Land Information New Zealand
Toitu te whenua

DRAFT Specifications for the Installation of GNSS Continuous Tracking Stations

Version 1.4
Customer Services

SPECIFICATIONS CURRENTLY UNDER REVIEW

30 May 2008

Contents

Foreword

Section 3 of the Cadastral Survey Act 2002 defines the purpose of that Act as:

(a) to promote and maintain the accuracy of the cadastre by—

(i) requiring cadastral surveys to be done by, or under the direction of, licensed cadastral surveyors; and

(ii) requiring cadastral surveyors to meet standards of competence to be licensed; and

(iii) providing for the setting of standards for cadastral surveys and cadastral survey data; and

(b) to provide, either on an optional or mandatory basis, for the electronic lodging and processing of cadastral surveys; and

(c) to provide for a national geodetic system and a national survey control system to be maintained.

This document contains specifications set by the Customer Services - Geodetic to contribute to achieving this purpose.

General Manager
Customer Services

Land Information NZ
P O Box 5501
Wellington
Phone: 0-4-460 0110
Fax: 0-4-460 0112
Internet http://www.linz.govt.nz/

SPECIFICATIONS FOR THE INSTALLATION OF GPS CONTINUOUS TRACKING STATIONS

1 Scope

These specifications form part of a set of geodetic standards, specifications and guidelines developed by Customer Services - Geodetic. This specification specifically relates to the installation of GPS Continuous Tracking Stations.

1.1 *Document History*

Version No	Amendments
1.0	Original specification developed 25 February 2000.
1.1	7 November 2000. Permanent Tracking Stations changed to Continuous Tracking Stations. Section 5, additions made to make it more relevant to New Zealand. Minor miscellaneous corrections made.
1.2	20 May 2003. Addition of requirement to provide scanned images of all offset marks and ancillary diagrams when new sites are established (see section 8.9). All data shall now be supplied in digital format only.
1.3	November 2006: References to Surveyor-General in the document changed to Customer Services.

2 Related Standards

Office of the Surveyor-General 1998: Accuracy Standards for Geodetic Surveys. OSG Standards 1

Customer Services 2006: Specifications for Geodetic Physical Network

2.1 *Definitions and Explanations*

Active Control Network Network of GPS Continuous Tracking Stations.

LINZ partnership station GPS Continuous Tracking Stations that provide direct benefit in LINZ's role of managing and maintaining the geodetic system.

LINZ certified station GPS Continuous Tracking Stations which are additional to LINZ's core requirements but which generally contribute to the utility of the geodetic network for other users. On request and on provision of supporting data, LINZ may agree to certify that these stations comply with an appropriate geodetic standard and are useable for geodetic or cadastral surveys.

3 Introduction

GPS continuous tracking networks are now forming an integral part of geodetic networks world-wide. GPS continuous tracking stations are used to support the geodetic infrastructure in the following ways:

- They enable the continuous monitoring of crustal deformation. These data are used to develop and maintain the velocity model required for the implementation and maintenance of NZGD2000. The current velocity model has been developed using repeated annual GPS surveys, which includes the 28 First Order marks. The development and installation of a significant number of continuous tracking stations would eliminate the need for re-surveys of the 1st Order network to monitor crustal deformation;

- They provide greater confidence in the geometry and performance of the datum through continuously collecting and analysing data. An improved confidence in the network is required as distortions in the Zero and 1st Order network will highlight discrepancies when fixing a point from two or more of these distant marks;

- They enable significant gains in the way that the datum (through geodetic control) can be developed and maintained through the control being surveyed directly into the high integrity geodetic infrastructure. Because the tracking stations are operating continuously, contractors can use this information along with their data to complete geodetic contracts more efficiently, and with less field personnel and equipment.

- Connecting local surveys, e.g.,cadastral surveys, into the high integrity geodetic infrastructure (continuous tracking network) will ensure seamless and spatially consistent data sets and will contribute to the local geodetic framework;

- With future improvements in the processing of longer GPS baselines, the design of the geodetic network will change. With a small number of high integrity stations (eg, continuous tracking stations) it will be possible to replace the current six tiered (e.g., Zero-5th Order) system with a two or three tiered system (e.g., Zero, 3rd and 5th Order) due to the ability to survey directly off the Zero Order network when fixing control marks;

- As other continuous tracking stations of suitable specification are implemented by spatial positioning users, eg, cadastral surveyors, utility companies and local authorities, they should be incorporated into the geodetic network. This will lead to an enhancement of the spatial reference system that benefits all users through simplifying the integration of spatial data sets within New Zealand and internationally. This will enable the seamless conversion between global and regional networks.

