**Abstract**

The West Bank in general suffers from water shortages due to many reasons, including: Israeli restrictions on water use, increasing of water demand which is related to population growth and last but not least, the limitation of water resources available for use. Enhancing water supplies is essential to improve water availability which contributes in economic development. For that matter, utilizing runoff water is the main concern of our project.

Wadi Al-Fara’a is the largest watershed in the West Bank which extends among three governorates: Nablus, Tubas and Jericho. It is known to have large amounts of runoff water which are lost in winter. This area has been exposed to landslides and large damages to the fields causing massive losses to the farmers due to floods. In addition, many farmers have been using waste water to irrigate their lands instead of proper irrigation water. All of these reasons combined have brought our attention as engineering students to devote our graduation project to propose a solution for this serious problem, this solution is to build a dam to store runoff water coming from nearby ridges and other places and then use it in many various areas.

In addition to hydrological and structural aspects, ecological and long term impacts of the project should considered to ensure that it will be able to satisfy the desired objectives which include: storing runoff water to be used later for irrigation, reduce flooding disasters that may happen due to powerful storms, reduce droughts in dry seasons, reduce soil sliding and in the future, this dam may be used to generate electricity.

After Wadi Al-Fara’a had been chosen as the project area, relevant data was collected including: topographic maps, rainfall intensities, land use maps, climate data, agricultural practices and available water resources. After that, Wadi Al-Fara’s watershed was delineated and its physical characteristics were estimated. Then a specified location of the dam was selected, as well as, dam type. Using HEC-RAS, data was analyzed to estimate the volume of runoff water and inflow design flood accordingly.

The design of the dam included spillway and outlet, as well as, its structural design were investigated. In addition, a conveyance network to distribute and manage water was designed in order to provide farmers with irrigation water needed in surrounding fields.

Although dam projects are very important, they’re not common in the West Bank; the only dam built so far is Aluja dam. However, the Palestinian Water Authority and the Ministry of Agriculture have recognized this importance by considering several options to find a solution for Wadi Al-Fara’s runoff water problem, one of these options is to build a dam. This has created a motivation for An-Najah National University students to dedicate their efforts to help these authorities.

Water optimum utilization is of prime importance, planning is therefore essential on geographically wide scale and over long periods of time. The greatest obstacle is usually the unavailability of funds for comprehensive investigations.

The main aim of this project is to enhance water availability and to seize runoff water by building a dam. A dam is a hydraulic structure that acts as a barrier to impound water. Dams serve the primary purpose of retaining water for storage which can be evenly distributed between locations.

Safety of the hydraulic structure is the engineers’ responsibility; the work must be in integrity giving consideration to the purpose of the project and ultimate effects on the human beings.

This project aims to design a dam at a specific location in Wadi Al-Fara’a. In addition to the dam, a conveyance water distribution network will be designed using the water stored behind the dam as its main source. All of this is to enhance water supplies of Wadi Al-Fara’a area, which is essential to improve water availability that contributes in economic development. For that matter, utilizing runoff water is the main concern of our project.

The main objective of this project is to perform a hydrologic study and analysis on Wadi Al-Fara’s catchment area in order to design Wadi Al-Fara’a dam based on this study. The dam will perform as a hydraulic structure that acts as a barrier to impounded runoff water. The water will be retained for storage which eventually will be distributed to the surrounding farms and fields in Wadi Al-Fara using a conveyance and distribution network which will be designed in addition to the dam.

In order to achieve the main goal of our project; specific objectives first must be satisfied to ensure the integrity of the project elements to function as a realistic engineering work, where the safety of the human beings and the environment are taken under consideration. These objectives include:

* Analysis of rainfall data of Wadi Al-Fara’a area; this is to estimate the volume of runoff water of the area of catchment, because the location and the dimensions of the dam are dependent on the volume of runoff water.
* Selection of the most appropriate location and dimensions of the dam, the selected location of the dam must be adequate enough to satisfy the desired objectives, does not disturb the nature of Wadi Al-Fara’a area and finally ,easy to access in order to perform engineering construction works.
* Design of the dam structurally; this is to ensure the stability and safety of this hydraulic structure. As engineers, failure of the designed structure is not taken for granted, so Wadi Al-Fara’a dam will be designed structurally and accurate calculations will be performed in order to produce an integral and long living structure.
* Design a spillway and outlet structures of this dam.
* Design a conveyance system; since the main aim of the project is to enhance water supplies of the area, the water retained behind the dam will act as the water source of this system to provide farmers in Wadi Al-Fara’a and the surrounding fields with irrigation water needed.

During the last two semesters, the desired objectives have been successfully accomplished. First, a background of the location of study, general view of project, objectives and importance of project has been determined.

In this project Wadi Al-Fara’s watershed has been delineated and divided into four sub basins which are Beit Dajan, Taluza, Tubas and Ras Al-far’a. Then, runoff volume of Wadi Al-Fara’s watershed has been estimated; also the dam height and length have been approximately determined.

The amount of water that the dam can store is approximately 4.7 MCM, this quantity is quite large due to the large area of the watershed under consideration. As for the dam length (300m) and depth (30m), these dimensions are estimated so that the dam is able to store the runoff estimated.

The dam type selected is a concrete arch dam. After that, the dam was designed structurally using SAP2000 program, by analyzing three different models, among these three; one is selected based on its critical point capacity. Subsequently, minimum steel reinforcement is estimated.

Thereafter, a hydrological analysis has been conducted using HEC-HMS program in order to estimate the design flood flow. This is to carry out the extra water by spillway so that no damage occurs to the dam crest. The storm in Jan 2013 was taken as the critical rainfall storm to simulate the critical flood. The peak discharge is 126.6 m3/s.

As for the hydraulic design of the dam, the spillway and the outlet are considered as integral parts of the dam, from the value of flow obtained from the hydrologic analysis using Hec-Hms ; a weir was designed, the type of this weir is broad crested weir. Thereafter, a free fall spillway was designed. Due to the high potential energy of water pouring from the spillway, an energy dissipater was introduced to the structure in order to reduce the downstream velocity.

The last step of the dam design is to release the stored water to fulfill the aim of this project which is; utilization of surface water in Wadi Alfara’a, we proposed a water conveying system to convey water from the dam through Annassariya and Alaqrabaniya, all the way till it reaches Ein Shebli existing irrigation system. From there, the water will be conveyed to Froush Beit Dajan and Aljiftlik. In order to do so, first we needed to estimate the annual amount of water abstraction from springs and wells, after that, the irrigation demand of the area to be irrigated was estimated. The water conveying system consists of a main pipe that diverts at some point into two pipes; northern and southern pipes.