SURVEY & CONSTRUCTION DRAWING GUIDELINES

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1. SCOPE

1.1 Purpose

The purpose of this document is to outline the survey and drafting requirements for associated works for the City of Karratha.

Surveying involves the measurement and mapping of existing land and built features to enable accurate new designs and construction activities.

The scope of this document includes feature, topographical and underground utility surveys.

1.2 Applicable Standards

The installation, materials and workmanship shall comply with all relevant current Australian Standards, Codes and Regulations and all reference codes and Standards listed in the prefaces to those standards and codes.

If a Standard other than an Australian Standard is specified, the contractor shall allow for complying with the provisions of the specified standard. The standard applying shall be the latest edition at the time of commencement of the contract.

Document	Title
AS 1100 Suite	Drawing Practice
ISO 216	Writing paper and certain classes of printed matter - Trimmed sizes A and B series, and indication of machine direction
Landgate CEDMI	Calibration of Electronic Distance Measurement Instruments.
Landgate GNSS TN	Global Navigation Satellite System Test Network
Landgate CBS	Calibration of barcoded staves
MRWA 67-08-43	Main Roads Western Australia – Digital Ground Survey
MRWA 67-08-44	Main Roads Western Australia – Mapping Standard
MRWA 67-08-121	Main Roads Western Australia – Underground Utilities Survey Standard
MRWA CSG	Main Roads Western Australia – Construction Surveying Guideline
WA ACHA 2021	Western Australia Aboriginal Cultural Heritage Act 2021

1.3 Acronyms

Acronym	Full Form
AHD	Australian Height Datum
CASA	Civil Aviation Safety Authority
GDA94/2020	Geocentric Datum of Australia 1994/2020 – a 3D co-ordinate system using latitude, longitude and ellipsoidal height in Australia
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
Grid Zone 50	The Universal Transverse Mercator (UTM) zone that the City of Karratha falls within (114°E and 120°E longitude range).
MGA94/2020	Map Grid of Australia 2020 – a 3D co-ordinate system taking into account the curvature of the earth.
RPL	Remote Pilot's Licence
RTK GPS	Real-time Kinematic Global Positioning System

2. REQUIREMENTS FOR DIGITAL GROUND SURVEYS

Digital ground surveying and mapping shall comply with the requirements of this document and Main Roads WA (MRWA) specifications for Digital Ground Survey 67-08-43, 67-08-44, and 67-08-121.

2.1 Extents Of Survey

The required extent of the survey should be defined by the City of Karratha and understood by the surveyor(s). The required extents may be defined in various ways, including by coordinated electronic boundary string/polygon. Regardless of defined extents, the surveyor(s) must use judgment and discretion with respect to including features near or crossing the boundary of the extent.

2.2 Surveyor Qualifications

A Licensed Surveyor shall be engaged to complete works related to greenfield land measuring, defining land boundaries, and creating new subdivision plans. Licensed surveyors shall be registered with the Land Surveyors Licensing Board of Western Australia or Surveyors Board of Western Australia.

An engineering surveyor shall take measurements to the required accuracy for data, design, construction and infrastructure development.

Surveyors shall hold an appropriate tertiary qualification in surveying.

2.3 General Feature Survey

General feature surveys gather geospatial data to represent the existing topography and infrastructure.

Feature survey data can be gathered using a combination of a Total Station, Global Navigation Satellite System (GNSS) such as a Global Positioning System (GPS), and a Digital Level.

The site shall be surveyed in accordance with the requirements from Table 1:

Table 1: Survey Requirements

Survey Specification	Value
Geocentric Datum	GDA94/2020
Map Grid	MGA94/2020
Grid Zone	50
Height Datum	AHD
Maximum point spacing	20m

The following items in Table 2 shall be surveyed where relevant:

Table 2: Features to be surveyed

Land features	Existing ground levels
	Trees – Location, base diameter and extent of branches
Built features & Street furniture	Roads
	Centrelines
	Kerbs – Top of Kerb (TOK)
	Signs – Location and diameter of pole
	Light Poles – Location and Diameter
	Manholes
	Footpaths
	Drains
	Culverts – Inverted Levels (ILs) & Top of Concrete (TOC)
Properties and Lots	Lot boundary locations
	Lot dimensions
	Details of adjoining properties
	Building footprints
	Finished Floor Levels (FFL)
	Ground levels along the common boundary
General	Any change of direction or grade

A survey control network shall be used that consists of a collection of fixed points with known positions and elevations that serve as the foundation for accurate positioning and measurements in surveying projects. For new subdivision development, Permanent Survey Marks are to be placed to provide good coverage over the extent of the site.