- Third, 4th and 5th Order 2000 marks will remain available to support more intensive surveys, and where GPS is not practicable, economic or technically feasible the placement/reinstatement of these marks is facilitated by a GPS continuous tracking network.

From Land Information New Zealand's perspective, continuous GPS tracking stations will fall into two broad groups:

1. "LINZ partnership" stations that provide direct benefit in LINZ's role of managing and maintaining the geodetic system. These stations will form part of the LINZ Zero Order 2000 network. (For the remainder of this report LINZ partnership stations will be referred to as LINZ stations); and

2. "LINZ certified" stations which are additional to LINZ's core requirements but which generally contribute to the utility of the geodetic network for other users. On request and on provision of supporting data, LINZ may agree to certify that these stations comply with an appropriate geodetic standard and are useable for geodetic or cadastral surveys. These stations will be assigned an Order 2000 status depending on the quality of mark installation, equipment used, and data collected and recorded.

This specification details LINZ requirements for the installation of LINZ stations to meet LINZ direct needs and the requirements for LINZ certified stations as developed by other users.

4 Density of Active Control Network

4.1 *LINZ Stations*

To satisfy LINZ requirements and monitor the kinematics of the NZGD2000 geodetic network a network of GPS continuous tracking stations spaced at a similar density to the current 1st Order 2000 network is proposed (20-30 stations). This density of approximately 80 km spacing between stations means that most parts, including all developed parts of New Zealand will be no more than approximately 60 km from a continuous tracking station. Over this distance most commercially available software will be able to compute results within the LINZ accuracy specifications for geodetic control surveys. To allow efficient upgrading and densifying of the geodetic and cadastral network it is intended that stations near population centres be implemented first to gain the maximum benefits from this network at an early stage of the project.

4.2 *LINZ Certified Stations*

The owner of a GPS continuous tracking station may seek LINZ certification and have that station included as part of the geodetic framework of New Zealand. If the requirements detailed in these specifications are met, certification will be considered and if granted that station will be given an Official LINZ Geodetic Code, Datum 2000 Order, and Datum 2000 coordinate status.

The density of LINZ certified GPS continuous tracking stations will be determined by the providers or owners of these stations. It is anticipated that many of these will also be located in major population centres. Others will be in areas of high scientific interest that may be in areas of lower economic activity, or may be specifically located to service offshore requirements.

5 Site Planning and Reconnaissance Guidelines

Any site forming part of an active control network should be stable and secure. Any LINZ station should have legal protection under the Survey Act 1986 in order to secure the long-term availability of the ground mark. The Surveyor-General identifying the station as part of the "National Survey Control System" can achieve this. This will also ensure that a registered surveyor may, with the written permission of the Surveyor-General, gain physical access to the station. Ideally, key LINZ stations will have the ability to house multiple geodetic sensors (eg, DORIS, other positioning techniques).

LINZ Zero Order 2000 stations will be required to be stable ground monuments (e.g., a pillar firmly anchored in bedrock or drilled monuments firmly anchored into gravel). Details of ground monumentation and methods adopted to ensure monument stability shall be supplied. LINZ certified stations may be on buildings; however, in such cases they will be assigned a 1st or lower Order 2000 status.

The following site planning and reconnaissance guidelines are taken from the University NAVSTAR Consortium (UNAVCO), Boulder, Colorado with some modifications to meet LINZ requirements.

5.1 *Site Selection*

An important consideration in selecting a site is a clear view of the sky with no obstructions above an inclination angle of 10-15 degrees. Keep in mind that tall, dense trees near the site can contribute to intermittent loss of lock of the signal, just as buildings do. Be aware of the impact of foliage when reconnaissance is conducted during the cold season. If small trees are present but do not block the sky appreciably, assess their rate of growth if the station is to be occupied for several years. Flat surfaces (vertical or horizontal) near the antenna can cause serious problems with multipath interference. As a rule of thumb, a one-story building should be at least 20 m away while taller buildings need to be farther away.

