Mid-term Evaluation: June 1, 2009

Acquisition, Cataloging, Processing and Analysis of Historical Aerial Photographs of Amherst, Massachusetts

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Introduction:

In late 2008, a collaborative project between the Town of Amherst, Massachusetts and private contractor Michael Warner began as an attempt to inventory, acquire, and process historic aerial photography of Amherst. Since the project's inception, it has grown to include previously unknown sources of data while simultaneously excluding datasets that were originally thought to be included, and maintaining its original purpose. This mid-term report is an attempt to document each of these changes along with updates on the current status of the project, and to identify what work remains to be done.

Methodology:

Initial Inventory: December 2008 - January 2009

The initial few weeks of the project were spent inventorying the hard copies of aerial photography within Amherst's Town Hall. This process included thumbing through files and folders, searching cabinets and drawers, and talking with Town Planner Jonathan Tucker about other potential sources of historic imagery located outside of Town Hall. After a few hours of work, the initial inventory revealed multiple series of imagery, including photos from the years 1956, 1967, 1972, 1974, 1985 (infrared), 1996, 1999 and 2004 (see Table 1).

Year	Agency	Location	# of Images
1956	Air Survey Corporation	Amherst Town Hall	55
1967	James W. Sewall Co.	Amherst Town Hall	40
1972	Lockwood Mapping, Inc	Amherst Town Hall	N/A
1974	Ainsworth & Associates	Amherst Town Hall	N/A
1985	N/A	Amherst Town Hall	N/A
1996	East Coast Mapping	Amherst Town Hall	N/A
1999	?	Amherst Town Hall	N/A
2004	?	Amherst Town Hall	N/A
2009	?	Amherst Town Hall	Full Town Covg.

Table 1: Results of inventory of historic aerial photographs held in Amherst Town Hall (to be updated before final report).

After the initial inventory, discussions were held with the Town's GIS Administrator, Mike Olkin, to prioritize the importance of each series within the scope of this project. The 1956 series was determined to be the top priority with the 1967 series identified as second priority and the 1970s series were identified as third priority if time permitted. The infrared 1985 series was deemed insignificant due to the relatively small-scale of the project and incomplete nature of the dataset. Also, the 1996, 1999 and 2004 series were also considered a low priority due to the availability of 1997, 2001 and 2005 aerial photography from MassGIS.

During the inventory process on of the most significant observations made was with regard to the condition and storage method of each series of images. For the most part, the hard copies of images were stored properly in either: map drawers for large-format images or manila envelopes for 9 x 9's. However, a series of large-format 1956 images were stored in a hanging map case in the basement of Town Hall. Traditionally, hanging map cases are used for quick access to paper maps that can easily be re-printed and re-hung if they tear. In this case, however, these high-quality and historic data were being ripped and slowly deteriorating in dank basement. Time was taken to properly remove each photograph from the metal strips before sending each image through the scanner. Recommendations were made after scanning the images to properly store them in a map case.

Scanning and New Discoveries: February 2009 - March 2009

The 1956 series was the first set of imagery scanned into digital format. Use was made of the Town's large format scanner to capture oversized images at 300 dots per inch (dpi) while smaller images (9" x 9") were scanned on a desktop flatbed scanner at 400 dpi. All total, 32 images were scanned into digital format for the 1956 series.

Shortly thereafter, other sets of imagery were uncovered at the Department of Public Works building located just south of town. Within the Town Engineer's office, map drawers were found to include other scenes from the large-format versions of the 1956 series that had previously been scanned by someone within DPW. Also discovered were oblique angle photographs of the Plum Brook area of South Amherst and an entire series of photo-negatives of the 1985 infrared series. While these negatives are a significant upgrade over the large-format hard copies found in Town Hall, a photogrammetric scanner was not available for this project and, resultantly, they were not scanned.

In late March 2009, it was discovered that Hampshire College's Department of Earth and Environmental Science had their own small library of historic photographs of the Pioneer Valley, including a series dated 1939 that centered on Amherst. After seeing the quality of Dr. Roof's 1939 re-prints, it was quickly determined that they were of great value and should be included in this project. A previous student of Dr. Roof had scanned the re-prints at 600 dpi and he was generous enough to allow them to be used. See Table 2 for a complete inventory of images available from Hampshire College.

