

Discovery and Evaluation of Water Resources By Aerial Photographic Method

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This paper discusses the application of aerial photographic method to engineering projects related to the discovery and evaluation of water resources, particularly for areas where no hydrologic records are available. Aerial photographic method has been used in the investigation of various hydrologic problems including: (1) the study of surface drainage patterns, (2) the preparation of drainage maps, (3) the evaluation of a watershed, (4) the study of stream channel conditions, (5) the preparation of hydrologic or hydraulic models, (6) the identification and location of water-bearing formations, (7) the study of patterns of water-bearing formations, (8) the evaluation of ground water potentials, (9) the evaluation of ground water inventories and the preparation of ground water region maps, and (10) the prediction of ground water quality of an area.

The merits of using aerial photographic method have been recognized to be: (1) time-saving, (2) economy in terms of labor, material and equipment required, (3) sufficient reliability and accuracy when compared with other conventional methods, and (4) capability of meeting urgent needs for areas where records of water resources are not available for their development.

A number of equations has been derived or modified and used by the author in conjunction with projects for the discovery and evaluation of water resources by aerial photographic method (1):

1. Let A be the total area of the watershed, $a_1, a_2, \dots, a_n$ the respective area of sub watersheds, having run-off coefficients $c_1, c_2, \dots, c_n$ and average precipitation $I_1, I_2, \dots, I_n$. It is possible to estimate the total surface runoff Q_r of the entire watershed by means of the modified rational formula:

$$Q_r = C_1 I_1 a_1 + C_2 I_2 a_2 + \dots + C_n I_n a_n = \sum_{1}^n C_n I_n a_n \quad (1)$$

If the average precipitation I of the entire watershed is determined from isohyetal charts compiled from precipitation record, the average runoff coefficient C of the main watershed can be determined as follows:

$$Q_r = CIA = \sum_{1}^n C_n I_n a_n \quad (2)$$

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2. If the hydraulic head of the water discharging from the watershed is determined, engineers can appraise the hydro-electrical potential of the watershed by the following expression:

$$K_w = HQ_r'd/k, \quad (3)$$

where K_w is the hydro-electric power in terms of kilowatts, Q_r' the flow rate, H the water head, d the density of water, and k , a conversion constant. When the daily surface runoff is estimated, the hydrograph of a watershed can be produced. This may lead to evaluating the annual total surface runoff, producing a mass hydrograph, and deriving a unit hydrograph for the area investigated. In this type of studies, the evaluation of C values relies greatly on the accuracy of the aerial photographic interpretation technique and the experience of the hydrologist-engineer.

3. The evaluation of the ground water (2,3,4) resources, or ground water potential, of an area can be deduced by means of an aerial photographic study together with some hydrologic, climatic, soil, vegetation, and geologic data. If the depth and areal boundary of the water-bearing formations are determined, the hydrologist-engineer can estimate the ground water storage of a particular area. In doing so, the specific porosity coefficients and infiltration capacities of the materials must be evaluated with reasonable accuracy. Let A be the total area under study with sub-areas $a_1, a_2, \dots, a_n$; $D_1, d_1, d_2, \dots, d_n$ the respective depths of water-bearing formations or deposits; and $P, p_1, p_2, \dots, p_n$ the respective porosity coefficients. The total water-bearing capacity or ground water storage can be estimated from the following expression:

$$W = ADP = a_1d_1p_1 + a_2d_2p_2 + \dots + a_nd_np_n = \sum_1^n a_nd_np_n \quad (4)$$

4. If the precipitation and also the infiltration coefficients of respective areas are determined, it is possible to evaluate the ground water Q_g by the following equation:

$$Q_g = AFI = a_1f_1I_1 + a_2f_2I_2 + \dots + a_nf_nI_n = \sum_1^n a_nf_nI_n \quad (5)$$

Where Q_g may be the total ground water yield per year; A the total area; $a_1, a_2, \dots, a_n$ the sub-area; $F, f_1, f_2, \dots, f_n$ the respective infiltration coefficients; and $I, I_1, I_2, \dots, I_n$ the respective precipitation of each area.

5. If the transpiration and evaporation coefficient T of water in the area is determined, the hydrologist can also determine the water loss in this respect. The common relation of all the coefficients discussed in this paper is that their sum equals unity:

$$C + T + F = 1 \quad (6)$$

In the discovery and evaluation of water resources, accurate values of all necessary coefficients must be determined. Aerial photographic method of studying an area can provide sufficient information for the derivation and determination of these hydrologic coefficients.

Aerial photographic method for the discovery and evaluation of water resources is still undergoing constant improvement along with photographic, instrumental and other technological progresses (5). Based on its merits, the horizon of using this method to serve mankind is indeed unlimited.

Literature Cited

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