

**Manual**

**TMR Surveying Standards  
Part 1 – General Information**

**January 2022**

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## **1 Introduction to the Standards**

### **1.1 Overview**

This *TMR Surveying Standards* document provides the specific requirements for the collection of survey data in any of the geomatic survey types used by the Department of Transport and Main Roads and also supplies the rigid application of context to that data. It is the covenant between users of Geospatial Information and the suppliers of this information. This document is to be used to supply surveying information to the department.

In this document, 'Standards' shall mean the current Department of Transport and Main Roads Surveying Standards document. The 'department' shall mean the Queensland Government department whose Chief Executive is responsible for the administration of the *Transport Infrastructure Act 1994* and associated legislation or their successors. 'DoR' shall mean the Queensland Government department whose Chief Executive is responsible for the administration of the *Surveyors Act 2003* and associated legislation or their successors.

### **1.2 Purpose**

The purpose of this document is to:

- a) advise all providers of geospatial information of the requirements applicable in undertaking surveying activities for, or on behalf of, the department, and
- b) advise all users of the survey product of the meaning/application of the geospatial information supplied.

It is intended that the Standards provide:

- safe supply of survey services both for those supplying the information and the general public
- an understanding of the strengths and limitations of particular geomatic types of surveys to allow 'fit for purpose' supply of geospatial information
- completeness, appropriateness and traceability of geospatial information supplied by surveying services
- standardisation of the presentation of geospatial information provided by surveying services throughout the department
- adequate accessibility to geospatial information provided by surveying services and protection from corruption.

### **1.3 Conditions for release**

This documentation is supplied on the following basis:

- a) The documentation is supplied on an 'as is' basis and no representation, warrant or guarantee is given by the department regarding:
  - i. its completeness, accuracy, adequacy or content, and
  - ii. any interpretations, deductions, opinions or conclusions that may be expressed or implied.
- b) Any interpretations, deductions, opinions or conclusions made by the recipients of the documentation are at the recipient's risk and the department accepts no liability or obligation in respect of the use of such documentation.

#### **1.4 Intellectual Property (IP) rights**

The intellectual property rights of any information produced by the survey shall be assigned to the department.

#### **1.5 Ownership of data**

All materials and information supplied in the commissioning of a survey project remain the property of the department. It shall not be used, copied or reproduced for any other purpose without the prior written approval by the department. The release of some data and information to external organisations may also require a Memorandum of Understanding to be signed prior to its use.

All materials and information supplied as part of the deliverables of any project shall become the property of the department. Custodianship shall reside with the Project Manager - the Principal Advisor (Geospatial Information). It shall not be used, copied or reproduced for any other purpose without the prior written approval by the custodian or the department.

#### **1.6 Structure of these Standards**

The Surveying Standards consists of two Parts and one Schedule.

#### **Part 1 – General Information**

This provides:

- an introduction to, and an explanation of, the Standards
- details of Surveyor qualification, experience and accreditation requirements
- the requirements for those aspects of surveying services that may be generally applied to all geomatic types of surveys undertaken
- the requirements of a survey brief
- Survey Datum and Survey Mark requirements, and
- the Survey Data Transfer requirements.

#### **Part 2 – Geomatic Survey Types**

This part describes the express requirements for the different types of geomatic surveys undertaken by the department and includes:

- ground and feature model surveys
  - including bridge and underground asset surveys
- Construction surveys
- audit surveys
- aerial photography surveys
- GNSS survey control, and
- cadastral surveys

These requirements will be enhanced for existing geomatic types as new technology and processing methodologies dictate.

## **Schedule 1 – Codes, Linestyles and Examples**

This provides the department's field codes used to represent survey data. It also shows the linestyles used to display those codes both on the screen and when plotted to hardcopy.

Situational examples show where, and how to use field codes to assist users to meet Transport and Main Road's requirements.

### **1.7 Definitions**

The following definitions (and abbreviations) are to be used in the context of this document.

#### **AUSGeoid2020**

AUSGeoid2020 is a 1' by 1' (approximately 1.8 km) grid used to transfer heights between the ellipsoid (GDA2020) and the Australian Height Datum (AHD). Unlike older versions of AUSGeoid ('93/'98).

AUSGeoid2020 provides users with height offset between the ellipsoid and AHD as opposed to the ellipsoid and the geoid.

AUSGeoid2020 provides uncertainty values.

#### **Australian Height Datum (AHD)**

Australian Height Datum is the national height datum surface based on mean seal level for 1966-1968 at 30 tide gauges around Australia, adopted by the National Mapping Council in 1971 (AHD71) as the datum to which all vertical control for mapping is to be referred.

#### **Bench marks**

Permanent or semi-permanent marks placed in a vertically stable environment primarily for the purpose of providing a height reference.

#### **Contractor**

The person identified in the contract as having the responsibility for providing the services, set out in the survey brief, which forms the basis of the contract.

#### **Cadastral Survey Requirements (CSR)**

Sets out a range of information, including standards and guidelines, that surveyors may require in relation to the conduct of cadastral surveys in the state of Queensland.

#### **Datum**

A set of parameters which define the origin and orientation of a reference system with respect to a fundamental absolute system.

#### **Datum Control Surveys**

These surveys define, extend or improve the National Geospatial Reference System (NGRS). These control surveys are included in NGRS adjustments to allow for the most rigorous estimation and testing of position and uncertainty for new and existing survey control marks in the NGRS. (refer SP1)

#### **DoR**

Department of Resources (Queensland)

#### **Gazettal chainage**

The cumulative chainage from the declared start of the road.

### **Geocentric Datum of Australia 2020 (GDA2020)**

An ellipsoidal surface expressed as latitudes and longitudes which has its origin at the centre mass (hence the term Geocentric) of the earth. The coordinate datum of the GDA2020 is the Australian Fiducial Network (AFN), which is tied to the International Earth Rotational Reference System (IERS) Terrestrial Reference Frame 2014 (ITRF2014), epoch 2020.0

### **Geospatial data/information**

Data/information with horizontal and vertical co-ordinates based on a grid system referenced to the earth.

### **Map Grid of Australia (MGA)**

Cartesian coordinates from a Universal Transverse Mercator projection.

The Coordinate Reference System (CRS) has three map projection zones for Queensland and for GDA2020 are expressed as:

- GDA2020 / MGA zone 54
- GDA2020 / MGA zone 55
- GDA2020 / MGA zone 56

### **National Geospatial Reference Frame (NGRS)**

The National Geospatial Reference System is Australia's high accuracy spatial referencing system.

### **Permanent Survey Mark (PSM)**

Permanent survey marks form part of the state's survey and mapping infrastructure and are maintained within the survey control register by DoR.

### **Project Reference Frame (PRF)**

The project location as evidenced by the coordinates of the Project Reference Frame Marks.

### **Project**

An enterprise undertaken which creates and delivers a unique product or service. It will contain activities with start and finish dates undertaken to achieve an objective. This objective will contain specific requirements including time frames, costs and resources.

### **Project Customer**

The person requesting and paying for the survey services.

### **Project Manager**

The person authorising the provision of surveying services and having responsibility for the co-ordination of a project including accepting the project deliverables – the Principal Advisor (Geospatial Information).

### **District Safety Officer**

The person nominated by the District Director whose authority includes all safety issues within the District.



## **Safety plan**

This is the plan that sets out the procedures that will be followed in applying the requirements of the *Work Health and Safety Act 2011* to complete the project.

## **SP1**

Standard for the *Australian Survey Control Network - Special Publication 1, version 2.2*, October 2014

## **Spheroidal heights**

Global positioning, such as GNSS, will generally give a latitude, longitude (or x and y position) and height. This height is usually the height above (or below) the spheroid (ellipsoid).

## **Survey**

All activities undertaken for a transport infrastructure purpose that define natural or artificial features, below, on or above the earth's surface, excepting that a survey, which involves the definition of the cadastre, shall be a cadastral survey.

## **Survey brief**

The instrument that authorises or instructs a Surveyor to perform a survey on behalf of the department, and sets out the requirements and instructions for the survey project. Survey brief may also be referred to as Project Brief.

## **Survey Control Database (SCDB)**

The register of all permanent survey marks in Queensland which includes coordinates, height, access notes and other administrative information.

