**Aqaba Water Resources Planning Decision Support System (DSS)**

by

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The paper presents optimization-based water resources planning DSS for the Aqaba Special Economic Zone Authority (ASEZA). As the supply of water continues to be depleted, it is essential to effectively manage existing and potential water resources. The Aqaba Water Resources System (AWRS) consists of:

**Pure Source Nodes**: The underground water supplies from Disi, Wadi Araba and Wadi Yutum the existing pure water sources. In addition, the model considers the introduction of Reverse Osmosis plant as a potential new source within such category.

**Pure User Nodes**: This node type only exists for users who consume water and never return any recycled amounts such as irrigation users and unaccounted for water.

**Source and Sink Nodes**: They receive water from other nodes in the system, process it then send all or part of it to other users. These nodes includes: (1) all users except for the irrigation, (2) fresh water and wastewater treatment stations. Part of the water consumed by the residential, governmental and tourism users is recycled to the wastewater treatment plant.

**Pipelines**: Two types of pipelines exist in the system. The first is pressure pipe network to convey water from pure source nodes to the Water Company (WC) facilities and from the WC facilities to various users. This type is also needed to move the water from the wastewater treatment facility to the treated wastewater users. The second type is a gravity pipe network carrying the wastewater from its generators to the wastewater treatment facility.

All the existing sources in the system are identified by their location, production /storage capacities and water quality. The associated production and transportation costs are also required. In addition, the model allows for the introduction of new facilities whether it's a new water production plant or an additional pressure or gravity pipelines. The model

also provides the user with the ability to assess the expansion of existing facilities, which would require the following additional parameters:

- The proposed capacity of, the expansion or, the new facility.
- The capital cost of constructing the addition.
- The lead time from construction until it becomes fully operational.

The model is also designed to run in two modes:

**1. Strategic Mode.** It is aimed at selecting the most attractive investments in new facilities to fulfill current and future demand for water in the area. In this case the user runs the DSS on annual basis for demands and capacities, without regard to detailed monthly operations. The water planning analyst can explore expanding some of the existing, or build new, water treatment or production facilities such as wastewater treatment plants or the purifying of water in the WC.

**2. Operational Mode.** The system uses monthly demand and capacities and would also consider seasonal variations among months to come with most attractive operational plan. In both modes, the system is aimed at minimizing the present value of the total cost including the capital, production, storage and transportation costs.

The DSS consists of several modules, namely:

**Input/output Interfaces:** these include two major input screens to specify the water users and the sources available to satisfy their demand for water.

**Data processor**: The input data is preprocessed to prepare the cost and constraints coefficients that will be used into the model.

**Model Builder**: This module generates the objective function and the constraints.

**Premium SOLVER Optimizer**: In this system, we used the professional version of the EXCEL SOLVER offered by Frontline Systems, Inc.

**Crystal Report Engine**: We used this efficient software to generate all production reports, water flows and capacity expansions.

The DSS system was used to develop the least cost water resources plan for the period 2006-2020. The optimal solution consists of Phase I of the Disi pipeline expansion in 2012 plus constructing a 7.5 MCM Reverse Osmosis desalination plant in the South in 2015. Based on our corroboration and validation of the RO desalination plants capital cost, the ASEZA proceeded to issue a request for proposal (RFP) seeking actual bids for constructing a RO desalination plant in ASEZ in October 2007.