



2010 On Site Review Report

2258.SAU

by Wael Samhouri

Wadi Hanifa Wetlands

Riyadh, Saudi Arabia



Planners

Moriyama & teshima Planners Limited / Buro Happold in joint venture

Client

Arriyadh Development Authority

Design

2001 - ongoing

Completed

2004 - 2007 (and ongoing)

Wadi Hanifa Wetlands

Riyadh, Saudi Arabia

Vision

The main concept of Wadi Hanifa is that of a 'living valley' or 'living wadi' brought back to health, sustainability and fully integrated into the life of the city of Riyadh. This vision seeks to transform problems into opportunities, and sees Wadi Hanifa as a clean, green, safe and healthy environment, providing a continuous ribbon of naturalised parkland that interconnects and interfaces city and Wadi, in which residential development, farming, recreation, cultural activities and tourism exist in harmony within an oasis that extends the full length of Riyadh, and beyond, into the surrounding rural areas.

Prologue

Wadi Hanifa could be seen as more of a phenomenon than a project. In the heart of the dry ruthless desert of Arabia, on the one hand, and a contemporary sprawling metropolis, on the other, a 'sunken' oasis cuts through a 120km valley that was formed as a result of both natural flood and artificial surplus drainage water discharges that were brought over from a desalination plant in the Gulf to satisfy the needs of the city of Riyadh.

Reflecting an important set of Islamic values that are seldom invoked by contemporary Muslim architects and planners, the Wadi Hanifa project aims at sustaining and protecting the environment, technically called 'land building or land inhabiting' (in Arabic this is 'Emaratul-Ard, *ضِرَالَا قَرَامَع*, which means both building [architecture] and planting [landscape]). Thus sustainability here is elevated to a moral and religious embodiment of the Islamic tradition.

Historic areas, wild life reserves, parks, land art, topography lighting, environmental installations, bridges and circulation hubs, natural and man-made lakes, agriculture utilised land, and plant nurseries, are only a few among the various components present in the Wadi today. More are also planned for the next stages.

This is the third cycle in which this project has been shortlisted for the Award. Although it is recognised as a major work for consideration, in the two previous cycles, the general view of the jury was that the project had not yet been completed; therefore, judgment was hard to make. Now the project has been officially and ceremonially opened and is in full use. After visiting the project for the second time this year (my first visit was in 2007), I have concluded that the jury should take into consideration the fact that this project is open-ended, hence its title 'the living wadi'. We are presented here with a process, not only an end-product. The wadi is designed to continue developing and growing according to the natural processes that have been allowed to reclaim their grip, in addition to man-made interventions that will be highlighted below.

By its sheer scale, the project integrates the whole range and scope of known architectural interventions, from master planning to landscaping, from architecture to signage and urban furniture. Add to this an eco-driven strategy which permeates the whole design of the project, culminating in the Bio-Remediation facility, a unique design marvel in its own right.

I. Introduction

Located in the middle of the Najd Plateau of the Kingdom of Saudi Arabia, the Wadi Hanifa watershed is the most significant natural landmark in the region. Its basin and many tributaries form a unique 120km-long ecological zone that descends from the Tuwaiq escarpment in the northwest to the open desert southeast of Riyadh. The development of the wadi is inextricably linked to the history of Riyadh.

An oasis at the heart of the Arabian peninsula, the Wadi Hanifa watershed system has long provided sustenance for communities along its length. For centuries a balance prevailed between the water, land and resources of the wadi and the people living around it, between natural processes and human interventions. This stability existed because the inhabitants of the wadi were completely dependent on it for their survival and prosperity

The first Saudi state strategically located its capital at Addiriyyah on the west bank of Wadi Hanifa, taking advantage of water, stone, and arable lands. Subsequently, Riyadh or Arriyadh, the new capital of the modern Saudi state, developed to the east of Wadi Hanifa. Until the rapid expansion of Riyadh that started in the mid-1970s, the city and the wadi existed in harmony, with the wadi used as a sustainable resource for water and food.

II. Contextual Information

A. Climatic Conditions

Rainfall is about 85 millimetres a year. More than half that amount occurs during the months of March and April.

Temperatures in the Riyadh area range from a low average of 6.4°C in January to a high average of 42.9°C in July.

B. Program (to date)

Cost to date: 600 million Saudi Rials.

C. Quick Facts

- The Study Area: 120km stretch of Wadi Hanifa running through Riyadh; Catchment area of 4500km².
- Timeline: Master plan development, restoration designs, and design of enhancements (2001-2004); construction/ implementation period: 2004 to present.
- Length: 120km
- Depth: 10 to 100 metres
- Width: ranges from 100 metres to 1,000 metres
- Natural drainage course for over 4,000m² of open area along its length.