## **Survey plot code library**

The document that sets out the departments' standard codes for feature points and strings.

## **Survey marks**

Permanent or temporary marks, either existing or specifically placed, used for survey purposes.

## **Survey records**

The documents necessary to adequately record every aspect of the survey, which may include:

- a) a measurement or an analysis made for, or in relation to, the survey
- b) information about:
  - i. survey marks placed in carrying out the survey, or
  - ii. survey marks used as reference points in carrying out the survey.
- c) the plan of survey, and
- d) any electronically produced measurement, analysis or plan of survey.

## **Surveyor**

Surveyor shall mean a competent person who takes personal responsibility for the survey with the qualifications and experience required as detailed in Section 2.4.3.

## **Uncertainty**

Uncertainty in these Standards means doubt about the validity of a measurement or result of a measurement (e.g a coordinate). It is an indication of how wrong a value may be and is used in these Standards to quantify the level of survey quality. Uncertainty is expressed as a standard of deviation in the International System of Units (SI) expanded to the 95% confidence level.

### **Uncertainty – Positional (PU)**

The uncertainty of the horizontal and/or vertical coordinates of a survey control mark with respect to datum.

## **2 General survey requirements**

### **2.1 Introduction**

This document outlines those aspects of survey requirements that apply to all geomatic survey types. It is the intention that this chapter, together with *Part 2 – Geomatic Survey Types* and *Schedule 1 – Codes, Linstyles and Examples*, will provide direction to ensure that any survey undertaken on behalf of the department will conform to the geospatial information requirements of the department.

### **2.2 Strategic policy – the wider corporate need**

The department is the state-wide road system manager. A consequence of this management role is that road projects are no longer isolated project sites, but form part of a state-wide road system network. To adequately manage this road system network, the relative geospatial locations of road projects are required to integrate information from one project to another.

There is therefore an increased need to supply crucial geospatial information to provide more informed management of the state-wide road system network and facilitate stakeholder relationships.

Surveys for Transport and Main Roads form part of the state's survey and mapping infrastructure and are of value to the community because they contribute to the state's economic, environmental and social development.

It is the responsibility of the Project Manager to make the Project Customer aware of the value to the corporation of the wider purposes to which this information can be put at the time of commissioning of the survey.

#### **2.2.1 Survey and mapping infrastructure purpose**

Survey's for Transport and Main Roads are of value for a survey and mapping infrastructure purpose, and therefore are subject to the conditions contained in the *Surveying and Mapping Infrastructure Act 2003* and *Surveying and Mapping Infrastructure Regulation 2014*.

The *Survey and Mapping Infrastructure Regulation 2014* states that:

*A survey is of value for a survey and mapping infrastructure purpose if, for example, the survey:*

- *produces information in a form that can be recorded in a state dataset; or*
- *places permanent survey marks; or*
- *makes measurements between permanent survey marks; or*
- *makes measurements that establish the relationship between the geodetic reference framework and a subsidiary framework (example of a subsidiary framework – cadastral boundary system).*

Surveys of value to surveying and mapping infrastructure must be carried out in a way that achieves the survey's intended purpose. The survey's intended purpose may be achieved by, for example:

- establishing appropriate survey marks for the survey by:
  - placing survey marks of a type complying with the relevant survey standard, or
  - using existing survey marks as reference points, and
- depicting in the survey record, the spatial location and extent of the features surveyed as required by an established survey standard, and

- achieving an acceptable level of survey quality that is appropriate for the survey's intended purpose as required by an established survey standard.

### **2.3 Geospatial information**

It should be noted that geospatial information is not just data, but 'data in context'. The context of geospatial data is provided by its position and relevance. This context can only be meaningfully supplied by competent and qualified surveyors using uniform and published standards. The relevance of geospatial data introduces aspects of positional accuracy, relative accuracy, currency, etc. The direct implication of this is that information about the data, its origin, authorship, relevance, limitations, accuracy and chronology, must also be provided with the data to enhance it from just data to geospatial information.

Geospatial information is a valuable multi-purpose asset. The collection of field data solely for the immediate need of a project is to be tempered with the wider corporate needs to which the geospatial data may be put by the department and other government agencies. The information can be mined at a later date to supply value to projects other than the primary project for which the information was captured.

### **2.4 Compliance**

The department, its staff and its agents have an obligation to comply with all applicable statutory legislation.

A failure to comply with the safety standards required by the legislation, or the recommendation within the manuals and codes is considered unacceptable to the department, and considered grounds for the termination of a contract.

All costs associated with the safe operations of both the public and the survey personnel, for the duration of the project, are to be met by the survey services supplier. No additional payments will be considered for costs associated with safety issues, unless specifically agreed to in the survey brief.

#### **2.4.1 Legislative and regulatory requirements**

In relation to survey work for Transport and Main Roads within the road corridor, attention is drawn to the following acts, regulations, manuals and codes (or their successors):

- *Transport Infrastructure Act 1994* and its Regulations
- *Surveyors Act 2003* and its Regulations
- *Survey and Mapping Infrastructure Act 2003* and its Regulations
- *Work Health and Safety Act 2011* and its Regulations
- Codes of Practice 'approved' under the *Work Health and Safety Act 2011*
- Inter-governmental Committee on Surveying and Mapping – Standard for the *Australian Survey Control Network – Special Publication 1 (SP1), Version 2.2*
- *Queensland Manual of Uniform Traffic Control Devices (MUTCD)*
- *Manual – Consultants for Engineering Projects*
- *National Measurement Act 1960* (Commonwealth) and its Regulations
- *Environmental Protection Act 1994*

- *Fisheries Act 1994*
- *Coastal Protection and Management Act 1995*
- *Water Act 2000.*

It is responsibility of the person working under Legislative or regulatory requirements to ensure they are using the current version of Legislation or regulation.

Where restrictions exist upon those entering onto the road corridor within legislation, persons who enter the road corridor are under an obligation to conform to these restrictions, notwithstanding what may or may not be stated or implied in these standards.

#### **2.4.1.1 Underground asset investigation**

All personnel undertaking underground asset investigation must be trained and accredited in accordance with the requirements of the owners of underground assets. This may include restrictions by the asset owner on lifting inspection lids. All personnel entering pits and other confined spaces must be trained and accredited in confined spaces at the time of survey. These accreditations must be current at the time of survey.

#### **2.4.2 Survey**

For the purposes of this document, 'survey' shall mean all activities undertaken for a transport infrastructure purpose that define natural or artificial features, below, on or above the earth's surface, excepting that a survey which involves the definition of the cadastre shall be a cadastral survey.

#### **2.4.3 Surveyor**

'Surveyor' shall mean a competent person who personally undertakes the survey or elects instead to supervise another person/s to undertake the survey as per the provisions set out in Section 2.4.3.1 of this document and takes personal responsibility for the survey. In the case of:

- **Cadastral Surveys**

Registration as a Surveyor with a Cadastral endorsement with the Surveyors' Board of Queensland. In some cases, registration as a Surveyor with a Consulting endorsement with the Surveyors' Board of Queensland may also be required.

- **Construction (Road or Structure), Ground and Feature Model (GFM), and Control Surveys**

