

Specialised Data Specifications

Section 10 Satellite Imagery

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

10 SATELLITE IMAGERY

10.1 Scope of Specification

- 10.1.1 Satellite imagery is collected from sensors mounted on orbiting satellites. The data collected by the satellites is transmitted to ground stations for processing. Satellite images often visually resemble an aerial photograph, but the image stores the amount of electro-magnetic radiation reflected and/or emitted by the Earth's surface. This information is used to perform data analysis.
- 10.1.2 E&IG uses satellite imagery in a wide range of analysis including: mapping and monitoring vegetation; estate planning; erosion or disturbance mapping; and change detection.
- 10.1.3 This specification provides guidance to E&IG staff on the acquisition of satellite imagery.
- 10.1.4 This specification will be used when a Major or Minor Work or Activity Request has been issued to undertake the acquisition of satellite imagery.

10.2 Background Information

- 10.2.1 The most commonly used commercially available satellite imagery for land management and monitoring include:
- ALOS
 - Aster
 - Digital Globe
 - Earth Resource Observation Satellites (EROS)
 - EO-1
 - GeoEye
 - IKONOS
 - Landsat TM and MSS (pre 1990)
 - MODIS
 - NOAA
 - Rapid Eye
 - RESOURCESAT-1 (IRS-P6)
 - SPOT
- 10.2.2 The selection of an imagery product is dependent on the requirements of the Statement of Work (SOW). A variety of these products are used within E&IG.
- 10.2.3 Spectral Resolution
- 10.2.3.1 Spectral resolution relates to the number and width of spectral wavelength bands collected by satellite sensors. Different bands are useful for distinguishing different land cover types. Spectral resolution requirements shall be carefully considered when designing a satellite image analysis / remote sensing project.

10.2.3.2 The following satellite imagery is available:

- **Multispectral Images** – are suitable for image analysis and remote sensing data analysis. Multispectral imagery can include data bands in the visible, near infrared and thermal infrared ranges with the pixel values representing a reflectance measure within each wavelength band of the sensor.
- **Three Band or RGB Images** – are enhanced satellite images that have been contrast stretched, colour balanced and/or mosaiced so that they are suitable for use as a background image in CAD or GIS software. This data is suitable for image feature classification to extract extents of the manmade features such as buildings, roads, dams or even general extent of vegetation cover (although it is not recommended for land cover/land use classifications). This type of imagery is not recommended for remote sensing image analysis as the pixel values are modified and do not represent reflectance measures.
- **Single Band Images (Panchromatic)** – These images often have high spatial resolution and can be used for image feature extraction. These images have limited applications on their own for remote sensing spectral analysis and should not be used for such purposes.
- **Pan-Sharpened Images** – a merged product derived from both panchromatic and multispectral imagery, often from the same sensor. This produces high resolution colour (natural and/or false colour) images similar to the above and can be used for image feature extraction. These data should not be used as the basis of image analysis processing as the pixel values are modified and do not represent reflectance measures.

10.2.4 Spatial Resolution

10.2.4.1 Spatial resolution is the area on the Earth's surface that is represented by an imagery pixel; spatial resolution affects the scale of mapping that can be obtained from imagery. Satellite imagery is available in a range of spatial resolutions, from 0.6m panchromatic imagery from Digital Globe to 30m multispectral imagery from Landsat TM.

Example: Satellite imagery with a resolution of 25m is suitable for mapping at 1:50,000 or smaller.

10.3 Deliverables

10.3.1 The digital imagery shall be delivered as specified in the Scope of Works

10.3.2 A metadata record shall be produced for each data file.

10.4 Deliverable Specification

The specification details any additional requirements in addition to those detailed in the **Section 2** Data Specification.

10.4.1 Data Format

10.4.1.1 Data shall be provided in Encapsulated Compressed Wavelet (.ecw) format with an associated header file (.ers) OR in georeferenced tiff format with associated world file.

