

The Consultant should note that "Dial Before You Dig" may not cover all utilities in the area and note if there are other utilities present (for example, traffic signal cables / NBN / etc.).

Proving underground utilities requires that the utilities will be exposed and the coordinates and level of the utility (not the depth from surface) will be captured. This information is intended to be shown on construction drawings. This may require that utilities are exposed outside the construction limits to ensure that they are either unaffected by works, or that appropriate mitigations can be made to avoid damage during construction.

The location of TasNetworks stay wires and stay anchors are to be included.

The Consultant shall liaise with the appropriate Utility Owner to determine the exact location of each utility and any conditions that are required by the Utility Owner.

The Consultant shall adhere to any requirements of the responsible Utility Owner in the execution of the work.

Evidence of Compliance shall include records of "Dial Before You Dig" contact, Utility or Property Owners records, property owner and any other correspondence relating to the utility establishment.

T4.9 Survey Control

T4.9.1 Datum

Generally, the horizontal datum for all surveys should be the national datum to ensure seamless integration with all other national and state datasets. Currently this is GDA2020, with survey data to be provided in MGA coordinates. Generally, the vertical datum for all surveys should be the AHD (Tasmania).

It is vital that all design and construction documentation clearly indicates that coordinates are MGA since they are coordinates on a map projection. The MGA is a method of displaying a portion of the actual "curved" surface of the earth on a flat "map" surface and distortions in distance must necessarily occur. That is, the distance between these "map projection" coordinates is not necessarily what would be measured on the ground with a tape measure. The distortion in distance varies in relation to the distance from the central meridian of the map zone and the height above sea level of the survey area. The scale factor at the central meridian of a map projection zone at sea level is 0.9996. It increases moving east or west away from the central meridian but decreases as height above sea level increases. The combined effect of these two scale factors is represented by a single Combined Scale Factor (CSF).

A statement of the "average" CSF to be applied to convert from GRID to GROUND distances must be included in a Survey Report ***Clause T4.10.3 Engineering Survey Report*** from the engineering surveyor and be clearly shown on all sheets and electronic files, both of the detail survey and design plans, where the survey control coordinates are displayed. This is particularly critical for any designs that include bridge construction, since generally a bridge will include an amount of pre-fabricated elements that will need to be in GROUND distances, not map projection (MGA) distances.

The origin for the MGA coordinates and AHD height must be specified in an accompanying engineering surveyors' Project Report ***Clause T4.10.3 Engineering Survey Report***.

Where the use of either of these datums is not practical an alternative datum proposal shall be able to be submitted to the *Department's Representative* for approval prior to the commencement of any survey operations.

T4.9.2 Primary Survey Control Network

A Primary Survey Control Network shall be established. As a minimum, it shall consist of at least 3 Primary Survey Control (PSC) marks in the area of the detail of survey.

The prime consideration in the location of a PSC should be the safety of the surveyor and the public, including livestock.

A PSC mark should preferably be located so that it will survive indefinitely i.e. the life of the entire project. However, it is recognised that often during the engineering detail survey the extent of the final construction earthworks is not known sufficiently well to guarantee the PSC longevity. If this is the case the PSC must be positioned on the basis that it would survive intact indefinitely if no construction were to ever take place, with

the condition that PSC should never be placed between the centre-line and open road-side drain on a formation without kerb and guttering.

A PSC must either be an SPM or a mark of a form as follows:

- In stable soils a 600mm long star bar or minimum 14mm diameter rod driven so the top is at least 20mm below the natural surface;
- In rocky soils a 600mm long star bar or minimum 14mm diameter rod driven to resistance and cut off preferably 20mm below natural surface or as close as possible to natural surface if this is not achievable;
- A new bolt, screw or bar affixed with a rapid-set grout in a pre-drilled hole in concrete or bedrock;
- Any existing fixing bolt or bar in concrete;
- In areas with unstable (i.e. reactive) soils the PSC should be constructed in a manner that will meet the requirements of this clause;
- A PSC must have a witness mark unless it is not safe to livestock or the public to do so. The PSC should all have a unique identifying label; Ideally it should be attached to the physical mark, or alternatively a witness mark, and marked in a permanent way (i.e. the number stamped or engraved on an aluminium tag);
- The maximum distance between adjacent PSC marks shall not exceed 500m with a preference for placement so that they are intervisible;
- A PSC must be located adjacent to all road intersections so that it is possible to define intersection detail, a pair of marks may be needed for large intersections.

