



## Revitalizing Historic Al-Salt Downtown: Implementing Smart City Tools and Sustainable Urban Planning Strategies

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### ABSTRACT

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The study focuses on historic city center development, using smart city tools combined with sustainable planning strategies for the revitalization of Al-Salt Downtown into a smart environment. The study opens with a profound analysis based on current conditions by analyzing maps of the city center, mental maps of the site, and the accessibility network to understand the nature of the existing urban structure and the challenges it faces. The present analysis will also give full insight into the peculiarities of the area and those sites that most need development, in addition to the identification of strengths and opportunities that may be valued for the improvement of the city. It also highlights the possible elements that can help develop this area by finding and identifying specific sites for development, such as upgrading pedestrian paths, green public spaces, al “Souk” market, restoration of heritage buildings, improvement of residential and commercial areas, and digital connectivity. It tends to be particularly concerned with site mapping elaboration in such a way that an integrated experience is achieved to make residents and visitors flow in, developing further attachment to the city. The study necessitates the presentation of a new master plan designed to comply with the initial analyses and development proposals, ensuring integration between heritage elements and smart innovations that conserve the cultural identity of Al-Salt Downtown while providing a better quality of life for the residents.

## 1. INTRODUCTION

The historic downtown of Al-Salt, declared a UNESCO World Heritage Site, presents a unique case to combine heritage conservation with modern urban planning. Despite the rich architectural and cultural heritage of Al-Salt, the city faces huge urban challenges in terms of infrastructure shortages, traffic jams, and limited public facilities, along with a lack of integrating traditional and contemporary elements.

These challenges hinder the ability of the city to sustain its historical and social vibrancy, thus making it important to find innovative solutions balancing tradition with modernization.

The integration of smart city tools offers a transformative approach to addressing these challenges while enhancing the city's sustainability and livability. Specifically, Al-Salt's steep topography and narrow streets necessitate smart mobility solutions to improve accessibility without compromising its pedestrian-friendly character. Furthermore, the growing need for energy-efficient infrastructure and waste management systems highlights the critical role of technology-based solutions in maintaining the environmental health of the city. This study reviews smart city tools, urban development, and

sustainable approaches for the revitalization of Al-Salt Downtown in line with the area's characteristics. The objective of this research is to develop a comprehensive master plan that integrates smart city technologies and sustainable planning methodologies to enhance the urban layout, cultural assets, and quality of life for both residents and tourists in Al-Salt Downtown.

### 1.1 Research problem

How can the revitalization of Al-Salt's historic downtown effectively integrate smart city technologies and sustainable urban planning methodologies to improve livability, protect cultural heritage, and promote a livable urban community, while responding to contemporary urban requirements?

### 1.2 Hypothesis

Using smart city tools and sustainable planning in the historic downtown of Al-Salt can bring together heritage and modern life. By improving current urban spaces, creating new areas, and involving the community with inclusive Living

Labs, Al-Salt can become a sustainable, walkable, and culturally lively urban area. This achieves quality of life for residents, helps the economy grow, and ensures that Al-Salt remains a lively city that embraces its past and looks toward its future.

## 2. SUSTAINABLE URBAN PLANNING STRATEGIES

Sustainable urban planning brings in all the dimensions of environment, social, and economic for balanced and resilient urban environments [1-4]. Key indicators of sustainability include effective resource management, inclusivity, community participation, and environmental preservation [5, 6]. Examples of such strategies involve polycentric development, whereby regional balance is enhanced by spreading urban growth across several centers, hence reducing congestion while improving accessibility [7, 8]. The second most important measure would be heritage-sensitive development in which heritage buildings would be rehabilitated upon incorporating smart technologies but retaining their historical identity, thus increasing functionality and energy efficiency [9-17]. Participatory urban planning is important in engaging residents within the decision-making process so that any development occurring is according to the needs of the residents and respects their cultural identity [18].

### 2.1 Smart city concept and tools

The principal aim of smart cities is to improve the quality of life of the individuals by improving the physical environment that they inhabit, such as housing, public services, parks, and air quality, and by making their daily life easier through faster access to services like housing, retail, education, and transport, among others. In the quest of this objective, it is essential to realize the tools that play a significant role in making a city smart. These tools can be divided into sustainability, technology, and physical environment tools. Thus, a smart city is never defined by the combination of sustainability and technology in the utilization of these tools [19, 20].

### 2.2 Smart city tools for urban revitalization

The strategic components of the Area-based development in the smart cities mission are city improvement (retrofitting), city renewal (redevelopment) and city extension (greenfield development) [21]. Retrofitting will introduce planning in an existing built-up area to achieve smart city objectives, to make the existing area more efficient and livable while redevelopment will replace the existing built environment and enable co-creation of a new layout with enhanced infrastructure and greenfield developments are required to address the needs of the expanding population. Pan-city development envisages application of selected Smart Solutions to the existing citywide infrastructure.

Application of Smart Solutions will involve the use of technology, information and data to make infrastructure and services better, wastewater recycling and smart metering can make a substantial contribution to better water management in the city [22, 23].

## 3. METHODOLOGY

The study's objectives include analyzing Al-Salt's current

urban conditions, identifying specific sites for development, and proposing actionable improvements such as upgrading pedestrian pathways, green spaces, market areas, and digital connectivity. Methodologically, the research begins with a detailed analysis of the city center using traditional maps, mental mapping, and accessibility networks to understand the existing urban structure and identify areas for potential enhancement. Building on this foundation, the study proposes initiatives focused on physical and digital infrastructure enhancements. The development of a new master plan will ensure a seamless integration of heritage preservation with smart innovations, establishing Al-Salt Downtown as a regional model of a smart city that honors its heritage while promoting economic, social, and environmental sustainability.

