

# **Submitting GNSS data for inclusion into the state-wide datum adjustment network**

## **Guideline**

**SIG/2018/4235**

**Version 1.00**

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## Version History

Version	Date	Comments
1.00	15/06/2018	Document created

## Approval

Position	Name	Date
Principal Survey Advisor	Matt Higgins	25/07/2018

## Summary

This document outlines the process and requirements for submitting Global Navigation Satellite System (GNSS) data to the Department of Natural Resources, Mines and Energy (DNRME), hereafter referred to as the department, for inclusion into the State Datum Network.

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# 1 Datum Overview

Currently in Queensland, for a Permanent Survey Mark (PSM) to be recognised as a horizontal 'datum' mark in the Survey Control Database (SCDB), it must be included in the Queensland State Adjustment known as ANJ. ANJ is an amalgamation of measurements/adjustments from the hierarchy of datum (see Figure 1).

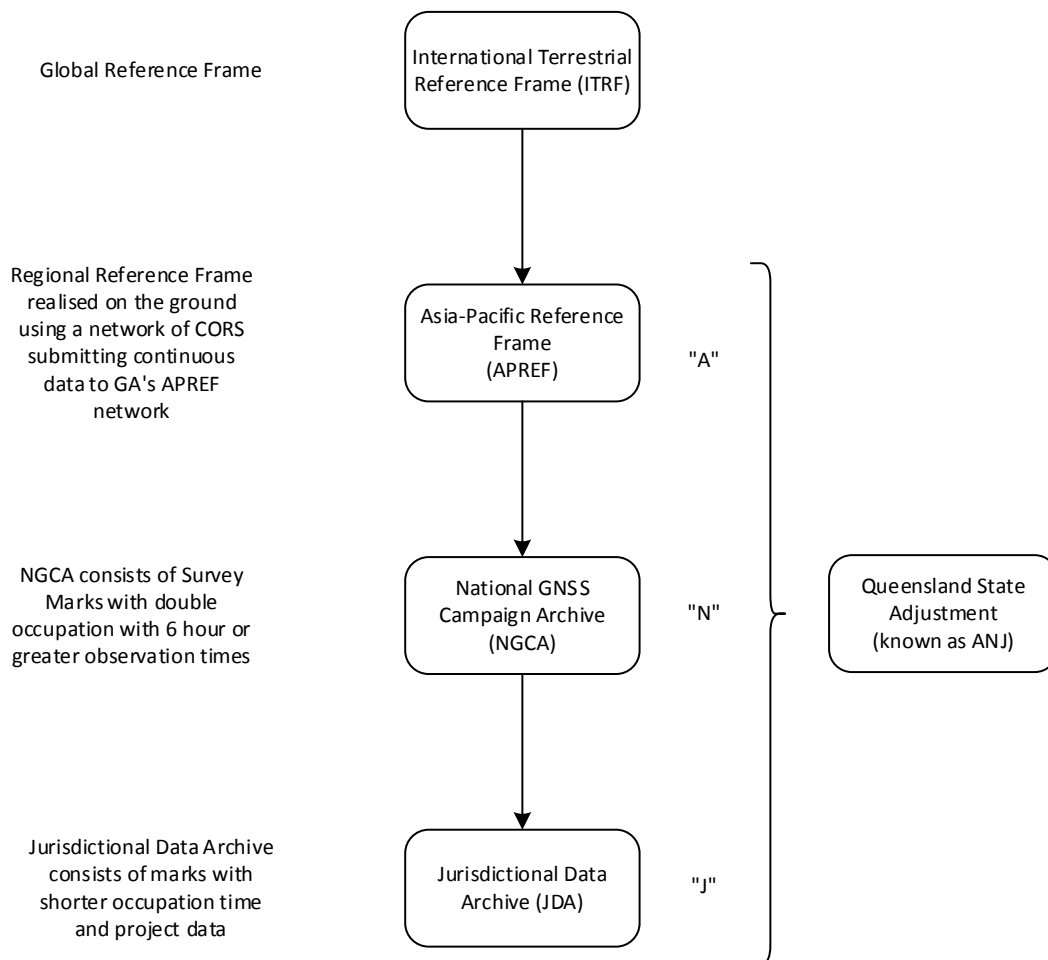


Figure 1: Hierarchy of Datum and the ANJ

## 2 DNRME Workflow

Below is a basic workflow for data that is submitted to the department. It is important to note that some of the processing is done by Geoscience Australia (GA) and the department must comply with minimum data standards set by GA.

