Proceedings of the 2nd Annual British Columbia Mine Reclamation Symposium in Vernon, BC, 1978.
The Technical and Research Committee on Reclamation

AIRPHOTOS AND COAL EXPLORATION PROCEDURE

Paper Presented by:

D.M. Galbraith

Reclamation Inspector
B.C. Ministry of Mines and Petroleum Resources
Victoria, B.C.

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AIR PHOTOS AND COAL EXPLORATION PROCEDURE

INTRODUCTION

In the last few years, aerial photography has seen increasing use in the mining industry. Air photos have been used in both exploration and development for planning and documenting work and access and in making topographic maps. Air photos clearly show topography, vegetation patterns, and ground detail as opposed to the topographic map which only indicates general topography. As such the air photo shows considerable promise with respect to environmental planning and government approvals.

Legislation states that industry shall submit plans of work which protect the environment and that bonding be set to cover the extent of disturbance created. Air photos are the best means of documenting these disturbances as it is possible to calculate from them directly the extent of a disturbed area. Another advantage with air photos is that other Ministries must be consulted in the approval of an exploration programme, and the air photo base is a format from which an appreciation of an area can be rapidly obtained.

MINISTRY OF MINES & PETROLEUM RESOURCES AIR PHOTO INVENTORY SYSTEM

The two major coal areas of B.C. are the Northeast Coal Block and the Southeast Coal Block (Figure 1). Both areas are mountainous with the Northeast having extensive alpine terrain. Coal licences of the Northeast are shown in Figure 2.

The objective of the 1977 Northeast project was to produce air photo mosaics of the major coal properties and document the exploration disturbances to date. The total mosaic coverage is shown in Figure 3. The photography and mosaics came from a number of sources. Black and white photography of Carbon Creek and East Mount Gething was provided by Utah Mines Ltd. and the mosaics with the licence boundaries were prepared by T.M. Thompson and Associates. Black and white mosaics with the licence boundaries for the Sukunka-Bullmoose, Bullmoose West Fork and Mt. Spieker properties were provided by Teck Corporation. Denison Mines Ltd. provided color mosaics with licence boundaries for the Quintette properties.

Completed mosaics showing coal licence boundaries were photographed and chronaflexes produced that were suitable for making blueprints. Mosaics were uncontrolled and the boundaries of the individual licences were therefore distorted. Controlled mosaics (ortho-photography) are costly and time consuming and the extra expense was not justifiable for this project.

Disturbances within the licence areas were interpreted and indexed on the chronaflex (Figure 4). The area of each specific disturbance was measured using a digitized planimeter and the results were summarized according to coal licence number (Figure 5).

