

PAPL-PO-STA-Spatial Data Standard

Projects and Development

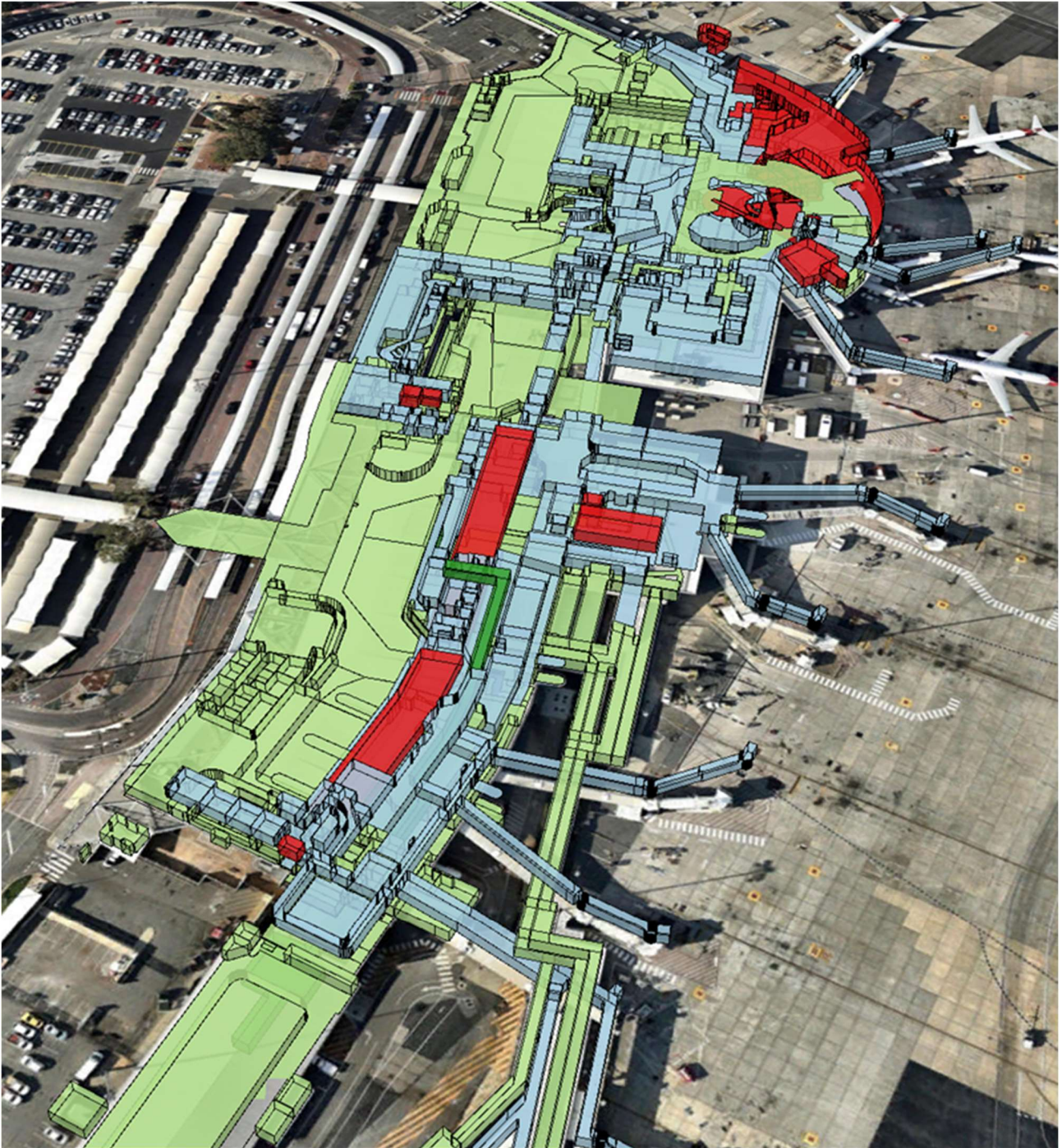


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1. Introduction

1.1 Purpose

This document is intended to establish a uniform method for spatial data interchange standards. It specifies general requirements for spatial data access requests and spatial data submission to Perth Airport Pty Ltd (PAPL). Thus, it promotes locational data consistency and integrity. It covers the requirements for the file delivery format and presentation of spatial data, including GIS, CAD and BIM data at any point during the Design, Development or Delivery stages of all projects. It also provides guidance to PAPL contractors, consultants, staff and any others who provide spatial data and products to PAPL.