## 4. AL-SALT DOWNTOWN

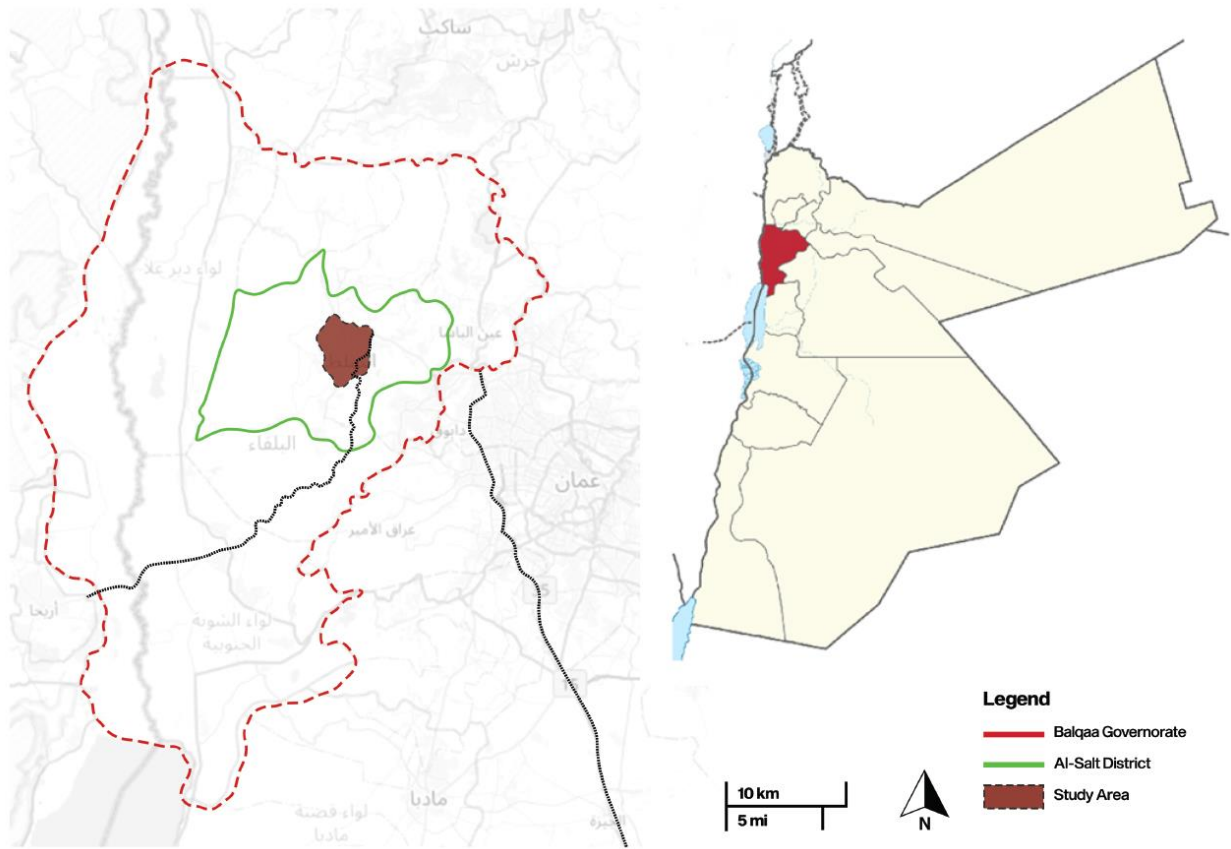
The urban regeneration of Al-Salt respects and enhances its unique topography, architectural context, and cultural character. Built on steep hills, the multi-story stone buildings and narrow pathways that make up the city's layered landscape dictate its urban pattern, creating scenic vistas and requiring delicate water management, which is woven into the revitalization through the restoration of traditional systems. Thus, it was marked by yellow limestone and Ottoman-style features such as arched windows and ornate facades, which the new developments preserved and celebrated by keeping this warm aesthetic. The organic form of the urban fabric has, with its narrow winding alleys and intimate courtyards, been prioritized for pedestrians to retain the characteristic village-like feel of Al-Salt. Revitalization for Al-Salt, a UNESCO World Heritage Site, also pictures tourism in a way that reveals respect for local life through authentic cultural experiences without over-commercialization. Al-Salt's urban revitalization reflects a balance between preserving its rich heritage and fostering a livable, economically vibrant urban environment [24].

### 4.1 Geographic exploration

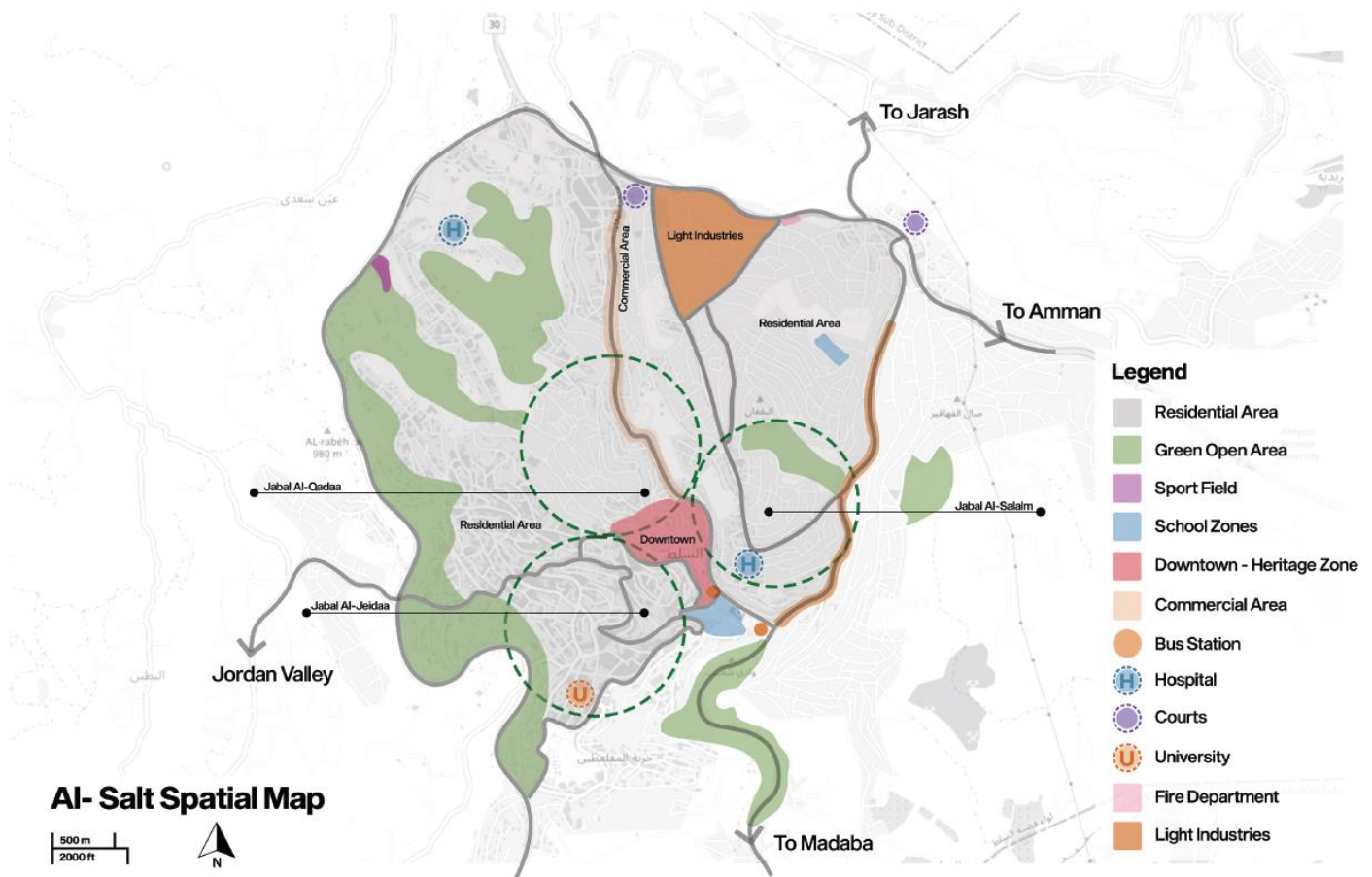
Al-Salt City is one of the historically important urban centers in Jordan, about 30 kilometers northwest of the capital, Amman, in a hilly area between the Jordan Valley and the highlands of Amman, as shown in Figure 1. Famous for its long history and unique mixture of architecture, Al-Salt is a very interesting object of study in geography and urban studies, due to its unique topography and cultural heritage, not to mention architectural characteristics.

