

Department of Climate Change, Energy, the Environment and Water


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# Survey benchmark guideline

Floodplain harvesting measurement

June 2024



# Acknowledgement of Country

The Department Climate Change, Energy, the Environment and Water acknowledges that it stands on Aboriginal land. We acknowledge the Traditional Custodians of the land and we show our respect for Elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

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Survey benchmark guideline

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# 1 Introduction

The NSW Government is implementing a framework to licence and measure floodplain harvesting to ensure this ‘take’ occurs within legal, sustainable limits.

An important part of this framework is that floodplain take is measured by accurate, auditable, and tamper-proof metering equipment.

The NSW Government has developed a series of implementation guidelines to assist water users and duly qualified persons in understanding their compliance obligations under this framework and ensure that floodplain harvesting water take is consistent with the individual’s licensed volumes and legal limits.

This guideline focuses on the surveying aspects of the process and intends to guide individuals carrying out survey work on licensed floodplain harvesting storages.

## 2 Qualifications, DQP Portal registration and process summary

This section outlines the professional qualifications required to carry out the work, introduces the DQP Portal and provides a brief outline of the process.

A registered surveyor for this project means a registered surveyor under the *Surveying and Spatial Information Act 2002* or a corresponding law of another state or territory.

A duly qualified person (DQP) is a person who possesses the necessary qualifications, skills and experience to perform specific tasks related to metering equipment. These tasks can vary depending on the type of DQP and the work involved with the metering equipment.

A registered surveyor or person approved by the Minister with the required surveying expertise is deemed a DQP under Clause 236 of the *Water Management (General) Regulation 2018*. The installation and validation of metering equipment requires DQPs with specialised technical functions. A list of these DQPs and their roles can be found on the NSW Department of Climate Change, Energy, the Environment and Water’s (the department) website at [water.dpie.nsw.gov.au](http://water.dpie.nsw.gov.au) > Plans and Programs > Floodplain Management > Floodplain harvesting measurement > Who can install floodplain metering equipment.

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## 2.1 Survey qualification requirements

To conduct this work, individuals must be suitably qualified in surveying. Field work may be undertaken by an experienced person under the supervision of a registered surveyor. All deliverables must be certified (signed off) by a registered surveyor at the time of submission.

The Minister may approve a person or class of persons with the necessary expertise to perform this function.

Where required, survey firms and personnel must be capable of, and competent in:

- placing Permanent Survey Marks (PSMs) and survey benchmarks
- undertaking surveys using continuously operating reference system (CORSnet-NSW or other state jurisdiction) Processing Global Navigation Satellite System (GNSS) or AUSPOS observations. (All survey equipment must be compatible with GDA2020 datum utilising AUSGeoid2020)
- processing GNSS data
- Class LC spirit levelling (preferably using digital levelling techniques)
- preparing quality results, presented professionally clearly and concisely.

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## 2.2 Registration in the DQP Portal

To upload survey information to the DQP Portal, registered surveyors must email WaterNSW at [dqp.enquiries@waterNSW.com.au](mailto:dqp.enquiries@waterNSW.com.au) with the subject line: 'Requesting floodplain harvesting survey benchmark upload'.

The email should include:






- their professional registration details (surveyor's name, company name (if applicable) and surveying registration number)
- evidence of the landholder's consent (this could be an email from the landholder approving the work or a signed contract).

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## 2.3 Process summary

Table 1 outlines a summary of the process for engaging surveyors and submitting survey work.

Table 1. Overview of the general process

	<p>The landowner engages a Certified Storage Validator (CSV) to install the storage metering equipment</p>
	<p>A CSV or landholder engages a registered surveyor:</p>
	<p>To limit visits by a registered surveyor, a landholder may have the metering equipment installed first.</p> <p>A registered surveyor can ensure that both the storage curve and survey points align with AHD.</p>
	<p>Registered surveyor installs survey benchmarks and undertakes all other necessary survey work. A minimum of three survey benchmarks are required, one primary and at least two secondary survey benchmarks or if one primary survey benchmark has been used for multiple storages then at least three secondary are required at each storage.</p>
	<p>If a PSM is installed, the registered surveyor documents all survey work for Department Customer Service (DCS) Spatial Services and submits it via the DCS Spatial Services Customer Hub.</p>
	<p>Registered surveyor documents all survey work for the department and submits to WaterNSW for upload to the DQP Portal.</p>

# 3 Field survey

The following section outlines the survey methodology to establish MGA2020 coordinates, zone, and AHD 71 (derived) heights on survey benchmarks for floodplain harvesting management.

