are also suggestive of a current flowing in that direction.

Discrepancies in the criteria listed are of two types. A steep cut bank at the sharp bend represents a point of impingement below which gravel bars have been built. The meander is in sharp contrast to the open reaches known to be immediately north, but in accord with an ox-bow lake about 400 yards above Slate Falls.

The great number of channel scars in the central portion of the broad flood plain are semicircular, and almost concentric with the northwest-southeast stretch of the Mississaugi. These features are characteristic of the downstream side.

Trails of white water, also indicate the direction of flow. However, alternate photographs may not show reflections of light on the water due to the changes in the angle of incidence at each camera station.

These notes were prompted by an original misinterpretation based upon one set of criteria, namely the meander markings. Familiarity with the area led, logically, to a search for the anomalous criteria, which eventually proved to be misleading.

Acknowledgment is made to the Department of Lands and Forests of the Province of Ontario, Canada which supplied a copy of photograph #770-56-17 for publication. Permission was also granted by the Director Performance and Aerial Photography Division for the use of photograph QU-QS-1-123.

PHOTO INTERPRETATION IN FLOOD CONTROL APPRAISAL*

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ABSTRACT

Acreage data on land use in river flood plains, by flood frequency zones, is difficult to obtain except by field survey. This type of information was needed by the New England-New York Inter-Agency Committee in a special study of the effect of flood control dams on land enhancement, particularly on agricultural land. Time limitations on the survey and the inadequacy of other methods suggested the use of photo interpretation to provide the needed information. A procedure was developed using photo interpretation to provide acreage data on land use by flood frequency zones on the Merrimack River within the required time limits.

INTRODUCTION

THE effect of flood control dams on agricultural lands downstream was one of several special items investigated in connection with a survey of the resources of the New England-New York Area. The main question requiring an answer was how much enhancement of agricultural land was accomplished by flood control dams. The primary purpose of such dams is to reduce flood damage, but usually they provide some land enhancement due to reduction of flood hazard.

Land enhancement takes place where change to a use yielding a higher net return per acre is made possible by reduction or elimination of flood hazard. For example, sections of flood plain land subject to frequent flooding may be used only for pasture. Reduction in flood frequency may justify use of such land for growing crops. The difference in value between pasture land and cropland would be the monetary value of land enhancement in this case. The New England-New York Inter-Agency Committee was called upon to investigate the degree and monetary value of agricultural land enhancement. This type of study was requested by State agencies in New Hampshire for the Merrimack River flood plain area below a dam at Franklin

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Falls on the main river and below a dam on the Blackwater River, a tributary. Both dams were built by the Corps of Engineers, U. S. Army.

The investigation was a cooperative survey by the State of New Hampshire, Corps of Engineers, and the Agricultural Research and Soil Conservation Services of the U. S. Department of Agriculture. To accomplish the objective, a basic requirement was the determination of acreage data on the various types of land use on the flood plain—particularly the agricultural land. In addition, it was necessary to have the information on land use by areas with different frequencies of flooding, that is, the area flooded every 2 years, every 5 years, every 10 years, etc. To provide the needed data, information was needed about natural flood conditions as well as modified conditions after construction of the flood control dams.

Limitations of time and funds precluded detailed field mapping of the area. Data on agricultural land use in the area were available by counties and minor civil divisions (townships) from the 1950 Census of Agriculture, but apportioning these data to the flood plain area by percentage of township in the flood plain area would be subject to serious error. In the same way, the use of sampling techniques to determine land use created difficult problems of sample selection and the projection of sample data. Neither of the above methods could provide the data by flood frequency zones which was essential for the investigation.

At this point in the analysis of the problem the author was consulted on his experience in obtaining land use data in a somewhat similar situation, by aerial photo interpretation.[1] A study of the requirements for data and the material available led to the conclusion that photo interpretation would solve the problem. The procedure followed provides another excellent example of what the author believes to be an appropriate use of photo interpretation.

The three parts of the problem are discussed separately along with the procedure used to solve them. These include (a) the photo interpretation classes, (b) delineation of flood frequency zones, and (c) measurement of photo interpretation data.

[1] Dill, H. W. Jr., "Airphoto Interpretation Inventory and Planning," *Journal of Soil and Water Conservation*, Vol. 7, No. 2, April 1952.

