

Enhanced Library Collection Access through GIS: Historic Colorado Aerial Photographs

Kathryn Lage
Christopher Cronin
Holley Long

Abstract:

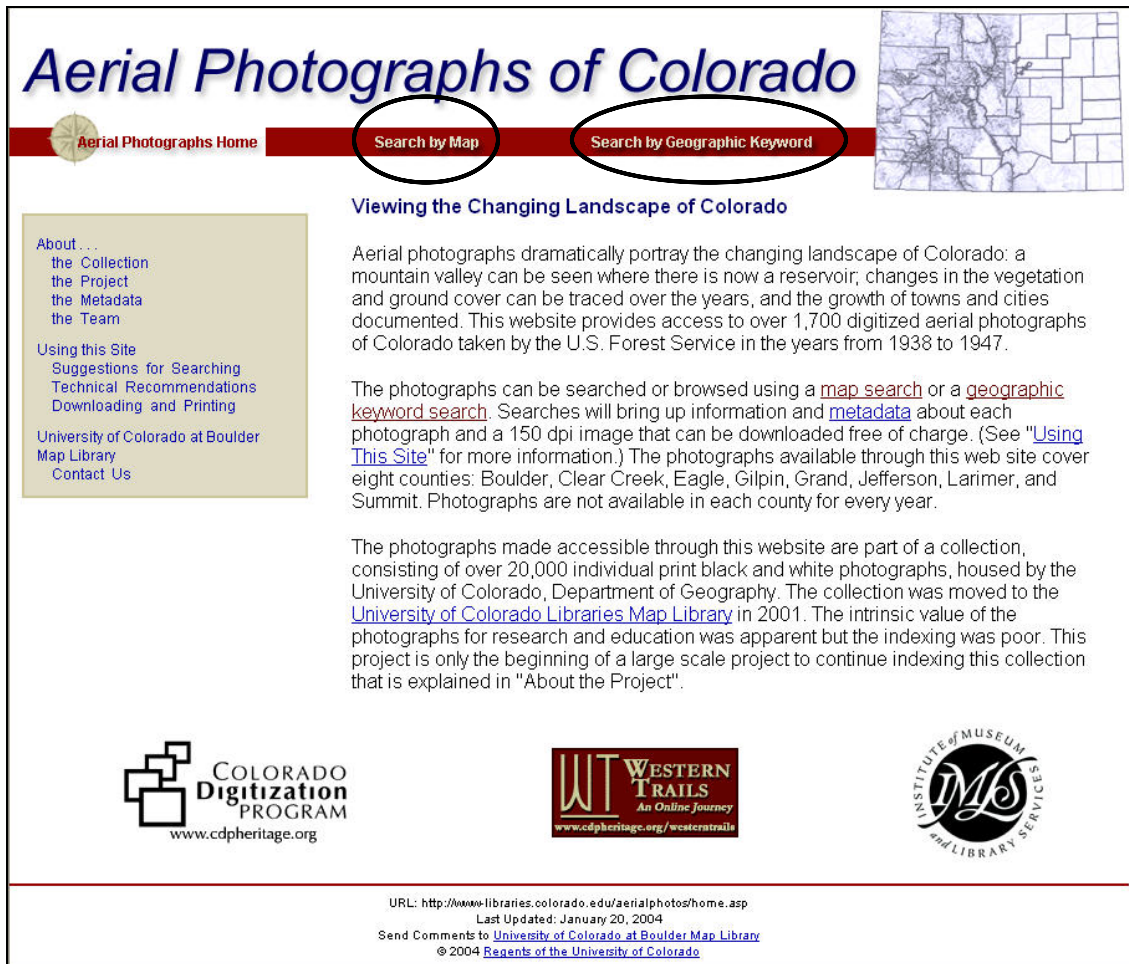
This case study presents the use of GIS in a map library to create an enhanced index for a collection of historical aerial photographs of Colorado. The University of Colorado at Boulder's Jerry Crail Johnson Earth Sciences and Map Library scanned and indexed 1700 aerial photographs taken from 1938-1947. Library staff used ArcView 3.2 and ArcGIS 8.1 to plot the center points of each photograph and enhanced the georeferencing with a detailed attribute table. The project Web site provides access to the photographs and the spatial data captured in the attribute table through a map search and a keyword search.

The Map Library at the University of Colorado at Boulder, in conjunction with the University Libraries' Systems Department and the Cataloging Department, has digitized, georeferenced, cataloged, and made accessible via the Web 1,700 aerial photographs of Colorado taken between 1938 and 1947. This paper will present the public and technical aspects of this project. The first section will introduce the public access Web site, discuss the print collection, and outline the funding and administrative aspects of the project. The latter part of the paper will discuss the technical aspects of the project. It will describe the digitization of the print aerial photographs and the use of Geographic Information Systems (GIS) software to georeference and assign metadata to each photograph. In addition, the database development and Web design, the forthcoming user needs assessment and the cataloging of the digital collection will be explained.

Public Access: The Web Site

The digitized aerial photographs are available through the Map Library Web site. (Click on “Historical Aerial Photographs of Colorado” at <http://ucblibraries.colorado.edu/map/>.) The database can be searched using a map to select a specific county and year or through a geographic keyword search. Users can view, print, and download the photographs and metadata. (See fig. 1).

Figure 1
Project home page



Aerial Photographs of Colorado

[Aerial Photographs Home](#) [Search by Map](#) [Search by Geographic Keyword](#)

[About . . .](#)
[the Collection](#)
[the Project](#)
[the Metadata](#)
[the Team](#)

[Using this Site](#)
[Suggestions for Searching](#)
[Technical Recommendations](#)
[Downloading and Printing](#)


[University of Colorado at Boulder](#)
[Map Library](#)
[Contact Us](#)


Viewing the Changing Landscape of Colorado


Aerial photographs dramatically portray the changing landscape of Colorado: a mountain valley can be seen where there is now a reservoir; changes in the vegetation and ground cover can be traced over the years, and the growth of towns and cities documented. This website provides access to over 1,700 digitized aerial photographs of Colorado taken by the U.S. Forest Service in the years from 1938 to 1947.

The photographs can be searched or browsed using a [map search](#) or a [geographic keyword search](#). Searches will bring up information and [metadata](#) about each photograph and a 150 dpi image that can be downloaded free of charge. (See "[Using This Site](#)" for more information.) The photographs available through this web site cover eight counties: Boulder, Clear Creek, Eagle, Gilpin, Grand, Jefferson, Larimer, and Summit. Photographs are not available in each county for every year.

The photographs made accessible through this website are part of a collection, consisting of over 20,000 individual print black and white photographs, housed by the University of Colorado, Department of Geography. The collection was moved to the [University of Colorado Libraries Map Library](#) in 2001. The intrinsic value of the photographs for research and education was apparent but the indexing was poor. This project is only the beginning of a large scale project to continue indexing this collection that is explained in "About the Project".

