Toitu te whenua
Land *whenua*
Information
New Zealand

Specifications for Geodetic Contract Deliverables

Version 1.5
National Geodetic Office

24 November 2010

Contents

Foreword

Section 3(c) of the Cadastral Survey Act 2002 defines a purpose of the Act to:

> *provide for a national geodetic system and a national survey control system to be maintained.*

These specifications form part of a set of specifications developed by the National Geodetic Office, Land Information New Zealand, to contribute to achieving this purpose. They relate to the provision of contract deliverables for geodetic control survey and geodetic control maintenance to support the geodetic programme as required by the Cadastral Survey Act 2002 sec 7(1)(a) and (b)**.**

This specification is an extract of the sections titled 'Contract Deliverables' from the Specifications for Geodetic Physical Network Version 1.13 published in November 2006 and Specifications for Geodetic Control Survey Version 1.3 published in November 2006.

Related Standards, Specifications

- Specifications for Geodetic Physical Network Version 2.6: National Geodetic Office 2010
- Specifications for Precise Levelling and GNSS Survey Version 1.0: National Geodetic Office 2010

Version 1.0	Released 31 July 2007
Version 1.1	Minor updates to section 2.5 Table 2, section 2.8.3, section 3.3 template (new item 2c), and section 3.4.1 mark details and phone coverage.
Version 1.2	Section 1.2. Minor updates to file naming conventions Section 3.4. Minor update to to clarify that destroyed or not found marks shall be included in the Report of Maintenance Work Completed or Required. Section 2. Minor additions to geodetic survey deliverables list. Section 2.2. Additional codes for data file types Section 2.3.3. Updated details on supplying RINEX files Section 2.6. Added alternative format for times in Vector Data File

	Section 2.10. New section on providing photos of mark and site
	Section 2.11. New section on providing a Report on Maintenance Work Completed or Required
	Section 2.11. New section on providing final and progress payment invoices.
	Section 3. Minor additions to geodetic physical maintenance deliverables list.
	Section 3.2. Additional codes for data file types
	Section 3.3. Additional items added to Maintenance Summary Report, 2.h) Preserve a mark 3.b) Supply and fix information plate
	Section 3.4.1. Update to NAME and GLREL field notes; additional field INFOEXIST
	Section 3.6. Additional photo requirements
	Section 3.7. New section on providing final and progress payment invoices.
Version 1.3	Section 1. Additional paragraph outlining requirements where work includes both survey and maintenance deliverables
	Section 2. Additional paragraph outlining requirements where work includes multiple cells
	Section 2.3.3. RINEX data now only required for $0-4^{th}$ order surveys
	Section 2.4. Clarification that no field notes are required for RTK surveys
	Section 2.7.1. Update SNAP version
	Section 2.8.3. Additional requirement to confirm that compulsory mark attributes complied with. Removed requirement to tabulate observation session details
	Section 2.8.4. Removed requirements to detail data eliminated and changed
	Section 2.8.5. Additional requirement to discuss weighting and re-weighting of adjustment data
	Section 2.9.4.1. Changed to permit adoption of a bearing swing from an approved CSD for a reliability check where the underlying data is

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	Old Cadastral Section 2.10. Added details of requirements for before photographs Section 2.12. New section requiring a Maintenance Summary Report whenever maintenance is carried out
Version 1.4	This document is now prepared and maintained by the National Geodetic Office, Land Information New Zealand. Section 1. Changes to approved Media and methods of submitting deliverables Section 2. Report of Maintenance Work Completed or Required has been added to the list of single combined data. Section 2.3. Addition of Field Note requirements for RTK sessions Section 2.4. Clarification of notes for MRKT & NAME Section 2.7.2 More description of the requirements of the Survey Report summary Section 2.8.1. Additional requirement to state that existing marks meet compulsory requirements Section 2.8.2. Addition of section for New Marks Section 2.9 Clarification of requirements for photos Section 2.10 Clarification of marks which require a Report of Maintenance Work Completed or Required Section 2.10. & 3.5.1. Modification of requirements, so that either an Access or Finder diagram is supplied for each mark. Section 3. Additional paragraph outlining requirements where work includes multiple cells Section 3.3. Addition of a separate Maintenance Summery Report (and template) during a geodetic control contract
Version 1.5	Section 2.1 Updated to incorporate height difference files Section 2.4 Updated to incorporate height difference files Section 2.6 New section covering height difference files

Chief Geodesist
National Geodetic Office

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 GEODETIC CONTRACT DELIVERABLES

1   General

All information relating to geodetic control survey and geodetic control maintenance shall be provided to the National Geodetic Office in digital form only, on approved media or be available for download directly from the Contractor's ftp site. Currently approved media are CD, DVD or USB flash device. Individual files which are being resubmitted may be delivered by email.

The vast majority of geodetic surveys also include some geodetic maintenance deliverables (eg photos, RMWCR csv files). Where this is the case, both the survey and maintenance deliverables are to be supplied in the same electronic directory with a single, combined index file.

