

Aurel von Richthofen

PATTERNS OF URBAN GROWTH AND EXPANSION: THE CASE STUDY OF AL KHOUD

AL KHOUD - A SHOWCASE FOR URBAN EXPANSION

Al Khoud is a showcase for the present phenomenon of government-planned urban expansion within the Greater Muscat Area. The site was planned in the early 2000s by the Ministry of Housing in Muscat and is the sixth phase within the Al Khoud residential development scheme. The site plan is a strict layout of similar plots with a regulating street network. Plots were awarded to citizens in 2007 and construction began slowly thereafter. Within this case study the site was surveyed from 2010 to 2013.

During this timeframe the plots and roads developed significantly, with 47.2% of the plots and 75.5 % of the roads built. Despite the governmental planning of Al Khoud, fresh water or sewage connections don't exist. Electricity is available on site, although many connections are just makeshift wires tapped from the main lines. The master plan is homogeneous and relatively easy to track in time. The rapid pace of development makes it an interesting "live" object of research, allowing for the study of not just the "result" but also the process. The actual form of urbanisation can be tested against the goals set in the master plan by the Ministry of Housing.

LOCATION AND SITE MORPHOLOGY

The new settlement is located in the northwestern Seeb District 1, about 40 km west of the old city centre of Muscat and 11 km inland from the coast. The elevation of the site is between

58 and 62 m above sea level, while the plateau on which the settlement is built is at an altitude of 60 m. The GPS coordinates are Latitude: 23.592251° Longitude: 58.142366°. The Al Khoud Phase 6 development occupies a site area of 2.4 km².

Al Khoud is located on a relatively flat and arid stretch of land referred to as Batinah Coastal Plain. Dry wadis (river beds) drain the Batinah originating from the Hajar Mountains to the southwest and running into the Arabian Sea to the north. The Wadi Al Khoud borders the site on the northern edge. The wadi is 10 m lower than the plateau on which Al Khoud is located. Its borders are marked by steep walls of gravel and are formed by erosion. The wadi occasionally floods, as there is no retention dam upstream. While the water level never rises very high, strong currents contribute to further erosion of the valley. The southern edge of the site is marked by gentle hills that are up to 15 m higher than the plateau. The northern and western sides run parallel to the wadi and continue along the flat plateau.

The Al Khoud site is located on a relatively young fluvial gravel plane that forms an alluvial fan emerging from the southern mountains. The fan is inactive nowadays and the main drainage is through Wadi Al Khoud immediately to the west of the area. Flooding of wadis in Oman occur infrequently. The worst-case flooding scenario is unknown and therefore there is a potential that the site might be inundated, causing landslides and major erosion on the edges of the wadi. The present urban design of Al Khoud does not take possible changes of the wadi-bed into consideration.

Furthermore the area is confined by hills to the east and south. These hills are made up of Eocene limestone and are known to be rich in fossils, the most spectacular of which are nummulites, which are single-celled organisms. Their remains can be found in millions within the rock, reaching sizes of 5 cm and more. Levelling of the site for construction destroys its fossil heritage.¹

MICROCLIMATE AND ECOLOGY OF THE SITE

The site is subject to the weather conditions predominant in the Batinah coast. Weather recording in the nearby Seeb international airport is one of the most complete in the country



Figure 2.1.1: Photo of local plants including thorny acacia trees in wadi Al Khoud in 2012