 COLORADO Digitization PROGRAM
www.cdphheritage.org

 WESTERN TRAILS
An Online Journey
www.cdphheritage.org/westerntrails

 MUSEUM AND LIBRARY SERVICES

URL: <http://www-libraries.colorado.edu/aerialphotos/home.asp>
Last Updated: January 20, 2004
Send Comments to [University of Colorado at Boulder Map Library](#)
© 2004 [Regents of the University of Colorado](#)

Searching for Photographs through the Web Site

Map Search

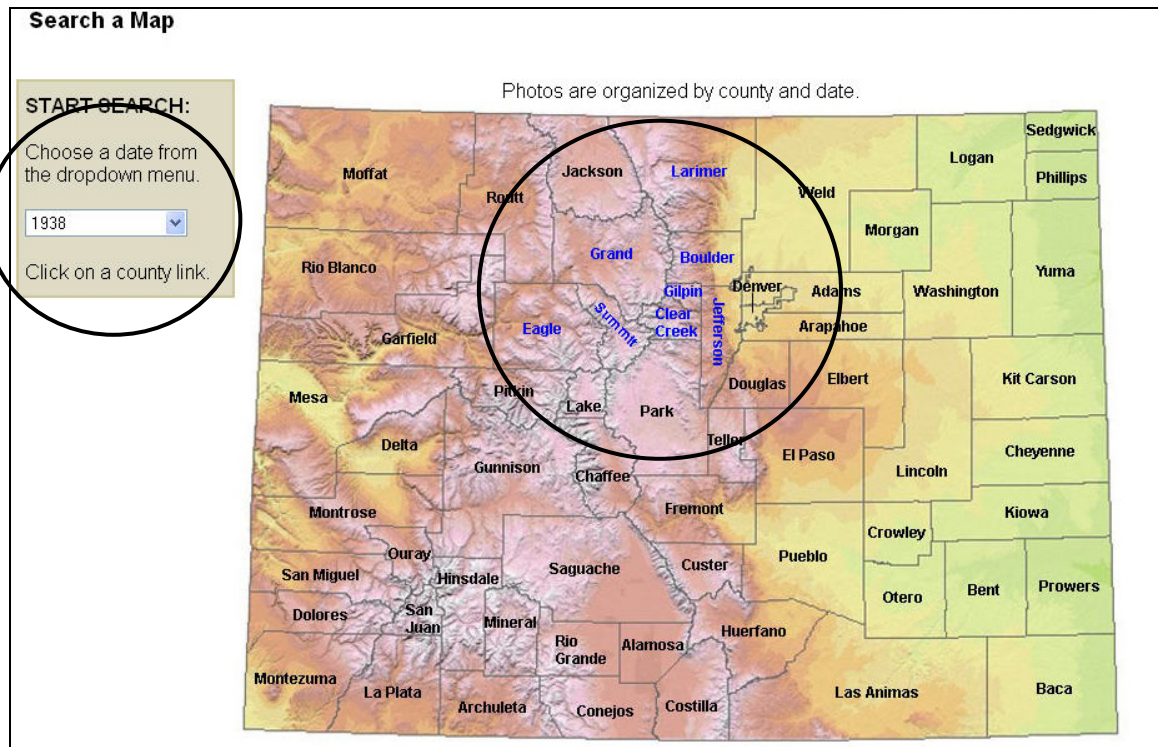
To find a photograph using the map search, the user drills down a series of state and county maps. Beginning with a map of Colorado, the user first limits the search by choosing a date from the menu on the left (see fig. 2).

Figure 2
Initial page of the map search

The screenshot shows the 'Aerial Photographs of Colorado' website. At the top, there is a navigation bar with 'Aerial Photographs Home', 'Search by Map', and 'Search by Geographic Keyword'. Below this is a 'Search a Map' section. On the left, a 'START SEARCH:' box contains a dropdown menu labeled '- Select a Date -'. Below the dropdown is a list of 'Available Counties' with their corresponding years: Boulder (1938, 1940, 1946), Clear Creek (1938, 1946, 1947), Delta (1938, 1946), Gilpin (1938, 1946), Grand (1938, 1946, 1947), Jefferson (1938, 1940, 1946), Larimer (1938, 1940, 1946, 1947), and Summit (1938, 1946). The main part of the page is a map of Colorado divided into counties, with labels for each county. A small inset map in the top right corner shows the state of Colorado with a grid overlay. At the bottom, there is a URL: <http://www-libraries.colorado.edu/aerialphotos/mapsearch.asp>, the text 'Last Updated: January 20, 2004', and a copyright notice: '© 2004 Regents of the University of Colorado'.

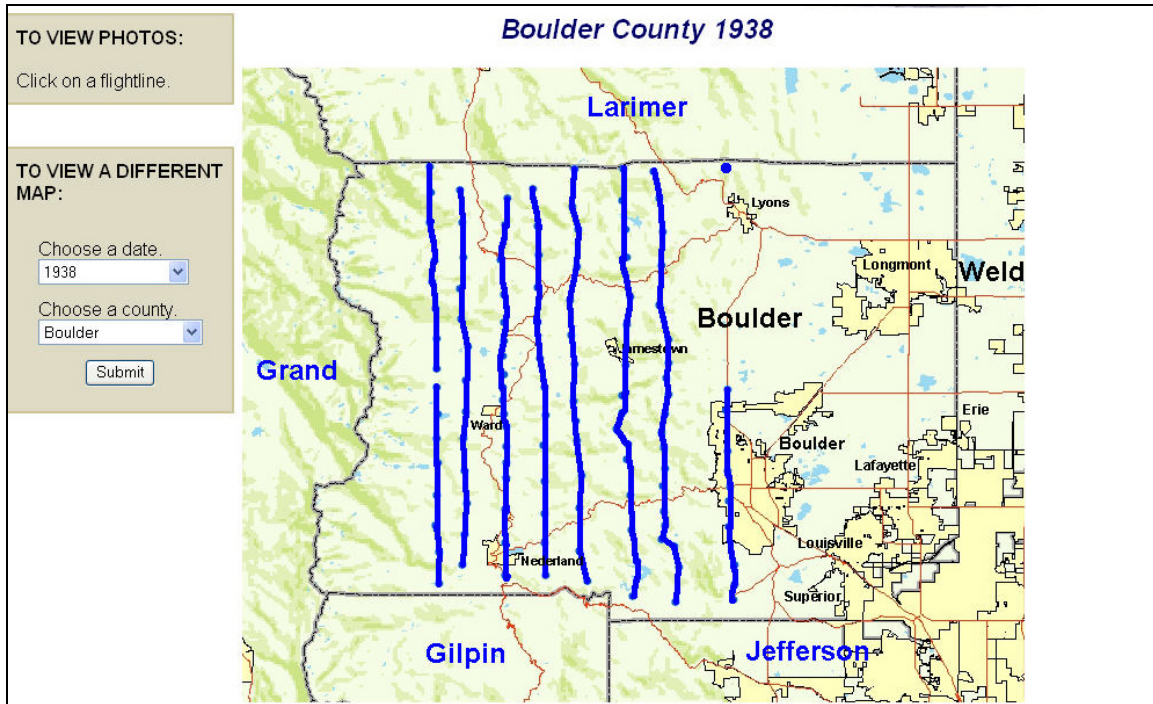
After a date is chosen, the names of the counties with photographs taken during the selected year are highlighted and hyperlinked (see fig. 3).

Figure 3
Counties with photographic coverage in 1938 are hyperlinked (in blue)



When the user clicks on a county, the next screen displays the appropriate county map. The locations of the available aerial photographs are shown as flight lines (in blue) plotted on a base map. (A flight line is the flight path of the airplane as it took the photographs.) The base map shows generalized relief, roads, lakes, and urban areas to place the flight lines in geographical context and enable the user to select the flight line of interest (see fig. 4).

Figure 4
Boulder County map showing 1938 flight lines



The user then selects a series of photographs by clicking on a flight line to display the results set (discussed in the “Search Results” section that follows).

Geographic Keyword Search

A user can search for a photograph that covers more specific area by using the geographic keyword search (see fig. 5). This option provides a guided search that allows the user to select terms from one or more of the following keyword categories: geographic landmark, U.S.G.S. 1:24,000 scale topographic quadrangle (7.5-minute series), and county. These categories correspond to metadata fields assigned during the indexing process. The search can also be limited by a date range.

Figure 5
Geographic keyword search screen showing landmark drop-down box

Aerial Photographs

Aerial Photographs Home Search by Map

Geographic Keyword Search

Choose a geographic keyword from the following list.
Choose a beginning and ending year to limit the search to a specific range.

