GREEN INFRASTRUCTURE SUPPLEMENT FOR SUBDIVISIONS:

REPORT ON THE GREEN INFRASTRUCTURE CONSULTATION HELD ON MAY 11, 2004 IN VANCOUVER

Green Infrastructure Partnership:

Master Municipal Construction Document Association
Water Sustainability Committee of the B.C. Water & Waste Association
West Coast Environmental Law Association
Ministry of Community, Aboriginal & Women's Services

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EXECUTIVE SUMMARY

The Green Infrastructure Partnership (GIP) is a consortium of four organizations that share a vision for developing and implementing a **Model Subdivision Bylaw and Green Infrastructure Standards** that will present options for land development regulation province-wide. Implementation by local governments will be voluntary, but once the decision is made to embrace green infrastructure, implementation will be by regulation. This will be a multi-step process. The first step will be the creation and dissemination of an optional 'Green Supplement' to the Master Municipal Construction Document Association (MMCD) Design Guidelines.

Mission: For the purposes of articulating what it wishes to accomplish over time, the short-term and long-term efforts of the GIP will be guided by the following Mission Statement:

> *The Green Infrastructure Partnership will provide leadership by developing practical tools and instruments for green infrastructure design practices and regulation, and by encouraging their application in BC.*

The GIP is promoting an integrated approach that addresses the need for coordinated change at different scales – that is: community, neighbourhood, site, and building. The GIP also recognizes that resolution of green infrastructure issues will depend on the sustained efforts of various groups and individuals over time.

Green Infrastructure Consultation: A workshop on May 11th 2004 provided an opportunity to introduce the Green Infrastructure Partnership to a selected audience. Workshop participants included persons with expertise from various jurisdictions and projects, which have embraced some aspect of green infrastructure. It also included practitioners and advocates of developing green infrastructure practices. This Report documents the workshop process and the outcomes, both immediate and subsequent. The workshop provided the opportunity to test and validate the direction in which the GIP is heading. It also provided a timely feedback loop that generated post-workshop discussion and reflection.

Outcomes: The primary purpose of the consultation was to explore the diversity of issues and difficulties inherent in defining and implementing a green infrastructure approach to land development. The consultation resulted in identification of 17 recommendations in five theme areas. These are summarized in Table 1.

An over-arching theme that emerged from the discussion revolves around the need to provide the bridge between those who make the decisions and those who implement the decisions. The GIP has concluded that an effective way to address this need is to produce two levels of 'why we are doing this' guides:

- Policy Guide for Elected Officials – to provide a big picture overview.
- Technical Guide for Senior Staff – to identify policy options and provide the technical pros and cons for each.

Framework: Key concepts that will define the framework for technical analysis include:

- Integration of Perspectives
- Performance-Based Objectives
- Context-Sensitive Design
- Adaptive Management
- Rainwater Management

Phased Program: The theme areas and associated recommendations provide direction for developing a multi-phase program that will provide options for designers, builders and governments.

TABLE 1	CONSULTATION OUTCOMES	
Theme	**Sub-Themes**	**GIP Recommendations Arising from the May 11th Workshop**
#1 – Naming and Approach	1.1 Name of MMCD Green Design Supplementaries	Title the Interim Supplement "Options for Greening of Existing Standards"
	1.2 Set Out Objectives of Supplement	Develop a Policy Guide that serves as a Decision Support Tool and sets out the broader objectives and reasons for adopting the Green Supplement.
#2 – General Design Considerations	2.1 Link Land Use Planning with Subdivision Servicing and Comprehensive Planning	Develop a Policy Guide that serves as a Decision Support Tool and outlines the need to integrate Land Use Planning and Subdivision Servicing Requirements on a Neighbourhood Scale
	2.2 Integrated Development Processes	Provide Policy Makers with Decision Support Tools that enable Implementation of more Integrated Lland Use Planning and Development Approval Processes.
	2.3 Performance-Based Objectives and Context-Sensitive Design	Establish Measurable, Achievable and Affordable Performance Objectives and Targets that enable Designers to exercise Professional Judgement in achieving Context-Sensitive Solutions to Public Infrastructure Issues.
	2.4 Monitoring and Adaptive Management	Identify appropriate Performance Monitoring Standards (including Timeframe and Process) for Public Infrastructure where possible
	2.5 Integrate Servicing Standards with Ecological Functioning	Identify Infrastructure Design Techniques that support Ecological Systems by applying Design with Nature Concepts.
#3 – Rainwater Management	3.1 Manage the Full Range of Rainwater Events and Use Infiltration Methods	Identify Landscape Solutions and Comprehensive Planning Techniques for Rainwater Management, with particular emphasis on returning water to Natural Hydrologic Paths.
	3.2 Rainwater Management and Roads	Identify Techniques that integrate Rainwater Management and Road Standards.
#4 – Roads	4.1 Grid Street Network	Develop a Policy Guide that serves as Decision Support Tool and sets out Standards for Use of Road Grid Patterns.
	4.2 Road Widths	Develop a Policy Guide that serves as a Decision Support Tool and sets out 'tradeoffs' between Road Width, Service Functionality, Land Cost, etc
	4.3 Crossings and Roundabouts	Provide options which focus on pedestrian safety and provide choices for roundabouts and other control measures.
#5 – Other	5.1 Greenways	Create Design Guidelines for Different Types of Greenways
	5.2 Accessibility Standards	Incorporate Well-Accepted Accessibility Standards in the Guidelines
	5.3 Lighting	Develop a Policy Guide that serves as a Decision Support Tool and sets out "trade-offs" between Service Functionality, Lighting Cost Safety Implications etc
	5.4 Edge Planning for Agricultural Land	Develop a Policy Guide that serves as a Decision Support Tool for Subdivision Servicing on lands adjacent to Agricultural Land
	5.5 Maintenance	Develop a Policy Guide that serves as a Decision Support Tool and sets out the maintenance implications of various servicing choices, and how to plan and accommodate on-going maintenance funding.