and dates back 30 years. Temperatures rise to 50°C in summer and drop to 18°C in winter. Wind directions are predominantly from the sea.² Air humidity is high in the summer months. Precipitation of 30 mm per year on average is very low, nonetheless Wadi Al Khoud is the channel for a massive drainage area in the mountains. Al Khoud dam located downstream is a testimony of the volumes of water anticipated as it was flooded in April 2013. Vegetation traces indicate pockets of favourable microclimates within the wadi and run-off sites on the plateau. Previous to construction in 2007 the site was not permanently inhabited. Satellite images show the presence of herding activities. Dirt tracks formed by vehicles and herding criss-crossed the site. The loose network connected the oasis of old Al Khoud to As Seeb on the coast. Vegetation occurred in the wadi and sporadically across the site. Acacia trees up to 3m tall were the most visible plants. As part of a larger habitat the wadi and plateau formed a complex and fragile ecosystem, relying on the sporadic flooding of the wadi and the replenishment of underground water.³ The name of the settlement refers to the village of old Al Khoud to the south. The wadi links both the village and the new settlement. Similarly, historic villages such as Bowsher, Fanja, Al Khoud and Halban are nested at the foothills of mountains, where water naturally surfaces and is captured in falaj irrigation systems. These old oasis settlements underwent and still undergo a dramatic shift, as traditional life-style patterns erode.⁴ The new developments like the one described here are placed within the former hinterlands of these historic centres. The transformation of ecosystems also transforms historic production landscapes that form the base of the extended urban network, of which the new Al Khoud is a part.

AL KHOUD WITHIN THE LARGER URBAN NETWORK

Al Khoud is located 20 km from the ministries district and 10 km from the airport to the east. It borders the campus of Sultan Qaboos University to the east. Lands to the east are reserved for future expansion of the university. The Royal Botanical Garden (under construction) is located 5 km south. Knowledge Oasis Oman – a technology park and incubator for media and science – is located southeast of the site at the interchange with the highway running to the interior of the country. The German University of Technology in Oman moved into their new campus in Halban located 15 km to the west in 2012 and the future Oman University is to be located there as well. Heavy industry is located close to the interchange in the Al Russayl industrial zone. In spite of the fact that Al Khoud was planned with the purpose of housing middle-class Omanis typically not working in one of these institutions, a considerable amount of properties is offered for rent.

Despite this host of institutions within a 20 km range, Al Khoud does not benefit from a particular location advantage. Rather it is one of numerous residential developments scattered further into the Batinah coast. The neighbourhoods of Mawaleh and Mabaila to the west of Al Khoud and the large campus of Sultan Qaboos University to the East are expanding and growing rapidly. In the case of Al Khoud and Mabaila only Wadi Al Khoud separates the two settlements. Other parts of the city have already merged into a continuous urban sprawl.

Due to the linear expansion structure of Greater Muscat Area the position of Al Khoud can be defined in relation to a network of institutions and local urban centres including places of work, commerce and recreation, but also within an expanding scheme of residential developments and infrastructural elements.

Similar to the transportation network, water is a key element in order to sustain settlements. Wadi Al Khoud does not contain enough water to sustain the new development. Hence trucks are needed to deliver fresh water and extract sewage. The closest desalination plant is located in Barka, 15 km to the North. The nearest sewage plant is less than 10 km away.

INFRASTRUCTURE AND CONNECTIVITY WITHIN THE EXPANDED URBAN AREA

The case study area is fully integrated into the overall road network of Greater Muscat Area. The Southern Expressway, a 6-lane modern highway opened in 2011, runs from Qurm in the East of Greater Muscat Area to the West for 60 km. Its construction into Willayat Barka and to Sohar started in 2014. This expressway runs parallel to the coastal Sultan Qaboos Highway. Running through a larger military zone between Ghala and Al Khoud it crosses a dramatic desert landscape. Al Khoud has its own highway exit and is well connected by motorised transport to the southern and western neighbourhoods of Muscat Capital Area and as well as the cities in the Batinah coastal region and the interior. Al Khoud Street is a 4-lane speed-road pointing to the coast in the North. Public transport is available only in the form of informal bus and taxi services running towards the neighbouring settlements and along the highway. The Al Khoud master-plan provides only basic amenities. During the construction phase (2007 to the present) very few shops or other services settled in the development area. Communal facilities are non-existent for the moment, and very few job opportunities exist. At the same time the settlement is located relatively far away from facilities such as kinder gardens, schools, mosques, recreation and sports facilities, medical services, shopping facilities and work places. Residents of Al Khoud need to commute every day even to cover basic needs. This generates a lot of traffic as all families use their private cars, since there is no alternative. The breadwinner of the family can drive more than 150 km per day, while spouses and kids need to travel long distances as well. Two or more cars per household are common.

