ECOSTREETS – INTEGRATING STORMWATER SOURCE CONTROLS INTO A MULTIPLE ACCOUNT ASSESSMENT OF URBAN INFRASTRUCTURE

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ABSTRACT (200 WORDS MAXIMUM)

This presentation will focus on the implementation of stormwater source controls as part of the redevelopment of urban streetscapes. The author will focus of constructed examples of stormwater source controls drawn from 20 years of experience in the Pacific Northwest. The presentation will highlight evolving design criteria for various streetscape elements and describe how these have affected the implementation of stormwater source controls.

The presentation focuses on the technical and economic impediments to the broader acceptance of source controls among development proponents and local governments. Using case study examples the author illustrates that source control solutions are technically well understood but that their incremental cost will continue to limit the broader acceptance over time.

KEYWORDS

Ecostreets, Source Controls, UniverCity, British Columbia

PRESENTER PROFILE

Doug Backhouse has focused on the development of sustainable cities for more than 20 years. As a principal in private practice since 1995 Doug has worked with local governments and environmental agencies supporting the creation of policy and industry outreach that has transformed the management of stormwater management in British Columbia. Trained in Canada and Scotland, Doug is a Fellow of the Canadian Society of Landscape Architects recognized for his leadership in supporting healthy and resilient communities.

1 INTRODUCTION

Over the past decade stormwater engineers have developed a broad consensus on the beneficial impacts of well implemented stormwater source controls. Referred to as Water Sensitive Urban Design (WSUD) in Australia or New Zealand, Low Impact Design (LID) in the United States, or Best Management Practices (BMPs) in Canada, many excellent examples now exist and their performance over time is closely monitored. Derived from the premise that urbanizing watersheds can, and should, perform in a way that mimics the pre development hydrograph designers have developed a range of tools that can efficiently match these trends. In this way urban infrastructure is taking on an expanded role that acknowledges its contribution to the ecological health of streams as well as its role in sustaining urban habitat and biodiversity.

Figure 1: This well recognised graphic illustrates the impact of urbanisation on stormwater flows. Considerable effort has been expended around the world to develop solutions that help development achieve a pre-development hydrograph. Progress has been slow. http://w3.salemstate.edu/~lhanson/gls100/image1/urbanization.gif

Controlling stormwater at source and encouraging increased infiltration has been a key strategic outcome and has in fact underwritten the development of new industry of stormwater manufacturers and suppliers. Notwithstanding the growing awareness of the stormwater benefits to be derived from source control strategies, their uptake has been moderate among mainstream practitioners and local governments have been slow to implement policy guidance which would favour the implementation of source controls as part of a complete stormwater solution. There are two practical impediments to a more widespread integration of source control strategies. The first is a limited but growing understanding of how source controls can perform. Concerns are raised about how source controls will cope with severe weather events and how performance may be degraded over time. The second impediment most frequently raised is related to the cost of designing, constructing and maintaining stormwater source controls. It is the later item which is the focus of this paper. The author believes that many of the technical limitations are now well understood and that the greater limiting measure is the creation

of a sufficiently broad accounting of this technology to encourage its more widespread adoption.

The word "Ecostreets" (CERA 2013) used in the title of this paper is drawn from the recent design and policy guidance from the City of Christchurch as it contemplates its earthquake rebuild. Having drawn design expertise from around the world it provides a suitable proxy for state-of-the-art aspirations for urban streetscapes. In its blueprint document the city acknowledges that it "has the opportunity to apply more sustainable solutions with measurable benefits" and that in doing so they will "provide pleasant and attractive microclimates for people to enjoy and can result in a healthier environment" (CERA 2013). This direction implies an understanding of the broadly based benefits of alternative stormwater solutions that are not frequently reflected in the budgeting and organizational structure of local government decision making.

