

## Epilogue

### Urban Ecological Infrastructure

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If this research report from New York green roof researchers were a typical scientific report, it might be strange to find an epilogue as the concluding statement. Similarly, if this were a typical policy paper it would be odd to end with this particular form of writing. Epilogues are most commonly written as the concluding section of a literary work or performed by an actor at the end of a play (O.E.D, 1993). But the work of this group is not typical. The members cannot easily be defined as exclusively scientific or public policy-oriented. Rather, it is a transdisciplinary assemblage of natural and social scientists, design professionals and economists. The creative tension that emerged through our collaborative effort to explore green roofs as a component of a larger urban ecological infrastructure has resulted in a report that is part science, part policy, and in the end something entirely different than any subset of us would have produced independently. The science leads to tantalizing questions that need to be addressed through further funded basic and applied research. The policy issues of green roofs are compelling and need to enter the public debate on the future of the city and its ecological resilience. The economic analysis must be expanded in scope and duration and tested even as the conditions that constitute its foundation are altered by shifts in social capital. But what bridges, and to some degree holds this report together, is a narrative structure that permeated our many meetings and winds through this first publication. This is a story of cities as complex ecological organisms whose socio-natural systems are measured in degrees of resilience. And so we end with an epilogue that frames the report in a larger context and

attempts to chart a path forward.

In the preface to this report, Rosenzweig introduces the transdisciplinary founding principle as the integration of “scientific knowledge and methods with practical mechanisms for achieving urban sustainability.” Defining this scope as the “interactions of the physical, biophysical, and social realms,” they immediately set the challenge of scalar integration across disciplinary perspectives as an overarching concern (Rosenzweig, this report). Interestingly however, with the exception of the report title, nowhere in their preface does the specific site or vehicle for investigation – the green roof – appear. Far from revealing ambivalence about the role of the green roof in urban ecological infrastructure, this omission signals a desire to return to the broader scientific and social complexities that research needs to address. And yet the question remains. While green roofs have offered a way into the question of the 21st Century sustainable city, they are but one path, so why did we begin with the roof? One answer is that large-scale, networked, and emergent questions of ecology and landscape permeate the report. From this particular scalar perspective the more than 1.3 billion square feet of roof surface in New York City, the vast majority of which, 925 million square feet, is flat-roofed (Hydroqual/Community Cartography, 2004), is an obvious point of departure. And yet, while it is clear that individual green roofs serve a range of discrete ecological and social functions, the problem of scale immediately returns. It is not possible to simply aggregate these distinct roofscapes and suggest that they necessarily mean more than the sum of their parts. To begin with, buildings are volumetric enclosures, not two-dimensional, extruded flat surfaces. Correcting for volumetric complexity is difficult in the current work, as diversity in building materials and forms inserts untenable indeterminacy into the equations. Green roofs as social spaces are equally difficult to qualify as they exist at

the intersection of environment, design and the never-settled relationship between private and public social space. Financing, regulation and building codes further complicate the calculus and it is, therefore, not surprising that strategic, wide-scale development of green roofs has met with varying degrees of success. Nonetheless, farsighted municipalities have advanced the idea that green roofs can be understood as part of an emerging field of ecological design and construction, which, when explored at an urban scale leads to a series of questions: Can such a thing as an “urban ecological infrastructure” exist beyond traditional understandings of urban forestry, park systems, waterways, etc.? If so, how would it acquire social meaning and social capital? Could urban vegetative roof structures be seen as harbingers of an emerging socio-natural urban ecology, through which cities assign value to human interactions with the natural world on an infrastructural scale? This is certainly one way to read Frith and Gedge’s assertion that “[t]he most important catalyst of green roof construction in Britain in the past five years has been the drive to reconcile biodiversity conservation with urban renewal” (Frith and Gedge, 2004).

If green roofs are to be evaluated as a component of an ecological infrastructure, they must cover enough of the city to have a measurable impact on microclimate, energy, and material flows as well as the cultural imagination of what the city is and can become. This report explores precisely that. And while our conclusions call for more study, we are significantly closer to being able to recommend and predict the impact of this particular aspect of an ecological infrastructure deployed across an urban field. Given sufficient acreage, green roofs of varying sizes, functions, and designs would constitute a mosaic of inter-related vegetative spaces; individual ecological patches whose benefits could be greatly multiplied to the point of producing larger-scale transformations of urban ecologies. Operating in this complex infrastructural fash-

ion, green roofs would attain a social relevance that would produce a feedback loop reinforcing their deployment across the urban landscape, and greatly impacting their perceived value.

From this perspective we can begin to ask how green roofs can be creatively considered in an urban context. Are they a sign of changing perceptions about the city? Do they indicate an extension of nature within the city or do they point to a commingling of the natural and built environments in a manner that might lead toward increased resilience and a more integrated socio-natural relationship? How do they impact the dynamics of the urban organism? What can they tell us about other ecological questions at the scale of urban infrastructure?

The scale and position from which these questions are explored will affect how green roofs are seen and understood. Urban green roofs as individual entities may be viewed as extensions of private space. They may also be seen as providing specific, localized benefits to the operation of buildings. Collectively, however, they have the capacity to impact urban ecology and, therefore, may also be understood in infrastructural terms. Mikami’s study of Tokyo is instructive of this scalar shift, examining how the aggregation of green roofs in that city are seen as part of an emerging infrastructure that has the potential to mitigate the urban heat island effect (Mikami, 2004).

Surfacing through this report is confirmation that green roofs acquire social capital in different ways (often related to scale) that may or may not facilitate their widespread application in urban environments. Understanding this calculus is essential if green roofs are to be one tool in the larger project of shifting the post-industrial city towards ecological (natural and social) sustainability. This shift is in its formative stages and charts a possible alternative urban future desperately in need of exploration. There is much work to be done, and as the geographer David Harvey reminds us: “[T]he

integration of the urbanization question into the environmental-ecological question is a sine qua non for the twenty-first century. But we have as yet only scraped the surface of how to achieve that integration across the diversity of geographical scales at which different kinds of ecological questions acquire the prominence they do” (Harvey, 1996). Which brings us back to Rosenzweig’s preface.

Running through the questions of scale, position and impact are the pragmatic realities of implementation. As Acks (Acks et al., this report) writes “Many seemingly worthwhile environmental projects are never implemented.” He establishes three potential roadblocks to the realization of those projects. The first is the calculus of costs versus benefits, the second is related to the indeterminacy of that calculus, and the last is an issue of perceived value. Through unique constellations of collaborative transdisciplinary research, researchers in this report have the potential to continue to substantively inform these variables, toward practical applications and assessments of potential socio-natural reconfigurations of the urban terrain. The group has been many things, but mostly it is a beginning. This report report is intended to present research and thinking to date on the green roofs chapter of our larger ecological and infrastructural ambitions.

## References

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- Note: Parts of this epilogue appear under the title “Imagining the City: Urban Ecological Infrastructure” by Joel Towers in *Green Roofs: Ecological Design and Construction*. Atglen, PA: Schiffer Publishing. 158 pages.