This spatial map of Al-Salt City portrays a unique urban pattern, emphasizing the main functional zones and natural boundaries. Residential quarters are mapped along the periphery of the city and surrounded by green areas, acting as a natural buffer and providing recreation areas for its citizens.

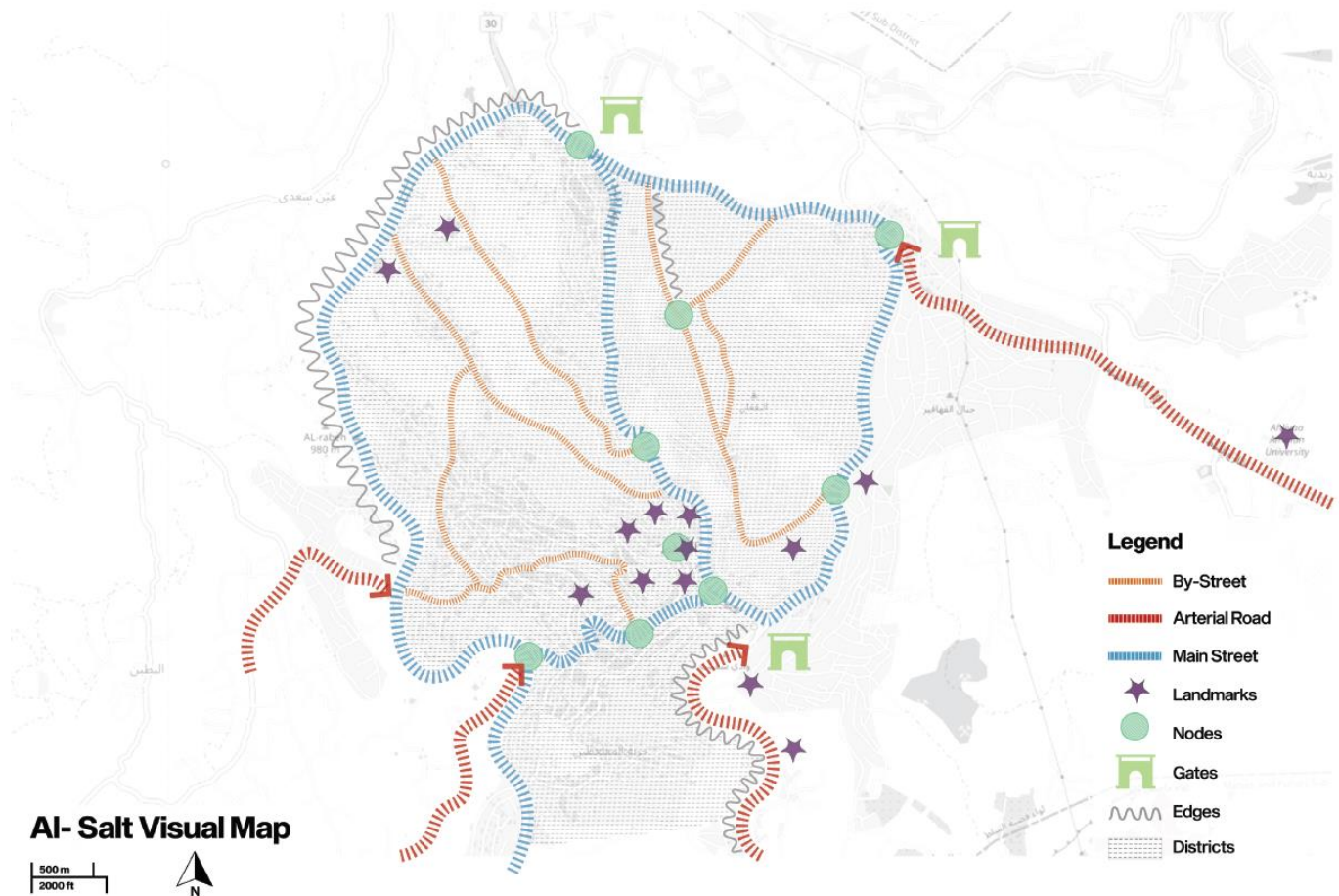
Figure 2 also identifies other relevant landmarks, including a university on one end, to form part of the educational tapestry of the city. It offers proximity to light industries and offers local jobs located near a residential area. More basic services are evenly distributed: two hospitals, one of them is new and placed within easy reach and the other one is old, several schools are spread out among neighborhoods, and a fire department is located near the entrance into the city to ensure quick access in case of emergencies, As show in Figure 2. This spatial map helps in capturing the Al-Salt mix of historical preservation and community-focused planning with its urbanism.



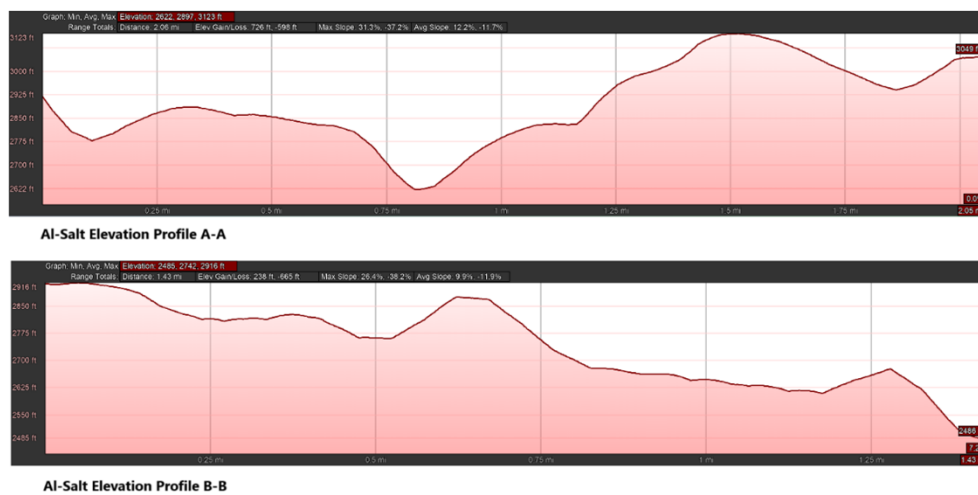
**Figure 1.** Location of Al-Salt City within Jordan and Al-Balqa governorate  
(Researchers, 2024)



**Figure 2.** Al-Salt City spatial map  
(Researchers, 2024)



**Figure 3.** Al-Salt City visual map  
(Researchers, 2024)



**Figure 4.** Al-Salt City elevation profile  
(Researchers, 2024)

Al-Salt City visual map presents a vast network of main roads that link it with several governorates, in addition to a main highway directly connecting the city center with Amman, as shown in Figure 3. Moreover, there is a ring road surrounding the western edge of the city passing through a marked highland that creates a clear edge, thus setting Al-Salt apart from other urban centers within Balqa Governorate, as shown in Figure 4.