The authors believe that by developing a fuller recognition of the role of stormwater source controls, practitioners can expect to be more successful in having these measures funding as part of a municipal green infrastructure program. Whereas source controls are more frequently viewed as an "extra cost" it is apparent from the examples illustrated below that a net benefit can be demonstrated when stormwater management is considered as part of a more complete design solution. In other words, budgeting for stormwater solutions that incorporate the benefits of source controls must also account for the benefits accrued by healthy growth of street trees (eg. canopy interception, evapotranspiration) alternative transportation (pervious paving for parking areas, runoff reductions attributed to narrower travel lanes). Source controls, properly implemented, are beneficial contributors to an urban watershed, but they are also part of a fuller suite of green infrastructure tools that are remaking urban areas at a lower overall cost and with a greater overall benefit. The examples illustrated later in this paper illustrate these cumulative benefits.

2 CUMULATIVE BENEFITS DERIVED FROM SOURCE CONTROLS

Source Controls can have many interrelated benefits for urban streetscapes, and by extension for the quality and efficiency of urban infrastructure generally. First among these is the ability to attenuate peak flows during moderate storm events. Whether they take the form of bioswales, infiltration trenches, infiltration galleries, box planters, or raingardens the function of the source control is substantially similar, to provide the facility to allow water to exfiltrate to groundwater without entering the traditional conveyance system. Through this process source controls have proven themselves to be effective at managing moderate flows but are not suitable to deal with higher level flows. Since extreme storm events most frequently occur during a wettest part of the annual hydrograph their contribution to flood attenuation is limited since they will tend to be fully saturated at the time of greatest need. As source controls have such a limited benefit for flood attenuation they tend to be accounted as an additional cost for stormwater – appreciated – but difficult to support in the context of tight financial constraints.

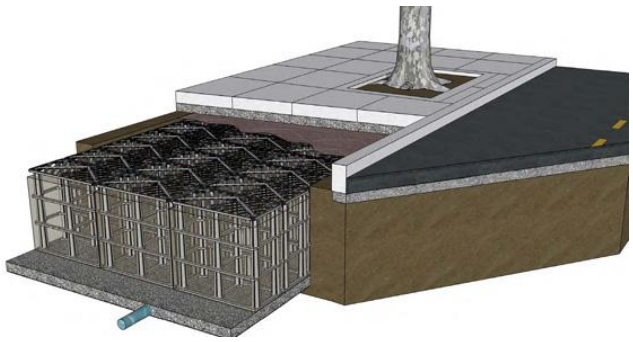

Figure 2: A generic source control solution may be developed to take advantage of increased soil volumes associated with modern street tree installations. Whereas the costs of this installation may be accounted as stormwater infrastructure the benefits are accrued more widely. Illustration by Golder Associates.

Too frequently "off balance sheet" benefits of urban infrastructure design solutions are not effectively incorporated into decision making. Take for example the contributory role of street trees as a part of the source control solution. Although difficult to quantify reliably the canopy interception of a mature tree canopy can reduce water volume by 76.5% for coniferous trees and 56.4% for deciduous trees (Asadian & Yeganeh 2007). Since the growth and vitality of urban street trees is enhanced by the provision of greater soil volumes and since these same facilities can perform the exfiltration functions of a typical stormwater source control the increased cost of this infrastructure may be shared, for the benefit of both, between local government initiatives that are responsible for stormwater and those that are responsible for urban parks, open spaces and natural areas.

Similarly a multiple account assessment must consider the incidental stormwater benefits of urban renewal initiatives that seek to create a higher density form of development that is in turn less reliant on single occupant vehicles in favour of transportation alternatives (bus, bike, pedestrian). As with the street tree illustration there are adjunct benefits to many source control solutions that encourage a compact, liveable community. As illustrated in the case studies below this phenomenon appears to be consistent across a wide range of project types and at many scales. Where community development has given an emphasis to liveability the standards have favoured narrower travel lanes and the introduction of cobble (pervious) pavements to reduce scale and enrich the aesthetic experience. Practitioners will understand the stormwater benefits of increased permeable pavements and reductions on the overall area of impervious surfaces associated with narrower travel lanes.

