![USGS logo](science for a changing world)

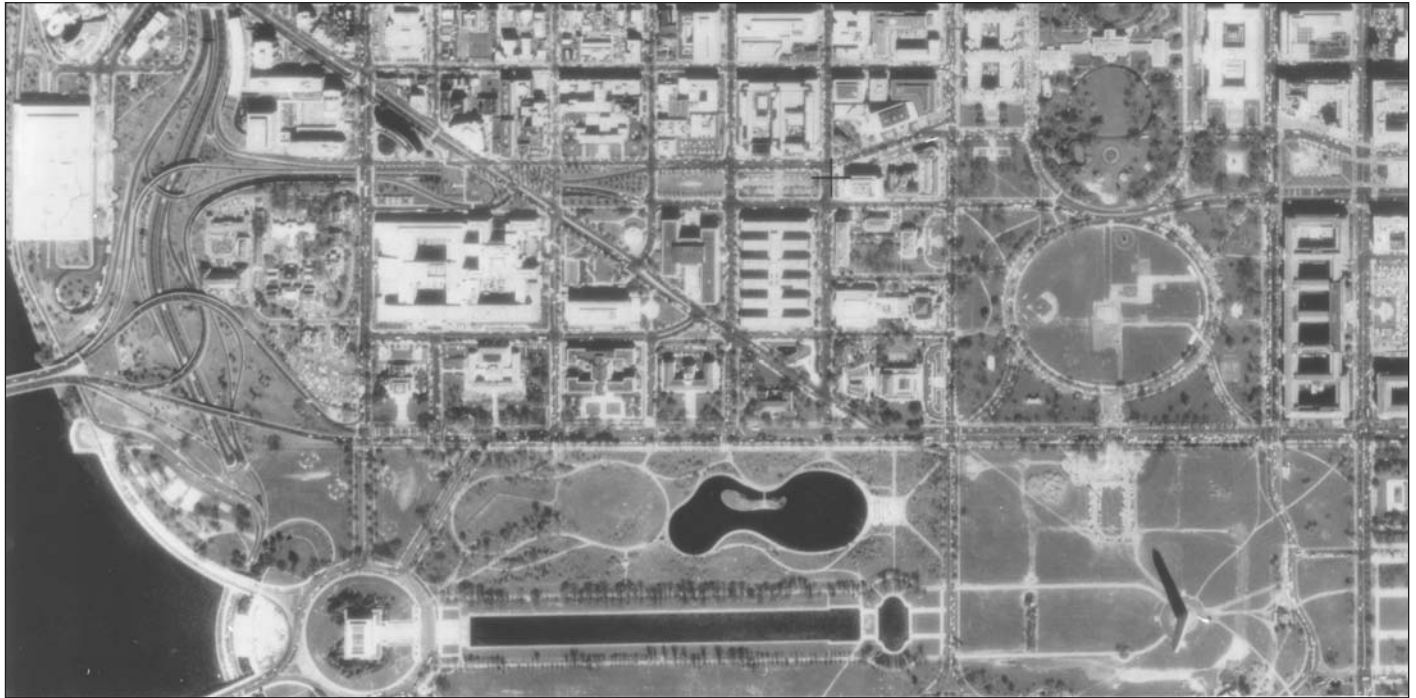# USGS GeoData Digital Orthophoto Quadrangles

Image from part of a digital orthophoto quadrangle of Washington, D.C.

A digital orthophoto quadrangle (DOQ) is a computer-generated image of an aerial photograph in which image displacement caused by terrain relief and camera tilts has been removed. It combines the image characteristics of a photograph with the geometric qualities of a map.

Characteristics of a USGS Digital Orthophoto Quadrangle

DOQs produced by the U.S. Geological Survey (USGS) are either gray-scale, natural color, or color-infrared (CIR) images with 1-meter ground resolution. They cover an area measuring 3.75-minutes longitude by 3.75-minutes latitude or 7.5-minutes longitude by 7.5-minutes latitude. Each DOQ has between 50 and 300 meters of overedge image beyond the latitude and longitude corner crosses embedded in the image. This overedge facilitates tonal matching and mosaicking adjacent images.

