

# THE EXECUTION OF ENGINEERING SURVEY AND MAP PROJECTS WITH WPA ASSISTANCE\*

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IT IS, I believe, of interest to the members of the American Society of Photogrammetry to know the extent to which the Work Projects Administration is assisting in the field of surveying and mapping. The work executed with the aid of WPA is of such volume that it becomes important for the professional and technical groups to have a detailed knowledge of operations and procedures as well as of the general activities. It is the opinions and standards set up by such groups upon which we largely depend in formulating the course that is followed in the operation of the survey and mapping projects.

The purpose of this paper, in general, is to describe the operation of engineering survey projects, including the development of such projects, the types of surveys executed, the volume of work in operation, the actual and potential results of such a program, and the value of training personnel in order to qualify them for employment in private industry.

I am sure this group appreciates that within the scope of a comparatively brief paper, the details of past operations and results accomplished to date cannot be given just consideration. I will attempt, however, to point out the essentials which should be brought to your attention, because future success is largely a matter of practical help which you may render.

## NEED FOR ACCURATE SURVEYS AND MAPS

The members of this Society are familiar with the need for accurate surveys and maps throughout the United States. Even in the urban areas, where more than 50% of our people live, the lack of survey and map information is astonishing. Except in a few instances, city, county, and state governments have obtained such data from time to time for immediate purposes, rather than by a well-organized survey program for application to long-range planning and operation. To a large extent, this information has been collected in piecemeal fashion, in proportion to the amount of public funds available from local sources.

In the same way, since the inception of WPA, various projects for executing surveys and preparing maps have been proposed, which appeared to be based on single-purpose objectives with little regard for future use, and which were to be prosecuted by the use of obsolete methods and equipment. It has been the policy of the Work Projects Administration, therefore, to develop and recognize projects which will serve future planning purposes without duplicating the work of other local, state, and Federal agencies.

In the year 1941, I do not believe that there is any justification for the often repeated statement that "Land values do not justify the expenditures required for the execution of accurate surveys." Our rapidly changing times increasingly require that surveys and survey methods keep pace with the changes in our everyday life. In addition, we are now undertaking a great national defense program, which requires in many fields of activity a co-ordination and an economy of energies, such as can be effected only through the information provided by adequate maps and surveys. A time element is vitally involved in the prosecution of the defense program, and this in turn has an important bearing on our

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survey and map program, immediate and future. It is in view of these important considerations, as well as of the normal needs of local, state, and Federal agencies, that I bring to your attention the work in this field now being executed under the WPA program.

#### WPA OPERATION

The WPA assists in the execution of surveys, in the preparation of various types of maps, and in the collection of information for plotting upon existing maps. The work of making maps, rather than the use of maps, is of principal importance to this Administration. Engineering surveys and maps are made by the WPA as project work, sponsored by public agencies having legal authority to engage in such activities for their own purposes or for the benefit of the general public. The expressed desires and needs of the sponsors appear to be of wide variety.

In general, the agencies legally authorized to sponsor WPA projects of an engineering survey nature consist of the following: Federal Agencies; city, township, and county engineering departments; boards of selectmen; state public works departments; state and local boards of education; state universities and colleges; conservation departments; state and county highway departments; state and local planning boards; aviation commissions; state bureaus of mines; and the U. S. War and Navy Departments, etc.

To initiate a WPA project, it is required that a Project Proposal, Form 301, be submitted by the sponsoring agency to the local WPA office. In conformity with the provisions of the current Relief Act and the administrative regulations, the average sponsor's contribution for all projects operating within a state must represent 25% of the total project cost, and at least 95% of the project personnel must be taken from the certified relief rolls. The remaining 5% may be employed on a non-certified basis and may be paid in excess of the security wage rates. If desirable, the state administrator may permit a 10% exemption, provided that only 5% of the project personnel receives more than security wages. These percentages need not apply to projects certified as being of importance for military purposes, provided approval of additional exemptions is obtained from the Washington office.

The sponsor's contribution consists of material, equipment, supplies, and other non-labor items, such as office rental, transportation, etc. In the operation of engineering survey projects, it is highly important that the technical supervisors and other key supervisory personnel be employed by the sponsor. This arrangement stabilizes the supervision and the fluctuation in the lower employment brackets of WPA has little effect upon the unit costs of the work. Naturally, too, this arrangement develops greater interest on the part of the sponsor. If WPA should be unable to complete the job, the sponsor would be familiar with all phases of the work and could continue it under a smaller program entirely financed by sponsors' funds.

