

XXV International Conference Living and Walking in Cities - New scenarios for safe mobility in urban areas (LWC 2021), 9-10 September 2021, Brescia, Italy

## Re-designing urban open spaces to act as green infrastructure - the case of Malta

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### Abstract

The need to strive for resilience and mitigate or adapt to climate change are increasingly at the forefront when planning for and managing urban concentrations. The planning and design of urban open spaces is integral to improving the sustainability and resilience of built environments. If urban open spaces function as urban green infrastructure they have the potential to contribute towards sustainable development, increase the resilience of our towns and cities and ultimately facilitate the potential of new scenarios for safe mobility. The poor quality of urban open spaces in Malta suggests that a ‘gap’ exists in their planning and design. The aim is to develop proposals for the planning and design of urban open spaces such that they may function as green infrastructure so as to improve their sustainability and resilience. The research also serves to identify potential barriers to adopting such an approach. Identifying and tackling such barriers is an important step in ensure places where people want to live, work and play. A ‘Mixed Method’ approach using Malta’s urban conurbation as a case study is adopted. The methodology is developed in two phases. The first phase utilises mixed data collection techniques to understand the situation. The second phase develops proposals in response to the results and uses focus group discussions to identify the barriers. The phase one results identify that existing urban open spaces in Malta are lacking in their potential to act as green infrastructure. Gaps in the planning process and policy as well as governance issues are also identified. Following a comparison with international literature, proposals are developed. These address three main themes: spatial implications; planning aspects; and governance requirements. This paper focuses on the theme concerning the spatial implications. Key planning and design principles which should be adopted, to move towards more sustainable and resilient urban spaces which facilitate sustainable mobility amongst other things, are presented. The potential barriers to implementing such an approach are identified and discussed. Ultimately, the paper concludes that determining planning and design principles is not sufficient. The barriers identified confirm that the success of redesigning urban open spaces to act as green infrastructure is not only a matter of design, but is also dependent on planning processes together with the engagement of stakeholders and suitable governance systems.

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Peer-review under responsibility of the scientific committee of the Living and Walking in Cities

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*Keywords:* Green Infrastructure; urban open space; Malta; open space networks; sustainability; sustainable design

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## 1. Introduction

The need to strive for resilience and mitigate or adapt to climate change are increasingly at the forefront when planning for and managing urban concentrations (Costa et al., 2014). Open space is one area within the dimensions of urban form which is integral to improving the sustainability and resilience of built environments (Haase et al., 2020; Bell, 2012; Beatley, 2012). The important role which green space networks play in cities and city regions is being recognized. Linked to this is the potential for open spaces to act as green infrastructure (GI). This is one of the most recent discourses being advocated as an approach with the potential to address urban challenges such as climate change and contribute towards sustainable development (EEA, 2011; Austin, 2014; Benedict and MacMahon, 2002; Hansen et al., 2017; Galan, 2015; Toth and Damyanovic, 2019). If urban open spaces could therefore function as GI they would have the potential to contribute towards sustainable development and increase the resilience of our towns and cities.

### 1.1. The Maltese Context

Malta is an island state and has the highest population density of all EU Member States. At the end of 2018, the population stood at 493,559 which implies a density of 1,562 persons per km<sup>2</sup> (NSO, 2019). Additionally, in 2019, 94.7% of its population lived in urban areas (World Bank, n.d.). Malta can be defined as an entirely urban area (Zammit, 2010). It has one of the highest motorization rates in Europe (Transport Malta, 2016). Economic growth, the lack of integrated land use and transport planning coupled with insufficient investment in public transport infrastructure has continued to fuel a culture of car dependency. A traditional predict and provide policy has resulted in infrastructure investment where the aim is to increase supply to meet the ever-increasing growth in demand. This has resulted in road space and urban open space being prioritized for car usage (Attard et al., 2017; Transport Malta, 2016).

The Maltese living environment has also been “systematically degraded”. (TPPI, 2015, p. 10) The lack of trees and vegetation in Maltese streetscapes results in lack of shade creating unbearable environments during the summer months and missing out on the opportunity to create carbon dioxide sinks. High vehicular traffic volumes result in uninviting urban environments, with peopling searching elsewhere for places supporting leisure activities (TPPI, 2008). Heavy investment in providing for cars has resulted in unsafe and uncomfortable infrastructure for non-car users (Attard, 2019). A participatory research study also identified the predominance of unsafe experiences as a trend affecting walkability (Cañas et al., 2020).