PAPL requires accurate data and detailed information on all buildings, infrastructure and utilities constructed on the Airport Estate. Additionally, PAPL are obliged to record environmental and/or heritage survey and assessments on and off the estate. It is the intent of PAPL to acquire, catalogue and manage all spatial data comprehensively across all projects to:

- ensure future use and access by PAPL teams and projects (data sharing)
- apply appropriate data standards and formats (data integration and interoperability)
- maintain and serve spatial data from single enterprise database (data integrity)
- provide a geospatially consistent basis for future activities
- facilitate access for the stakeholders to PAPL spatial data, information, and services.

This document needs to be reviewed in its entirety before preparing data for submission to PAPL. Failure to meet the standards, where set, will be treated as a failure to meet contractual obligations.

1.2 Updating this Procedure

Proposed changes and additions to this document should be submitted in writing to the document owner with accompanying examples, discussion, or other supportive material. Changes will only be made with the approval of the authorised person specified in the Authority Table section.

1.3 Distribution

This Procedure forms part of Perth Airport's Work Contracts or Agreements for the provision of information, design, construction, supply, and installation.

2. Definitions

Term	Definition
ArcGIS	Esri ArcGIS is the standard Geographic Information Systems software platform used by Perth Airport
ArcMap	ArcMap is a component of the ArcGIS software platform, which is used for analysis and visualisation of spatial data
As-Built Drawings	The final set of project drawings to be provided to Perth Airport under the terms of the contact of agreement. Any changes made during construction which are not recorded on the 'Construction Issue' drawings must be reflected on the 'As Built' Drawings so that the 'As Built' drawings accurately reflect the completed Works.
As-Built Survey	The detail site survey to be provided to Perth Airport under the terms of the contract of agreement. These surveys must accurately record the details of completed Works, as opposed to designs or proposed conditions drawings.
BIM	The processes, protocols, rules, procedures, and the like for building information modelling.
BIM Model	The digital representation of the geometrical, physical and functional characteristics, attributes and artefacts of a facility and arising for and from the design in CAD, construction, commissioning and operations of that facility created for the implementation of BIM in respect of the Project and the operations of the facility
CAD	Computer-Aided Design. CAD software is used to create, modify, analyse, and optimise designs in two- or three-dimensional space, and is commonly used in surveying, engineering and architectural applications
DGN	Bentley MicroStation software design file extension
DWG	AutoCAD software drawing file extension
ESRI	Environmental Research Systems Institute. ESRI is the vendor of ArcGIS, the standard GIS software platform used by Perth Airport
GIS	Geographic Information Systems. GIS software is used to store, manipulate, analyse and visualise spatial data.

IFC	Industry Foundation Classes model exchange format. It is an open standard that is intended to describe architectural, building and construction industry data.
PAPL	Perth Airport Pty Ltd
PCG94	Perth Coastal Grid (1994). It is a projected coordinate system based on the GDA94 datum.
PCG2020	Perth Coastal Grid (2020). It is a projected coordinate system based on the GDA2020 datum.
RVT	Autodesk Revit software BIM file extension

3. Spatial Data Release

Perth Airport spatial data (GIS, CAD, and BIM) are subject to strict release criteria for issuing to external parties, all data is only provided in pdf format except when required for project design work.

External parties (contractors, consultants, or suppliers) must submit the data request via a PAPL representative (e.g.: PAPL Project Manager). The PAPL representative will then notify the Spatial Data team to extract and process the requested data.

3.1 Data Transfer Requirements

Copyright © Perth Airport Pty Ltd: All digital data is released with the understanding that reproduction by external parties for plans or diagrams requires acknowledgement of the source of the base information to be clearly displayed.

All data is valid at the time of release only, recipients agree not to reuse any portions of our digital data for any future projects without written consent from Perth Airport Spatial Data team.

PDF Data: PDF files are the primary format that data is released, for DBYD or other location-based requests. This prevents the loss of information caused by conversion of data to different formats, or external operators releasing maps without all information being displayed correctly.

CAD Data: Retention of historical Perth Airport CAD files by external parties has and can cause issues, out of date information being used for works. CAD data is issued for project design work only (not for DBYD). CAD data released for such purposes is issued in MicroStation DGN format only and may be write protected, with an appropriate expiry date set to it, with a 6-month maximum. At which time an external party can request a new version of the file if design works are continuing.