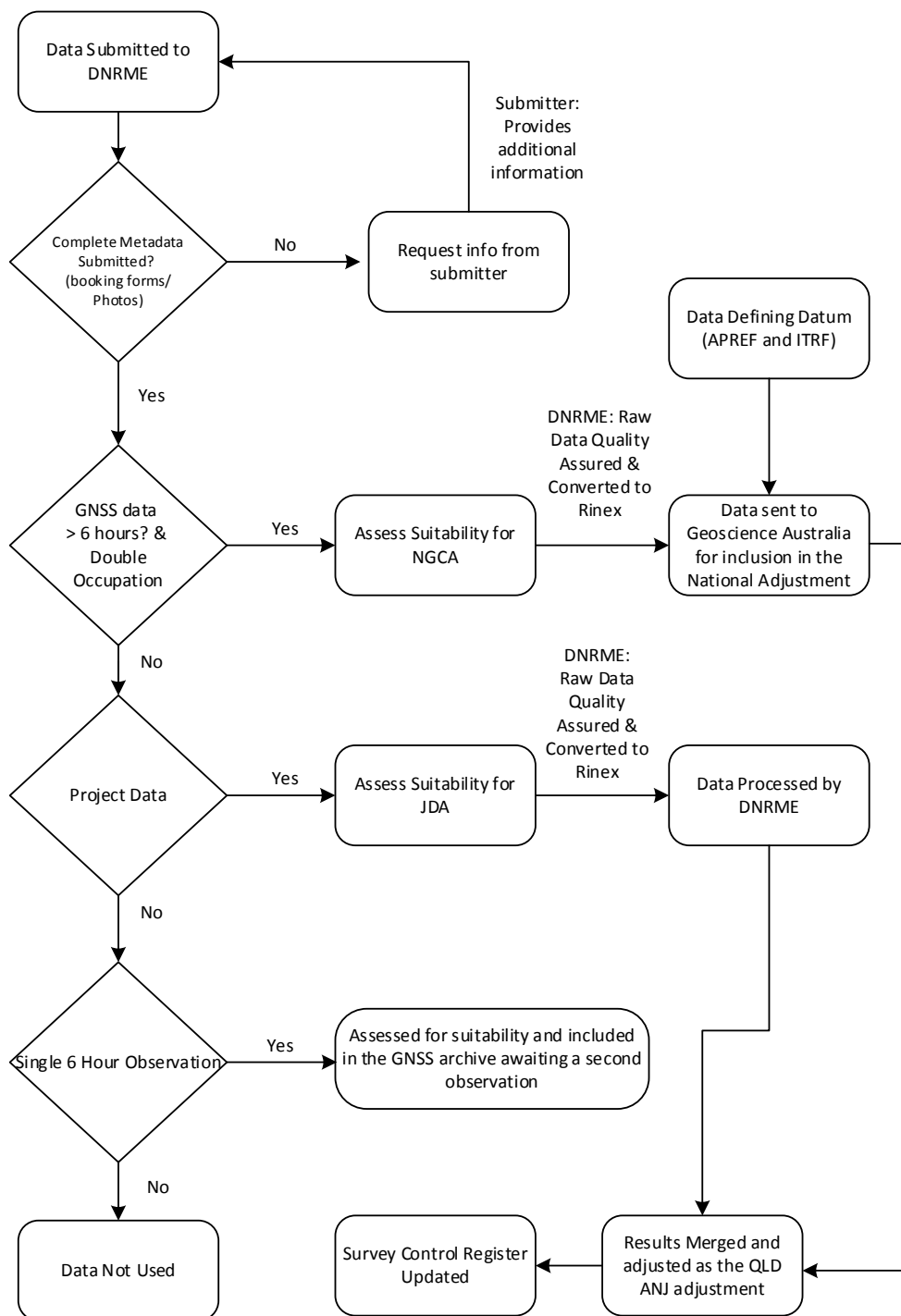


Figure 2: Basic Workflow

It is important to note that each measurement is processed individually and related to APREF. This means that it is not necessary to provide your own network adjustment with the data.