1.1   *Format of Digital Image Files*

Digital image files are required to be supplied in the following format:

Characteristic	Black & White Sheet Survey	Black & White Sheet Maintenance	Colour Sheet Survey and Maintenance
Scanning resolution	200 dpi	200 dpi	200 dpi
Colours	Black and white	Black and white	True colour
Compression algorithm	CCITT Group 4 (2d)		
Image type	TIFF (single page)	PNG	JPEG
Filename extension (EXT)	tif	png	jpg

1.2   *Digital Data – Common File Naming Conventions*

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

Code	Description
BB	unique two character Contractor Identification code as supplied by the National Geodetic Office
CODE	four character geodetic code
FFF	sequential Index File number
idx	'IDX' indicates 'Index File'
NNNN	the last four digits of the Cell Code (where multiple cells are being delivered, use the first cell code)
p	'P' indicates 'Photograph'
V	Sequential number of visit, photo, or for staged deliverables (1, 2 etc)
YY	the last two digits of the calendar year except where it is used in conjunction with the last four digits of the Cell Code (NNNN) when YY is the last two digits of the year in the Schedule Number

For additional file naming conventions:
- Survey – refer to section 2.1
- Maintenance – refer to section 3.1

1.2.1   *Index File*

The Index File contains a list of all the digital files submitted as deliverables (eg doc, xls, dat, tif, jpg). Information on all digital data files submitted as deliverables 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 with which this line of data is associated
DATE	Date	Approximate date relating to the information contained within the Data File (DAFL). To be shown as Year.Month.Day in NZ Standard Time format yyyy.mm.dd (eg 2007.06.02)
SCNO	Schedule Number	Schedule Number as issued by the National Geodetic Office. Where no schedule no. is provided use YYYY999.
CLID	Cell Code	Cell Code as issued by the National Geodetic Office. Where no cell code is provided use YYYY99999.
DAFT	Data File Type	Refer to section 0 for Survey data file types Refer to section 3.2 for Maintenance data file types
COMM	Comments	Optional comments about the data file.

An example file for survey deliverables is:

DAFL,DATE,SCNO,CLID,DAFT,COMM
060203S.doc,2007.02.01,2006102,200610203,GCRD1,Control Survey Report
LI00013M.csv,2007.02.03,2006102,200610203,MDFC1, Mark Data File
LI00013V.csv, 2007.02.03,2006102,200610203,VECC1,Vector Data File

The filename format is to be:

  BBidxFFF.csv
  eg LIIDX001.csv

2   Geodetic Survey Deliverables

The contract deliverables for the Geodetic Control Survey are:

- Index file

- RINEX data where required (0-4th order surveys)

- Mark data

- Vector data

- Height difference data (typically height changes)

- Adjustment data

- Geodetic control survey report

- Mark reliability check data

- Mark and Site Photo(s)

- Report of Maintenance Work Completed or Required (RMWC)

- Access or Finder Diagrams

- Final Invoice(s) and Progress Payment Invoice(s)

The vast majority of geodetic surveys consist of multiple cells. Where this is the case, all deliverables are to be supplied in the same electronic directory with a single combined: index file, mark data file, vector data file, SNAP adjustment, RMWC file and control survey report.

2.1   *Survey Digital Data - File Naming Conventions*

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

Code	Description
DDD	Julian day of the year
EEEEE(E)	Five or six character alphanumeric code chosen by the Contractor to ensure unique digital filenames for all data supplied as part of the current or any previous contract. For a Mark Data file, the final character must be 'M'. For a Vector Data file, the final character must be 'V'. For a SNAP data file, the Contractor should choose all six characters.
O	Order of control For 1st order = 1 For 2nd order = 2 For 3rd order = 3 For 4th order = 4 For 5th order = 5
s	'S' indicates 'Survey'.
S	Session number which reflects the consecutive sequence of separate occupations of

	the same mark within a particular Julian day, beginning 0 or 1.
V	Sequential number of diagram.
L	Indicates 'Levelling'
VV	Sequential number for each levelling run

'DAFT' field in Index File

The format of the 'DAFT' field in the Index file is as follows:

Field Name	Contents	Notes

DAFT	Data File Type	Five character codes for the data file type. For Geodetic Control Survey these codes are:
		MDFC1 Mark data file - csv, comma delimited file format
		VECC1 Vector data file, -csv, comma delimited file format
		INVF1 Digital copy of final invoices –pdf format
		INVPv Digital copy of any progress payment invoices – pdf format, where v = sequential number
		SNPA1 Adjustment data (Note - provide files in SNAP format)
		GCRD1 Geodetic Control Survey Report – doc, word document or pdf format
		MRCT1 Mark reliability checks – tif format
		RNXR1 RINEX observation data files
		MISv1 Miscellaneous data file where v =
		        D for .doc file
		        X for .xls file
		        T for .tif file
		        J for .jpg file
		        A for ascii file
		        C for .csv file
		        R for RINEX .zip file

2.2   GNSS Data

2.2.1   *Time and Date Conventions*

In all GNSS data files, the following conventions are to apply for times and dates:

- All times are to be in terms of UTC.

- Julian day is to be regarded as the day of the year in terms of UTC.

- For any particular session, the Julian day is that corresponding to the beginning of the UTC observation period.

Data files commencing before 1200 hours NZST will be one Julian day before those representing observations commencing after 1200 hours NZST.

2.2.2   *Raw Data*

Raw data is **NOT** to be supplied.

2.2.3   *RINEX Data*

For any survey required to meet 4th order standards or better, the raw data is to be converted to RINEX version 2.10 format (http://igscb.jpl.nasa.gov/igscb/data/format/rinex210.txt).   Note that RINEX data is not required at stations where only RTK observations have been made. Where possible the receiver manufacturer's recommended RINEX software translator should be used as this generally produces the most accurate RINEX file from that data.   However other translators may be used provided they produce an accurate translation to RINEX (version 2).