Problem and Solution Procedure

THE PHOTO INTERPRETATION CLASSES

Aerial photos of the area were available from surveys of Hillsboro and Merrimack Counties, made by the former Production and Marketing Administration, U. S. Department of Agriculture. The 1:20,000 contact scale photos were used. This scale was rather small for the purpose, but the photos were recent and of good quality. A preliminary study of the photographs and consultation with the cooperating agencies indicated that satisfactory land use and other data could be obtained well within the time limits of the survey. Preliminary study of the photos indicated that the following land use items could be obtained:

Recording Symbol	*Description*
C	Cultivated cropland (plowed land, row crop and small grain)
H	Hayland
P	Permanent pasture
F	Forest
IA	Idle farmland
IU	Urban open areas, real estate development, etc.
U	Urban areas and farmsteads
I	Industrial areas outside definite urban centers
O	Other—institutions, schools, cemeteries, golf courses, airports
M	Miscellaneous—gravel pits, quarries
R	Roads, RR, power lines
W	Water
S	Swamp (large areas)
RW	River wash (heavy deposition of sand and gravel)
B	Area in river bank
Bf	River bank—forested
Bn	River bank—no cover
Bp	River bank—pasture
Bo	River bank—urban or non-agricultural
s	Apparently stabilized
e	Eroding

Example—*Bfs*: River bank, forested, apparently stabilized

In addition, the following items were obtained from photos by count or measurement:

Farm residences
Other residences
Other buildings (barns, silos, etc.)
Industrial buildings
Storage tanks
Miles of roads (main highways and others)
Miles of railroad

It was realized that there would be some error in the interpretation of classes, particularly for *P*, *IA*, and *IU*, because the cover on all three may become similar. A typical example is the situation where permanent pasture, without management or treatment and with little or no grazing, will resemble open areas growing up to grass and brush which are waiting for real estate development. For the purpose of this study, interpretation was based, in some cases, on the location and relationship to the surrounding area. Land use areas determined by photo interpretation were outlined on the photos with china marking pencils, and were annotated with the appropriate symbols listed above.

DELINEATION OF FLOOD FREQUENCY ZONES

Subsequent to the interpretation of the various land use classes in the flood plain area, it was necessary to locate these units by the flood frequency zones in which they occurred. Information on flood frequency for both the natural and modified conditions was made available by the Corps of Engineers. Using this information, the flood zone boundaries were established by using a Kelsh Plotter and the available photos. A projector was used to transfer the flood zone boundary lines to transparent overlays. These overlays were placed over the photos on which interpretation data had been recorded. It was then possible to locate a given unit of land use, both in the natural and modified flood frequency zone, by using the appropriate overlay.

MEASUREMENT OF PHOTO INTERPRETATION DATA

The final part of the problem to be solved was the area measurement of the land use flood-frequency zone units which could be determined by use of the annotated photo and the overlay. Due to the small scale of the photos, measurement of these areas individually by planimeter appeared to be impractical as well as time consuming. After some testing, the following procedure was adopted to get the needed information:

The area of a given flood plain segment was determined by planimeter. Areas of each land use class, by flood frequency zone, were determined by dot count, using a transparent dot grid superimposed on the flood frequency overlay and the annotated photo. The grid count process included both area measurement and interpretation, and provided data on items that could not be measured by planimeter. Such items included the areas occupied by roads, railroads, powerline rights-of-way, narrow bands of trees, small gravel pits and farmsteads. It was believed that by this system due weight could be given to all land use items within the flood area and still minimize errors in area measurement. Dot counts for each land use-flood frequency zone class were totaled and the percentage of each class was computed, based on the total dot count for a given flood plain segment. These percentages were then applied to the area of the flood plain segment as determined by planimeter to obtain the acreage for each land use-flood frequency class.

CONCLUSION

By use of the procedure above described, the following results were accomplished:

1. Suitable acreage data by land use-flood frequency classes were obtained with great savings in time, funds and personnel.
2. Over-all information for the entire area was provided, as opposed to using samples and projection.
3. Error was minimized to that occurring between classes in the case of interpretation and within segments for area measurement.
4. The data provided were up-to-date for the time of photography (1952); if census data had been used, it would have been for 1949.