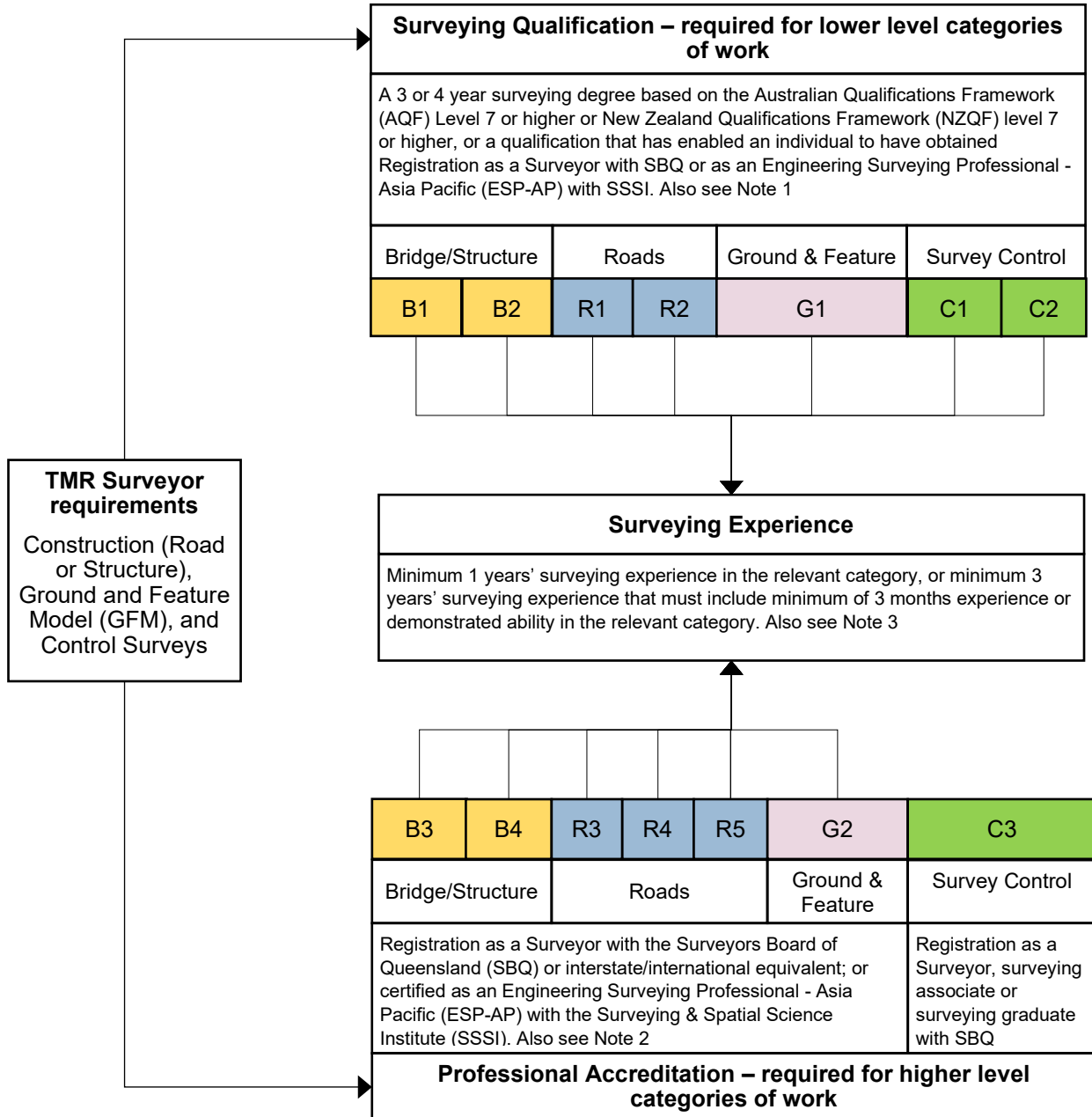
Meets the Surveyor requirements as outlined in Flowchart 2.4.3

Where an individual does not possess the relevant qualifications, and / or professional accreditation where specified in the different categories in Flowchart 2.4.3, the individual must provide evidence that will, in the opinion of the Director Geospatial Technologies, demonstrate acceptable competency as per Flowchart 2.4.3. These assessments are for individuals undertaking Transport and Main Roads work only and cannot be used for other purposes. The department reserves the right to carry out assessments at their discretion. As the department is not an accrediting agency, Transport and Main Roads cannot guarantee providing an ongoing competency assessment process. To undertake this type of assessment, make contact with the Director Geospatial Technologies [TMR\\_Spatial\\_Enquiry@tmr.qld.gov.au](mailto:TMR_Spatial_Enquiry@tmr.qld.gov.au)

- Audit Surveys**

An Audit Surveyor is to meet the competency requirements as specified in the Flowchart 2.4.3 for the category that they are auditing.

**Flowchart 2.4.3 – Construction (Road or Structure), Ground and Feature Model (GFM), and Control Surveys**



**Note 1:** To undertake the lower level categories of work for construction (Road or Structure), Ground and Feature Model (GFM), and Control Surveys, there are two components to meet the Surveyor requirements – the qualification component and the experience component.

**Note 2:** To undertake the higher level categories of work for construction (Road or Structure) and Ground and Feature Model surveys (GFM), there are two components to meet the Surveyor requirements – the accreditation component and the experience component. The higher level requirement for undertaking control surveys requires registration as a Surveyor, surveying associate or surveying graduate with SBQ.

**Note 3:** The relevant category experience component can be gained by working in any of the engineering related survey categories as specified in Table 2.4.3. The experience component can also be gained under supervision as per the provisions set out in Section 2.4.3.1 of this document.

For example, to undertake R4 work, an individual must have a minimum of 3 years' experience made up of any or a combination of other categories including a minimum of 3 months experience in R4 work or demonstrate ability to undertake R4 work.

Descriptors for categories for B1, B2, B3, B4, R1, R2, R3, R4, R5, G1, G2, C1, C2 and C3 are listed in Table 2.4.3.

**Table 2.4.3 – Construction (Road or Structure), Ground and Feature Model (GFM), and Control Surveys**

Category	Description (R (road) and B (bridge) categories are adapted and referenced from Appendix A of Austroads National Prequalification System for Civil (Road and Bridge) Construction AP-C96-19 with additions in italics that best reflect surveying requirements. Ground & Feature (G) and Survey Control (C) are specific TMR requirements.
B1	<p><b>Typical Features of Structure:</b></p> <ul style="list-style-type: none"> <li>• Large culvert including link slab or cast in-situ deck units and multiple bay (&gt; 10 bays) culverts and other drainage structures</li> <li>• Basic earth retaining structures</li> <li>• Footbridges</li> <li>• <i>Works excludes setting out of bridge abutments and piers.</i></li> </ul> <p><b>Earthworks:</b></p> <ul style="list-style-type: none"> <li>• Earth retaining structures, excluding mechanically stabilised earth</li> <li>• Basic earthworks.</li> </ul> <p><b>Foundations:</b></p> <ul style="list-style-type: none"> <li>• Simple spread footing foundations. for example, large base slabs</li> <li>• Foundations for gantries.</li> </ul> <p><b>Construction Environment / Traffic:</b></p> <ul style="list-style-type: none"> <li>• Simple traffic management (for example, rural roads)</li> <li>• Small stream crossing</li> <li>• Small cantilever retaining wall.</li> </ul> <p><b><i>Conformance and as constructed surveys.</i></b></p>
B2	<p>B1 activities plus majority of the following:</p> <p><b>Typical Features of Structure:</b></p> <ul style="list-style-type: none"> <li>• Cast in-situ reinforced concrete flat slab bridges</li> <li>• Simple bridges</li> <li>• Single span simply supported steel or pre-stressed concrete girders</li> <li>• Simple steel bridges</li> <li>• <i>Setting out of bridge abutments and piers or other structures without horizontal and vertical curve geometry.</i></li> </ul>

	<p><b>Earthworks:</b></p> <ul style="list-style-type: none"> <li>• Moderate earthwork, including guide banks and rock protection</li> <li>• Mechanically stabilised earth structures</li> <li>• Embankment supporting relieving slab.</li> </ul> <p><b>Foundations:</b></p> <ul style="list-style-type: none"> <li>• Standard non-complex pile foundations (generally &lt;25m length) without the need for floating equipment or temporary bridges</li> <li>• Precast prestressed piles.</li> </ul> <p><b>Construction Environment / Traffic:</b></p> <ul style="list-style-type: none"> <li>• Construction over operating roads (low traffic volumes) and non-electrified rail lines.</li> <li>• Typically semi-urban work location.</li> </ul>
B3	<p>B2 activities plus majority of the following:</p> <p><b>Typical Features of Structure:</b></p> <ul style="list-style-type: none"> <li>• Voided slab superstructures</li> <li>• Post tensioned cast in-situ structures</li> <li>• Complex geometry</li> <li>• Complex cast in-situ composite decks</li> <li>• Steel girder bridges</li> <li>• Structures carrying significant public utilities</li> <li>• Cable stayed pedestrian bridges</li> <li>• Complex steel girders</li> <li>• Super T's / T-roffs</li> <li>• Major slipform piers</li> <li>• <i>Setting out bridge abutments and piers or other structures with horizontal and vertical curve geometry.</i></li> </ul> <p><b>Earthworks:</b></p> <ul style="list-style-type: none"> <li>• Complex earthworks, including guide banks and rock protection</li> <li>• Detailed earthwork (exposing cast insitu &amp; pre cast piles.</li> </ul> <p><b>Foundations:</b></p> <ul style="list-style-type: none"> <li>• Foundations which may be complex and/or require deep piling and/or require floating equipment or temporary bridges</li> <li>• Include cast in-situ piles, which may include simple dry rock sockets.</li> </ul> <p><b>Construction Environment / Traffic:</b></p> <ul style="list-style-type: none"> <li>• Construction over operating roads</li> <li>• Simple bridge widening of plank unit bridges.</li> </ul>
B4	<p>B3 activities plus majority of the following:</p> <p><b>Typical Features of Structure:</b></p> <ul style="list-style-type: none"> <li>• Significant fabricated steel superstructures</li> <li>• Complex geometric/aesthetic shapes</li> <li>• Balanced cantilever construction</li> <li>• Major cable stayed structures</li> <li>• Construction over water using coffer dams or large floating cranes and launching trusses for placement of girders</li> <li>• Structures constructed using top down methodology</li> <li>• Incremental launched structures.</li> </ul> <p><b>Foundations:</b></p> <ul style="list-style-type: none"> <li>• Very heavy foundations. Including complex rock sockets at depth &gt; 10 metres</li> </ul>



