

# Specialised Data Specifications

## Section 9 Aerial Photography

Not GEMS Geo-enabled	
GEMS Geo-enablement Planned	✓
Content GEMS Geo-enabled	

## **9 AERIAL PHOTOGRAPHY**

### **9.1 Scope of Specification**

- 9.1.1 This specification applies to the capture and post processing of aerial imagery over Defence Properties by E&IG Contractors using cameras and digital sensors mounted on aircraft.
- 9.1.2 The focus of these specifications is on the delivery of final products that meet E&IG's requirement for current and future use in the most cost-effective manner. Within the foreseeable future, Aerial Photography Acquisition Programs are likely to involve one of a finite number of digital camera/sensor technologies. For this reason, the imagery acquisition hardware/software technologies are not specified here. Instead, it is the responsibility of the contractor to meet the Deliverable Specifications using the most appropriate technology.

### **9.2 Deliverables**

- 9.2.1 The primary deliverable from aerial photography is digital imagery which should be supplied in TIFF and compressed ECW format. In the case of vertical photography, the imagery must be ortho-rectified and other secondary deliverables may also be required (see Section 3.3).

### **9.3 Acquisition Requirements**

#### **9.3.1 Platform**

- 9.3.1.1 Aircraft will be required to operate at altitudes from 1,200 feet to 25,000 feet above ground level and have a suitable altitude range for the project. In exceptional circumstances it may be required to fly at higher altitudes.
- 9.3.1.2 The Contractor will only deploy aircraft that are maintained in accordance with manufacturers' and statutory requirements and have current airworthiness certification. E&IG will also require written acknowledgement from the Contractor that all aircraft operations and clearances will be the responsibility of the Contractor and that they will be undertaken in accordance with Australian Air Safety Regulations.

#### **9.3.2 Flight Planning**

- 9.3.2.1 It will be the responsibility of the Contractor to plan the photographic sortie to meet the requirements of the project and the specifications outlined in this document. This includes managing situations such as obtaining permission to enter property to survey ground control points, or to place a GPS ground station.
- 9.3.2.2 Approval to acquire imagery over Defence installations (especially Airfields) shall be gained prior to any imagery being flown. The contact details for the respective approval authorities shall be provided to the contractor.

- 9.3.2.3 The contractor shall build a suitable lead time into the flying program to allow for the approvals.

### 9.3.3 Special Acquisition Requirements

- 9.3.3.1 When the photography is required for oblique or pictorial purposes only, optimum image quality will be sought. When the photography is required for ortho-rectification the imagery should be sourced using a calibrated metric camera/sensor system.

### 9.3.4 Camera

- 9.3.4.1 Vertical photography will be exposed using a large format metric camera or sensor. Details of any proposed metric camera to be used for the project must be submitted to E&IG for approval. For vertical photography the Contractor will provide a current calibration certificate from the manufacturer or an approved standardising laboratory for any sensor lens that will be used.
- 9.3.4.2 Oblique photography may be exposed with smaller format, side mounted cameras where appropriate and acceptable to E&IG. Specific specifications for this type of camera may be contained in the project brief and are not contained in this document.

### 9.3.5 Image Resolution

- 9.3.5.1 For vertical photography the image resolution (ground sample distance or GSD) and the area to be covered will be defined in the project brief. The Contractor will be required to demonstrate that the defined resolution is achievable.

### 9.3.6 Stereo Imagery

- 9.3.6.1 All vertical aerial photography will be acquired as overlapping (stereo) frames or swaths.
- 9.3.6.2 For perspective centre cameras the required forward overlap between consecutive photographs in each flight strip will be 60% unless otherwise specified. The deviation range in forward overlap will not exceed +/- 5%.
- 9.3.6.3 The minimum lateral overlap shall be 25% unless otherwise specified. The deviation range in lateral overlap will not exceed +/- 5%.
- 9.3.6.4 For push broom sensors the forward, nadir and back view angles will be required. The minimum lateral overlap shall be 30% unless otherwise specified.

### 9.3.7 Camera Attitude

- 9.3.7.1 Photography will not be undertaken when atmospheric conditions are likely to produce excessive tilts in the aerial photographs or deviation from flight paths.

9.3.7.2 Compensation is to be made for crabbing and drift by rotating the camera about the vertical axis such that the lateral edges of each frame are parallel to and not displaced laterally from the intended flight path by more than 5% of the specified side overlap.