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## 3.1 Fieldwork preliminaries

DQPs establishing PSMs for floodplain harvesting must adhere to the following legislation and documentation (in force at the date of survey):

- [Surveying and Spatial Information Act 2002](#)
- [Surveying and Spatial Information Regulation 2017](#)
- [Surveyor-General's Direction No.1 – Approved Permanent Survey Marks \(SGD1\)](#)
- [Surveyor-General's Direction No.2 – Preparation of Locality Sketch Plans \(SGD2\)](#)
- [Surveyor-General's Direction No.12 - Control Surveys and SCIMS \(SGD12\)](#)
- [Surveyor-General's Direction No.12 –Control Surveys and SCIMS \(Technical Specifications for NSW Secondary Control Surveys\)](#)
- [Surveyor-General's Direction No.12 - Control Surveys and SCIMS \(Resource Pack\)](#)
- [ICSM's publication Standards and Practices for Control Surveys \(SP1\), Version 1.7.](#)

These will be referred to in further detail in this guideline.

For the establishment of all other survey benchmarks, DQP's must adhere to the Metering Equipment Standard Schedule 2 survey benchmark standard.

The approximate MGA2020 coordinates (and zone) of the storage centroid will be the unique identifier for each survey and storage location and are essential metadata to ensure the information is applied to the correct storage.

MGA2020 coordinates, zone and AHD 71 heights can be obtained from SCIMS or [SIX Maps](#) before commencing fieldwork.

Before attending each site, surveyors must contact the landowner to gain consent to enter the land. This presents an opportunity to discuss potential hazards on the property, confirm access requirements and any other important information (such as soil type/reactivity) which may inform the survey.

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## 3.2 Survey benchmark selection

All survey benchmarks placed must be in the form and style as described in *Metering Equipment (Storage) Standards 2024 – Schedule 2 survey benchmark standard (Appendix A)*.

If a survey benchmark type chosen is a survey mark approved under Schedule 4 of the *Surveying and Spatial Information Regulation 2017*, DCS Spatial Services recommend using the following types of PSM's, as these are known to be the most stable types of PSM for this use:

- for stable soils:
  - Type 1 (State Survey Mark; not to be used as secondary marks)
  - Type 4 (Stainless Steel Pin in cover box)
  - Type 6 (Non-Urban Type; use of 1800 mm star pickets driven fully or until refusal – must be used and in cover box).
- for unstable soils (for example, highly reactive and/or 'black' soils):
  - Type 8 (Department of Water Resources "Type" C; diameter 20 mm non-ferrous rod – driven to a depth of 1800 mm or until refusal – must be used and in cover box).

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## 3.3 Survey benchmark installation

All surveyors who install survey benchmarks for floodplain harvesting are required to install at least 3 survey benchmarks as close as practical to the on-farm storage (considering ongoing stability, accessibility, and longevity), including:

- One primary survey benchmark: this will be given a 'PM' or 'SS' prefix (as appropriate) and a subsequent number allocated by DCS Spatial Services if a survey mark approved under Schedule 4 of the *Surveying and Spatial Information Regulation 2017* is used. Otherwise, all other types of survey benchmarks will be given a 'BM' prefix and number allocated by the registered surveyor where the primary benchmark should be numbered 1, and subsequent secondary benchmarks should be numbered 2 onwards. The primary survey benchmark will be located closest to the storage measurement device. This is the most important survey benchmark within the storage location and should therefore be placed in a safe location.
- At least 2 secondary survey benchmarks: this will be given an 'MM' prefix and a subsequent number allocated by DCS Spatial Services if a survey mark approved under Schedule 4 of the *Surveying and Spatial Information Regulation 2017*. Otherwise, all other types of survey benchmarks will be given a 'BM' prefix and number allocated by the registered surveyor where the first secondary benchmark should be numbered 2, and subsequent secondary benchmarks should be numbered 3 onwards. It is recommended these are placed at least 50 to



100 metres away from each other and removed somewhat from the primary survey benchmark. They must also be placed in a safe location.

- If the registered surveyor chooses to use a survey mark type approved under Schedule 4 of the *Surveying and Spatial Information Regulation 2017* for their secondary survey benchmarks, the registered surveyor must use types 4, 6 and 8 benchmarks.
- If multiple storages are located close to each other and accuracy can be maintained, then the registered surveyor has the option of installing one common primary survey benchmark for all of the storages but must have at least three secondary survey benchmarks at each storage.
- All survey benchmarks should be clearly identifiable, highly visible, easily located and painted. If a survey mark approved under Schedule 4 of the *Surveying and Spatial Information Regulation 2017* is used, then a 'witness' star picket shall be placed 1 metre from each PSM, painted yellow to assist in the protection, location, and identification of each PSM, with a survey plaque attached to the witness picket (refer to Section 4 of *SGD2*).

Selecting sites with excellent visibility to the sky is crucial for achieving accurate GNSS results, preventing the need for re-surveys to meet the required positional uncertainty specifications.

Upon placement of each PSM, a Locality Sketch Plan (LSP) must be prepared in accordance with *SGD2*. Individual sketch plans are required for each PSM.

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## 3.4 Field observations

### 3.4.1 General requirements

Mark prefixes must be PM, SS, GB, MM, TS, or BM (SSM and PSM are not to be used).

