



Sustainable Urban Drainage Master Plan for Al Khor Municipality

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Abstract

It is of utmost importance that the type of hydrological basin of the region should be established before developing its drainage strategy. Unlike exhoric basin which is characterised by well-defined pattern of streams and rivers ultimately discharging into the sea, Qatar's topography exhibits mix of arheic, and predominantly endorheic basin features i.e., rainwater drains to inland depressions to form temporary water bodies. Keeping drainage basin type in view, Al Khor drainage master is developed which function sustainably with the nature with aim to utilize drainage water to achieve Qatar National Vision 2030 and Qatar Water Strategy goals.

Keywords: Al Khor SUDS; Drainage strategy; Stormwater; Drainage water management and reuse in endorheic basin

1 Introduction

Al Khor Municipality Sustainable Urban Drainage Masterplan is a project of national importance that will not only transform current drainage water management approach from rejection to utilization but more importantly, shall provide an infrastructure platform to help achieve targets and goals envisioned in Qatar Water Strategy based on Qatar National Vision 2030.

2 Sustainable Urban Drainage System

The foremost objective of this project is to solve drainage problems in a sustainable manner i.e., working in line with natural hydrological pattern of the region to control flooding, in addition to achieving long term benefits in terms of environmental, social, and economic fronts. This project is envisioned to manage stormwater using natural hydrology of the project area. The hydrological pattern of a typical watershed in the project area consists of flat terrain and local depressions. Most of the undeveloped watersheds in the project area retain and store stormwater runoff within depression areas. A wadi (natural stream/ channel) is very rarely observed conveying water from one watershed to another. However, the current stormwater drainage strategy in the urban areas completely overlook the natural hydrological pattern of the watersheds. It is based on design approach to collect, convey, and dispose stormwater into the sea via tunnels and outfalls. Consequently, in the event of rainfall exceeding design capacity of the stormwater system, the excess runoff follows the natural hydrological pattern of the urban watershed and accumulates in the low laying depression areas causing flooding of properties and facilities located therein. Likewise, surficial groundwater generated due to human activities (leakage from wet utility pipes, excess landscape, and agriculture

irrigation etc.) also appear at the low-lying areas in the watersheds. Therefore, it is prudent that watershed topography and hydrological characteristics should be considered thoughtfully while planning and designing infrastructure facilities for the development. Accordingly, the roads and drainage system should follow natural topography of the watershed enabling roads to facilitate conveyance of excess runoff in the form of sheet flow from overwhelmed drainage system to lowest areas in the watershed reserved as stormwater storage and treatment facilities. This design approach will not only provide a reliable and resilient drainage strategy but will also result in much cheaper infrastructure to cater for stormwater system.

The design philosophy of the project is developed using MME-IPD flood portal, which employs 2D runoff model of the watershed in identifying watershed hydrological characteristics.



Fig. 1: Natural Hydrology of Al Khor

Figure 1 shows model results highlighting sporadically distributed flooding in depression areas. The runoff from two wadies i.e., Wadi Al Jalta and Al Jalat also shown to be obstructed by current and future developments as more prominently shown in figure below by overlapping with land use policy plan.