Other potential fixed reflectors include chain-link fences, metal objects located in the vicinity, and time-varying reflectors such as parked cars, moving vehicles, scaffolding, etc. A station obstruction diagram should be sketched to identify the approximate distance and bearing to the nearest obstacles. Include potential sources of radio interference such as high-power television or microwave transmission towers. Ideally, the site should be kept at least 300 m away from such structures.

During the initial visit to the proposed site, try to collect data for at least 24 hours (preferably 48 hours) to assess the quality of the site. Consider also ease of access and proper authorisation from private property owners. For example, permission to build a station may be granted by the owner, but access may have to be negotiated with landowners whose properties are adjacent to the site in question. Names and numbers of site contacts should be well documented.

Weather conditions at a site should be considered, eg, a high site on a peak may be prone to lightening strikes or snow accumulation on the antenna may become a factor.

5.2 *Monumentation*

A permanent, stable, high-quality monument is a must for a continuous site installation. At each site one 4th Order 2000 mark, ideally within 200m of the continuous tracking station, shall be installed and surveyed. This mark can act as a reference station to the continuous tracking station and will allow conventional observations to be made from the site. Other nearby datum 2000 stations can be used as other reference marks as required.

A typical continuous tracking station monument has a ground-level base that is anchored at depth and decoupled from the surface as much as possible, and an antenna mount that can be precisely positioned on this base. The actual specifications for the monument will depend on the application and local site characteristics. Stability, cost, and access are the driving considerations. LINZ Customer Services – Geodetic will approve any monument designs before installation.

Geodetic quality monuments must meet the most stringent quality construction standards. Weather-related changes that affect soil stability can mask important geodetic signals. Soil expansion and compaction in response to varying amounts of moisture, or thermal expansion are examples of such problems. So, the lack of significant outcropping in the area of interest may require the construction of a deeply anchored, isolated, braced monument to minimise environmentally caused displacements. If bedrock is available, assess its quality and look for unfractured, unweathered, highly indurated rock that is free of clay minerals. You may consider clean carbonates too, but watch for fractures that fill with soil, as well as water. These fractures will be subjected to expansion and contraction with varying temperature and water saturation. In any case, avoid placing a monument in an area likely to be affected by runoff or natural drainage during precipitation events or snow melt. The depth of the water table and its fluctuations due to natural or human causes are also important considerations in the long-term stability of a monument. Finally, make sure that the 'outcrop' or boulder you are looking at is not just embedded in surrounding soil. Such a marker will move around with the soil as it creeps, expands, contracts, etc. Based on the above considerations, it is quite obvious that ultimate stability is dictated by the ground material. The accuracy of the geodetic signal is only as good as the weakest link in the measurement process and the burden is typically placed on the monument.

As outlined above, reconnaissance requires evaluation of the rock quality or, if no outcroppings are present nearby, the determination of the expansive characteristics of the soil. Also include an estimate of the time and expense needed for building the monument. For instance, the hardness of the rock will determine the type of drill bit for the marker. Simple design can often be achieved for monuments being placed on very high quality bedrock, while a more elaborate design will be required for a monument anchored in highly expansive soils. Remember that the quality and stability of the permanent marker must reflect its intended use to keep construction costs reasonable.

5.3 *Power*

All continuous GPS sites require a reliable power supply for continuous data logging and periodic downloads. The simplest alternative is to install the receiver and ancillary equipment near a local AC power outlet, or to string a power cable out to the instrument box. Therefore, it is necessary to consult local utility companies or local owners of nearby power hook-ups. If a cable must be used, decide whether it will run above ground or will be buried for security or safety reasons. The cost for trenching may become significant, both in terms of labour and the contracting of earth-moving equipment. The reliability of the power supply should be assessed.

If a GPS site is located in a remote area, an independent source of power may be required. A photovoltaic (solar-powered) system with a battery backup is normally used to ensure a stable power supply. Design considerations are particularly important and the size of the system must be balanced against the cost of using more panels for increased autonomy. Solar panel efficiency is dependent on the season, latitude, and local climate (cloud cover and temperature). Solar radiation statistics should be obtained from the weather facility nearest the proposed GPS site along with worst-case scenarios based on a return rate corresponding to the estimated length of occupation for the station.

