APFO’s Historical Treasures:
How Aerial Imagery Can Track Agricultural Change

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The Aerial Photography Field Office is part of the U.S.D.A. Farm Service Agency.

It has one of the largest collections of historical aerial photography in the nation.
Nearly every county in the lower 48 states is represented by at least 3 years of aerial photography.
APFO’s History

• USDA was created May 15, 1862 as a non-cabinet level department
  – Became cabinet level in 1889
• Agricultural Adjustment Act of 1933
  – Created new programs to help farmers
• Aerial photo labs were created in 1937
  – Initially in Washington, D.C. and Salt Lake City.
  – Established to provide rectified aerial photography for accurate field measurements, in support of the newly created farm programs.
• Rectified Film Enlargements
  – 24” x 24” Photo Maps
  – Technicians drew field boundaries on photo enlargements; these hand drawn boundaries were predecessors to CLU (Common Land Units) boundaries used in GIS projects.
Field acreages were measured with a planimeter.
APFO Was Part of Interagency Aerial Photography Programs

- National High Altitude Program (NHAP); 1980 – 1989
  USGS coordinated interagency program
  48 continental states
  5 year cycle

  USGS coordinated interagency program
  48 continental states + Hawaii
  5 – 7 year cycle
Since 1977, APFO has been authorized to contract any USDA imagery project larger than 100 square miles.

U.S. Forest Service uses imagery:
- Forest planning
- Forest heath protection
- Watershed restoration
- Disturbance processes
- Habitat
- Recreation
- Transportation
- Research
- Fire

NRCS Employees Create Information: Empowered With Imagery, GIS, GPS, and Digital Cameras
Since 2003, APFO has administered the NAIP program, delivering digital aerial imagery to Farm Service Agency service centers and partners.

As the years go by, the imagery from this “new” program will soon become part of the “historical” collection.
Why is this collection important?  
How do people use historical imagery?

- Farm program history
- Land use change studies
- Landform change studies
- Environmental restoration projects
- Site selections
- Community planning
- Real Estate
- Legal cases
- Personal interest
See the changes from 1958 to 2006 near the smaller airport in suburban Salt Lake City.
Within the past 10 years, FSA has moved from paper photo enlargements with hand drawn field boundaries to digital imagery with hand digitized field boundaries.
CLU files contain attributes relating to fields enrolled in FSA programs. They are not available to the general public.
The current CLU file is displayed against MDOQ imagery, flown in 1997.

Digital aerial imagery in GIS can show the effects of suburban sprawl.
Historical aerial imagery can be scanned and georeferenced, then compared to current vector data.

A few fields retain the same dimensions they had 50 years ago.
This series of slides shows the progression of land use change in the Fresno area.
The three circled areas will be shown in greater detail later.
The loss of farmland is an area of concern throughout the country. It can be studied and quantified with aerial imagery.
Compare 1987 to 2006
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Farmland is disappearing at a rapid pace.
Farmland will continue to disappear in the future, according to the city’s land use plans.
Using aerial imagery for historical analysis in GIS often involves hand digitizing vector layers.

This is especially true with older Black and White imagery.
A polygon file digitized from earlier imagery can be used to locate areas of change when viewed with newer imagery.
• Many different methods can be used when setting up a change detection project.

• Work can be done manually, or with differing levels of automation.

• A thorough knowledge of imagery software programs and the behavior of digital imagery is necessary for successful use of automated classification procedures.

• Results will not be any better than the quality of the imagery and the skill of the operator.

• Care must be taken with land cover as opposed to land use classifications. Automated procedures will identify land cover – the operator must select a classification system and translate land cover results into this system.
In one method, individual imagery bands can be classified “by hand” in ArcGIS as a way of visualizing features. This method would utilize knowledge of the spectral characteristics of different bands. Classes can be extracted and converted to shapefiles.
In this example, the band’s histogram was used to set the class boundaries, and a color ramp was selected for display.
Four band NAIP imagery allows the user to take advantage of Feature Extraction techniques which were originally better suited to satellite imagery.

Unsupervised classification creates different classes which can also be used separately to create polygon files.
Blue polygons show areas of change.

The extraction from Band 3 is

An example of using of

A subset of a DDOQ

will display the use

A software tool in

The software allows the

features were not all

was identified as

A single section

was processed using the rule-based

bands, size, shape, textur, and other factors.
Some standard models can be run with a simple setup and click of a button.

An NDVI image created in ERDAS Imagine, and derived from the NAIP imagery, can be used to highlight features for analysis. The user can set symbology to highlight different types of features.
The Vegetation Suppression tool in ENVI software will output an image which downplays the bright red vegetation in a CIR image, and lets the impervious surfaces stand out.
APFO’s historical imagery is mostly black and white, and would be less useful for automated classification tools.

The same image, with color classes set in ArcGIS symbology, demonstrates that black and white imagery would require visual and manual interpretation.
• Imagery with infrared bands can be especially useful in analysis.

• NAIP is increasingly being flown with four bands – RGB and Near Infrared

• Landsat imagery is now available online for free download. Imagery dates from 1973 (Landsat 1) to the present.

• Basic indices such as the Normalized Vegetation Difference Index (NDVI) can be run with Four Band NAIP or satellite imagery.

• Individual imagery bands can be classified as a means of identifying different types of features.

• Feature Extraction software can be used for Supervised, Unsupervised, or Rule-based classification.
Using Imagery for Change Detection

Satellite imagery and higher resolution aerial photography are now available for free download, or at a low processing fee.

Satellite imagery advantages:

- Many dates of imagery available for the same scene
- Multiple bands of data
- Larger pixel size allows quick processing

Satellite imagery disadvantages:

- Larger pixel sizes lack detailed information.
- Image quality may be poor, with cloud cover or unusable data

Aerial Imagery Advantages:

- Smaller pixel sizes provide more detail
- Image quality generally good

Aerial Imagery Disadvantages:

- Acquired much less frequently than satellite imagery
- Imagery with 1 – 3 bands is less useful for analysis
- Smaller pixel size requires more processing time and storage space
APFO will be scanning historical imagery from the Wasatch Front in Utah.
• The scans in Salt Lake County will be used to create DOQQs.

• Scans from the other four counties along the Wasatch Front (Davis, Weber, Summit, and Utah) will be georeferenced.

• Pixel resolutions will depend on the original scale of flying and the scanning resolution.

• The scans will be used as a research tool for customers looking for historical imagery.

• The imagery will be available for purchase in a digital format, or as a high quality paper photograph.

• Customers can request scans of historical imagery from any roll of film in APFO’s collection.

• The APFO Imagery Catalog is available online, and lists film available for each county.

• This project may pave the road towards scanning the entire film collection.
NAPP3 film was used to create USGS DOQQs.

Film available for Salt Lake County

APFO also has film for 2003 and 2004 NAIP In Utah.
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Imagery can help us look at change in our own backyards.

APFO is located in West Valley City, Utah, close to a small preserve called Decker Lake.

The area has changed a great deal in 50 years,
In 1958, Decker Lake was much larger, and the area to the south was classified as wetlands on the USGS topo map. By 1997, development had covered most of the open lands in the area. The northern part of the old lake area was developed, but land to the south was not. The E Center, a large hockey arena, was built where the wetlands had been.

MDOQs made from 1997 NAPP photography. 1:40,000 scale.
Summary statistics can be used to create spreadsheets and charts illustrating the change in land use over time.
What about the natural landscape under all of the new development?

Businesses have been built where there once were wetlands, and there are several fault lines nearby.

Preparation for natural hazards is one important use of historical imagery, maps and vector data.