Year	Agency	Location	# of Images
1939	U.S. Geological Survey	Hampshire College	14
1960	U.S. Geological Survey	Hampshire College	30
1975	U.S. Geological Survey	Hampshire College	20
1990	U.S. Geological Survey	Hampshire College	11
1991	U.S. Geological Survey	Hampshire College	40
1992	U.S. Geological Survey	Hampshire College	3

Table 2: Results of inventory of historic aerial photographs held at Hampshire College.

Processing the 1939 imagery and Deliverable Set #1: April 2009

After acquiring the 1939 imagery, the data was geographically referenced to 1999 orthophotography available from MassGIS. In total, 14 scenes were geographically referenced with an RMS error of 7.7 feet. After georeferencing, each image was clipped and mosaicked using ESRI's ArcGIS (Version 9.3). The images were feathered together using a weighted distance factor to attempt to seamlessly blend the images together.

While the resulting images are anything but seamless, one has to remember that these images were capture in 1939 with far lower photogrammetric standards than we live by today. As a result, the images are plagued by dark shadows and warped edges that making blending difficult. In the end, the resulting merged dataset provides a reflection of the Pioneer Valley in 1939 stretching from Holyoke to Northampton, East to Amherst, South to Granby and back to Holyoke.

The mosaicked 1939 dataset was stored in a file geodatabase that included an index map (Figure 1) and an index shapefile and delivered to the Town of Amherst on May 1, 2009 as deliverable 1 of 3. *(for more information on the 1939 imagery, please see appendix A)*.

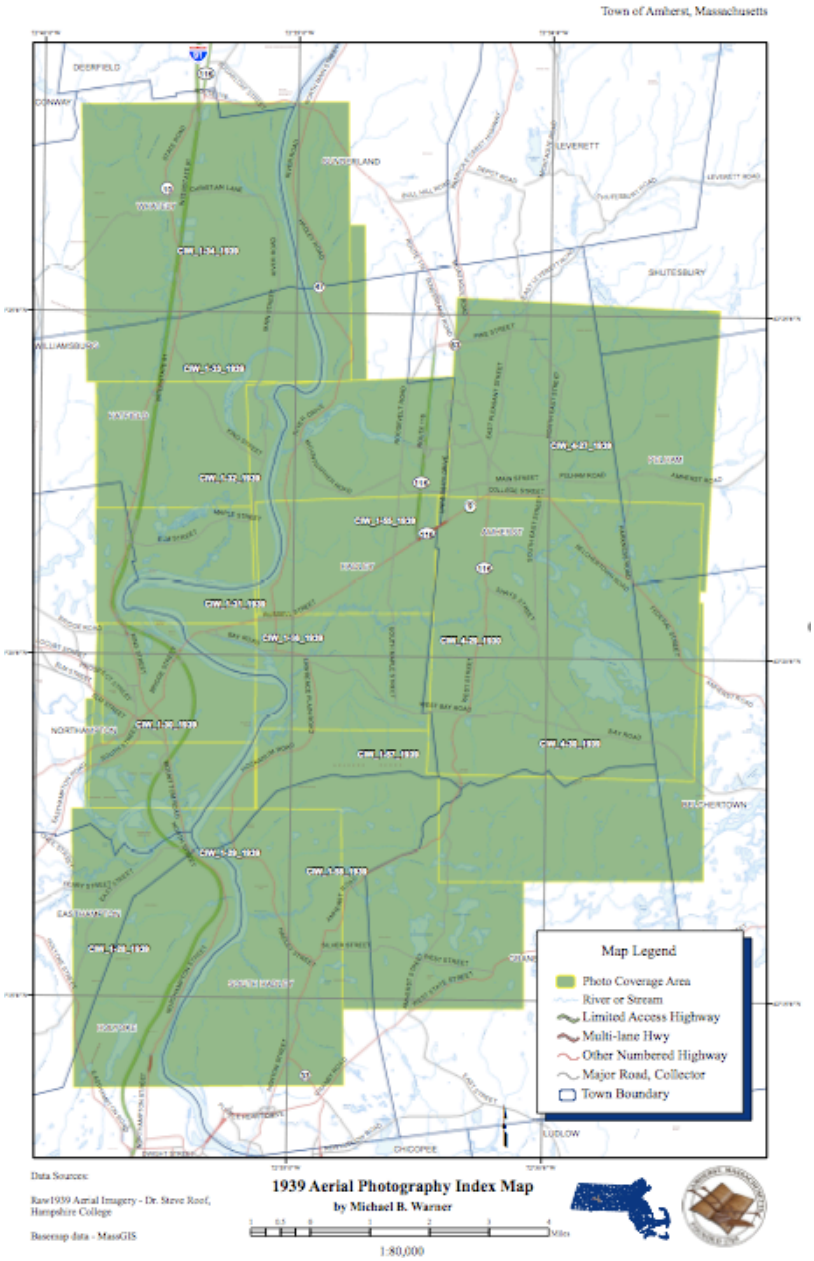

Figure 1: Index Map of 1939 Imagery - submitted as part of deliverable 1 of 3.