All GNSS equipment and observation techniques adopted must be able to achieve positional uncertainties (at the 95% confidence level) of:

- $\pm 30$  mm horizontal
- $\pm 50$  mm vertical.

All surveyors establishing PSMs should familiarise themselves with the *SGD12 Technical Specification* and the *SGD12 Resource Pack*. In particular, surveyors should be thoroughly familiar with the following sections of the technical specification:

- Section 5 Differential Levelling Specifications: This section details how to carry out differential levelling observations to fulfil DCS Spatial Services requirements for entry into SCIMS

- Section 6.1 GNSS Static: This section details how to carry out GNSS static observations to fulfil DCS Spatial Services requirements for entry into SCIMS
- Section 6.3 AUSPOS: This section details how to carry out AUSPOS observations to fulfil DCS Spatial Services requirements for entry into SCIMS.

When conducting the PSM survey (submission to SCIMS) at each storage location, surveyors must not 'mix and match' different GNSS observation techniques. For example, if the surveyor is establishing the primary PSM at the storage location via AUSPOS, then only AUSPOS may be used for any other secondary PSMs at that location if submitted to SCIMS. This is the same for CORSnet-NSW post-processed baselines. That is, a combination of observation techniques at the same storage site cannot be used for the establishment of PSMs and will be rejected at the submission stage, requiring re-survey.

If an existing established PSM is being used as either a primary or secondary mark, its MGA2020 coordinates, zone and height must be validated as part of this survey. This information must be entered into the DQP Portal.

All spirit levelling equipment and/or total station equipment must be capable of achieving  $\pm 10$  mm relative vertical accuracy between the survey benchmarks of any one storage.

Real-time kinematic (RTK) observations may be used to transfer AHD levels and GDA2020 coordinates between the primary and secondary benchmarks and elsewhere in the preparation of the department's storage plan, provided that the base station for the survey is set locally on the primary survey benchmark using the GDA2020 coordinates, zone and AHD level established as part of determining the primary survey benchmark. (This will typically involve a 3-parameter transformation or block-shift of the collected RTK data once co-ordinates and level of primary survey benchmark are determined as part of post-processing and least squares adjustment). Check measurements must be made to both secondary survey benchmarks if RTK methodology is used so that the validation of both the base station and rover setup can be made.

### **3.4.2 Establishing the primary PSM**

The primary PSM will be the 'point of truth' at each storage location, with its MGA2020 coordinates, zone and AHD (derived) height typically generated and adopted from either AUSPOS or static GNSS originating from CORSnet-NSW.

The following GNSS observation methods may be used to establish the primary survey benchmark:

- Method 1 – AUSPOS (preferred option if installing PSMs)
  - minimum occupation 4 hours (or longer if deemed necessary until the stated accuracies are achieved in the resultant processing report)

- consideration shall be given to overnight sessions being logged. By taking this approach, session times are extended, providing significantly improved results and reducing waiting time on site (this will generally result in a return to the site to collect equipment)
- for this method, the  $\pm 50$  mm vertical must be met for ellipsoidal heights (before the addition of geoid model correction – refer to AUSPOS Section 3.4 standardised report). Accuracy for AHD heights shown on the AUSPOS report may be larger than  $\pm 50$  mm due to local distortions in the AHD datum and geoid model but will be acceptable if ellipsoidal height vertical accuracy is less than  $\pm 50$  mm.
- Method 2 - CORSnet–NSW or other states continuously operating reference stations post-processed static baselines
  - 5 or more continuous operating reference stations must be used to introduce redundancy into the survey
  - to ensure a strong survey network for the establishment of the primary survey benchmark, the selection of continuous operating reference stations should be based on ensuring that at least one continuous operating reference station is located in each quadrant surrounding the proposed primary survey benchmark and there is a good spread of continuous operating reference stations surrounding the proposed primary survey benchmark
  - minimum occupation 1.5 hours (or longer if deemed necessary until the stated accuracies are achieved)
  - processing and adjusting the baselines being measured through GNSS processing and least squares adjustment packages respectively is required. Error ellipse from constrained adjustment of determined marks co-ordinates must comply with the required accuracy under 3.4.1
  - be familiar with the user’s guide for continuous operating reference stations as per state surveying requirements
  - if this option is used to establish PSMs, it should be noted that DCS Spatial Services has advised that SCIMs coordinates may not be processed for at least 6 months.

### 3.4.3 Establishing the secondary PSMs

The secondary survey benchmarks are to be established using RTK and survey levelling techniques recognised in Part B, Section 2 of the Standards and Practices for Control Surveys (SP1 v1.7), to transfer AHD levels and GDA2020 coordinates between the primary and secondary benchmarks. They will act as redundancy for the primary survey benchmark where the primary survey benchmark is tampered with, damaged or there has been ground movement.