The poor quality of urban open spaces in Malta (GoM, 2012; TPPI, 2008; TPPI, 2015; GoM, 2015), thus suggests that a ‘gap’ exists in their planning and design. The Environment and Resources Authority (ERA)’s also concludes that there are potential research opportunities in relation to adopting a “multifaceted planning approach to GI and building expertise and experience in this regard.” (ERA, 2019, p. 52) The aim is therefore to develop proposals for the planning and design of urban open spaces in relation to their potential to function as green infrastructure so as to improve their sustainability and resilience. The research also serves to understand the potential barriers to adopting such an approach with the aim of creating places where people want to live, work and play.

## 2. Methodology

An adapted version of the ‘Mixed Method Exploratory Sequential Approach’ (Creswell, 2014) using Malta’s urban conurbation as a case study is adopted (Scheiber, 2020). The methodology is developed in two phases. The first phase utilised: physical surveys; online survey; interviews; case study project review; and policy review to allow an in-depth study the existing situation. The phase one results identified that existing urban open spaces in Malta are lacking in their potential to act as green infrastructure (Scheiber, 2019; Scheiber, 2020). There is the opportunity to redesign existing open spaces within Malta’s urban conurbation such that they may contribute to creating sustainable and

resilient cities. Challenges relating to planning processes and policy as well as governance issues are also identified (Scheiber, 2020).

The second phase of the research developed proposals in relation to the results of phase one. These address three main themes: spatial implications; planning aspects; and governance requirements. This was done through a literature review of international best practice. The proposals were subjected to focus group discussions, which created a platform for discussion, so as to identify potential barriers and implications to implementing such proposals. Two sets of focus groups were held. One included the authorities related to the following themes: transportation, spatial planning, environment, water management, local governance as well as ministerial entities. The other focus group was ‘mixed’ including NGOs and academics from interdisciplinary backgrounds.

The sessions were structured as follows: the results from phase one were presented followed by a set of proposals and then questions for discussion. Some were held online due to a global pandemic, so an online survey was also used to gather participants opinions during the sessions. The data was analyzed qualitatively. A database was compiled for each thematic session including: discussions notes; and the compiled survey data for each participant group in chart and text format. The textual data was coded using NVivo and emerging topics were identified for each theme. This allowed the potential barrier/threats to be identified. The results presented here relate to the spatial implications theme.

### 3. The Spatial Proposal

To develop the proposals concerning spatial implications, a conceptual design for a network of open spaces was developed for part of the Maltese urban conurbation. The aim was not to illustrate an exact solution but rather to visualize the approach. Concept designs illustrate how typical urban open spaces could act as GI. These address various typologies visualizing key design principles. The approach addresses the key findings related to design aspects, identified through phase one of the research (Scheiber, 2020). Such principles require attention in the Maltese context, to move towards more sustainable and resilient urban spaces including facilitating the potential of new scenarios for safe and sustainable mobility. This section presents these proposals while the results present a summary of the feedback and reactions from the focus group participants.

#### 3.1. A Network of Open Spaces

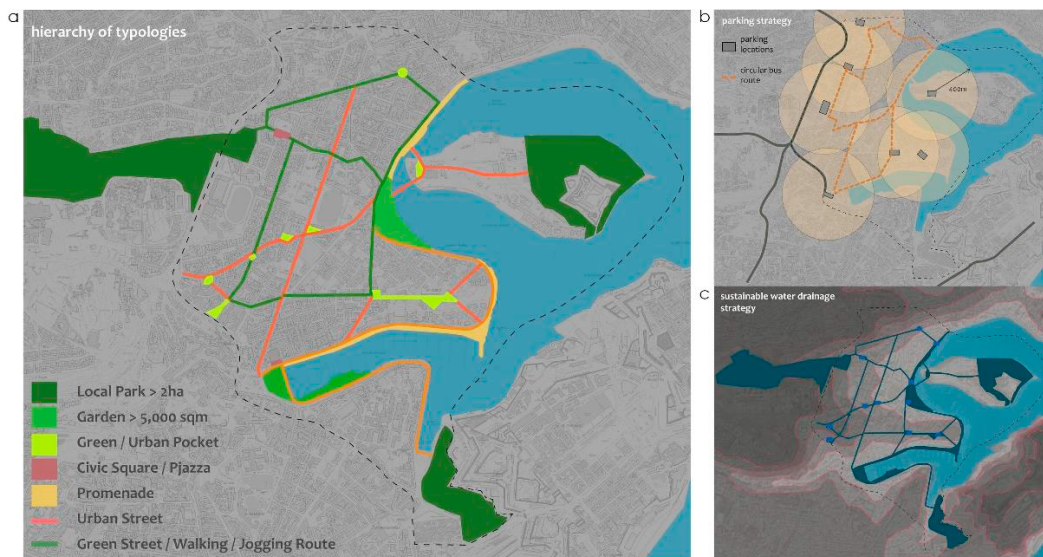


Fig. 1. Images illustrating the (a) hierarchy of open spaces; (b) parking strategy; and (c) sustainable water drainage strategy