URBAN DESIGN CHARACTERISTICS OF AL KHOUND

Al Khoud phase 6 was planned by the Ministry of Housing in Muscat. The site of 2.4 km² is subdivided into 2000 plots, grouped into 112 clusters of different sizes. The total road length within the settlement will be 40 km once completed. These figures hint at the fact that Al Khoud phase 6 was planned to meet certain targets in terms of numbers and infrastructure allocated to it.

The access to Al Khoud phase 6 is on the southern side of the site. The development can be entered from a roundabout close to the exit from the Southern Expressway and the 4-lane speed road towards As Seeb. There is no through-fare, all traffic enters and exits the residential development through the same point. The development is organised around a central spine of mixed-use commercial and residential buildings, up to seven stories tall running north-south. Two street lanes on either side surround this spine. Generous parking spaces separate the street from the plot lines. This central spine divides the site into three parts; the spine itself and two residential zones located in symmetrical fashion to the East and West, The southern edge is reserved for light industry with larger plots. Facilities are centred around the central spine. Next to basic amenities, very few facilities exist.

RESIDENTIAL PLOT LAYOUT IN AL KHOUD

The residential zone features plots for self-standing villas. These plots are mostly rectangular in shape and have the standard dimensions of 20x30 m, totalling 600 m². The plots are typically arranged in rows of two, back to back, forming clusters between 8 and 24 houses. The clusters are surrounded by large streets. The government distributes the plots through the land-allocation lottery system.⁵ The plots are governed by set-back rules, height restrictions and usage with a so-called krookie also issued by the Ministry of Housing. The plots are developed with single-family villas, semi-detached or twin villas, and lately with a special form of villa-apartment hybrid. Since the overall layout is not a rectangular grid but a diamond shaped lozenge, plots in the corners meet in larger and smaller angles. These corner plots are slightly bigger to compensate for the irregular shape. Some plots in the South-East are 1200 m² - twice the size of a standard plot. Each plot has a buffer-zone of up to 10 m to the front and 5 m to the back. These serve as outdoor parking and as a back alley.

Once awarded their plot, the future residents mark the plot-corners with cement hollow blocks and quickly erect a surrounding wall up to 3 m in height. Ideally, they will develop the plot by building a house conforming to the laws and guide-lines determined in the master-plan and the krookie, a colloquial term for a site-plan indicating the individual plot location, necessary