For RTK measurements:

- the base station for the survey is set locally on the primary survey benchmark using the GDA2020 coordinates, zone and AHD level established as part of establishing the primary survey benchmark
- minimum occupation 3 minutes (or longer if deemed necessary until the stated accuracies are achieved)
- repeat occupation of each secondary survey benchmark is to be made at least 30 minutes after the first occupation as a check.

For survey levelling measurements:

- the method of measurement chosen must be a technique as recognised in Part B, Section 2 of the Standards and Practices for Control Surveys (SP1 v1.7) and ensure the  $\pm 10$  mm relative vertical accuracy required between the survey benchmarks and the storage gauge at each storage site
- an appropriate number of measurements should be taken to form a closed survey network between the survey benchmarks and the storage gauge at each storage site and will form a check against the AHD height derived from RTK observations.

Results must satisfy the positional uncertainties specified in Section 3.4.1. The submission of data is addressed in Section 4.

### **3.4.4 Department storage plan & field coding for survey observations**

All surveyors must report using a consistent reporting structure to the department. To facilitate this process, surveyors must use the *Survey Form for Floodplain Harvesting Survey Benchmarks and Storage Meters* (Appendix B) to record observations and findings on site. This information will later be submitted to WaterNSW to upload to the DQP Portal. All field data sections of this form should be completed before leaving the site.

To aid consistency, the following field coding (Table 2) has been developed to record PSMs and significant points digitally in the field as well as providing standard labelling for the department's storage plan.

Table 2. Field coding for survey observations

Point description	Code
Permanent Survey Mark “xxxxx” = mark number from SCIMS	PMxxxxx, MMxxxxx, MMxxxxx
Temporary benchmark ‘x’ = next number available	TBMx
Survey benchmark	BM1, BM2, BM3, BMx
Ground surface for Light Detection and Ranging ( <b>LiDAR</b> ) comparison. Four flat sites external to dam/storage.	LGS1, LGS2, LGS3, LGS4
Dam water level (current)	DWL1, DWL2
Dam wall top	DTOPGS
Dam (full supply) top water level	DTOPWL
Dam lowest point (near outlet)	DLP
Dam meter – primary (survey by class C levelling)	DMETERP
Dam meter – secondary (survey by class C levelling)	DMETERSx

# 4 Deliverables

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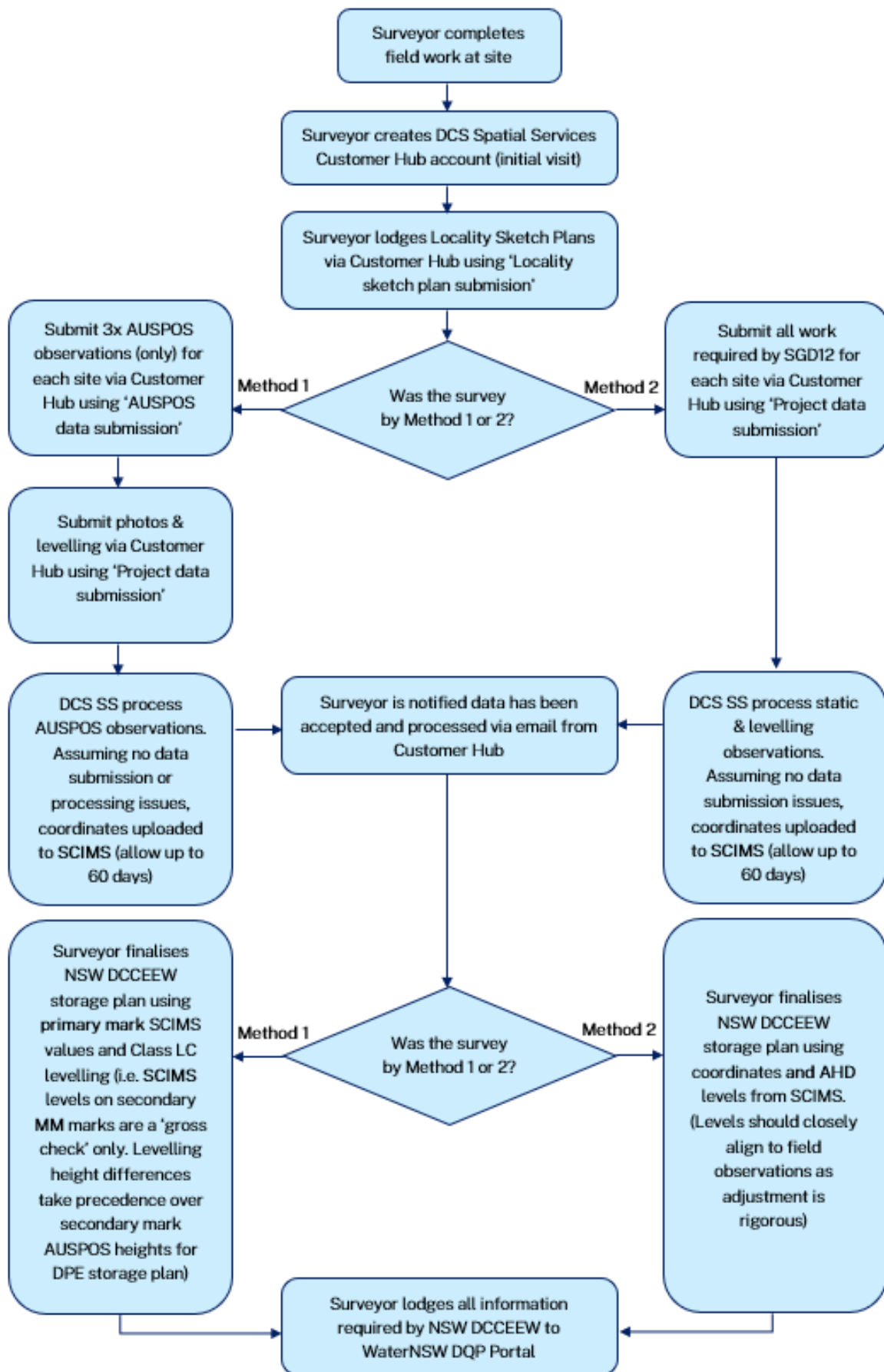
## 4.1 General information and process