When considering a GI approach, it is important to think in terms of a network or system of open spaces (Stiles, 2009; Laforteza et al., 2013). The proposal therefore starts by identifying a potential network of open spaces made

up of nodes and connections. The network would determine the typologies and hierarchy in terms of size, character and functionality as part of a holistic approach as illustrated in Fig. 1 (a).

The potential for a sustainable storm water drainage network would also need to be defined. This would consider: whether there is the potential for groundwater recharge or flood attenuation; how to manage reservoir overflows/discharge points; and how to connect to existing storm water networks. The strategic scale would also need to define a parking strategy which would consider how to shift on-street parking (thus re-creating space which can be re-designed for GI, including alternative mobility) to centralized built parking locations. These would ensure that all areas are within a 5-minute walk of such parking facilities. A circular public transport route connecting car parks to main activities zones and services would also be introduced to ensure accessibility for those with reduced mobility.

### 3.2. Key Design Principles and Typological Interventions

In parallel to thinking in terms of a network, a green infrastructure approach advocates other principles such as multifunctionality and grey-green integration (Hansen et al., 2017). Additionally, when creating sustainable and resilient urban spaces with the potential to contribute to sustainable development, a number of design principles are important. These were identified through a literature review and sorted into 12 categories and used to survey existing spaces in the Maltese conurbation (Scheiber, 2019). Through phase one of the research, design principles were identified which require attention in the Maltese context when transforming urban open spaces with the aim of providing green infrastructure. In response a set of guiding principles were developed (Scheiber, 2020) and refined (see list below) in relation to the spatial proposals developed for the focus groups. Ultimately, these principles were illustrated through a number of typological interventions as shown in Fig. 2.

- Explore the potential for restructuring transport infrastructure to create/transform open spaces
- Maximize vegetation connectivity to facilitate habitat creation
- Design spaces as places to walk through to enhance connectivity
- Connect open spaces to buildings or other open spaces to maximize relationships and synergies
- Explore the potential of valleys as local nature parks
- Identify the potential to create larger open spaces > 5,000 sqm
- Maximize the presence of tree cover, dense vegetation and contact with nature
- Improve the multi-functionality of spaces
- Consider the potential for flexible and adaptable spaces
- Ensure provision of activities and uses which respond to the communities' needs
- Explore the potential for varied compatible activities which bring demographics together
- Explore the potential for informal playscapes, adventurous play and water play
- Consider the potential for activities which are currently lacking (picnicking, ball play, riding scooters and bikes)
- Facilitate the creation of a walking/jogging routes to promote active lifestyles
- Shift surface/on-street parking to underground, semi-underground or off site built centralized parking facilities to create green open spaces and improve provision for sustainable mobility
- Maximize the presence of trees, vegetation and seating in streets depending on the street typologies
- Maximize footpath widths and design street furniture in an integrated manner to improve pedestrian infrastructure and 'Access for All'
- Adopt street alignments and carriageway widths which induce traffic calming
- Design vegetation to ensure climatic comfort throughout the seasons
- Ensure detailed vegetation design which creates positive impacts for biodiversity and benefits for the local community
- Increase the use of vegetation to mitigate the impact of vehicles and improve air quality
- Explore potential for vegetation canopies using creepers in narrow streets
- Consider the potential for rain gardens, permeable paving, tree pits and swales which maximize ground water infiltration or flood mitigation as may be appropriate
- Maximize the use of reservoirs for storm water collection and link these to irrigation systems
- Introduce the use of space efficient waste separation facilities

