Prospectus

Stormwater and Hydrologic Design for the UVA Ivy Corridor

(Technical Topic)

Stormwater Management Design as a Symbolic Gateway to the University

(STS Topic)

By

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

The natural world is typically quite adept at accepting rainfall, but when water falls onto impervious surfaces such as pavement, it wastes no time in becoming runoff (Bogust, 2017). This water must go somewhere, so in our world where the natural environment is being rapidly developed in order to meet the changing needs of global societies, systems must be engineered that carry rainfall runoff away from its original point of deposition so that problematic flooding does not occur.

Currently, the fourteen and a half acre parcel of land that sits at the intersection of Emmet Street and Ivy Road at the heart of UVA's Grounds awaits development following the demolition of the Cavalier Inn which had previously occupied much of the site since 1967 (Anderson, 2016). If the University's new site layout fails to come into compliance with both local and state regulations for water quality and quantity, UVA will jeopardize both its Municipal Separate Storm Sewer System (MS4) and Virginia Pollutant Discharge Elimination System (VPDES) permits, as well as be at risk of flooding, among other environmental concerns (Environmental Protection Agency [EPA], 2005).

The technical solution to the problem at hand is a comprehensive stormwater management system that will control and treat stormwater runoff from the Ivy Corridor area on the UVA Grounds. However, a solution meeting only these requirements would disregard the broader social implications of such a design and fall short of capitalizing on the unique opportunity that the University currently has to bridge the gap between north, west, and central grounds, as well as to put on display at the northern gateway to the University its leadership in social, political, and environmental resilience.

At present, the distinct campuses within the UVA grounds exist largely as separate entities. The absence of programmatic connections between Central Grounds, the Arts Grounds, the Athletics Precinct, and the Darden School and Law School of North Grounds define a missed opportunity for growth by means of proximities and interconnections that would foster enhanced community living and learning culture (Emmet Ivy Task Force, 2019). Overlooking these nuanced circumstances and designing a site with the sole purpose of removing nutrients from urban runoff and transporting water away from it would be to ignore what is an infrequent alignment of University goals and desires with local, advantageously-located land availability. The case of Boston's Emerald Necklace park provides an example of how a network builder achieved network success by improving the functionality of a space through stormwater infrastructure design (Fabos, 2004). By taking these less obvious social dimensions into consideration and using actor-network theory to analyze the roles that different human and non-human entities will play in determining the fate of UVA's network, we gain a broader awareness of how technology and physical characteristics of a designed space can be integrated in a way that drives network success by benefiting a community socially.

To maximize the benefits of a redesigned site and subsequent stormwater management system at the Ivy Corridor, then, attention must be paid to both the technical and social features of this development. Below I outline a technical approach for redesigning the site in a way that will bring it into compliance with stormwater runoff regulations. Furthermore, I will employ actor-network theory to analyze the various pieces of the socio-technical system hanging in the balance with this land redevelopment in order to highlight the ways in which UVA can employ best management practices and design principles to ensure maximal growth and productivity of its network.

Technical Problem

On a global basis, flooding accounts for approximately one third of all disaster events that occur naturally. Additionally, they are responsible for more than half of all known fatalities and greater than one third of the total economic loss attributable to natural disasters (March et al., 2007). With this in mind, the engineers and urban planners of today's modern societies are tasked with designing systems that will minimize the risks of flooding in urbanized settings, as well as mitigative measures for when floods do occur. When pervious surfaces such as soil are replaced with impervious ones such as asphalt or concrete, runoff from storm events increases dramatically as that water is not able to infiltrate back into the ground as readily as before. Stormwater engineers deal with this problem by implementing, often in combination with one another, a number of design features known as best management practices (BMPs) which serve the purpose of both reducing runoff volume and removing pollutants, such as Nitrogen and Phosphorus (Urbonas et al., 1993). It makes sense, then, that the respective utility of each of these BMPs is measured in terms of the volume of stormwater runoff reduction provided as well as respective pollutant removal abilities.