	<ul style="list-style-type: none"> <li>• Difficult installation conditions, including poured insitu piles in wet conditions</li> <li>• Pile installation from floating equipment.</li> </ul> <p><b>Construction Environment / Traffic:</b></p> <ul style="list-style-type: none"> <li>• Construction over navigable waterways</li> <li>• Complex cast-in-situ cut and cover tunnels</li> <li>• Staged construction in highly urbanised environment</li> <li>• Complex bridge widening or staged bridge construction (one lane at a time).</li> </ul>
R1	<p><b>General features of works:</b></p> <ul style="list-style-type: none"> <li>• Typically rural or semi-urban works with minimal traffic and issues</li> <li>• Minor works including simple construction, reconstruction and widening.</li> </ul> <p><b>Earthworks:</b></p> <ul style="list-style-type: none"> <li>• Earthworks to a maximum of 2 m in cut or fill.</li> </ul> <p><b>Pavement:</b></p> <ul style="list-style-type: none"> <li>• Simple granular pavements with sprayed seal surfacing.</li> </ul> <p><b>Drainage:</b></p> <ul style="list-style-type: none"> <li>• Minor culvert work (RCP &lt; 600 mm dia only no more than 2 bays) and reinforced concrete works.</li> </ul> <p><b>Services:</b></p> <ul style="list-style-type: none"> <li>• Nil.</li> </ul> <p><i>Conformance and as constructed surveys.</i></p>
R2	<p>R1 activities plus majority of the following:</p> <p><b>General features of works:</b></p> <ul style="list-style-type: none"> <li>• Low complexity at grade intersection and channelisation works.</li> </ul> <p><b>Earthworks:</b></p> <ul style="list-style-type: none"> <li>• Significant earthwork including structural fill and rock protection</li> <li>• Excavation in rock not requiring blasting</li> <li>• Cut or fill with slopes up to 1:2 and up to 5 m in height or depth (cutting).</li> </ul> <p><b>Pavement:</b></p> <ul style="list-style-type: none"> <li>• Significant longitudinal joints with existing pavements</li> <li>• Multi-layer granular pavements or simple A/C pavements.</li> </ul> <p><b>Drainage:</b></p> <ul style="list-style-type: none"> <li>• Medium-sized culvert works, RCBC &lt; 1.8 m height and &lt; 6 bays)</li> <li>• Cross and longitudinal drainage</li> <li>• Interface with bridge construction.</li> </ul> <p><b>Services:</b></p> <ul style="list-style-type: none"> <li>• Non – complex service relocation works.</li> </ul>
R3	<p>R2 activities plus majority of the following:</p> <p><b>General features of works:</b></p> <ul style="list-style-type: none"> <li>• More complex intersections located at urban location</li> <li>• Medium to large scale of works.</li> </ul> <p><b>Earthworks:</b></p> <ul style="list-style-type: none"> <li>• General earthworks exceeding 5 m in cut or fill</li> <li>• Mechanically stabilised earth construction to a nominal 5m in height</li> <li>• Excavation in hard rock where blasting is likely to be required.</li> </ul>

	<p><b>Pavement:</b></p> <ul style="list-style-type: none"> <li>• Pavement construction using marginal materials (non-standard)</li> <li>• Pavement construction using modified materials (e.g. cement treated sub-base)</li> <li>• Deep lift asphalt</li> <li>• Small scale concrete pavement.</li> </ul> <p><b>Drainage:</b></p> <ul style="list-style-type: none"> <li>• Special foundation and/or subgrade and subsoil drainage treatments</li> <li>• Includes large size culverts, multiple bays and link slab culverts.</li> </ul> <p><b>Services:</b></p> <ul style="list-style-type: none"> <li>• Moderately complex service relocations including conduits (e.g. electrical, communication services)</li> <li>• <i>Setting out dedicated services corridor alignments.</i></li> </ul>
R4	<p>R3 activities plus majority of the following:</p> <p><b>General features of works:</b></p> <ul style="list-style-type: none"> <li>• Grade-separated intersections</li> <li>• Complex staging of construction works</li> <li>• Duplication of major arterial road.</li> </ul> <p><b>Earthworks:</b></p> <ul style="list-style-type: none"> <li>• Mechanically stabilised earth construction &gt; 5 m in height &amp; other substantial retaining structures</li> <li>• Embankments over very soft soils using wick drains, stone columns, etc &amp; sophisticated monitoring.</li> </ul> <p><b>Pavement:</b></p> <ul style="list-style-type: none"> <li>• Heavy duty asphalt pavements</li> <li>• Bitumen treated base pavements.</li> </ul> <p><b>Drainage:</b></p> <ul style="list-style-type: none"> <li>• Permanent sedimentation catchment</li> <li>• Complex gully box</li> <li>• Arrangements for urban works.</li> </ul> <p><b>Services:</b></p> <ul style="list-style-type: none"> <li>• Complex service relocations. (e.g. construction of dedicated services corridor)</li> <li>• Including multiple staging of coordination of Utility Services.</li> </ul>
R5	<p>R4 activities plus majority of the following:</p> <p><b>General features of works:</b></p> <ul style="list-style-type: none"> <li>• Complex grade separated interchanges, multiple carriageways</li> <li>• Motorway on a new urban alignment.</li> </ul> <p><b>Earthworks:</b></p> <ul style="list-style-type: none"> <li>• Construction of zonal embankments</li> <li>• Earthworks within 2 m of tidal areas</li> <li>• Aggressive unsuitable materials including acid sulphate soils.</li> </ul> <p><b>Pavement:</b></p> <ul style="list-style-type: none"> <li>• Slipform, large-scale concrete pavements.</li> </ul> <p><b>Miscellaneous:</b></p> <ul style="list-style-type: none"> <li>• Permanent variable message signs and complex ITS arrangements.</li> </ul>

G1	<p>Small scale, non-complex ground and feature modelling surveys – often rural or simple urban with minimal surface and or underground features. Work can be undertaken by survey personnel with limited or supervised ground and feature modelling surveying experience. Works may include:</p> <ul style="list-style-type: none"> <li>• rural roads with low traffic volumes</li> <li>• open terrain with few features</li> <li>• simple drainage culverts</li> <li>• simple bridges and bridge site surveys.</li> </ul>
G2	<p>Work can be generally undertaken by survey personnel with highly developed or specialised skills and substantial ground and feature modelling surveys. Works include the capability of category G1 activities, plus any or all of the following:</p> <ul style="list-style-type: none"> <li>• complex urban environments with high number of features</li> <li>• complex intersections</li> <li>• multi lanes with high traffic volumes</li> <li>• complex bridges/structures</li> <li>• extensive underground services.</li> </ul>
C1	<p>Small scale control networks. Work can be undertaken by survey personnel with limited or supervised control network experience using Global Navigation Satellite Systems (GNSS) field-based measuring techniques. Works may include:</p> <ul style="list-style-type: none"> <li>• field GNSS observations using <ul style="list-style-type: none"> <li>– Static</li> <li>– Quick static</li> <li>– Kinematic</li> <li>– RTK</li> </ul> </li> <li>• terrestrial observations</li> <li>• levelling networks.</li> </ul>
C2	<p>Medium to large scale control networks. Work can generally be undertaken by survey personnel with highly developed or specialised skills in GNSS Control networks. Works include the capability of category C1 activities, plus any or all of the following:</p> <ul style="list-style-type: none"> <li>• control network design</li> <li>• GNSS processing.</li> </ul>
C3	<p>Placing or reinstating Permanent Survey Marks (Registered Surveyors, surveying associates or surveying graduates only).</p>

#### 2.4.3.1 Supervision requirements

This section does not apply for Cadastral Surveys. The *Supervision Policy for Cadastral Surveys* is found under the following link: <https://sbq.com.au/more-information/policies-guidelines/>

An individual who does not meet the Surveyor competency requirements for Audit Surveys and Construction (Road or Structure), Ground and Feature Model (GFM), and Control Surveys as specified in the *TMR Surveying Standards*, may undertake surveying work for Transport and Main Roads under direct supervision of the nominated Surveyor who meets those requirements.