	Before	After	Design Principles
<b>Garden</b>			<p>Restructuring infrastructure to create/transform open spaces</p> <p>Reconnecting open spaces with buildings/other open spaces - connecting recreational garden to the promenade &amp; church parvis</p> <p>Use of salt resistance and low maintenance vegetation</p> <p>Providing varied activities to bring different demographics together: flexible space for community activities (inc. bocci pitch), picnic garden, areas for ball play, scooters, a formal playground &amp; cycle parking</p> <p>Providing a green/more natural character/sense of refuge/connection with the sea</p> <p>Introduce water play with potential to use sea water</p>
<b>Green Pocket Park</b>			<p>Introduce semi-basement parking</p> <p>Reconnecting open spaces with buildings frontage e.g. connect to school</p> <p>Maximise vegetation - trees, shrubs &amp; green wall - green 'lung' /comfortable micro-climate</p> <p>Vegetation and water feature provides an informal play area and contact with nature combined with seating</p> <p>Street swale/rain garden creates potential for water infiltration/flood mitigation</p> <p>The water reservoir allows for water storage reducing run off and re-use for irrigation</p> <p>Integrated waste separation facilities</p>
<b>Green Pocket Park</b>			<p>Remove unnecessary vehicular routes/ connect open space to building frontage</p> <p>Green 'lung' - maximises vegetation - comfortable micro-climate &amp; allows for water infiltration/flood mitigation</p> <p>Informal play areas &amp; seating</p> <p>Street alignment - induces traffic calming /reduces speeds</p> <p>Water reservoir/storage linked to irrigation</p>
<b>Urban Pocket Park</b>			<p>Connect open space to building activity/ eliminate isolated open space - shaded informal play area with seating oriented to open space/buildings/activity not road</p> <p>Permeable materials for flood mitigation</p> <p>Water reservoir linked to irrigation</p> <p>Maximise trees &amp; shrubs for shading/cooling</p> <p>Introduce creepers to create vegetation shading canopies in narrow streets</p> <p>Provide cycle parking facilities</p>
<b>Green Street</b>			<p>Appropriate carriageway dimensions</p> <p>Maximise footpath widths to facilitate multiple uses e.g. jogging/seating</p> <p>Paving materials &amp; street swales allowing for water infiltration/flood mitigation</p> <p>Introduce trees for shading/cooling effect</p> <p>Maximise vegetation to create pleasant environment &amp; buffer traffic</p>
<b>Urban Street</b>			<p>Reduce parking/carriageway widths</p> <p>Maximise footpaths for walking/seating</p> <p>Paving materials &amp; street swales allowing for water infiltration/flood mitigation</p> <p>Use of trees for shading/cooling effect</p> <p>Tree pits maximise footpath widths &amp; allow for flood mitigation</p>

Fig. 2. Collage of typological interventions and respective design principles

## 4. Results: Focus Groups on Spatial Implications

### 4.1. General Reactions

Overall there was a positive response to the spatial proposals presented, from the ‘authorities’ and ‘mixed’ stakeholders focus groups. Participants agreed with the suitability and moreover the need for such ideas. Also, that they could be adapted to the Maltese context. In particular maximizing the use of trees in urban areas, bringing nature and greenery back into our urban areas, and ensuring that people have access to such spaces and nature close to where they live, was stressed.

A small number of participants showed concern for the possible over formalization of such spaces. The focus on creating natural spaces, and especially leaving natural spaces for nature rather than for people was mentioned/discussed. The introduction and provision of appropriately designed parking facilities as part of a parking management scheme was singled out as being important to the success of such proposals.

The results also identified a few aspects requiring more focus than was potentially given in the proposals. These are the need to: focus more on the health benefits; identify biodiversity corridors which connect these urban spaces to the wider context; and ensure the consistency of the network which is essential for facilitating sustainable mobility.

### 4.2. Potential Barriers/Threats

Through the focus group discussions and surveys a number of potential barriers or threats to adopting such an approach or implementing such proposals were identified. Table 1 summarizes the main themes which were identified by both the ‘Authorities’ and ‘Mixed’ stakeholder groups.

Table 1: Barriers and threats relating to the spatial implications emerging through the focus groups.