The internal thoroughfares are divided into semi-principal routes all leading to the Al-Salt Downtown, with meandering

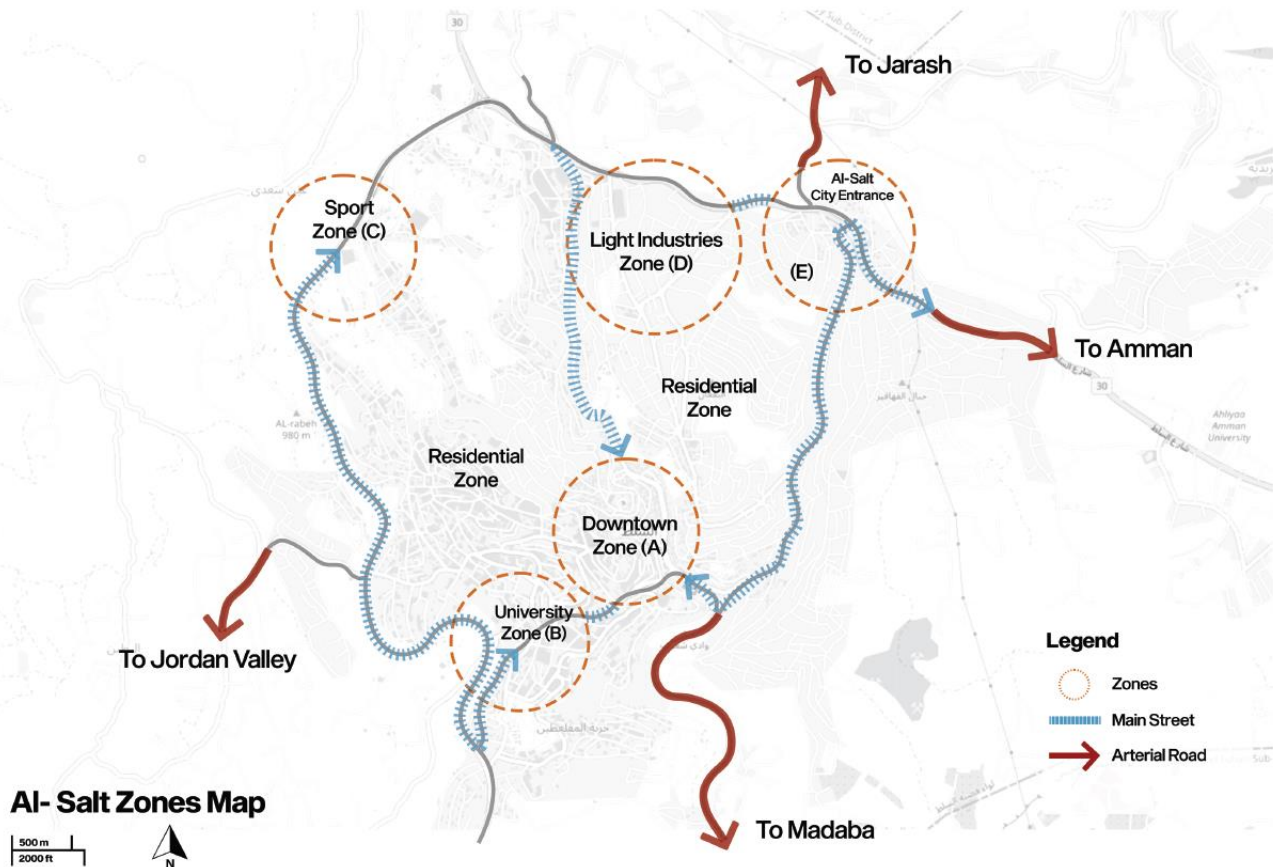
secondary lanes interlinking residential neighborhoods. Several nodes emerge at the intersections of the roads, with a major node located at the center of the city offering a main bus terminal and a public parking space. The city has visual gates from the north, east, and south, so that one may enter it from whichever direction. Al-Salt has many landmarks that are distributed throughout its boundaries, with a higher concentration in the old center, reflecting the historical value of the city.



## 4.2 Definition of possible innovation

Figure 5 illustrates Al-Salt City possible innovation Map, five areas are distinguished that require reconfiguration to enhance functionality, accessibility, and integration into the urban setting. Zone (A) is the Downtown Zone, a place of history and culture, located in the heart and acting as a social and commercial center of the city. Urban revitalization strategies would aim to improve pedestrian access, preserve

historical architecture, and enhance public spaces, making them more livable places for locals. The Al-Balqa University Zone (B) is another priority, as this area requires better planning for educational infrastructure, student housing, and pedestrian connectivity. Innovations in this space may be in the form of accessible transportation links between the university and different parts of the city, besides renovation of facilities and services for the benefit of students and faculty members.



**Figure 5.** Al-Salt City possible innovation zones map  
(Researchers, 2024)

The Sport Zone (C) could be developed to provide recreation and athletic facilities: sports halls, parks, and multipurpose green areas that encourage physical activity and provide aesthetic outdoor spaces for residents. The Light Industries Zone (D) could be designed in a way to encourage clean, light industry, meeting both the environmental and aesthetic standards of Al-Salt and providing sustainable industrial infrastructure along with strategically planned access to transport networks. Finally, the Al-Salt City Entrance Zone is the entry point into the city and, therefore, the first impression for new visitors. This might involve landscape upgrading for aesthetic views, improvement of transportation infrastructure, and very inviting and informative signage about the unique heritage and culture of Al-Salt. All these new developments preserve the cultural identity of Al-Salt while enhancing a more functional, accessible, and sustainable urban environment.

## 4.3 Al-Salt Downtown as a place of cultural heritage

Several restoration and revival initiatives have taken place

in the downtown area of Al-Salt City. These include establishing a new public plaza, creating a green park, and preserving and enhancing the facades of heritage buildings. The redesign of shop-front signs, lighting, and doors has been done in line with giving this city its heritage character. One of the biggest projects in this regard is the Urban Regeneration Project related to the Urban Core of Al-Salt, Jordan, which included the conservation and rehabilitation of the old Great Mosque of Al-Salt, the restoration of four heritage houses complexes, and the regeneration of Al-Salt central area, specifically Sahat al-Ain Plaza; These projects are very important to protect the architectural heritage and cultural identity of Al-Salt, thus making it more attractive to its inhabitants and tourists.

