

***Geographic Information System – Spatial Data***

***Technical Specification***

Version 1.0

Contents

[Contents 1](#_Toc73549355)

[1 General Information 2](#_Toc73549356)

[2 Suitable Data Recording Equipment and Methods 2](#_Toc73549357)

[**2.1** GPS / GNSS Technology 2](#_Toc73549358)

[**2.2** Drone (UAV / UAS) Technology 3](#_Toc73549359)

[**2.2.1** When to use Unmanned or Manned Aerial Solutions 3](#_Toc73549360)

[**2.2.2** Legal Limitations 3](#_Toc73549361)

[**2.2.3** Physical Limitations 4](#_Toc73549362)

[**2.3** Field Sketches and Site Plans 5](#_Toc73549363)

[3 Recording of Ground and Aerial Surveys 6](#_Toc73549364)

[**3.1** Production of Terrain and Contour Products 6](#_Toc73549365)

[**3.2** Specific Requirements for Surveys 6](#_Toc73549366)

[4 Recording of Work As-Constructed Information 7](#_Toc73549367)

[**4.1** General Requirements for all As-Constructed Data 7](#_Toc73549368)

[**4.2** Requirements for Data Capture, Feature Coding, Validation and Submission 8](#_Toc73549369)

[5 Specification for GIS Data Exchange 9](#_Toc73549370)

[**5.1** Data Specification and Accuracy 9](#_Toc73549371)

[**5.2** Data Structure 9](#_Toc73549372)

[**5.3** Allowable Digital Data Formats 10](#_Toc73549373)

[**5.4** Spatial Data Attribution 10](#_Toc73549375)

[**5.5** Supply of Digital Files 10](#_Toc73549376)

[6 Contacting Coliban Water GIS Team 10](#_Toc73549377)

# General Information

It is important to note that not all information presented herein will relate directly to every project. This document presents a global data specification and supplementary information to assist planners and contractors, which can be applied to any activity that generates output in the form of a spatial representation of Coliban Water property, assets or land interests.

This specification applies to both hardcopy (printed) and softcopy (digital) products, which may be required to be submitted to Coliban Water to represent output from activities such as: reality-mapping of topography, environment or terrain; detailed ground and aerial surveys (manned and unmanned), and; recording of ‘as-built / as-constructed’ data relating to capital works programmes, developer or privately installed works (network assets), or consultants commissioned to undertake work on behalf of Coliban Water.

This document does not relate directly to the scope of requirements set out in any contractual arrangement with Coliban Water, its contractors or partners; rather its intent is complimentary to design specifications, to provide guidance to those involved in planning and those responsible for capturing and compiling information to meet requirements.

The purpose of this specification is to ensure that all output spatial-data products created by firms or individuals who are employed by Coliban Water or its contractors, sub-contractors, consultants or other parties, meets the requirements of Coliban Water’s corporate geographic information system (GIS), for data structure, accuracy, symbology and attribution.

The Coliban Water GIS Team is available to work directly with Coliban Water staff and contractors to assist with and recommend suitable methods, devices and solutions. It is advised to consult with us at the earliest possible time in project-planning to ensure the best outcome is able to be achieved for all parties.

# Suitable Data Recording Equipment and Methods

Coliban Water does not specify or require any particular type of technology, device or methodology be used to capture data which relates the spatial location, condition or metadata, to Coliban Water property, assets or land interests.

Subsequent sections in this document detail the requirements for recording data related to particular types of work, which may produce data that has a spatial component, and therefore it is an expectation that any firm involved in capturing or producing data under any of these conditions will ensure that appropriate equipment, devices and methodologies are employed to undertake and complete the work to the required standards defined in these sections.

## GPS (Global Positioning System)/GNSS (Global Navigation Satellite System) Technology

Autonomously collected GPS/GNSS data is not acceptable, i.e. uncorrected coordinates extracted from mobile phone, vehicle Satnav, or small hand-held navigators such as for hiking.