The PSC must meet the following standards in relation to survey accuracy:

- Horizontal Control - The survey class of the PSC must be CLASS B if using GPS techniques or CLASS C if using traditional surveying techniques, in accordance with Part A of SP1. Part B of SP1 provides suggested survey procedures for achieving these classes. GPS is not to be used where the PSC separation distance is less than 400 metres, due to the difficulties in consistently achieving the required Local Uncertainty between marks with smaller separation distances;
- Vertical Control - Height determination must comply with class LC for differential levelling techniques or CLASS C for trigonometrical heighting, (i.e. level difference better than $12\sqrt{K}$ mm). A one way level run between existing SPM's may be acceptable provided the comparison between the level run and the existing bench marks shows a difference of less than $12\sqrt{K}$ mm, otherwise a 2 way level run is required. GPS equipment is not to be used for measurement of height on the PSC, other than for the transfer of an AHD origin height to one PSC from an off-site SPM;
- Final PSC network or traverse coordinates must be derived from some form of adjustment, i.e. the final coordinates must be determined from redundant observations and they must not be field captured radiation / RTK GPS measurements.

The coordinate values of all existing SPM's used as PSC must only be adopted from SURCOM if their Local Uncertainty is validated during the Primary Control Survey as meeting the required survey CLASS outlined above.

T4.9.3 Minor Survey Control

The PSC will generally need to be broken down / extended so that all the information for the engineering survey and other investigation surveys may be measured using traditional surveying techniques. This is achieved with the Minor Survey Control (MSC).

There is no minimum requirement with regards to the number of MSC. The only determinate in MSC provision is if they are required for the engineering detail data capture method to meet the tolerances specified in ***Table T4.10.1.1 Tolerances***.

The intention is for the MSC to have the same level of precision as the PSC – only the marking standard, spacing and intended life span is different - so that theoretically they could be used for construction set-out subject to verification.

The prime considerations when placing new MSC for traditional surveying techniques are:

- the safety of the surveyor and public,
- the suitability of the mark for radiate observations,
- the long term stability of the mark,
- to avoid low height of sight lines when observing,

The physical characteristics of MSC are as follows:

- MSC may be physically marked by any of the following methods;
    - star bar,
    - steel spike,
    - wooden peg,
    - nail
    - drill hole in concrete or rock,
    - ramset nail in concrete
    - or with other similar materials
- The maximum spacing between MSC should be 200 metres.
- MSC should generally have a unique identifying label either attached to the physical mark (where possible) or to a witness mark. This label will have the MSC number marked on it in a permanent way (i.e. the number stamped or engraved on an aluminium tag).
- An MSC does not necessarily require a witness mark but one may be placed if it is safe to do so.

The MSC must meet the following standards in relation to survey accuracy:

- Horizontal Control - The survey class of the MSC must be CLASS C using traditional surveying techniques, in accordance with Part A of SP1. Part B of SP1 and Guide NG71 provide suggested survey procedures for achieving these classes. GPS is not to be used for directly coordinating MSC, due to the difficulties in consistently achieving the required Local Uncertainty between marks with smaller separation distances.
- Vertical Control - Height determination must comply with class LC for differential levelling techniques or CLASS C for trigonometrical heighting. (i.e. level difference better than $12\sqrt{K}$ mm). A one way level run

between existing SPM's or PSC may be acceptable provided the comparison between the level run and the existing bench marks shows a difference of less than 12√K mm, otherwise a 2 way level run is required. GPS equipment is not to be used for measurement of height on the MSC.

- Final MSC network or traverse coordinates must be derived from some form of adjustment. I.e. the final coordinates must be determined from redundant observations and they must not be field captured radiation / RTK GPS measurements.
- The MSC may be augmented with additional non-substantial temporary marks in order to obtain infill detail. These marks must be clearly differentiated as temporary and must not be included in the Station List of the Survey Report. The temporary marks must be placed with sufficient accuracy to ensure that the Spatial Data tolerances for the feature details specified in Table 1 are met.