A. CONTEXT AND OVERVIEW

Infrastructure design in North America and throughout the English-speaking world is in a major sea change, and British Columbia is in the vanguard of that change. Increasingly, the focus of design professionals is on how to build and/or rebuild communities in balance with the natural environment. This involves revisiting the community design standards that dictate how land will be cleared, roads built, infrastructure services provided, building sites (re)developed, and rainwater runoff managed. Increasingly, the design of infrastructure will require a focus on adapting existing facilities to new uses. There may be irreversible processes, (climate change,) and population growth to consider as well.

The legacy of the past is that today's land development standards and practices reflect scant consideration for preserving ecological processes such as the natural water balance and considering the implications of designs on greenhouse gases. These standards and practices are seen by many as the root cause of the loss of aquatic habitat, water pollution and flooding.

Rapid population growth, redevelopment of older neighbourhoods, and land use densification are now creating opportunities to protect and/or restore, (to varying degrees), the natural environment by improving the built environment. In planning for the next 50 years, the vision is one of greener communities that will achieve higher levels of ecological and stream protection. Achieving this outcome will require changes to existing land use regulations, design guidelines and construction standards.

The process of implementing change will be incremental. One early opportunity to make a difference is to expand the current **Master Municipal Design Guidelines and Construction Standards**, to provide options to the designers of municipal infrastructure, that will move us in the direction of desired change. Over the past decade, the MMCD documents have emerged as the 'documents of choice' for BC Municipalities, Contractors and the Consulting Industry involved in infrastructure construction. They have collectively supported these documents because of the benefits that have accrued from province-wide standardization on cost effective construction techniques.

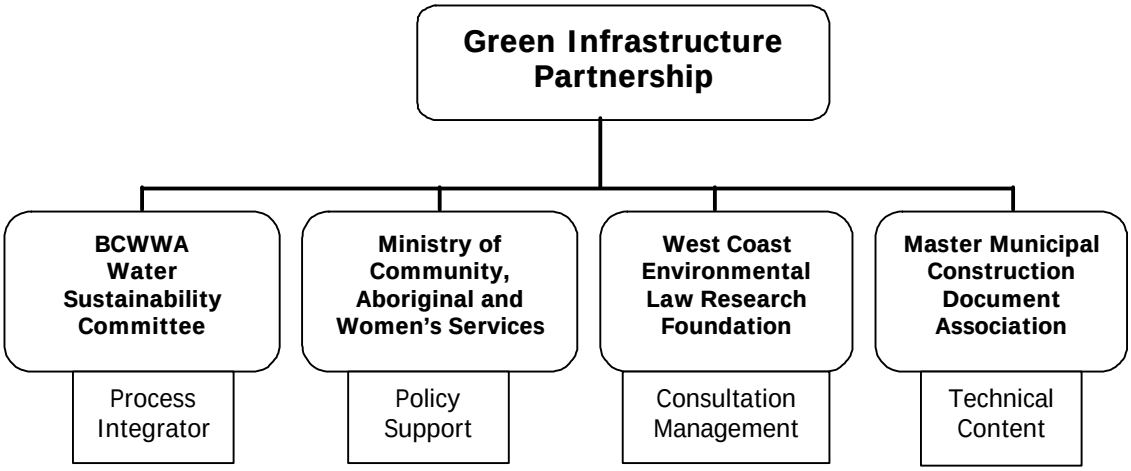
The Green Infrastructure Partnership is supporting, among other initiatives, the 'greening' of the recently developed MMCD Design Guidelines, currently referred to as "the Green Supplement". The Partnership also wants to make green infrastructure practices more accessible to communities across B.C. The Green Supplement is only one step in what is envisioned as a multi-step process. (Refer to Appendix A for an explanation of the term ***green infrastructure***, and to the *Integrated GIP Work Plan*, for a comprehensive view of the Partnership's aspirations).

To initiate a consultation process with key stakeholders, the Partnership convened a one-day workshop of invited experts who are working on incorporating green infrastructure into municipal development standards. The objectives of the consultation were to understand the diversity of issues and difficulties inherent in applying a green infrastructure approach to land development, and to canvass existing best practices. The purpose of this Report is to record the outcomes of the workshop, and to show how those outcomes will be accommodated within the Partnership's work plan.

B. GREEN INFRASTRUCTURE PARTNERSHIP

The Green Infrastructure Partnership (GIP) is a consortium of four organizations as listed below. The role of each Partner is highlighted in the accompanying organization chart.

- Water Sustainability Committee (WSC) of the BC Water & Waste Association
- Municipal Master Construction Document Association (MMCD)
- West Coast Environmental Law Research Foundation (WCEL)
- BC Ministry of Community, Aboriginal and Women's Services (MCAWS)



The members of the Partnership share a vision for developing and implementing a **Model Subdivision Bylaw and Green Infrastructure Standards** that will present a 'best practice' summary for land development regulation and will comprise three components:

- **Guide for Decision Makers** – consisting of typical bylaws, definitions, legal/planning content and related green infrastructure discussion content.
- **Technical Content** – supplementary specification consisting of references to MMCD Design Guidelines and Construction Standards and Supplementaries
- **Decision Support Tools** – (1) the MMCD's *CrossCheck* contract management software; (2) the *Water Balance Model for BC*; and (3) an instrument to be developed by the WCEL to assist municipal councils with the decision of when and how to use the Green Infrastructure Standards.