Devices must be capable of either; capturing data that can be extracted in proprietary or industry format and post-processed to apply corrections, such as via GPSNet, or; capable of receiving ‘real time’ correction services via satellite (noting that in Australia this is only possible via paid subscription) or in-conjunction with a ‘base station’.

Positioning technologies incorporated into mobile phones and vehicle Satnav devices, while capable of locating and tracking a vehicle moving along a road-alignment, or a person or object within the immediate or general vicinity of a point of interest, on a digital map, are not suitable for capturing location information to the high degree of absolute accuracy, which is required by Coliban Water to utilise in GIS to represent the real-world.

Choice of equipment should consider commercially available devices specifically designed and priced for GIS mapping, to deliver reliable and repeatable position and height data, that meets international and industry accepted standards for data structure, format and accuracy.

## Drone (UAV / UAS) Technology

Where drone technology has become a ubiquitous solution for many terrain and feature mapping, and imaging projects, this technology has limitations that must be considered before commissioning products and services based on using the technology, especially for large areas and where legal caveats and consequences to data accuracy exist.

## When to use Unmanned or Manned Aerial Solutions

Generally, drone solutions are best suited to small-area surveys of up to a few hectares, as the time-cost of ferrying the aircraft with camera equipment and operations crew to and from the project site is factored into the project quote, which can be less than manned aerial survey solutions.

For larger projects areas, proposals should be sought from both manned and unmanned platform service providers, to ensure the best-fit solution is applied, as the ferrying costs can be similar, but the time-cost for capture and processing of drone imagery can be vastly higher than a manned-platform solution.

It is imperative that where drone technology is being considered by project managers, or recommended by service providers, that the project manager is confident with a service provider’s proposed solution and expertise; and for the service provider to be confident with the suitability of their proposed solution to meet the project requirements for deliverables as well as budget, and that the output products are reliable and fit-for-purpose in terms of accuracy, content and delivery timeframes.

## Legal Limitations

There are legal and regulatory restrictions imposed by CASA, upon the operating environments and flight conditions within which an operator is able to use the technology, summarised as:

* The operator must only fly during the day and keep the drone within visual line-of-sight. This means being able to see the aircraft with your own eyes (rather than through a device) at all times
* The operator must not fly a drone higher than 120 metres (400ft) above the ground
* The operator must keep the drone at least 30 metres away from other people
* The operator must not fly a drone over or near an area affecting public safety or where emergency operations are underway (without prior approval). This could include situations such as a car crash, police operations, a fire and associated fire-fighting efforts, and search and rescue
* The operator must only fly one drone at a time
* The operator must not fly over or above people. This could include beaches, parks, events, or sport ovals where there is a game in progress
* If the drone weighs more than 100g, the operator must keep at least 5.5km away from controlled aerodromes
* Respect personal privacy. Don’t record or photograph people without their consent—this may breach state laws
* More information can be obtained at:
<https://www.casa.gov.au/aircraft/landing-page/flying-drones-australia>

## Physical Limitations

There are physical limitations inherent in flight, sensor (camera / scanner) and computing platforms, which can translate to vastly increased capture and processing times, with commensurate increase in delivery times and costs, compared to traditional ‘manned’ aerial surveys, which use larger format sensor platforms and larger engine-driven airframes.

A drone’s limitations are:

* Very Small Image Footprints – results in an exponentially increased number of photos and time required to cover the same area when compared a larger-format sensor.

 *example: a single drone operator crew, using a commercially available drone platform may capture high-resolution imagery for a feature survey, along a 30km stretch of road in around 3 weeks. Comparatively: a light aircraft solution could capture the same imagery, and same specifications, in about 1 hour.*

* Low Battery Capacity and Endurance – results in the need for regular landings and battery-changes, thus hugely increased number of flight legs to complete the mission.

*the effects of this can be gargantuan; in terms of the number of flight segments needed to cover the area of interest, and subsequent processing and delivery time*
* Low Stability in Wind – this restricts the weather and operating zones within which a drone can be used to successfully obtain high-quality data and blur-free imagery.
* Low Quality Image Geometry – compared to metric camera lenses, which have calibrated geometry, precision optics and residual errors known for each lens.