Processing the 1956 imagery and Deliverable set 2 of 3

Similar to the 1939 data, the 1956 data was scanned and geographically referenced. However, being that the 1956 data falls within the boundary of the Town of Amherst, the historic data was georeferenced to the higher-resolution 2005 orthophotography.

All together, 32 of the 55 scenes were geographically referenced with an RMS error of 5.2 feet. Thirteen of the images were not georeferenced because they either:

a.) overlapped with other images and were omitted to prevent redundancy,
b.) because some images had excessive writing or drawing on them, or
c.) because an image fell outside the town boundary.

Using the same mosaicking techniques as the 1939 imagery, the 1956 data was similarly feathered together to seamlessly blend the images together.

The mosaicked 1956 dataset was stored in a file geodatabase that also included an index map (Figure 2) and an index shapefile and delivered to the Town of Amherst on June 1, 2009 as deliverable 2 of 3. *(for more information on the 1956 imagery, please see appendix B)*.

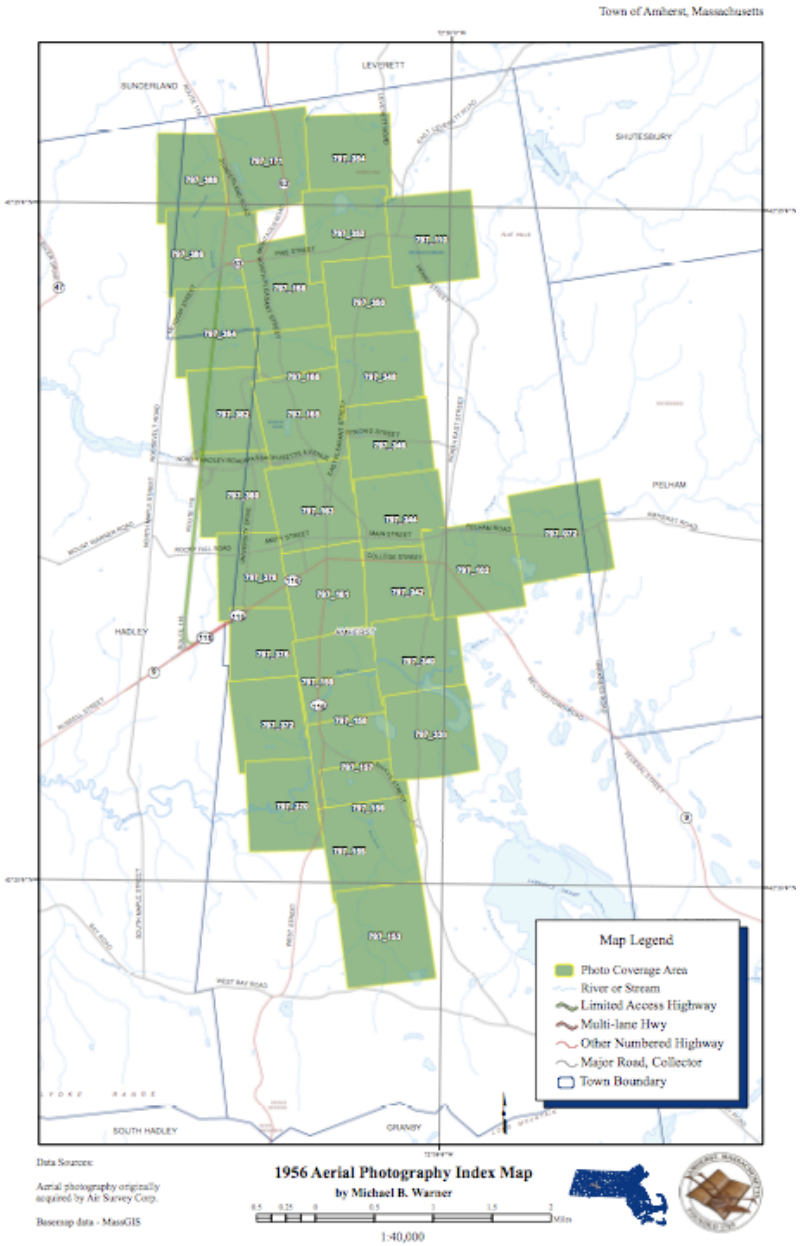

Figure 2: Index Map of 1956 Imagery - submitted as part of deliverable 2 of 3.