This section outlines the deliverables that the DQP must provide. All submissions must be made through the WaterNSW DQP Portal at [dqp.waternsw.com.au](http://dqp.waternsw.com.au).

If the registered surveyor chooses to use a survey mark type under Schedule 4 of the *Surveying and Spatial Information Regulation 2017* for the primary and/or secondary survey benchmarks, an additional submission must be made to DCS Spatial Services via the DCS Spatial Services Customer Hub and meet all documentation and reporting requirements set by DCS Spatial Services. Submission to DCS Spatial Services will be required to be approved by Spatial Services before submitting to the WaterNSW – DQP Portal.

The process for submitting information to DCS Spatial Services is shown in Figure 1.

Figure 1: Flowchart for submission of deliverables to DCS Spatial Services (to be used for uploads to SCIMS ONLY)



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## 4.2 DCS Spatial Services submission

This section provides information regarding the requirements of DCS Spatial Services.

### 4.2.1 DCS Spatial Services' Customer Hub

All survey data involving PSMs is to be lodged with DCS Spatial Services via the [DCS Spatial Services Customer Hub](#) (the Customer Hub).

Once an account has been created, surveyors must select 'Survey Services', where various types of data can be submitted.

### 4.2.2 DCS Spatial Services specific process & deliverables

In general terms:

- the process shown in Figure 2 of this guideline must be followed
- all legislation outlined in Section 3.1 must be followed in addition to further requirements necessitated by this guideline
- a registered surveyor must validate all survey work completed
- LSPs must be prepared to show all PSMs placed at each site. An individual LSP shall be prepared for each PSM
- data for this project must be submitted for each site separately through the Customer Hub utilising one of two methods outlined in Section 3 of this guideline
  - Method 1: AUSPOS (preferred option) – separate data submissions for each PSM will be required via the 'AUSPOS data submission' option
  - Method 2: CORSnet-NSW post-processed static baselines - the data shall be supplied as one combined submission for each site in accordance with SGD12 via the 'Project data submission' option.
- Sections 10 and 11 of SGD12 must be adequately addressed or the submission will be rejected.

Note for Method 1 (AUSPOS), a least squares adjustment report and checklist are not required.

For assistance regarding export file formats for specific instruments, please contact DCS Spatial Services before submission of data. Spatial Services may have one available which could expedite the process.

Photographs of each placed PSM must be provided showing:

- close-ups of each PSM with the mark number clearly visible



- ‘all in view’ photographs for context, clearly showing the storage facility and all PSMs with witness posts installed
- as a guide, approximately (but not limited to) 6 photographs would be expected at each site
- photograph file names will be provided in line with the following examples:
  - PM123156 YYYYMMDD (1) Mark
  - PM123456 YYYYMMDD (2) North.... (this would be taken south of the mark looking north)
  - MM501589 YYYYMMDD (3) East

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## 4.3 Submission to the department

### 4.3.1 DQP Portal

To upload survey information to the DQP Portal, registered surveyors must email WaterNSW at [dqp.enquiries@waternsw.com.au](mailto:dqp.enquiries@waternsw.com.au) with the subject line: ‘Requesting floodplain harvesting survey benchmark upload.’

The email should include:

- their professional registration details (surveyor’s name, company name (if applicable) and surveying registration number)
- evidence of the landholder’s consent (this could be an email from the landholder approving the work or a signed contract).

Note: that the process required by DCS Spatial Services must be followed before information can be uploaded to the DQP Portal.