#### TYPES OF PROJECTS OPERATED

Although there are many varied types of surveys executed with the assistance of WPA, the general types are as follows:

- Geodetic Control
- Topographic
- Boundary
- Underground and Surface Structures
- Hydrographic

Geologic  
 Cross Sections and Profile  
 Drainage and Flood Control  
 Soil  
 Test Borings, Pits, and Cores  
 Surface and Underground Water Resources  
 Aerial Photographic  
 Building Locations  
 Plans of Existing Public Buildings  
 Defense Mapping

Many of the projects submitted include only one type of survey, but a consolidated or master project may be initiated which proposes several major items. The master project is usually developed when the local sponsor is planning a long-range survey program, or for the purpose of facilitating the technical and administrative supervision of the work.

#### VOLUME OF PROJECTS

Since the engineering survey projects were transferred to the Engineering Division in June 1939, the data concerning the volume of work, the amount of Federal funds involved, sponsors' funds pledged, and the personnel are approximately as follows:

Number of applications approved . . . . .	442
Federal funds approved . . . . .	\$20,395,239
Sponsors' funds pledged . . . . .	\$ 4,888,284
Number of WPA jobs made available . . . . .	23,096
Sponsors' personnel . . . . .	889

Since the inception of WPA, the peak year in regard to the amount of Federal funds approved for engineering survey projects was in 1938, when approximately 50 million dollars were approved to carry on this work. During this period, however, approximately 75% of the amount of funds representing these projects were actually expended.

The type of work in this field which appears to be of greatest interest to sponsoring agencies is the survey of underground and surface utility structures. The mapping of public and private utilities has evidently been neglected in this country for many years. A large percentage of the urban areas have little or no information in regard to these structures, except those that have been constructed within recent years.

#### CONFORMANCE WITH STANDARD PROCEDURES

The policy of this Administration concerning the operation of the survey projects has been that such work conform to the best engineering practice resulting from the standards established by professional societies, and those recommended by various Federal agencies having years of experience in the survey and mapping field.

In the operation of projects executing geodetic control in the urban or metropolitan areas, the work must conform to the procedures established in Manual No. 10, *Technical Procedure for City Surveys*, adopted by the American Society of Civil Engineers in 1934. On projects of this type for rural or statewide areas, the specifications of the U. S. Coast & Geodetic Survey are required, and the project applications are referred to that agency for comment and recommendation before the final review is completed.

One of the phases in the mapping program that has been somewhat disturbing is the apparent lack of concern for appropriate map scales. This Administration has been requested to assist in preparing maps of both urban and rural areas in which the proposed map scales did not conform to "standard scales." The sponsor's reason for proposing odd scales is generally based upon the desire to match old available maps that have become obsolete. It has been the policy of the Work Projects Administration to recommend a scale of  $1'' = 200'$  as a standard scale for topographic maps in urban areas, with contour intervals ranging from one to five feet, depending upon the maximum difference in elevation. The various types of maps needed for operation on large scales, such as utility structure surveys, block maps, tax maps, etc., should be an even divisor of 200 feet. Such scales not only facilitate reproduction problems, but are advantageous when used by architects. Small scale maps in urban or rural areas are recommended to be  $1'' = 400'$ ,  $800'$ ,  $1,000'$ , etc.

#### OPERATING SEQUENCE OF SURVEY PROJECTS

An important factor in a well-organized engineering survey program is believed to be the sequence in which the projects are operated. It has been the experience of WPA during the past five years that, in many areas, sponsoring agencies appear to give little consideration to the proper succession of surveys and maps. There may be instances where it is advisable to deviate from the order of priority established by the best engineering practices. Such changes are necessitated by local conditions, and particularly by financial circumstances. The WPA has found that the most satisfactory operating sequence for engineering surveys in the average urban area, which is the result of experience with all types of surveys executed under the WPA program, is as follows:

1. Geodetic Control
  - a. Triangulation
  - b. Traverse
  - c. Levels
2. Topographic
3. Restoration and Monumenting Boundaries
  - a. Section Line
  - b. Urban
  - c. Street and Road
  - d. Block
4. General Mapping
  - a. Street and Property Line
  - b. Land Classification
  - c. Tax Maps
5. Underground and Surface Structures
6. Cross Sections and Profiles
7. Riparian, Stream, and Hydrographic
8. Drainage and Flood Control

When project applications are submitted which appear to lack the proper continuity of operations, complete justification is requested from the sponsoring agency through official channels of this Administration.