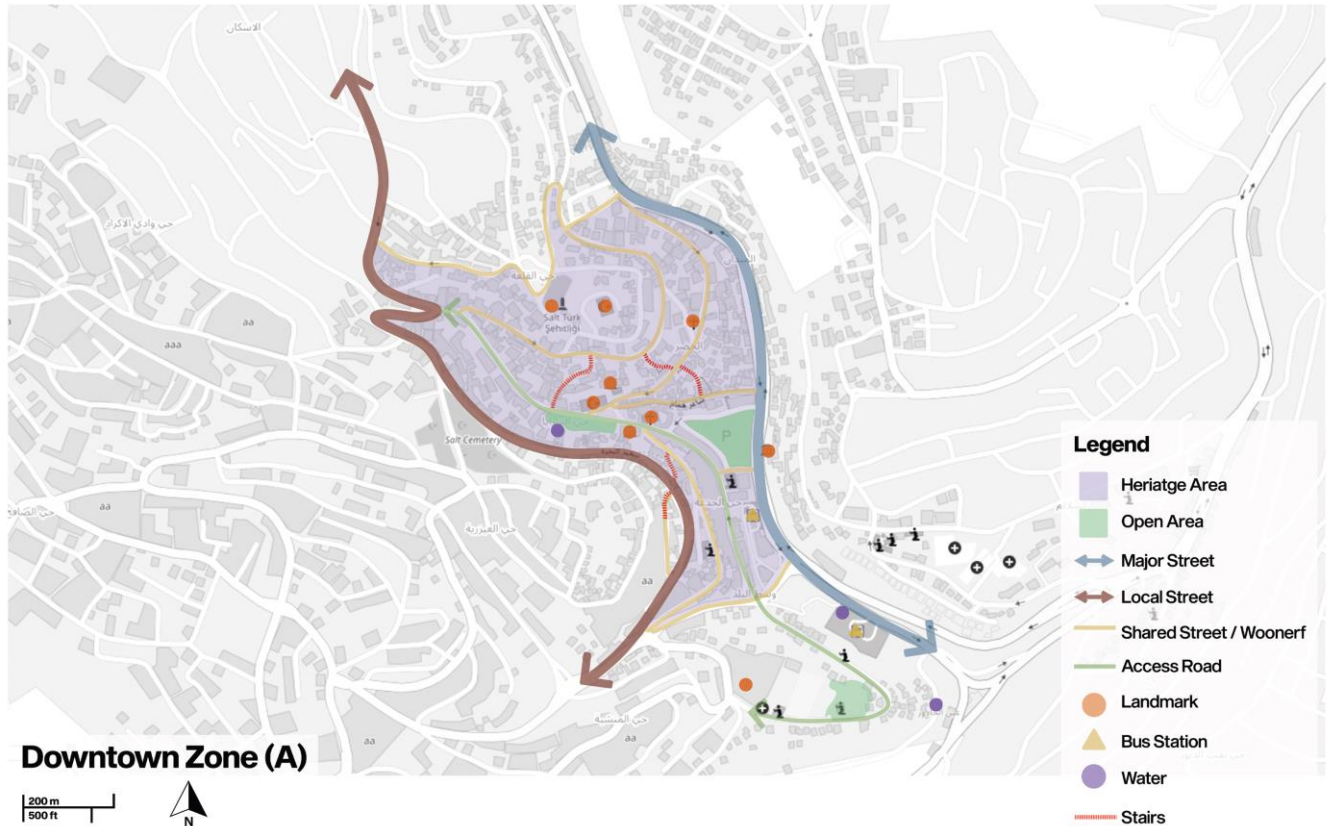
However, up to now, there is a need for a comprehensive re-development plan of Al-Salt City Downtown, which responds to the prevailing problems and improves the sustainability and technological development in the area. This plan should include a holistic approach that considers all aspects of urban planning, along with clearly outlined projects involving specific improvements and development.

#### 4.3.1 Character

Al-Salt Downtown is a wide complex cultural heritage characterized by traditional limestone buildings, narrow alleys architecture. The downtown area is a vibrant display of Al-Salt's unique heritage, which comprises intricate facades, arching doorways, and ornate balconies that portray its history.

Many buildings date back to the Ottoman period and retain

their original stonework; hence, they are not only aesthetic but also of great historical value. Added to this architectural heritage is the downtown area's compact and very interconnected urban fabric; thus, it is a warm and welcoming place in contrast with many other modern cities, as shown in Figure 6.



**Figure 6.** Al-Salt Downtown (Zone A) possible innovation  
(Researchers, 2024)

The presence of several landmarks, a central plaza, the public park, and the main bus garage that serves as a crucial transport node have highly contributed to enriching the essence of Al-Salt Downtown. Roadways could be used for various purposes, including areas reserved only for pedestrian traffic and woonerf streets that give priority to pedestrian access while allowing limited vehicular traffic at a low speed.

Another unique feature is the system of historical stairways that helps move between the older quarters, acting as a significant historical and practical element that ties the community with its past. All these, together with the different street patterns and prominent landmarks, add up to the individual character of the downtown area, making it a central focus that blends tradition with modern city life in Al-Salt City downtown (Figure 7). Yet residential areas remain predominant, particularly in the northern and western parts of the district. The central area is largely dedicated to commercial use and includes several government buildings, while a green open space enhances the southern side of downtown, providing a recreational area for residents. Below this green space lies a vacant area with potential for development as an open public market, which could serve as a vibrant addition to the community.

Educational land use is present within the downtown boundaries, supporting local academic needs. Additionally,

two historic cemeteries are located within these limits: one on Jabal Al-Jadour and the other on Jabal Al-Qala'a. These cemeteries are culturally significant and add a historical layer to the landscape, underscoring Al-Salt's heritage and connection to its past.



**Figure 7.** Al-Salt City downtown: Buildings and topography  
Source: <https://shorturl.at/eb11x>

## 5. SMART CITY TOOLS FOR AL-SALT DOWNTOWN

In addition to their architectural advantages, recent studies

have shown that SDN and NFV play a critical role in enhancing network security. By leveraging SDN's centralized control and NFV's flexibility, organizations can deploy advanced security mechanisms that were previously challenging to implement. For instance, researchers have demonstrated how SDN-based security frameworks can dynamically adapt to evolving threat landscapes, enabling real time detection and mitigation of cyberattacks [9]. Similarly, NFV allows for the deployment of virtualized security functions, such as firewalls and intrusion detection systems, which can be scaled and reconfigured on demand [10]. These capabilities not only improve the overall security posture of networks but also facilitate a more responsive and resilient approach to cybersecurity challenges in modern networking environments.