FIGURE 1

LOCATION OF MAJOR BRITISH COLUMBIA COAL BLOCKS

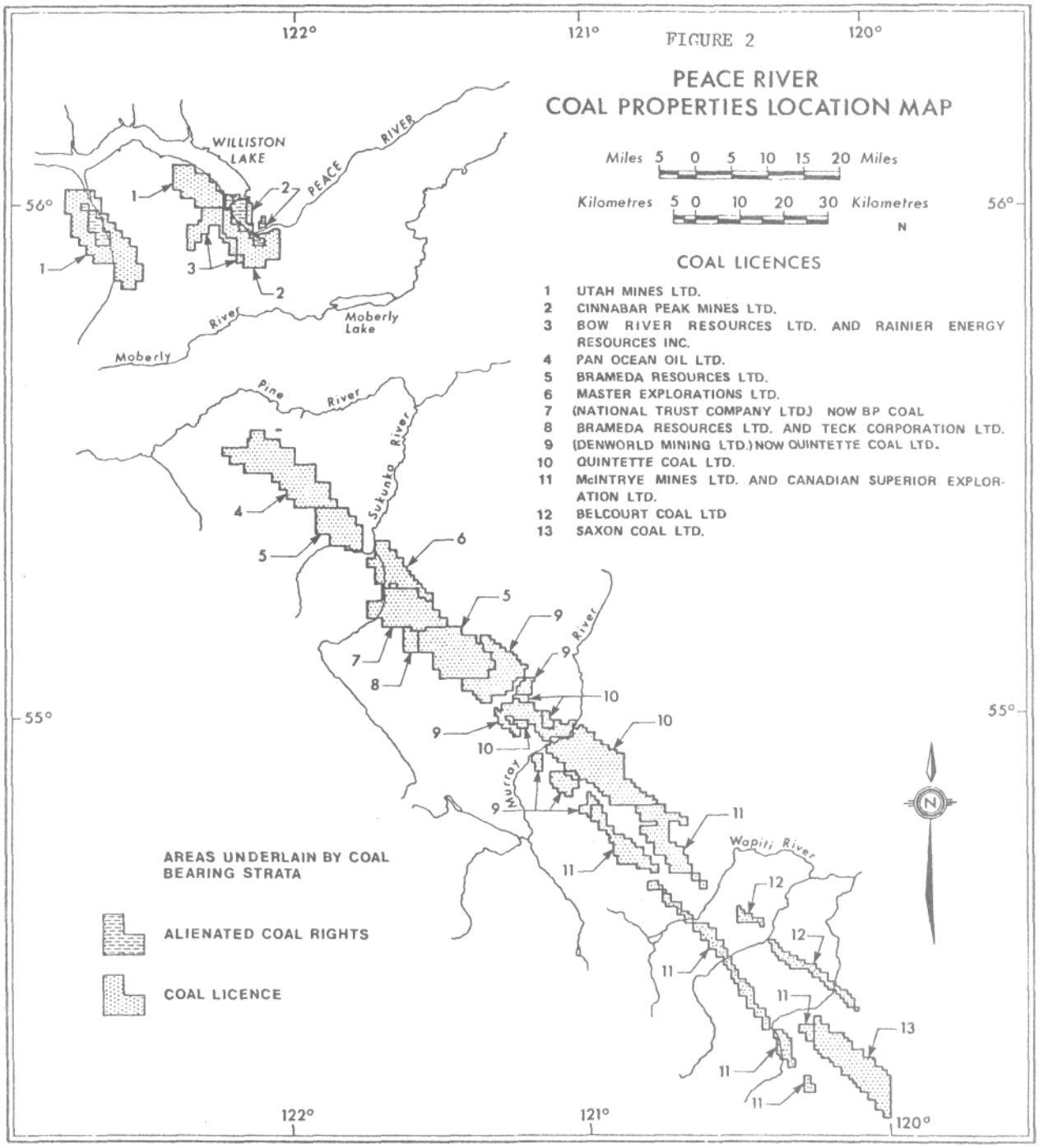
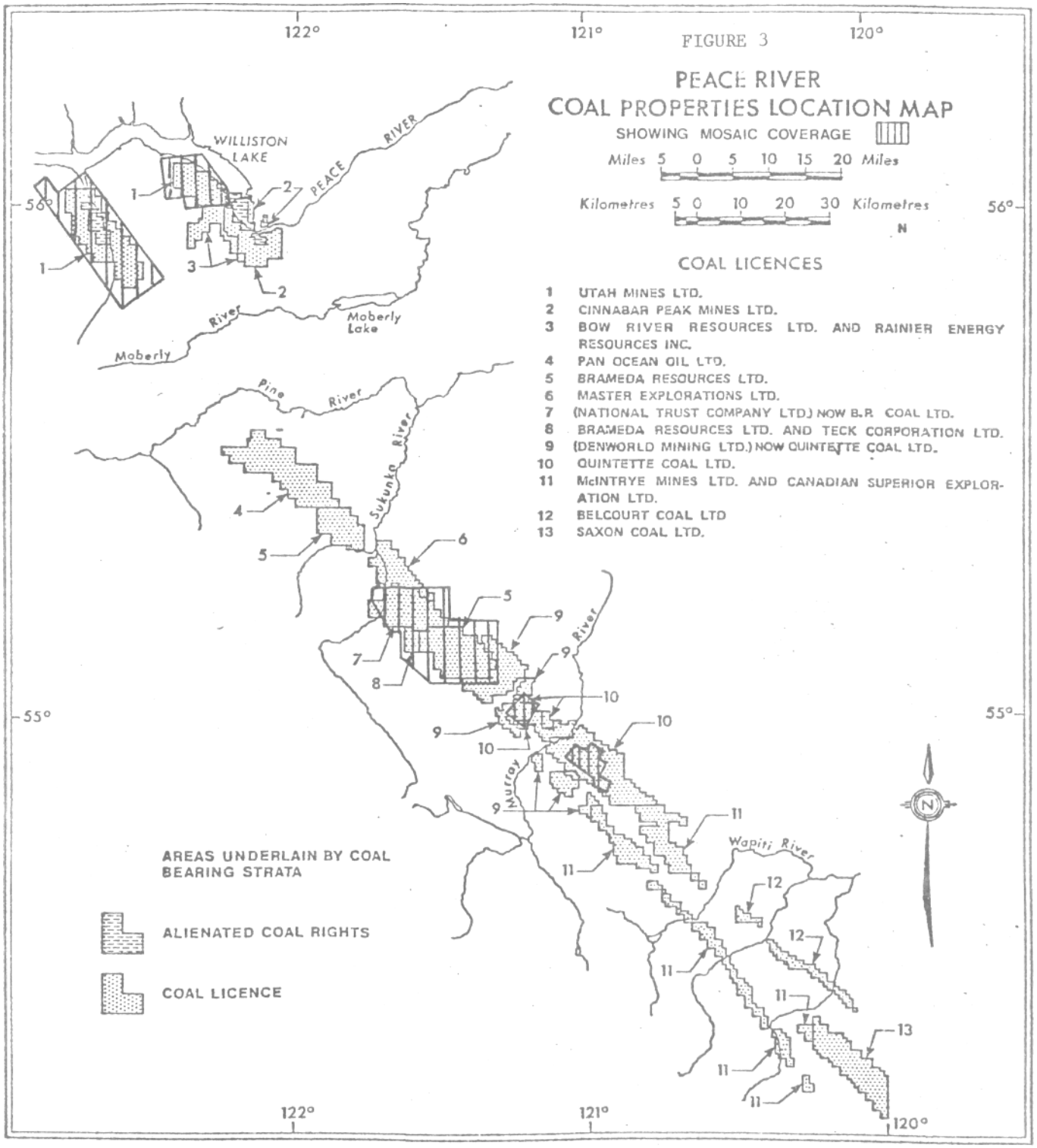