GIS Data: All Perth Airport GIS data is in ArcGIS format Version 10.6. Data is released in file geodatabase format, shapefiles or ESRI Map Packages.

Data Format: Contractors and subcontractors should also be advised that if they use CAD programs other than MicroStation, that due to the inaccuracies that have and can occur when exchanging between file types, Perth Airport Spatial Data team does not convert our data to different formats.

Perth Airport spatial data is recorded in certain coordinate system as defined in section 12 of this document, converting files to other formats or coordinates is done at the risk of the third party.

4. Design Modelling and Drafting Requirements

4.1 Compliance

Documentation and Data supplied in a form not complying with this technical specification or agreed to in the scope of works shall be rejected as being a non-conforming and require to be re-submitted. Failure to do so will be contrary to the contract or agreement and may incur charges for rectification of documents by others.

All questions on the contents of this document should be directed in the first instance through the PAPL Project Manager. Further clarification may be sought from Perth Airport's Spatial Data team.

It is a requirement of this document for the consultant/contractor to seek approval and/or direction from Perth Airport for each individually commissioned project, in relation to:

- CAD application
- BIM application
- CAD seed files or template drawings
- Survey Control Network
- GIS application
- Native File submission
- Metadata and/or survey reports

4.2 Addresses, Site Codes and Building Numbering

All Street Addresses, Site Codes and Building numbering for a project shall be obtained from Perth Airport's Spatial Data team.

4.3 Asset and Service Identifiers

All unique identifiers for new Assets Services and Equipment shall be allocated by the relevant Perth Airport department (e.g. Electrical, Maintenance etc.). This will be provided on request and consultation with Perth Airport's Spatial Data team to ensure integration with PAPL existing GIS system.

4.4 Quality Assurance/Quality Control (QA/QC)

Consultants, Contractors or Suppliers are responsible for carrying out basic Quality Assurance/Quality Control (QA/QC) of all data prior to supplying it to PAPL. Quality Assurance can be described as the process of preventing errors from entering into datasets, while Quality Control can be described as the process of identifying and correcting existing errors in datasets.

All datasets should be checked for:

- Spatial errors (e.g. errors in coordinates entered in raw data tables or errors in the geometry of features in spatial datasets)

- Attribute errors (errors and inconsistencies in the data recorded in raw data table columns or in spatial data attribute fields)
- Completeness (are all the datasets present?)
- Consistency with data shown in any accompanying documents (such as reports or drawings), and
- Topology rules - GIS topology is a set of rules and behaviours that model how points, lines, and polygons share coincident geometry, e.g., polygons must not overlap, must not have gaps, and polyline must not self-overlap, must not self-intersect, etc.
- Compliance with the Data Standards described in this document.

All data and survey information submitted must be accompanied by a delivery checklist form (see section 14) and/or survey report that provides description of the accuracy and compliance of the information provided (see section 8). Once submitted, data will be reviewed by PAPL and non-compliant datasets or datasets containing errors will be returned to the contractor for modification and resubmission.

5. GIS Data Standards

Perth Airport is an ESRI GIS site and as such prefers all information is provided in ESRI compatible formats.

5.1 Vector Data

Vector data includes points, lines, and polygons. Each GIS Vector dataset must include three deliverables, prepared according to the specifications outlined in table below.

Key Deliverables	Requirements
Vector Dataset	<p>File Format:</p> <ul style="list-style-type: none"> - ESRI File Geodatabase (.gdb) or - ESRI Shapefile (must include *.SHP, *.SHX, *.DBF and *.PRJ files as a minimum). <p>Datum, Projection and Coordinates:</p> <ul style="list-style-type: none"> - Correct datum and projections must be used for all datasets submitted (see section 12). <p>Attributes:</p> <ul style="list-style-type: none"> - Attribute fields must be clearly and logically named. - Attribute fields must be properly formatted for correct data type. i.e., Date or Text or Number/ Integer. - All unwanted attribute information is to be deleted when exporting from GPS or CAD products, provide only the relevant fields. <p>File Name:</p> <ul style="list-style-type: none"> - File name should include Project name - Use the date for document version control. Date shall be in yyyyymmdd format at the end of the file name (e.g.: FileName_yyyyymmdd)
Layer File (ArcGIS users only)	<p>If ArcGIS is used to prepare the spatial dataset, and the data are symbolised in a complex or specific way in figures, an ESRI Layer file that defines the symbology should be submitted along with the vector dataset.</p>
Metadata File	<p>Please complete one metadata form to accompany each Feature Class or Shapefile being submitted. Refer to section 13 for details.</p>

5.2 Raster Data

Raster data includes raster surfaces (DEM, DTM, etc), satellite and aerial imagery. Each GIS Raster dataset must include three deliverables as shown in table below.