6. REVITALIZING AL-SALT DOWNTOWN

The revitalization of Al-Salt City downtown is strategic in practice, supplementing its historical, social, and economic perspective while preserving the architectural and cultural heritage of the city. This includes the restoration of historic buildings and upgrading the infrastructure to meet modern-day requirements. Pedestrian pathways take a main part in A-salt Downtown revitalizing, including woonerf streets. Public spaces-for example, the central plaza and green areas-have been connected to enable community interaction and help the tourism business, as shown in Figure 8.

Several focused initiatives are bringing visible improvement in various aspects of the downtown area. The Smart Heritage CommerceHub will strengthen the main commercial district by integrating digital technologies to support local businesses and create a friendly and lively shopping environment. The Smart Scholar Academy, in line with educational growth, focuses on Al-Salt Secondary School

for to enhance infrastructure and bring in smart learning resources to further help students' development. The Salt Bazaar will be a traditional open market that brings dynamism and potential to the economy, accentuating local crafts, agricultural products, and merchandise in an energized, community-focused space.

The Living Space Rehabilitation program aims at improving the quality of housing structures so that residents are assured of better and safer housing conditions, as shown in Figure 9. Finally, it is envisioned to have the Al-Salt Historic Panorama on Jabal Al-Qala'a, which will offer a view that captures both the scenic beauty and historical value of Al-Salt, thereby bequeathing local citizens and visitors alike with a unique perspective of the city's cultural landscape.

Downtown Pedestrian-friendly paths in Al-Salt City are designed carefully with the aim to enhance walkability, safety, and connectivity, by celebrating the historic and cultural character of the area. More significant routes, including (NMT) Transport leading to (GAP) (Non-Motorized Transport to Gathering Areas in Public), provide alternative dedicated pathways for pedestrians and cyclists to public spaces to bring a community atmosphere full of life. Terraced Heritage (TH) routes bring to the fore historic stairways that connect various levels of old neighborhoods in Al-Salt and provide easy, panoramic access that preserves the city's unique topography and heritage.

In Figure 10, SHC designates vehicular streets with limited speeds that promote pedestrian circulation while connecting important cultural destinations through creating functionally and visually interesting routes. Major Shared Streets (MSC) are designed to host both vehicles and pedestrians with combined walkways and crosswalks for shared safe use. Vehicle flow and congestion are controlled through Smart Parking Systems (APS) installed at five different spots, offering real-time availability and reservation facilities, as shown in Figure 10.

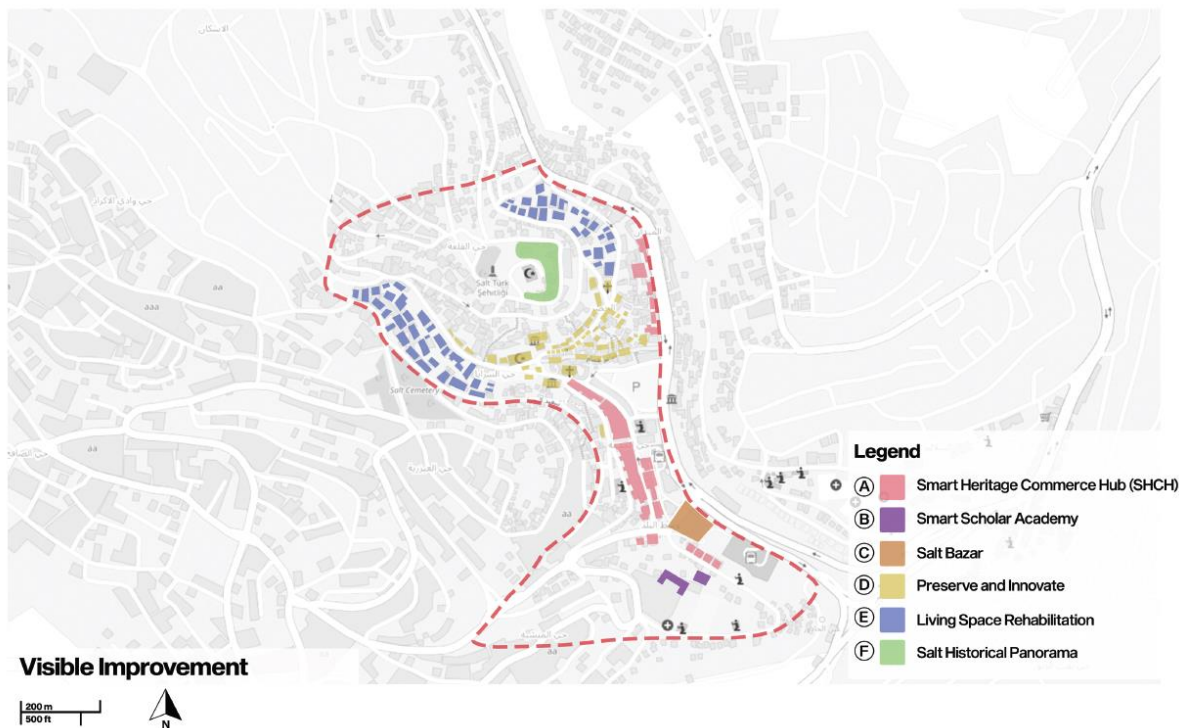


Figure 8. Al-Salt City downtown visible improvement (Researchers, 2024)