The GIP will not address "greening issues" outside the scope of the defined vision. The Model Bylaw will be presented for voluntary adoption or use by individual municipalities. The "Green Supplement" will complement the MMCD Design Guidelines by providing alternatives to current infrastructure design practices. The MMCD Design Guidelines are available at http://www.mmcd.net/admin/Draft-DesignGuidelines.pdf.

Sustainability Context

The focus of the GIP is on providing choices and encouraging action by individuals and organizations … so that environmental stewardship will become an integral part of land use planning and related infrastructure construction. The GIP will promote consideration of environmental, social and governance factors (involving shared responsibility), as well as economic concerns when developing infrastructure.

The GIP is one of six elements that comprise the ***Water Sustainability Action Plan for British Columbia***. The Action Plan promotes and facilitates sustainable approaches to water use, land use and resource management *at all levels* – from the province to the household; *and in all sectors* – from domestic, resource, industrial and commercial, to recreational and ecosystem support uses. Refer to Appendix B for background.

The Action Plan reflects a *watershed / landscape-based approach* to community planning and infrastructure servicing. This approach recognizes that the greatest impact on water and land resources occurs through individual values, choices and behaviour. This approach enables consideration and application of an ecosystem perspective that links physical, biological and human perspectives.

The pursuit of well-being for current and future generations is often characterized as thinking globally and acting locally. This means making decisions at the site and activity level that, when taken together, lead to *cumulative benefits* rather than to *cumulative impacts*. Local governments have the primary authority in this regard and the *watershed / landscape-based approach* is aimed at enabling them to sustain not only their own communities but, by doing so, contribute to broader interests as well.

Desired Outcomes

The GIP envisions that the model subdivision bylaw and supporting documents will:

- Apply to many land development and municipal infrastructure projects. (The Partnership recognizes that not all projects are appropriate for "green" standards. There are issues of integration into existing systems as well as risk management and financial factors to be considered.)
- Be developed against a backdrop of environmental protection and enhancement, including watercourse, foreshore and terrestrial habitat.
- Become widely recognized.
- Promote more affordable housing and infrastructure construction. (The Partnership recognizes that alternative standards will have a cost implication. Full-cost accounting will therefore be promoted to ensure long-term financial implications are considered in the decision process.)
- Promote sustainable approaches to water resource management.
- Be linked to lower-cost, more time-sensitive, approval processes. (The Partnership recognizes that added complexity generally means more processing.)
- Be supported by outreach, training and education programs.
- Have the potential to become recognized nationally as a ‘best management’ approach to the provision of more affordable land development and public works servicing.

Mission Statement

The GIP has adopted the following Mission Statement to guide its short-term efforts in a long-term context:

> *The Green Infrastructure Partnership will provide leadership by developing practical tools and instruments for green infrastructure design practices and regulation, and by encouraging their application in BC.*

The reference to "encouraging their application" highlights the outreach and continuing education efforts that are critical to the success of the Green Supplement, once the tools are completed.

The GIP is promoting an integrated approach that addresses the need for coordinated change at different scales – that is: community, neighbourhood, site, and building. The GIP also recognizes that resolution of green infrastructure issues will depend on the sustained efforts of various groups and individuals over time.

C. GREEN INFRASTRUCTURE CONSULTATION

The **Green Infrastructure Consultation** on May 11th 2004 provided a timely and strategic opportunity to formally launch the Green Infrastructure Partnership and broaden awareness of the goals and objectives of the Partnership in developing a Model Subdivision Bylaw and Green Infrastructure Standards. Of relevance, prior to the formation of the GIP, the WCEL and MMCD had been proceeding on independent tracks to develop a Model Bylaw and Green Infrastructure Standards, respectively. Therefore, the Consultation had symbolic significance in merging the two streams of effort.

Because there was recognition by the Partnership that the ultimate credibility of the event depended on engaging the design community early in the process, this resulted in the concept for a two-part workshop:

- **Morning** –facilitated by WCEL in order to consult with experts to discuss what "green infrastructure" means in the context of engineering Design Guidelines.
- **Afternoon** –facilitated by MMCD in order to involve and educate the design community regarding the MMCD expectations in "greening" the current MMCD standards.

Consultation participants included representatives with expertise in the jurisdictions and with the projects that have embraced some aspect of green infrastructure. It also included practitioners who are at the forefront of developing green infrastructure practices (architects, developers, engineers, biologists, and transportation planners). In addition to the participants, the MMCD invited practitioners who are interested in green infrastructure and who may be involved in developing the interim Green Supplement to observe the discussion of the participants. Refer to Appendix B for a list of participants and observers, and to Appendix C for the agenda, expectations of participants, and scope of discussion.

The primary purpose of the workshop was to explore the diversity of issues and difficulties inherent in applying a green infrastructure approach to land development, and to provide this information to the MMCD Technical Team. Other purposes included:

- Alert the Partnership to the best practices underway in B.C. and to the technical documents available to the MMCD Team.
- Understand the breadth of what "green infrastructure" currently means or could encompass.

The outcomes were twofold: (1) a better understanding of the range of issues involved in translating green infrastructure into on-the-ground standards; and (2) a summary report of the Consultation that will provide input to MMCD in developing the interim Green Supplement.

D. THEMES AND RECOMMENDATIONS

The Green Infrastructure Partnership hopes to bring an holistic view to the provision of infrastructure. Implementation issues should be addressed and integrated at multiple scales (e.g. community, neighbourhood, site, and building). Viewed in this context, the MMCD domain is *public* infrastructure, owned and controlled by local government, which responds to decisions made at the community and site scales.