Landmark:

County:

Topographic Quad:









From: To:

- Black Creek
- Ben Delatour Scout Camp
- Bennett Campground
- Bennett Creek
- Big Elk Park
- Big Gulch
- Big Hole Creek
- Big Meadows
- Big Meadows Creek
- Big South Campground
- Big Thompson Canyon
- Big Thompson River
- Bighorn Flats
- Bighorn Mountain
- Bills Peak
- Binco Reservoir
- Birch Creek
- Black Creek
- Black Gulch**
- Black Lake
- Black Mountain

Search Results

The information displayed on the search results pages for both the map search and the geographic keyword search functions is the same. The results are displayed as thumbnails of the digital images, in order from north to south. If the search pulls up a large number of hits (as with many of the county or topographic quadrangle searches), the search results are listed with 20 record per page. In addition to the thumbnail images, the results page displays minimal metadata about the photograph: general location, date, and identifier (see fig. 6).

Figure 6
Results set for the flight line that covers the town of Nederland (Boulder County, Colorado, 1938)

Your Search: Boulder County 1938 Flightline #7		Hits: 16	New Search
Results Page: 1			
Search Results			
<i>Click on thumbnail to view larger image. Some photographs are temporarily unavailable.</i>			
			
Identifier: BOW17-58 Location: Boulder County, Colorado Date: 10/25/1938	Identifier: BOW17-60 Location: Boulder County, Colorado Date: 10/25/1938	Identifier: BOW17-62 Location: Boulder County, Colorado Date: 10/25/1938	Identifier: BOW17-64 Location: Boulder County, Colorado Date: 10/25/1938
			
Identifier: BOW17-66 Location: Boulder County, Colorado Date: 10/25/1938	Identifier: BOW17-68 Location: Boulder County, Colorado Date: 10/25/1938	Identifier: BOW17-70 Location: Boulder County, Colorado Date: 10/25/1938	Identifier: BOW17-72 Location: Boulder County, Colorado Date: 10/25/1938

The user can click on a thumbnail or identifier to view the higher resolution access image (150 dpi) and an extended list of metadata. The metadata fields displayed on this page are: latitude and longitude (for the nadir of the photograph), county, state, 7.5' topographic quadrangle name, geographic landmark, and scale, date and identifier of the photograph (see fig. 7).

Figure 7
Access image showing Barker Reservoir and the town of Nederland with associated metadata

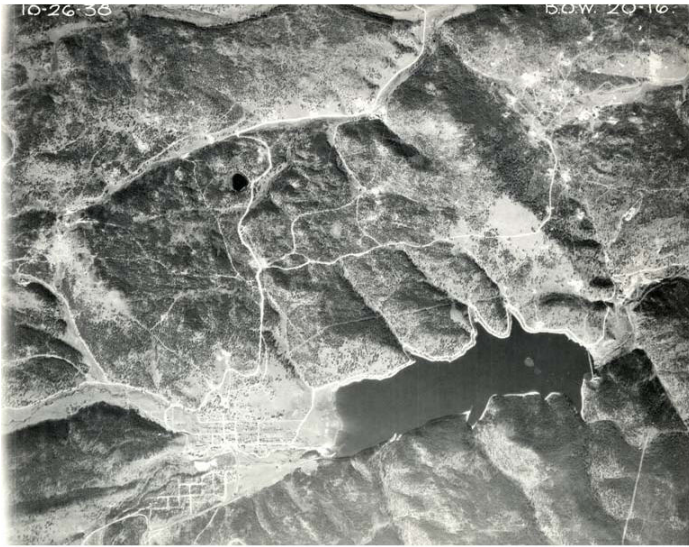



Photo ID: BOW020016 from the collection of the University of Colorado at Boulder Map Library

[View North Photo](#)



[View South Photo](#)

Longitude:	-105 30 03	County:	Boulder	Scale:	1:20,000
Latitude:	39 58 20	Topo Quad:	Nederland	Date:	10/26/1938
Landmark:	Nederland	State:	Colorado	PhotoID:	BOW020016

[Return to Search Results](#)

Collection Background, Project Funding, and Project Administration

In 2001, the Geography Department at the University of Colorado at Boulder donated an estimated 20,000 partially inventoried and indexed aerial photographs of Colorado to the Jerry Crail Johnson Earth Sciences and Map Library. The photographs were taken between 1937 and the 1970s. The project to scan, georeference, and catalog these photographs was initiated by the need for better access to the collection.

Aerial photographs are used for research in many disciplines and this gift added valuable resources for historical research to the map collection. A geologist studying erosion, landslides, or evidence of past earthquakes will analyze historical aerial photographs; a geographer may use aerial photographs to view changes in land use or land cover, such as evidence of ranching, agricultural activity, or vegetation changes; the lay person might use an old aerial photograph to show evidence that a road once existed on his property so that the county will approve paving it today. Aerial photographs provide a unique look at natural and human traces on the land over time.

The photographs in this collection were taken by various federal agencies, the bulk of them United States Department of Agriculture projects by the United States Forest Service (USFS) and the Soil Conservation Service. Most of the photographs are black and white 9-inch by 9-inch prints; some photographs taken more recently (1960's and 1970's) are black and white, color, or color infrared on film roles. All of the photographs digitized and indexed in this stage of the project are black and white prints taken by the USFS. from the project code "BOW".

At most one quarter of the donated collection was indexed, mainly with photomosaic indices (which describe the location of each photograph in relation to the others in the flight line by showing a line of thumbnails). While these indices are useful for those experienced with interpreting aerial photographs and knowledgeable about their study area, they are not as helpful for the less experienced user. The goal of this project was to provide more specific access points to the photographs using the capabilities of geographic information systems, and to allow for remote access to the scanned photographs through a Web interface.

In March 2001, the project was conceived and georeferencing began. The map librarian submitted a successful application for an Institute of Museum and Library Services (IMLS) grant, administered by the Colorado Digitization Program (CDP). The grant was funded through the CDP's Western Trails project in May 2002. The initial principal investigator on the grant, the map librarian, left the library just as the grant was approved and the Head of the Earth Sciences and Map Library became the project manager and principal investigator for the grant.

This project required staff with specific knowledge and experience. Among the essential skills needed were project management, knowledge of how researchers use and search for aerial photographs, knowledge of methods of organizing and cataloging cartographic information, GIS experience, the ability to interpret aerial photographs and topographic maps, and knowledge of digitization methods, standards, and technology. Technical abilities including database and Web development skills and experience with network administration were necessary. The final project team consisted of a project manager (the earth sciences librarian), the map librarian, a systems librarian, a cataloging librarian, and a scanning manager.

Digitizing the Print Collection

In order for the Web interface to provide access directly to the photographs, they needed to be digitized. Scanning the photographs required the establishment of a standard to guide the scanning, the software and equipment to scan the photographs, and the technology and capacity to store and back up the digital files. A scanning manager trained and supervised student scanning technicians and performed quality control of images by random sampling.

Establishing a Scanning Standard

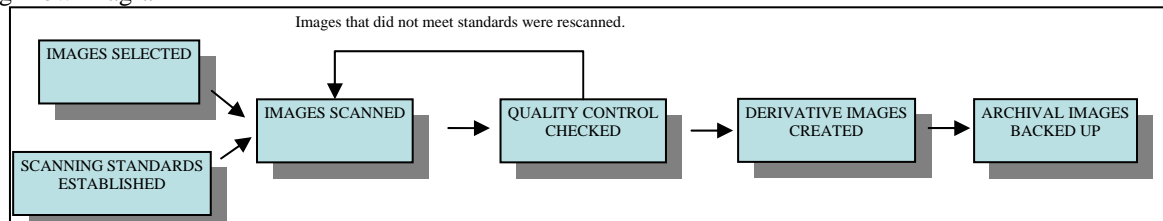
The original aerial photographs are generally low contrast and vary greatly in terms of visual characteristics. Variance among the photographs made it difficult to establish a single scanning standard. Creating several different scanning profiles would have entailed significantly more training and scanning time than the project team had.