## 3 ANJ inclusion and loading into SCDB

### 3.1 Timeframes

DNRME aims to update the SCDB with a new release of ANJ on a monthly basis. However this timeframe can vary depending on how long it takes to receive results back from GA or if unforeseen problems are encountered during the loading into the SCDB. A new version of ANJ may not be released if there is minimal change in the number of observations added since the last release. This would typically occur during the end of year period.

### 3.2 SCDB rules applied during rollout

During a rollout of ANJ into the SCDB, there are a number of rules that are adhered to so that the integrity of the SCDB is maintained.

For a mark to be given ANJ coordinates and listed as “datum” in the SCDB, it must:

- Be a registered PSM in the SCDB;
- Have current administrative and coordinate information in the SCDB at the time of the rollout. Approximate coordinates from a Form 6 are required to be in the SCDB prior to ANJ being uploaded;
- Be part of the ANJ adjustment at the time of the rollout. This includes adhering to the minimum requirements of this document;
- **Not** have Regulation 13 certified coordinates in the SCDB. A PSM assigned to a CORS with Regulation 13 certified coordinates will not be overwritten in a rollout of ANJ.

## 4 Data Submissions

### 4.1 Observation requirements

**For inclusion into NGCA the following criteria must be met:**

- 2 independent 6 hour observations suitable for achieving a horizontal survey uncertainty of 15mm or better. See ICSM SP1 Guidelines for control surveys recommendations.
- Sufficient and acceptable metadata for each observation (See Section 4.3)
- Raw data files from the receiver. The raw data files are quality assured and converted to RINEX by DNRME. If Leica equipment is used it is preferred that the data is converted to RINEX v2.11 and the RINEX file sent to the department. Raw Leica files will be accepted but RINEX is preferred. RINEX is preferred in the case of Leica because of the large number of raw files Leica receivers create.
- If a Single 6 hour observation is submitted, and is the only observation available on that mark, it will wait for a second observation before becoming part of the NGCA. The single observation may be included in JDA in the interim.

**For inclusion into JDA the following criteria must be met:**

- Specific project data with shorter observations may be accepted by the department. This is not covered in this document. If you are intending to conduct a GNSS project for submission please contact [GeodeticSupport@dnrme.qld.gov.au](mailto:GeodeticSupport@dnrme.qld.gov.au) to ensure any observations will meet our requirements.

**For inclusion into GNSS archive waiting for additional occupation before inclusion into datum:**

- A single 6 hour observation
- Sufficient and acceptable metadata for each observation (See Section 4.3)
- Raw data files from the receiver (unless Leica receivers are used then RINEX version 2.11 is preferred, see above). The raw data files are Quality Assured and converted to RINEX by DNRME.

Please note that GA cannot currently accept RINEX version 3. Translation software from RINEX v2 to RINEX v3 is still maturing and not fully functional. Therefore at this time we can only accept RINEX files in version 2.11.



## 4.2 Antenna Height Measurement Requirements:

A minimum of two measurements must be recorded in the field. One directly to the Antenna Reference Point (ARP)/ Bottom of Antenna Mount (BAM) and one to the manufacturers' specified height measurement point. In Figure 3 below, the manufacturers specified height measurement point is referred to as the Slant Height Measurement Point (SHMP), and is at the bottom of the bumper at the corner. The details of individual antennas can be found on the NGS antenna calibration website: <https://www.ngs.noaa.gov/ANTCAL/>. The details of the North Reference Point (feature on the antenna to be orientated north) can also be found on that website.