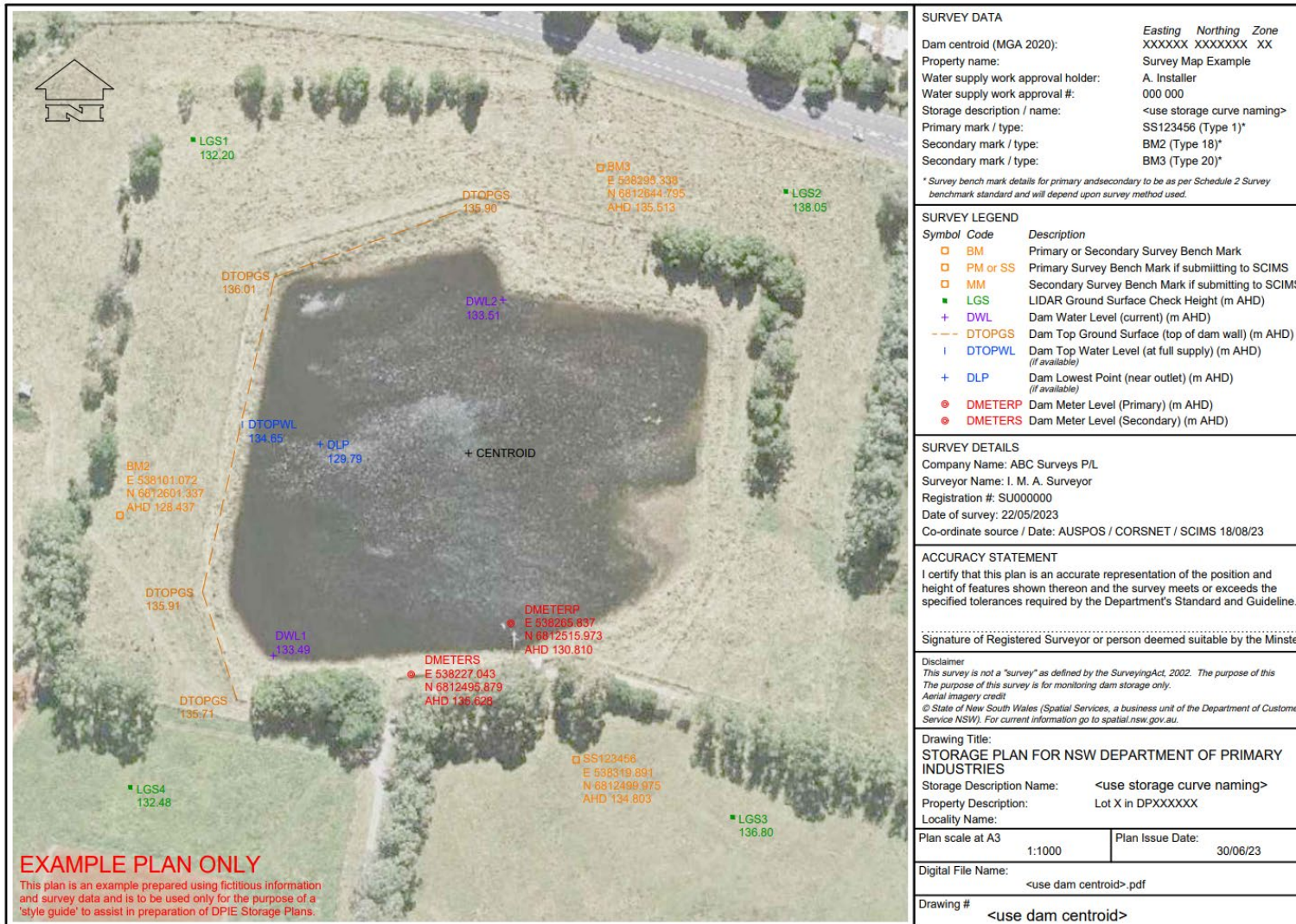
### 4.3.2 Department’s deliverables

A DQP must submit all site information to WaterNSW via email to [dqp.enquiries@waternsw.com.au](mailto:dqp.enquiries@waternsw.com.au) for uploading to the DQP Portal. The subject of the email should include the Registration of Interest (ROI) number or works approval number and the following supporting information should be provided:

- a copy of all data supplied to DCS Spatial Services (if PSM has been installed)
- CSV file containing all features detailed in the survey form for floodplain harvesting survey benchmarks and storage meters – see Appendix B
- a copy of any supporting information to the landowner and Certified Storage Validator
- a concise and professionally CAD drawn plan (known as the ‘department storage plan’) shall be prepared for each site showing the following:

- certification by a NSW Registered Surveyor to validate that the plan accurately represents the position and height of features depicted on it and the survey meets or exceeds the specified positional uncertainties outlined in this guideline
- table of MGA2020 coordinates, zone and derived AHD heights for survey benchmarks
- date of survey
- surveyor’s company name
- surveyor’s name
- surveyor’s registration number BOSSI (if applicable)
- property name
- water supply work approval number
- storage description name (for example, BR002\_02\_west storage)
- accuracy statement
- primary survey benchmark
- secondary survey benchmarks
- dam centroid (MGA 2020)
- LiDAR ground surface check height (m AHD)
- dam water level (current) (m AHD)
- dam top ground surface (top of dam wall) (m AHD)
- dam top water level (at full supply) (m AHD)
- dam lowest point (near outlet) (m AHD)
- dam meter level (primary) (m AHD)
- dam meter level (secondary) (m AHD)
- aerial photo underlay
- storage plan format:
  - colour
  - A3 size
  - PDF format (preferably geo-referenced).