One of the biggest challenges in setting the scanning standard was getting an acceptable tonal dynamic range. A setting of 24-bit color at 600 dpi was chosen, using *Western States Digital Imaging Best Practices* (http://www.cdpheritage.org/resource/scanning/documents/WSDIBP_v1.pdf) as a guide, because it resulted in better histograms, on average, for the test set. This setting also reproduced and, in some cases, enhanced differences in hue.

Scanning the Photographs

Once the project team determined the scanning standard, the digitization could begin. The figure below illustrates the digitization process (fig. 8).

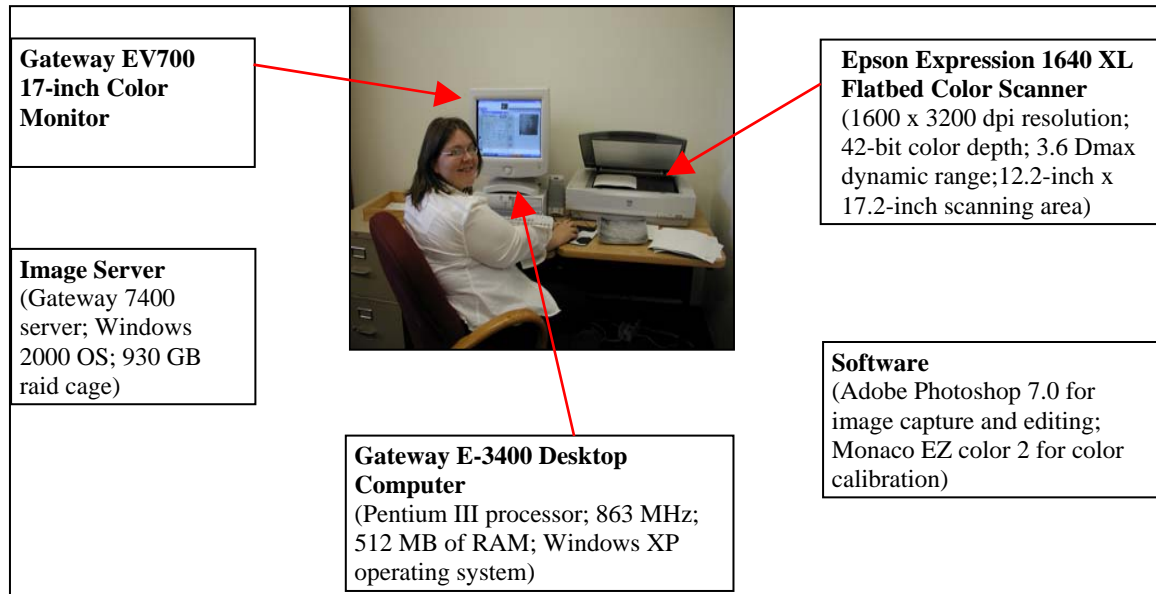
Figure 8
Scanning Flow Diagram



Digitization Technology

The technology and equipment shown in the diagram below were used to scan the photographs (fig. 9).

Figure 9
Scanning Station



The digital images are stored on a Gateway 7400 server with a 930 GB raid cage (Windows 2000 OS). Copies of the tiff files are stored on the CDP servers. The images were backed up to tape locally. The size of the scanned images varies by resolution. The tiff images are approximately 65 MB, the jpeg access and thumbnail images are about 100 KB and 20 KB, respectively. The total size of all the scanned images is roughly 140 GB.

Using GIS Software to Georeference and Apply Metadata to the Photographs

Georeferencing and indexing the photographs was a key part of the project. Recording the location of each photograph through georeferencing was the first step in giving access to these photographs. The metadata recorded in the attribute table is the basis for the geographic keyword search access and, by linking the attributes about each feature to it using GIS, allows for the most specific access points to this collection.

It was important to have people with basic knowledge of GIS and experience interpreting topographic maps and aerial photographs to accomplish this key task. The grant funding was used to hire two undergraduate geography students to index the photographs using GIS by interpreting the photographs using current and historical U.S.G.S. topographic maps as references. The student assistants plotted the nadirs (center

points) of the photographs on a base map using ESRI's ArcView 3.2 and ArcGIS 8.1 software.

Digital Raster Graphics (DRGs) at a scale of 1:100,000 were used as the base map for the project to allow for accurate plotting of the points. At times it was necessary to consult the paper 1:24,000 topographic quadrangles for better detail.¹

Assigning Metadata Using the Attribute Table

The GIS indexers recorded metadata about each photograph in the attribute table at a much more granular level than traditional cataloging allows. The attribute table was developed to allow for metadata fields that would record important information about different facets of each photograph: identifying and administrative information, geographic location, data about the image and the print, and data that describes the scanned file (see fig. 10).

Figure 10
Attribute table fields

Identifying Information
Unique identifier
Shape (e.g. point, line, or polygon)
U.S. Department of Agriculture project code
Frame number
Geographic Information
Latitude and Longitude of the center point
Landmark
U.S.G.S. 1:24,000 topographic quadrangle name
County
State
Image Data
Type of image (black and white)
Number of prints
Image quality
Print quality
Month/Day/Year
Lens
Altitude
Scan Data
Scan date
File name
Scanned by

The latitude and longitude fields were completed using the field calculator and an Avenue script to automatically populate those fields. Text-based metadata was assigned

¹ At the time, loading all of the 1:24,000 scale DRGs into the project was too computing-intensive. As the project continues, the team will reevaluate the pros and cons of using of 1:100,000 DRGs versus the 1:24,000 DRGs.

using the Geographic Names Information System (GNIS) (<http://geonames.usgs.gov/>) as a controlled vocabulary. The topographic quadrangle names were taken from the names of the current U.S.G.S. 7.5' series topographic quadrangles that covered the area shown in each photograph and verified using GNIS. The landmark field was more problematic because of the subjective nature of the assignment of a landmark. Guidelines were established that stated that distinct geographic features such as lakes, peaks or mountains, towns, glaciers, canyons, valleys, and meadows were the preferred landmarks to use. Rivers, streams, or roads were deemed acceptable if the photograph was clearly centered on the head of a river or a highway intersection. Some photographs did not cover a prominent feature and were not assigned a landmark. The lens and altitude fields have not been populated yet. Much of this metadata later became the basis for the geographic keyword search.

GIS indexers conducted quality control tests by random sampling and verification of plotted center points. Text-based fields were checked against controlled vocabulary part-way through the project and again at the end.

As the project continued, the library migrated to ArcGIS 8.1. However, in order to populate the latitude and longitude fields the project was imported back into ArcView so the Avenue script could be used because the project team was not familiar with Visual Basic for Applications programming language used in ArcGIS.

Development of the Web Interface

The development of a Web-based GIS was the obvious solution to convert the project from an ArcGIS project on a single workstation to a public access Web interface. However, library staff did not have the technical knowledge or support to implement a Web-based GIS. The project team decided to construct the site using html and database technology for a low-tech, less costly solution. The Web site relies on static image maps to provide map searching capabilities. This solution provides satisfactory access to the photographs, but did result in a loss of dynamic and interactive mapping that geographic information systems provide. Plans for further expansion and improvements will consider moving the project to a Web-based GIS.

