

COMMONWEALTH OF KENTUCKY

Oblique Aerial Imagery Technical Specifications

*Prepared by: Kentucky Aerial Photography & Elevation Data Program Technical Subcommittee
Adopted during the April 20th, 2022 meeting of the GIAC*

I. Introduction

Oblique aerial imagery is recognized as a resource addition to high resolution, high accuracy, aerial orthoimagery assets (<https://www.iaao.org/>). In this context, the collection of oblique aerial imagery for the Commonwealth of Kentucky may be performed as needed by select state agencies or local units of government.

II. Project Areas and Sub-Areas

A. General

An oblique aerial imagery acquisition project area shall include the entirety of a given county or defined geographic region within the Commonwealth of Kentucky. The project area may be subdivided into two project sub-areas:

1. The “Base Resolution” project sub-area is defined as the project region(s) for which oblique aerial imagery acquisition will be carried out at the lowest spatial resolution (*see Section III. B. 1. a. below*).
2. The “Higher Resolution” project sub-area will be defined as project region(s) encompassing incorporated areas, developed areas or other administrative jurisdictions subscribing to the buy-up option for acquiring oblique aerial imagery at higher spatial resolution (*see Section III. B. 1. b. below*).

B. Buffering

Each project area (county or defined geographic region) shall cover the assigned area with a minimum 1,000 feet buffer on all sides.

C. Geographic Extent

Region extents shall be computed by projecting the geographic corners and side midpoints to the appropriate projection, then adding the buffer on each side of the resulting minimum bounding rectangle.

D. Project Area Coverage

All points within the project area must be fully covered by all camera orientations. A minimum of four views are required along the cardinal directions (i.e., N, E, S and W).

III. Oblique Aerial Imagery Production

The production of oblique aerial imagery to be acquired will be done in accordance with the following requirements, specifically:

A. Collection conditions

1. Oblique aerial imagery shall be acquired during leaf-off conditions.

2. Oblique aerial imagery shall be acquired during minimal shadow conditions. Imagery acquisition shall occur when the sun angle is greater than 30-degrees above the horizon.
3. Imagery shall be acquired only under conditions free from clouds and cloud shadows, smoke, haze, light streaks, snow, ice on water bodies, foliage, flooding, and excessive soil moisture.

B. Image resolutions:

1. Ground (spatial) resolution:

(http://www.asprs.org/a/society/committees/standards/Positional_Accuracy_Standards.pdf)

- i. The photography requirement for acquisitions will be specified as ground sampled distance (GSD) in the statement of work. The contractor is responsible for selecting a suitable focal length and flying height to achieve the required ground sampling distance and minimize the lean effect in built up areas to enable easy identification of ground features. Projects will be flown with customer specified GSD. The GSD shall be measured at the center point of each oblique image. GSD tolerance for image resolution is + or – 10%.
- ii. “Base Resolution” oblique aerial imagery must be captured at a resolution of .25 feet (3 inches) or better.
- iii. For defined “Higher Resolution” sub-areas, oblique aerial imagery must be captured at a resolution of .0833 feet (1 inch) or better.

2. Spectral resolution:

The sensor or camera shall capture light bands corresponding to natural color (red, green, and blue or RGB) but may optionally capture the near infrared (NIR) band.

3. Radiometric resolution:

See USGS Publication: <https://pubs.usgs.gov/tm/11/b5/pdf/tm11-B5.pdf>

C. Overlaps

The oblique aerial imagery must exceed 60% in forward overlap at all times. The side (lateral) overlap shall be not less than 30%. Image metadata must be reviewed quickly after image capture to ensure overlaps are within specification. Each orientation must have full stereoscopy throughout the capture area. Acquisitions not meeting this requirement must be re-flown.

D. Coordinate system:

All mapping products will be delivered in Kentucky Single Zone State Plane Coordinate System (SPCS) coordinates (parameters defined in FIPS 1600 or EPSG/SRID 3089, and units of U.S. Survey Feet), NAD83 geometric datum.

E. Horizontal Accuracy:

See ASPRS Publication:

https://www.asprs.org/a/society/committees/standards/Positional_Accuracy_Standards.pdf

The vendor shall provide a statement certifying recommended usage and the expected range of positional and dimensional accuracy, expressed in native units (feet) or percentage/ratio of results, pertaining to measurements derived from the delivered product.

F. Digital Elevation Data and Horizontal Accuracy:

The production of oblique imagery will utilize the Kentucky Aerial Photography and Elevation Data Program (KYAPED) digital elevation data, insofar as it reflects the current topography at time of oblique imagery acquisition.

G. Metadata:

1. Project-level, FGDC-compliant metadata, shall be provided in extensible markup language (.xml) format for each acquisition. Additionally, an accuracy statement certifying recommended usage and the expected range of positional and dimensional accuracy, expressed in native units (feet) or percentage/ratio of results, pertaining to measurements derived from the delivered product shall be included in the supplemental information section of the metadata.
2. The project-level metadata suitable for publication to the Kentucky GeoPortal (<http://kygissserver.ky.gov/geoportal/>) will be also delivered, based on an XML sample file provided by the Commonwealth Office of Technology, GIS Branch.