122°
121°
120°
56°
55°
PEACE RIVER
COAL PROPERTIES LOCATION MAP
Miles 5 0 5 10 15 20 Miles
Kilometres 5 0 10 20 30 Kilometres
N
COAL LICENCES
1 UTAH MINES LTD.
2 CINNABAR PEAK MINES LTD.
3 BOW RIVER RESOURCES LTD. AND RAINIER ENERGY RESOURCES INC.
4 PAN OCEAN OIL LTD.
5 BRAMEDA RESOURCES LTD.
6 MASTER EXPLORATIONS LTD.
7 (NATIONAL TRUST COMPANY LTD.) NOW BP COAL
8 BRAMEDA RESOURCES LTD. AND TECK CORPORATION LTD.
9 (DENWORLD MINING LTD.) NOW QUINTETTE COAL LTD.
10 QUINTETTE COAL LTD.
11 McINTRYE MINES LTD. AND CANADIAN SUPERIOR EXPLORATION LTD.
12 BELCOURT COAL LTD
13 SAXON COAL LTD.
WILLISTON LAKE
PEACE RIVER
Moberly River
Moberly Lake
Pine River
Sukunka River
Murray River
Wapiti River
AREAS UNDERLAIN BY COAL BEARING STRATA
ALIENATED COAL RIGHTS
COAL LICENCE

FIGURE 2

FIGURE 3


PEACE RIVER
COAL PROPERTIES LOCATION MAP
SHOWING MOSAIC COVERAGE
Miles 5 0 5 10 15 20 Miles
Kilometres 5 0 10 20 30 Kilometres
N
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121°
120°
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13 SAXON COAL LTD.
AREAS UNDERLAIN BY COAL BEARING STRATA
ALIENATED COAL RIGHTS
COAL LICENCE