Database Development

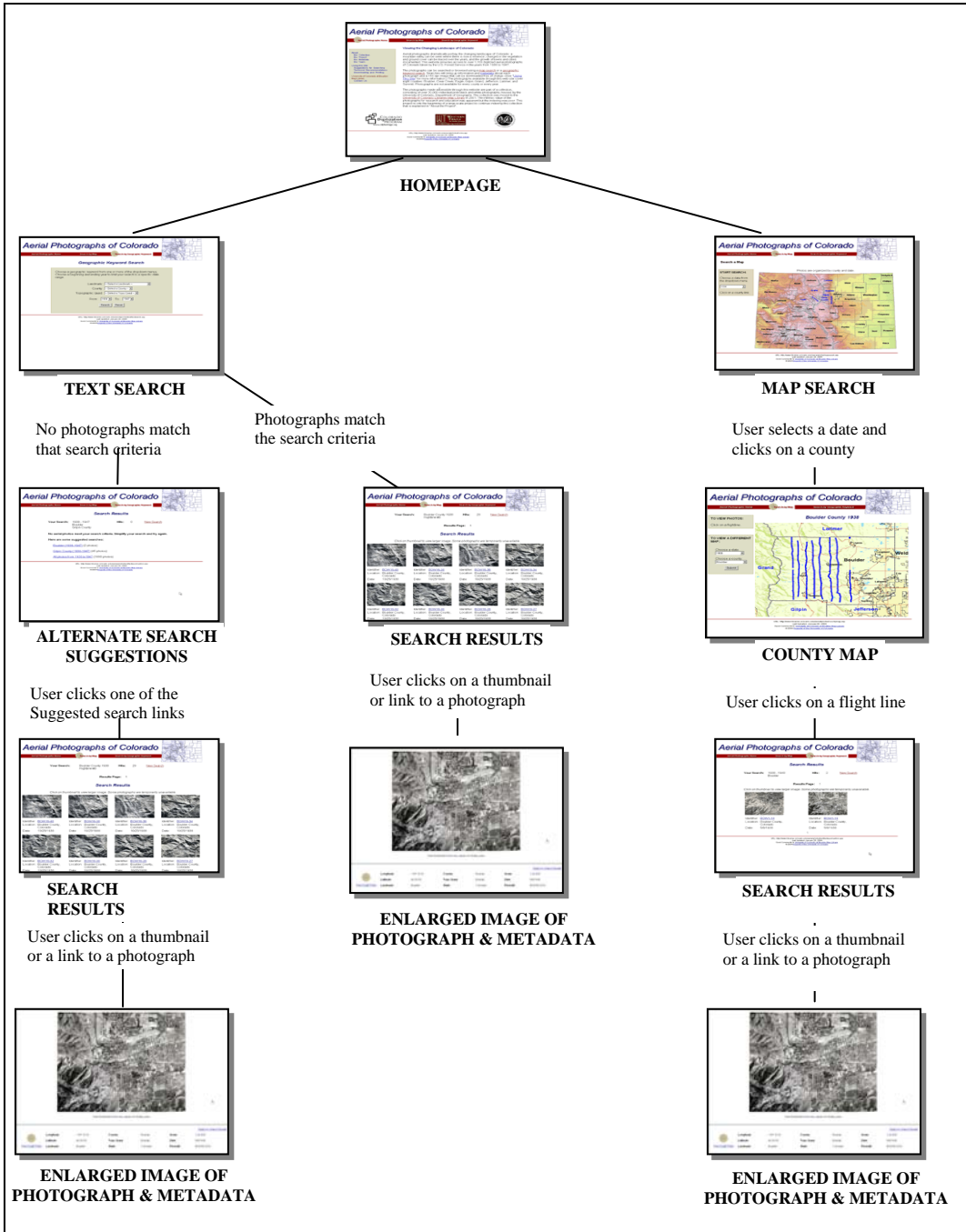
The aerial photos are accessible from a database-driven Web site. The metadata in the ArcMap attribute table was imported into a MySQL 3.23 database with four tables: a photo table, and lookup tables for counties, landmarks, and topographic quadrangles. The MySQL database includes a field for flight line ID in the photo table which was not present in the attribute table. The flight line ID was critical to the functioning of the map search interface because it linked photos from the same flight line together.

Web Site Development

Web Architecture

The Web pages were built using ASP, the middleware that queries the mySQL database and sends the resulting data set to the Web server as html.

Figure 11
Web architecture



Creating the Search Interfaces

The map search and the geographic keyword offer the user different ways to execute queries within the SQL database populated with the metadata exported from the ArcMap attribute table. This section provides an overview of the technical aspects of constructing the geographic keyword and map search functions.

Geographic Keyword Search Construction

The geographic keyword search allows the user to select terms from the database fields which provide geographic access using drop-down menus: landmark, U.S.G.S. 7.5' series topographic quadrangle name, county, and date. The landmark field is the most specific; one landmark may fall into the footprint of two photographs at most. The user can choose the topographic quadrangle name for a broader search. The county drop-down box is provided as another option and can act as a limit to the topographic quadrangle option, as do the date range selection boxes.

Creating Images for the Map Search

The capability of ArcGIS to export screen views as images was used to create jpeg images showing the flight lines for each year in a specific county for the map search function. Using the "selection by attributes" function in ArcMap, the point data representing the nadir of each photograph was selected for each county and for each year.

In preparing to export the images, the team investigated cartographic elements that would allow users to effectively select their area of interest. The 1:100,000 DRGs, while useful for indexing the photographs, were not a clear backdrop for the exported maps. The details were indistinct at the scale needed to view all of one county. The project team decided that, basic data such as state and county boundaries, populated areas, generalized roads and hydrology, and relief would give most users enough information to select an area. The center point features were layered over this data and exported to be used on the Web site.

The main map search page uses a digital elevation model painted relief image of Colorado at a scale of 1:250,000 created by the Colorado Bureau of Land Management (1998). The relief image used for the images of the individual counties is a grayscale shaded relief image of the state from the Colorado Office of Emergency Management (1999) that the project team re-colored. The roads, lakes, cities, county, and state layers used in the county images were all downloaded from the Colorado Department of Transportation Web site.

Initially, the project plan called for exporting the plotted center points as they were displayed in the ArcGIS project. Because the team decided not to use a Web GIS, html image maps were chosen as a low-tech solution to create a spot index that would be hyperlinked to the thumbnails and metadata. It quickly became apparent that it would be too time consuming to map 1,700 points to create the image maps. A line index was chosen as a compromise. The added capabilities of the geographic keyword search make the index more thorough and more flexible the traditional line index.

The Web developer created line indices using Photoshop 6.0 using the spot index images exported from ArcMap as a base. The image maps linking to the appropriate search results were created using Dreamweaver MX.

Web Site Navigation

During the Web development, the project team attempted to make the site navigation prominent and intuitive. The bullets below outline a few of the key navigational aspects of the site.

- A horizontal navigation bar at top of each screen allows users to move between the homepage, keyword search, and browsing map.
- From the county map screen, there are two ways to navigate to a different county: adjacent counties on the map are hot linked and a form on the left of the screen with drop down menus allows the user to select a different county and year.
- On the results pages, the search criteria, number of hits, and a “new search” link are displayed at the top of each page. If a query does not generate any hits, the system suggests alternative searches based on the original search criteria.
- On the access image page, the main frame contains the aerial photo and the smaller horizontal frame contains the complete metadata record. This design allows users to scroll to any part of the image and still see the metadata. Users can navigate north or south to other access images without returning to result set.

User Needs Assessment and Usability Testing

Functional specifications for the pilot Web site were based on the experience of team members, who have extensive knowledge of the materials and frequent contact with users, as well as anecdotal input from potential users. Once the pilot site was completed, the team decided to perform a formalized user needs assessment to confirm or rethink assumptions made about the functional specifications. The needs assessment is currently underway. Target audiences have been identified and interview questions have been written. The next steps are to recruit participants who represent the site’s target audiences and conduct the interviews.