The following site contains information pertaining to the content and creation of the required metadata: <https://www.usgs.gov/products/data-and-tools/data-management/metadata-creation>

IV. Deliverables

A. Source Imagery:

1. Characterization Reports: A Product Characterization Report for the digital camera or the sensor used shall be included as a deliverable.
2. Camera Station Control:
 - i. Airborne GPS: Positional data and statistical summary report shall be submitted on portable media, in a non-proprietary format. A statistical report shall be produced and delivered, summarizing the results of the airborne GPS adjustment.
 - ii. IMU Data: If IMU exterior orientation data is part of the Technical Proposal, a sensor orientation data and a statistical summary report will be prepared and submitted on portable media, in a nonproprietary format. A statistical report summarizing the overall accuracy of the adjusted IMU data will also be submitted.
3. Flight Diagram: A Flight Diagram that illustrates the project area outline, the location of the flight lines and the approximate location of image centers, if relevant, shall be included as a deliverable. This diagram shall be provided as a feature class in a file geodatabase, suitable for loading into ArcGIS.
4. Photography and Supplemental Report(s): A Photography Supplemental Report of all

the imagery flown shall be produced for the project. The report shall show the flight line numbers and exposure station or strip numbers.

B. Processed Images:

1. Oblique Aerial Image Characteristics: Changes in color balance across the project, if they exist, shall be gradual. Abrupt tonal variations between images are not acceptable.
2. Oblique Aerial Imagery Format: Images shall be submitted in untiled, non-proprietary, ArcGIS readable, JPEG format (of the highest quality level).
3. Delivery Medium and Format: Oblique Aerial Imagery, in JPEG format (of the highest quality level), shall be submitted on portable media. All imagery, and the portable media it is delivered upon, will remain the property of the Commonwealth of Kentucky.

C. Oblique Aerial Imagery Viewer Application

A standalone and/or web-based application appropriate for viewing and interacting with oblique aerial imagery shall be provided. The application, at a minimum, must include the following capabilities.

1. Oblique View Button
2. Measure Length
3. Measure Area
4. Measure Height
5. Measure Slope
6. Insert Text button
7. Pan & Zoom
8. Coordinate Display
9. Export View
10. Zoom in & out
11. Change Camera Angle East, West, North, & South

V. Quality Assurance and Quality Control:

Shall be performed to ensure that all processes and procedures used, and metadata produced, meet all specifications cited as deliverables. Visual inspection of the data will be performed for the following:

- A. Atmospheric artifacts: Cloud cover, smoke, and haze shall be absent
- B. Tonal balance: Oblique aerial images shall be tonally balanced to produce a uniform contrast and tone across the entire acquisition area. Extreme tonal or color variation across shall be avoided. Changes in color balance across the project, if they exist, shall

be gradual. Abrupt tonal variations between images or inconsistencies in tone and density between individual and/or adjacent oblique aerial images are not acceptable.

- C. Clipping of ground features: Features appearing in the oblique imagery, such as building rooftops, water tanks, water towers, and radio towers, shall not be clipped at seamlines or at image file boundaries.
- D. Image quality: The image with the best contrast shall be used as a reference image when the oblique images are created. All other images shall have their brightness values adjusted to that of the reference image.
- E. Image artifacts: The delivered color oblique aerial images will not contain defects such as out-of-focus imagery, blurs, whorls, twists, color blemishes, dust or lint marks, or scratches. The images shall also be free from image blurs, smears, voids, image artifacts, “cold” or “hot” pixels, color distortion, color balance or tonal problems, or any other kind of “digital blemish” or data corruption. Specular reflections and other artifacts should be minimized, especially in developed areas; by patching the area using chips from adjacent overlapping imagery. Evidence of oversaturation or undersaturation as a result of image processing or histogram manipulation should be avoided.
- F. Image compression: JPEG compression quality setting of less than 95% shall not be applied without express written consent of the KyFromAbove Technical Advisory Subcommittee.
- G. Completeness: Data are to cover the specified geographic extent, with no omissions or corrupt data. The images delivered will contain neither background data nor NODATA pixels.
- H. Verify Metadata Adequacy: Verify that accompanying metadata is complete as defined by FGDC metadata standards - <https://www.fgdc.gov/metadata>

VI. References

Commonwealth of Kentucky Digital Orthophoto Production Technical Specifications.

https://kygeonet.ky.gov/kyfromabove/pdfs/Specs_OrthoPhoto_Production.pdf

International Association of Assessing Officers (IAAO). Guidance on International Mass Appraisal and Related Tax Policy. Approved January 2014.

https://www.iaao.org/media/Standards/International_Guidance/FD79B463326AEAC2BD590863C4DA7309/International_Guidance.pdf

American Society for Photogrammetry and Remote Sensing (ASPRS). Primary Data Acquisition Division. Oblique Aerial Imagery Committee. Standards for Describing and Quantifying Digital Aerial Oblique aerial imagery Products. Version 1.3. May 15, 2015 (Not published).

<https://www.asprs.org/pdad-division/pdad-oblique-aerial-imagery-committee.html>