The battery bank size will determine the autonomy or reserve time for the system in case of prolonged overcast conditions. Keep in mind that a total overcast is not necessary to deplete battery charge over time. If, for instance, the system was designed for an average of 3.5 hours of bright sunshine daily, and, that for an unusually cloudy month, sunshine averages only 2 hours per day, the deficit in power output by the solar panels will have to be supplemented by the batteries which will then register a voltage drop over time. Therefore, proper design must include battery discharge and charge rates for various scenarios.

The decision of using solar power verse local AC power to supply the site may not be an easy one if local AC power is available but some distance away, and must be brought in. There are no hard-and-fast rules on the maximum distance for which a cable can be run to the nearest power source. A higher-gauge power cable will be required for lengths exceeding a few meters to prevent significant voltage drop over distance. The final decision is usually one of cost: at which point does a self-powered continuous station become cheaper than one relying on AC power? The question may not even arise if the reliability of local power cannot be demonstrated.

5.4 *Communications*

Besides being self-sufficient with power, the significant advantage of unstaffed, maintenance-free GPS sites lies in the capability to download data on a regular basis which provides a way to monitor ground motion rates and station performance on a near "real-time" basis. Remote communications equipment comes in a wide variety of hardware configurations depending on the application.

First, determine the desired location of the data relay site. Can the download computer be co-located with the receiver, or is it required to place it some distance away from the equipment box (ie in a nearby building)? If co-location is not feasible, a communication link between the receiver and computer will be needed. If local phone service is available nearby, will other users share the line, so that a dedicated line may become necessary? As in the case of AC power, the cost of running a cable to the site must be looked into.

If phone service is not available, one should turn to short-haul modems or radio modems. A short-haul modem is required if the base computer is located at a distance greater than the practical limit of 15m for standard serial RS-232 cables. However, the requirement for a physical wire connecting the computer and receiver limits the usefulness of a short-haul modem to distances usually shorter than their intended limit of approximately 7km. One reason is that the transmission rate is a function of distance with maximum data rates of 19200 bps being achieved over distances of 1km or less.

New wireless technology offered by radio modems provides an effective data throughput using a carrier-independent mode of transmission over distances of up to 100 km so long as line-of-sight is maintained. For remote sites, this may be the only alternative to ensure regular data downloads. For truly remote sites, consideration should be placed on high gain antennas, radio repeater sites, or the use of in-line amplifiers to boost the range and data throughput. Inquire with local communication licensing authorities regarding the use of high-powered radio communications. Another option for enhanced communications is the choice of a directional (Yagi) antenna over an omnidirectional one, particularly if only one leg is required between the master and slave. The initial investment for a radio modem is relatively high but the cost is somewhat offset by the fact that, once installed, the user does not incur additional toll charges for each connection. A mixed communication mode may also be a viable alternative where a remote radio link is connected to a remotely located phone line (especially if it means removing the need for radio repeaters).

Once a location has been selected for the base computer, implement a data retrieval mechanism for distribution, post-processing, and archiving. The availability of an internet connection facilitates the process by allowing regular data transfers to regional processing centres.

For all telecommunication modalities, it is important to test communication links. In the case of phone communications, intermittent noise on the line could prevent successful data downloads. For radio and cellular phone communications, physical obstructions or electromagnetic interference can seriously affect communications. In the case of cellular phones make sure that the site is well within range of cellular access.

5.5 *Security*

Site safety is especially important if the electronic equipment cannot be placed in a secure building adjacent to the site. There are two levels of protection one must consider for a continuous station: protection against the elements and security from manmade and/or animal interference. It is imperative that all external surface cables be protected against animals and pests (deer, sheep, goats, cows, keas, rats, etc). A good level of protection is achieved by using flexible tubing to house cables, or better yet, burying them.

The station should be as unobtrusive as possible to avoid drawing the attention of passers-by. However, ease of access must be balanced against the need to prevent potential acts of vandalism and/or theft.

Protection against environmental factors can be determined by consulting the regional weather bureau on the local climate and extreme conditions likely to be experienced. Industry standards use rating systems to identify a lock box's ability to perform well under certain types of conditions. The lowest level of protection should prevent rain and/or snow from affecting everyday operations. Higher ratings may provide additional protection against factors such as windblown rain, windblown dust (arid areas), icing conditions (mountain tops, cold climates), etc. For outdoor enclosures, temperature extremes should also be factored in, as well as their impact on each piece of equipment. Heat generated by electronic devices may sometimes compound high outside temperatures, and a fan or other cooling device may be needed.