In addition to reframing functional specifications based on a user needs assessment, the pilot Web site is being tested for usability. The team chose two usability inspection methods, heuristic evaluation, and task analysis. In a heuristic evaluation, the site is assessed based on established Web usability criteria. The criteria selected for this test were based on several different sources. Guidance on generic usability issues came from Xerox’s Usability Special Interest Group Usability Toolkit (<http://www.stcsig.org/usability/index.html>) and Jakob Nielsen’s online article, “Ten Usability Heuristics” (http://www.useit.com/papers/heuristic/heuristic_list.html). The team also came up with a list of questions geared specifically toward problems identified during the development and deployment of the aerial photography pilot Web site. In a task analysis, potential Web site users are asked to perform a typical task. Members of the design team will observe and record notes about aspects of the site that the user found confusing or problematic. The selected tasks will be based on data collected during the user needs assessment. Findings from the usability testing will inform a future redesign of the site.

Cataloging and Metadata Provision

As discussed earlier, the print collection came to the Map Library partially inventoried and incompletely indexed, using rudimentary photomosaic indices. Detailed metadata for each photograph was assigned during the GIS indexing phase of the project. These detailed entries in the attribute table were transferred to the MySQL database and became the basis for the geographic keyword search. In addition to the granular searches possible through the database-driven Web site, the project team also wanted to increase access to the collection through traditional library cataloging and metadata standards. The collection was cataloged in the Libraries' local online catalog in Machine Readable Cataloging (MARC) format and, in accordance with the grant requirements, records were added to the Colorado Digitization Program's Western Trails database using Dublin Core metadata.

Planning the cataloging

With approximately 1,700 photographs digitized as part of this initial project, each with a detailed entry in the GIS index, creating single catalog records for each photograph seemed not only unwieldy but unnecessary. It was thought that set-level bibliographic records would provide sufficient keyword and subject access through the Libraries' catalog and would point to the project Web site, where the user could then perform even more advanced searches through the enhanced GIS index. A metadata crosswalk would then be developed to semantically map the MARC records into Dublin Core-compliant metadata.

Having decided upon set-level records, the collection needed to be grouped into sets for cataloging. The collection does not have natural administrative divisions that form convenient sub-groups. The aerial photographs are cartographic materials and should be organized in a way that makes sense spatially. They needed to be cataloged in such a way as to demonstrate not only a flight line's spatial relationship to the other flight lines, but also its geographic context within Colorado. The team decided to create set-level catalog records organized by county and the year the photographs for that county were taken (a total of twenty-two set-level bibliographic records), as well as one collection-level record for the entire project. Each set-level record would be given a spatially-oriented title, indicating geographic location and date (e.g., *Aerial photographs of Colorado. Boulder County, 1938*). Organizing the records this way would further function to have them all display together alphabetically in the catalog, and thereby aid browsing.

The aerial photographs were cataloged in accordance with several standards: the second edition (2002 revision) of the *Anglo-American Cataloging Rules (AACR2)*, the *Library of Congress Rule Interpretations*, *Cartographic Materials: A Manual of Interpretation for AACR2, 2002 revision*, the *Library of Congress Subject Headings*, the *Library of Congress Subject Cataloging Manual* and the third edition of the Online Computer Library Center's (OCLC) *Bibliographic Formats and Standards for MARC 21*. Knowing that the metadata in the MARC records would eventually be crosswalked into Dublin Core for the CDP added another layer of planning, as well as compliance with another standard: the CDP's *Western States Dublin Core Metadata Best Practices*

(<http://www.cdpheritage.org/resource/metadata/index.html>). Because the project team wanted to provide as much exposure to the project as possible, it was decided that original set-level and collection-level catalog records would be created in the OCLC for inclusion in WorldCat online union catalog, and then exported to the local database.

Performing the cataloging

The records were created using a MARC template for cartographic materials, which included information about the fact that these are remote sensing images and the electronic reproduction aspect of the collection. Notable access points in the catalog record include:

- The bounding coordinates used in the collection-level and set-level records are rounded to fifteen-second intervals.
- Main entry was given to the United States Forest Service, since they are the corporate body responsible for taking the photographs.
- Although the photographs digitized in this initial phase of the project all had the same United States Department of Agriculture code symbol for aerial photography (BOW), the team decided that having an access point for that symbol, while seemingly redundant for these records, will be useful as other parts of the collection containing photographs with different project symbols are digitized and cataloged.
- Because the title structure of the set-level records is hierarchical [i.e., the first part of the title refers to the collection (*Aerial photographs of Colorado*), and the second part of the title refers to the set/county (e.g., *Boulder County, 1938*), a direct-order alternative title was added to the records. Therefore, the alternative title for *Aerial photographs of Colorado. Boulder County, 1938* is *Aerial photographs of Boulder County, Colorado, 1938*.
- Subject access was provided using geographic subject headings for names of the state and counties, as established in the controlled vocabulary of the *Library of Congress Subject Headings*. Names of the U.S.G.S. 1:24,000 topographic quadrangles represented in each set-level record were given in a geographic coverage note (MARC 522 field). This topographic map series is so commonly used that it is a de facto reference point for a geographic area and the inclusion of the quadrangle names in the catalog record provides a very important access point. As with the assignment of metadata in the attribute table, the form of the name for these topographic quadrangles was validated against its entry in the United States Geological Survey's Geographic Names Information System (GNIS) (<http://geonames.usgs.gov/>).
- An electronic reproduction note (MARC 533) was added to describe the photographs in their digitized form. It includes information on file size, mode of access, as well as scanner and software specifications.

Figure 12
Collection-level public display record

Chinook Library Catalog

[Start Over](#)
 [Recall/ Hold](#)
 [Save to List](#)
 [MARC Display](#)
 [Return to Browse](#)
 [Another Search](#)

TITLE
 View Entire Collection
 System Sorted
 Search

Record: [Prev](#) [Next](#)

Corp author Title Edition Publisher Descript. Subject	United States. Forest Service [Aerial photographs of Colorado] [electronic resource] / [United States Forest Service] Scale ca. 1:20,000 ; (W 109°07--W 102°00/N 41°00--N 37°00) [Washington, D.C. : United States Forest Service, 1938-1947] 1699 remote-sensing images ; 18 x 24 cm. and 23 x 23 cm Colorado -- Aerial photographs Still image. dct Computer network resources. local	Repeat Search in: Prospector Repeat Search in: CU Law Library Auraria CU Denver CU Health Sciences CU Colorado Springs Center for Research Libraries
----------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Click on the following to:

[Access aerial photographs online](#)

Note Summary Lib format Note Other name Other title Contract # OCLC #	Vertical images Title supplied by cataloger Flight symbol: BOW Bounding coordinates rounded to 15-second intervals Collection of 1699 black and white aerial photographs taken in 1938, 1940, 1946, and 1947 Electronic reproductions. Boulder, Colo. : University of Colorado. Map Library, 2003. 1699 digital images : image/JPEG (thumbnail), 72 ppi ; image/JPEG (access), 150 ppi ; image/TIFF (master), 600 ppi. Mode of access: World Wide Web. Scanned on Epson Expression 1640XL scanner. Images processed with Adobe Photoshop 7.0 Contact the Map Library at the University of Colorado for information on copyright restrictions applying to the use or reproduction of these images Colorado Digitization Program Website title: Aerial photographs: viewing the changing landscape of Colorado BOW Funded by a grant from the Institute of Museum and Library Services administered by the Colorado Digitization Program for its Western Trails Project 55655222
------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Figure 13
Collection-level MARC display