FIGURE 4

SAMPLE PHOTOMAP OF COAL LICENCE L 326

SCALE: APPROX. 1:10,000

DATE OF PHOTOGRAPH: SEPT. 1976 DATE OF INVENTORY: APRIL/MAY 1977

FIGURE 5

SAMPLE FORM USED TO RECORD EXTENT OF DISTURBANCE ON EACH COAL LICENCE

COAL LICENCE NO. Lot 326

Photomap based on airphoto McElhanney 14: 95

For stereo coverage use photos BCC 143: 86, 87

Types and acreages of disturbed areas

(Mining)

ROADS				DRILL SITES		ADITS		TRENCHES		OTHER	
Sec.	Length m	Width m	Area m^2	Sec.	Area m^2	Sec.	Area m^2	Sec.	Area m^2	Sec.	Area m^2
1	380	8	2,900	1	1,850	1	14,730				
2	1,270	4	5,010			2	8,730				
3	2,120	8	16,810								
4	230	4	920								
5	560	4	2,230								
6	840	5	4,120								
7	130	3	410								
8	1,360	6	8,260								
9	460	11	5,470								
10	250	3	770								
11	150	3	460								
Total			46,860		1,850		23,460				
Grand total											72,170

7.2 ha

Disturbances caused by other operations

Sec.	Area m^2	Remarks

The cost of the program was $10,800. It was done under contract by T.M. Thompson & Associates of Victoria. Some of the details and results of the program are as follows:

Number of licences in the Northeast Coal Block = 721

Number of licences reviewed = 212 which included most of the activity.

Number of licences with exploration work done = 129 (out of 212)

Total disturbance measured = 408.7 ha (There may be another 100 ha outside the areas surveyed)

Disturbance per worked licence = 3.2 ha average

Non-mine related disturbance (seismic, forestry) = 1.2 ha average per licence

These figures summarize only disturbances within the actual coal licences and not those which lie outside. The areas of disturbance calculated by this program were found to be similar to those submitted by the companies.

REVISED PROCEDURE FOR DOCUMENTATION OF COAL EXPLORATION

Permit procedure requires that *a* "Notice *of* Work on a Coal Licence" must be submitted prior to the actual starting of field work, preferably one month in advance, in any calendar year. As well, a "Programme for Protection and Reclamation" (to be available in 1978 but presently called "Application for a Reclamation Permit"), must also be submitted where the employment of mechanical equipment is likely to disturb the surface of the land. Currently *12* copies of 1:50,000 topographic maps are requested to accompany these forms. After the summer of 1978, the "Programme for Protection and Reclamation" will be required to be documented on *2* copies of a 1:10,000 air photo base as well as the *12* copies of a 1:50,000 topographic map.

Permit procedure also requires that a "Notice of Work on a Coal Licence" be submitted within one month of completion of work. A 1:50,000 topographic map documenting the year's activities must accompany the notice of Work. A "Reclamation Report" which describes reclamation work which has been completed for the calendar year must be submitted subsequent to cessation of exploration activities. A 1:10,000 air photo base documenting reclamation activities must accompany two copies of the Reclamation Report. Formerly, a 1:50,000 topographic map was required.

The above requirements were recently reviewed in conjunction with the Geology, Titles and Economics sections of the Ministry which also make requests for information to industry. A common form of work reporting is being aimed at which will satisfy the legislative requirements of both the Coal Act and the Coal Mines Regulation Act. The objective is to have a single submission reporting on work after it is completed. The air photo base appears to be the key to integrating reporting of surface work as it allows for a reduction in the required text, maps and drawings

The Reclamation Section of the B.C. Ministry of Mines and Petroleum Resources is optimistic that much of the currently available air photo coverage can be utilized by operators who are engaged in mine exploration or production. The Airphoto Services of the Ministry of the Environment have extended their co-operation, and both color and black and white photography of twenty mine sites should be completed by the summer and be available by late fall, 1978.

Included at the end of this paper is an Information Bulletin that outlines the procedure to be used to select and obtain available aerial photography.