T4.10 Engineering Detail Survey

T4.10.1 General

Engineering detail surveys shall include all features, ground levels, overhead and underground utilities.

All points that represent a single feature shall be a single string.

Stringlines and select points within each string shall be created to ensure that the surface modelling of existing features will meet the general tolerances in ***Table T4.10.1.1 Tolerances***. That is, for any point randomly selected on the surface the height difference and horizontal distance between the coordinates within the DTM and their true values must comply with the tolerance specified in ***Table T4.10.1.1 Tolerances.***

T4.10.1.1. Tolerances

Feature	**General Tolerance (m)**	
	Horizontal. Distance	Height Difference
Nominated Special Features	±0.02	±0.005
Railway, roads and bridges included in the design	±0.02	±0.01
Roads and bridges located as a natural feature	±0.05	±0.03
Roads and bridges where pavement overlay is considered	±0.02	±0.01
Railway lines	±0.03	±0.01
Drainage structures (Sewer, SW) including pipe inverts	±0.05	±0.02
Natural Surface	±0.25	±0.10
Batters, edge of formation and drains	±0.10	±0.05

Feature	General Tolerance (m)	
	Horizontal. Distance	Height Difference
Buildings including floor heights	±0.05	±0.03
Utilities above ground	±0.10	±0.05
Utilities below ground	±0.20	±0.20
*Trees / edge of vegetation	±0.25	±0.10

*Note: * Trees / edge of vegetation may be given null levels if the topography has been accurately defined by other strings.*

RTK GPS is NOT to be used to capture information for a building or any feature where the Horizontal Distance or Height Difference tolerance is less than ±0.05.

For the survey of an existing pavement, bridge, or railway, strings shall have points approximately adjacent each other and at even intervals measured along the road centreline. The approximate maximum interval should not exceed 20 metres - a smaller interval may be required (i.e. on roads with tight curves). Additional points may be required to accurately represent the changes in pavement shape. Edge and centreline strings shall generally be continuous in the direction of the link chainage

In addition to all other accuracy requirements, the side lengths of triangles forming the DTM must not be greater than 25 metres on pavement areas and 50 metres in all other areas.

T4.10.2 Verification Surveys

The DTM surface must be verified and results included in the Engineering Survey Report.

The following guidelines apply to verification surveys:

- **Validation strings must be observed independently of the survey observations**;
- The verification strings may be in a separate model and not included in the detail model;
- The survey control used must be the same control used for the engineering survey. However the same instrument set-up for ground detail and verification measurements must not be used. The instruments must be completely removed and re-set up. The preferred method is to make the validation observations following completion of processing the engineering survey;
- Validation strings must be provided as follows:
    - A minimum of three strings per survey, and
    - Two strings per road intersection, and
    - One string for each 200 metres of surveyed corridor on urban projects, or
    - Rural projects
        - three per kilometre for projects under three kilometres in length, or
        - nine strings plus two per kilometre over three kilometres for projects between three and ten kilometres long, or
        - twenty three strings plus one per kilometre over ten kilometres for projects greater than ten kilometres long,
- Each string should traverse the model at approximately 45 degrees to the nominal centreline of the road.

The DTM surface shall be compared to the verification strings and the height differences reported. The surface is deemed to pass vertical deviation requirements if 80% of verification points are within the accuracy range specified in ***Table T4.10.2.1 Verification Ranges***.