The technology used for feature surveys shall be calibrated in accordance with the requirements of Table 3.

Table 3: Feature Survey – Calibration Requirements

Technology	Calibration Requirements Document
Total Station	Landgate – Calibration of Electronic Distance Measurement Instruments
Global Positioning System (GPS)	Landgate – GNSS Test Network
Digital Level	Landgate – Calibration of barcoded staves

2.4 Digital Photogrammetric Mapping (DPM) – Aerial Or Satellite Photography

Digital Mapping created from aerial photography or satellite imagery can be used to capture new, undisturbed areas.

Mapping is ideal for waterway and drainage analysis surveys, to aid in route analysis for planning purposes, and for creating maps for preliminary and final road design.

Digital Mapping captured for the City of Karratha shall comply with MRWA 67-08-44. Mapping accuracy shall be Accuracy Class A in accordance with Table 6 below.

Any person capturing aerial photography must possess a Remote Pilot's Licence (RPL) administered and registered with the Civil Aviation Safety Authority (CASA). Drones and remote aircraft are to be operated under the guidelines provided by CASA.

2.5 Mobile Laser Scanning And Photogrammetry

3D laser scanning can capture 3D spaces in the form of "point clouds". This technology shall be utilised where appropriate to survey existing built features such as kerbs, drainage piping or for any tie-in points for new infrastructure. 3D scans shall be tied into the grids and datums stated in Table 1.

3D scanners shall be calibrated in accordance with the manufacturer's national quality standard, i.e., DIN55350-18 or equivalent.

2.6 Underground Utility Surveys (UUS)

Pickups of underground services must be checked against documented Before You Dig Australia plans for all relevant stakeholders and must comply with MRWA 67-08-121.

The City of Karratha shall nominate to the Surveyor the level of accuracy required (refer to Table 4) based on project requirements.

Table 4: Underground Utilities Survey Accuracy Classes

Underground Utilities Survey (UUS) Accuracy Class	Description of UUS Accuracy class
UUS A	Construction Quality
UUS B	Design Quality
UUS C	Planning Quality
UUS D	Data Quality

Existing underground services shall be identified using electromagnetic locators (wanding), ground penetrating radar, or other suitable technologies. Non-metallic piping shall use pipe and cable locators.

2.7 Construction Compliance Surveys

Compliance surveys are to be undertaken by contractors using the above technologies. Works shall comply with the tolerances specified for the project, including MRWA Construction Surveying Guideline (CSG). Compliance surveys are required for all constructed road pavement works at each pavement layer (if road construction is included in the works).

The As-constructed infrastructure shall be verified against the Issued for Construction drawings.

As agreed, upon with the City of Karratha, a sample of key critical dimensions shall be taken by the Construction Surveyor.

The acceptance criteria are as per Table 5. Refer to the individual specifications for further.

Table 5: Construction Tolerances – to be verified by surveyor

Infrastructure Type	Construction Tolerances (mm)	Further References
General Earthworks	Clearing and Grubbing: +/-500 Earthworks – overall level: +50/0 Earthworks – top and toe of cut and fill batters: +/- 100 Earthworks – drainage basins: 0/-100 Final finish level: +/- 25 Flatness – maximum deviation measured with a 3m straightedge: +/-15mm Top soiling minimum thickness: +50/-20 Batter/embankment slope toe: +/- 30 Fill batter – horizontal location of top of batter/shoulder: +/-300 Foundation earthworks width: +300/0 Foundation centreline / set-out lines: +/- 50 Drain/levee – deviation from design line: +/-50 Drain/levee: drain base depth: +/-50	CKS-900 Subdivision Design Guidelines
Roads	Subgrade Level: +10/-30 Subgrade Width: +200/0 Subbase Thickness +15/0 Subbase Level: +10/-20 Subbase Width: +200/0 Base Course Thickness: +10/0 Base Course Level: +5/-10 Base Course Width: +100/0 Bituminous Spray Seal Surface Level: +5/-10 Bituminous Spray Seal Width: +100/0 Asphalt Surface Thickness: +5/0 Asphalt Surface Level: +5/-10 Asphalt Surface Width: +100/0 Shape (departure from 3m edge): +5/-5	CKS-400 Road Design and Construction Guidelines
Pipes, box culverts	Horizontal Alignment: +/- 25mm	CKS-500 Stormwater

