Design of Flood Protection for Miqat Yalamlam

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Abstract

The project goals are to maintain the runoff from Wadi Yalamlam and design a flood protection model for Miqat Yalamlam area. Flooding can be a risk to property and life and has adverse effects on the built environment and society. Therefore, it is critical that flood risk is managed and mitigated. The goal of GP1 was to design flood protection for the Miqat Yalamlam. Rainfall data was collected for Yalamlam area and analyzed, leading to the development of Intensity-Duration-Frequency (IDF) curves. Delineation of the watershed was carried out for Yalamlam area by using the software Watershed Modeling System (WMS). The peak flow rate was calculated using Hydrologic Modeling System (HEC-HMS). To prevent the stream from passing through the Miqat Yalamlam, two open channels were designed from the outlet of Wadi Yalamlam. Flooding can also be prevented by constructing a dam at the Wadi outlet. Dams are important because they generate electricity and provide domestic water, while preventing floods. The goal of GP2 was to propose a dam in order to prevent flooding of the area and supply floodwater to the Miqat Yalamlam. The hydraulic design begins with selecting the optimum dam location. In order to prevent water from overflowing above the dam, the hydraulic design of the dam's spillway was evaluated, the length of the spillway was set at 10% of the length of the dam, with a 5 m spillway height. With a length of 42 m, the stilling basin is designed to dissipate water energy that produces scour. Dam break analysis for the proposed dam was done by using River Analysis System (HEC-RAS).

Problem Statement

Design of flood protection system for Yalamlam area, specifically flood protection to protect people from the disastrous consequences of floods.

Objectives

The following are the objectives for graduation project I (GP I):

- Collection of rainfall data for Yalamlam area and development of Intensity-Duration-Frequency (IDF) curves
- Delineation of the watershed for Yalamlam area by using the software WMS (Watershed Modeling System)
- Calculation of peak flow rate by using HEC-HMS
- Layout and design of flood protection model for Miqat Yalamlam
- Cost estimation of the designed open channels

The objectives for graduation project II (GP II) are:

- Hydraulic study of the dam
- Reliability analysis
- The spillway and stilling basin design
- Single drop structure design
- Dam break analysis

Background

Stormwater is defined as surface runoff, primarily from rain and other forms of precipitation. Stormwater is an important environmental concern. As stormwater flows across the ground, it can cause danger to people. The main goals of the project are to design and optimize a stormwater drainage model and provide a design for flood protection via different software with realistic constraints.