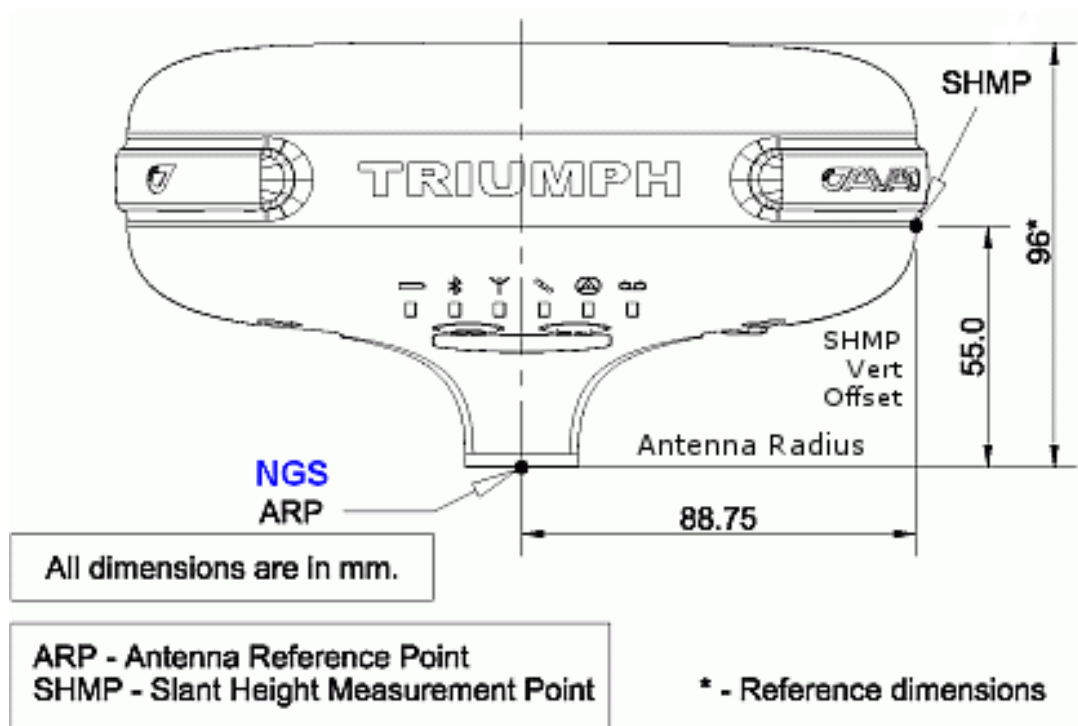


Figure 3 Javad Triumph Diagram.

Source: [https://www.ngs.noaa.gov/ANTCAL/LoadImage.xhtml?name=JAV\\_TRIUMPH-1+NONE.gif](https://www.ngs.noaa.gov/ANTCAL/LoadImage.xhtml?name=JAV_TRIUMPH-1+NONE.gif)

The ARP can be calculated precisely using the formula

$$ARP = \sqrt{SHMP^2 - Antenna\ Radius^2} - SHMP\ Vertical\ Offset$$

Given the inaccuracy that can occur when measuring the ARP/BAM on some models of antenna, the difference between the calculated ARP and the height check measurement to the ARP should be less than +/- 0.005m.

## 4.3 Metadata requirements

### Booking sheets

Booking sheets must clearly show the following information:

- Mark ID
- Project ID
- Observer and Agency/Company
- Antenna/Receiver Types and Serial Numbers (if the antenna and receiver are separate both are required)
- Start/Stop Date and Time in 24 hour format and local time (Australian Eastern Standard Time)
- Slant Height using two different measurement methods (measurement to the BAM/ARP and a measurement to the SHMP)
- Station Setup Check that must be completed
  - Antenna heights measured to two different points must be within 5mm when reduced to the vertical height to ARP
  - Centring/Level
  - Antenna Orientated North
  - Logging data/tracking satellites
  - PM number must be physically confirmed
  - Comments or issues observed in the field (e.g. power off on return time/date)

### Photos

Photos of the following are required:

- Mark ID
- Slant Height to manufacturers specified height measurement point
- Antenna Serial Number
- Obstructions if present with an approximate bearing and distance to the obstruction. North, South, East, West photos are not required if no obstructions present.