*the effects of this may be geometric errors that cannot be removed during orientation and adjustment of the resultant imagery; consequently, these errors are propagated throughout the image-model space which is used to make terrain, mapping and image products*

These restrictions may create unwanted, unintentional and irreparable errors in output data products, especially distortions. However; it also has to be understood that these errors may not adversely affect some project deliverables. Very low flight altitudes applicable to drones, combined with high-resolution sensors (albeit low cost and low quality) can sometimes invalidate the negative effects of poor or unknown image-geometry in some projects.

## Field Sketches and Site Plans

Hand compiled drawings and sketches are not an acceptable form of recording accurate spatial location information - nor is manually drawing the location of features in CAD - unless spatial locations are captured using suitable positioning and/or measurement technology that is fit-for-purpose, then compiled into the required data structure and formats defined in this document.

To be deemed suitably-prepared, a field sketch or site plan must identify the following, as applicable:

* Dimensions that indicate position, depth and height relative to ground level, to accurately represent the real-world existence at the time of completion of the activity
* Locations representing the centre of all single-point features, which represent planned or as-built assets
* Locations representing start and end points of all linear features or sections, which represent planned or as-built assets
* Locations representing all points of discrete change in direction or elevation, along linear features, which represent planned or as-built assets

*accurate underground position and alignment must be able to be determined with a degree of certainty which equates to approximately ½ the diameter or smallest-dimension of the feature, e.g. any point along a 40mm diameter pipe must be able to be located within 20mm, to negate the need for pot-holing or other random-digging techniques in future, which may cause undue damage or rupture due to inaccurate information.

alignments can be captured using a series of thoroughly measured offsets and angles to and from nearby or adjacent features (such as a pavement, building or other asset), which enables the Draughter to accurately reconstruct the alignment of the entirety of feature, relative to these surrounding features.*
* Locations representing all points of change in condition; such as material, diameter, depth
* Symbolisation, annotation and dimensioning of features that ensures correct geometry, size and shape, are able to be gleaned from all provided information, e.g. a manhole would require 3D spatial location of the centre of the manhole lid in real-world coordinates (in accordance with this specification), identification of the structural material used, its overall diameter/extents, RIM height relative to ground-level, invert depth relative to RIM, and depth of any inlets or outlets within the manhole relative to the RIM height
* Locations representing the real-world position of associated property boundaries and existing survey marks used (for developments), buildings and adjacent road reserves and easements

Clarification of whether a particular device, methodology or production process is suitable to achieving the required results, should be sought from the Coliban Water GIS Team, prior to undertaking any work on the project.

# Recording of Ground and Aerial Surveys

This aspect of the specification applies to any work involving the conduct of ground or aerial surveys, for the purpose of establishing or re-establishing boundary alignments, pegging or marking land parcel corners and boundary directional changes, and the production of 2D and 3D mapping or imagery data products, such as detailed feature surveys, terrain and contour generation, and orthogonally-rectified aerial imagery mosaics (commonly referred to as ‘ortho photos’).

This applies to all technologies used, whether ground, aerial or satellite based, by means of manned or unmanned sensor platforms, and for manually or automatically generated output.

## Production of Terrain and Contour Products

All terrain products are to be a representation of the ‘bare earth’ terrain. Prior to final output and for contour generation, the terrain model is to be geometrically corrected to remove any vertical separation from the ‘bare earth’ such as for errors, spikes and anomalies caused by vegetation, shadows, water reflection (water must be flat), elevated features and non-terrain features including any man-made objects (vehicle, building, bridge/overpass, conveyor etc).

All requests from Coliban Water for terrain products are to be implied to mean a representation of the ‘bare earth’, unless specifically stated by Coliban Water, e.g. where the project output is required to represent the whole ‘surface’ terrain for the production of vegetation or building surface models.