Other considerations that shape the integration process are the time scale, (what is desired over time versus what can be accomplished in the short-term), the economic impact of alternative standards, and the ability to build support and consensus for change.

The foregoing provides a direction for the GIP. The Green Infrastructure Consultation validated that direction. Participants underscored the vital need for a multi-level approach that goes beyond the "right-of-way" scope of the MMCD Design Guidelines. Participants recognized that this change will not be achieved overnight. Hence, participants also recognized the importance in managing expectations as what can be realistically accomplished with the limited scope of the current MMCD Green Supplement initiative.

Guiding principles that emerged during roundtable discussion, that provide a framework for an "integrated work plan" for the Partnership, are highlighted as follows:

- Judge progress by the distance travelled, not the distance remaining to reach the goal.
- Create a momentum for change by highlighting success stories and sharing lessons learned.
- Understand what 'integration of perspectives' actually means at the working level.
- Simplify our way of thinking and communicate technical concepts in commonsense language.

Consultation Outcomes

The previously introduced Table 1 consolidates specific recommendations arising from the roundtable discussion. Five theme areas emerged and are listed below:

- Theme #1 - Naming and Approach
- Theme #2 - General Design Considerations
- Theme #3 - Rainwater Management
- Theme #4 - Roads
- Theme #5 - Other

The details of each theme area and the associated recommendations by the GIP are described in the following pages. An over-arching theme is the need to provide a bridge between those who make the decisions and those who implement the decisions. The GIP has concluded that an effective way to address this need is to produce two levels of guides:

- Policy Guide for Elected Officials – to provide a big picture overview.
- Technical Guide for Senior Staff – to identify policy options and provide the technical pros and cons for each.

1. Theme #1 - Naming and Approach

1.1 Name of MMCD Green Design Guidelines Supplementaries

Synopsis of Discussion:
The existing budget for the MMCD Green Design Guidelines Supplementaries will not address issues beyond the limited scope of identifying some design alternatives for public infrastructure.

Recommendation:
Title the MMCD project as "Options for Greening Existing Infrastructure Design Standards".

1.2 Set Out Objectives of Supplement

Synopsis of Discussion:
The objectives of taking a green infrastructure and smart growth approach to land development are not obvious when applied on the ground. Explanatory material about the objectives should be furnished to a wide audience of designers, regulators and decision makers

Recommendation:
Develop a policy guide that serves as a decision support tool and sets out the broader objectives and reasons for adopting the Green Supplement.

2. Theme #2 - General Design Considerations

2.1 Link Land Use Planning with Subdivision Servicing & Comprehensive Planning

Synopsis of Discussion:
All aspects of subdivision reflect land use decisions, including the type of servicing needed in a neighbourhood. Increased attention to roads and rainwater management, will potentially result in better developments and decrease the costs of servicing over the long term. For example, a minimum density of ten dwelling units per acre average ensures that municipal servicing can be used more efficiently and this higher density can also support improved neighbourhood amenities, commercial uses and better transit. services However, the MMCD Green design Guideleines Supplementaries will not address land use planning explicitly.

Recommendation:
Develop a policy guide that serves as a decision support tool and outlines the need to integrate land use planning and subdivision servicing requirements on a neighbourhood scale

2.2 Integrated Development Processes

Synopsis of Discussion:

Taking account of the green infrastructure requires many disciplines, including engineers, planners, landscape architects, and biologists, to work together to plan and design integrated urban systems. This approach requires changes at the municipal staff and procedure level, as well as a more integrated and comprehensive approach to regulation. Municipal departments must take a team approach to problem-solving for specific projects. The team should include all department staff who are involved in the project, the developers' professionals, and community members.

Recommendation:

Provide policy makers with decision support tools that enable implementation of more integrated land use planning and development approval processes.

2.3 Performance-Based Objectives and Context-Sensitive Design

Synopsis of Discussion:

Experience shows that performance-based approaches are more effective than prescriptive approaches because each watershed and site is unique and there are site-specific requirements to maintain ecological functioning. Achieving the best solution for a particular site (context-sensitive design) requires flexibility. Performance-based approaches promote creativity in the way a design objective can be achieved through the application of professional judgement. The essence of a performance-based approach is that the regulatory agencies establish reasonable and affordable performance targets. A prime example of development and implementation of a performance target approach in BC is the water balance methodology for runoff volume reduction that is at the heart of *Stormwater Planning: A Guidebook for British Columbia.*

Recommendation:

Establish measurable, achievable and affordable performance objectives and targets that enable designers to exercise professional judgement in achieving context-sensitive solutions to public infrastructure issues.

2.4 Monitoring and Adaptive Management

Synopsis of Discussion:

Ecological function changes over time and public infrastructure should also adapt Performance monitoring can be used to support adaptation and sustainability in public infrastructure A North American precedent for developing and institutionalizing an adaptive management program for land development has been established at **UniverCity** on Burnaby Mountain.

Materials testing is an example of monitoring and an adaptive approach at the construction scale of activity.

Recommendation:
Identify appropriate performance monitoring standards (including timeframe and process) for public infrastructure where possible

2.5 Integrate Servicing Standards with Ecological Functioning – Design With Nature and Engineered Ecology

Synopis of Discussion:

Introduce 'design with nature' principles and engineered ecology techniques which optimizes the use of soil, plants and trees and surface treatments for rainwater management into the Green design Guideline Supplementaries

Recommendation:
Identify infrastructure design techniques that support ecological systems by applying design with nature concepts.