Project Status: To be completed.

The components included in final deliverable (3 of 3) in this series have been determined and work is already underway. Deliverable 3 will include a georeferenced mosaic of the 1967 series of images, forty in total. These 1967 images have already been scanned into digital format. The next stage of the project requires them to be geographically referenced and mosaicked together.

Also, the final deliverable will include scanned versions of historic Sanborn insurance maps of Amherst from a variety of dates. The list of acquired Sanborn maps includes: The Sanborn maps include 2 maps from 1887, 5 from 1892, 7 from 1896, 8 from 1902, eighteen from 1910, fifteen from 1916, seventeen from 1930, and seventeen from 1950. If time permits, the Sanborn maps will also be georeferenced and included with the final deliverable, however, this is not guaranteed.

A final report will also be compiled and included with deliverable 3. Its format will largely be similar to this mid-term report but with a slight change in organization, more detailed information, and an appendix for each series of imagery.

Appendix A: 1939 Imagery

Photography Author:
United States Geological Survey (USGS)

Inventory:
14 images in total. More are available but they fall outside of this project's study area.

Background:
The original photographs were captured by the USGS in 1938/1939 as a result of a significant flood that affected the Pioneer River Valley and other localities throughout the Connecticut River basin.

These photographs were "re-discovered" at the Natural Resource Conservation Services in Northampton, MA by Eve Preus (Hampshire College). Dr. Preus has now moved on from her position with the Department of Natural Sciences. However, records indicate that Dr. Preus contracted to King Visual Technology (Bara-King Photographic, Inc.) in Hyattsville, Maryland, to acquire the imagery from a National Archives facility in Maryland. Unfortunately, King Visual Technology is no longer in business and could not be contacted.

Contact information for King Visual Technology:

4805 Frolich Lane
Hyattsville, MD 20781-1290
(301)322-7900

Dr. Preus was interested in purchasing black and white 10" x 10" reprints of these photographs. Hampshire College has these reprints in their possession and they are of superb quality.

Dr. Steve Roof, at Hampshire, is now in possession of the imagery and uses it quite often for his GIS classes. Dr. Roof was more than happy to share the data and can be contacted at sroof@hampshire.edu

Methodology:
For this project, all of the 1939 aerial images were scanned and geographically referenced. From there, per request of the Town of Amherst, the images were stitched together using a feathering technique and imported into a geodatabase for faster/easier display.

This data was submitted to the Town of Amherst as a deliverable on May 1, 2009. The products provided in this deliverable include:

a.) The original scanned, raw images.
b.) Georeferenced version of each image tile.

c.) Mosaicked image that was clipped to a smaller study area (the footprint of the 2004 orthophoto provided by the Town of Amherst).
d.) An Index map.

Recommendation:
The quality of re-prints in the possession of Hampshire College indicate that they were produced using original film. Therefore, with the use of modern technology, the data could be scanned at a much higher resolution.

If there is significant interest in higher-resolution versions of these photos, they could be tracked down by contacting either the National Archives or the EROS Data Center (USGS). While possible, it may prove to be a significant undertaking due to the date of the data and the vague references cited in the letters of Dr. Preus (i.e. “the archives in Maryland”).

If the data were to be tracked down, a contracting firm, approved by the National Archives, would need to be contacted to provide the services. Unfortunately, this step alone would significantly increase the cost associated with the project.

For more information on this product, or project, contact:
Michael Warner at mbwarner@gmail.com or,
Michael Olkin with the Town of Amherst at OlkinM@amherstma.gov

Appendix B: 1956 Imagery

Photography Author:
Air Survey Corporation - http://www.airsurvey.com

Inventory:
The original survey collected approximately 392 images at two different scales, 500-scale and 1000-scale. Currently, the Town of Amherst has in it's possession 55 hard-copies of these images.