- Smaller tributaries, known as sha'ibs up to about 25kms long: Al Ubaytah, Al 'Ammariyyah, Safar, Al Mahdiyya, Wabir, Laban, Nammar, Al Awsat and Laha. The eastern tributaries include Al Aysan and Batha'.
- 500,000 m³ dumping removed
- 10 million m² cleaned wadi bed
- 2.5 million m³ in reprofiling cut and fill
- 40 side wadis (10 major wadis)
- 9 major parks created
- 5 lakes created (25.1 hectares total surface area)
- 7.4 km pedestrian promenades
- 46.8 km of recreational trails created
- 30 toilet blocks designed and built
- 30,000 shade trees planted
- 6,000 date palms planted
- 50,000 shrubs planted
- 2,000 large Acacias transplanted
- Bio-remediation facility consisting of 134 bio-remediation cells designed and built.
- 42.8 km of wadi roads
- 2,000 parking spaces created
- 350,000m³ of urban wastewater cleaned per day (2010)
- 1,200,000m³ of urban wastewater cleaned per day (expected in 2025)
- 730 pieces of interpretive signage
- 2,500 light standards along walking trails and wadi roads
- 600 pieces of feature lighting
- 22 bridges
- 2,500 lighting pillars
- 87,000 trees planted at heart of wadi

D. Historical Background

From the early 1970's Riyadh expanded westward towards Wadi Hanifa, eventually spreading along its west bank. The wadi was exploited to satisfy the increasing demand for water and to provide mineral resources to meet the massive construction needs arising from the rapid growth of the capital city. By the 1980s, the water resources in the wadi and indeed the whole region could not cope with demand, and water table levels dropped to well below sustainable limits.

To meet this new level of demand, water began to be supplied from the desalination plant in the Eastern Province. This brought with it new problems: the rise in groundwater, and the need to control this increase. As the natural drainage system for the region, Wadi Hanifa provided the solution: groundwater control by its discharge into the wadi.

Groundwater is drained from the city of Riyadh through the storm drainage system, and discharged into a surface flow channel in Wadi Hanifa, which drains the flow south of Al-Hair. The resulting permanent flows to the lakes south of Al-Hair have been a mixed blessing. On the one hand, dry weather flows have created attractive microclimates for diverse plant and wildlife communities, as well as popular recreational opportunities. On the other hand, the

permanent flow was perceived as a sewer because its water quality was poor; it smelled in certain places; and was a health hazard in others. The solution to the problem of rising urban groundwater had been appropriate and positive, but did not fully exploit the potential benefits of the water flows into the wadi because the question of water quality had not been adequately addressed.

Despite regular attempts to improve the condition of Wadi Hanifa at that time, mainly by clearing dumped material, the ongoing condition of the wadi deteriorated rapidly. The structures of responsibility for its ongoing maintenance remained unclear because the wadi had no special planning and development status. The lack of a comprehensive plan then, that addressed ongoing problems, had also made it difficult to improve and restore Wadi Hanifa to health and so improve the quality of life for the people of Riyadh.

E. The Problems that faced the Arriyadh Development Authority and Required Action

The problems that the Arriyadh Development Authority ADA had to address encompassed environmental degradation, loss of natural functioning and ecosystem productivity of the wadi due to the unsustainable use of land, water, energy and other resources. They specifically included:

- Illegal dumping of solid and liquid wastes.
- Lack of special development controls for Wadi Hanifa and its environs.
- Development that had led to encroachments on the flood flow channel, and to changes in the level of the wadi bed. These conditions had negatively affected the wadi's function as a natural drainage system, and its ability to deal with floods.
- Inadequate system of surface flow channels, which receive flow resulting from rising groundwater as well as discharge from the Manfouha Sewage Treatment Plant. The measures that had been taken at that time had provided an interim response to the problem, but required planning and coordination that would address a broader range of issues.
- Uncontrolled discharges into the wadi surface flow channel and/or its tributaries - for example from the abattoir, the tannery, as well as unauthorised discharge from sewage tankers.
- Health issues related to the quality of water in surface flow channels because of uncontrolled discharges.
- The general waste of a potentially valuable water recycling resource.
- Visual degradation, resulting from loss of natural environment, dumping, quarrying, lack of co-ordinated infrastructure installation, and lack of development control.
- Uncoordinated use of the wadi for trunk utilities, such as sanitary, potable water, irrigation mains, and use of the wadi for overhead electrical distribution.

The above-listed problems of the degradation of the wadi needed to be reversed if a sustainable future for the city and the region was to be achieved.

III. Programme

A. *Actions Taken by the Arriyadh Development Authority*

In the 1980s, investigations began into the consequences for Wadi Hanifa of the recent development and expansion of Riyadh, which had led to the rise of ground water, dumping, and other negative outcomes. The Arriyadh Development Authority (ADA) has since taken actions to alleviate the degradation of the wadi's environment and to prepare for a comprehensive development plan.

The ADA started the technical studies alongside the development of a strategy for the wadi. In addition to the groundwater studies and ongoing groundwater monitoring, the ADA conducted studies on water resource and flooding, as well as historical and archaeological assets in the area.