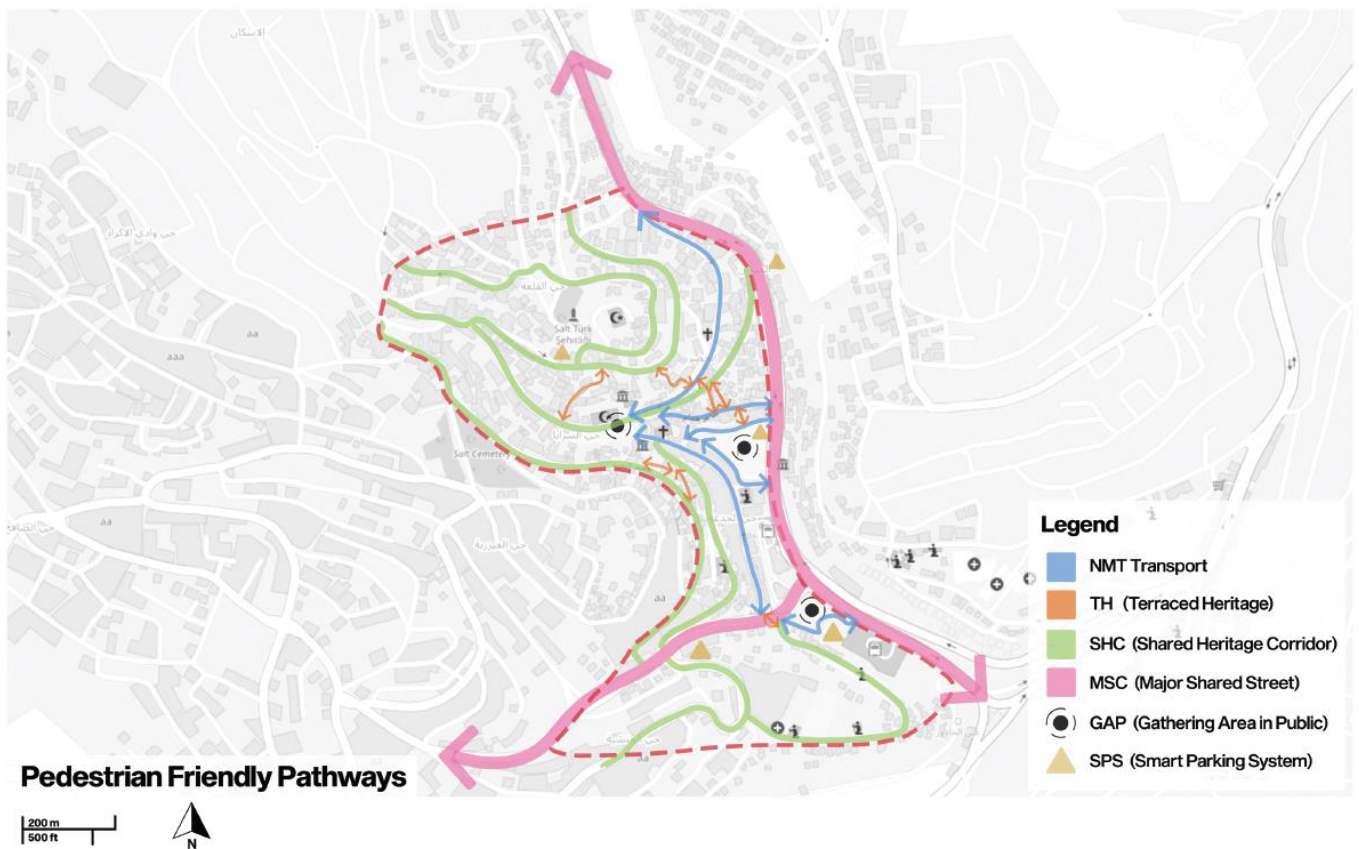


Figure 9. Al-Salt City downtown pedestrian friendly pathways  
(Researchers, 2024)

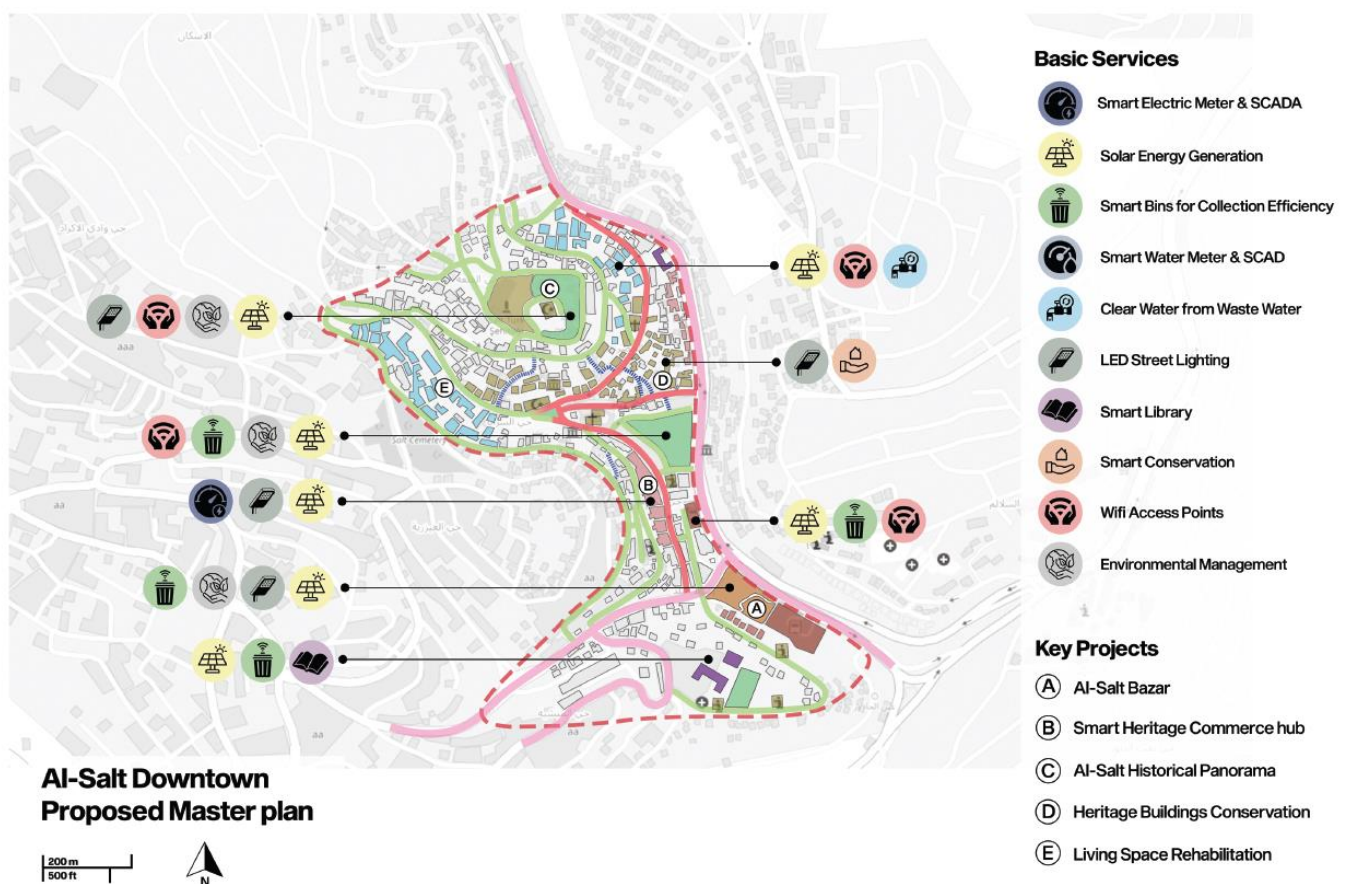


Figure 10. Al-Salt City downtown proposed master plan  
(Researchers, 2024)



Al-Salt City downtown proposed master plan focuses on the revitalizing major areas while incorporating sustainable technologies to enhance the city in terms of operational efficiency and cultural heritage value. Among the prominent initiatives is the Al-Salt Bazaar (A), a vibrant traditional marketplace built to showcase local handicrafts and goods, thus contributing both economically and culturally to the downtown area. The Smart Commerce Hub (B) aims at improving the commercial setting through intelligent technologies, rendering a convenient and seamless shopping experience. The Al-Salt Historical Panorama (C) intends to be a scenic lookout point on top of Jabal Al-Qala'a with a wide view and insights into the historical perspective of the city. Heritage Building Conservation (D) will make sure that prominent buildings are preserved in a manner that protects the architectural integrity that defines Al-Salt. The final project, the Living Space Rehabilitation (E), will improve the quality of residential buildings, assuring that local residents have comfortable and sustainable housing, as shown in Figure 10.