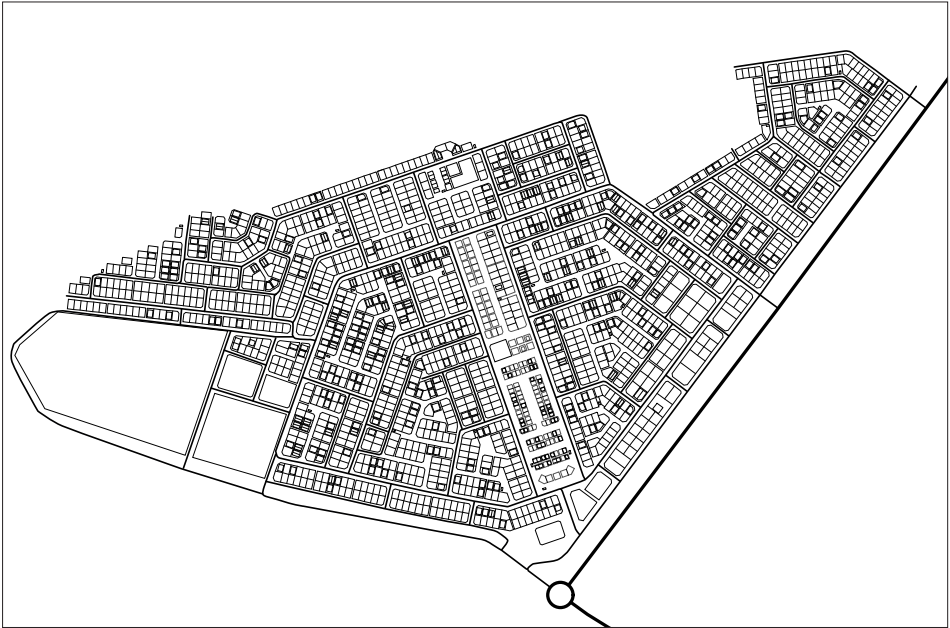


Figure 2.1.1: Typical plots in Al Khoud, so called krookies (Source: Ministry of Housing, Muscat 2010)

set-backs, and basic building regulations. In reality, development is not uniform and depends on the financial ability of the resident to construct a house, the chances of getting the appropriate infrastructure provided by the government and the prospects of making a profit with land speculation. As a result the site is randomly and loosely built up, construction is permanent and infrastructure in form of road and electricity is not used efficiently. More often, the plots are over-built, exceeding the maximum floor area ratio of 0.4 but keeping the required set-back distances.

TRACING THE URBAN DEVELOPMENT PROCESS IN TIME

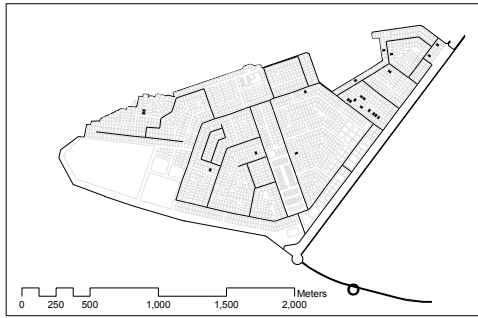
In November 2010 when the first field study took place, development in the area had become more dynamic and plots along the finished roads were being developed rapidly. Within only one year, at the end of 2011, building activities could be observed in the inner zones, along secondary roads or even along not yet paved roads. Road construction work was pushed forward in 2010. Until April 2013 the roads had not been developed completely and many houses could only be reached by improvised dirt tracks.

The development process can be traced in time thanks to satellite images. The earliest available satellite imagery goes back to January 2004. At the time of writing this chapter, 4 distinct snapshots in time were available: March 2008, February 2011, March 2012 and April 2013. The first building activity was recorded on the satellite image of March 2008. As one can see on the chronological map of Al Khoud in March 2008, 1.1% of the plots was built while 40.5% of the roads were already built. This indicates that very few residential construction projects started before a minimum amount of roads was available. About one third of these houses was actually located directly on one of the roads built. Access to the other houses was gained by travelling the last metres across improvised dirt tracks. The next available snapshot can be seen in the chronologic map of Al Khoud of February 2011. Here building activity slowly progressed with 5.2% of the plots built. Houses are randomly scattered around the site and only half of them are fully accessible by road. The road construction has not progressed and is still at 40.5% built roads. This is to remain so for the next snapshot as seen in the chronological map of Al Khoud dated March 2012. Here building activity has significantly increased with 26.7% of the plots built up.

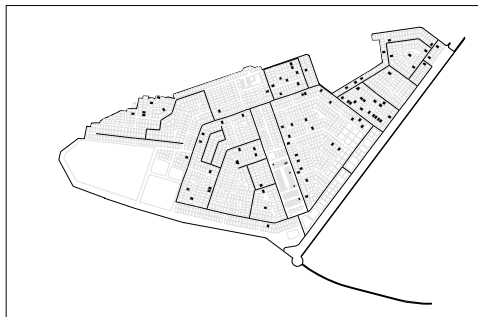
The most recent snapshot as seen in the chronological map of Al Khoud dated April 2013 shows an increase in both developed plots and a second phase of road construction with 47.2% of plots and 75.5% of roads built.