3 CASE STUDY UNIVERCITY, BURNABY BC – HIGH DENSITY RESIDENTIAL DEVELOPMENT

UniverCity is a complete community located at the top of Burnaby Mountain beside one of Canada's top comprehensive universities, Simon Fraser University. Perched high above its most beautiful metropolis, UniverCity offers the qualities and services of a modern urban neighbourhood - nestled into a wild, protected forest (UniverCity CA

2013). Working for the Simon Fraser University Trust Golder Associates (Lanarc Consultants Ltd.) were part of a planning team engaged to develop a new community in the heart of Vancouver based on the trust's mandate to deliver on its 4 fundamental principles: Environment, Economy, Equity, and Education. Part of this expansive sustainability agenda was the expectation to deliver a stormwater infrastructure that closely matched the pre-development flows of the endowment lands.

Picture 1: Urban streetscapes in high density developments can provide a high level of stormwater infiltration while at the same time contributing to a high quality, high value developments. Photo: Golder Associates.

Stormwater solutions at UniverCity included a variety of measures from constructed wetlands to greywater harvesting. A central component of the overall strategy was the development of a self-mitigating streetscape. In the context of this paper it is significant to note that many aspects of the proposed road cross section are initially advanced as urban design recommendations not directly attributable to the development of a stormwater response. Specifically, the increased cost of including pervious pavements to differentiate land use (parking vs. travel) may be shared among urban designers and utility engineers. Further, although the cross section does not specifically reference the inclusion of larger soil volumes, these have been included for the benefit of the urban streetscape and to facilitate stormwater source control.

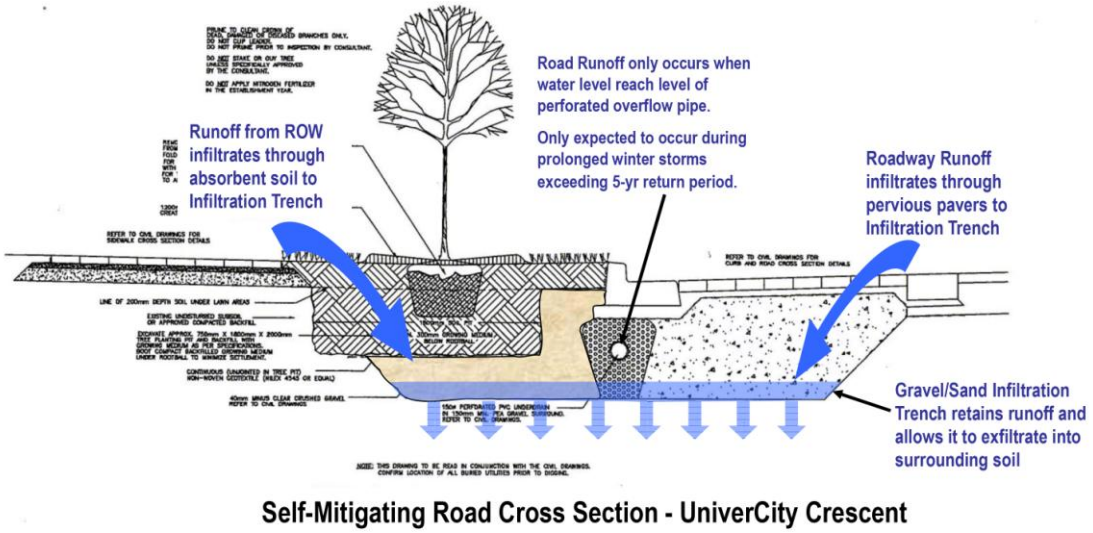

Figure 3: A self-mitigating road cross section is intended to provide a sufficiently well-developed network of stormwater source controls such that a stormwater pipe conveyance is not required expect on the most extreme circumstances. Illustration by Golder Associates.