The standard DOQ is formatted with an ASCII keyword header followed by a series of 8-bit binary image lines. Color DOQs are 24-bit band-interleaved-by-pixel (BIP) images. The header contains a wide range of data for identifying, displaying, and georeferencing the image.

All DOQs are referenced to the North American Datum of 1983 (NAD 83) and cast on the Universal Transverse Mercator (UTM) projection. Primary (NAD 83) and secondary (NAD 27) datum coordinates for the upper left pixel are included in the header so that users can spatially reference other digital data to the DOQ.

The file size of a 3.75-minute gray-scale DOQ is 40-45 megabytes, and a 3.75-minute color or 7.5-minute gray-scale DOQ can be three times this size.

Producing a Digital Orthophoto Quadrangle

To produce a DOQ requires (1) a minimum of three ground positions that can be identified on the photograph to be rectified, (2) camera calibration parameters, such as the calibrated focal length and the coordinates of the camera fiducials, (3) a digital elevation model (DEM), and (4) a digital image produced by scanning an aerial photograph with a precise, high-resolution scanner.

The digital image is rectified to generate an orthophoto by processing require-ments 1 through 3 above for each image

picture element (pixel), using rigorous photogrammetric equations on a computer. The finished product is a spatially accurate image with planimetric features represented in their true geographic positions.

Accuracy Requirements

The accuracy and quality of USGS DOQs must meet National Map Accuracy Standards at 1:12,000 scale for 3.75-minute quarter quadrangles and at 1:24,000 scale for 7.5-minute quadrangles. Accuracy and quality depend on the following:

• photographs that meet National Aerial Photography Program standards, which are quarter-quadrangle centered. The photographs are exposed at a flying height of 20,000 feet above mean terrain;

• a DEM with the same area coverage as the DOQ and that is equal to or better than a level 1 USGS DEM having a root-mean-square error in elevation no greater than 7 meters;

• a highly accurate image-scanning process that uses a scanning aperture between 7.5 and 32 micrometers (μm). A 1:40,000-scale image scanned with a 25-μm aperture produces a ground sample distance of approximately 1 meter; and

• identifiable ground control positions with coordinates acquired from ground surveys or aerotriangulation.

Uses for Digital Orthophoto Quadrangles

A DOQ can be incorporated into any geographic information system (GIS) that can manipulate raster images. It can function as a cartographic base for displaying, generating, and modifying associated digital planimetric data. Other applications include vegetation and timber management, routing and habitat analysis, environmental impact assessments, emergency evacuation planning, flood analysis, soil erosion assessment, facility management, and ground-water and watershed analysis. The accuracy and extraordinary detail provided by the DOQ allow users to evaluate their data

for accuracy and completeness, make real-time modifications to their data, and even generate new files.

Distribution Media

DOQs are distributed in either native (standard) or GeoTIFF format on a variety of media, including 8-mm tape, CD-R, DVD, and FTP as uncompressed files. DOQs covering selected counties are also available packaged as individual, JPEG-compressed files on CD-ROM. Note that the county DOQ products contain DOQs built to the pre-1997 (old) standard and do not contain the keyword header.

Obtaining Digital Orthophoto Quadrangles

DOQ files are available from the USGS Sales Data Base and can be ordered online through Earth Explorer at earthexplorer.usgs.gov or by contacting any Earth Science Information Center (ESIC). DOQ coverage is not available for all areas in the United States.

For price and ordering information see the USGS GeoData Digital Orthophoto Quadrangles order form, available online at mac.usgs.gov/mac/isb/pubs/forms/doq.pdf.

Information

More information about DOQs can be found at mapping.usgs.gov/www/ndop.

For information on other USGS products and services, call 1-888-ASK-USGS, use the Ask.USGS fax service, which is available 24 hours a day at 703-648-4888, or visit the general interest publications Web site on mapping, geography, and related topics at mac.usgs.gov/mac/isb/pubs/pubslists/index.html.

For additional information, visit the ask.usgs.gov Web site or the USGS home page at www.usgs.gov.