and lined channels	Grade: +10mm per m length / -20mm per m length Level: +/- 10mm	Drainage Design Guidelines
Concrete Drainage Structures	Horizontal Alignment: +/- 20mm Level: +/- 10mm	CKS-500 Stormwater Drainage Design Guidelines

2.8 Disturbance of Cultural Heritage Areas

It is an offence to harm or disturb Aboriginal cultural heritage sites under the Western Australia Aboriginal Heritage Act 1972 – Amended in 2023. Ground shall not be disturbed within an Aboriginal site without s18 consent; this constitutes a potential breach of the Act.

No disturbance to these sites without the required approvals. In the event that human skeletal material is uncovered, work will cease within 50m of the material and the location of the material will be reported to the Police.

In the event that artefacts or material of Aboriginal origin is discovered, work must cease within 50m of the material and a qualified Archaeologist will investigate the item(s) and take appropriate actions.

3. SURVEY ACCURACY

3.1 Required Feature Survey Accuracy

Features are classified into Feature Classes in MRWA 67-08-43 Clause 24, ranked in descending order of survey accuracy required. The accuracy of features captured shall be according to MRWA 67-08-43 Clause 6.1.

Table 6 summarises these requirements that have been included to demonstrate feature types, accuracy classes, and required survey accuracies.

Table 6: Accuracy requirements of surveyed features

Accuracy Class	Horizontal Accuracy	Vertical Accuracy	Feature
A	+/- 15 mm	+/- 10 mm	Survey control points
B	+/- 20 mm	+/- 15 mm	Road kerbs: Top of Kerb / Bottom of Kerb Road Barriers Structures: Abutment, Columns, Bridges, Piers
C	+/- 50 mm	+/- 20 mm	Drainage - Box culvert (both internal edges), Culvert (pipe), Headwall, Obvert - string - top inside of drainage structure/pipe, Drainage pipe, Top outside of pipe/culvert, Invert, Obvert Road and lane markings Structures: Bridge expansion joint, Brick paving, Fuel bowser, Column centre, Deck level, U/G tank filler, Floor level, Oil main marker, Edge of concrete – left & right, Ramp, Underpass, Verandah, Awning – left & right

			Manholes
D	+/- 150 mm	+/- 40 mm	Street furniture – Bike racks, park benches, handrails, bollards, bus shelters Fences & Gates
E	+/- 250 mm	+/- 50 mm	Natural features – trees, water level, creeks, swamps

RTK GNSS/GPS must NOT be used for the capture of class A or B features.

3.2 Survey Technology Accuracy

The accuracy of surveys is limited by the technology used; refer to Table 7 for the required accuracy based on the survey equipment used.

Table 7: Survey Accuracy required based on technology

Technology	Horizontal Accuracy	Vertical Accuracy
Real-time Kinematic Global Positioning System (RTK GPS)	+/- 20mm	+/- 30mm
Digital Photogrammetric Mapping (DPM)	+/- 100mm – Hard Surfaces +/- 200mm – Soft Surfaces	+/- 70mm – Hard Surfaces +/- 100mm – Soft Surfaces
Ground Penetrating Radar (GPR)	+/- 150mm for Utilities ≤ 1.2m depth +/- 300mm for Utilities > 1.2m depth	+/- 150mm for Utilities ≤ 1.2m depth +/- 300mm for Utilities > 1.2m depth
Light Detection and Ranging (LIDAR)	+/-3mm @ 10m range	+/-3mm @ 10m range

4. DRAWINGS

4.1 General Requirements

Designers shall prepare comprehensive drawings detailing all structures and services installed within the scope of work. Drawings shall show relevant features to the project, including finished ground levels, road levels, road boundaries, approved street names, lot boundaries, lot numbers, services, and any building footprints and finished floor levels. The location of survey pickups shall be shown on the drawings – e.g. edges and centrelines of existing roads. Drawings shall show the exact depth and location (±50mm) of all in-ground services. Such services shall be dimensioned off actual building lines or surveyor's datum.