6 Hardware

6.1 *LINZ Stations*

Hardware used for LINZ stations for the development of an active control network needs to be of a design and type that is capable of measuring inter-station vectors to OSG geodetic accuracy standards. For LINZ stations deployed at the density of the 1st Order 2000 network, the appropriate standard will be B100H/*B300V (Office of Surveyor-General Standard 1*) which is the Class 2000 associated with the 1st Order Network. Accordingly, GPS receivers at these stations will need to be of a dual frequency type and will require an antenna that minimises the effects of multipath.

Ancillary equipment will include power supply and equipment for data transfer.

6.2 *LINZ Certified Stations*

For LINZ certified stations, which may be higher density and intended for use over shorter distances, it is possible that single frequency stations may be used. The order of the station coordinate can be specified and the class of observations that this station is capable of supporting will be dependent on the type of hardware installed (ie, the station can be certified to a given order of accuracy).

7 Access to Data

7.1 *LINZ Stations*

The following is required for access to data by LINZ or LINZ geodetic contractors:

- Data must be available at 30 second intervals. Higher data logging rates may be required for other applications and users. This will be acceptable provided that the data-logging interval is an exact divisor of 30 seconds.
- Data shall be provided in at least RINEX format. Other proprietary formats may also be provided.
- A clear process will be required for providing assurance of data quality.
- Data shall be recorded and made available for at least 95% of the time with any outages being restricted to less than 24 hours where possible. A mechanism will be required to allow potential users to identify whether a station is operating at a given time or not.
- Data shall normally be available for downloading and use within 24 hours from the time of observing.
- Provision must be made for data storage and availability on line for 12 months and then archived for a time agreed to with LINZ Customer Services - Geodetic.

7.2 *LINZ Certified Stations*

LINZ certified stations will need to have a mechanism to provide data to the general survey community (either free-to-air or, more commonly, on a commercial basis) in order to be considered for LINZ certification. The following are the expectations for access to data by general users for LINZ certified stations.

- Data logging intervals should be an exact divisor of 30 seconds so that data from these stations and the LINZ partnership stations can be processed together.
- Data should be provided in commonly used formats. These may be proprietary formats such as those of the major GPS receiver manufacturers. Ideally, data for post-processing should also be available in RINEX format or should be readily translatable to RINEX.
- A clear process should be in place for providing assurance of data quality.
- Data should be recorded and made continuously available for at least 95% of any week.
- Data should be available either immediately for real time survey, or within 24 hours for post-processing.

8 Documentation for a GPS Continuous Tracking Station

All documentation for a GPS continuous tracking site, whether a LINZ station or LINZ Certified station shall be supplied to Customer Services - Geodetic in **digital** format only. The information required by Customer Services - Geodetic to document a station is:

- Index file
- GPS continuous tracking station equipment
- Mark and site detail form
- Report of work completed
- Photographs of the mark and site including immediate environs to the horizon
- Diagrams of offset marks and any other detail
- GPS Continuous tracking station report

8.1 *Digital Data - File Naming Conventions*

The following codes for naming conventions are to apply for digital files:

AD	=	Access diagram
BB	=	Unique two Character Contractor code as supplied by LINZ (for non accredited geodetic survey providers use XX)
BD	=	Beacon Diagram
CODE	=	Customer Services - Geodetic geodetic code
EXT	=	Digital file type eg, tif, jpg, doc or xls
FFF	=	Sequential Index File number
V	=	Sequential number of visit, photo, or for staged deliverables (1,2 etc)
d	=	diagram
e	=	‘E’ indicates ‘Equipment’
gp	=	‘GP’ indicates ‘GPS’
idx	=	‘IDX” indicates ‘Index File’
m	=	‘M’ indicates ‘Maintenance’
p	=	’P’ indicates ‘Photograph’
r	=	‘R’ indicates ‘Report’
s	=	‘S’ indicates ‘Site’

8.2 *Supply of Digital Data*

The digital data are to be supplied on either a CD or ZIP 100 Mb disks unless it is more practical to use another Customer Services - Geodetic approved medium such as where data quantities are relatively small.

Files required to be supplied in a zipped (compressed) format shall be compressed using LINZ approved software, which currently include PKZIP, WINZIP and LHA.