Background:
Remarkably, the company that originally flew the flight some 50+ year ago, Air Survey Corporation, is still in business today. As a result, it was quite simple to track down the imagery and learn about the availability. Not surprisingly, they have all 392 images available in their library and can provide digital scans for a cost. (hopefully they provide me with a quote before the final stage of this project).

The point of contact with this project was Dan Ducharme, a Reprographics Manager with Aero-Metric, Inc. Mr. Ducharme was both prompt and informative when responding to each of my inquiries regarding the 1956 dataset. Mr. Ducharme can be contacted at the following:

Daniel Ducharme
Reprographics Manager
Aero-Metric, Inc.
45180 Business Court, Suite 800, Dulles, VA 20166-6706
Phone: 703-471-4510
Fax: 703-471-8092
Email: dducharme@aerometric-va.com

If there is interest in acquiring digital scans of the imagery, there are a few things that need to be considered before inquiring about a price quote. They include:

a.) Resolution of images - when Aero-Metric provides digital scans, they need to know a specific "ground resolution". With modern cameras and scanning technology, a newly acquired 500-scale imagery dataset with a 1-foot pixel/ground resolution would require scanning at 500 dpi. If a 0.5-foot pixel resolution is required, they would scan the negatives at 1000 dpi. However, since this imagery was acquired in 1956 with an old Fairchild camera and a slow shutter speed, that combination along with older film will not provide the same level of image quality as modern cameras and film.

b.) Number of images - How many images are you interested in acquiring? Affects both cost and method of delivery (see bullet letter 'd' below).

c.) File format - they provide images scanned in either .tif or .jpeg format. A scanned .tif file will be larger in file size but provide more detail. Comparatively, a

scanned .jpeg file will be much smaller in file size but provide less detail (especially in areas of low contrast).

d.) Data delivery format - How do you want the data delivered to you? Aero-Metrics provides two options for data delivery: DVD or external hard drive. For a small amount of images DVD is the most simple way to acquire the data. However, for a large order (i.e. the entire dataset), an external hard drive would definitely be the way to go.

Methodology:
For this project, all available hard-copies of the images were scanned and geographically referenced. From there, per request of the Town of Amherst, the images were stitched together using a feathering technique and imported into a geodatabase for faster/easier display.

This data was submitted to the Town of Amherst as a deliverable on June 1, 2009. The products provided in this deliverable include:

a.) The original scanned, raw images.
b.) Georeferenced version of each image tile.
c.) Mosaicked image that was clipped to a smaller study area (the footprint of the 2004 orthophoto provided by the Town of Amherst).
d.) An Index map.

Recommendation:
While I have yet to receive either a cost quote or a digitally scanned example from Aero-Metrics, it's safe to assume that the quality of the digitally scanned film would be far superior to the scanned hard-copies provided in this deliverable. However, the cost associated with acquiring that data would also likely be considerable. *(Once I receive a price quote I will insert it here and reformat the paragraph accordingly).*

Before acquiring digital scans of the original film from Aero-Metric, it is import to consider a number of different factors. Primarily, the Town's current, and future uses of the data are the most practical determinant of whether or not to acquire the imagery. For example, if the Town believes that the imagery is best used as simply a visual tool to overlay current GIS data, to view using the online GIS viewer, or as basemapping material, then this deliverable is more than enough. However, if there is interest in using the imagery for high-resolution analysis (i.e. detailed vegetation mapping, precise hydrographic changes, etc.) then the acquiring the data from Aero-Metric should be considered.

Secondly, and just as important and relevant as potential use, is cost. ***As mentioned above, the cost associated with acquiring the data is likely to be significant. More information will be provided when a price quote is received.***

Lastly, it is important to recognize that full extent of the original survey (392 images) more than likely covered the entire town. This deliverable, however, only covers parts of town where hard-copies of the images were available. The most notable gaps include most of the Eastern part of town, the Southern part of town from Bay Road to the Holyoke range, 3 or 4 images in the Southwestern corner, and the obvious gap in the middle of the imagery just south of Puffer's Pond. Thus, if there is interest in any of these areas that are not covered in this deliverable, then the only option is to contact Aero-Metric.

For more information on this product, or project, contact:
Michael Warner at mbwarner@gmail.com or,
Michael Olkin with the Town of Amherst at OlkinM@amherstma.gov