The master plan incorporates the necessary smart services and sustainable infrastructure to support such projects. Energy consumption is optimized, and the impact on the environment is reduced with smart electric meters and solar energy generation, while visibility and safety are enhanced through LED street lighting in an energy-efficient way. Intelligent waste receptacles and a cutting-edge water management system, including the reclamation of wastewater, shall be added to further improve the waste management arrangements,

to maintain cleanliness and sustainability. This will bring Wi-Fi hotspots all over the area, alongside environmental monitoring that continuously measures and controls air quality, noise pollution, and several other ecological factors. Together, these smart facilities will lead to Al-Salt's transformation into a smart sustainable urban setting, rich with its historical legacy and smart city structures, as shown in Figure 10.

## 6.1 Community engagement

Community engagement through Living Labs is a core component of the Al-Salt City revitalization plan. Living Labs are environments where citizens, planners, and stakeholders can actively engage in the development of urban plans [25]. This incorporates technology to ensure that change within the physical structure and functionality of a city reflects the values, needs, and identities of its people. This will be made possible with the help of instant feedback and community-driven insights, creating a platform for continual dialogue where residents feel a sense of ownership and connection to their city's future [26, 27].

This practice is very close to UNESCO's Historic Urban Landscapes (HUL) recommendations, which require the recognition of social contexts within the scope of urban planning [28]. HUL argues for urban areas to move beyond the mere conservation of tangible heritage through the promotion of dynamic heritage, which involves the social, cultural, and emotional relations of communities with their environment, as shown in Table 1.

**Table 1.** Al-Salt City downtown revitalization proposed living labs (Researchers, 2024)

Living Lab	Key Projects	Objectives Activities	Participants
Heritage Marketplace Living Lab	Al-Salt Bazaar (A), Smart Commerce Hub (B)	- Engage local vendors and artisans in designing a sustainable marketplace.	Local vendors, artisans, business owners, residents
Historical Preservation Living Lab	Heritage Building Conservation (D)	- Collaborate with historians and artisans on sustainable restoration. - Pilot smart building monitoring.	Historians, architects, artisans, residents
Community Resilience and Smart Living Lab	Living Space Rehabilitation (E)	- Engage residents in designing sustainable housing solutions. - Use smart meters for water monitoring.	Residents, architects, urban planners
Al-Salt Historical Panorama Lab	Al-Salt Historical Panorama (C)	- Provide data for sustainable urban planning. - Educate residents and tourists on environmental and cultural heritage.	Scientists, tourists, residents, local authorities, tech-experts

## 7. PRACTICAL APPLICATIONS FOR AL-SALT DOWNTOWN

These applications involve the embedding of smart technologies into different zones: the downtown area, education, and recreational spaces. For instance, the redeveloped downtown zone might include a walkable pathway, traditional markets, and smart heritage commercial hubs that create a vibrant commercial area while retaining the cultural identity of the city. Similarly, retrofitting heritage buildings with intelligent systems for energy efficiency and waste management ensures historic architecture meets modern standards of sustainability.

Other key applications involve the development of community-oriented open spaces, including green parks and recreational zones, which would help maintain ecological balance and social interaction. The introduction of smart parking systems and efficient public transportation in nodal

points like city entrances and university areas will result in easy access with lesser congestion. Besides, with living labs, residents will be involved in the process, thus securing the revitalization to the needs and cultural values of the community. These applications contribute to increasing Al-Salt's livability and touristic appeal and provide a model of integrating heritage conservation with smart city development strategies.

## 8. CONCLUSIONS

The revitalization of historic downtown Al-Salt with smart city tools and sustainable urban planning strategies is being pursued in the enhancement of existing urban spaces and the introduction of new innovative areas. Such a strategy is not only supposed to conserve the rich heritage of Al-Salt but also turn it into a livable city that integrates the old with the modern.

It should not be just an eco-heritage site but a living, breathing urban district with its active citizens together with their historical culture. Most of the residential buildings are not historically relevant, yet they are the key towards an alive community. Thus, rehabilitation for these areas is required to improve the quality of living for the residents and that the area remains inhabited and useful.

Education is an important part of Al-Salt's identity, and one of the major components of the Revitalization Plan is the development of a smart education project near Al-Salt Secondary School for Boys. This will carry innovation with heritage and contribute to sustainable urban development. The overall strategy for urban development process of redevelopment integrates the architectural heritage of the old city with the needs of modern urban life. Involvement from the community through the Living Labs would ensure that solutions are inclusive, practical, and need-based from the very start.

The Al-Salt Bazaar is one of the mega projects within the revitalization process and is sited near the central bus station. It will return to the city its commercial vibrancy without contributing to congestion. Because all commercial activities will be housed within this market, it will ensure economic growth without altering the nature of the downtown area into anything other than a purely pedestrian-friendly environment, hence responding to the objectives of sustainable urbanism. Other relevant components of the revival strategy involve the preservation of the pedestrian character in Al-Salt. While there is little traffic in the old city, the establishment of shared streets, intelligent parking systems, and well-marked pedestrian routes will provide further access and protect the special topography of the area, including heritage stairways carrying historical and cultural values.

It also covers community activities of all kinds. Having a UNESCO-listed city for the values of tolerance and urban hospitality, the development of the Al-Salt Downtown public areas will turn into one with easy accessibility, more representative of its rich history, and in better knitting up with residents' and visitors' needs. The revitalization efforts, then, should aim at the perfect integration of tradition and innovation while positioning Al-Salt as a non-polluting, sustained human settlement-alive, able to preserve its tradition without renouncing its future.

## 8.1 Recommendation

- Involve multi-stakeholder involvement in all the decision-making processes concerning various local citizens, businessmen, and educational institutions.
- Start rehabilitation in residential areas; this will keep the area more livable, ensuring a continuous working urban community.
- Increase walkability by introducing smart parking solutions and highly connected public space.
- Develop the Al-Salt Bazaar as an important commercial node, renewing the economy but preserving the heritage in the city center.
- Enhancing educational initiatives that merge heritage with modern technologies for an environment which is sustainable and future oriented.
- Continuously support smart city tools to enhance urban infrastructure, resource management, and environmental sustainability.

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