The data in the RINEX files must be correct, ie geodetic control mark names and 4 character geodetic codes.   Only the header section may be modified and any such changes are to be documented in the "Processing Section" of the Contract Report (see section 2.8).   Antenna heights must be reduced to the vertical and stated with respect to the bottom surface of the antenna (the antennae reference point - ARP).   The position of the antennae reference point shall follow the IGS standard available from:

   ftp://igscb.jpl.nasa.gov/igscb/station/general/antenna.gra;type=a

The NGS web site is a useful reference for antenna dimensions:

   http://www.ngs.noaa.gov/ANTCAL

The following minimum fields must be populated with information in the RINEX header:

- RINEX Version/Type

- Observer/Agency

- Marker Name

- Marker Number

- Rec # / Type / Vers

- Ant # /Type

- Antenna: Delta H/E/N

- # / Types of Observ

- Interval

- Time of First Obs

Separate RINEX observation files are required for each occupation of each mark for each Julian day. However, each day's data may be supplied in one .zip file. Navigation and station files are **NOT** required.

The individual RINEX observation files shall be named using the following format:

> *CODE*DDDS.YYO
> **eg   A3PM1181.09O**

The zipped RINEX observation files shall be named using the following format:

> BBOYYDDD.zip
> **eg   LI509118.zip**

All RINEX files (or the single zip file) for each Julian day shall be supplied in a sub directory. The format of the sub directory name is to be:

> YYDDD
> **eg   09118**

2.3   *Field Notes*

Field notes are expected to be retained by the Contractor in case they are requested by LINZ. Each field note shall be checked and signed by the Contractor. Field notes are required for each observing session for RTK observations (some of this information may be stored as .dat file) and for each mark for all other GNSS data. Field note data shall consist of:

- the geodetic code and mark name;

- the schedule number and the cell code;

- the name of operator;

- the instrument/antenna make(s), model(s), and serial number(s);

- the local date and time for the start and finish of observations;

- the Julian day of the year and the start and finish times of observations in terms of UTC;

- the session number beginning from 0 or 1, that records the sequence of occupations at each mark per Julian day;

- the logging interval and elevation cut off angle set in the receiver;

- the antenna orientation (for antennae where this is not required include a statement in the Field Observation Section);

- the vertical distance in metres between the top of the mark and the bottom of the GNSS antenna (ARP);

- a diagram clearly showing all the measurements and constants used to compute the vertical distance in metres between the top of the mark and the bottom of the GNSS antenna;

- the vertical distance in metres between the bottom of the antenna (ARP) and the phase centre (L1 and L2 if different) of the antenna;

- any eccentricities (document any eccentricities fully, including independent checks and diagrams);

- any problems experienced (eg equipment problems, battery failures, broken sessions, obstructions, or any potential multipath problems);

2.4   *Mark Data File*

The Mark (Coordinate) Data file contains the NZGD2000 coordinates of all marks (new and existing nodes) stored in the Vector Data files (section 2.5) and Height Difference Data files (section 2.6). The primary link between the Mark Data file and the Vector and Height Difference Data files is the 4 character code (*CODE*).

For the field EXMK, Y or N will apply depending on whether such marks are in the geodetic database or not. Option Y will always apply to any higher order 2000 mark and to any geodetic bench mark or trig station. Contractors should check the geodetic database for any other marks that may already exist in the geodetic database. Exactly the same criteria apply for the field MRKS, where COMM indicates the mark is in the geodetic database and PEND means it is not.

Stations are to be listed in the following order:

- Existing higher order 2000 marks;

- Existing order 2000 marks of the same order as the design;

- Proposed order 2000 marks that exist in the geodetic database;

- Proposed order 2000 marks that are not in the geodetic database.

Information on all marks is to be supplied in the following comma delimited format with the header line as shown and followed by one line per mark:

**CODE,MRKS,MRKT,EXMK,DISTRICT,CROD,ORDV1,ORDV2,ORDV3,
NAME,ALTN,COMM**

Fields required for each record of this inventory are -

Field Name	Contents	Notes
CODE	Geodetic Code	4 character geodetic code.
MRKS	Mark Status	A code from the Mark Status table (see Table 1) Relates to the status of the mark in the geodetic database.
MRKT	Mark Type	A code from the Mark Type table (see Table 2). Note: where an existing 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). However, the mark name will remain the same i.e. IT IV DP 412345
EXMK	Existing Mark	Y- Existing mark that is in the geodetic database. N- Not in the geodetic database.
DISTRICT	Land District	A code from the Land District table (see Table 3)
CROD	Coordinate Order	If an existing Order 2000 mark, show order of mark. If mark is upgraded or a new mark, show proposed new Order 2000 (use code in Table 4).
ORDV1	Ordinate Value 1	The NZGD2000 latitude in decimal degrees to 8 decimal places (+ve if north, -ve if south)
ORDV2	Ordinate Value 2	The NZGD2000 longitude in decimal degrees to 8 decimal places (+ve if east, -ve if west)
ORDV3	Ordinate Value 3	NZGD2000 ellipsoidal height shown in metres to 3 decimal places. If unknown leave field blank.
NAME	Mark Name	For marks in the geodetic database use the database name. For other marks use their existing identifications. All letters in the name are to follow case naming conventions detailed in the Geodetic Survey Control Specification Section 4.
ALTN	Alternative Mark Name	Where there is an alternative mark name include in this field otherwise leave blank.
COMM	Comments	Optional comments field

An example file is:

**CODE,MRKS,MRKT,EXMK,DISTRICT,CROD,ORDV1,ORDV2,ORDV3,
NAME,ALTN,COMM
AP8Y,COMM,PIN,Y,HN,2k2,- 37.95659775,177.00867006,209.716,
WHAKATANE NO 2,WHAKATANE, 2nd Order Control Mark**

The filename format is to be:

BBEEEEEM.csv
eg   LI06102M.csv

Coordinates shall be sufficiently accurate to indicate network geometry and are not necessarily final adjusted values.

Table 1. MRKS - Mark Status

Code	Mark Status Description
PEND	Pending - Upgraded mark is not in the geodetic database.
COMM	Commissioned - Existing or upgraded mark is in the geodetic database.