### 9.3.8 Atmospheric Conditions

9.3.8.1 No cloud or cloud shadow should obscure detail on any area being photographed. However, if the Contractor considers that conditions on the day of the flight will not improve once on site, contact will be made with E&IG to decide whether the photography is to be flown.

9.3.8.2 The photography will not be attempted when smoke, haze or any other conditions would impair the quality of the photographic image. However, if the Contractor believes conditions will not improve once on site it is critical that contact must be made with E&IG to decide the future of the project. Failure to consult with E&IG before proceeding with the photography under marginal conditions could lead to rejection of the materials captured.

### 9.3.9 Solar Altitude

9.3.9.1 Photography over open terrain with low relief will not be attempted when the solar altitude is less than 25 degrees, or less than 35 degrees over steep or timbered country.

9.3.9.2 Where water surfaces are extensive over the area being photographed, the solar altitude will be such that the sun's reflection does not appear in the photographs.

9.3.9.3 If a project cannot be completed in one sortie or on the same day every effort must be made to complete the outstanding runs at the first weather window of opportunity. If photography is being undertaken to complete a project or to re-fly rejected frames taken some days, (or weeks) earlier, careful consideration must be given to the time of day the adjacent runs were captured. The next additional new run or re-fly must be undertaken as close to the same time of day as possible.

### 9.3.10 Tidal Conditions

9.3.10.1 For projects that include the capture of aerial photography over large coastal water bodies every effort must be made to complete the intertidal zone in one sortie. If it cannot be completed in one sortie then any appending runs must be flown at a similar tide height and sun angle if logistically possible. If only one parameter is possible the similar tide height is most critical.

### 9.3.11 Coverage

9.3.11.1 Each run will extend outside the specified area by at least one stereoscopic pair, i.e. two principal points will fall outside of the specified area at the beginning and end of each run.

- 9.3.11.2 The first and last runs will have at least 15% of each photograph extending laterally outside of the boundaries of the specified area.

#### 9.3.12 Airborne DGPS Data

- 9.3.12.1 The recording of airborne Differential Global Positioning System (DGPS) data for photo centres and photo metadata is part of the aerial photography acquisition requirements. The contractor is responsible for ensuring that this data is recorded for all vertical aerial photography.
- 9.3.12.2 The contractor is required to supply the photo metadata to E&IG within 7 days of the acquisition of the photography

#### 9.3.13 Image Quality and Colour Balance

- 9.3.13.1 The contractor will be responsible for the supply of raw metric digital imagery to the same quality of Colour Balance and Consistency as the Benchmark imagery samples (where supplied by E&IG). E&IG understands that due to various climatic and seasonal conditions there will be some variations to the Benchmark Colour imagery. In this case sample images from the new photography, representative of the area, should be supplied to E&IG for acceptance.
- 9.3.13.2 E&IG may undertake random checks of the digital imagery supplied for colour balance and extraneous materials appearing on the scans plus other image degradation (such as steps or banding of scan lines). Results of this assessment will be made known to the contractor and if considered excessive remedial action by the contractor will be required.

### 9.4 Orthophoto Specifications

- 9.4.1 The focus of these orthophoto specifications is to ensure the final deliverables meet E&IG's requirements for current and future use in the most cost-effective manner. For this reason, the actual imagery acquisition hardware/software technologies and production methodology to be used are deliberately not specified. In the case of ortho-rectified imagery E&IG will determine the image resolution required for their project requirements. It will be the responsibility of the contractor to ensure that the specifications applicable to the specified resolution are met.

### 9.5 Orthophoto Deliverables

- 9.5.1 Deliverables will often be limited to the supply of orthophoto (ortho-rectified image) tiles (ie the primary deliverable). In some cases, E&IG may also require the supply of secondary deliverables. This is particularly the case when the raw stereo imagery and associated data sets are required for photogrammetric mapping.
- 9.5.2 Primary Deliverables
- The primary deliverables are 3 band (RGB) orthophoto tiles.
  - In some instances there may be a requirement for 4 band (RGB & NIR) imagery.
  - A metadata record for each data file.