Key Deliverables	Requirements
Raster Dataset	<p>File Format:</p> <ul style="list-style-type: none"> - Preferably JPEG2000 (.JP2) or - Enhanced Compression Wavelet (.ECW) or - GeoTIFF(.TIF, .TIFF) or - ESRI GRID (ASCII or Binary) <p>Compression: (if supported by selected raster file format)</p> <ul style="list-style-type: none"> - Lossless compression (or no compression) should be used for most raster datasets. - Lossy compression methods may be appropriate for some kinds of raster data (primarily data that is used for display purposes rather than for analysis). <p>Datum, Projection and Coordinates:</p> <ul style="list-style-type: none"> - World file to be included for each raster dataset. - Correct datum and projections must be used for all datasets submitted (see section 12). <p>File Name:</p> <ul style="list-style-type: none"> - File name should include Project name - Use the date for document version control. Date shall be in yyyyymmdd format at the end of the file name (e.g.: FileName_YYYYMMDD)
Layer File (ArcGIS users only)	<p>If ArcGIS is used to prepare the spatial dataset, and the data are symbolised in a complex or specific way in figures, an ESRI Layer file that defines the symbology should be submitted along with the raster dataset.</p>
Metadata File	<p>A metadata form must be completed for each raster dataset submitted to PAPL. Refer to section 13 for details.</p>

5.3 Map Document Requirements

Where contractors use ArcGIS, ArcMap documents (.mxd) or ArcGIS Pro projects (.aprx) are required for delivery with accompanying data in a stand-alone directory structure. Map formats also need to be configured to use relative paths and not be set to use a printer-specific paper setting. Such documents are recommended to be provided as Esri map/project packages (.mpk/.ppkx).

5.4 Environmental Dataset Requirements

In addition to the above GIS data requirement, to meet data standards for services supplied for environment and/or heritage survey and assessments, it is mandatory for the consultant (provider) to ask for the layer format and template to ensure attribute definitions and schema are consistent with historical surveys/assessments.

Data supplied not complying with these requirements will be rejected and require to be re-submitted.

6. CAD Model and Drawing Standards

6.1 CAD Application

Perth Airport is a MicroStation CAD site and requires all information to be provided in DGN format. All Models and Drawings shall be:

- prepared and provided to Perth Airport in MicroStation (*.dgn) file format, version V8 or later
- using Perth Airport provided templates (*.dgn) “seed file”, to overcome problems associated with georeferencing (coordinates), scale, symbology, rotation and layer naming standards
- the file format is preferred to be MicroStation 3D Bentley Design File (.dgn)
- Survey information shall be presented as a single 3D CAD file, showing all survey data (points, strings and annotations).
- All level (height) annotation shall have its insertion point located at the level’s Z (height) recorded position – it is acceptable for this text to overlay other entities.
- All services and utilities indicated shall be annotated with its size, material type, number.

A “seed file” is available upon request from Perth Airport’s Spatial Data team.

Base CAD files are to be verified as suitable prior to commencement of Design Works.

AutoCAD (dwg.) files may be acceptable if they are coincident with existing Perth Airport information and are approved as such by Perth Airport’s Spatial Data team prior to commencement of works.

Perth Airport will not undertake correction of non-geospatially aligned data and non-conforming to the standards defined in this document.

Consultants/Contractors should also be advised that if they are using CAD programs other than MicroStation, the product version must be verified as compatible with Perth Airport data formats.

Note: AutoCAD (*.dxf) format will not be accepted. It is the responsibility of the consultant/contractor to ensure that all drawings prepared in a CAD application (other than MicroStation), on transfer to MicroStation format, all levels (layers), line styles and fonts are retained with no loss of data.

It is the responsibility of the data provider to ensure that all drawings include relevant Xrefs and Reference files to ensure the drawings integrity.

All native file formats are to be provided as well to PAPL in addition to the compliant format.