## Specific Requirements for Surveys

* A survey connected to MGA by traditional or GNSS methods in accordance with the Surveyor General of Victoria Practice Directives 2014. GDA 94 Datum is to be used unless instructed otherwise to use GDA 2020.
* All digital survey data must be determined and scaled to true Map Grid of Australia (MGA) coordinates (scaled to grid) – UTM Grid Zone 55, GDA 94 datum. All reduced levels must be to Australian Height Datum (AHD)
* A Record of Having Re-established a Cadastral Boundary is to be prepared in accordance with Schedule 4 of the Surveying (Cadastral Surveys) Regulations 2015. A PDF copy is to be supplied to Coliban Water along with the assigned OSGV RE number at time of invoicing.
* Survey results must be supplied in GIS compatible data formats and meet all specifications.

# Recording of Work As-Constructed Information

## General Requirements for all As-Constructed Data

Unless explicitly mentioned in project documentation, all as-constructed record plans are to be provided to Coliban Water in digital PDF-print and digital GIS-compatible formats, meeting all requirements of Sections 2, 3, 4 and 5 as is applicable to the project.

The field record sheets used by the Contractor are not required by Coliban Water.

All design drawings submitted to Coliban Water shall, after completion of construction, be amended by a competent CAD draughtsperson to accurately show as-built condition and spatial location of the works, in relation to surrounding infrastructure and property boundaries. This requirement also applies to all works by subcontractors.

Location and alignment of all Coliban Water network assets, private extensions and common drains connected to, or adjacent to, the works, must be included in the as-built drawing.

The Certificate of Practical Completion will not be issued until these Work-as-Constructed drawings are submitted and accepted by both the Coliban Water project manager and GIS administration.

* All attached or referenced files must be bound (embedded) into the primary file/s delivered to Coliban Water, i.e. no separate attachments, XRef or image files (e.g. photos; logos; aerial photography).

This data will be uploaded without adjustment (geo-referenced) into Coliban Water’s GIS and must not introduce potential spatial conflict with future additions to the database.
* The drawing must contain the Coliban Water Drawing Number issued by Coliban Water – when quoting please consider the number of drawings to be delivered so an appropriate number of drawing numbers (or ranges) can be generated.
* If a Certified Plan and Drawings are required: One (1) hard copy and one (1) soft copy (in both PDF and GIS –ready formats) of each plan/drawing, shall be required.

## Requirements for Data Capture, Feature Coding, Validation and Submission

Coliban Water has implemented a system for standardisation of As Constructed asset data that ensures interoperability with stakeholders, external agencies and our GIS. This system comprises three (3) components, each utilising proprietary inputs forming one integrated solution: an AutoCAD template; a data specification, and; online validation and certification.

From 01 July 2021, it is mandatory that all ‘as constructed’ data relating to Water and Sewer network assets be compiled, validated and submitted to Coliban Water using this system. Note: this is separate to, and does not include, as built technical drawings e.g. long-sections and fully-symbolised drawings relating to O&M manuals, which are still required to be compiled against Coliban Water Technical Standards – A3 and A1 Drawing Templates.

The Coliban Water GIS Team is custodian of this system and is available to provide assistance to developers and contractors, to enable a smooth transition and successful use of the system for mutual benefit.

Compilation of final ‘as constructed’ data relating to all Water and Sewer network assets, shall utilise these two (2) tools, to ensure all data submitted to Coliban Water meets minimum requirements for data structure, geometry, coding and attribution.

* ASPEC AutoCAD Template: a common set of specifications developed by GISSA International, for the capture and supply of digital data relating to ‘As Constructed’ infrastructure assets that meet APSEC feature coding and attribution requirements

Coliban Water is a member of the ASPEC Consortium, and licenses W-Spec (water) and S-Spec (sewer) specifications to enable Developers to capture ASPEC-compliant data.

Two data specifications are built into a single AutoCAD (DWG) template, which is provided by Coliban Water, and must be used for compilation of ‘as constructed’ data.

Submission of ‘as constructed’ data in a template other than specified here, is not acceptable and will fail the validation and certification process.

* ACDC (As Constructed Design Certification) - a software tool developed by Open Spatial, which provides an online ‘ACDC Validation Portal’ to enable the self-validation and certification of ‘as constructed’ data, prior to submission to Coliban Water

The Developer shall contact the Land Development Team or Project Manager to obtain a Project Number.