Table 2. MRKT - Mark Type

Code	Mark Type
IS	Iron Spike, Bridge Spike, Iron Bar, Iron Bolt, Iron Rod
IT	Iron Tube, Iron Pipe
LP	Lead Plug
NAIL	Nail
PIN	Stainless Steel Pin (12/22 mm), Bronze Pin (formerly bronze or brass plaque), Steel Pin, Iron Pin
OTHR	Any other mark type e.g. Bayonet, Forced Centring
UNMK	Unmarked
UNKN	Not Specified

Table 3. DISTRICT - Land District Codes

Code	Land District Name	Code	Land District Name
AA	Antarctica	OI	Offshore Islands
CH	Canterbury	DN	Otago
CI	Chatham Islands	HN	South Auckland
GS	Gisborne	IN	Southland
NA	Hawkes Bay	NP	Taranaki
BM	Marlborough	WN	Wellington
NN	Nelson	HK	Westland
AK	North Auckland		

Table 4. CROD - Coordinate 2000 Order of Mark.

Code	Coordinate Order Description
2k0	Zero Order PositioNZ station
2k1	1st order
2k2	2nd order
2k3	3rd order
2k4	4th order
2k5	5th order
2k6	6th order or lower

2.5   *Vector Data File*

Vector data file format is to be used for data that can be represented in terms of a three dimensional earth centred Cartesian coordinate system (such as NZGD2000 or WGS84). This vector format shall be used for GNSS data.

The filename format for the Vector Data file is to be:

> BBEEEEEV.csv
> **eg   LI06102V.csv**

The three dimensional vector data is to be supplied in the following comma delimited format with the header line as shown and followed by one observation per line:

> **FCODE,TCODE,DATE,TIME,dX,dY,dZ,ROBG,COMM**

Vectors rejected from the SNAP adjustment must not be included in the vector data file.

Fields required for each record of this inventory are:

Field Name	Contents	Notes
FCODE	From Code	Geodetic code for receiver 1
TCODE	To Code	Geodetic code for receiver 2
DATE	Date	Year and Julian day of year (yyyy.ddd; eg 2000.062)
TIME	Time	Hour and Minute in UTC expressed in terms of a 24 hour clock (hh.mm OR hh:mm; eg 09.05 OR 09:05) at the start of the session
dX	Delta X	Delta x in metres (show at least 3 decimal places)
dY	Delta Y	Delta y in metres (show at least 3 decimal places)
dZ	Delta Z	Delta z in metres (show at least 3 decimal places)
ROBG	Class	Horizontal Class of survey observations **best matching** the errors assigned in the SNAP adjustment (eg VIII for 5th order)
COMM	Comments	Optional comments field

An example record is:

> **FCODE,TCODE,DATE,TIME,dX,dY,dZ,ROBG,COMM**
> **1163, A79B, 2006.359, 12.59, -12440.912, -7725.093, 12799.139,VIII,**

2.6   *Height Difference Data File*

Height Difference data file format is to be used for the normal-orthometric height differences between marks.

The file name format for the Height Difference Data file is to be:

BBEEEEEE.csv

Eg   LI00013L.csv

The height difference data is to be supplied in the following comma delimited format with the header line as shown and followed by one observation per line:

FCODE,TCODE,DATE,TIME,DHGT,LVDIST,ROBG,COMM

Fields required for each record of this inventory are -

Field Name	Contents	Notes
FCODE	From Code	Geodetic code for start mark
TCODE	To Code	Geodetic code for end mark
DATE	Date	Year.Month.Day in NZ Standard Time (eg yyyy.mm.dd; 2001.09.26)
TIME	Time	Hour.Minute in NZ Standard Time expressed in terms of a 24 hour clock (eg hh.mm; 09.05) at the start of the levelling run
DHGT	Difference in Height	Unadjusted levelled height difference between 'from' and 'to' marks. Must be reduced to account for instrumental and atmospheric errors, but normal-orthometric correction should not be applied.
LVDIST	Levelling distance	Slope distance levelled expressed in metres to the nearest metre.
ROBG	Class	Class of survey observations (use "VI")
COMM	Comments	Optional comments field

An example file is:

FCODE,TCODE,DATE,TIME,DHGT,LVDIST,ROBG,COMM
AP8Y,AP83,1999.12.25,23.59,-6.4534,465,VI,

2.7   *Adjustment Data*

All the observations in the vector data files are to be included in both a free-net and a constrained adjustment of the entire network(s).

No adjustment is required for height difference data.

2.7.1   *SNAP Adjustment Software*

Unless the National Geodetic Office gives prior approval, SNAP Version 2.3.28 dated 14 October 2009 or greater shall be used to carry out adjustments. The following SNAP input and output adjustment files for free-net and constrained adjustments are to be supplied with the specified filename conventions:

Free-net Adjustment:

BBFONNNN.snp	SNAP Command file
BBFONNNN.crd	SNAP Coordinate file
BBFONNNN.lst	Listing file produced by SNAP
BBEEEEEE.dat	SNAP Data file (*Note: Not the same format as the vector data file*)

Constrained Adjustment:

BBCONNNN.snp	SNAP Command file
BBCONNNN.crd	SNAP Coordinate file
BBCONNNN.lst	Listing file produced by SNAP
BBEEEEEE.dat	(*As for Free-net Adjustment above*)

Where F is for Free-net and C is for Constrained.

The format of the contents of these files are to meet the SNAP data format specifications.

A copy of SNAP and its associated utilities may be obtained from the LINZ website at: http://www.linz.govt.nz/downloadsoftware.