These studies were used, together with the ongoing water flow and quality monitoring, as the technical basis of the Strategy for Wadi Hanifa, which was adopted in 1994. The core objectives of this plan were as follows:

- Conservation of the wadi's natural environment
- Removal of disorderly activities and uses
- Preparation of the wadi as a natural drainage course for Riyadh
- Use of the wadi as a recreational area
- Enhancing and upgrading agricultural use
- Preservation and utilisation of heritage assets

The 1994 Strategy for Wadi Hanifa was partially implemented. Quarrying in Wadi Hanifa was stopped. While the wadi provided a convenient and substantial source of stone and aggregates for construction, mining and excavation activities, the landforms of the wadi had been severely damaged. Cessation of this activity within the wadi had a positive effect, although uncontrolled dumping in some quarries had created a potential health hazard. Where inert building or excavation material was dumped, no health risk had been created. However, in areas where industrial, clinical or domestic waste was being dumped, there was a risk of groundwater or surface runoff contamination.

There had also been, at the time, significant and frequent actions taken to clear dumped material throughout the wadi. These had led to an immediate improvement in appearance, but not to the cessation of dumping as a general practice.

The wadi continued to deteriorate because proper implementation of the 1994 strategy required a comprehensive and co-ordinated development plan, as well as a management structure to implement this plan. The ADA believed that the adoption of a comprehensive development plan for Wadi Hanifa would provide a framework for action to restore the ecosystem functioning of the wadi; create healthy environments and provide opportunities for water reclamation; and ultimately lead to improvements in the quality of life. They were convinced that without a comprehensive development plan, and the actions to implement such a plan, there was a real risk that Wadi Hanifa would continue to decline, keeping opportunities

for recreation, tourism and water recycling beyond reach, and preventing future generations from being able to meet their basic needs.

As an important part of the action plan, a committee of people from the concerned agencies was formed to define the flood boundaries of the wadi and identify the encroachments thereon. The outcomes of this search, which was approved by the High Commission in 2001, formed the base for the works laid out in the Wadi Hanifa Comprehensive Development Plan.

B. The Wadi Hanifa Comprehensive Development Plan

In 2001 the ADA appointed the British firm Buro Happold as consultants and, along with their Canadian Landscape Architect partners Moriyama & Teshima, commissioned them to develop the Wadi Hanifa Comprehensive Development Plan (WHCDP), to draw together all the completed studies and integrate them in a plan that would meet the future needs of the city. The terms of reference also required that designs be prepared for a first contract of works for the restoration of the wadi from the Al-Ilb Dam in the north to Al Hair in the south.

The WHCDP formed part of a ten year programme of works that aimed to restore and develop Wadi Hanifa as an environmental, recreational and tourist resource—not only to restore its natural beauty, but also to harness and rehabilitate its water. In addition, the consultants were also asked to develop guidelines for the use as a planning policy document. The ADA recognised that the lack of such planning controls would seriously undermine the restoration project, and an area known as the Wadi Hanifa Reserve was defined as the place where the planning policies would be applied.

The ADA's vision to restore the wadi back to its original state is almost completely realized. The wadi is now in complete use and was opened by Prince Naif Bin-Abdulaziz Al-Saud in an official ceremony, an event covered by the media and widely celebrated across the city and the Kingdom.

The capital construction works to implement the master plan were divided into two parts: The Wadi Hanifa Restoration Project that involves those construction works necessary to restore flood performance and water quality, and to complete the restoration of the wadi bed; and the Wadi Hanifa Development Programme, which is formulated around those public infrastructure and public landscape capital construction works which, together with private sector investment projects, will build on the platform provided by the Wadi Hanifa Restoration Project to complete the implementation of the Wadi Hanifa Comprehensive Development Plan.

C. The Wadi Hanifa Restoration Project

The project began the overall implementation process by first meeting existing demands along Wadi Hanifa before addressing future needs. The key steps involved restoring and protecting the environmental values of the wadi and upgrading its functionality, including:

- Cleaning the wadi bed of dumped material.
- Improving the flood performance of the channel by reprofiling and regarding.

- Improving the wadi's road network in relation to the proposed water restoration works, to better accommodate local access needs, improve connections to the Riyadh road network, and provide better performing and safer local roads.
- Improving and relocating the utilities network in the wadi (required by the proposed water restoration works and road works).
- Introducing landscaping to re-establish natural vegetation in the wadi bed.
- Improving the surface flow channels and introducing discharge, bio-remediation and monitoring practices to clean the water flowing through Wadi Hanifa.
- Developing a major part of the 'Wadi Bed Naturalized Parkland' and the 'Recreational and Interpretative Trail', to get early public participation and use of the wadi environment and to encourage public 'buy-in' and 'ownership' of the Wadi Hanifa project.
- Establishing a platform for the project that emphasises a clean environment, accessibility, environmental quality, public landscape and cultural resources in order to attract private investment for additional private-sector projects. This is critical for attracting private sector tourist investment.