#### VALUE OF RESULTS

As the execution of engineering surveys and the collection of accurate map information are essential to any community development or long-range public

planning program, the projects operated under the WPA program in this field are believed to be a valuable contribution to the general public. These surveys establish a basis for all future surveys, and the preparation of much needed maps afford the sponsoring agencies valuable factual information from which to plan future operations efficiently and economically.

Surveys and map information are, of course, important factors in the construction program. The need for such information is generally recognized as more acute because of the demands of a comprehensive defense program. It appears to have been the lack of preliminary surveys, plans, estimates, and layout surveys that constituted a "bottleneck" in the construction of airports. This is particularly true because the time element is now of primary concern. Local sponsors have not been able to supply the needed information with sufficient speed to cope with construction needs. This situation is being met with local and statewide projects to assist in supplying the needed preliminary information and for executing the layout surveys.

A large volume of data pertaining to roads, designated as important for military purposes, is available in the Public Roads Administration, and from the Highway Planning Surveys executed by WPA in co-operation with State Highway departments and the Public Roads Administration; but there is need for detailed data concerning secondary rural roads and routes considered as of military importance, and the access roads to military establishments. Steps are being taken to set up a nation-wide project to assist in the collection of these data, necessary mapping, and establishing the needed horizontal and vertical control.

For the U. S. War Department, WPA is assisting in the preparation of maps for strategic, tactical, and fire-control purposes. This work consists of the revising of the U. S. Geological Survey's quadrangle sheets by the use of aerial photographs and other available information.

Considerable attention is given by WPA to the training of personnel. Taking advantage of the opportunities afforded by the engineering survey program, persons with varying degrees of education and practical experience have been able to equip themselves so as to serve as assistants in private practice; and, in a number of instances, they have been enabled to direct similar work for the sponsoring or other agencies. In this connection, it appears that there has been a misapprehension among young students and graduates, to the effect that the survey field is already too crowded. On the contrary, from the experience gained by WPA during the past five years of operation, it is evident that such work in this country is still in its early stages. That the future will provide larger work opportunities in this field is sufficiently clear, when consideration is given to the volume of work remaining to be done. Whether or not future operations are executed by the use of public funds, a greater number of men will be required than are now being trained or educated to direct surveys and prepare appropriate maps. To the WPA this professional field appears to be practically unlimited for the next twenty-year period.

#### PRECISION SURVEYS

The geodetic control surveys are considered as the basic framework of the survey system. They not only afford a simplified means for executing supplemental surveys, but they provide the basic control necessary in the preparation of maps, and they establish a means of permanently preserving the locations of property boundaries in the field as well as in the public records.

This Administration has advocated the execution of such control in areas where it is not available, or is too widely spaced for convenient use by prac-

ting surveyors or engineers. Projects of this type are now being operated in city and county areas as well as on a state-wide basis.

It is the purpose of some of the exhibit panels to portray the type of control which should be supplemental to the nation-wide system established by the U. S. Coast and Geodetic Survey. Current engineering practice has established definite specifications pertaining to accuracy and spacing of each type of area involved. By applying accurate basic control surveys to present-day measurement of land, conclusive evidence is available which demonstrates the need of a high order of accuracy, and abandonment of the use of equipment and methods that have been outmoded. In all operations of this character, the use of the Statewide Plane Co-ordinate System is recommended and has been used, except in a very few instances where there has been some local controversy over its adoption on a state-wide basis. It has also been recommended that the North American Datum be adopted on all projects as a basis for the vertical control system. In this connection, it may be mentioned that urban areas formerly used as high as five different level datums before the work was initiated with the assistance of WPA.

#### USE OF AERIAL PHOTOGRAPHS

Although aerial photographs are being used on many WPA projects, their principal use is in the preparation of tax maps, planimetric fire control maps for the U. S. Forest Service, building locations in urban areas, highway planning surveys, land-use maps, and in the preparation of tactical maps for the U. S. War Department.