## 4.4 Transferring data

All Form 6s and PSM maintenance forms must be completed as per the DNRME Completion of Permanent Survey Marks Plans Specification (<https://www.dnrm.qld.gov.au/?a=109113> :policy\_registry/completion-permanent-survey-mark-plans.pdf).

The departments preferred method to receive the data is via an online file hosting service (e.g. Dropbox or ownCloud), with data uploaded by the collecting party and a link to the data sent to [GeodeticSupport@dnrme.qld.gov.au](mailto:GeodeticSupport@dnrme.qld.gov.au).

For projects with large datasets that cannot be uploaded easily please email [GeodeticSupport@dnrme.qld.gov.au](mailto:GeodeticSupport@dnrme.qld.gov.au) and arrangements can be made to receive the data at a regional DNRME office.

It is preferred if the data is structured in the following folder format.

### Preferred File Structure:

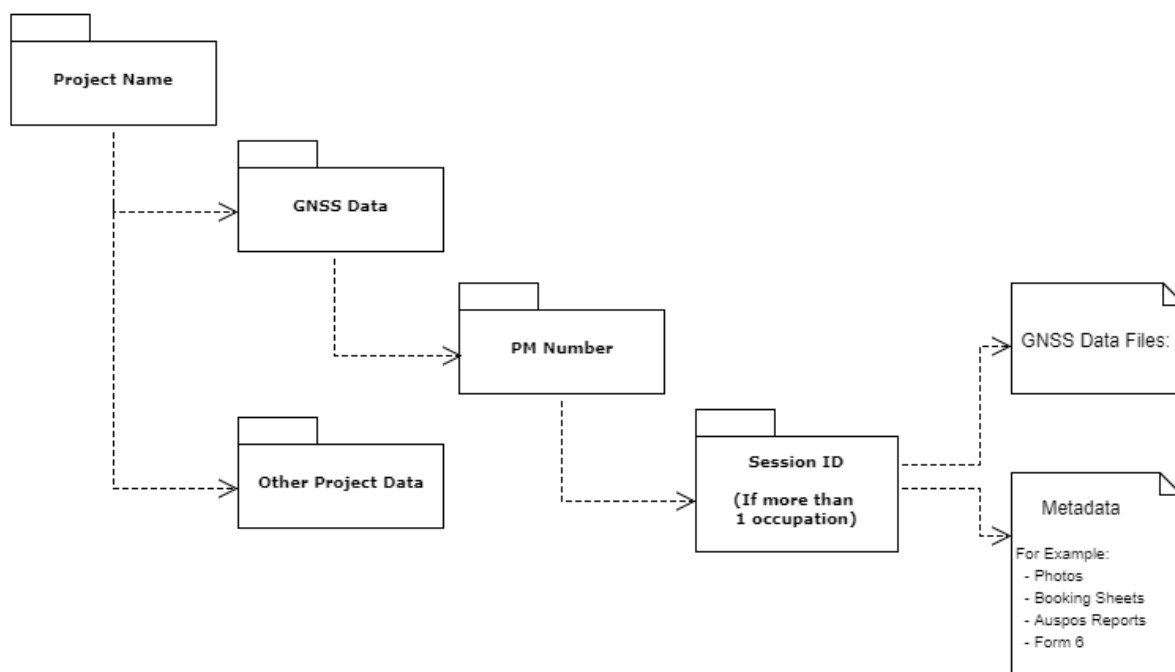


Figure 4: Preferred File Structure

## 5 Rejected submissions

### Most common reasons for data being rejected:

- Insufficient Metadata: This is the most common reason. If the mark ID, antenna height, antenna height reference point, type and serial number of receiver cannot be confirmed by the booking sheets and photos. The lineage of the data will be compromised and the data will be rejected.

- **Poor Quality Measurements:** If the data cannot be processed to a suitable accuracy the data will be rejected. DNRME will contact the submitter to try and determine the source of the problem.