Coliban Water shall set up a project area in the ACDC Validation Portal, and assign the Developer to one or more projects.

The Developer shall contact the GIS Team to obtain information about how to access and use the ACDC Validation Portal, which will provide access to the specific project site for uploading and validating DWG files, and enable download of all supporting documentation related to a project, including the latest Coliban Water ASPEC drawing template (DWG).

Coliban Water pays all licensing fees and costs-per-project, which are applicable to using the ‘ACDC Portal’ for validation and submission of project ‘as constructed’ data to Coliban Water.

# Specification for GIS Data Exchange

Coliban Water uses ESRI’s ArcGIS platform as its corporate GIS. To ensure compatibility of datasets for import, all position and height data are to conform to the following requirements.

The Coliban Water project manager or GIS Team must be consulted before preparing and submitting any digital spatial data, to confirm current software versions and any changes to spatial data specifications applicable to the data requirements below.

## Data Specification and Accuracy

*Coordinate System* Map Grid of Australia (MGA)

*Projection* Universal Transverse Mercator (UTM)

*UTM Grid Zone* 55

*Horizontal Datum* Geocentric Datum of Australia 1994 (GDA94)

*Vertical Datum* Australian Height Datum (AHD)

*GNSS height to AHD Conversion* AUSGeoid09 model

*Horizontal Target Accuracy* 0.1m (Asset Survey and Construction Activities)
 or ½ the diameter / shortest side, whichever is smallest

 1-3m (Environmental Mapping and General Asset Verification)

*Vertical Target Accuracy* 0.15m (Asset Survey and Construction Activities)

 1-5m (Environmental Mapping and General Asset Verification)

*Precision*  Confidence level (95% of all features shall meet target accuracy requirements)

## Data Structure

All digital data is to conform to the CAD data structure as defined in Coliban Water’s latest and current Drawing Templates. It is the responsibility of the contractor to liaise with their respective Coliban Water project manager or GIS Team to confirm and/or obtain the latest template version.

All title and feature information are to be integrated in a single dataset (container).

All final design CAD files are to be ‘bound’ to ensure that no information is missing from the drawings.

All lines, symbols and title block attributes must be captured in accordance with Coliban Water’s A1 or A3 digital Drawing Templates, where these are a project requirement.

One file must contain the complete project depicting all lines, annotation, symbols and any survey reference marks or stations, and any property boundary alignments used in the survey.

## Allowable Digital Data Formats

All spatial data must be supplied in one of the following formats stated below:

* AutoCAD - DWG
* ESRI - shapefile or file-geodatabase (personal geodatabase **is** **not** acceptable)

**Versions:** the data preparer MUST email the Coliban Water GIS Team, to confirm the current version of GIS software that Coliban Water is using, before finalising any digital data in preparation for delivery to Coliban Water. This is to ensure that project deliverables are compatible with Coliban Water’s GIS.

Coliban Water will not accept data files supplied in versions higher than those stated. It is the responsibility of the supplier to be aware of, and ensure data is either produced or exported in, the correct format and version.

## Spatial Data Attribution

Attribute information, which relates directly to the data, must be embedded into the spatial data structure (schema) for each record.

All ‘as constructed’ data relating to Water and Sewer network assets must be compiled to ASPEC standards and submitted to Coliban Water using the ACDC Validator portal outlined in Section 4.2

For non-standard project data, such as that which necessitates complex coding or long descriptions, a unique feature identifier must be assigned directly to each spatial element, to enable direct referencing to a delimited text file (also to be provided), which then contains the relevant attribute information.

## Supply of Digital Files

Digital data can be supplied to Coliban Water using the following methods:

* USB memory-stick
* HDD
* e-mail (if file sizes are suitably small to pass gateway restrictions)
* Online File Transfer (e.g. Dropbox / FTP site)

# Contacting Coliban Water GIS Team

To obtain further information or clarification about any aspect of this specification, or to obtain supply of datasets or other documents referenced herein, please feel free to contact the Coliban Water GIS Team using this email for all correspondence:

gisadministration@coliban.com.au