2.7.2   *Non-SNAP Adjustment Software*

Prior approval is required from the National Geodetic Office if an adjustment programme other than SNAP is to be used. This approval will also state the format the adjustment files need to be provided in.

2.8   *Geodetic Control Survey (Contract) Report*

A contract report on the survey shall be supplied in Microsoft Word digital or PDF formats.

The format for the name of the Contract Report digital file is to be:

> YYNNNNs.doc
> YYNNNNs.pdf
> **eg   060203S.doc**
> **060203S.pdf**

The report shall be verified as correct and certified by the Contractor and should contain as a minimum the following sections.

2.8.1   *Header Section*

 Each report must have a header with:

- Schedule number

- Cell code(s)

- Schedule or Cell Name(s)

2.8.2   *Summary Section*

Each report shall have a summary section that summarises all problems encountered including: issues, agreed variations, other communications with LINZ and any deviations from the information provided in any tender documents. It is a requirement that the Contractor provides details of any situations where the specifications have not provided adequate guidance ie where the Contractor has made assumptions or used their "professional judgement".

2.8.3   *Field Observation Section*

This section shall include the following:

- an overall summary of the office planning and field campaign for the survey;

- a list of personnel involved in the survey and their function in the survey;

- a list of the equipment used on the survey including their system/configuration number, type of equipment, precise level and GNSS receiver specifications and characteristics, serial number of levels, GNSS receivers and antennae, precise level calibration reports;

- a list of the names and geodetic codes for the geodetic survey marks involved in the survey;

- a scaled diagram of the network observed that shows each mark involved, its name or code and the vectors that were observed (eg an image from SNAPPLOT). Note that this can also be provided as separate tiff or jpeg files in the following format
    YYNNNNV.*file type*
    eg   0602031.tif or 0602031.jpg

- a description of the methods adopted, including details of any equipment calibrations carried out, to meet the required accuracy standards.

2.8.4   *Processing Section*

This section is to explain the processes used to check and reduce the observed baselines (ie. computing the vectors between GNSS marks) and changes in height (ie precise levelling) and shall include:

- details of the software used and the parameters used for baseline processing;

- details of reductions carried out to produce changes in height between benchmarks

2.8.5   *Adjustment Section*

This section is to explain the processes used to adjust the baseline vectors and shall include:

- details of the software used;

- the parameters used for the adjustment and a list of the fixed marks;

- details of how the *a priori* errors were selected and how/why any re-weighting was carried out

- details of any data eliminated from the adjustment, with explanation;

- proof that the Class 2000 standards for observation have been met;

- proof that the Order 2000 standards for coordinates have been met.

2.8.6   *Future Maintenance Recommendations*

This section is to include a table of marks requiring non-urgent maintenance. The table shall include geodetic code, mark name and maintenance required.

2.9   *Photographs of Mark and Site*

Digital colour sheet images (see section 1.1 for format) can be generated from scanning a photo or obtained directly from a digital camera.

The photographs must be vertically aligned for ease of viewing (ie ground at the bottom of the photograph, sky at the top). The photographs must not be digitally altered, except that the geodetic code may be added as text if the code is not visible elsewhere in the actual photo, and the location of the mark may be circled (or otherwise identified digitally) if this is not obvious in the photo.

Each image shall include a photo of the mark and a photo of the site. However a single photo of the mark and site will suffice if both can be depicted clearly. Each image shall clearly show the geodetic code of the mark.

At least one additional extended site photo is required which shows the relationship of the mark to its surroundings. The purpose of this photo is to aid mark location and convey the suitability of the mark for GNSS or terrestrial observations. For mark location purposes it is preferable that the extended photo is taken at a distance from the site rather than a wide angle photograph at the site.

Care must be taken to avoid including members of the public in the photographs, or anything else which could compromise an individual's privacy, bearing in mind that the photograph will be made available over the internet in a public database.

The filename format for those photographs showing the mark and site and extended site shall be:

> *CODE*YYpV.JPG
> **eg   AQ2D07P1.jpg**

Where physical maintenance is carried out, a 'before' photograph is required to show the nature of the maintenance required.

The filename format for those photographs taken before maintenance is carried out, the 'before' photographs, shall be:

> *CODE*YYpb.JPG
> **eg   AQ2D07PB.jpg**

2.10   *Report of Maintenance Work Completed or Required*

A report shall be completed for all geodetic marks surveyed, except those which are higher order control marks. This includes those marks for which no maintenance was

carried out. The purpose of this report is to help surveyors access and locate geodetic marks, and advise LINZ of any maintenance requirements. It is identical to that required for Geodetic Maintenance Deliverables.

Access diagrams are required for all trigs or marks with complex access instructions. Finder Diagrams are required in all other situations. See section 3.5.1

2.10.1   *Format of Report of Maintenance Work Completed or Required*

See section 3.4.1.

2.11   *Maintenance Summary Report*

A maintenance summary report is to be prepared for each mark maintained. See section 3.3 for further information.

2.12   *Final Invoices and Progress Payment Invoices*

A hard copy of the final invoice should be provided as part of the completed dataset. In addition, a digital copy of all invoices (including any progress payments) should be provided and included in the Index File.

3   Geodetic Maintenance Deliverables

The contract deliverables for the Geodetic Physical Network are:

- Index File

- Maintenance Summary Report

- Report of Maintenance Work Completed or Required

- Access Diagrams

- Non-Standard Beacon Diagrams (if applicable)

- Before and After Photographs

- Final Invoice(s) and Progress Payments

- Maintenance Contract Report

Where a contract consists of multiple cells all deliverables are to be supplied in the same electronic directory with a single combined: index file, maintenance summary report, RMWC file and maintenance contract report.