Further experience with air photos subsequent to the Vernon Symposium suggests a considerable improvement is possible to the use of mosaics. This involves obtaining original photography at scales of 1:25,000 or larger (thus covering several licences simultaneously) and blowing up to produce prints at a scale of 1:10,000. This procedure has been discussed with several companies in the Northeast Coal Block, who will use it in 1978 reporting of work and reclamation done. Results will be discussed at the 1979 symposium.

INFORMATION BULLETIN

GENERAL INFORMATION

The federal and provincial governments are the major sources of air photography in British Columbia. General keys to indexes of B.C. photography are available in a publication by the Surveys and Mapping Branch of the B.C. Ministry of the Environment entitled "Map and Air Photo Catalogue".

In cooperation with the National Air Photo Library, Ottawa, microfilm of federal air photography with the relevant air photo indexes and catalogues for British Columbia, Yukon, and Northwest Territories, is available for viewing at the Provincial Air Photo Library, 533 Superior Street, Victoria. These indexes are retained on 1:500,000 map scale. Air photographs shown on them can be ordered from Ottawa by writing to:

National Air Photo Library,
Dept. of Energy, Mines and Resources,
615 Booth Street,
Ottawa, Ontario. KlA OE9
Tel. (613) 998-9900 - Telex 053-4328

Provincial air photographs are indexed under block photography and special projects. The bulk of photography is contained in the block system and is available in a number of scales. These scales are 1:10000, 1:15840, 1:20000, 1:31680, 1:40000, 1:50000 and 1:63360. The special projects index is a guide to special air photography comprising several hundred projects of varying scales. Each special project has an individual index.

Two types of photography are available: colour and black and white. Most of the available photography is black and white. Colour photographs have been flown only over certain special projects; there is no general colour photography in British Columbia, and it is not

possible to obtain a colour print from a conventional black and white photograph. Colour is very useful for obtaining ground detail and vegetation patterns.

Mosaics can be made from colour or black and white photographs. Colour mosaics are a one-of-a-kind production as currently copies of mosaics can be made only in black and white. A great deal of detail and clarity is lost in duplicating colour mosaics.

Enlargements of the standard 23 cm x 23 cm air photograph are available from the B.C. Provincial Surveys and Mapping Branch. The largest blow-up for a complete photograph is a 4X enlargement measuring 92 cm x 92 cm. Portions of a standard air photo can be blown up to 6X enlargements. Air photograph qualities begin to decrease with blow-ups 4 times and greater.

Air photo mosaics are available for portions of B.C. The Map and Air Photo Catalogue previously mentioned has a key showing the areas covered by these mosaics. A more detailed key showing the location of available mosaics can be obtained by stating the exact geographical reference of your area and writing to:-

Director,
Surveys and Mapping Branch,
Ministry of the Environment,
Parliament Buildings,
Victoria, B.C. V8V 1X5
Attention: Map & Air Photo Sales Office

SELECTION OF AIR PHOTOS

The following series of steps should be followed to obtain air photographs:

Scale

Before ordering any air photos, it is necessary to determine what scale is best suited to your requirements. Mine exploration and

development usually require large scale photography to plan and document reclamation activities. For use in making 1:10,000 mosaics, 1:20,000 photography is best as it only requires 2X enlargement.

Date of Photography

The most recent photography is usually desirable.

Flight Lines and Photo Numbers

Block and special project photography are shown on index maps available at $1.00 each from the B.C. Provincial Map and Air Photo Sales Office. These index maps are also mounted on sets of aperture cards. Aperture card indexes and readers are available at the following locations:

Map and Air Photo Sales Office,
553 Superior Street,
Victoria, B.C.

Geological Survey of Canada
100 W. Pender Street,
Vancouver, B.C.
V6B 1R8

Simon Fraser University,
Geography Department
Library, Vancouver, B.C.

University of British Columbia,
Geography Department Library,

Vancouver, B.C.

