Thesis Project Portfolio

Optimizing for Water Equity in the Colorado River Basin

(Technical Report)

The Technopolitics of Israeli Water Management

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

Hania Adela Abboud

Spring, 2022

Department of Engineering Systems and the Environment

Table of Contents

Sociotechnical Synthesis

It is evident that water management is interdisciplinary; these infrastructure systems are studied by hydrologists and physical scientists, designed by civil and water resource engineers, administered by governing authorities, improved by community stakeholders, but most importantly, they are controlled and informed by political actors. My thesis portfolio addresses the question of "how do technical needs and political conditions influence the design and management of water resource systems?" I develop an understanding of water distribution systems from a purely technical standpoint, as well as the political and social factors embedded in water infrastructure design and management. I address my overarching research question using two distinct case studies- a technical project of the Lower Colorado River Basin's water management operating politics and a sociotechnical (STS) research study on Israeli-Palestinian hydropolitics. My technical research deepens my understanding of the technical complexities of water management, design compromises and decision priorities, and engineering considerations made by planners engineers. My STS research, examining how the Israeli Occupation has impacted water resource management, provides insight on the power dynamics embedded in water infrastructure as a result of the political environment in which water resource systems are designed.

The Colorado River Basin has been experiencing shortages of increasing severity and frequency; with its scale and multitude of end users, this presents a dire problem. Working on a team of undergraduates, a technical study focusing on the Lower Basin's reservoir conditions was conducted to explore alternative operating policies. We couple the Borg multi-objective optimization algorithm with RiverWare model, a decision support system, to model reservoir conditions under a series of potential climate change scenarios to produce a set of alternative operating rules that address historic and current environmental justice issues for Native American water users. The Colorado River Basin's water allocations are governed by the "Law of the River", a body of legal documents, thus they cannot be altered, but individual reservoir operating rules that influence user shortage frequency and severity can be optimized for future climate change scenarios. We balance conflicting decision variables to find a robust operating solution, one that is applicable over a wide range of future climate change scenarios.

To study the social and political aspects of water management, I research the development and management of Israeli water infrastructure, and the subsequent injustices faced by Palestinians as a result of the overall technopolitical system. I provide a summary of the region's hydrography, a brief analysis of Israeli law governing Palestinian water and its related infrastructure, and discuss water management in Occupied Palestinian Territories (OPT). I use the technological politics framework to discuss and identify the political qualities and subsequent oppressive power dynamics of the overall system, revealing motives behind Israeli water infrastructure design and the consequential impacts on Palestinian communities living under Israeli apartheid.

Together, these projects work in conjunction by deepening my grasp on water management as a system that performs a scientific, technical task while executing certain political agendas. They serve as an example of the interdisciplinary complexities involved in designing efficient and equitable water management systems, dispelling narratives about the dichotomy between science and politics, as they are interconnected.