The residential development triggered by private investment follows a linear curve with a distinct turning point in 2011. In the first phase (2008-2011), development is very slow with 2% annual growth. This can be explained by the nearby construction of the Southern Expressway completed in 2011.

During its construction the noise and dust impact to Al Khoud was tremendous. At the same time road access was limited. The slow development of the houses questions the timing of the Al Khoud development starting in 2008, at the same time as the highway was constructed. The second phase from 2011 to 2013 sees a steep linear growth of 20% annually. At the current rate Al Khoud might be fully constructed in less than 3 years (2016). Nonetheless, the extended construction period of over 8 years is a significant drawback for the residents.



2008
1.1 % plots built
40.5 % roads built



2011
5.2 % plots built
40.5 % roads built



2012
26.7 % plots built
40.5 % roads built



2013
47.2 % plots built
75.5 % roads built

Figure 2.1.2: Chronological map of Al Khoud development 2008 - 2013

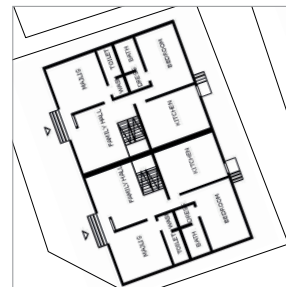
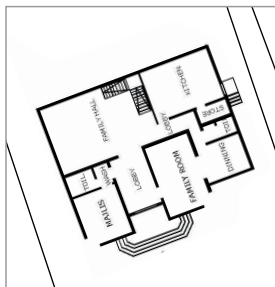
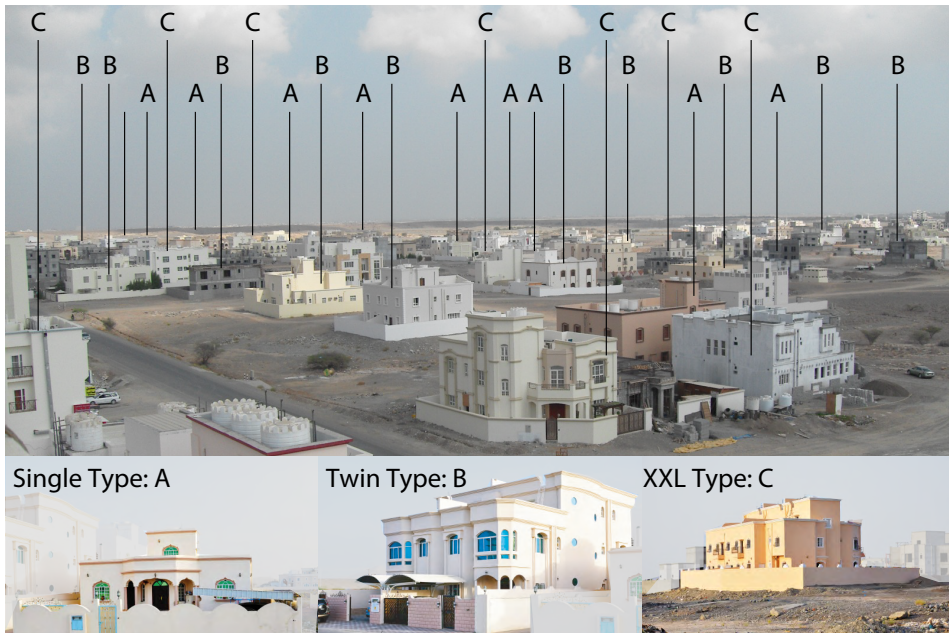


Figure 2.1.3: Photo of mixed-use building in Al Khoud

The road network provided by the state stays ahead of the residential development. Road construction follows a step-by-step model. The first phase, implemented at the beginning of construction development, saw 25% of the roads built in one stage. In the next phase, implemented in 2013, an additional 50% of roads were constructed. The pattern of construction of roads is less obvious. More developed parts of Al Khoud (to the North-East) have been prioritised in the process while others close to the Southern Expressway in the South are still awaiting development. The sporadic nature of the progress makes its development unpredictable for the residents. Until the road-network is complete no effort is made to work on the common outdoor space. For all these years and the years to come residents will live on a large construction site, subject to noise and dirt pollution.