T4.10.2.1. Verification Ranges

Feature	**Vertical Tolerance (m)**
Roads and bridges included in the design	±0.01
Roads and bridges located as a natural feature	±0.03
Roads and bridges where pavement overlay is considered	±0.01
Railway lines	±0.01
Drainage structures inc pipe inverts	±0.02
Natural Surface	±0.10
Batters, edge of formation and drains	±0.05

T4.10.3 Engineering Survey Report

A full survey report shall be provided. It should include the following details as a minimum:

- Table of Contents
- Location of survey, type and State Growth consultancy number
- Surveyors name(s) and equipment used
- Horizontal Control - a brief description of the closure adjustment and Local Uncertainty achieved.
- Vertical Control - a summary table of the of accuracies (closures) achieved in the two levelling runs and values adopted, datum mark(s) adopted and discrepancies with existing SPMs with published AHD values
- A Station listing of only those marks sufficiently stable and precise for use as construction set-out (i.e. PSC and MSC): sorted according to traverse order, containing station identifier, corresponding SPM number (if applicable), Map Grid of Australia 94 (MGA94) coordinates and AHD height, the CSF at that point, the type of ground mark and witness mark, the source of the mark coordinates (whether adopted from SuRCoM or calculated by the survey)
- The "average" CSF value adopted to convert from PLANE to GRID distances
- List of all Models: relevant comments associated with any model included, in particular the estimated accuracy of the property boundary model
- Exception Report: details of any abnormalities relating to the survey, e.g. if the "boundary model" has regions of reduced accuracy
- Certification that survey procedures to satisfy required accuracy standards (as per the specification) were employed.
- Results of the DTM verification surveys

T4.10.4 Preliminary Property Boundary Survey

The Preliminary Property Boundary Model shall consist of a model that includes the following clearly identified information:

- Property boundaries;
- Owners names;
- Folio References;
- Easements and other encumbrances affecting the land;
- Nature of ownership of road corridor including "User Roads";
- Crown Land and Reservations.

Compilation of existing boundaries shall be made ensuring probable error in position of calculated boundaries does not exceed 0.5m in rural areas and 0.25m in urban areas.

T4.11 Property Acquisition Surveys

All Property Acquisition Surveys shall meet the requirements of the Surveyor General and the Survey Direction pursuant to the Surveyors Act. Survey diagrams shall be prepared to the requirements of the Lands Titles Office.

T4.12 Presentation of Information

T4.12.1 Drawings

All survey drawings shall be in accordance with ***Standard Professional Services Specification T13 CADD MANUAL*** and the Project Brief.

T4.12.2 Survey Control Sheet

The survey control sheet shall be provided as a separate sheet and shall contain the primary Survey Control network schedule with easy identification and field location of the survey control network.

T4.12.3 Primary Survey Control Network Schedule

The schedule shall list the values of all adopted survey control marks used in the survey as identified in ***Table 0***

Primary Survey Control Network *Schedule.*

T4.12.3.1. Primary Survey Control Network Schedule

String Label	Easting	Northing	Class Order	Source	Height AHD	Class Order	Source	Combined Factor	Description	

T4.13 Payment

Further to ***Standard Professional Services Specification PM1 General Provisions Clause P1.7 Payment***, payment shall be as detailed in the project brief. No payment shall be made until all survey information and reports have been received and accepted.

T4.14 Hold Points & Deliverables

The following hold points have been identified in this specification:

T4.14.1 Hold Points

Ref	Description of Hold Point	Nominated Work not to proceed	Evidence of Compliance
T4.6	Submission and acceptance of Consultancy Management Plan	All work	Consultancy Management Plan
T4.6	Traffic Management Plan	All field work	Traffic Management Plan
T4.7	Provision of all data and reports	Completion of the project	Survey reports, verification surveys, consultancy records

T4.14.2 Deliverables

Name	Timing	Digital File Format
Communication Records	At completion of survey	• PDF • Consultation Manager (if appropriate)
Survey Control	At completion of survey	• CAD (AutoCAD preferred) • Text (GENIO preferred, 12da acceptable)
Engineering Survey • Feature Model • Digital Terrain Model (Triangulation) • Contour Model • Verification Model	At completion of survey	• CAD (AutoCAD preferred) • Text (GENIO preferred, 12da acceptable)
Preliminary Property Boundary Survey	At completion of survey	• CAD (AutoCAD preferred) • Text (GENIO preferred, 12da acceptable)
Survey Report	At completion of each stage of survey	• PDF
Property Acquisition Survey	At completion of survey	* • CAD (AutoCAD preferred) • Text (GENIO preferred, 12da acceptable)

* Deliverables to In line with the requirements of the Lands Titles Office.

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