8.3 *Format of Digital Image Files*

The digital image files are to be supplied in the following format:

Characteristic	Black & White Sheet	Colour Sheet
Scanning resolution	200 dpi	200 dpi
Colours	2	True colour
Compression Algorithm	None	Quality Factor = 75%
Image type	PNG	JPEG
File extension (EXT)	png	jpg

Original documents to be scanned that can be clearly represented as black and white images shall be supplied in TIFF PNG format. Original colour or grey scale documents that can not be shown clearly in TIFF PNG format shall be supplied in JPEG format.

8.4 *Index File*

The Index File contains a list of all the digital files relating to the contract (eg, doc, xls, dat, tif, jpg). Information on all digital data files relating to the contract are to be supplied in the following comma delimited format with the header line as shown and followed by one data file per line:

DAFL,DATE,SCNO,CLID,DAFT,COMM

Fields required for each record of this inventory are -

Field Name	Contents	Notes
DAFL	Data File	The name of the data file for which this line of data is associated
DATE	Date	Reference date for work done relating to DAFL.

		Show as year.month.day in New Zealand Standard Time format yyyy.mm.dd
SCNO	Schedule Number	Schedule number as issued by Customer Services - Geodetic
CLID	Cell Code	Cell Code as issued by Customer Services - Geodetic
DAFT	Data File Type	GPSD1 GPS station offset and ancillary diagrams – tif format GPSE1 GPS station equipment form – tif format GPSS1 Mark and site details forms – tif format GPSM1 Report of maintenance work completed – csv, comma delimited file format PHOJ1 Photo – jpg format PHOT1 Photo – tif format ACDP1 Access diagram png format BCDP1 Beacon diagram png format GPSR1 Continuous tracking station contract report – doc, word document MISv1 Miscellaneous data file where v = D for .doc file X for .xls file T for .tif file P for .png file J for .jpg file A for ascii file C for .csv file
COMM	Comments	Optional comments about the data file

An example file is:

DAFL,DATE,SCNO,CLID,DAFT,COMM
AU50GPS1.tif,1999.03.02,,,GPPS1, Mark and site details
AU50GPP1.jpg,1999.03.02,,,PHOJ1,Photograph of AU50
AU50GP1.doc,1999.03.02,,,GPSR1,AU50 GPS Continuous Tracking Station installation report.

The filename format is to be:

BBidxFFF.csv

eg, XXIDX001.csv

8.5 *GPS Continuous Tracking Station Equipment Form*

A GPS continuous tracking station equipment form shall be completed for each GPS continuous tracking station.

A digital copy of each new GPS Continuous Tracking Station Equipment Form shall be delivered to Customer Services - Geodetic. The digital copy is to be supplied as a digital scanned image in TIFF format with filename format of:

*CODE*gpeV.tif

eg, AU50GPE1.tif

The GPS continuous tracking station equipment form will contain all the fields as laid out in the following form, which may be used as a template.

GPS Continuous Tracking Station Equipment Form

GPS Continuous Tracking Station Equipment	
Mark Geodetic Code: **Mark Name:** **Date:**	
Owner/Contact of Equipment Address Telephone Fax Email	
RECEIVER Manufacturer Model No. Serial No. Description	
ANTENNA Manufacturer Model No. Serial No. Description Dome	
COMPUTER Manufacturer Model No. Serial No. Description Power Supply	
COMMUNICATION Computer Manufacturer Model No. Serial No. Description Description of communication	
Other Comments	

8.6 *Report of Work Completed*

A digital copy report shall be provided of work completed upon installation of a GPS continuous tracking station. In addition to the report an access diagram and diagram of the mark shall also be supplied in digital form (PNG file). The digital report is to be supplied in the following comma delimited format with the header line as shown and followed by one line per mark:

CODE,NAME,EXMK,MRKT,MRKS,MPSC,PLRF,EDAT,MRKR1,MRKR2, MRKE, GLREL, BCNHGT1, BCNHGT2, BCNHGT3, BCNHGT4,BCNHGT5, BCNHGT6,BDAT,BECC,MRKD,MLOC,PLQEXIST,PLTEXIST,MDAT, MPSM,MPSB,MPSP,MDMK,MDBE,MDPR,OWNR,PHNO,PADD,ARES, GPSU,ADAT,COMM

Fields required for each record of this inventory are:

Field Name	Data Required	Notes
CODE [1]	Geodetic Code	The four letter unique mark identifier
NAME [1]	Mark name	Where an existing mark, use it's official name from the geodetic database. Where a proposed new mark, use proposed new name.
EXMK[1]	Existing mark	Show 'Y' for existing mark in geodetic database.
MRKT [1]	CRS mark type code	Refer codes in table Table 2 below. Note: where a mark is upgraded use the new mark type, i.e. If a Stainless Steel Pin is placed in an iron tube the mark type is Stainless Steel Pin (PIN).
MRKS [1]	CRS mark status code	Refer codes in Table 3 below.
MPSC [1]	Mark physical state code	Refer codes in Table 4 below.
PLRF	Plan references	All survey plans relevant to the mark (maximum of 100 characters). This information should be transferred from existing Mark and Site Details forms (or N7 cards). It is not necessary to research all plans that may have used the mark.
EDAT	Date established	Year.Month.Day format - yyyy.mm.dd (Note - Leave blank if not applicable)
MRKR [1]	Primary mark protection structure type code	Refer codes in table Table 6 below Note: Where more than one type of Mark Protection exists for a particular mark, select the most prominent protection type.
MRKR2	Secondary mark protection structure type code	Refer codes in table Table 6 below. Note: Leave blank if no secondary protection type.

MRKE [1]	Mark beacon type code	Refer codes in Table 5 below.
GLREL [1]	Ground level relationship	The height (in decimals of metres) of the ground above (value positive) or below (value negative) the top of the mark. (Field is to be left empty if the ground level relationship cannot be measured).
BCNHGT [3]	Beacon/protection Structure height	See table Table 7 for height description.
BCNHGT2 [3]	Beacon/protection Structure height	See table Table 7 for height description.
BCNHGT3 [3]	Beacon/protection Structure height	See table Table 7 for height description.
BCNHGT4 [3]	Beacon/protection Structure height	See table Table 7 for height description.
BCNHGT5 [3]	Beacon/protection Structure height	See table Table 7 for height description.
BCNHGT6 [3]	Beacon/protection Structure height	See table Table 7 for height description.
BDAT	Date Beacon Erected	Year.Month.Day format - yyyy.mm.dd
BECC [2]	Beacon Eccentricity	**If beacon is found to be central:** Add the comment “Central”. **If beacon is found eccentric and subsequently made central**: Dimension the (north/south and east/west or direction and distance) offset (north/south/east/west (or direction) and distance) s with respect to ground mark. Then add the comment “Now central”.. **If the beacon is now centred:** Add the comment “Now centred” else **If the beacon is found eccentric and not subsequently centredmade central:** Dimension offset (north/south/east/west (or direction) and distance) with respect to ground mark. Add the comment “Not centredcentral”. (tThe reason for not centring the beacon is to be recorded in the work contract report.

MRKD [1]	Mark details	Provide a full description of the ground mark as found, modified or proposed (maximum of 200 characters). Common abbreviations may be used, but spelling and grammar must be correct. There is no need to include information detailed elsewhere in this csv file (eg plaque and plate details), except that details of mark destruction should be included here if applicable. **For existing marks**: Use mark details from the geodetic database, edit/update details as required and re-supply full description ie add to but don't loose any existing information with the exception that any access information can be deleted and recorded in the MLOC field. Any spelling or grammar errors in existing information should be corrected. If the existing information is all in capital letters, it should be converted to "sentence case"..
MLOC [1]	Mark location	A description of the location of the mark with respect to surrounding topography, including access details if off the road (maximum of 2000 characters). Common abbreviations may be used, but spelling and grammar must be correct. Any spelling or grammar errors in existing information should be corrected. If the existing information is all in capital letters, it should be converted to "sentence case".
PLQEXIST [1]	ID plaque exists/installed?	Show E if exists, Y if installed, N if non-existent. If N please explain under COMM.
PLTEXIST [1]	ID plate exists/installed?	Show E if exists, Y if installed, N if non-existent. If N please explain under COMM.
MDAT [1]	Date of maintenance	Date the most recent maintenance work was undertaken or site inspected (Year.Month.Day format - yyyy.mm.dd).
MPSM [1]	Description of mark maintenance completed	Brief description of the mark maintenance work completed. (Note: if no maintenance was required this should be stated).
MPSB [1]	Description of beacon maintenance completed	Brief description of the beacon maintenance work completed. (Note: if no maintenance was required this should be stated).
MPSP [1][2]	Description of protection maintenance completed	Brief description of the protection structure maintenance work (includes site maintenance) completed. (Note: if no maintenance was required this should be stated).
MDMK	Description of mark maintenance required	Brief description of the mark maintenance work still required.