Results

Hydrological analysis

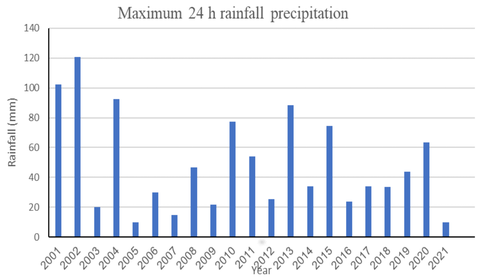

Figure 1 Maximum 24 h rainfall precipitation at TA-109

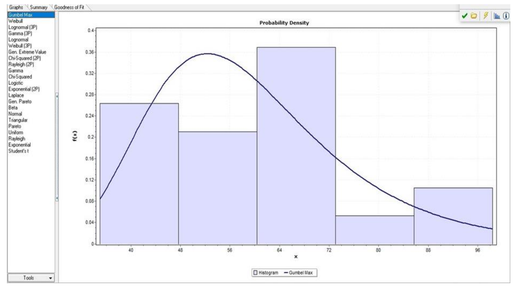

Figure 2 IDF curve of Wadi Yalamlam area

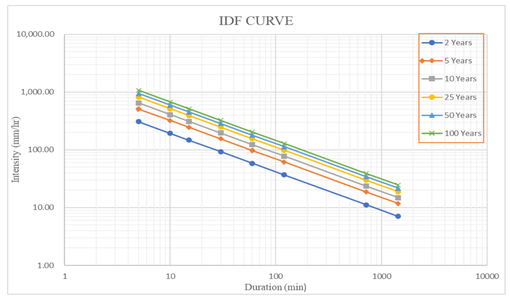

Figure 3 IDF curve of Wadi Yalamlam area

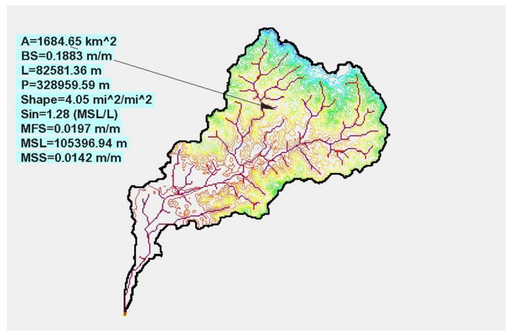

Figure 4 Conducting the catchment delineation

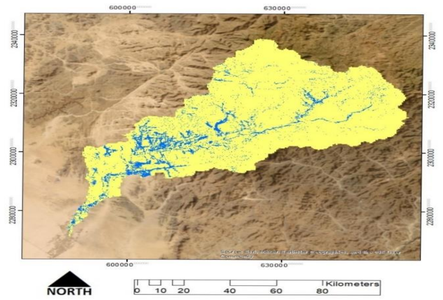

Figure 5 Land use for Wadi Yalamlam

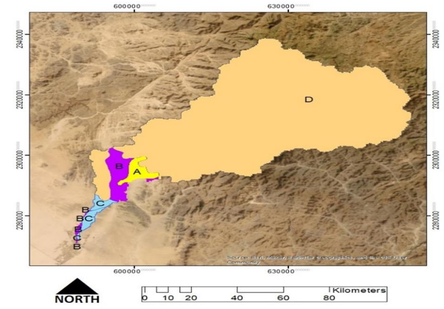

Figure 6 Soil type for Wadi Yalamlam

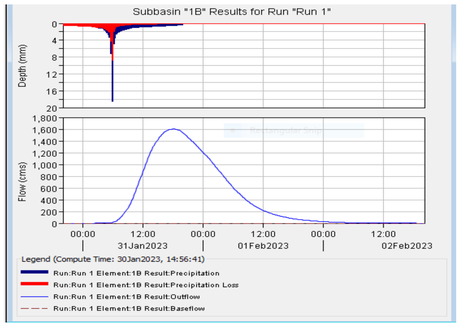

Figure 7 Stream hydrograph

Software

Figure 9 HEC-HMS program

Figure 8 WMS program

Figure 10 EasyFit program

Figure 11 HEC-RAS program

Reliability & Hydrological analysis of spillway

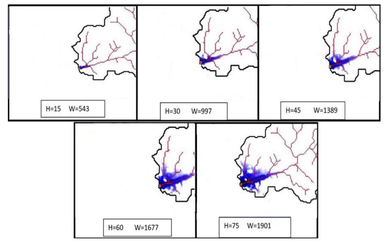

Figure 12 Relationship between height &extend of reservoir

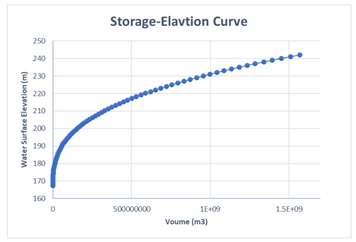

Figure 13 Storage-elevation curve

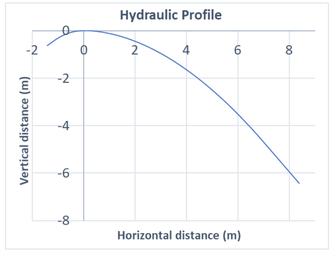

Figure 14 Profile for ogee-crest

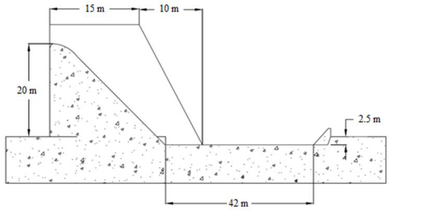

Figure 15 Final design of ogee spillway

Figure 16 Reliability of the dam

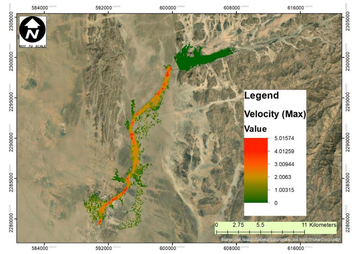

Figure 17 Velocity

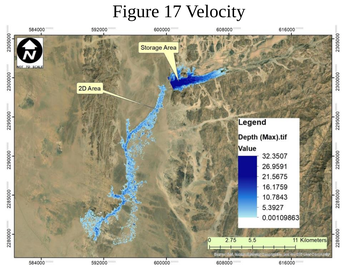

Figure 18 Storage and 2D area

Conclusions

- A frequency analysis was conducted on the rainfall data records of the station TA-109 using Hyfran software. It is found that the maximum rainfall depth corresponding to a 100-year return period event is 156.04 mm and after multiplied by the reduction factor of 0.75, the rainfall depth was 121.7 mm.
- By using WMS, the minimum value of curve number in Wadi Yalamlam is found to be 39, maximum value is 83 and the average is 81.37.
- Relationship between the dam height and dam width used to obtain the different width of dam with different height of different alternatives dam. The height of the dam is 25.
- The current population is 3960 Capita, and the annual growth rate is 1.5%, and the project duration is 100 years, so the future population is 17551 Capita.
- The dam will supplies the people and the agricultures area 1500 m^3/s.
- Reliability analysis is based on daily 40 years of rainfall record (long term).
- Design of the spillway initial guess for design head equal to 5 meters and the crest depth equal to 20 meters.
- Dam break analysis was done by HEC-RAS. It was found that the flow will reach to the city within less than 50 minutes. Therefore, there must be warning and preventive measures to protect the people of the city.