Theme	Description/Quote from Focus Group Participant
Lack of/Expense of Maintaining such Spaces	Maintenance of open spaces is often neglected or not prioritized. “I am still worried about afterwards, the implementation and maintenance. Who sustains it afterwards?”
Lack of Implementation/ Enforcement/Monitoring	The few existing policies are not being implemented. Where plans are strategic or set a vision or objectives, these are often ignored. This is also linked to lack of enforcement. “All monitoring stops when the compliance certificate is issued”
Lack of Political Will	Current political will and institutional/government entities mandates/agendas do not support such proposals. “If we want to do something we can do it (e.g. roundabouts with flowers, rigorously maintained, with all that water use etc.). It can happen, if the will is there.”
Cost Implications	“Underground costs are 10x the cost of level parking (capital cost)” The methodology for Cost Benefit Analysis (CBA) is prohibitive due to current weightings. “CBA is an economic exercise...we need to look at the environmental and social dimensions too, next to economic value.” The re-use of water is hindered due to CBA/MCA results. “In terms of water, the price of water is cheap, so any intervention will weigh heavier in the CBA.”
Lack of Popular Support/Predominance of Private Interests	Such proposals are not backed by popular support. There is the tendency to protect private property and interests over the public good. “What do Maltese people value? When they value their health, their wellbeing, at an equal footing as their income and way of movement (cars), then there would be more support for such proposals to succeed.”
Lack of/Apathy in relation to Public Engagement	Projects are not carried out in cooperation with the public. “...you also see it is hard to convince the community, that they have a right, that they are entitled to that space. They feel resigned, that things are being decided for them.”
Lack of Knowledge and Capacity	The question was raised as to whether the national capacity, in terms of policy makers and at a technical design level and implementation exists. Also, the lack of knowledge in relation to green infrastructure.

Theme	Description/Quote from Focus Group Participant
Car Lobby/Parking Provision	It is clear that the prioritization of cars and the demand for parking provision and vehicular access is one of the main barriers and competes for the allocation of space. “Car lobby is very powerful. The elephant in the room is that everyone wants to drive.” “Someone wanting to create a garage cannot be denied such a request...” “...if government agencies are going to keep...prioritizing cars over people, public space doesn’t stand a chance.”
Lack of Integrated Approach	It was suggested that such an approach requires a departure from the usual silo mentality. Ministries take care of their own portfolio and there is no strategic coordination to address something like this and sustainable development. The Strategic Plan for Environment and Development (SPED) tried to adopt an integrated approach but this was not translated into educating and ensuring that it is carried through. There is also fragmentation with how legislation is enforced. It also requires consultation between Local Councils and others, which does not happen.
Lack of Supporting Framework/Driving Entity /Inappropriate Local Council Structures	“The problem is that there is no agency to develop or push for such projects.” The formation of such spaces needs to be initiated at a planning level. When local councils have ideas/plans which adopt an integrated approach it is unclear what they should do next to move forward with such proposals and get the backing and resources. It isn’t clear who should drive such initiatives in the urban environment. It is also unclear as to who is responsible for enforcing and monitoring the implementation and functioning of the various aspects. This would depend on the various authorities’ responsibilities. However, it is fragmented.
Lack of Guidance	“The policy regime tends to conserve the current open space. No guidance on how to improve or create new space” “What you put in the garden, what flowers, soil-sealing, there are no guidelines for this.”

A few more themes, not common to both groups, emerged. The ‘Authorities’ mentioned inadequacies in the planning system: “...landscaping is overlooked in the planning process...it is retained as reserved matters...which is then not followed up.”; and “Guidance is not policy. Even if a plan is against guidance, it can still be accepted.” While the ‘Mixed’ stakeholders identified: resistance to change; time taken for adopting such an approach, especially when considering the parking management strategy; and, land availability, particularly for the larger type of spaces.

## 5. Discussion and Conclusion

Phase one of the research, revealed that urban open spaces in Malta are lacking in their potential contribution to sustainable development (Scheiber, 2019). Spatial planning and governance, were also identified as contributing to the existing situation (Scheiber, 2020). The research objective to develop proposals for urban open spaces to function as GI has been addressed by presenting key planning and design principles which should be adopted, to move towards more sustainable and resilient urban spaces, and ultimately also facilitate the potential of new scenarios for safe mobility. The potential barriers to implementing such an approach have also been identified and discussed. The results illustrate that in principle, focus group participants agreed with the need and benefits of adopting a GI approach for urban open spaces in Malta. The barriers identified did not relate to the design principles/approach. Rather, the barriers reflect primarily planning processes and governance aspects. Ultimately, the paper concludes that determining planning and design principles is not sufficient. The barriers identified confirm that the success of re-designing urban open spaces to act as green infrastructure is not simply a matter of design, but is also dependent on planning processes together with the engagement of stakeholders and suitable governance systems, as also revealed by GREEN SURGE (Hansen et al., 2017; Pauleit et al., 2018).

The research results therefore continued to confirm the need to develop a framework for the planning and governance of urban open spaces with a focus on GI. Moving forward, phase two of the research builds on these results through the focus groups which address planning aspects and governance requirements.

## Acknowledgements

The research work disclosed in this publication is partially funded by the ENDEAVOUR Scholarships Scheme (Group B).

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