If a submission is rejected as part of the quality assurance process the department will contact the lodger by email to request extra metadata or to highlight poor quality measurements.

## 6 FAQs

### **Q. I have submitted data. Why is it not in Datum?**

**A.** If the metadata and observation time/quality criteria have been satisfied the data progresses into the adjustment. The most common reason for data not appearing in the ANJ (datum) adjustment is because the administrative data (Form 6) has not been submitted. A Form 6 with approximate coordinates must be submitted before the mark is included in datum.

The second possibility is that the data has not yet been through the entire adjustment process.

### **Q. Why do you no longer want my constrained adjustment?**

**A.** To maintain traceability and data consistency in the network the department reprocess all observations from the RAW data files. During this process if the observation is over 6 hours it is sent to GA for inclusion in NGCA. As part of the NGCA, GA processes the observation relative to APREF stations and removes trivial baselines (in a process similar to AUSPO). DNRME follow a similar data reduction process for the JDA adjustment and constrain to APREF and NGCA stations. The automated removal of trivial baselines and processing relative to APREF means that the data will be different from your submitted adjustment but consistent with the rest of the national/state network.

### **Q. Can I get a copy of the relative uncertainties (RU) and Survey Uncertainty (SU) for each station?**

**A.** The state ANJ adjustment is a constrained adjustment. The department does not keep individual projects in an unconstrained state but adds them to the state adjustment as a whole. This means that we cannot provide SU or RU values as we do not have them in our published datasets. Given that the Positional Uncertainty (PU) of a mark is heavily influenced by the SU it is recommended that the PU values are used in place of SU values.

### **Q. Who Should I contact if I have more questions?**

**A.** Contact your local DNRME Office for more information or email [GeodeticSupport@dnrme.qld.gov.au](mailto:GeodeticSupport@dnrme.qld.gov.au)

## 7 Definitions

ANJ	Queensland State Adjustment (State Control Survey) comprising APREF, NGCA & JDA
APREF	Asia-Pacific Reference Frame
ARP	Antenna Reference Point
BAM	Bottom of Antenna Mount
CSR	Cadastral Survey Requirements
DNRME	The Queensland Department of Natural Resources, Mines and Energy
GA	Geoscience Australia
GNSS	Global Navigation Satellite System
ITRF	International Terrestrial Reference Frame
JDA	Jurisdictional Data Archive administered by DNRME
NGCA	National GNSS Campaign Archive administered by Geoscience Australia
Project Data	Project data includes booking sheets, raw receiver files and photos from smaller campaign like projects. These projects are not necessarily conducted for geodetic purposes but may contain data that can be valuable for geodesy.
SHMP	Slant Height Measurement Point