6.2 Industry Standards

All drawings shall be prepared in accordance with the industry standard, AS1100 - Technical Drawing Standards, unless otherwise stated or indicated in this or any other PAPL document:

- Part 201: Mechanical Drawings
- Part 301: Architectural Drawings
- Part 401: Engineering & Survey Design Drawings
- Part 501: Structural Drawings

6.3 CAD Layer Naming Standards

PAPL has CAD layer naming standards that must be followed by all contractors and data providers. The layer naming standards are defined in PAPL CAD template files ('seed files'). All layers must be properly separated as defined in the templates. The standard of layer names is governed by discipline with a separate template file for each discipline.

The layer names must be sourced from the PAPL template files. Any exceptions to the standard layer names must be submitted in writing and approved by the PAPL Project Manager after consulting with Spatial Data team. Additional layer names can be added, provided they are logical, unique (information not captured elsewhere) and conform to the guideline below.

The guideline for layer naming structure is illustrated below. Layer names consist of distinct data fields, separated from one another by a hyphen. The full standard allows for five fields, but not all fields have to be completed.

Discipline	-	Major	-	Minor 1	-	Minor 2	-	Status
X	-	XXXX	-	XXXX	-	XXXX	-	X
e.g.:								
A	-	WALL	-	FULL	-	DIMS	-	N
Architecture		Wall		Full (height wall)		Dimensions		New construction

Discipline

Discipline defines what kind of subject matter the layer contains. It is a mandatory single character as below list.

A – Architectural	G – General	P – Plumbing
B – Geotechnical	H – Hazardous Materials	S – Structural
C – Civil	I – Interiors	T – Telecommunications
E – Electrical	L – Landscape	V – Survey / Mapping
F – Fire Protection	M – Mechanical	

Major Group

The major group normally identifies a building component or airport feature. This field is required and has four characters. For examples:

ANNO- Annotation	CURB – Curb	PLNT – Plantings and Landscape
BEAM – Beam	DOOR – Door	PRKG – Parking
BLDG – Buildings	ELEV – Elevation	PROP – Property
BNDY – Boundary	EQPM – Equipment	ROAD – Roadways
BRDG – Bridge	FLOR – Floor	SECT – Section
CLNG – Ceiling	FNDN – Foundation	SITE – Site Improvements
CODE – Code compliance plan	FURN – Furniture	TOPO – Topography
COLS – Column	GRID – Grid	WALL – Wall
	GLAZ – Glazing	

Minor Groups

Minor groups are optional and are intended to further define what is contained within each layer. It has four characters.

Status

Status defines what work/construction status the items on the layers have. This is an optional single character that is predetermined in the list below.

N – New work/As built

E – Existing

D –Demolished/Removed

A - Abandoned

6.4 Scales

All CAD models and drawings shall be prepared at full scale in model space with scaled outputs in paper space only. The model units shall be either 1 unit = 1mm or 1 unit = 1m (this is to be agreed at the beginning of the project).

7. BIM Model Data Standards

Any 3D/BIM models produced during the development of Works for the Airport are to be provided to PAPL. PAPL may require these prior to the project completion, at each stage of the design process, for coordination purposes. These models will be:

- Building architectural models
- Structural design 3D CAD models
- Building/Engineering Services and infrastructure models (schematic and 3D models)
- Fly-through development models (model data and video files)
- Civil design models (DTM's, design string surfaces and triangulated surfaces).

File formats for BIM Models will be agreed with PAPL prior to commencing design works for a project. At a minimum these formats shall include:

- The original native authoring file including any object libraries and project set-up files (preferable in Revit (RVT) format)
- Industry Foundation Classes (IFC) data model or Bentley i-models
- CAD 3D exports (MicroStation DGN or AutoCAD DWG).

PAPL supports Autodesk Revit 2015 through 2020 file format (*.rvt) and requires Revit model in metric (metres) unit. Display units in the Revit Model must be the same as units of the coordinate system definition (metres).

7.1 Scales

All BIM models shall be prepared at full scale in model space with scaled outputs in paper space only. The model units shall be either 1 unit = 1mm or 1 unit = 1m (this is to be agreed at the beginning of the project).