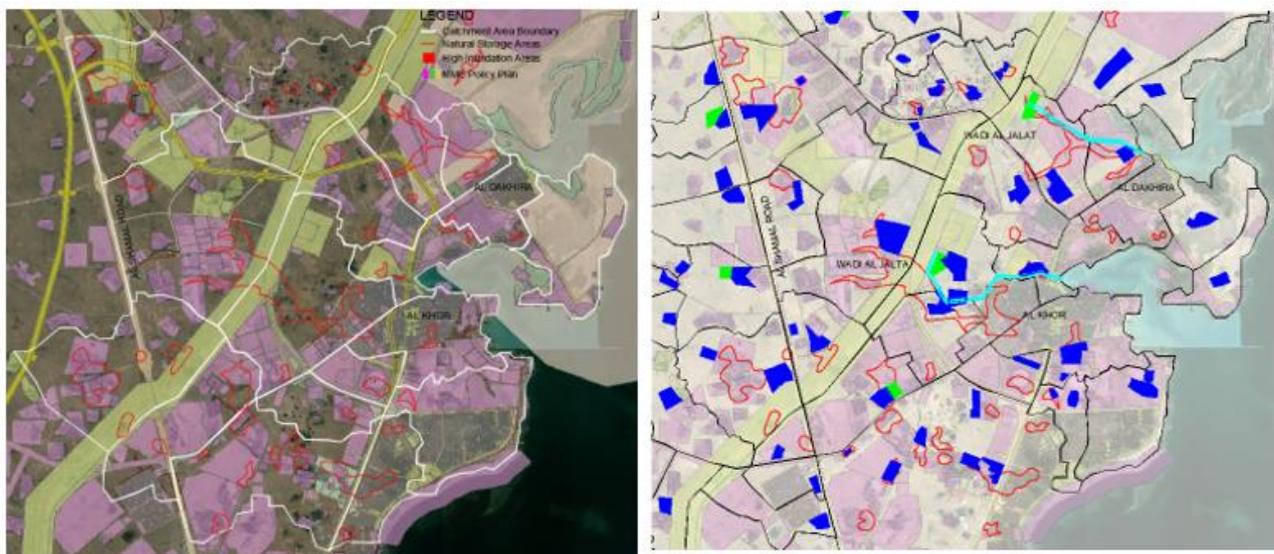


Fig. 2: Natural Hydrological Pattern, Land Use Policy Plan & Proposed SUDS

From left part of figure 2 it can be observed that current and future developments are at the risk of inundation due to natural hydrological characteristics of watershed conflicting with land use policy plan. Ideally low laying depression areas in watersheds should be allocated for storing and managing rainfall runoff, however due to land already taken by existing and future developments suitable adjacent areas are proposed to be allocated for managing drainage waters in the watersheds as shown in the right part of Figure 2. The proposed rainfall storage lagoons are shown as blue polygons designed to cater for 100mm rainfall event which exceeds 100-year return period. The wadis are restored as channels following natural wadi alignment shown in as cyan lines. The green polygons are areas dedicated as wetlands for treatment of groundwater.

The vision of Qatar Water Strategy is based on sustainable and integrated management of all water resources. The strategy elements warrant for the development of smart infrastructure capable to manage seasonal rainwater and rising groundwater levels. The water strategy policy elements demand harvesting and treatment of rainwater to recharge groundwater aquifers and development of new sources of water by treating groundwater and storm water to enable maximum reuse potential. In this context, the depressed areas of the watershed in the drainage strategy of this project as shown in blue polygons in Figure 2 will serve to store rainwater. The stored rainwater will be treated to suitable standards for recharging of shallow groundwater aquifers or to be used for agriculture irrigation. The stormwater system for the project area shall be designed with integrated groundwater lowering system. This will not only benefit in lowering the surficial groundwater table level but will also provide a perennial source of water which can be treated for recycle use. During wet season the major volume of water collected by the drainage system will be rainwater which shall be stored in the depression areas. However, during dry season the drainage system will collect groundwater which will be pumped to wetlands located in designated areas as shown in green polygons of figure 2 for treatment and reuse. The groundwater treated in the wetlands will be used to help meet economic and environmental objectives of Qatar national programs.

Economic and environmental development are two of the four pillars of Qatar National Vision 2030. One of the goals for the economic development is to develop world class infrastructure and diversification of economy. Whereas environmental development requires using the resource wisely and managing the environment in harmony with economic growth, social development, and environmental protection. This project supports Qatar National Vision 2030 by providing new avenues for economic diversification and environmental protection and development objectives. The drainage water collected, stored, and treated in wetlands and EFAs will be used for urban resilience programs, sports/ outdoor activities, commercial, research and edutainment programs. The objectives of drainage master plan reinforce Al Khor City Master Plan 2032 vision seeking to develop verdant coastal garden city that blends traditional Qatari culture, maritime heritage, and innovative family attractions to create a thriving green and blue crescent community. Figure 3 shows recommended development master plan for Al Khor which amplifies the development of green city-wide network by utilizing drainage masterplan element to create green urban designs such as wadi channels alignment to create wadi and spring meadow parks in a form of naturalistic park setting for active leisure and nature intermigration using wider landscape setting with planting density and species carefully considered to enhance natural environment. Drainage water captured shall be used to support Green Oasis program which aims to plant 115, 000 trees to lower city daytime temperatures upto 9°C.