9.5.3 Secondary Deliverables

- Raw (un-rectified) imagery as frames or swathes
- Ground control identification sketches and their surveyed coordinates (in terms of MGA/AHD)
- Aero-triangulation report/s
- Image support files (interior and exterior orientation data for each frame or image swathe)
- Digital elevation model (DEM)
- Key diagram in ESRI shapefile format
- DGPS camera centre air station coordinates (in term of MGA/AHD)

9.6 Deliverable Specification

9.6.1 Table 9-1 sets out the typical uses for orthophotos at various resolutions and lists their associated accuracy and tiling requirements. E&IG brief will indicate the appropriate resolution for each defined area. Table 9-2 defines the orthophoto technical specifications.

**Table 9-1 Orthophoto Options for Resolution and Accuracy**

Description/Use	Orthophoto Resolution (GSD)	Spatial Accuracy (RMSE)	Orthophoto tile size
Very low level photography / Very detailed engineering and infrastructure design.	5cm	15cm	500m x 500m
Standard resolution for built environment / Facilities management	10cm	30cm	1km x 1km
Standard resolution for built environment / Facilities management	15cm	45cm	1km x 1km
Standard resolution for rural environment / Range management	20cm	60cm	2km x 2km
Standard resolution for rural environment / Range management	25cm	75cm	2km x 2km
Standard resolution for rural environment / Large range management	30cm	90cm	2km x 2km
Very high level photography / Regional area coverage	40cm	120cm	5km x 5km
Very high level photography / Regional area coverage	50cm	150cm	5km x 5km

**Table 9-2 Orthophoto Technical Specifications**

General	Description
Coverage	E&IG will provide a full description to define the extent of the each area

Horizontal Datum	All survey values/airborne DGPS data will be supplied in terms of GDA94 and be directly tied in to the local published survey control network.
Vertical Datum	All elevation data must be supplied as heights above/below Australian Height Datum (AHD) and be directly tied in to the local published survey control network. Ellipsoid heights must be reduced to AHD heights using AUSGeoid09 model.
Map Projection	All ortho-rectified imagery must be supplied in terms of the Map Grid of Australia (MGA) coordinate system.
Data Tiling	All Primary data sets should be supplied in predefined tiles specified in Table 9-1 (tile layout to be based on the MGA coordinate system).
Special Considerations	E&IG will provide details of any special considerations applicable to the project. For example: All coastal data should be acquired at low tide (+/- 2hrs) on any day.
Digital Elevation Model	The digital elevation data used in the ortho-rectification process should be of sufficient accuracy to enable the resulting orthophoto to meet the accuracy specifications detailed in Section 3.1
File Format	24 bit GeoTIFF and compressed ECW

## 9.7 Quality Assurance Documentation

- 9.7.1 Prior to commencement of the aerial photography capture, a quality assurance plan shall be submitted to E&IG.
- 9.7.2 It is expected that the documentation will provide detailed information on systems to be used in the survey, operational information to be captured during the survey (e.g. mission date, time, flight altitude, forward and side overlap), maps of survey coverage and boundary overlaps, flight plans and any other pertinent survey information.

**Table 9-3 Orthophoto Quality Assurance Plan**

QA Deliverables	Description
Quality Assurance Plan	The Contractor shall prepare and submit a Quality Assurance Plan. The plan must address the organisation and management of the project, work procedures, environmental considerations, safety and risk control and test procedures. The Quality Assurance Plan must detail the procedures to be used to verify that the deliverables meet the required specification. Approval to commence the aerial survey is contingent on E&IG's acceptance of the Quality Assurance Plan.
Pre-Survey Quality Assurance Deliverables	Proposed aerial photography flight plan

## 9.8 Specific Metadata Requirements

- 9.8.1 A number of additional metadata requirements shall be recorded for all aerial photography. These requirements are listed in Table 9-4 with the name of the metadata element in which the information shall be recorded. These elements should be recorded in the metadata 'Lineage' element.

**Table 9-4 Aerial Photography Specific Metadata Requirements**

Metadata Element
Acquisition Start Date
Acquisition End Date
Sensor type
Focal Length
Flying Height (AGL)
INS/IMU Used
Number of Runs
Number of Frames/Swathes
Output Pixel Size
Description of Aerotriangulation Process Used and Residual Results
Description of Ortho-rectification Process Used
Spatial Accuracy – Horizontal
Spatial Accuracy – Vertical
Limitations of the Data