8. As-Built Survey Data and Quality Requirements

8.1 Survey Report

The Contractor shall prepare a brief final summary report, which includes the following:

- The Contractor's name, the name, registration number and contact details of the Licensed Surveyor, the dates between which field work was undertaken and the names of any survey Sub-Contractors and the services they provided.
- Horizontal and vertical control used for the survey and any comments on the reliability/accuracy of those control marks (including any existing control points damaged/destroyed)
- Photographic data to assist with verification should also be included where possible.
- A statement by the Contractor's Surveyor certifying that all data was obtained entirely from field observations and site survey under his/her supervision and that none of the as constructed data was extracted from design drawings.

8.2 General

All information shall be based on surveyed or field measured data. Providing:

- Design drawings marked "As Built" or "As Constructed" will not be accepted.
- Scanned hand marked or ink stamped construction documents to be represented as constructed drawings shall not be accepted.
- Drawings issued during the construction or installation should be the basis for as constructed drawings. When issued as an as constructed record the revision number shall be raised to the next number and the wording 'As Constructed' shall be noted in the amendment details field of the title block.

The following works shall be surveyed for as constructed horizontal and vertical location and certified by a licensed surveyor approved by PAPL:

- Building locations and elevations
- All in ground engineering services, annotated with information (where applicable) relating to the purpose, size, material type and the like that can identify the attributes of the services
- Any temporary works that remain at the completion of the Project
- Removed, altered, abandoned, or decommissioned engineering infrastructure

8.3 Units of Measure

The following units of measurement shall be used:

- Linear measurements shall be in metres

- Vertical measurements shall be in metres
- Angular measurements shall be clockwise from 0 degrees to 360 degrees
- Azimuth shall be on the local plane rectangular grid system.

8.4 Airport Survey Control Network

Perth Airport has an extensive existing Survey Control Network. This data can be provided on request in plan and table format from Perth Airport's Spatial Data team. This control is under constant review and currency shall be verified by the Contractor with Perth Airport prior to use.

Airport Control marks may be represented as:

- PSM's (Permanent Survey Marks)
- Deep Driven Rods
- Star Pickets
- Other Miscellaneous Survey Marks such as Iron Pins, Bolts etc.

Damage to any Airport Control marks shall be notified to the Owner's Representative and Perth Airport's Spatial Data team immediately upon being identified.

If the Contractor intends to establish any new permanent Survey Marks on which they will rely in conducting as constructed surveys then this may be done only with express prior approval of the Owner's Representative and, if located airside, then in consultation with the Airside Operations team.

All permanent Survey Marks shall be tagged and registered in consultation with the Perth Airport's Spatial Data team.

8.5 Surface and Above Ground Features to be Recorded

The survey of surface features should include, but is not limited to:

- Structures and Surfaces: Paths, driveways, retaining walls, slabs/paved areas, significant structural footings, poles, floodlighting.
- Drainage Structures: Headwalls, open drains, grated drains, culverts.
- Roads: Kerbs, edges, shoulders, line-marking, bridges, road furniture.

Note: The back of, invert and lip level of all kerbs and water channels shall be surveyed and recorded

- Buildings: Footprints, awnings, overhangs, columns, external fixtures (stairs, ramps, plant, etc.)
- Fences and Gates: Airside, security, general fencing and handrails

- Aircraft Pavements: Finished Surfaces, should distinguish between full strength, shoulder and blast etc.
- Movement Area Structures: Pavement markings, airfield markers/signage/ navigational aids, air bridges, airfield ground lighting and other aeronautical infrastructure.
- Topographical Features: General topography, embankments, earthworks platforms and surcharge.
- Vegetation: Gardens, significant trees (>0.2 trunk diameter, decorative shrubs), vegetation stands. (mangroves, casuarinas, etc.)
- Signage: Road, parking, advertising, other general signage.
- Survey Marks: Survey control points used, any settlement plates/ monitoring points placed during works.