10.4.2 File Names

10.4.2.1 To provide consistency and facilitate data discovery the following filename format shall be adhered to:

Format: [Short Property Name]_[Other relevant information]_[Satellite Imagery Sensor]_[Data of Capture in YYYYMMDD format]

Example: GardenIsland_NorthernSection_LandsatTM_20070604

CultanaTA_DigitalGlobe_20070430

10.4.3 Specific Metadata Requirements

10.4.3.1 A number of additional metadata requirements shall be recorded for all satellite imagery. These requirements are listed in **Table 10-1** with the name of the metadata element in which the information shall be recorded.

Table 10-1 Satellite Imagery Specific Metadata Requirements

Requirements	E&IG Metadata Element
Number of rows in imagery	<i>Data Quality Information > Lineage</i>
Number of columns in imagery	<i>Data Quality Information > Lineage</i>
Cell (pixel) size: these must be square	<i>Resource Identification > Resolution > Sample Distance</i>
Sensor- platform, including version number (eg. SPOT5, LANDSAT TM7)	<i>Data Quality Information > Lineage</i>
Date of capture	<i>Extent Information > Temporal Extent</i>
Time of capture	<i>Extent Information > Temporal Extent</i>
NADIR angle: angle of sensor	<i>Data Quality Information > Lineage</i>
Sun angle: sun angle at time of image capture	<i>Data Quality Information > Lineage</i>
Spectral bands: number and wavelengths	<i>Data Quality Information > Lineage</i>
Sensor resolution: may differ from image cell size due to resampling	<i>Data Quality Information > Lineage</i>
Image processing: detailed description of image processing undertaken including details on georeferencing, orthorectification (RMS errors, source data); resampling methods	<i>Data Quality Information > Lineage</i>

10.5 Specific Data Requirements

10.5.1 NADIR Angle

- 10.5.1.1 NADIR angles shall be minimised and should be between 0 and 15 degrees. The NADIR angle is the pointing angle of the sensor at the time of capture relative to the area of land being sensed. A number of the satellites are programmable and can scan the earth at varying angles to increase the frequency of image capture. However, this can result in high NADIR angles and significant skewing of the imagery which can be detrimental to the product quality when mapping land cover.

10.5.2 Cloud

- 10.5.2.1 Cloud cover shall be minimised and where possible products with 0%-10% cloud cover should be obtained. Satellite imagery is affected by cloud, haze and smoke (the exception being radar imagery) as well as the shadows produced, therefore minimising cloud present in the imagery is important. Cloudy or hazy conditions can affect the diffuse light penetration and reflectance (and hence the overall image quality) even if cloud or shadow is not present within the specific area of interest.

10.5.3 Sensor and Pre-Supply Processing Artefacts

- 10.5.3.1 Banding, and line or pixel drop outs relating to a mal-functioning sensor and / or satellite communication can affect usability of imagery. Images with

artefacts shall be rejected and must be resupplied with the capture of new or replacement imagery.

10.5.4 Georeferencing

10.5.4.1 Satellite imagery shall be orthorectified, particularly in areas of high relief. This shall be undertaken using the best available Digital Terrain Model (DTM) and ground control data. If this is not being undertaken by the satellite image provider then an 'ortho-ready' product type or unprocessed imagery should be specified. Satellite image providers pre-process imagery using standard models, however, the accuracies of these models and the nature of the terrain in the area of interest should be considered before selecting this option. Where orthorectification is specified a Route Mean Square (RMS) error of less than one pixel is required.

10.5.4.2 Georeferencing using ground control coordinate locations is an alternative to orthorectification. Georeferencing in this manner shall only be undertaken following consultation with the commissioning E&IG Project Manager and after an acceptable accuracy is agreed. A Route Mean Square (RMS) error of less than one pixel is preferred.

10.5.4.3 For change detection, all images shall be co-registered to within one pixel.

10.5.5 Image Compression

10.5.5.1 Owing to the large size of image files (including aerial photography); image compression is very useful for usability within CAD and GIS systems. Compressed imagery shall not be used for image analysis and shall not be used as an input to such processes. Where compressed imagery is requested or supplied, imagery should also be supplied in an uncompressed 'lossless' format.