

## Introduction

### *Picturesque Azraq*

Al Azraq basin is an arid gently contoured landscape, made of bare flint and basalt plains, crossed by Wadis (ephemeral riverbeds) and dotted with Qa's (mudflats). Wadis run all over the Azraq basin, beginning life in its slopes, meandering for kilometers before losing themselves at the edges of Qa' Al Azraq mudflat as '*Wadi spreads*', with wide expanses of channels with silt beds and shrubby covered hummocks. Qa's, pale patches painted conspicuously on to the dark landscape canvas, are the mudflat depressions. Floored with fine silt or clay deposited from the Wadis. They are entirely flat, and in dry weather, entirely hard and impermeable, hindering plant germination and survival. During winter, they become vast shallow lakes frequented by countless traveling birds [1].

Al Azraq town lies in the center of this endorheic *Azraq Basin*. The town conservatively surrounds Qa' Al Azraq mudflat, which once encompassed lush wetlands, and is a Ramsar Convention declared major station for migratory birds on the African-Eurasian flyway [2].

### *Desert Drainage Systems*

Wadis, synonymous with arid climates, contain water only when heavy rain occurs. Traditionally, Wadis provided refuge, acting as oases suitable for settlements, and were respected as corridors for the common flash floods. Nowadays, Wadis along with Qa's are exploited and misused, resulting in the deterioration of their natural ecology and morphology, and their disconnection from the rural urban context. However, a change can be seen, with several projects emerging in the Middle East to restore the Wadis' natural and cultural values, and reconnect them to urban life as public parks [3].

## Context

Our work lies in Wadi Al Rettami's watershed, named after the plant *Retama raetam* that generously strokes the edges of the Wadi's stream. The Wadi is situated centrally in multiple senses, relative to modern and ancient, natural and cultural considerations of the landscape. Wadi Al Rettami's watershed is recognized as a possible refuge landscape, essentially providing water, food, shelter, recreation, flood passageway and microclimate asylums- integrated into Al Azraq town.

Currently, Wadi Al Rettami and its nearby mudflats, are illegally excavated, overgrazed, exposed to unsystematic logging, used as dumping grounds, and are inadvertently used as dirt roads at certain connection points. The Wadi's morphology has been altered, to forcibly channel the ephemeral stream, limiting its benisons of an originally wide 'Wadi spread' to a narrow-gullied channel. The Wadi is inaccessible, it segregates Al Azraq town, and urban development is recklessly sprawling in highly floodable areas. Further, the flood plains are under-prepared to deal with the flash floods; the flow of water is obstructed by various barriers and excavated pools.

## Project

*Al Azraq basin is envisioned as an ecological hub in the arid and semi-arid climates of the Middle East, where the Desert Drainage Systems' intrinsic harmonious composition, is read, protected, restored and utilized as the underlying green infrastructure, refuge landscapes and pivotal axes for development.*

### *Restoring water flow 'where water flows'*

The natural flows of the Wadi streams are restored by widening its culvert, crossing the main Badia road, into an extensive bridge. To restore the *Right of Wadi* (wadi floodplains), the floodplains are graded, urban expansion in flood prone areas is halted [4], and existing services and structures in the Wadi and mudflats are relocated to less flood prone areas.

***Food and water security*** ‘Where water nourishes the soil’

Communal agricultural land is laid along the proximal Wadi Al Rettami’s spread, with strips of land left as ecological corridors [5]. In the urban landscape, the reestablished floodplains are afforested as rain-fed and flood-fed orchards [6] weaved with trees native or adapted to Azraq’s climate, in an effort to *make every drop count*. For better establishment, the trees will be planted progressively along contour lines, in Vallerani basins [7, 8], and protected until establishment with basalt rock piles; reducing evaporation and the impact of frost. The urban orchard is proposed to be a communal productive park that also provides floodplain stability, improved water infiltration, and enhanced biodiversity.

A series of underground water storage systems, linked to the existing infiltration ponds are proposed, decreasing evaporation and contamination of the collected water [9].

***Land Restoration*** ‘Where water infiltrates and restores’

Through healing the land, the drought and flooding issues are addressed. The restoration site will be temporarily fenced to allow for land protection, ecological succession, grazing land emergence and eventually managed grazing. Restoration is accomplished through phased water harvesting and soil building ephemeral techniques, in the high potential areas ‘where water goes’.

Our first restoration intervention is in the three bigger Wadi tributaries in our site; utilizing land imprinting [10] and basalt-rock lines [11] simultaneously; slowing runoff, increasing water infiltration, enhancing the microclimate effect and hence promoting rapid vegetative response. Our second restoration intervention is contour-planting the lower watershed areas, with native and adapted plants, in Vallerani basins [7, 8]. Closer to the Wadi, more drought resistant fruiting trees are proposed, while higher up, the better adapted native trees are proposed. Restoration will be gradual, from the lower to the higher terrains, as way of thoughtful water distribution and efficient utilization; acknowledging that the plants’ establishment time is the critical factor.

Our third restoration intervention is adopted in the mudflats; shallow ephemeral circular depressions are excavated, and basalt-rock circles are laid gradually along its circumferences. The depressions lower the accumulated water’s surface area, and add more surface area around the depression’s peripheries [12]. The planted basalt-rock circles loosen the hard soil surface, reduce the water evaporation, and add to the *edge effect*. Depressions will be formed gradually from the drier to the wetter areas. The basalt-rock circles are moved from distal to proximal circumferences in synchrony with the plants’ establishment and succession. This approach is would result in unique ecological areas, while still maintaining their role in slowing and storing flood water.

The proposed methods are ephemeral; basalt-rock lines would eventually be fully removed, while the land imprints, the Vallerani basins and the shallow depressions would naturally fill up.

***Safety, Accessibility and Connectivity*** ‘Where water connects’

A fenestrated flood protection wall is constructed around the urban orchard and the existing housing area, providing as well a shaded seating area along the edge. Submersible wide steps are proposed at the Wadi banks. Ramps leading into the wadi are introduced on the sides of the main Badia road bridge.

Connecting the Wadi banks are vehicular and pedestrian bridges and a pedestrian only bridge. A network of pedestrian-friendly greened roads, in the urban and agricultural areas, integrates the project into Al Azraq town, and creates a new space for safer and more inclusive commercial use areas [13]. A network of bridges and trails starting from the urban area will connect it to the mudflats, through the basalt terrain, and into the Wadi.

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