All CAD drafting shall be to AS 1100 unless otherwise specified. Confirm exact requirements with the Superintendent in each case prior to submission.

The drawings shall be accompanied by a letter certifying the accuracy of the drawings on company letterhead and signed by a senior company representative.

The following CAD Drawing Standards are to be adhered to by third parties when submitting electronic drawings for the purposes of Development Application, Design, and As Constructed submission to the Principal. Any variation to these CAD Standards must be approved in advance of submittal by the Principal's Representative.

4.2 Drawing Review Process

The drawing naming convention should be as follows [Project Number]-[Drawing Number In Sequence]-[Revision]. An example of this is SP024-001-A.

Drawings shall be issued to the City of Karratha as Issued for Review (IFR), with a *Preliminary / Not for Construction* stamp. The preliminary design shall be suitably engineered, i.e. with structural and drainage elements suitably sized by a qualified and experienced engineer.

The City of Karratha shall markup drawings based on a stakeholder review and return them to the designer for digitally updating.

Upon completion of redline updates, drawings shall be revised to Issued for Construction (IFC).

Contractors involved in construction works shall redline any deviations from the construction drawings during the construction process, using site surveys and site measurements. The redlines shall be provided to the City of Karratha, who shall re-engage the designer/developer for updating the drawings As-Constructed.

Table 4: Drawing Versions

Revision Number	Drawing Stage
Alphabetical order (i.e., “A”, “B”, etc.)	Issued for Review (IFR)
Numeric (i.e., “0”)	Issued for Tender (IFT)
Numeric (i.e., “1”)	Issued for Construction (IFC)
Numeric (i.e., “2”)	As Constructed

If changes are required to drawings, the next alphabet/numeric Revision shall be re-transmitted to the City of Karratha.

4.3 Electronic File Format

All drawings shall be submitted in electronic AutoCAD, DWG, DXF format and PDF export.

4.4 Layers

- All points are to be logically named and allocated to appropriately named layers.
- No points are to be duplicated.
- All unused layers are to be purged.
- No frozen layers are to remain.

4.5 Title Block

If a City of Karratha Standard Title Block has been supplied and its use is requested, all drawings shall utilise the supplied Title Block without alterations beyond the completion of Drawing Details.

All fields of the Title Block in each drawing shall be completed as appropriate.

All ‘As Constructed’ drawings shall incorporate the Contractor's name within the title block.

A statement shall be provided on each drawing to read: ‘As Constructed by (company name and telephone number) and the name of the senior representative of the company responsible for the engineering responsibility of the drawings.

4.6 External References

- External References are to be bound within the required drawings.
- Drawings that contain images must be submitted as Autodesk *e-Transmit* files.

- Drawings that contain entities that are referenced from separate drawings must have these referenced elements bound to the drawing and have the external reference removed.

4.7 Sheet Sizes

- Accepted sheet size is A1 and shall be drawn on the A1.dwg file provided.
- Drawing extents shall match the sheet size as defined by ISO 216.

4.8 Linetypes And Linewidths

- Linetypes shall be set as a layer attribute and not to individual entities.
- Lineweights must be set as follows:
    - If using a Colour-Dependant Plot Style (CTB), all Lineweights will be determined by the colour attributed to the layer attribute of an entity and not set for the entity separately.
    - If using a Name-Dependant Plot Style (STB), all Lineweights will be determined by the layer attributed to an entity and not set for the entity separately.

4.9 Text Fonts And Hatch Styles

- All Text Fonts Hatch Styles used in a drawing will be standard AutoCAD issue.

Standard Number:	**CKS-910**
Previous Standard/Number:	**N/A**
Last Reviewed:	**January 2025**
Next Reviewed:	**January 2026**
Responsible Officer:	**Principal Engineer Coordinator**