One of the most important occasions for the use of aerial photographs is the preparation of tax maps on a county-wide basis, such as are displayed here on one of the exhibit panels. This work involves the establishing of supplemental geodetic surveys for controlling the contact prints of the AAA which are on a scale of  $1'' = 1,666'$ . The drainage and culture are plotted on the photographs by stereoscopic methods. A planimetric or base map is then made by radial-line method on a scale of  $1'' = 1,600'$ . The property deeds from record information are then plotted on a scale of  $1'' = 660'$ , using the enlarged aerial photographs of the AAA, in order to locate the property parcels in their relative position according to the deed description. The base map is then enlarged to  $1'' = 800'$  in the rural areas, with all detail projected into its proper position; and then the aerial photographs containing the deed lines are projected on to this sheet. The map of the urban areas will be made on a final scale of  $1'' = 50'$ . This type of map is of the utmost value to the sponsor, since it is of sufficient accuracy for computing taxable areas. In its preparation, many unlisted properties are found which result in an increase in the tax income to an amount many times greater than the cost of the survey.

The U. S. Forest Service sponsors projects to compile planimetric maps of national forests by the use of aerial photographs with contact prints 1:20,000. The ground control consists of positions established by the U. S. Coast and Geodetic Survey, U. S. Geological Survey, and the sponsor. The scale of the final map is 1:31,680, and is plotted in fifteen-minute quadrangles. According to the opinion of the sponsor, these maps are invaluable for use in fire control, and also serve the general purposes of the Forest Service.

The location of buildings in urban areas has become increasingly important in the past five years. Field measurements were too costly to use in the mapping of building locations. The work is now done by the use of aerial photographs, which are usually enlarged to  $1'' = 50'$  from a scale of  $1'' = 500'$ . The locations

of the buildings are then projected and traced on block maps, which are plotted from a combination of record and field survey information.

#### RELATION OF SURVEYS TO PUBLIC RELIEF AND NATIONAL DEFENSE

Employment of personnel certified as in need consists of more than merely providing temporary jobs to people who, through no fault of their own, have been forced to apply for public aid. In this group there are thousands of persons having the prerequisites for accepting technical training, and who should be given the opportunity for personal advancement. The services of such individuals should not be required for long periods of time on work of an unskilled nature. In consideration of the need for surveys and maps throughout the country, the WPA assists in training these persons to execute the technical phases of the engineering survey projects. The training received under the direction of a competent supervisor is invaluable to these workers. Their confidence has been restored, and they learn useful techniques that contribute to preparing them for a lifelong vocation.

National defense obviously is essential to this nation. One of the fundamental needs of a defense program is accurate maps based upon engineering surveys. Such surveys are suitable for operation under the WPA program. Sponsors should co-operate fully with the WPA in utilizing the services of persons with the necessary abilities, who are to be found on the relief rolls, by setting up defense projects of this nature.

Irrespective of the means by which an extensive survey and map program is initiated, the ultimate success of the program is dependent largely upon the standards and specifications adopted as acceptable for the execution of such work. These standards should be determined by those who are recognized as experts in basic surveys and the making of maps. It is believed, therefore, that the opinions and co-operation of the members of the American Society of Photogrammetry, as well as members of other technical groups, are important to the success of this phase of WPA operations.

In the preparation of various types of maps for use in urban areas acceptable results are obtained in shorter periods of time by photogrammetric methods than by standard ground methods. As time is an important factor in the National Defense Program, full use should be made of aerial photographs by the sponsors of survey and map projects. The members of this Society are in a position to impress upon local and state sponsors the advantages of the latest developments in photogrammetry.

The combined efforts of individuals and agencies interested in surveys and maps are needed in order to obtain the best results in a mapping program, whether the objective is to obtain information for defense purposes or for normal long-range planning.

The Work Projects Administration assists in the execution of practically all types of engineering survey and map projects, and is prepared to continue such operations. The value of the results of these WPA operated projects is primarily dependent upon the adequacy of the technical supervision furnished by the sponsors. With full-time competent supervision available to the project, the final results and the unit costs of the work are comparable to similar work executed by other public or private agencies.

The execution of engineering survey and map projects is believed to be a valuable contribution to both national defense and public planning. These projects, while serving public needs, afford employment for competent engineers and surveyors as well as for thousands of workers certified as in need.