## 8 Appendix 1: GNSS Booking Sheet 1

AGENCY		Observer		Project:							
Mark ID (PSM#)		Alternate Name		Mark Type		Time Start		:			
						Time Stop		:			
Antenna			Receiver (if not a combined ant/rec)			Date					
Type:			Type:			Station Setup Checks		Before		After	
S/N:			S/N:			Antenna Height		<input type="checkbox"/>		<input type="checkbox"/>	
Elevation Mask °	Epoch Rate	Seconds	NGS Ant ID (if known):			Levelled & Centred		<input type="checkbox"/>		<input type="checkbox"/>	
Antenna Height Details			Before		After		Antenna Oriented North		<input type="checkbox"/>		<input type="checkbox"/>
Height to BAM							Logging Data		<input type="checkbox"/>		<input type="checkbox"/>
Manufacturer's recommended Slant Height							PSM number physically confirmed		<input type="checkbox"/>		
Measurement Point (SHMP) Feature Used:							Photos		<input type="checkbox"/>		
Slant Height to SHMP											
Antenna Height Checks:			BAM = Bottom of Antenna Mount. ARP = Antenna Reference Point			Electronic Data File Names:					
ARP(calc) = $\sqrt{(\text{SHMP}^2 - \text{Radius}^2) - \text{Ground Plane Offset}}$						RAW:					
Height Check Parameters: $-0.005 \text{ m} \leq \text{ARP} - \text{BAM} \leq 0.005 \text{ m}$						Comments:					
ARP = $\sqrt{(\quad^2 - \quad^2) - \quad}$											
ARP =			ARP - BAM =								
Mark ID (PSM#)		Alternate Name		Mark Type		Time Start		:			
						Time Stop		:			
Receiver			Antenna (if not a combined ant/rec)			Date					
Type:			Type:			Station Setup Checks		Before		After	
S/N:			S/N:			Antenna Height		<input type="checkbox"/>		<input type="checkbox"/>	
Elevation Mask °	Epoch Rate	Seconds	NGS Ant ID (if known):			Levelled & Centred		<input type="checkbox"/>		<input type="checkbox"/>	
Antenna Height Details			Before		After		Antenna Oriented North		<input type="checkbox"/>		<input type="checkbox"/>
Height to BAM							Logging Data		<input type="checkbox"/>		<input type="checkbox"/>
Manufacturer's recommended Slant Height							PSM number physically confirmed		<input type="checkbox"/>		
Measurement Point (SHMP) Feature Used:							Photos		<input type="checkbox"/>		
Slant Height to SHMP											
Antenna Height Checks:			BAM = Bottom of Antenna Mount. ARP = Antenna Reference Point			Electronic Data File Names:					
ARP(calc) = $\sqrt{(\text{SHMP}^2 - \text{Radius}^2) - \text{Ground Plane Offset}}$						RAW:					
Height Check Parameters: $-0.005 \text{ m} \leq \text{ARP} - \text{BAM} \leq 0.005 \text{ m}$						Comments:					
ARP = $\sqrt{(\quad^2 - \quad^2) - \quad}$											
ARP =			ARP - BAM =								
Antenna Offsets		TRM R8 (M1, 2 & 3), 5800 & MC L1/L2	TRM Zephyr	TRM Zephyr Geodetic 1&2	TPS Hiper_SR + NONE	LEI GS15 (Viva)	JAV Triumph 1				
Radius		0.091	0.0937	0.1698	0.0950	0.0980	0.0888				
Ground Plane Offset		0.0552	0.0387	0.0444	0.0300	0.1580	0.0550				

# 9 Appendix 2: GNSS Booking Sheet 2

PROJECT:			AGENCY:				OBSERVER:				Date <sup>(x)</sup> :		
Station Details			GNSS Observation Details								Checks (Tick Box)		
ID (PSM#)	Alternate Name	Mark Type	Antenna S/N <sup>(1)</sup>	Antenna Make, Type & Model	Antenna Ht BAM <sup>(2)</sup>	SHMP Description <sup>(3)</sup>	Slant Ht to SHMP	Start Time <sup>(x)</sup>	Finish Time <sup>(x)</sup>	True ARP Height <sup>(4)</sup>	Level & Cent	Power on at End	PSM Num Check
								:	:				
								:	:				
								:	:				
								:	:				
								:	:				
								:	:				
								:	:				
								:	:				
								:	:				
								:	:				
								:	:				
								:	:				
								:	:				
								:	:				
<b>Comments:</b>													

All cells except Alternate Name are **MANDATORY** Information

<sup>(1)</sup> If antenna and receiver are separate, include receiver S/N, Make, Type & Model on the next line down.

<sup>(2)</sup> BAM = Bottom Antenna Mount. Measure height to top of adaptor before attaching antenna if sighting to bottom of antenna mount is difficult.

<sup>(3)</sup> SHMP = Slant Height Measurement Point. Please specify which manufacturers' recommended SHMP is used (e.g. Bumper, Lever, Leica hook etc.)

<sup>(4)</sup> ARP = Antenna Reference Point =  $\sqrt{(\text{Mean SHMP}^2 - \text{Radius}^2)}$  - Ground Plane Offset. This height should be entered into the receiver/controller and in RINEX.

<sup>(5)</sup> Photos of the PSM#, Antenna S/N and Slant Ht to SHMP are **REQUIRED**. Desirable are photos of obstructions (if present)

<sup>(x)</sup> All Dates and Times (24 hour format) in Local Time (AEST)