If one of these locations is readily accessible then the following procedure should be used to find air photographs:

1. Locate area of concern in the appropriate air photo key in the Map and Air Photograph Catalogue. The choice of key depends upon the scale of photography.
2. Determine the geographical reference from the map.
3. Aperture cards are indexed according to scale and geographical reference. Use the geographical index for the area of concern to select the appropriate aperture card.

4. View the card in the reader. Locate exactly the desired area and record the flight lines and photo numbers that cover the area. Air photos along a flight line are plotted with approximately every 10th photo centre numbered. To determine the photo which covers an area between numbered centres, it is necessary to interpolate along the line between those centres.

5. Order air photos following the procedure outlined under ORDERING AIR PHOTOS.

If these index and reader locations are not readily accessible then photos may be obtained through the Map and Air Photo Sales Office in Victoria. Phone the office (Telephone (604) 387-3174 or 3175) and describe to them where the area is and what type of photographs are desired. They will send by mail a photo copy of the relevant index for the scale of photography required. Because several indices may cover an area, to get the correct index the area must be located by geographic place name or by the District Lot numbers within a 15' latitude/longitude square, based on the National Topographic Numbering System.

The necessary flight lines and photo numbers can be read from the index sent by the sales office.

ORDERING AIR PHOTOS

Orders for air photos should be in writing and addressed to:

Director,
Surveys and Mapping Branch,
Ministry of the Environment,
Parliament Buildings,
Victoria, B.C. V8V 1X5
Attention: Map and Air Photo Sales Office

Appendix I* shows the form to be filled out when ordering air photos. The flight numbers and air photo numbers must be included. If stereoscopic cover is not required, it is only necessary to order alternate photos along a flight line. Appendix II lists the prices on materials. Air photographs are printed to order and have NO RETURNABLE VALUE. Prepayment is required and 5% sales tax is applicable for orders within British Columbia. Cheques or money orders should be made payable to the Minister of Finance.

Portion enlargements are possible for squares off a photo as listed in Appendix II. To obtain a partial enlargement, mark the area required on a xerox copy of the air photo, in black, to be sent in with the order. The marked square must be parallel to the edges of the photograph.

It is also possible to get a blow-up to exact scale, provided the total blow-up does not exceed 4X. To do this a bar scale on a piece of mylar film of two known points on the air photo is needed, with another bar scale below it to show the desired final scale of these two points.

Diapositives of photographs are also available. Their main use is in photogrammetric mapping but they can also be used in overhead projectors to illustrate on screens, or diazo-printed to provide cheap multiple copies. For information on diapositives contact the Map and Air Photo Sales Office in Victoria.

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*The Appendices referred to are presented at the end of this seminar paper.

APPENDIX I

ORDER FORM FOR MAPS AND AIR PHOTOGRAPHS

Your Name ..... Date .....

Address .....

.....

.....

Please send me the following maps and or air photographs

Quantity	Index No.	Map No./Flight No.	Map Name/Photo Nos.	Unit Price	Amount

Add $1.00 if maps desired rolled _____

For orders delivered in B.C. add 5 per cent sales tax _____

total remittance enclosed _____

Address orders to:
Director, Surveys and Mapping Branch,
British Columbia Lands Service,
Victoria, British Columbia.
V8V 1X5
Attention: Map & Air Photo Sales Office.

Tear Here

Second Order

ORDER FORM FOR MAPS AND AIR PHOTOGRAPHS

Your Name ..... Date .....

Address .....

.....

.....

Please send me the following maps and or air photographs

Quantity	Index No.	Map No./Flight No.	Map Name/Photo Nos.	Unit Price	Amount

Add $1.00 if maps desired rolled _____

For orders delivered in B.C. add 5 per cent sales tax _____

total remittance enclosed _____

Address orders to:
Director, Surveys and Mapping Branch,
British Columbia Lands Service,
Victoria, British Columbia.
V8V 1X5
Attention: Map & Air Photo Sales Office

Tear Here

First Order

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APPENDIX II

Prices of Reprints:

Black and white	- paper	23cm x 23cm	Price per Print $1.25
Black and white	- film positive	23cm x 23cm	Price per Print $3.00
Color	- paper	23cm x23cm	Price per Print $3.00