3.1   *Maintenance Digital Data – File naming Conventions*

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

Code	Description
AD	Access diagram
b	'B' indicates photographs taken before any maintenance is carried out.
BD	Beacon Diagram
m	'M' indicates 'Maintenance'
p	'P' indicates 'Photograph'
V	Sequential number of visit, photo, or for staged deliverables (1, 2 etc)

3.2   *'DAFT' field in Index File*

The format of the 'DAFT' field in the Index file is as follows:

Field Name	Contents	Notes
DAFT	Data File Type	Five character codes for the data file type. For maintenance the codes are: MSRX1 Maintenance summary report – xls, Excel spreadsheet MWRC2 Report of maintenance work completed – csv, comma delimited file format INVFv Digital copy of final invoices – pdf format INVPv Digital copy of progress payment invoice pdf format, where v = sequential number PHOJ1 Photo – jpg format ACDP1 Access diagram png format BCDP1 Non standard beacon diagram png format MCRD1 Maintenance contract report – doc, word document or pdf format 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

3.3   *Maintenance Summary Report*

A maintenance summary report is to be prepared for each mark maintained. An inspection of the site, mark and structure shall be carried out and an assessment of the maintenance work that is necessary and/or completed shall be recorded.

For marks requiring approved major maintenance, the work to be identified in the Maintenance Summary Report is that which was completed on the first visit to the site as well as that which remains outstanding in terms of the contract requirements for completion on the second visit.

The assessment and details of the work already completed or required shall be recorded on a Maintenance Summary Report for each mark.   The maintenance summary report shall be in the form of the following template and supplied in digital form. For survey control contracts the Survey Control Maintenance Summary Report shall be used. Additional information that will assist any subsequent maintenance works (such as a description of the damage or defect to be repaired) shall be supplied under Comments. The report shall be supplied digitally in Microsoft Excel format, one worksheet per mark where the worksheet name shall be the geodetic code. The filename format is to be:

YYNNNNmV.xls

eg   060502M1.xls

Maintenance Summary Report (Use form as a template)

MAINTENANCE SUMMARY REPORT			
Mark Geodetic Code:	**Schedule No. or Cell Code**:		
Mark Name:			
Date of Inspection:			
	Work Required Y/N	Work Completed Y/N	Comments
1. Site Maintenance			
a) Clear tall plants			
b) Clear vegetation			
c) Spray vegetation			
d) Dispose of unwanted materials			
2. Ground Mark Maintenance			
a) Supply and fix ID plaque			
b) Establish a new mark in rock			
c) Establish a new mark in concrete with cover			
d) Replace an existing mark			
e) Upgrade an existing mark			
f) Modify height of an existing mark			
g) Stabilise an existing mark			
h) Preserve a mark			
i) Offset an existing mark			
j) Paint a bench mark block			
3. Beacon and Mark Protection Maintenance			
a) Supply and fix ID plate			
b) Supply and fix information plate			
c) Erect new 2 m metal beacon with ID plate			
d) Paint an existing 2 m beacon			
e) Supply and fit mast locking pin			
f) Paint an existing 3m and 4m wooden beacon			
g) Paint an existing cone beacon			
h) Repair an existing beacon			
i) Modify an existing wooden beacon			
j) Erect new marker post with ID plate			
k) Maintain an existing marker post			
l) Erect new post and rail enclosure with ID plate			
m) Maintain an existing post and rail enclosure			
n) Raise or lower cast iron protection cover			
o) Install/replace cast iron protection cover			
p) Replace cast iron or concrete lid			
4. Other Services			
a) Paint an existing pillar			
b) Maintain a PositioNZ site			
5. Additional Information:			

Survey Control Maintenance Summary Report (Use form as a template)

MAINTENANCE SUMMARY REPORT			
Mark Geodetic Code: Schedule No. or Cell Code:			
Mark Name:			
Date of Inspection:			
	Work Required Y/N	Work Completed Y/N	Comments
1. Site Maintenance			
a) Clear tall plants			
b) Clear vegetation			
c) Dispose of unwanted materials			
2. Ground Mark Maintenance			
a) Establish a new mark in rock or existing concrete structure			
b) Establish a new mark in concrete with cast iron protection cover			
c) Replace an Existing Mark			
d) Offset an Existing Low Order Geodetic Mark			
3. Mark Maintenance			
a) Upgrade an existing mark			
b) Modify height of an existing mark			
c) Stabilise a Mark/ Install Concrete collar			
d) Preserve a mark			
4. Beacon and Protection Structure Maintenance			
a) Supply and fit mast locking pin			
b) Repairs for Safety			
c) Raise or lower a protection cover			
d) Install/replace cast iron protection cover			
e) Replace cast iron or concrete lid			

3.4   *Report of Maintenance Work Completed or Required*

Information on geodetic marks is held by the National Geodetic Office. When maintenance is undertaken or required at any mark, this information shall be checked/corrected/updated and recorded in the Report of Maintenance Work Completed or Required. A report shall be completed for all marks including those marks visited but for which no maintenance was carried out, marks found to be destroyed and marks not found. This report, in digital format, includes all information required except for the access diagram and diagrams for non-standard (NS) beacons. Digital diagrams for these shall be prepared and supplied in addition to the report (see section 3.5).