The construction in the wadi was split into 5 zones; work had been ongoing for almost four years in an area that stretches from the Al-Amariyah road to Al-Hair dam, a distance of some 71kms.

The construction works involved the removal of almost 1.25 million cubic metres of construction waste as well as other inert and non-inert waste that had been dumped in the wadi over many years. There was also a restoration of the wadi channel to cope with a one-in-twenty-year storm, so flood waters would be contained. Prior to this work, there had been widespread flooding when it rained due to the rubble and illegal building within the wadi, which impeded the flow of water into the channels.

In conjunction with this, the original network of un-coordinated roads, utilities and dry weather flow channels were reorganised and co-ordinated as much as possible. A majority of the overhead power lines were relocated underground, and other utilities placed in dedicated corridors beside the reconstructed road system that had been designed to withstand flooding.

Pollution caused by decades of illegal and unrestricted dumping of untreated waste, rubbish and development had resulted in an environment that was injurious to the local environment and the people of Riyadh.

Approximately 450,000 cubic metres of water (dry weather flow) continually flowed at that time out of the city each day into the Wadi Hanifa from various side wadis and channels. The main sources of flow into the wadi are:

The North Diversion Channel	24,000m ³ /day
Wadi Gudwannah	3,600m ³ /day
Wadi Umm Qassar	9,000m ³ /day
West Ship	19,300m ³ /day
Batha Channel (Manfouha STP outfall)	250,000m ³ /day (average)
	450,000m ³ /day (peak)

These flows are expected to increase two-fold by the year 2021.

Currently, this water cannot be reused for irrigation, agriculture and non-potable water uses, because of water quality concerns.

Riyadh consumes 1.3 million cubic metres of water and this is expected to rise to 3 million cubic metres by the year 2021. Because of the continual draw-down of the water table to cope with the city's ever increasing population, Riyadh has had to find alternative sources of water. At present, most of the city's (desalinated) water supply is piped in from the coast 350km away, a very expensive and unsustainable option.

The ADA's plan was to try and recycle one million cubic metres of water per day by 2021 to meet a third of the city's total water demand; to achieve this, it is necessary to clean up the water entering the wadi.

The system that had been set up to clean the water makes use of natural processes. Introducing oxygen into the water gave rise to the coliform bacteria present in the water at that time, being killed off and allowed micro organisms to grow, further adding to the natural cleaning of the water. Various methods were used to achieve this, including the construction of a new stone-lined channel that allows micro organisms to grow, which in turn act as a part of a food chain for various other predators such as fish that feed on the various life forms in the water and rocks. A series of natural stone weirs were built in order to introduce oxygen into the water as it passes over and through them.

Just downstream of the weirs, pools were constructed. These will have a series of Artificial Periphyton Benthic Substrate Devices (APBS) placed in them. The units resemble upside-down mops and have a very large surface area to allow the various organisms that will feed on the pollution to grow. There will also be fish in the pools.

Although the features described above will help reduce the amount of pollution in the wadi, the major part of the water-cleaning process comes out of the bio-remediation plant.

D. Wadi Hanifa Development Programme

The cleaning up of Wadi Hanifa was of course a critical part of the project. However, just as important are the other measures designed to bring the wadi back to the people of Riyadh. The Wadi Hanifa Development Programme builds on the work of the restoration project, with strategic public and private sector projects aimed at developing the environmental, cultural, recreational and water resources of the Wadi Hanifa. The programme's methods include:

- Providing open spaces and parklands along the wadi and extending them into surrounding residential areas.
- Developing the magnificent cultural resources of Wadi Hanifa, particularly at Addiriyyah, Hay Al Masani, the Old Dam and Old Al Hair.
- Re-establishing the natural landscape in the desert tablelands and rangelands of the desert catchment area above the wadi bed, including construction of check dams.
- Providing private sector investments to renew the Seyah mixed-use development area.

- Providing private sector investment opportunities for recreational and leisure facilities.
- Providing private sector investment opportunities for tourist development.
- Providing private sector investment for innovative agricultural development.
- Constructing the impoundment downstream of Al Hair, to meet the future reserve capacity needs for water recycling in Riyadh.
- Constructing water recycling and treatment facilities, to meet the future water recycling needs of Riyadh.

To achieve these goals, a series of landscaping and other features have been introduced:

- Rock features to introduce an interesting natural feel to the wadi.
- Planting of palm trees at some of the gateways to Riyadh.
- Landscaping cells of indigenous species of flora that occur naturally in the Wadi and are proven to be hardy in the harsh environment. Through natural regeneration these will spread throughout the wadi.
- Interpretative trails that wind their way throughout the wadi allowing the public to access the area easily and to direct them to places of interest (interpretative trails and wadi roads will be lit to allow safe access through the area at night).
- Lighting to provide an interesting ambience to the Wadi by lighting up certain features, such as rock escarpments, to bring about an interesting look.
- Using existing features to create interesting landscapes.
- Creation of lakes and parks for recreational purposes. At the moment, five large parks are under construction.
- Prayer areas.
- Toilet blocks.
- Interpretative signage.