Prices of Enlargements:

Black and white	- paper	23cm x23cm	Price per Print $3.00
Black and white	- paper	46cm x 46cm	Price per Print $5.00
Black and white	- paper	68cm x 68cm	Price per Print $10.00
Black and white	- paper	92cm x 92cm	Price per Print $15.00
Black and white	- film positive (clear or matte)	23cm x 23cm	Price per Print $5.00
Black and white	- clear or matte	46cm x 46cm	Price per Print $10.00
Black and white	- clear or matte	68cm x 68cm	Price per Print $15.00
Black and white	– clear or matte	92cm x 92cm	Price per Print $20.00

Examples of Prices of Partial Enlargements:

	Finished Size	Cost
3X of a 7.7 cm square	23cm x 23cm	$3.00
6X of a 7.7 cm square	46cm x 46cm	$5.00*
2X of a 11.5 cm square	23cm x 23cm	$3.00
4X of a 11.5 cm square	46cm x 46cm	$5.00
6X of a 11.5 cm square	69cm x 69cm	$10.00*

* only possible when the centre of the photograph falls within the boundary of the marked square.

DISCUSSION RELATED TO D.M. GALBRAITH'S PAPER

Hubert Maxwell - O.K. Syndicate. Do you have an approximate cost of the program born by the government of B.C., the cost of photography and of making this information available?

ANS. Yes. We have accurate figures for the N. E. Coal Block. It was done on contract for $10,800.00. For this sum, the photography was assembled, two mosaics and chronoflexes were made, and the disturbed area was identified and then measured using an electronic planimeter.

The Ministry of the Environment undertakes photographic assignments for other government departments. In the future, I think that this photographic capability will see increased use. We are certainly going to press for it. Provincial aerial photography already has a variety of uses such as forestry and agriculture, and I think it is time we made a case for photographic coverage by the provincial government of mining and exploration areas.

The cost to us of photography, as far as the Ministry is concerned, is merely the cost of the film. To photograph a mine site through a contracting service the cost may be in the neighbourhood of $5,000.00. It varies with the site. You can't compare the cost for a mine site that requires one photo to an exploration area that covers 100 square miles. The cost of the film, the prints and everything else is very minor compared to the cost of aircraft and aircrew rental. I can't foresee many mines paying more than two to three thousand dollars for a complete flight and print development programme.

The Ministry has a program that includes 20 major operating mines and this will be made available to industry for use in reporting reclamation activity.

At the moment we are feeling our way, but it appears that if we are going to coordinate the reporting of work, reclamation and other activities of concern to the Ministry, then the airphoto base is the optimum approach.

James Meier - Byron Creek Collieries. How often are you going to fly?

ANS. We have no plans other than the 20 mine sites that we have requested so far. If companies are contracting out their own photography, the frequency of flying will depend upon their rate of activity. For example, if a given coal exploration programme covers 40 licences (40 square miles), it may be that the activity is covered in only two square miles. In this case, the initial flying of the exploration area for the base mosaic will be the major cost. Updating of photographic data will then only require flying over the area where activity has taken place.

For an operating mine, flying every second year would be adequate, although some fly annually for their own purposes.

Ralph McGinn - O.K. Syndicate. For these 20 mine sites you are going to fly, will you be establishing survey targets on the ground?

ANS. No. For our purposes, an uncontrolled mosaic is suitable. If you want a geometrically exact mosaic, you have to go to an expensive process that is called orthophotography where you have to establish ground control. However, what we are after is a documentation of what is on the ground, and whether or not it is geometrically accurate, is beside the point. You can get ten uncontrolled mosaics for the price of a controlled one.

Martin Bik - Elco Mining Ltd. Do you have to repeat the flying and prepare a mosaic annually?

ANS. No. Photography every second year in the average case would be quite adequate for documenting a reclamation programme.

Marv Mitchell - Ranger Oil. What degree of correlation did you actually get between the aerial photography and what you found on the ground when you went in to check?

ANS. I don't know because we never checked it. However, we found that the disturbed areas as submitted, in total, were in the same "ballpark" as that measured from the maps.