The Surveyor supervising an individual undertaking surveying work must:

- have sufficient knowledge of the scope of surveying work to be undertaken
- personally review the surveying methodology

- personally conduct day to day supervision of the supervisee including regular site visits, and
- have sufficient control over methodology and any outputs of the surveying work to reasonably form the view that the standard of the survey work is that to be expected of a Surveyor under the *TMR Surveying Standards*, its supporting documents and specifications.

In practice, Transport and Main Roads considers that for supervision as required by these Standards, the supervision must:

- be direct and not through a third person
- direct the individual in undertaking the work
- oversee the undertaking of the work by the individual
- evaluate the undertaking of the work by the individual, and
- take full professional responsibility for the surveying work.

The supervisor must have **direct** contact with the supervisee and knowledge of the professional surveying work being undertaken. By **directing**, the supervisor must not merely observe the undertaking of the surveying work. Directing is a process of instruction, guidance and overseeing.

Within reason, the supervising Surveyor may not need to be physically present at all times at the site. In these circumstances, direct contact may be through written correspondence (letters, drawings, or emails), telephone, or voice or video chat. However, the contact must be directly between supervisor and supervisee. In addition, the supervisor must have sufficient knowledge of every significant element of the surveying work undertaken.

The supervising Surveyor must **oversee** the individual throughout all stages of undertaking the surveying work.

The supervising Surveyor must **evaluate** the undertaking of survey work. The supervisor must be satisfied that, at all times, the undertaking of surveying work by the supervisee is to a standard which might reasonably be expected of a Surveyor, in a professional and competent way, exercising adequate knowledge, skill, judgement, and care and be in accordance with the *TMR Surveying Standards*, its associated surveying supporting documents and specifications.

The supervising Surveyor must **take full professional responsibility** for the undertaking of surveying works. This means that if a complaint is made about the standard of the supervised surveying works, the supervisor must accept that the complaint will attach to them as the person who provided direct supervision of the carrying out of the service, and not the supervisee. And the supervisor may be subjected to investigation and subsequent disciplinary action by Transport and Main Roads. A Registered Surveyor may also be subject to investigation and subsequent disciplinary action by the relevant Surveyors Board. Engineering Surveying Professional – Australia Pacific (ESP-AP) holders may also be subject to investigation and subsequent disciplinary action under the Surveying and Spatial Science Institute's (SSSI) Code of Ethics.

Finally, Transport and Main Roads considers that **both the supervisor and supervisee shall document and retain documentation of the supervision provided** by the supervisor. This must be produced if verification of the existence and nature of the supervision is ever required.

NOTE: The supervision wording has been adapted from the Board of Professional Engineers of Queensland (BPEQ) Practice Note 4.5 (1A) direct supervision with permission [© Board of Professional Engineers of Queensland (BPEQ)]

#### 2.4.4 Equipment

In relation to survey equipment:

1. Survey instruments and ancillary equipment must be kept in good adjustment (within equipment manufacturers stated precisions) and condition
2. Electromagnetic Distance Measuring equipment (EDME) measured distances must be legally traceable. Thus, EDME must be validated via comparison with a Regulation 13 certified baseline under the *National Measurement Act 1960* (Commonwealth):
  - a. using recommended procedures
  - b. at least annually
  - c. after the equipment is serviced or repaired
  - d. after any other event which may affect the quality of distance measurement.
3. Current and historical records of calibration and collimation of all survey instruments must be kept and be available for inspection by the Project Manager or their authorised representative.

### 3 Project compliance

The project area is defined as that area covering the extent of the required survey data and will be defined in the survey brief. Generally the project area will cover the road corridor, which consists of the carriageway extending to the road boundary on each side. The required project area may also include private property, a stream or waterway, railway property, or a construction site. Various Legislation and Acts cover the entry onto different types of land and conducting work thereafter.

#### 3.1 Environmental impact

All surveys for Transport and Main Roads will be performed to minimise the impact on the environment. Disturbances should be kept to an absolute minimum and the site reinstated, cleaned-up and left in as close as possible to pre-disturbed condition on the completion of the survey works.

Consultants engaged by Transport and Main Roads will be solely responsible for any breach of Legislation whilst undertaking the project work.

Applicable legislation is the *Environmental Protection Act 1994* especially *Chapter 7 Part 1 Section 319 - General environmental duty*:

*“(1) A person must not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practicable measures to prevent or minimise the harm (the general environmental duty).”*

The district environmental officer may at times give direction or place conditions on the works undertaken on a project site. This may be because a rare or endangered plant has been found and must be protected, or noxious weeds are present and must not be spread by work activities. Survey personal have an obligation to report any potential siting of rare or endangered flora and fauna, noxious weed or significant disturbance of the natural environment to the district environmental officer.

##### 3.1.1 Surveys on streams and waterways

Surveyors should be aware of the various legislative requirements that may impact on the manner in which they carry out surveys in general. Surveys carried out on streams and waterways, particularly on tidal streams, require special caution. Legislation that may impact in these areas includes, but is not limited to:

- *Fisheries Act 1994*, particularly:
  - Part 5 – Fisheries Management
  - Part 6 – Protection and Conservation of Fish Habitats, particularly:
    - Section 123 - Protection of marine plants.
- *Coastal Protection and Management Act 1995*
- *Water Act 2000*
- *Environmental Protection Act 1994*, particularly:
  - Chapter 7 - Environmental Management.

### **3.2 General Safety**

Transport and Main Roads has an aspirational goal of Zero Harm – a work environment free of injury or incidents. An effective workplace health and safety system is an integral component of achieving this objective.

Following the commissioning of the project, and prior to the commencement of survey work, the Project Manager shall complete, or cause to be completed, any risk assessment procedures (including work method statements) and permits necessary to conform to District safety requirements.

This shall comprise the Safety Plan. Where necessary, approval is to be obtained from the District Safety Officer. This approval in no way exempts others entering the project area to carry-out the project from their responsibility in relation to the above legislation. The Safety Plan will comprise part of the survey brief as outlined in Section 4.

It is the responsibility of the Project Manager to ascertain what, if any, restrictions relate to the lands upon which the survey is to be carried out and produce a plan for access to those lands.

All personnel entering the project area shall have received the appropriate training and possess current accreditation required by legislation and the department.

#### **3.2.1 General safety and site induction**

All personnel entering onto the road corridor to perform work for the delivery of a Geospatial Information Project must have completed a course in General Construction Induction and produce a currently valid induction card when requested by a WH&S representative. If the project area has any project-specific requirements under WH&S, then those persons entering upon the project site must also have completed a project site induction and produce evidence of the induction when requested.

All personnel are to be aware of what constitutes a confined space. Entry to confined spaces is restricted by WHS legislation. The departments' requirements for risk assessment, entry permit and training must be adhered to.

#### **3.2.2 Unsafe situations**

Should an on-site work situation occur or an on-site work procedure be adopted, either of which in the judgement of the District Safety Officer, constitutes an unsafe situation, the surveyor shall, upon being advised of it, take immediate action to rectify the situation. If the situation continues unresolved, the District Safety Officer shall order that all work cease until the matter is resolved with the surveyor.