Figure 3. Example of a department storage plan



# Appendix A

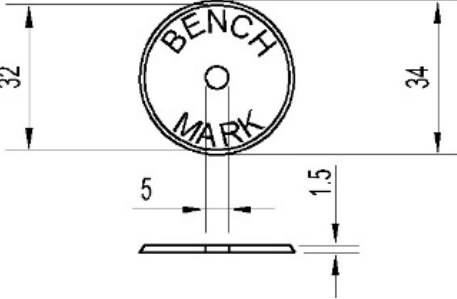
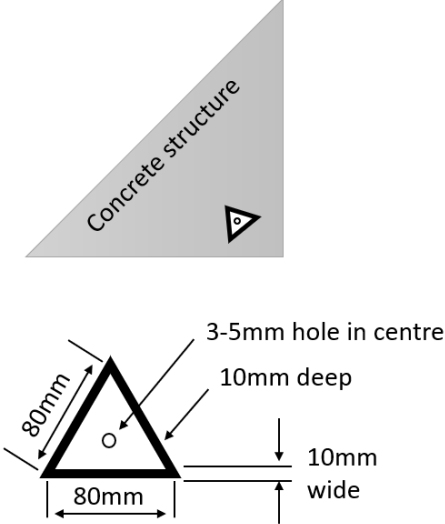
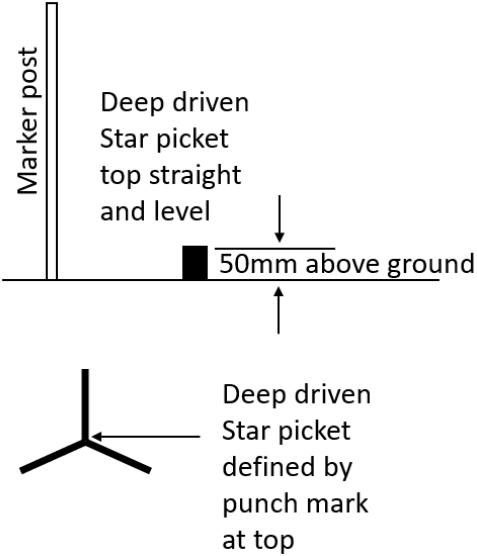
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## Metering equipment (storage) standards 2024

### Schedule 2

#### Survey benchmark standard

- 1 Survey benchmarks must be referenced to MGA2020 coordinates, MGA zone and AHD 71 heights.
- 2 At least three survey benchmarks are required to be installed as close as practical to the on-farm storage —
  - (a) one primary survey benchmark,
    - (i) can be used for multiple storages, on condition that accuracy is maintained at item 7.
  - (b) two or more secondary survey benchmarks,
    - (i) more than three secondary survey benchmarks if option 2(a)(i) is used.
- 3 The following GNSS observation methods must be used to establish the primary survey benchmark —
  - (a) METHOD 1 — AUSPOS —
    - (i) minimum occupation 4 hours (or longer if deemed necessary until the stated accuracies are achieved),
  - (b) METHOD 2 — post processed static baselines using CORSnet–NSW or other State continuous operating reference stations —
    - (i) five or more continuous operating reference stations must be used to introduce redundancy into the survey,
    - (ii) minimum occupation 1.5 hours (or longer if deemed necessary until the stated accuracies are achieved),
    - (iii) processing and adjusting the baselines being measured through GNSS processing and least squares adjustment packages respectively is required, and
    - (iv) be familiar with the user’s guide for continuous operating reference stations as per State surveying requirements.
- 4 The secondary survey benchmarks are to be established using real time kinematics (RTK) and survey levelling techniques recognised in Part B, Section 2 of the Standards and Practices for Control Surveys (SP1v1.7), to transfer AHD levels and GDA2020 coordinates between the primary and secondary benchmarks.
- 5 Survey benchmarks must use a survey mark that meets the requirements of a survey mark type set out in the following table.