3. Theme #3 - Rainwater Management

3.1 Manage the Full Range of Rainwater Events and Use Infiltration Standards

Synopsis of Discussion:
Rainwater management has traditionally focused on planning for the extreme yet infrequent storm events. However, there are approximately 170 days per year that have measurable precipitation in the Georgia Basin. Roughly 75% of the total annual rainfall volume falls as 'light showers'. Analysis of rainfall patterns shows that 90% rainfall capture is typically within reach. Achieving this target means that runoff would be limited to 10% of annual rainfall. The 10% figure represents the synthesis of biophysical and hydrologic understanding. Comprehensive planning for the full range of rainwater events can ensure that most rainwater is returned to natural pathways and servicing costs decreased. Refer to **Stormwater Planning: A Guidebook for British Columbia** for complete details.

Recommendation:
Identify landscape solutions and comprehensive planning techniques for rainwater management, with particular emphasis on returning water to natural hydrologic paths.

3.2 Rainwater Management and Roads

Synopsis of Discussion:
Because green streetscaping enhances livability and quality of life, rainwater management in conjunction with an overall 'green roads' strategy could encompass practical 'small steps' such as reduced pavement widths to make a tree canopy achievable, pulling sidewalks back from curb edges to create a landscape strip beside the roadway, planting appropriate tree types within the landscape strip to promote the tree canopy growth over the roadway, and constructing infiltration trenches within boulevard areas. In a typical residential area, about 30% of the land is in public road rights-of-way. This results in considerable potential for integration of rainwater management with road design.

Recommendation:
Identify techniques that integrate rainwater management and road standards.

4. Theme #4 - Roads

4.1 Grid Street Network

Synopsis of Discussion:
Road networks are best addressed at regional, community and neighborhood scales. Local roads design guidelines should allow designers to address a variety of functions through cross-section elements and design details. An example that was highlighted in discussion as being a desired high priority in greenfield areas would be a grid pattern that is keyed to a 183 metre (600 foot) connectivity standard between through streets to provide adequate pedestrian crossings and slow traffic. There was a suggestion to provide sidewalks on both sides of streets. There was also a suggestion that cul-de-sacs only be allowed adjacent to agricultural and other resource lands.

Recommendation:
Develop a guide that serves as a decision support tool and sets out standards for use of road grid patterns.

4.2 Road Widths

Synopsis of Discussion:
Road networks are best addressed at regional, community and neighborhood scales. Local roads design guidelines should allow designers to address a variety of functions through cross section elements and design details. Where appropriate, narrower streets and fewer lanes can be adopted to reduce impervious surfaces and improve some aspects of safety and accessibility..

The MMCD Design Guidelines will provide alternatives for decreased road widths where possible. Road widths should reflect the character of the traffic. Alternatives examined by TAC and others could be cited.

Recommendation:
Develop a policy guide that serves as a decision support tool and sets out 'tradeoffs' between road width, service functionality, land cost, etc.

4.3 Crossings and Roundabouts

Synopsis of Discussion:
Road networks are best addressed at regional, community and neighborhood scales. Local roads design guidelines should allow designers to address a variety of functions through cross section elements and design details. In some cases roundabouts offer an alternative to traffic control measures.

Recommendation:
Provide options which focus on pedestrian safety and provide choices for roundabouts and other control measures.

5. Theme #5 - Other

5.1 Greenways

Synopsis of Discussion:
Greenways are a primary connectivity technique that fulfills most green infrastructure goals. Greenways could include undeveloped rights of way on agricultural lands.

Recommendation:
Create design guidelines for different types of greenways (i.e. that fulfill habitat, rainwater management, pedestrian and cycling objectives)

5.2 Accessibility Standards

Synopsis of Discussion:
Enhance accessibility objectives for all persons, including sight and hearing impaired and mobility challenged people..

Recommendation:
Include well-accepted accessibility standards in the design guidelines.

5.3 Lighting

Synopsis of Discussion:
Some public infrastructure lighting escapes as light pollution into the sky and affects adjacent properties.

Recommendation:
Develop a policy guide that serves as a decision support tool and sets out "trade-offs" between service functionality, lighting cost safety implications etc

5.4 Edge Planning for Agricultural Land

Synopsis of Discussion:
Urban land uses and the design of road ends at the urban-agriculture interface affect the viability of farming. Consider interface fire risk and other bio-risk issues.

Recommendation:
Develop a policy guide that serves as a decision support tool for subdivision servicing on lands adjacent to agricultural land

5.5 Maintenance

Recommendation:
Develop a policy guide that serves as a decision support tool and sets out the maintenance implications of various servicing choices, and how to plan and accommodate on-going maintenance funding.

APPENDIX A – WHAT IS GREEN INFRASTRUCTURE?

Using a narrow interpretation, green infrastructure refers to the ecological processes, both natural and engineered, that are the foundation for a healthy natural and built environment in communities. Municipalities using the green infrastructure as an integral part of how development occurs find that it is often less costly than hard infrastructure, and also offers aesthetic, environmental, health and recreational benefits.

The green infrastructure includes:

- ditches, rivers, creeks, streams and natural wetlands that contain and carry rainwater runoff, improve water quality, and provide habitat;
- parks and greenways that link habitat and provide recreation opportunities;
- working lands such as agricultural or forested areas that are a key part of the economy;
- aquifers and watersheds that provide drinking water;
- engineered wetlands (rainwater detention ponds) that retain rainwater, improve the quality of rainwater runoff, and promote infiltration;
- landscaping-based rainwater management solutions that capture rain where it falls;
- infiltration-based rainwater drainage systems incorporated into streets, parking areas, buildings and yards; and
- trees, rooftop gardens and community gardens that clean air, cool urbanized areas in the summer, and provide a local food source.