Future enhancement features included:

- An educational and visitor centre will be constructed within the wadi's boundary. This centre will focus on the educational and social aspect of the wadi by using videos and interactive features to show how important the wadi is and has been to the city of Riyadh.
- Development of the side wadis to link them with the main wadi.
- Kiosks and food and drink outlets will be added.
- Establishment of prayer areas throughout the wadi.
- Iconic bridges will be introduced into areas of public interest.
- Establishment of play and recreation areas.
- Cable car access will be introduced into some areas.
- Reintroduction of animals indigenous to Saudi Arabia into some areas of the wadi.
- Establishment of a wadi plant nursery that will be used as a resource to further enhance the wadi and to supply trees and plants to other ADA projects throughout Riyadh.

Currently the ADA is looking at further ways of enhancing the main wadi and to develop and restore many of the sub-wadis, to bring these into what is becoming more than the 'Great Park of Riyadh', rather than the 'Grater Park of Riyadh'.

The ADA has set up the Wadi Hanifa Directorate, which is ultimately responsible for the continued maintenance and development of the wadi.

With water at a premium in many developing countries, this scheme is a cost-effective method of achieving cleaner water to help create a healthy environment and to allow people to achieve a more healthy and productive life.

E. Overall Achievements and Outcomes to Date

The Wadi Hanifa Restoration Project is showing remarkable progress. It is rapidly taking shape as one of the world's most distinguished park systems and will become, if it is not already, truly Riyadh's Great City Park.

This remarkable progress has been made possible through the concerted teamwork of the ADA, Moriyama & Teshima and Buro Happold, ADA/Site Management, outside experts and the contractors - all working together with exemplary dedication. Although there is much work still ahead to complete the implementation of the master plan, the restoration projects in the main wadi have been completed. The positive socio-cultural and measurable scientific outcomes are already evident and very impressive. The level of design is of very high standard; so is its supervision and maintenance. A summary of outcomes and achievements follows:

- Flood-proofed entire landscape along 70km stretch of Wadi Hanifa through combination of grading and channelisation; relocation of all piped utilities (except heavy sewers) and removal of all overhead utilities (relocated underground).
- Re-designed wadi road system to reduce road widths and rationalize road system into a single primary route into the wadi.
- Implementation of the channel system designed to biologically remediate wastewater as it flows along the channels.
- Completed construction of a major Bio-remediation Facility with four water quality experts on site collecting data and continually monitoring outcomes. Water quality test reports showed extremely significant improvement in water quality.
- Designed and built seven major public landmark parks (with additional two under construction) along the wadi.
- Designed and built 30 toilet blocks.
- Designed and built about 46.8km of walking trails running throughout the entire park system.
- Designed and built 7.4km of pedestrian promenades.
- Designed and built street lighting and trail lighting systems for the entire wadi, consisting of 2,500 fixtures + 600 feature lights.
- 'Branding' of the wadi and 730 pieces of signage including way-finding and interpretive signage (all now installed).
- Grown and planted 30,000 indigenous shade trees, 6,000 date palms, 50,000 shrubs and groundcovers, and transplanted 2,000 large native Acacia trees.
- Designed and built over 2,000 lay-by and parking spaces along the length of the wadi.
- The people of Riyadh have started using the wadi parks and open spaces in large numbers as evidenced by the almost full capacity crowds on weekends.

- Technical and construction issues are systematically being resolved. The wadi is becoming visibly green again and, as per the Nelson Environmental Test results discussed above and presented in the ADA report and the water is being significantly cleaned.
- The Bio-remediation Facility is developing the biology that will do the work of cleaning the water. There is a tremendous difference in quality between the water flowing into the Bio-remediation and that flowing out and into the wadi. Already the Bio-remediation Facility is performing beyond expectations.
- Maintenance and management of the wadi is underway and will continue to enhance the entire length of the wadi.
- Wadi Hanifa is increasingly becoming recognized in Saudi Arabia and around the world as a landmark initiative. Principles and techniques developed for the wadi will have been applied in many places around the world.

F. Impact of the Project

It could be said that the rehabilitation of the wadi (especially upstream near the town of Derayyeh) has contributed to the strengthening of the cultural identity of the inhabitants through re-linking them with the roots of their social fabric, to a time when people actually inhabited the area (the Hanifa tribe). The very first human settlement in this dry region took place in the wadi and continued to the rise of the modern city of Riyadh. The present Al-Saud ruling family are originally from this area (from the Hanifa tribe), a fact that gives the wadi additional significance.