MDBE	Description of beacon maintenance required	Brief description of the beacon maintenance work still required.
MDPR	Description of protection maintenance required	Brief description of the protection structure maintenance work still required.
OWNR [1]	Owner/occupier of the land	Name of contact person to permit access and occupation of the mark. If in road reserve state 'Road Reserve' (maximum of 100 characters).
PHNO	Phone number	Of owner/ contact person. (Note - Leave blank if not applicable)
PADD	Physical Address	Where owner/contact person can be located. (Note - Leave blank if not applicable)
ARES	Access Restrictions	Examples include locked gates, lambing season. (Note - Leave blank if not applicable)
GPSU [1]	GPS Suitability	Refer to suitability codes in table Table 8 below.
CELL	Cell phone coverage	Confirm if available at or near site and state the cell phone network access code and provider (eg 027 Telecom, 021 Vodafone)
ADAT [1]	Access Date	Date access notes, or owner/contactor details updated. In yyyy.mm.dd format.
COMM	Comments	Any additional comments including additional protection structures if more than one two exists. Note: This field does not get stored in Customer Services – Geodetic Databasesdatabases., Aany information which may be of interest to users of the geodetic network should be placed in one of the other descriptive fields.

Notes: [1] Leave blank if not applicableMandatory field for all marks..
[2] Mandatory if the mark is beaconed.
[3] Mandatory if the mark is beaconed EXCEPT where the beacon type is "Non-Standard".

If a field is not mandatory, it should be left blank if not applicable.

The filename format is to be :

*CODE*gpmV.csv

eg, AU50GPM1.csv

- **Table 2: MRKT - CRS Mark Type Codes**

CRS Code	Mark Description
IS	Iron Spike, Bridge Spike, Iron Bar, Iron Bolt, Iron Rod, Iron Dog.
IT	Iron Tube, Iron Pipe
LP	Lead Plug
NAIL	Nail
PIN	Stainless Steel Pin (10/25 etc), Bronze Pin (formerly bronze or brass plaque), Steel Pin, Iron Pin
OTHR	Bayonet, Forced Centering, See Description Field
UNMK	Unmarked
UNKN	Not Specified

- **Table 5: MRKE - CRS Mark Beacon Code**

GDB Code	Description
AA	Cairn
CN	Chimney
LH	Lighthouse
MR	Marine Beacon
MS	Mast
ND	Unknown
PL	Pillar
PS	Post
TO	Tower
TT	Transmission Tower
2M	2 m Beacon
4M	3 m or 4 m Beacon

◆ **Table 6: MRKR - CRS Mark Protection Type Codes**

CRS Code	Protection Description
2MBE	2 m Beacon
4MBE	3 m or 4 m Beacon
CICV	Cast Iron Cover
COVR	Cover and Box
MKPT	Marker Post
PREN	Post & rail enclosure
NOPR	No Protection
NSPE	Not Specified

Note: Where more than one type of mark Protection exists for a particular mark, only one is to be selected from Table 6 for the Report of Maintenance Work Completed or Required. References to other type(s) of Mark Protection are to be made under the field Comments of this same report.

8.7 *Photographs of Mark and Site*

Photographs shall be supplied of the mark, the site and the GPS equipment installation.

The photographs shall be supplied as a digital image, either scanned or as supplied from a digital camera. The digital image shall contain the geodetic code and date (yyyy.mm).

The filename format is to be:

*CODE*gppV.EXT

eg, AU50GPP1.jpg

8.8 *Diagrams of Offset Marks and any Other Detail*

Diagrams of any offset marks or any other detail shall be supplied as digital images. The digital copy is to be supplied as a digital scanned image in TIFF format with filename format of:

*CODE*gpdV.tif

eg, MASTGPD1.tif

8.9 *GPS Continuous Tracking Station Report*

A digital copy of the report on the contract shall be supplied in Microsoft Word format.

The format for the name of the contract report digital file is to be:

*CODE*gprV.doc

eg, AU50GPR1.doc

The report shall be verified as correct and certified by the contractor.

The report shall have a short description of the work carried out and any problems or issues encountered.