Using the green infrastructure to manage common processes, such as rainwater runoff, keeps water on the land longer, thus recharging aquifers while protecting stream hydrology and morphology. Street trees, greenways and rooftop gardens, the "urban forest," help mediate summer heating in developed areas, restore pre-development levels of evapotranspiration, and sequester pollution while providing habitat for many species. Green infrastructure in neighbourhoods, such as green streets, constructed wetlands, protected stream corridors and new greenways, are seen as amenities and increase property values. Finally, maintaining working lands is important both for the economy and for their contribution to the green infrastructure of a region.

Smart Growth Context

Green infrastructure can also be defined in a broader sense as it relates to overall community planning, liveability goals, and taking a smart growth approach to land development.

"Smart growth" means the land use strategies and types of developments that create more compact complete communities, and also use tax dollars more efficiently. It means neighbourhoods that have a mix of stores and services within walking distance of a variety of housing options, connected by sidewalks and bike paths, and accessible by public transportation. Smart growth means revitalizing existing commercial centres and also supporting a viable rural working land base. The principles of smart growth include:

1. Promoting urban revitalization and rural preservation by containing urban areas, channeling development into existing neighbourhoods and adopting integrated planning and management approaches;
2. Incorporating green infrastructure into communities;
3. Creating compact complete communities by mixing land uses and using land more efficiently;
4. Increasing transportation choices through land use decisions;
5. Creating inclusive neighbourhoods by ensuring that a diversity of housing types are accessible to a wide range of people of different age groups, family types and incomes;
6. Maximizing the enduring benefits of developments by using resources wisely on sites and in buildings that are tailored to specific neighbourhood conditions;
7. Supporting municipal goals through cost recovery by ensuring that development cost charges and property taxes reflect the true cost of different types of growth;
8. Promoting smart growth throughout the development process by reforming administrative processes and addressing liability issues.

In short, smart growth is good planning with an explicit injection of affordability, sense of place, and renewal of the green infrastructure into community development. Over the long term most smart growth strategies cost less than traditional approaches to municipal development.

Municipal Infrastructure Design

Municipal infrastructure design focused on using the green infrastructure more fully and incorporating smart growth principles points towards servicing practices that use land and resources more efficiently. These include:

- Drainage standards based on infiltration, environmental protection, and community amenity;
- Utility alignments for more compact roads where bicycle and pedestrian infrastructure needs are given equal weight to the needs of automobiles;
- Road standards tailored to specific uses, lower speed limits, and community amenity goals such as achieving 40 percent tree canopy at maturity;
- Traffic calming built into road designs;
- A connected (grid) road network;
- Pavement structure allowing for permeable paving in certain circumstances;
- Unique road and servicing standards for projects near working lands;
- Significant street trees and boulevard plantings;
- Low maximum driveway standards;
- District heating systems;
- District water recycling systems;
- Water & sewer infrastructure requirements for subdivisions of high performance (green) buildings (in some cases allowing for smaller pipe sizing); and
- Dark sky outdoor lighting standards and energy efficiency requirements.

For more information on the range of smart growth and green infrastructure practices please see the Smart Bylaws Guide at www.wcel.org/issues/urban/sbg.

APPENDIX B – WATER SUSTAINABILITY ACTION PLAN FOR BC

The main goal of the **Water Sustainability Action Plan for British Columbia** (i.e. the 'Action Plan') is to encourage province-wide implementation of fully integrated water sustainability policies, plans and programs. The Action Plan:

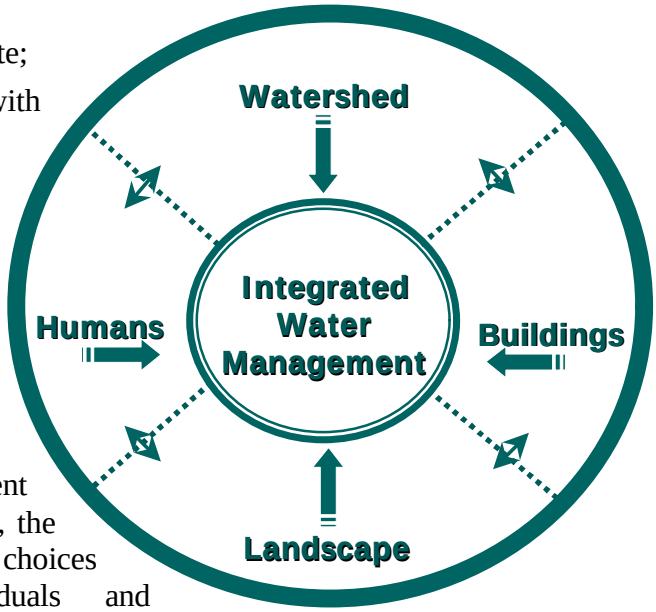
- Recognizes that the greatest impact on water, land and water resources occurs through our individual values, choices and behaviour.
- Promotes and facilitates sustainable approaches to water use, land use and water resource management *at all levels* – from the province to the household; *and in all sectors* – from domestic, resource, industrial and commercial, to recreational and ecosystem support uses.

The Action Plan Elements are comprehensive in scope, ranging from 'governance' to 'site design'. Element selection also reflects a guiding philosophy to concentrate efforts in those areas where there is the will, the energy and the long-term commitment *to create change*. Future elements and success will build on the foundation provided by the initial Action Plan Elements.