Socially, the project proved very popular among the inhabitants of the city across social classes (both Saudis and other people living and working there). One can find diplomats and high-ranking government officials in the same place, at the same time as workers from the Indian subcontinent and the Philippines. The park's design allows for a fair degree of privacy. Most people feel comfortable bringing over their families for a day out surrounded by nature. Conventions necessitate an atmosphere of respect and decorum where women and families are present. In the four days I spent visiting the wadi, which included two busy weekend days, I was surprised to see how quiet and peaceful it was, compared with the city with its teenagers driving fast with car stereos blasting sounds.

The way that the vehicular circulation system has been designed and implemented, and the strict codes of conduct in the wadi, both contribute to the family-friendly atmosphere in the wadi. In addition, the signage system, with its well thought-out banners, educate and encourage people to act responsibly towards the environment of the wadi, and contribute to giving them a sense of being actively involved, and an acute sense of ownership.

The parks are designed in a way that provides family compartments, in the form of semi-enclosed areas, which each family can use for the day, without being disturbed by neighbouring families. The authorities provide clean toilet facilities, running water, medical points, an active ranger patrol service for help and security, and operate in coordination with the city's fire and police departments.

One of the most important impacts of the project is its educational potential, which has begun to materialise. The rich diversity of flora and fauna that can be found along the vast areas of the wadi has proved very attractive to school programs, from elementary level to university level scientific experiments. The Bio-remediation Facility with its grand scale and its informational signage is a most interesting and attractive scientific experimentation facility. The fact that it is visited by school groups shows the environmental consciousness of the new generation. The ADA also has plans for engaging the general public by installing (by 2011) a cable car system that circles the area of the facility with audio presentations explaining the way it is operated and the importance of reusing surplus water.

G. Problems Raised

The popularity and success of the wadi and its parks, lakes and activities have exposed some problems that had not been foreseen and issues that were not given sufficient attention. The first rather urgent problem is chaotic and illegal parking. This is probably due to the insufficient number of parking spaces. Thus cars park along the roads bumper-to-bumper, or tread and encroach on places that have been heavily landscaped (both hard and soft landscaping) destroying plants and edgings. The ADA said that it was in the process of immediately addressing the problem, especially after the local press wrote about it. The ADA has promised to solve the problem before the school summer holidays begin. It has also stated that it is cooperating fully with traffic police to ensure rapid traffic supervision. The ADA is also in the process of launching a media campaign that educates the public as how to preserve the wadi. This is in the form of posters, TV ads and mobile exhibitions that circle the city.

The wadi as a whole is an exclusively governmental project. The private sector is not engaged and has not contributed to anything significant. The wadi looks very clean and neat, but lacks restaurants, small vendors, kiosks, and the like. The authorities seemed to me over-protective of the sites. One would wonder how great the burden solely placed on the municipality is, even one of the calibre of the ADA, and how long and at what cost it would be logical to bear the burden alone. On the other hand, it is of considerable concern that the prices of the land and property surrounding the wadi have become more than ten times their value before the development. What negative repercussions this might have with regard to real-estate speculation is still to be seen.

H. Awards/Distinctions for Wadi Hanifa

- Waterfront Centre (USA): Top Honour Award to Wadi Hanifa Comprehensive Development Master Plan, Riyadh, Saudi Arabia, 2003.
- Master Plan Presentation to United Nations Commission on Sustainable Development, April 2004.
- “Highly Commended” Award by the British Expertise Association, UK, 2006.
- International Awards for Livable Communities (LivCom) Community Sustainability Award “Natural Projects” - Gold, 2007.

I. Landmarks At Wadi Hanifa

- Al- Elb Dam

- Al-Elb Dam Park: 93 family picnic areas with a 5,500 metre-long pedestrian promenade
- Wadi Hanifa Park: 27 family picnic areas with a 5,600 metre-long pedestrian promenade
- Sultana Park
- Eid prayer area, a 3,000 metre-long pedestrian promenade.
- Utaigah balconies and terraces.
- Historical Ad'Diriyah village
- At'Turiaf District
- Irga area
- The Diplomatic Quarter
- Wadi Hanifa Dam
- Al- Quriashiya area
- Al-Badi'a Palace
- The Bio-remediation Facility. A 52 family picnic area with a 1,100 metre-long pedestrian promenade
- The Stone Dam
- The Stone Dam Park: Seven family picnic areas with a 4,500 metre-long pedestrian promenade
- The Jiz'ah Lake
- The Jiz'ah Lake Park: 37 family picnic areas with a 5,400 metre-long pedestrian promenade
- Al- Masane Lake Park: 22 family picnic areas with a 4,100 metre-long pedestrian promenade

J. The Bio-remediation Facility

The Bio-remediation Facility is one of the most impressive features of the project. Unique in the world, it has an image of science fiction-like formation, albeit built in natural materials. The technical term bio-remediation means the use of natural biological functions for the remediation of a variety of environmental damages. It is a naturally-occurring process which can be augmented in wastewater systems through the establishment of an ecologically efficient food web consisting of not only primary producers (algae and higher plants) but also consumer organisms (fish, birds, insects, etc). Less costly than mechanical treatment, this process has become the preferred methodology of cleaning the water because it enhances the natural processes of the wadi ecology. This has contributed to the improvement of the environmental quality of the wadi, which in turn has greatly enhanced public perception and public use.