BUILDING TYPES IN AL KHOUD

Al Khoud features a central spine of taller mixed-use buildings and lateral zones of self-standing residential buildings on individual plots. The central spine of Al Khoud is marked by apartment houses with a commercial ground floor and an additional five to six stories for rent. Neon signs advertise the respective



activity inside: small convenience store, barbershop, coffee shop, etc. These buildings stand 10 m apart. The apartments are designed for lower-income Omanis or expatriate workers. The streetscape seamlessly blends into the parking spaces in front of these buildings. The buildings have two staircases and one elevator shaft linked by a central, dark corridor. The footprint is usually square. The small rooms have small openings to one side only. The lower floors have poor natural ventilation and light. There are no balconies or other protrusions from the facade. No external shading protects from the sunlight. The roof is flat and used for air-conditioning split units and satellite dishes.

Figure 2.14: Photo of type A, B, C villas in Al Khoud

Figure 2.15: Typical Floor plans for single, twin and commercial buildings

The detached villa is the predominant house type in the lateral zones. The self-standing buildings differ considerably in size. Three categories are present: Type A: the 1 or 2 storey single-family home that covers a footprint of 180 m² or about 40% of the plot area; Type B: the mostly 2 storey semi-detached twin-villas with a footprint of up to 240 m²; and Type C: “XXL villas” with up to three storeys. These super-sized villas maximise the allowed footprint to up to 300 m². The front-side is reserved for an ostentatious villa with a “backpack” of 2 apartment units for rent to the back. Within the set-back rules, but exceeding the desired Floor Area Ratio, the maximum footprint of 308 m² results in the plot being overbuilt by 155%.

The local distribution pattern at the sampling time in April 2012 showed 61.4% of the plots built with Type A villas, 30.4% with type B villas and 8.2% with type C villas. The emergence of building types in time shows that the percentage of type C villas increased lately, although the 3 sampling points, in 2008, 2011 and 2012, are not sufficient to sustain a rigorous test.

EVOLUTION OF BUILDING TYPES IN AL KHOUD

In order to respond to the demographic pressure the Ministry of Housing focuses on residential development in the areas of growth in the expanding urban area fringe. All single villas and twin villas are exclusively for residential purposes. Nonetheless, the evolution of residential dwelling typologies from type A to type B, correlates with building trends all over the Greater Muscat Area. Buildings are no longer produced for individual demand but increasingly for real estate speculation. In the case of the XXL-villas a hybrid of both was invented. These buildings increase the density of the urban fabric offering up to three units per plot (house + 2 apartments for rent), but undermine the actual purpose of housing one family on a plot. These houses show that the plot size allocated by the government is too generous and leads to market distortion and excessive construction. Moreover, these XXL-villas are not incorporated into the urban design scheme of Al Khoud and stress the existing shared infrastructure such as water, sewage, electricity and parking spaces. Mixed use is to be found in the central area dedicated to multi-storey buildings – ground floor plus five or six levels. Uses such as commerce, restaurants, and

services are located on the ground-floor level, while offices and residential flats are placed in the upper floors. The distribution of taller mixed-use residential building, self-standing residential units and light industry has been pre-determined by the master plan. This layout continues the predominant segregation of functions deployed at a larger scale.