Chinook Library Catalog		Start Over	Regular Display	Return to Browse	Another Search
LEADER	00000nec 2200421Ia 45 0a				
001	55655222				
003	OCOLC				
005	20040615025942.0				
006	m c s				
007	ru bcubbaa				
007	cr bn-024maama				
008	040615i19381947dcu z f 0 z d				
034	1 a b20000 dW1090700 eW1200000 fW0410000 gN0370000				
040	COD cCOD				
043	n-us-co				
049	GWRE				
052	4310				
110	1 United States. bForest Service				
245	10 [Aerial photographs of Colorado] h[electronic resource] / c[United States Forest Service]				
246	1 iWebsite title: aAerial photographs: bvviewing the changing landscape of Colorado				
255	Scale ca. 1:20,000 ; c(W 109°07--W 102°00/N 41°00--N 37°00)				
260	[Washington, D.C. : bUnited States Forest Service, c1938- 1947]				
300	1699 remote-sensing images ; c18 x 24 cm. and 23 x 23 cm				
500	Vertical images				
500	Title supplied by cataloger				
500	Flight symbol: BOW				
500	Bounding coordinates rounded to 15-second intervals				
520	Collection of 1699 black and white aerial photographs taken in 1938, 1940, 1946, and 1947				
533	Electronic reproductions. bBoulder, Colo. : cUniversity of Colorado. Map Library, d2003. e1699 digital images : image /JPEG (thumbnail), 72 ppi ; image/JPEG (access), 150 ppi ; image/TIFF (master), 600 ppi. nMode of access: World Wide Web. nScanned on Epson Expression 1640XL scanner. nImages processed with Adobe Photoshop 7.0				
536	Funded by a grant from the Institute of Museum and Library Services administered by the Colorado Digitization Program for its Western Trails Project				
540	Contact the Map Library at the University of Colorado for information on copyright restrictions applying to the use or reproduction of these images				
651	0 Colorado vAerial photographs				
655	7 Still image. 2dct				
655	7 Computer network resources. 2local				
710	2 Colorado Digitization Program				
730	0 BOW				
856	40 zAccess aerial photographs online uhttp:// ucblibraries.colorado.edu/aerialphotos/home.asp qimage/ jpeg				
946	cc				

Figure 14
Set-level public display record

Chinook Library Catalog

[Start Over](#)
 [Recall/ Hold](#)
 [Save to List](#)
 [MARC Display](#)
 [Return to Browse](#)
 [Another Search](#)

TITLE
 [View Entire Collection](#)
 System Sorted

Record: [Prev](#) [Next](#)

Corp author United States. Forest Service
Title **[Aerial photographs of Colorado. Boulder County, 1938] [electronic resource] / [United States Forest Service]**
Edition Scale ca. 1:20,000 ; (W 105°42'00--W 105°03'15/N 40°15'45--N 39°54'45)
Publisher [Washington, D.C. : United States Forest Service, 1938]
Descript. 121 remote-sensing images ; 18 x 24 cm
Subject Colorado -- Aerial photographs
 Boulder County (Colo.) -- Aerial photographs
 Still image. dct
 Computer network resources. local

Click on the following to:

[Access aerial photographs online](#)

<p>Note Vertical images Title supplied by cataloger Flight symbol: BOW Bounding coordinates rounded to 15-second intervals</p> <p>Summary 121 black and white aerial photographs taken May 8, Oct. 25-26, and Oct. 29, 1938</p> <p>Note Photographs cover portions of the Allens Park, Longs Peak, Ward, Nederland, Panorama Peak, Raymond, Gold Hill, Tungsten, Pinewood Lake, Lyons, Boulder, and Eldorado Springs 1:24,000 topographic quadrangles</p> <p>Lib format Electronic reproductions. Boulder, Colo. : University of Colorado. Map Library, 2003. 121 digital images : image/JPEG (thumbnail), 72 ppi ; image/JPEG (access), 150 ppi ; image/TIFF (master), 600 ppi. Mode of access: World Wide Web. Scanned on Epson Expression 1640XL scanner. Images processed with Adobe Photoshop 7.0</p> <p>Note Contact the Map Library at the University of Colorado for information on copyright restrictions applying to the use or reproduction of these images</p> <p>Provenance Gift of the Department of Geography, University of Colorado at Boulder</p> <p>Other name University of Colorado, Boulder. Dept. of Geography Colorado Digitization Program</p> <p>Other title Website title: Aerial photographs: viewing the changing landscape of Colorado Aerial photographs of Boulder County, Colorado, 1938 BOW</p> <p>Contract # Funded by a grant from the Institute of Museum and Library Services administered by the Colorado Digitization Program for its Western Trails Project</p> <p>OCLC # 54314638</p>	<p>Repeat Search in: Prospector</p> <p>Repeat Search in: CU Law Library</p> <p>Auraria CU Denver</p> <p>CU Health Sciences</p> <p>CU Colorado Springs</p> <p>Center for Research Libraries</p>
-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Figure 15
Set-level MARC display

Chinook Library Catalog		Start Over	Regular Display	Return to Browse	Another Search
LEADER	00000nec 2200000Ia 4500a				
001	54314638				
003	OCoLC				
005	20040202014700.0				
006	m c s				
007	ru bcubbaa				
007	cr bn-024maama				
008	040202s1938 dcu z f 0 z N/A d				
034 1	a b20000 dW1054200 eW1050315 fN0401545 gN0395445				
040	COD cCOD				
043	n-us-co				
049	GWRE				
052	4313 b.B6				
110 1	United States. bForest Service				
245 10	[Aerial photographs of Colorado. pBoulder County, 1938] h[electronic resource] // c[United States Forest Service]				
246 1	iWebsite title: aAerial photographs: bvviewing the changing landscape of Colorado				
246 3	Aerial photographs of Boulder County, Colorado, 1938				
255	Scale ca. 1:20,000 ; c(W 105°4200--W 105°0315/M 40°1545--N 39°5445)				
260	[Washington, D.C. : bUnited States Forest Service, c1938]				
300	121 remote-sensing images ; c18 x 24 cm				
500	Vertical images				
500	Title supplied by cataloger				
500	Flight symbol: BOW				
500	Bounding coordinates rounded to 15-second intervals				
520	121 black and white aerial photographs taken May 8, Oct. 25-26, and Oct. 29, 1938				
522	Photographs cover portions of the Allens Park, Longs Peak, Ward, Nederland, Panorama Peak, Raymond, Gold Hill, Tungsten, Pinewood Lake, Lyons, Boulder, and Eldorado Springs 1:24,000 topographic quadrangles				
533	Electronic reproductions. bBoulder, Colo. : cUniversity of Colorado. Map Library, d2003. e121 digital images : image/ JPEG (thumbnail), 72 ppi ; image/JPEG (access), 150 ppi ; image/TIFF (master), 600 ppi. nMode of access: World Wide Web. nScanned on Epson Expression 1640XL scanner. nImages processed with Adobe Photoshop 7.0				
536	Funded by a grant from the Institute of Museum and Library Services administered by the Colorado Digitization Program for its Western Trails Project				
540	Contact the Map Library at the University of Colorado for information on copyright restrictions applying to the use or reproduction of these images				
541	Gift of the Department of Geography, University of Colorado at Boulder				
651 0	Colorado vAerial photographs				
651 0	Boulder County (Colo.) vAerial photographs				
655 7	Still image. 2dct				
655 7	Computer network resources. 2local				
710 2	University of Colorado, Boulder. bDept. of Geography				
710 2	Colorado Digitization Program				
730 0	BOW				
856 40	zAccess aerial photographs online uhttp:// uchlibraries.colorado.edu/aerialphotos/countymap.asp?CID=1 &YR=1938 qimage/jpeg				
946	af				

Once the MARC records were created and added to the OCLC union catalog and that of the University Libraries, the metadata was mapped semantically to Dublin Core (see fig. 16). A crosswalk (see fig. 17) of the metadata was sent to the CDP for loading into its Western Trails database (<http://www.cdpheritage.org/westertrails/index.html>). While most all of the metadata transferred smoothly, the syntax for expressing bounding coordinates in MARC differs from the syntax of the Dublin Core Metadata Initiative's Box Encoding Scheme (<http://dublincore.org/documents/dcmi-box/>). Therefore, the bounding coordinates could not be directly crosswalked from MARC, and required manual manipulation in Dublin Core.