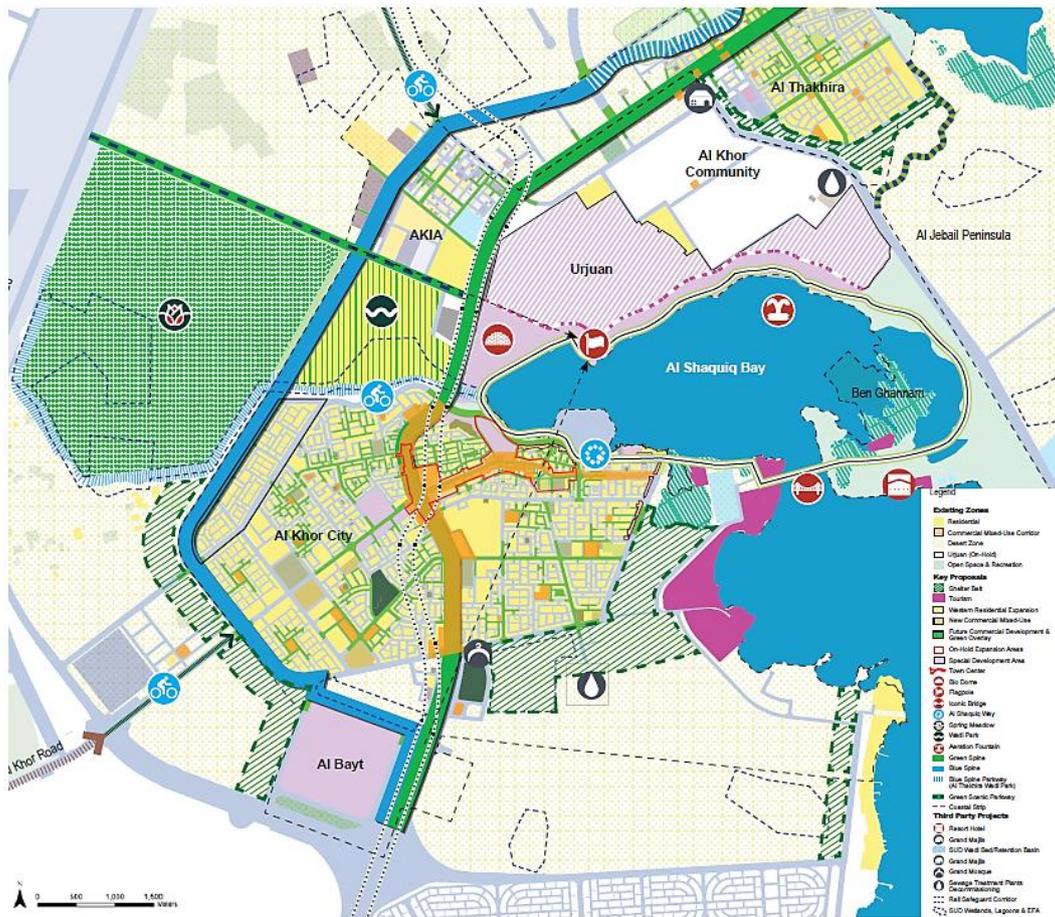


Fig. 3: Al Khor City Master Plan

3 Conclusion

The effects of global warming are noticeably changing weather patterns resulting in erratic storm events and pronounced flooding in gulf region. The climate change is also impacting natural environment and is causing desertification, biodiversity loss, pollution in marine and coastal areas, air pollution, and water scarcity and quality. The planning and development for the future warrant addressing solutions to these challenges and drainage water planning strategies are no exception. Keeping these challenges in view Al Khor drainage master plan is prepared which not only supports environment challenges but also provides a reliable and resilient drainage solution to manage flooding for current and future development conditions.

References

- Ministry of Municipality, Infrastructure Planning Department (2017). Flood Mapping Portal. <https://aldeera.gisqatar.org.qa/mmeflood/>
- Ministry of Municipality, Infrastructure Planning Department (2014). Utilities Planner Portal. <https://swprupfs.mmaa.gov.qa/javaapps/mapviewer2/>
- Ministry of Municipality, Infrastructure Planning Department (2017). Qatar Rainfall and Runoff Characteristics. <https://www.mme.gov.qa/webcenter/portal/MM>
- Ministry of Municipality, Urban Planning Department (2022). Al Khor City Master Plan.
- Public Works Authority 'Ashghal', Design Department (2017). Qatar Integrated Drainage Master Plan.

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