EVALUATING THE URBAN EXPANSION PATTERNS OF AL KHOUD

The general guidelines followed by the Ministry of Housing for development zones go back to Weidleplan's 1991 regional study for Muscat Capital Area. This study subdivides the larger Muscat Capital Area into various functional zones. In accordance with this functional map, the Muscat Municipality Building Code forms a legal framework for its urban development. According to the Weidleplan zoning, Al Khoud is a residential zone with mixed-use facilities and light industry.⁶

The planning process is characterised by a clear linear succession of events. The Ministry of Housing chose a site in proximity of road infrastructure and within reach from the various centres of Greater Muscat Area. Natural features and topography were not considered major obstacles or elements worth working with. The Ministry of Housing developed a master plan in-house, aiming to meet certain target figures (2000 plots / 40 km of road on 2,44 km²). This plan was developed only in two dimensions. No sections or other three-dimensional representation exists. There is also no phasing indicated in the plan (although the case study is phase 6 of similar developments in the Al Khoud area). This plan proposes zones for different uses (mixed-use and residential) and delimits the individual plots that are then turned into krookies. These krookies are allocated to the future residents by lottery. Stakeholder analysis, participatory elements or feedback mechanisms from the real estate market are not part of this top-down planning approach.

The building process is less clear and linear, as governmental and private sector develop the site in parallel. Roads and other basic infrastructure are provided by the government. As one can see from the time-based map of development only parts of the infrastructure are built. These parts appear randomly. While all plots are allocated in a single lottery session, not all

new owners decide to develop their plots at the same time, if at all. Since the infrastructure is not always present or still under construction, owners are deterred from building immediately. Others will wait for a rise in the market value to trade an empty lot at higher prices. Others still will buy up adjacent plots to develop larger parts. Plots randomly filling up make an inefficient use of the infrastructure. As one can also see from the time-based map, the heterogenous development of the houses turns the whole site into a permanent construction site.








Figure 2.1.6:
Al Khoud within the Greater Muscat Area



Figure 2.1.7: Road-network on Greater Muscat Area and Al Khoud site based on GIS data from openstreetmap.org 2013

1:300,000
1 cm = 3 km



-  Mountains
-  Wadis / Flood plains
-  Place Names 2013
-  Building Footprint
-  Road Infrastructure 2013