Survey mark type	Image of mark
<p>(a) Type 17—"Benchmark" token must—</p> <ul style="list-style-type: none"> <li>(i) be a non-corrodible token at least 32mm in diameter and 1.5mm thick with a 5mm hole in the centre, with "BENCH MARK" permanently stamped, engraved or etched on the upper surface,</li> <li>(ii) be secured using a non-corrodible nail, spike, rivet or screw, and</li> <li>(iii) be permanently painted and coloured so that it is highly visible, clearly identifiable and easily located.</li> </ul>	<p>Dimensions are in millimetres</p> 
<p>(b) Type 18—Chiselled triangle must—</p> <ul style="list-style-type: none"> <li>(i) be an equilateral triangle with sides at a maximum of 80mm long, 10mm wide and 10mm deep and chiselled into concrete,</li> <li>(ii) be permanently painted and coloured so it is highly visible, clearly identifiable, and easily located.</li> </ul>	
<p>(c) Type 19—deep driven steel star picket fence post must—</p> <ul style="list-style-type: none"> <li>(i) be identified with a marker post,</li> <li>(ii) have a punch mark made by a centre punch tool or similar tool at the top,</li> <li>(iii) have a top that is straight and level, and</li> <li>(iv) be permanently painted and coloured so it is highly visible, clearly identifiable, and easily located.</li> </ul>	

Survey mark type	Image of mark
<p><b>(d) Type 20 –mark on steel structure must—</b></p> <p><b>(i) be an embedded mark that is easily identified being a cross, triangle, a notch, or screw that is obvious and distinguishable from the surrounds,</b></p> <p><b>(ii) have an image supplied, and</b></p> <p><b>(iii) be permanently painted and coloured, so it is highly visible, clearly identifiable, and easily located.</b></p>	
<p><b>(e) Any survey mark approved under Schedule 4 of the <i>Surveying and Spatial Regulation 2017</i> must be installed as per the Surveyor General’s Directions, including its coordination and level.</b></p>	<p>See Schedule 4 of the <i>Surveying and Spatial Regulation 2017</i></p>

6 All surveys carried out under this standard must use the survey codes set out in the following table:

	Point description	Code
(i)	PSM benchmark “xxxxx” = mark number from SCIMS	PMxxxxx, MMxxxxx, MMxxxxx
(ii)	Temporary benchmark “x” = next number available	TBMx
(iii)	Survey benchmark	BM1, BM2, BM3, BMx
(iii)	Ground surface for LiDAR comparison. Four flat sites external to dam/storage	LGS1, LGS2, LGS3, LGS4
(iv)	Dam water level (current)	DWL1, DWL2
(v)	Dam wall top	DTOPGS
(vi)	Dam (full supply) top water level	DTOPWL
(vii)	Dam lowest point (near outlet)	DLP
(viii)	Dam primary meter (survey by class LC levelling)	DMETERP

(ix)	Dam secondary meter/s (survey by class LC levelling)	DMETERSx
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- 7 Survey benchmark coordinates and heights must achieve a positional uncertainty equal to, or better than (at the 95% confidence level) —
- (a)  $\pm 30$  mm horizontal,
  - (b)  $\pm 50$  mm vertical (for Method 1 - AUSPOS, vertical accuracy must be met for ellipsoidal heights),  
and
  - (c)  $\pm 10$  mm relative vertical accuracy between the survey benchmarks of any one storage.

# Appendix B

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## Survey data for survey benchmarks and storage meters

Please print multiple copies of this form to use in the field.

	Easting	Northing	Zone
Dam centroid approx. (MGA from SIX Maps)			
Dam centroid Lat/Long values in decimal degrees to 6 decimal places			
Property name			
Water supply work approval holder's name			
Water supply work approval number			
Storage descriptor (e.g., BR003_2_west dam)			
Date of survey (dd/mm/yy)			
Surveyor's company name			
Surveyor's name			
Surveyor's registration number			
GNSS ARP location			
BM1 (primary survey benchmark)/type description			
BM2 (secondary survey benchmark)/type description			
BM3 (secondary survey benchmark)/type description			



Mark observation	Survey method and comments	Start time	Finish time	Observation time
BM1 (primary survey benchmark)				
BM2 (secondary survey benchmark)				
BM3 (secondary survey benchmark)				
	LGS1	LGS2	LGS3	LGS4
LiDAR ground surface (LGS) level (mAHD)				
	Easting	Northing	mAHD (1)	
Primary storage meter – measurement point				
	Level survey (mAHD) (2)		Difference between (1) and level survey (2)	
Primary storage meter – measurement point Level check				
Storage water level – current (DW1) (mAHD)				
Storage (full supply) top water level (DTOPWL) (mAHD)				
Storage bank (wall top) (DTOPGS) (mAHD)				
	Level (mAHD)	Storage has water at the time of survey? (Y/N)	Is low point of outlet accessible? (Y/N)	
Storage low point near outlet sill (DLP)				

<p>Aerial image of storage</p> <p>Include aerial image that identifies the following:</p> <ul style="list-style-type: none"><li>• storage (incl. eastings and northings)</li><li>• dam low point</li><li>• primary meter</li><li>• secondary meter</li><li>• primary survey benchmark</li><li>• secondary survey benchmark 1</li><li>• secondary survey benchmark 2</li><li>• LGS1, LGS2, LGS3, LGS4</li><li>• dam top water level</li></ul>	
<p>Comments</p>	