Integrated Water Management

Integrated water management involves consideration of land, water, air and living organisms – including humans – as well as the interactions among them. Through partnerships, the Action Plan is:

- Forging links as conceptualized opposite;
- Developing a continuum of products, with policy at one end, and pragmatic applications/tools at the other end; and
- Promoting the watershed as a fundamental planning unit

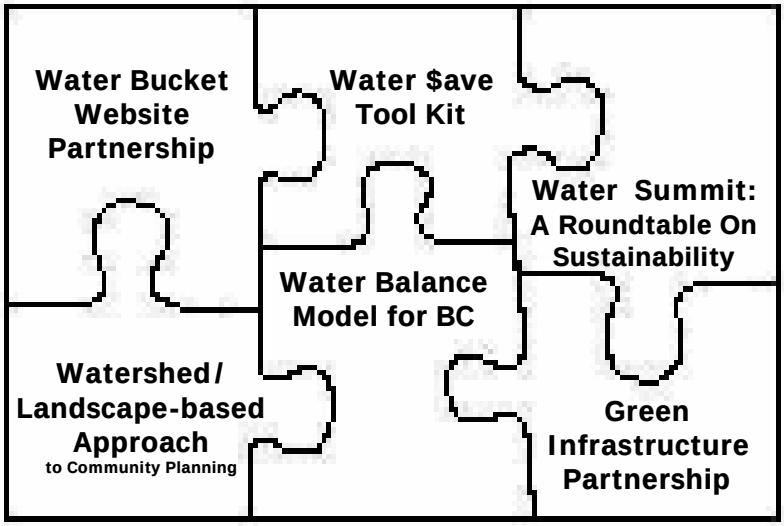


The Action Plan will use existing and emerging government policies, legislation and programs as fundamental starting points and will build on these.

Land use planning and water management practices are intertwined. For this reason, the intent of the Action Plan is to influence choices and encourage action by individuals and organizations - so that water resource stewardship will become an integral part of land use and daily living. Sustainable communities are all about choices – choices that become reality very quickly, with lasting consequences. In the years ahead, much will depend on getting the choices right in British Columbia, especially in those communities that are experiencing growth and/or renewal.

Action Plan Elements

The Action Plan comprises six elements that holistically link water management with land use, development and resource production. Briefly, each Action Plan Element will achieve the following outcomes:



Water Bucket Website Partnership: This centralized website will provide the complete story on integrated water management - *why*, *what*, *where* and *how*.

Water $ave Took Kit for British Columbia: This tool will enable individuals and communities to achieve water conservation and water-use efficiency objectives.

Water Summit: A Roundtable on Sustainability: This dialogue will provide a starting point for provincial and partnership action, with an emphasis on water governance, policy and practices.

Watershed/Landscape-Based Approach to Community Planning: This adaptable 10-step methodology will facilitate planning with reference to watershed-based features.

Water Balance Model for British Columbia: This web-based evaluation tool will enable better land development decisions because it quantifies the watershed benefits resulting from implementing rainwater source controls at the site level.

Green Infrastructure Partnership: This initiative will produce a 'best practice' *Model Subdivision Bylaw and Green Infrastructure Standards* for land development regulation.

Partnerships

The Action Plan recognizes that partnerships hold the key to building broad-based support for improving water management practices, and for integration of water management with land use.

The Action Plan also recognizes that numerous groups and organizations implicitly share a vision for integrated water management. Hence, over time it is envisioned that other elements will be added as momentum builds and support grows province-wide for fully integrated water sustainability policies, plans and programs – resulting in conservation and stewardship practices by BC's enterprises, institutions and in homes.

Cascading Levels of Decision-Making

The Watershed/Landscape-based Approach, the Water Balance Model, and the Green Infrastructure Partnership are linked and involve cascading levels of decision-making.

The first level is comprehensive planning with reference to watershed features so that resource, land use and community design decisions are made with an eye towards their potential impact on the watershed.

At the second level, Water Balance Model enables better land development decisions because it creates an understanding of how to get rainwater into the ground and/or absorbed by trees and landscaping – under any combination of land use, soil and climatic conditions.

The third level is detailed design when one decides how to do what at the site or subdivision scale by applying the Green Infrastructure Standards.

APPENDIX C – LIST OF PARTICIPANTS AND OBSERVERS

Participants	Expertise	Contact Information
Mark Allison Transportation Planner, City of New Westminster	Complete communities, Road design	(604) 527-4654 mallison@city.new-westminster.bc.ca
Dipak Basu Municipal Engineer, City of Chilliwack	Rainwater management, Community design	(604) 792-9311, Ext 2950 basu@chilliwack.com
Patrick Condon James Taylor Chair in Landscapes & Livable Environments, UBC	Complete communities	(604) 822-9291 patrick.condon@ubc.ca
Franc D'Ambrosio Principal D'Ambrosio Architecture & Urbanism	Complete communities	(250) 384-2400 fdambrosio@fdarc.ca
Richard Drdul Community Transportation Planner	Transportation management, Road design	(604) 222-3541 richard@drdul.com
Chris Hartman VP Development Simon Fraser Community Trust (UniverCity)	Complete communities	(604) 291-3220 hartman@sfu.ca
Todd Litman Executive Director, Victoria Transport Policy Institute	Transportation management, Road design	(250) 360-1560 litman@vtpi.org
Patrick Lucey Principal, Aqua-Tex Consulting	Green infrastructure, stream health	(250) 427-0260 aqua-tex@islandnet.com
Steve Muenz Manager Development Engineering, City of Kelowna	Hillside development	(250) 862-3339 ext. 477 smeunz@city.kelowna.bc.ca