8.6 Underground Services and Utilities to be Recorded

Prior to any backfilling or covering, information on all underground services and duct banks (including encasing) shall be obtained in situ, including but not limited to:

- Electrical: (LV and HV) Cables and conduits, pits/ manholes and chambers, HV cable joints, earth points and earth mats, substations/ transformers and surrounding pad, pillars, cabinets, and switchboards.
- Fuel Control: Cables and conduits, pits/ manholes and chambers, cabinets, emergency shut-off points.
- Telecom: (Telstra, Optus etc.) Cables and conduits, pits/ manholes and pillar.
- Communications: Fibre optic, micro ducts, comm.'s cables and conduits, pits/ manholes and chambers.
- Drainage: Pipe type, size and invert level, inspection openings, pits/ manholes and chambers, roof water drainage (downpipes, small pits/ grates)
- Fuel: Pipe type, size and invert level, pits/ manholes and chambers, valves, hydrants, earth points, test points.
- Sewer: (note whether gravity or rising main) Pipe type, size and invert level, inspection openings, pits/ manholes and chambers, vent pipes, pump stations and associated components.
- Water: (differentiate between potable, recycled and fire) Pipe type and size, thrust blocks, pits/ manholes and chambers, valves (and type), meters, taps, hydrants, tanks, pumps, irrigation control.
- Compressed Air: Pipes, hoses and other fixtures.
- Gas: (PAPL and ATCO managed) Pipes, valves, tanks, meters.

9. Survey Methodology

9.1 Survey Equipment

Survey equipment shall be used, calibrated, and maintained in a manner that reflects industry best practice.

9.2 Immediate Backfilling

Where immediate backfilling has been unavoidable the Contractor shall have placed, numbered, and marked up on a plan PVC pipes as location and level measures in accordance with their General Requirements. The Contractor shall ensure an as constructed survey then be carried out at the earliest opportunity.

9.3 Surface Features

Sufficient points shall be recorded to ensure that the extremities of all surface features, structures and footings are clearly defined and all bends, intersections, and changes of gradient are accurately recorded. The distance between points of location should generally be about 10 metres and shall not exceed 15 metres. All curves shall be accurately defined using a minimum of three points (two tangent points and one midpoint).

Where actual positions of linear features deviate from a straight line, sufficient additional points of location shall be provided to define the deviation - horizontal and/or vertical change in directions.

9.4 Services and Underground Features

Sufficient points shall be recorded to ensure that the extremities of all pits, manholes, and any other features related to the service are clearly defined and all bends, joints, intersections, changes of gradient, and fittings on or along the service, pipe or conduit are accurately recorded.

All curves shall be accurately defined using a minimum of three points (two tangent points and one midpoint). Where actual positions of linear features deviate from a straight line, sufficient additional points of location shall be provided to define the deviation (horizontal and/or vertical change of directions). The maximum distance between points of location along services shall not exceed 15 metres. Levels should generally be taken as an obvert location, the exception being for pipes entering sewer and drainage pits where invert levels are shown. These should be annotated as being invert levels for clarity.

The Contractor's surveyor should record and annotate all services and utilities with information relating to the size, number of and material type and owner when appropriate. The surveyor shall record and clearly differentiate between Telstra, Optus or other communication service providers and communications infrastructure.

The Contractor's surveyor shall record the position of each conduit within a multi-pipe duct bank. Details relating to the number of conduits making up the duct bank, their size and material type shall be recorded. Any general service ducts/ enveloper pipes should be located, noting its size and material type, and which services run through it. Any ducts/ pipes put in as spares for future capacity should also be noted.

The Contractor's surveyor shall record the size and orientation of all grates, pits and manholes. Grates and pits exceeding 400mm in size shall be recorded using a minimum of three corner or

edge points. Pit/ manhole chambers only need to be located and where the extents of the chamber extend past the extremities of the pit at surface level.

In all instances, any thrust blocks or concrete cover / protection over services should be located, showing dimensions and depth.

9.5 Existing Features and Services

Existing services and features shall be located and recorded by the Contractor's surveyor.

9.6 Tunnel Boring

The Contractor's surveyor shall provide records (logs, profiles etc.) relating to all tunnel boring undertaken as part of the works.

9.7 Services Alteration/ Abandonment / Demolition

Where existing infrastructure, building services and/or utilities are demolished, or services realigned or abandoned this information must be reflected in the as constructed survey data. A distinction shall be made between services (or part services) which have been abandoned (but left in the ground) and those that have been physically removed.

10. Survey Accuracy

10.1 Vertical Control

All levels are to be in Australian Height Datum (AHD). The following as constructed measured tolerances to design shall apply:

- Building structural elements +/- 5 mm
- Building elevations and features +/- 10 mm
- Engineering services +/- 10 mm
- Civil structural elements and ground works +/- 5 mm
- In ground engineering services +/- 10 mm
- Other +/- 20 mm

10.2 Horizontal Control

Horizontal measures shall rely on the Survey Control Network. The following as constructed measured tolerances to design shall apply:

- Building structural elements +/- 10 mm
- Building elevations and features +/- 10 mm
- Engineering services +/- 10 mm
- Civil structural elements and ground works +/- 10 mm
- In ground engineering services +/- 20 mm
- Aircraft movement markings +/- 10 mm (noting markings must be to an accuracy of +/- 20 mm from design locations).
- Other +/- 20 mm

Note: above tolerances are for as-constructed measurement only and not for design or for construction.