3.4.1 *Format of Report of Maintenance Work Completed or Required*

A digital copy report shall be provided of the maintenance work completed or required. 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,MRKR,MRKR2, MRKE, GLREL, BCNHGT, BCNHGT2, BCNHGT3, BCNHGT4,BCNHGT5, BCNHGT6,BDAT,BECC,MRKD,MLOC,PLQEXIST,PLTEXIST,MDAT, MPSM,MPSB,MPSP,MDMK,MDBE,MDPR,OWNR,PHNO,PADD,ARES, GNSSU,CELL,ADAT,COMM

Fields required for each record of this inventory are:

Field Name	Data Required	Notes
CODE [1]	Geodetic Code	4 character geodetic code.
NAME [1]	Mark name	For marks in the geodetic database use the database name. For other marks use their existing identifications. All letters in the name are to be UPPER CASE, unless the name includes a survey district in parentheses, in which case the survey district should be in Sentence Case (eg X (Waiau SD)).
EXMK [1]	Existing mark	Y- Existing mark that is in the geodetic database. N- Not in the geodetic database..
MRKT [1]	Mark type	A code from the Mark Type table (see Table 5). Note: where an existing 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]	Mark Status	A code from the Mark Status table (see Table 6) Relates to the status of the mark in the geodetic database.
MPSC [1]	Mark physical state code	Refer codes in Table 7.
PLRF	Plan references	All survey plans relevant to the mark (maximum of 100 characters). This information should be transferred from existing Mark Diagrams. It is not necessary to research all plans that may have used the mark.
EDAT	Date established	Year.Month.Day format - yyyy.mm.dd. For existing marks, this information should be transferred from existing Mark Diagrams if it is present.
MRKR [1]	Primary mark protection structure type code	Refer codes in Table 8. 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 8
MRKE [1]	Mark beacon type code	Refer codes in Table 9.
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. Note: If the mark is destroyed GLREL is to be left blank
BCNHGT [3]	Beacon/protection Structure height	See Table 10 for height description.
BCNHGT2 [3]	Beacon/protection Structure height	See Table 10 for height description.
BCNHGT3 [3]	Beacon/protection Structure height	See Table 10 for height description.
BCNHGT4 [3]	Beacon/protection Structure height	See Table 10 for height description.

BCNHGT5 [3]	Beacon/protection Structure height	See Table 10 for height description.
BCNHGT6 [3]	Beacon/protection Structure height	See Table 10 for height description.
BDAT	Date Beacon Erected	Year.Month.Day format - yyyy.mm.dd. For existing marks, this information should be transferred from existing Mark Diagrams if it is present.
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 offset (north/south/east/west (or direction) and distance) with respect to ground mark. Then add the comment "Now central". **If the beacon is found eccentric and not subsequently made central:** Dimension offset (north/south/east/west (or direction) and distance) with respect to ground mark. Add the comment "Not central". The reason for not centring the beacon is to be recorded in the contract report.
MRKD [1]	Mark details	Provide a full description of the ground mark as found, modified and left (maximum of 4000 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 wooden beacon state if beacon can or cannot be easily removed. **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 lose 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 4000 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.
INFOEXIST [1]	Information plate exists/installed?	Show E if exists, Y if installed, N if non-existent.
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]	Description of protection maintenance completed	Brief description of other 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 other 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.
PADD	Physical Address	Where owner/contact person can be located.
ARES	Access Restrictions	Examples include locked gates, lambing season, health and safety requirements.
GNSSU [1]	GNSS Suitability	Refer to suitability codes in Table 11.
CELL	Cell phone coverage	Confirm from site visit 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 two exist. Note: This field does not get stored in LINZ databases. Any information which may be of interest to users of the geodetic network should be placed in one of the other descriptive fields.

Notes: [1] Mandatory 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:
      YYNNNNmV.csv
      eg   060502M1.csv

Table 5: MRKT - Mark Type Codes

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 (12/22 mm etc), Bronze Pin (formerly bronze or brass plaque), Steel Pin, Iron Pin
OTHR	Any other mark type e.g. Bayonet, Forced Centering
UNMK	Unmarked
UNKN	Not Specified

Table 6: MRKS - Mark Status

Code	Mark Status Description
PEND	Pending - Maintained mark is not in the geodetic database.
COMM	Commissioned - Existing or maintained mark is in the geodetic database.

Table 7: MPSC - Mark Physical State Condition

Code	Condition Description
DEST	Destroyed
DMGD	Damaged
NFND	Not Found
RELB	Reliable
THRT	Threatened
NSPE	Not Specified

Table 8: MRKR/MRKR2 - Mark Protection Type Codes

Code	Protection Description
2MBE	2m Beacon
4MBE	3m or 4m Beacon
CICV	Cast Iron Cover
COVR	Wooden or Concrete Cover and Box
MKPT	Marker Post
PREN	Post and Rail Enclosure
NOPR	No Protection
NSPE	Not Specified
NSTD	Non Standard Beacon

Table 9: MRKE - Mark Beacon Type Codes

Code	Description
AA	Cairn
CN	Chimney
LH	Lighthouse
MR	Marine Beacon
MS	Mast
NB	Not Beaconed
ND	Unknown
PL	Pillar
TO	Tower
TT	Transmission Tower
2M	2m Beacon
4M	3m or 4m Beacon
NS	Non Standard

Table 10: BCNHGT – Height types

The height (in decimals of metres) of parts of the beacon above (+ve) or below (-ve) the top of the mark (fields are to be left empty if the mark is Not Beaconed (code NB) or Non Standard (NS)).

	Beacon	Pillar	For all other Non-Standard Beacons
Beacon Code	**2M or 4M**	**PL**	**NS**
BCNHGT	Top of mast	Top of pillar	*Leave all height fields blank*
BCNHGT2	Top of vane panels (target boards)	Top of black strip	
BCNHGT3	Bottom of vane panels (target boards)	Bottom of black strip	
BCNHGT4	Top of alloy head or apex (whichever is appropriate)		
BCNHGT5	Top of side panels (sight boards)		
BCNHGT6	Bottom of side panels (sight boards)		

Table 11: GNSSU – Suitability for GNSS

Suitability Code	Suitability Description
GD	Good: sky visibility (above 15 degrees), no obstructions or activities likely to cause interference (eg microwaves or reflective surfaces)
PR	Poor: Reduced sky visibility, structures that could cause multipath from satellites in some quadrants (ie at certain angles/altitudes)
US	Unsuitable: Major reduction of sky visibility, obstructions and activities likely to cause continuous interference.