Figure 16
Set-Level Dublin Core Record for Western Trails Database

The screenshot shows a web browser displaying the 'Full Record' page for a record in the Western Trails database. The page has a dark red header with the 'Western Trails' logo and navigation tabs. The main content area is white with a dark red border. On the right side, there is a 'Search Results' sidebar. The record details include fields for Title, Creator, Link, Publisher, Description, Date Digital, Subject(s), Type, Source, Relation, Coverage, Format, Create, Rights, and Project. Navigation buttons for 'Previous', 'Next', 'Results', and 'Save' are visible at the top and bottom of the record area. The footer contains information about the project's collaborative efforts and funding.

Western Trails
A Cultural Journey

You are here: Western Trails > Western Trails Collections > Full Record

Trails Through Time Exhibits | Western Trails Collections | Trails for Teachers | About Western Trails

Collections Home | New Search | History | Saved Records | Databases | Help | Exit

Full Record

Record: 23 | Jump to: 1 11 21

Previous | Next | Results | Save

Save Record

Title [Aerial photographs of Colorado. Boulder County, 1938]
Aerial photographs of Boulder County, Colorado, 1938

Creator United States. Forest Service

Link <http://www-libraries.colorado.edu/aerialphotos/countymap.asp?CID=1&YR=1938>

Publisher University of Colorado. Map Library

Description 121 black and white aerial photographs taken May 8, Oct. 25-26, and Oct. 29, 1938. Title supplied by cataloger. Vertical images; bounding coordinates rounded to 15-second intervals; flight symbol: BOW.

Date Digital 2003

Subject(s) Colorado -- Aerial photographs
Boulder County (Colo.) -- Aerial photographs

Type image

Source 121 remote-sensing images ; 18 x 24 cm.

Relation Western Trails Project World Wide Web Western Trails Project

Coverage westlimit=105.7; eastlimit=105.054167; northlimit=40.2615; southlimit=39.9125 Photographs cover portions of the Allens Park, Longs Peak, Ward, Nederland, Panorama Peak, Raymond, Gold Hill, Tungsten, Pinewood Lake, Lyons, Boulder, and Eldorado Springs 1:24,000 topographic quadrangles.

Format image/tiff JPEG (thumbnail), 72 ppi ; JPEG (access), 150 ppi ;
Create TIFF (master), 600 ppi. Scanned on Epson Expression 1640XL scanner.

Rights Contact the Map Library at the University of Colorado for information on copyright restrictions applying to the use or reproduction of these images.

Project University of Colorado, Boulder - Earth Science

Record: 23 | Jump to: 1 11 21

Previous | Next | Results | Save

Search Results

You Searched for:
kw: aerial photographs of colorado

26 Hits Found

Refine | Sort

Western Trails

-Western Trails Project: 26

Western Trails was created through the collaborative efforts of:
The Colorado Digitization Program, the state libraries and participating institutions in Colorado, Kansas, Nebraska and Wyoming.

The Western Trails Project is funded through a grant from the Institute of Museum and Library Services, a Federal agency that fosters innovation, leadership and a lifetime of Learning.

Figure 17
Dublin Core to MARC Metadata Crosswalk

Dublin Core Elements	Dublin Core Qualifiers	MARC Fields	MARC Subfields	NOTES
Title		245	ap	
	Alternative	246	a	
Creator		110	ab	
Subject		651	av	
Description	Abstract	520	a	
Publisher		533	c	remove comma at end
Date.Digital	Issued	533	d	
Date.Original	Created	997	a	
Type		655	a2	
Format	Creation	999	a	
	Use	856	q	
Identifier		856	u	
Source		300	ac	
Language		008	bytes 35-37	
Relation	IsPartOf	730	a	
	Requires	998	a	
Coverage	Spatial	255	ac	
	Spatial	522	a	
Rights Management		540	a	

Future Plans

This collaborative project between the Map Librarian, Digital Initiatives Librarian, and Electronic Resources Cataloger has given remote access to the Library's collection of historical aerial photographs of Colorado. The project used GIS technology to create an added value index. The Web site provides access to the digitized photographs through browsing and search methods that take into account the geospatial nature of the aerial photographs. Traditional library methods of cataloging and applying metadata standards give added access through the Libraries' local catalog, the CDP's Western Trails catalog, and OCLC's WorldCat.

The team plans to continue to scan and index photographs from this collection. The next stage of the project is evaluation and assessment. All aspects of the project will be evaluated based on the user needs assessment, usability testing, and observations by Map Library staff. Observations and input gathered through these assessment tools will inform choices about methodologies for indexing, cataloging and assigning metadata to the photographs, and will influence decisions about the technologies used to digitize the photographs and to give online access to them.

Acknowledgments

A portion of this paper was first presented as a poster session at the American Library Association 2004 Annual Conference in Orlando, Florida.

References

- Anglo-American Cataloguing Committee for Cartographic Materials. 2003. *Cartographic Materials: A Manual of Interpretation for AACR2, 2002 revision*. 2nd ed. Chicago: American Library Association.
2002. *Anglo-American Cataloging Rules, 2002 revision*, 2nd ed. Chicago: American Library Association.
- Bureau of Land Management, Colorado. 1998. *Digital Elevation Model (DEM) of Colorado at 1:250,000 Painted Relief Image*.
<http://www.co.blm.gov/metadata/cothemes.htm>.
- Cataloging Policy and Support Office, Library of Congress. 1996. *Subject Cataloging Manual: Subject Headings*, 5th ed. Washington, D.C.: Cataloging Distribution Service, Library of Congress.
- Colorado Department of Transportation. *Geographic Data: Statewide Data set*.
http://www.dot.state.co.us/App_DTD_DataAccess/GeoData/index.cfm?fuseaction=GeoDataMain&MenuType=GeoData. (County Boundaries, Municipal Boundaries, Highways, and Lakes data sets; accessed December 12, 2003).
- Colorado Office of Emergency Management. 1999. *Colorado Shaded Relief Grid*.
<http://www.dola.state.co.us/oem/cartography/datasset.htm>.
- Hiatt, Robert M., ed. 1989-2003. *Library of Congress Rule Interpretations*, 2nd ed. Washington, D.C.: Cataloging Distribution Service, Library of Congress.
- Neilsen, Jakob. (August 25, 2003). *Usability 101*.
<http://www.useit.com/alertbox/20030825.html> (Accessed April 8, 2004).
- Online Computer Library Center. 2002. *Bibliographic Formats and Standards*, 3rd ed. Dublin, Ohio: OCLC.
- Pierotti, Deniese. 1995. *Heuristic Evaluation - A System Checklist*.
<http://www.stcsig.org/usability/topics/articles/he-checklist.html> (Accessed April 7, 2004).
- Western States Digital Standards Group. 2003. *Western States Dublin Core Metadata Best Practices, version 1.2*.
<http://www.cdpheritage.org/resource/metadata/documents/WSDCMBP.pdf>.

Author Information

Primary Author:

Kathryn Lage

Map Librarian

University of Colorado at Boulder

University Libraries, Jerry Crail Johnson Earth Sciences and Map Library

PH: 303-735-4917

FX: 303-735-4879

katie.lage@colorado.edu

Co-Authors:

Christopher Cronin

Electronic Resources Cataloger

University of Colorado at Boulder

University Libraries

303-492-2412

christopher.cronin@colorado.edu

Holley Long

Digital Initiatives Librarian

University of Colorado at Boulder

University Libraries

303-492-7513

holley.long@colorado.edu