Within the dry weather flow channels of the Wadi Hanifa watershed, naturalised channel design provides continual bioremediation of toxicants, harmful bacteria, and excess nutrients (contaminants from urban and rural discharge) in the year-round flow.

The main bio-remediation facility is located north of the main highway interchange; it incorporates a series of weirs, riffles, pools, aerating pumps, bioremediation cells, artificial periphyton and benthic substrates, and riparian planting.

Together, the elements of this design have developed the appropriate aquatic and riparian conditions to assimilate contaminants and to further remediate the water through a community

of natural organisms that aggregate to form a food web. While all principles utilised in the Bio-remediation Facility are proven, the design of the system integrates a hybrid of natural ecological principles and is the first of its kind in the world. This project is already successful in providing water treatment while creating a one-of-a-kind natural facility and open-space public attraction.

The ADA is in its final stages of planning for installing a cable car service that circulates the facility, providing a sort of educational tour and tool that shows and highlights the environmental principles on which the design is based.

The water enters the system on the far right of the picture and works its way down through a series of cells (see below) to the final area where a fountain again adds more oxygen to the system. The fountain will achieve at least a 20m column of water.

There are now three compartments to the bio-remediation system, although in the original concept, there were four. The reduction in size was due to the high cost of rerouting some of the larger services buried within the wadi bed. To overcome this 'loss', however, the cells from the compartment that was not realised have been redistributed in the third compartment, so there has been no loss in the function of the facility.

There are 134 individual cells in the bio-remediation system, configured in a herring-bone arrangement. The cells are designed to have the same amount of water flowing at the same time and to keep the water within the cells as long as possible, in order for the various parts of the cell to act on the water to reduce the amount of pollution.

To help reduce the coliform bacteria and other pollutants in the water, oxygen will be introduced into each of the inlet channels (running down the spine of each compartment) by a series of perforated pipes (similar to the ones used in the bases of fish tanks, only much larger).

Within the cells, natural organisms will create a food chain which will act on the bacterial organisms and in doing so clean up the water. Fish will be the top predator and these will be introduced to the bio-remediation facility where they will be harvested on a regular basis. It is anticipated that in excess of one ton of fish per day will be taken from the facility.

VIII. Persons Involved

Arriyadh Development Authority

Abdlatif Al Sheik - President ADA

Ibrahim Al Sultan - Vice President ADA

Tariq Al Faris - Director of Construction ADA

Saleh Al Fayzi - Project Director

Moriyama & Teshima Planners Limited / Buro Happold in Joint Venture

Moriyama & Teshima Planners Limited

George Stockton - President - Landscape Architect

Drew Wensley - Vice President - Landscape Architect

Christopher Walter - On-site Landscape Architect

Buro Happold

Terry Ealey - Principle Emeritus - Civil Engineering

Alan Travers - Principle - Technical Director Infrastructure & Environmental Group