11. Perth Airport Surveyors

Perth Airport retains a Licensed Surveyor who is familiar with Perth Airport estate and its as-constructed survey requirements. The Surveyor is on call and can be contacted on mobile - **0458 964000**.

12. Coordinate Systems

NOTE: PAPL is currently planning to migrate from PCG94 to PCG2020. Once the migration is completed, PAPL will adopt PCG2020 as a standard for our coordinate system.

The coordinate system for GIS, CAD and BIM data provided to PAPL should be in Perth Coastal Grid 1994 (PCG94). This is a special map projection zone, based on Transverse Mercator Grid and is based on the GDA94 Datum. The GDA94 specifications are:

- Datum: Geocentric Datum of Australia 1994 (GDA94)
- Geographical coordinate set: Geocentric Datum of Australia 1994 (GDA94)
- Grid coordinates: (UTM, using the GRS80 ellipsoid) Map Grid of Australia 1994 (MGA94)
- Reference Frame: ITRF92 (International Terrestrial Reference Frame 1992)
- Epoch: 1994.0
- Ellipsoid: GRS80
- Semi-major axis (a): 6,378,137.0 meters
- Inverse flattening (1/f): 298.257222101

A known projection file in a standard mapping coordinate system may be supplied as an alternative to PCG94 after approval from PAPL Spatial Data team. This is to ensure compatibility with Perth Airports existing spatial data.

13. Metadata Requirements

PAPL requires that a metadata form is completed to accompany each of the individual datasets that is provided.

The metadata form is explained in table below.

DATASET DESCRIPTION	
Title	<i>Title of the dataset</i>
Data Created	<i>Date on which the dataset was created</i>
Date Last Updated	<i>Date on which the dataset was last updated</i>
Abstract	<i>A brief narrative summary about the content of the dataset</i>
Point of contact 1	<i>Person and his/her details who is supplying the data</i>
Point of Contact 2	<i>Person details who is receiving the data at Perth Airport</i>
Lineage	<i>Describe how the dataset was created, the sources, accuracy and processes that were used</i>
Datum/Coordinate System	<i>Name of the datum and coordinate system, if the data includes geographic or projected coordinates</i>
Restrictions	<i>Any restrictions on access to or use of the dataset</i>

14. Delivery Checklist

Each deliverable spatial data should minimally adhere to the following checklist:

Data	Yes	Does Not Apply	Mandatory Comments
Is each vector file (including CAD) in PCG94 coordinate system?	<input type="checkbox"/>	<input type="checkbox"/>	
Is each raster file in PCG94 coordinate system?	<input type="checkbox"/>	<input type="checkbox"/>	
Is each data file in a PAPL acceptable format as specified in this document?	<input type="checkbox"/>	<input type="checkbox"/>	
Does each data file have a fully compliant metadata form?	<input type="checkbox"/>	<input type="checkbox"/>	
Are data files following the suggested file name structure?	<input type="checkbox"/>	<input type="checkbox"/>	
Are CAD layer names organised as suggested in this standard document?	<input type="checkbox"/>	<input type="checkbox"/>	
Where ArcGIS is used, are layer files, Esri map/project packages included in the delivery?	<input type="checkbox"/>	<input type="checkbox"/>	

Authority Table

Authorised by	Robert Mikhail (Head of Perth's New Runway & Infrastructure)
Document Owner	Husen Kang (Spatial Data & Systems Coordinator)

Revision Index

Version number	Date	Revised or reviewed by (Position title)	Revisions approved by (Position title)	Reasons and details of changes
01	21/12/2020	H Kang	R Mikhail	Draft release for team feedback
02	22/01/2021	H Kang	R Mikhail	Updated as per team feedback
03	17/03/2021	H Kang	R Mikhail	Added as-built survey requirement and CAD layer naming standards
04	16/04/2021	H Kang	R Mikhail	Updated environmental data requirement, added as-built definition and updated CAD layer naming standards