Sharp pointed objects, such as pickets, should not be placed on footpaths or in any other pedestrian area. In order to reduce conflict with pedestrians, survey marks should be driven 'flush' or below the surface.

Personnel using power-assisted equipment must have been instructed in, certified to use, or being immediately directed in the safe use of, such equipment.

#### **3.2.3 Personal protective equipment (PPE)**

Personnel engaged in work within the project area are to correctly wear the necessary personal safety equipment or apparel at all times.

### **3.3 Safety on the road corridor**

Works undertaken within the road corridor may cause interference or obstruction to the normal use of a road by road users. Maintaining the safety of workers, and the safe and convenient movement of traffic are of paramount concern (refer Section 3.3.2 of this document for more information).

Access to carriageways may be restricted during times of heavy public use or by departmental Prohibition Orders. The Project Manager is to give advice on such restrictions in the survey brief and the surveyor is to ensure that all work is carried out in accordance with these restrictions. Advice on the times of restrictive access or prohibition can be provided by the District officer responsible for such advice.

#### **3.3.1 Traffic management plan**

As part of the Safety Plan, a Traffic Management Plan must be developed and presented for approval by a safety representative of the department. District requirements shall be adhered to.

#### **3.3.2 Roadworks signage**

The Queensland *Manual of Uniform Traffic Control Devices (MUTCD)* “together with the Queensland *Guide to Temporary Traffic Management (QGTTM)*, is to provide organisations and individuals carrying out works on roads with a set of uniform practices for the signing, delineation, and use of devices for works on roads which will promote the safety of workers and the safe and efficient movement of road users at the work site.” and shall be adhered to.

All personnel working on, or adjacent to, a road shall have completed training in the basic application of the Queensland MUTCD Part 3.

At least one person must be onsite, who has the appropriate Queensland MUTCD Part 3 training and possesses current accreditation commensurate with the roadwork signage activities being undertaken (for example, to set up signage, one person onsite must have received the appropriate Queensland MUTCD Part 3 training and be currently accredited to set up signage).

No signage is to be left displayed when inappropriate (such as overnight). Evidence of work in progress must always be visible to the travelling public. Any object placed in the project area should be within the limits of the signage and, if left unattended for any period, additionally identified by the use of ‘witches hats / safety cones’.

#### **3.3.3 Use of traffic control**

Where the presence of the survey party is sufficient to seriously impede or endanger the public or survey personnel, arrangements must be made with the department for the employment of traffic control personnel. In all cases where people, other than police officers are to be used for traffic control, then the surveyor is to ensure that the person having the traffic control responsibility “holds an appointment as an accredited person under Section 21 of the *Transport Operations (Road Use Management) (TORUM) Act 1995* to perform the functions of a Traffic Controller as prescribed by Subdivision 6 of the *Transport Operations (Road Use Management – Accreditation and Other Provisions) Regulation 2015*.”

(Queensland MUTCD Part 3, Section 1.3.19, July 2021)

### **3.4 Entry onto land**

Entry onto land other than the road corridor is often required to enable completion of a survey.



### **3.4.1 Private land**

To provide the surveyor with the specific authority to enter upon private land when necessary, in order to effect the survey, the wording, as set out below, will be included in the survey brief:

*"You are authorised to exercise the powers as set-out in sections 35 and 36 of the Transport Infrastructure Act 1994 for the purpose of carrying out this instruction."*

#### **3.4.1.1 Notice of entry forms**

Before entry is made onto land, held under freehold or leasehold tenure, subject to native title claim or upon land which may be regarded as not open to the general public, a Notice of Entry (Form M727) is to be served on the registered owner, Crown Lessee or the nominated head of the organisation in control of the particular land at least seven working days prior to any entry onto such lands.

Where applicable, a copy of the Notice of Entry is to be served on the occupier of the land if that person is not the owner. Where notices are served on the owner and occupier, as separate entities, each copy of the notice should be noted to that effect. In addition to this, a Notice of Entry must be served on any entity registered as a Native Title claimant.

Names and addresses of land owners are available from the local authority. Notice of Entry may be served either personally or by certified mail.

It is the responsibility of the Project Manager to issue the Notice(s) of Entry or cause them to be issued. Prior to the first entry onto private land, the surveyor responsible for carrying out the survey task is to ensure that the Notice of Entry has been served.

#### **3.4.1.2 Refusal to accept Notice of Entry**

If, at any time, the owner or occupier of any land refuses to accept the Notice of Entry, or denies access to the land, they should be advised of the conditions printed on the Notice. If they continue to deny entry or refuse to accept the Notice, the surveyor must notify the Project Manager and not enter the land until further advised.

#### **3.4.1.3 Public enquiries**

While serving Notice of Entry, or during the survey, the surveyor is often asked questions relating to the purpose of the survey, the timing of proposed works, the method of assessing compensation, etc. In such cases, the property owner or member of the public should be advised to direct their enquiries to the Project Manager or any person designated in the survey brief as the person assigned to respond to enquiries.

### **3.4.2 Construction sites**

Where entry is necessary onto any construction site within the project area, the survey team must hold the required inductions including any specific site induction as necessary. The surveyor who is responsible is to make arrangements for the project team members to conform to any legal requirements of the *Work Health and Safety Act 2011* for such entry, such as specific certified safety induction requirements.

It is the responsibility of the individual project team member to carry evidence of current inductions and produce the documentation upon request.

### **3.4.3 Entry onto railway lands**

The survey brief may require personnel to collect information within a railway reserve, or land under the control of Queensland Rail. Prior to entry onto any land under the control of Queensland Rail, the surveyor must advise Queensland Rail and conform to any requirements they may have regarding working conditions, inductions, times of operation and safety issues.

## **4 Survey brief**

### **4.1 Purpose**

The survey brief is the document which stipulates the requirements for the delivery of a survey. It must include certain information (listed below) as well as any project specific variations or additions to what is required by the Standards. The survey brief is the only instrument where the requirements of the Standards may be varied. The survey brief must be sufficiently comprehensive to ensure delivery of survey information that meets the project's requirements.

### **4.2 Requirements**

The survey brief must address at least the following requirements:

- Project identifiers
- The intended use of the data and specific requirements of the survey
- Coordinate, azimuth, vertical (height) and chainage Datum (including AUSGeoid version)
- Notice of Entry (if applicable)
- Land entry authorisation statement (vide section 3.4.1)
- WH&S including Safety Plan
- Public consultation / confidentiality
- Documentation supplied
- Applicable dates e.g project due date, earliest start date
- Deliverable specifics
- Contact information for Project Manager and communications officer (if applicable)
- Version of the *TMR Surveying Standards*, 12d Customisation and eSB to be used, and
- Variations from the Standards.

### **4.3 Supplied information**

All information, supplied as a part of the survey brief, is to be returned with the project deliverables. This includes any cadastral plans, survey books, aerial photographs, and so on.

## **5 Survey datum**

Survey Datum is the framework upon which all geospatial information is referenced. The Survey Datum not only supports the accuracy of captured survey data, but also provides geospatial correlation with other data sets. It decides the integrity of delivered geospatial products and is the core element for sharing geospatial information within the department and other agencies in government, as well as the private sector.

Survey Datum points must be clearly annotated and referenced within the deliverable survey information. This traceability shall include datum origin information, values adopted and cross reference to the originating document.

### **5.1 Horizontal coordinate datum**

Horizontal coordinate datum for all TMR surveys shall be the Geocentric Datum of Australia 2020 (GDA2020) and implemented in the relevant zone of the Map Grid of Australia (GDA2020 / MGA Zone\*\*).

For further information on GDA please refer to:

<https://www.icsm.gov.au/gda2020>

### **5.2 Azimuth datum**

Azimuth is obtained from the horizontal coordinates used for datum.

### **5.3 Vertical (Height) datum**

All surveys shall be based on the Australian Height Datum 1971 (AHD71).

For more information on AHD71 search for “Australian Height Datum” on:

<https://www.icsm.gov.au/australian-height-datum>

#### **5.3.1 GNSS derived heights**

GNSS derived heights shall use the current AUSGeoid2020 separation model of differences between ellipsoidal heights and AHD71 to reconcile GNSS heights directly to AHD71.