4 CASE STUDY HAWTHORNE, NANAIMO BC – LOW DENSITY RESIDENTIAL DEVELOPMENT

Working with source controls on less intensively developed sites does not alter the need to consider a multiple account assessment of benefits and costs.

During the development of 230 single family dwellings in Nanaimo, British Columbia the design for this new neighbourhood was guided by sensitivity to the site's natural features and to the character of its surrounding neighbourhoods. A park and greenway system, pedestrian-oriented streetscape and stormwater management elements are key components of this project. A key element of the permitting process was to ensure adjacent sensitive wetlands continued to be protected.

A key element of the Hawthorne subdivision was the creation of a Greenway Street which included series of bioswales and raingardens. Stormwater from the main street was sheet drained into a swale designed to incorporate a series of weirs and check dams allowing stormwater to infiltrate over time. The nature of the hydrograph in this areas means that in a typical year more than 75% of precipitation is handled in this way. Storm events are accommodated within a central city park that incorporates a large natural wetland with sufficient freeboard to accommodate flood volumes.

At the same time the Greenway Street provides a significant recreation and alternative transportation link. Badged as part of the Trans Canada Trail the wide pedestrian pavements provide an important recreational connection for cyclists and pedestrians.

At Hawthorne, and at UniverCity the support for innovative stormwater solutions has been enhanced by the communication of cumulative benefits. In each case a standard

stormwater solution has been incorporated to respond to the requirements of property protection during worst case storm events so that source controls are supplementary to the rudimentary requirements.

5. Economic and Technical Impediments to the Broader Acceptance of Stormwater Source Controls

As has been illustrated in the examples above, stormwater practitioners have been successful incorporating source control techniques into streetscape designs for high density urban developments, as at UniverCity, and for lower density traditional form housing subdivisions as shown at Hawthorne. Although the technologies will vary to respond to the different demands of these solutions have been successful implemented and monitored at a variety of sites across North America and around the world. We anticipate that the evolution of design solutions will continue to evolve in response to individual site conditions but that the broad contribution of source control solutions is now sufficiently well understood that it no longer poses a meaningful limit to the future adoption of these solutions. As practitioners recognize and plan for the limitations of source controls in responding to severe flood events their use can be expected to continue to grow over time.

On the other hand we believe that a significant impediment to the broad use of source controls where their additional costs are not properly allocated. Each of the examples illustrated above have been focused on achieving a "higher than market norm" level of sustainability. Their proponents have successfully demonstrated that they are able to develop a greater market value by demonstrating a high level of environmental response. Each has achieved a "first mover" advantage in this context. In this way the incremental costs of higher service levels has been underwritten by the step up in value. As the market sees greater adoption of source control solutions we anticipate that there will be continued downward pressure on costs which will continue to put pressure on proponents interested in adopting source control solutions. To counteract these market pressures we believe that practitioners will need to develop a fuller understanding of the benefit cost equations for source control solutions which are likely to include at a minimum: horticultural benefits, urban design benefits, community economic development benefits, as well as the more difficult to quantify benefits related to livability and ecosystem health.

6 CONCLUSIONS

This paper has illustrated several recent stormwater installations from British Columbia with the intent of describing a current state-of-the-art for stormwater source controls. These illustrations highlight a range of solutions applicable in different contexts. In each example the technical solutions have been innovative but practical, illustrating that the techniques of source control are sufficiently well understood that they do not create significant impediments to the future adoption of these solutions by development proponents or local government. In extrapolating from this context the author has suggested that the limiting factor for the broader implementation of stormwater source controls is likely to be downward pressure on costs. To counteract these trends

stormwater practitioners will need to be aware of the related beneficial effects of source control for their communities. As local governments and developers are called upon to provide sustainable and environmentally resilient services there will be a continued and focused expectation for the assessment of results based on a multiple accounts assessment of benefits.

ACKNOWLEDGEMENTS

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