3.5   *Access and Non-Standard Beacon Diagrams*

The diagrams are to be supplied as PNG images. These images must be square in shape, and the detail must be clearly visible when the image is reduced to 8cm x 8cm.

3.5.1   *Access and Finder Diagrams*

Every mark included in the Report of Maintenance Work Completed and Required (csv file) must have either an Access Diagram or Finder diagram, irrespective of whether it was maintained or not.

- Access Diagrams should be provided for all trigs and marks with complex access instructions.

- Finder Diagrams should be provided in all other cases.

If the diagram on the most recent Mark Diagram is still applicable, and the content and formatting requirements can be met, it is acceptable to supply this image as the Mark Diagram.

 The Access Diagrams must:

- Be drawn at a scale appropriate to show features useful in accessing the mark;

- Have a north arrow and be aligned so that the north arrow points up the page;

- Show all topographical features and names useful in accessing the mark, including the geodetic code of the mark;

- Show the relationship of any marker post with respect to the ground mark.

The Finder Diagrams must:

- Be drawn at a scale appropriate to show features useful in locating the mark;

- Have a north arrow and be aligned so that the north arrow points up the page;

- Show all topographical features and street names useful in locating the mark, including the geodetic code of the mark;

- Show the relationship of physical features with respect to the ground mark, which would allow the mark to be located within a timely manner.

The diagrams must have a filename format of:

> *CODE*YYAD.png
> **eg   AQ2D07AD.png**

3.5.2   *Non-Standard Beacon Diagrams*

Every mark included in the Report of Maintenance Work Completed and Required (csv file) which has a beacon type (MRKE) which is not "4M", "2M", "PL" or "NB" must have a Non-Standard Beacon Diagram, irrespective of whether it was maintained or not. If the Non-Standard Beacon Diagram on the most recent Mark Diagram is still applicable, and the content and formatting requirements can be met, it is acceptable to supply this image as the Non-Standard Beacon Diagram.

The Non-Standard Beacon Diagrams must:

- Clearly depict the appearance of the beacon;

- Show prominent parts of the beacon, with the height (in decimal metres) of each part above (+ve) or below (-ve) the top of the mark.

- Show the height of the ground (in decimal metres) above (+ve) or below (-ve) the top of the mark.

The diagrams must have a filename format of:

> *CODE*YYBD.png
> **eg   AQ2D07BD.png**

3.6   *Photographs of Mark and Site*

Digital colour sheet images (see section 1.1 for format) can be generated from scanning a photo or obtained directly from a digital camera.

The photographs must be vertically aligned for ease of viewing (ie ground at the bottom of the photograph, sky at the top). The photographs must not be digitally altered, except that the geodetic code may be added as text if the code is not visible elsewhere in the actual photo.

3.6.1   *Before and After Images*

'Before' and 'after' colour images shall be supplied in digital form to provide evidence of the work carried out. Each image shall include a photo of the mark and a photo of the site. However a single photo of the mark and site will suffice provided evidence of maintenance work done is clearly shown. Each image shall clearly show the geodetic code of the mark.

Where a site has to be revisited to complete the maintenance required, the 'after' image need only be supplied after the second visit when all the maintenance work has been completed.

If, however, no maintenance is required at a particular mark, only one image of the mark and of the site need be supplied.

The filename format for those photographs taken before maintenance is carried out, the 'before' photographs, shall be:

>   *CODE*YYpb.JPG
>   **eg   AQ2D07PB.jpg**

The filename format for those photographs showing the maintenance carried out, the 'after' photographs, shall be:

>   *CODE*YYpV.JPG
>   **eg   AQ2D07P1.jpg**

3.6.2   *Extended Site Images*

At least one additional extended site photo is required which shows the relationship of the mark to its surroundings. The purpose of this photo is to aid mark location and convey the suitability of the mark for GNSS or terrestrial observations. Care must be taken to avoid including members of the public in the photograph, or anything else which could compromise an individual's privacy, bearing in mind that the photograph will be made available over the internet in a public database.

The filename format for those photographs showing the mark and site and extended site shall be:

> *CODE*YYpV.JPG
> **eg   AQ2D07P1.jpg**

3.7   *Final Invoices and Progress Payment Invoices*

A hard copy of the final invoice should be provided as part of the completed dataset. In addition, a digital copy of all invoices (including any progress payments) should be provided and included in the Index File.

3.8   *Maintenance (Contract) Report*

A report of the maintenance shall be supplied in Microsoft Word digital or PDF formats.

The format for the name of the Contract Report digital file is to be:

> YYNNNNmV.doc
> YYNNNNmV.pdf
> **eg   060203M1.doc**
> **060203M1.pdf**

For a geodetic maintenance contract where a number of cells are included under the same schedule number, all cells may be grouped into a single contract report. In such cases, the cell code in the file name (NNNN) is to be that of the first cell listed under the schedule number.

The report shall be verified as correct and certified by the Contractor and shall have the following sections.

3.8.1   *Header Section*

Each report must have a header with:

- Schedule number

- Cell code(s)

- Schedule or Cell Name(s)

3.8.2   *Summary Section*

Each report shall have a summary section that summarises all problems encountered, issues, and variations to the contract.

3.8.3   *Field Work Undertaken Section*

This section shall have a short description of the work carried out, including a list of marks maintained.