For additional information, search for “AUSGeoid2020” on:

<https://www.ga.gov.au/scientific-topics/positioning-navigation/geodesy/ahdgm/ausgeoid2020>

### **5.4 Chainage datum**

Gazettal chainage is to be based on the current departmental reference for the road. The Road number, name and section as well as the gazettal distance shall form the chainage datum for a project.

### **5.5 Exceptions to use of standard datum's**

The Project Manager may, via the survey brief, direct that the survey be based on another datum other than the department's standard datum's. When an alternative datum is used, the survey must be connected to the departments standard datums (vide Section 5.5.2). Alternative datum's may be:

- a) on the datum of an existing survey where the new survey extends or adds to that existing survey
- b) on a project specific projection.

### 5.5.1 Cadastral surveys

Cadastral surveys are bound by the requirements of the Cadastral Survey Requirements (CSR). Hence, cadastral surveys are exempt from using the standard azimuth and chainage datum's. Cadastral surveys are also exempt from using the departments standard horizontal and vertical datum's except where required by the Cadastral Survey Requirements (e.g volumetric).

Cadastral surveys must however be connected to the departments standard horizontal coordinate datum as specified in Section 5.5.2).

### 5.5.2 Connection of non-standard datum to standard datum

All surveys, including cadastral surveys, on a horizontal coordinate datum other than TMR's mandated datum (or no coordinate datum), must include ties to at least two Survey Control Database (SCDB) PSM's with known GDA2020 / MGA Zone\*\* coordinates and Positional Uncertainty of less than 0.030 m to allow transformation of the project onto GDA2020 / MGA Zone\*\* for the corporate record.

Similarly, if a vertical datum other than AHD71 is used, a tie to least one AHD71 mark of at least 4<sup>th</sup> Order Class D (AHDD) must be surveyed to provide correlation.

## 5.6 Traceable datum information

Traceability to datum is to be documented and must clearly show what marks were used and how datum was determined. The basic elements of traceability include, but are not restricted to:

- all datum marks and measurements are to be presented in the control section of the project
- the actual datum 'starting points' are to be clearly identifiable
- the type, material, and condition of marks is to be stated
- show all calculations relating to datum establishment including adjustment reports
- provide a statement to clarify why decisions were made.

The feature coding system has been developed as a hierarchal system to enable a logical traceable order in the establishment of datum and project control. Correct use of this system and clear presentation within project data and documentation enables future users to quickly identify the origin of project datum and its relation to any previous datum.

## 5.7 Summary of datum sets

**Table 5.7 – Datum sets**

Datum	Geographical coordinate set
Geocentric Datum of Australia 2020 (GDA2020)	(latitude, longitude and height from ellipsoid)
Projection	Coordinate set
GDA2020 / MGA Zone**	Horizontal (Zone) (Easting, Northing)
Australian Height Datum 1971 (AHD71)	Vertical (Height from reference surface)

## **6 Survey marks**

A survey mark is a mark placed as:

- a) evidence of a survey, or
- b) a reference point for a survey (monument).

Survey marks must be appropriate for the surveys intended purpose. They must be of a durable nature, which resists corrosion or decay and stable enough to serve as a suitable reference for locating those features required in the relevant geomatic survey type. The reference point of the mark must be clearly identifiable (i.e tack in peg, centre punch hole in star picket).

Under no circumstances shall square pegs be used in conjunction with any survey other than a cadastral survey.

### **6.1 Safety of marks**

Irrespective of the type of mark or indicator placed, the surveyor must ensure that it is not hazardous to people, livestock or vehicles. This hazard must be mitigated by some process like driving the mark flush with or below the ground level.

### **6.2 Identifiers and indicators**

All survey marks must be clearly and permanently marked with a unique identifier. Sufficient indicators such as finder pegs or paint markings are to be placed to identify the position of all survey marks. Indicators should be discrete to avoid unwanted attention or cause visual pollution.

### **6.3 Survey mark protection**

Survey marks are vitally important to a wide range of people in the community and are used to support the surveying of property boundaries, road building, mapping and other land surveys. Disturbance or destruction of survey marks has significant cost effects on construction projects and degrades the integrity of the state survey control network and property boundary cadastre.

Legislative requirements are in place for the protection of survey marks of value for survey and mapping infrastructure purposes. Section 42 of the *Survey and Mapping Infrastructure Act 2003* (current as at 1 January 2015) makes it clear that a person must not interfere with a survey mark, unless:

- a) *for a cadastral survey mark for a boundary – the person interferes with the mark in order to erect a fence, wall or other permanent structure along a boundary; or*
- b) *for a recognised permanent survey mark - the person interferes with the mark under an authority given under section 43; or*
- c) *for a mark other than a recognised permanent survey mark - the person, before interfering with the mark -*
  - i. *causes a survey to be carried out to establish the relationship between the mark and at least 2 recognised permanent marks; and*
  - ii. *gives the chief executive a copy of the plan of survey; or*
- d) *the person has a reasonable excuse.*

In this context, significant survey marks are Permanent Survey Marks, Bench Marks and cadastral marks (common marks are pegs with bevelled edges, buried iron pins, screws in kerbs).

Care should be taken to position the projects primary (significant) survey marks in safe positions where they are least likely to be affected by the construction process. They should be easily visible and identifiable as a survey mark requiring protection.

All works should avoid disturbing or destroying marks where possible. The local Transport and Main Roads Principal Advisor (Geospatial Information) should be contacted as soon as it is realised that a significant survey mark could be disturbed or has been disturbed.

## **6.4 Permanent Survey Marks**

Permanent Survey Marks (PSM) are the preferred mark to be placed or used for primary survey control on Transport and Main Roads projects. Their installation and maintenance thereafter are covered by Legislation. All existing PSM's within the project limits or immediately adjacent shall be connected to and referenced in the project records.

### **6.4.1 Placement and recording of Permanent Survey Marks**

Section 14(2) of the *Survey and Mapping Infrastructure Regulation 2014 Part 4* states that:

*"A person must not place or reinstate a permanent survey mark for a survey unless the person is-*

- a) a surveyor, or*
- b) a person supervised by a surveyor."*

New PSM's shall meet the criteria for type, accessibility and location as set out in Section 3 of SP1's *Guideline for Installation and Documentation of Survey Control Marks v2.1* (as below).

*A survey control mark should be:*

- Made of good quality, durable, corrosion resistant materials. It should employ robust construction techniques and be installed in stable ground or in solid rock, such that it is least likely to be subject to local displacement or other seasonal or periodic movements. If a survey control mark is to be installed in an unstable area, permanent marking may require placing deep-seated survey control marks that penetrate the surface soil to the depth of refusal, thus bypassing the zone of seasonal or periodic influence.*
- Installed in allocation where it is likely to be disturbed, damaged or removed, or to constitute a hazard, such that its long-term stability and useability is maximised.*
- Permanently and clearly marked with a unique identifier to ensure unambiguous identification. A station identifier should be engraved or stamped on the survey control mark, or a durable tag with the identifier firmly attached. A marker post or indicator should be installed if a survey control mark will not be easy to find.*
- Accessible to allow for its proper use, and*
- Located in a position that maximises the use of various measurement techniques and connection to existing and future marks. For instance, a survey control mark that is intended to be observed using GNSS techniques will require optimal sky view free of obstruction, multipath and radio frequency interference (RFI) sources.*

Marks suitable to Transport and Main Roads include but not limited to:

- 2.4 m galvanised star pickets, driven to refusal or full length, with a concrete collar or cap,
- Deep-driven, non-corrosive rods anchored in stable sub-strata or driven to refusal
- Screw, plug or plaque anchored to a permanent structure.

All new PSM's will be registered as required by Legislation. In accordance with the *Survey and Mapping Infrastructure Act 2003*, a PSM plan is to be prepared on the current approved form (form 6) for each PSM placed in the course of conducting a survey. DoR specifications set out in *Completion of Permanent Survey Mark Plans* (currently v1.05) shall be followed. For further information and PSM plan forms refer to:

<https://www.business.qld.gov.au/industry/property-construction-trades-engineering/surveying/permanent-survey-marks>

#### **6.4.2 Maintenance, updates & amendments**

All existing PSM's associated with the project, either as datum for the Project Reference Frame or within the bounds of the project, shall have a PSM Maintenance Form completed. Section 45 of the *Survey and Mapping Infrastructure Act 2003* requires any irregularity in information recorded in the survey control register (SCDB) or disrepair, destruction or removal of a PSM to be reported to the chief executive (of DoR).