Charlottesville is by and large an urban environment, and is therefore comprised largely of impervious surfaces. In fact, there are roughly one hundred million square feet of impervious surfaces in Charlottesville (City of Charlottesville Virginia, 2019). It should also be noted that unlike many other municipalities whose storm drains connect to water treatment facilities, runoff from Charlottesville drains directly back into local waterways, carrying industrial pollutants with it (UVA Facilities Management, 2019). As a result, contaminated stormwater runoff generated by this large amount of impervious surface cover is a major contributor of pollution to local creeks and streams, which will ultimately drain to the Chesapeake Bay. As previously stated, the fourteen and a half acre site that sits on the corner of Emmet Street and Ivy Road is currently under planning for redevelopment. While the introduction of new impervious surfaces will also introduce new runoff, the existings soil type that comprises most of the site also exhibits poor infiltration as a result of previous urbanization (USDA, 2019). These site characteristics, in combination with the large contributing watershed area, will create a technically difficult design challenge. Because of Charlottesville's unique treatment of stormwater, or rather lack thereof, failure to implement a comprehensive stormwater management design that effectively removes pollutants would not only put the corridor at risk of flooding, but would also threaten the larger natural ecosystems to which our locals streams are a part of.

The solution to this technical problem is to design an effective stormwater management system for both controlling and treating stormwater runoff at the Ivy Corridor project area on the UVA grounds. The effluent from this site must meet both local and state regulations for water quantity and quality, and the design must accommodate flood risks based on historical data. While developing this design, the Virginia Runoff Reduction Method (VRRM) software and Storm Water Management Model (SWMM) will be utilized thoroughly to ensure that post-development parameters will exceed regulatory expectations. Additionally, modeling will be used to analyze the design's performance under climate change. The ultimate goal of this technical stormwater design will be to ensure that the site is well equipped to handle future large rainfall events as well as to ensure that any runoff generated and discharged into the local watershed will not contribute to waterway impairment.

STS Problem

As the global population rises, the number of people living in urbanized environments is growing in dramatic fashion. It is projected that by the year 2050, 68% of the world's populations will live in Urban Areas (United Nations, 2018). With this increased flocking to cities, there will be an increased need for roadways, sidewalks, and buildings, and each of these entities will increase the total surface area that is comprised of impermeable surfaces. The rate and scale at which this shift in surface cover is happening calls for a dramatic need for concurrent innovations in stormwater management design, such as the design that is necessary for the new development of the Ivy Corridor on the UVA Grounds. While a design that effectively reroutes storm runoff away from the site would mitigate the risk of flooding that is increasing as our world becomes increasingly urbanized, the case of the Emerald Necklace in Boston demonstrates that stormwater management infrastructure can be employed in a way that also works to favorably enhance the social networks and interactions that occur in a given space (Fabos, 2004).

Research has shown that there is a direct correlation between increased geographical proximity and network collaboration (Bergé, 2016). It is also known that there is a high positive correlation between the aesthetics of a designed space and the extent to which it appeals to a community (Aysha Jennatha, 2016). In the case of the area that is to be developed on the corner of Emmet Street and Ivy Road on the UVA Grounds in Charlottesville, Virginia, I argue that development made with regards only to the quantitative performance of the space in terms of effectively managing stormwater runoff would be to overlook the ways in which stormwater infrastructure design can be used to create a sense of beautificiation and cohesion.

My analysis of the potential development of the Ivy Corridor utilizes the science, technology, and society (STS) concept of actor-network theory, which assesses the various human and non-human actors who have been recruited into a network by a network builder to achieve an outlined desire. Applying actor-network theory to the case of the new development site located on the corner of Emmet Street and Ivy Road will afford the reader valuable insight into some of the ways that stormwater management design can be used as a tool by UVA, the network builder, for achieving network success in the form of broader sociological advancements. Analysis of the case of the Emerald Necklace in Boston will highlight how a network builder achieved similar network success through the effective implementation of stormwater management design. UVA, the UVA Board of Visitors, average annual rainfall of Charlottesville, parents of UVA students, Charlottesville residents, and the ecology of the Rivanna watershed will be among the actors analyzed to better understand how UVA can achieve network success.

Conclusion

The technical report will deliver a new design for a site layout and stormwater management system at the intersection of Emmet Street and Ivy Road on the UVA Grounds, as well as an analysis of how the system will perform under climate change. This design will be largely centered around compliance with local and state regulations pertaining to the allowable quantity and quality of stormwater runoff discharge. The STS research paper will set out to provide further insights into the ways in which stormwater infrastructure design can be used in the Ivy Corridor to improve the functionality of UVA's network by employing the STS concept of actor-network theory; analysis of the stormwater design in Boston's Emerald Necklace park will shed light on the factors that led to Boston's success as a network builder.

The products of the technical report will aid in showing how UVA can achieve stability in its network by using stormwater management design to establish an intentional physical and conceptual institutional space. In addition, the findings from the STS paper will reveal important connections between aesthetics and proximity, among other physical characteristics, by analyzing Boston's success as a network builder through its design of the Emerald Necklace Park to establish increased functionality and social interaction.

Word Count: 1850

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