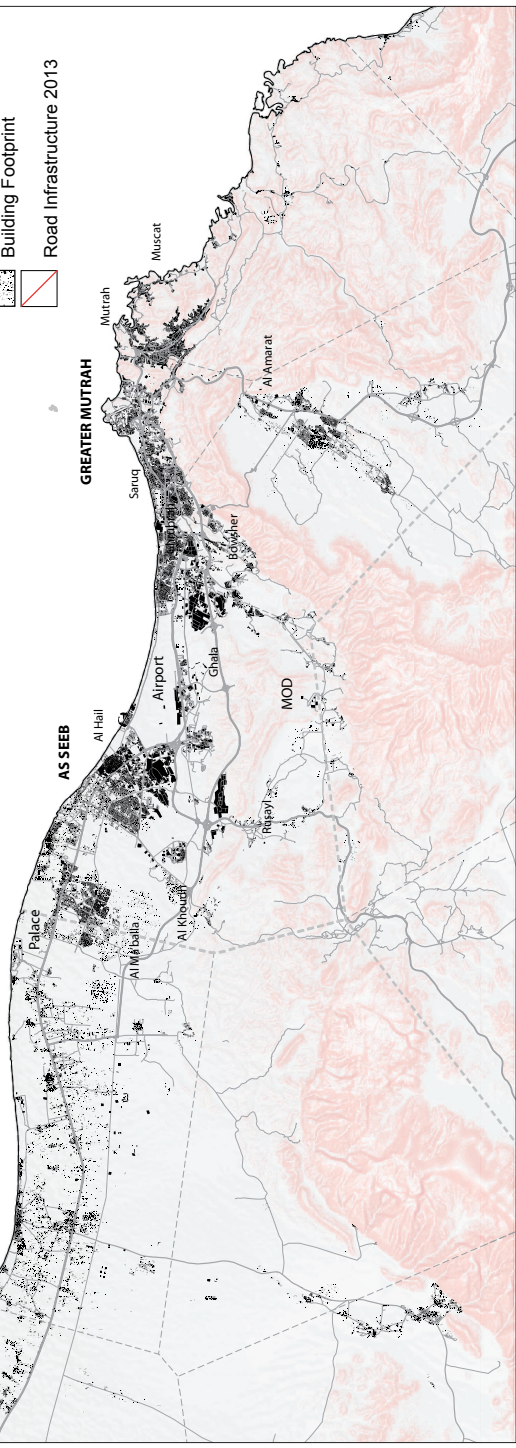
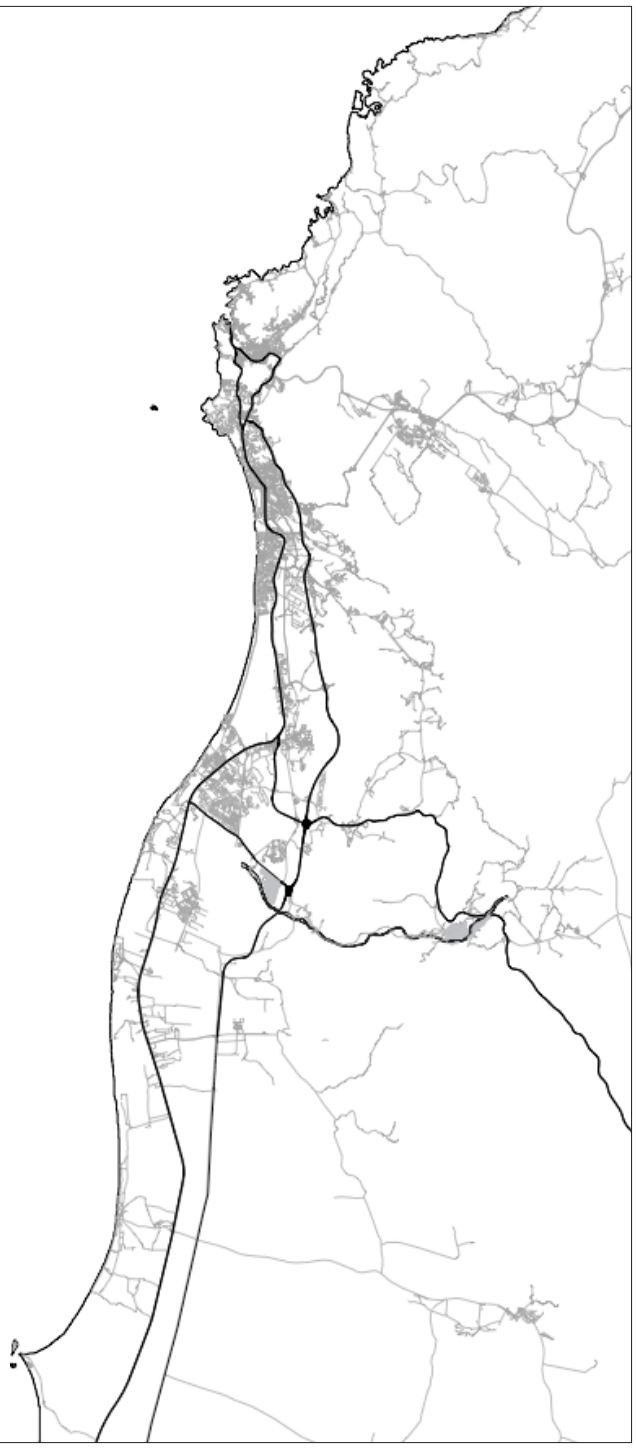


Figure 2.1.8: Map of Al Khoud and neighbouring centres with the Greater Muscat Area 2013



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NOTES

1. Interview with Dr. Goesta Hoffmann, geologist at GUtech Oman 2013
2. Seeb Airport weather records interpreted with Ecotect software by the author
3. Pickering and Patzelt, Field Guide to the Wild Plants of Oman, 4.
4. See Fanja Case Study in this book for the detailed examination of the rural-to-urban transformation process
5. Ministry of Housing Oman, Land Allocation by Lottery - Awarded Plots in Oman during 2009.
6. Weidleplan, Muscat Area Structure Plan Phase 3 Final Report.