Where the information on the location sketch or data sheet of the PSM Form 6 requires updating, the new information will be completed as outlined in DoR's specification *Completion of Survey Mark Plans*.

For relevant specifications and forms please refer to the website listed above in Section 6.4.1.

#### **6.4.3 Submission of PSM forms to DoR**

All new Form 6's, updated Form 6's and PSM Maintenance Forms shall be submitted as part of the deliverables to the Project manager for submission to DoR.

### **6.5 Bench Marks**

Bench Marks may be placed when it is not practical or useful to place a Permanent Survey Mark. This may be because a sufficient number of high quality PSM's exist in the area or the mark will be of limited value past the construction phase.

Bench Marks will meet the same requirements for type, accessibility and location as set out in Section 6.4.1 of this document. They must meet their primary objective, that is, they be stable vertically.

All existing Bench Marks within the project limits or immediately adjacent shall be connected to and referenced in the project records. Consideration should be given to registering existing Bench Marks as Permanent Survey Marks where they meet the requirements of a PSM and meet Transport and Main Road's obligations to enhance the states survey and mapping infrastructure.



## **6.6 Height**

The height of all survey marks must be recorded and shall be the highest point of the mark. This may not necessarily be the same point observed as the horizontal reference. Care should be taken when placing survey marks to ensure, where possible, that the highest point and the horizontal reference point are coincident (e.g. on PM and BM's - cut the star picket 'wings' off so the centre of the star is the high point).

### **6.6.1 Levelling**

The project height values for all Permanent Survey Marks, Bench Marks and traverse stations shall be determined from the average of two-way independent differential level runs from a project height datum mark. Where a secondary height datum mark is available, it must be observed in order to verify the value of the primary mark.

The maximum allowable misclose (in millimetres) as determined from the reciprocal level runs must not be greater than  $12 \text{ mm} * \sqrt{k}$ , where 'k' is the distance in kilometres from the datum mark (vide Section 4 of the *Guideline for Control Surveys by Differential Levelling, Special Publication 1 version 2.2 (ICSM)*).

Differential levelling equipment and observation techniques shall adhere to the requirements for  $12 \text{ mm} * \sqrt{k}$  (km) as specified in Section 3.1.1 and 3.1.2 of the *Guideline for Control Surveys by Differential Levelling, Special Publication 1 version 2.2 (ICSM)*. The following SP1 requirements do NOT need to be adhered to: wood or fibreglass staff, calibrated within 5 years; and temperature recorded. They are however encouraged.

Total station differential levelling may only be used with prior approval of the Project Manager. When used, the equipment and observation techniques shall adhere to the total station differential levelling requirements for  $12 \text{ mm} * \sqrt{k}$  (km) as specified in Section 3.2.1 and 3.2.2 of the *Guideline for Control Surveys by Differential Levelling, Special Publication 1 version 2.2 (ICSM)*.

## **7 Survey data delivery**

### **7.1 Introduction**

Data produced in conjunction with a survey shall form part of the deliverables and will be specified within each Geomatic Survey type in Part 2 of the Standards or the survey brief. Acceptable file formats for Survey Data are controlled by the software packages used by the department. Specific file formats may also be identified in the survey brief.

Should a survey brief request survey information in any format other than those used by the department, it is beholding on the officer responsible for accepting the information (Project Manager) to ensure that all the information can be converted to the standard format without loss of functionality or integrity for archival purposes.

### **7.2 Transport and Main Roads standard software**

12d Model is the departments standard software and as such, survey data will generally be required in 12d archive format. Any variations to this requirement will be specified in the specific Geomatic Survey type or survey brief.

### **7.3 Field data**

The department requires a file/s containing the raw recordings of the field data for the entity information located in the field. The field data file shall be supplied in a format acceptable to the Project Manager.

All relevant and necessary information used to create the projects delivered 12d archive file shall form part of the deliverables to the Project Manager.

#### **7.3.1 Survey comments**

Comments provided on survey data must be necessary and relevant. Repetition of the same comment from the previous point is unnecessary and unacceptable. The principal purpose of comments is to provide useful information to the users of the data. Comments that are not relevant or do not provide additional information are not acceptable. For example, commenting kerb lip on a kerb string is not relevant or necessary as the code already informs the user that it is a kerb lip.

### **7.4 Processed data**

The processed data shall be an accurate representation of the raw field recordings edited of any mistakes. The processed data shall be delivered to the Project Manager in 12d archive format file unless otherwise specified in a specific Geomatic Survey type in Part 2 of these Standards or in the survey brief.

### **7.5 Survey report**

A Survey Report shall be created for every project. It shall be signed and dated by the person who meets the relevant requirements, detailed in Section 2.4.3 of this document, who is taking responsibility for the survey. The report must include:

- the project identifiers
- datum information
- any information, pertinent to the survey, that may affect either the design of the project
- any information, pertinent to the survey, concerning land owners or occupiers

- variations from the survey brief and the reasons for such variations.

## **7.6 Delivered data**

### **7.6.1 Ownership**

All digital data supplied by a contractor, albeit 'in-house' personnel or private contractors, shall become the property of the department. Custodianship shall reside with the Project Manager. It shall not be used, copied or reproduced by the contractor for any other purpose without the prior written approval by the custodian or the department.

### **7.6.2 Media**

Due to the complexity and quantum of modern survey information, the media used for transfer of the data becomes the property of the department. For example, if Mobile Laser Scanning (MLS) data is supplied on portable hard drives, then those hard drives become the property of the department.

### **7.6.3 Malicious code**

Contractors are to certify that the transferred data is free from malicious code. Data files in compressed executable files (.exe) are unacceptable.

### **7.6.4 Corrections**

Any errors, deficiencies or ambiguities identified by the Project Manager shall be referred back to the Surveyor responsible for correction or clarification. These must be actioned within one business day of the notice being given. The project will not be considered complete until all errors, deficiencies and ambiguities have been resolved in accordance with these Standards and the survey brief to the satisfaction of the Project Manager. Transport and Main Roads will not be responsible for any additional expense incurred in completing these corrections.

## **7.7 Metadata**

All survey information / data that is captured and provided to Transport and Main Roads must provide metadata inclusive of project details as listed below.

### **7.7.1 Locality**

- Locality:
  - Region
  - Local Authority
  - Locality
- Road:
  - Road (Number / Name)
  - Project Description
  - Start Chainage
  - End Chainage

### 7.7.2 Project details / Resources

Include all relevant project details including:

- Project Details:
  - Project Number
  - Project Name
  - File Name
  - Fieldbook ID
  - Survey brief ID
- Project Resources:
  - Captured by
  - Processed by
  - Surveyor Responsible
  - Accreditation
  - Number.

### 7.7.3 Datum / Coordinate Operations

- Geodetic Datum – for example:
  - GDA2020 (EPSG:1168)
- Horizontal Coordinate Reference System (CRS) – for example:
  - GDA2020 / MGA zone 55 (EPSG:7855)
- Vertical Coordinate Reference System (CRS) – for example:
  - AHD Derived
- Geoid Model – for example:
  - AUSGeoid2020\_QLD\_20170908

### 7.7.4 Accuracy

- Geomatic Survey Type:
  - Survey Type
  - Survey Purpose
- Accuracy:
  - TMR Surveying Standards Version
  - Relative Uncertainty at 95%:
    - Horizontal (m)
    - Vertical (m)

### Capture Method

Include all equipment details that have been used to capture data. For example:

- Total Station
- Global Navigation Satellite Systems (GNSS)
- Photogrammetry
- Airborne Laser Scanning (ALS)
- Terrestrial Laser Scanning (TLS)
- Mobile Laser Scanning (MLS)

#### **7.7.5 Timing / Contact**

- Timing:

All timing components of a project shall be supplied that should include as a minimum:

- Date of instruction
- Date/s of data capture
- Date/s of data processing

- Data Contact:

- Name
- Company
- Position
- Phone
- Email

#### **7.7.6 Notes / Disclaimers**

Any relevant notes should be included. For example:

- Any additional General notes
- Any additional GDA2020 notes
- Any additional DBYD information
- Underground services notes – for example: data is only valid at the time of capture.