Mark Taylor - Landscape Architect

Badan Landscape Contractors

Nelson Environmental

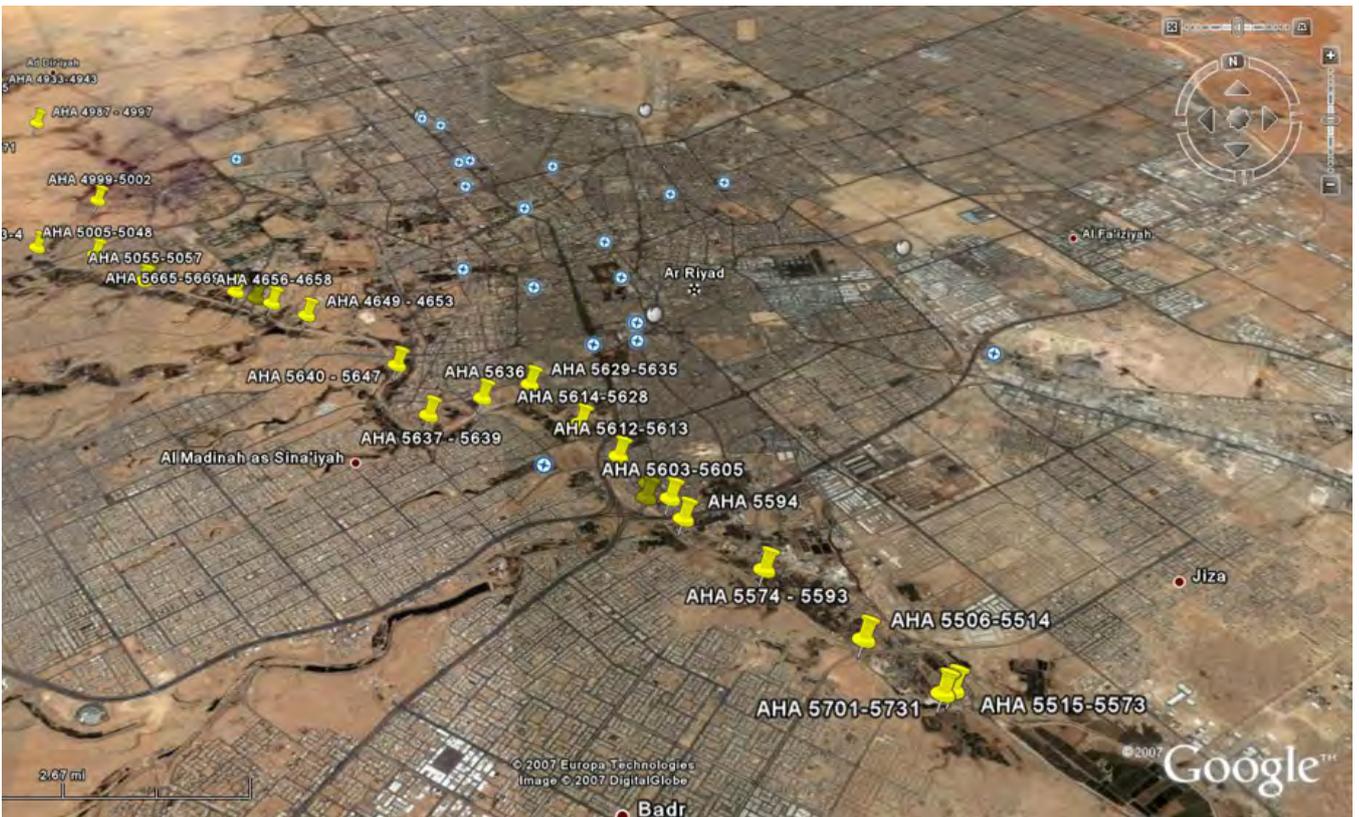
Martin Hildebrand - President - Civil Engineering

IX. Selected Bibliography

- 2010 Arriyadh development authority | Moriyama & Teshima | Buro Happold Wadi Hanifa Restoration Project, | march 2010.
- 2010 Arriyadh Development Authority (ADA)
Bioremediation & Surface Water Report - February 2010
Prepared By: Nelson Environmental Inc.
Website: www.nelsonenvironmental.com
- 2010 Arriyadh Development Authority (ADA). Kitab Al-Ta'heel Al-Bee'I, Rihlat Al-'odah, February 2010 كتاب التأهيل البيئي: رحلة العودة، شباط فبراير 2010
- 2010 Muhammad Al- Ghunaim: Wadi Hanifa report covering the Inauguration, Al-Riyadh News paper (in Arabic), Wednesday, April 7th 2010, PP 14-15.
- 1992 Akbar, Jamel A, 'Imarat al-'ard fi al-'islam, published by Dar al-Qibla, Jeddah, Saudi Arabia. 2nd. ed. in 1995, published by Dar Al-Bshir, Amman, Jordan. 3rd ed. published by Al-Resalah publishers, Beirut, Lebanon. (in Arabic).
- 1988 Akbar, Jamel A., Crisis in the Built Environment: the Case of the Muslim City, published by Concept Media (the publishers of Mimar magazine), formerly in Singapore, and moved to England, ISBN: 9971848694; distributed by. J. Brill, Leiden, the Netherlands; ISBN Hardback: 9004087575, ISBN Paperback: 9004087583.

Wael Samhouri

April 2010





Aerial view of the Wadi Hanifa, 2007.

Aerial view of the Wadi Hanifa, 2009.





Before the implementation of the Wadi.

The flood performance of the channel is improved by reprofiling and regrading.





Aerial View of the bio-remediation facility.

This project is already successful in providing water treatment while creating a one-of-a-kind natural facility and open-space public attraction.





The Bio-remediation Facility is all built with natural materials.

The Bio-remediation Facility is one of the most impressive features of the project.





Introduction of landscaping to re-establish natural vegetation in the Wadi bed.



Interpretative trails that wind their way throughout the Wadi allowing the public to access the area easily and to direct them to places of interest.



Open spaces and parklands along the Wadi.

Picnic area along the Wadi.





Re-establishing the natural landscape in the desert tablelands and rangelands of the desert catchment area above the Wadi bed, including construction of check dams.

The parks are designed in a way that provides family compartments, in the form of semienclosed areas, that each family can use for the day, without being disturbed by neighboring families.





Developing a major part of the Wadi Bed Naturalized Parkland and Recreational and Interpretative Trail, to get early public participation and use of the Wadi environment.

A series of natural stone weirs were built in order to introduce oxygen into the water as it passes over and through them and helps to reduce the amount of pollution in the Wadi.



