The Analysis of Youngdam Basin's Hydrologic Response

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1. Introduction

For managing and designing for hydraulic structures, it is necessary to determine hydrologic data for corresponding basins. Specially, it is important to make hydrographs for corresponding basins. In this study, unit hydrographs are obtained for Yongdam basin using GIS. Curve Numbers in each sub-basin were obtained from GIS process such as basin delineation, landuse, stream network, and soil map. Triangular SCS Unit Hydrographs in each sub-basin were made from calculated Curve Number, Slope, and main stream length. In addition, data which are necessary for the management of reservoir were made by river routing and reservoir routing with data from Triangular SCS Unit Hydrograph. In course of carrying out this study, GIS was used in many of parts. A GIS can offer an effective spatial data-handling tool that can enhance water resources modeling through interfaces with sophisticated models. Therefore, GIS is an appropriate tool to use for such an application.

2. Method

With Land use and soils map, Curve Number values were calculated using GIS. Triangular SCS Unit Hydrographs in sub-basins were made with Calculated Curve Number, the percentage of slope and the length of main stream in each sub-basin. Unit Hydrograph in basin was made using the method of Kinematic Wave River Routing with calculated Q_p and run-off time. Level pool and Runge-Kutta, the methods of Reservoir Routing were used to manage a reservoir.

3. Methodology

3.1. Data

Basin map, Basin boundary map, Stream network map, DEM, Land use map and Soil type map which came from K-water were used in performing our project.

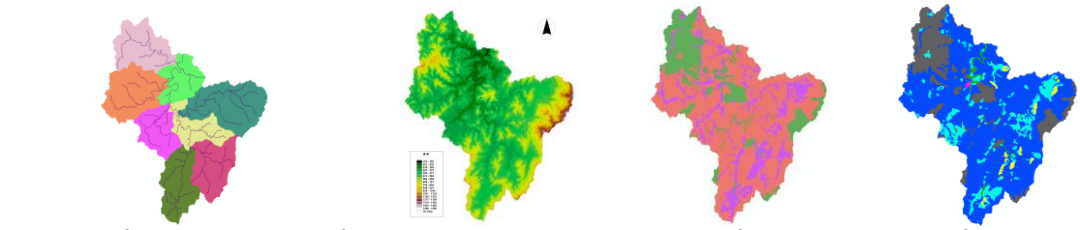

Figure 1. GIS data for Youngdam Basin

3.2. Curve Number Estimation by GIS

The curve number is an index developed by the Soil Conservation Service (SCS), now called the Natural Resource Conservation Service (NRCS), to represent the potential for storm water runoff within a drainage area. In calculating the quantity of runoff from a drainage basin, the curve number is used determine the amount of precipitation excess that results from a rainfall event over the basin. The manual calculation of curve numbers for large areas or many drainage basins can be cumbersome and time-consuming, therefore a Geographic Information System (GIS) is an appropriate tool to use for such an application.

3.3. Triangular SCS Unit Hydrograph (UH)

In this study, SCS method is used since it requires geographical parameters which can very easily be obtained by using GIS techniques. It is based on dimensionless unit hydrograph which is developed from a large number of unit hydrographs obtained from basins ranging in size and from different geographic locations. In this method, the hydrograph is represented as a simple triangle with peak flow Q_p(cfs), time to peak t_p(hr), time base t_b(hr) and duration t_r(hr).

[Table 1] For 1 inch of rainfall excess and 1 hr which is the duration

	CN_{aw}	S	y(%)	L(ft)	A(mi^2)	t_L(hr)	t_P(hr)	t_b(hr)	Q_P(cfs)
Basin 1	75.60	3.23	29.92	99001.07	48.96	2.62	3.12	8.33	7599.21
Basin 2	55.99	7.86	22.72	75020.74	33.01	4.04	4.54	12.12	3519.16
Basin 3	60.99	6.40	31.08	84566.22	55.19	3.35	3.85	10.28	6938.28
Basin 4	55.61	7.98	26.49	111741.23	66.55	5.20	5.70	15.21	5655.31
Basin 5	52.74	8.96	26.62	62901.08	31.88	3.52	4.02	10.73	3840.08
Basin 6	49.22	10.32	22.06	54405.95	34.54	3.76	4.26	11.38	3921.73
Basin 7	54.28	8.42	23.32	50974.58	44.21	3.06	3.56	9.50	6017.16
Basin 8	51.65	9.36	22.78	68764.25	44.90	4.20	4.70	12.55	4624.34

3.4. River Routing

Once obtained the UH in each basin, it is necessary to route them to the main outlet of the watershed. The following UH didn't need routing, since their outlet is located inside of the reservoir: 1,2,3,5 and 6. On the other hand, the UH's 8 and 7 were routed over the main stream of the basin 5 with features showed in Table 4.1. The UH 4 was routed in the basin 5 again, but now over only a part of the main stream because the outlet has a different location, the table below shows both parts of the stream. The channel width assumed was 80 m.

The relationship between water surface elevation and reservoir outflow can be derived by Gate opening data of Yongdam Dam. The peak inflow is 34,100cfs and occurs at 5hour; the detention Yongdam Reservoir reduces the peak outflow to 7,505cfs and delays it until 11hour. It is inferred that a little difference is come from the interpolation between elevation and discharge. The next time subject is concentrated to apply real data of Yongdam Dam.

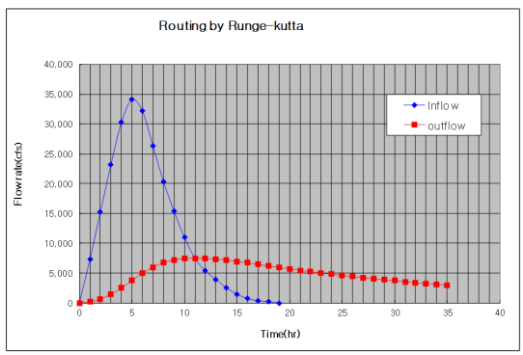

Figure 2. GIS data for Youngdam Basin

4. Results

The Curve Number Generator is an excellent GIS application that provides engineers and planners with efficient and useful tool for hydrologic and hydraulic analysis in ungauged basin and storm water analysis. River routing and reservoir routing using calculated CN and Q_p is conventional way for the management of reservoir. However, it is necessary to compare between observed hydrologic data and calculated data using GIS and review other methods out of methods used in our project. We need to apply our project under various conditions. If we verify and develop our considerations, this system will become a useful tool in management of reservoir.

5. References

[1] McCuen, Richard H., A Guide to Hydrologic Analysis Using SCS Methods. Prentice Hall, Inc. Englewood Cliffs, New Jersey, 1982.
[2] Chow, V.T., Applied Hydrology. McGraw-Hill. New York, USA, 1998.
[3] Larry W. Mays., Water Resources Engineering. John Wiley & Sons. New York, USA, 2001.