Participants	Expertise	Contact Information
Adriane Pollard Manager Environmental Services, District of Saanich	Dark sky lighting, Green infrastructure	(250) 475-5494 , ext. 3556 pollarda@saanich.ca
Barry Smith (Retired) Senior Land Use Specialist, Ministry of Agriculture & Food	Working lands, agriculture/urban interface	(604) 853-6779 bsmith9@shaw.ca
Kim Stephens KSA Consultants/Coordinator Water Sustainability Committee/Water Balance Model	Rainwater management, Community design	(604) 922-4657 kimastephens@shaw.ca
Karen Thomas Land Agrologist, Ministry of Agriculture & Food	Working lands, agriculture/urban interface	(604) 556-3104 karen.thomas@gems2.gov.bc.ca
Joe van Belleghem Principal, Windmill Developments	Green buildings, Green infrastructure	(250) 592-6769 joevb@shaw.ca
John Volpe Associate Professor, University of Alberta	Fish & riparian health	(250) 480-1955 jvolpe@ualberta.ca

Invited Observers	Affiliation	Contact Information
Ron Bowman	Terasen & BC Public Works Association	ron.bowman@terasen.com
Bob Dolphin	Master Municipal Construction Document Association	ssu@telus.net
Ed von Euw	GVRD Policy & Planning Department	Ed.vonEuw@gvrd.bc.ca
Marian Kim	GVRD Policy & Planning Department	marian.kim@gvrd.bc.ca

Invited Observers	Affiliation	Contact Information
Don Moore	Wesbild Holdings	dmoore@wesbild.com
Ron Smith	Ministry of Sustainable Resource Management; & Water Sustainability Committee	ron.smith@gems6.gov.bc.ca
Ted vander Gulik	Ministry of Agriculture, Food & Fisheries; and Water Sustainability Committee	ted.vanderGulik@gems8.gov.bc.ca
Robyn Wark	City of Burnaby; & Water Sustainability Committee	robyn.wark@city.burnaby.bc.ca
Phil Wong	Environment Canada & BC Water & Waste Assoc.	phil.wong@ec.gc.ca
Pamela Zevit	Como Watershed Group	cwg@vcn.bc.ca

Interested Consultants	Affiliation	Contact Information
Lianna Mah	Associated Engineering	mahl@ae.ca
John van der Eerden	Associated Engineering	vandereerdenj@ae.ca
Robert Wridgway	Aplin & Martin Consultants	rwridyway@aplinmartin.com
Jim Dumont	McElhanney Consulting Services Ltd	
Colin Kristiansen	Delcan	c.kristiansen@delcan.com
Alan Newcombe	Earth Tech	alan.newcombe@earthtech.ca
Greg Scott	Earth Tech	greg.scott@earthtech.ca

APPENDIX D – AGENDA FOR GREEN INFRASTRUCTURE CONSULTATION, MAY 11, 2004

Location:	Room 1430, 515 West Hastings Street (Harbour Centre)
8:30-9:00 a.m.	Arrival & Welcome
9:00-9:15 a.m.	Introductions (Green Infrastructure Partnership) Overview (Deborah Curran)
9:15-10:30 a.m.	Five Minute Statement from Each Participant
10:30-10:45 a.m.	Break
10:45-12:30 p.m.	Discussion
12:30-1:30 p.m.	Lunch
1:30-3:30 p.m.	General Discussion (Participants & Observers) Introduction to Request for Proposals for Green Infrastructure Supplement (Neil Nyberg)

EXPECTATION OF PARTICIPANTS

Participants are asked to contribute in three ways:

- Relevant Documents and Materials – please bring to the Consultation a list of resources (and copies of the resources if you have extras) that you believe reflect the best development practices for green infrastructure. These include municipal plans, technical reports, and other studies. The comprehensive set of resources from the Consultation will alert the MMCD Technical Team to the standards and projects already in place.

- Five Minute Statement on Best Development Practices – please attend the Consultation prepared to make a brief statement (five minutes maximum) on what you believe are the key green infrastructure best practices used today in your area of expertise, and what are the key issues yet to be resolved.

- Discussion – please be prepared to discuss the topics with which you are familiar in the MMCD Draft Design Guidelines (see below).

SCOPE OF DISCUSSION

The scope of the discussion on May 11 will be limited to those infrastructure standards over which municipalities have regulatory control. As the Green Infrastructure Supplement will follow the MMCD Draft Design Guidelines closely, the discussion will focus on the topics dealt with in the Draft Design Guidelines and those topics that should be included in a Green Infrastructure Supplement. See Appendix D for the Table of Contents of the MMCD Draft Design Guidelines for Municipal Infrastructure, and see http://www.mmcd.net/admin/Draft-DesignGuidelines.pdf to review the MMCD Draft Design Guidelines for Municipal Infrastructure.

Appendix E outlines a number of green infrastructure issues that the Draft Design Guidelines raise. For ease of reference, the sections and order of issues in Appendix E reflect the structure of the Draft Design Guidelines. This scoping of issues is intended only to spur discussion and should not limit your analysis of the Draft Design Guidelines and what should be included in the Green Infrastructure Supplement.

APPENDIX E - TABLE OF CONTENTS FROM MMCD DRAFT DESIGN GUIDELINES FOR MUNICIPAL INFRASTRUCTURE

SECTION 7.0 - TRAFFIC SIGNALS

APPENDIX F - POTENTIAL ISSUES FOR DISCUSSION[1]

1. General Design Considerations

Incorporating the green infrastructure into municipal infrastructure design requires a systems-based and integrated approach to planning, zoning and infrastructure design. Municipal departments and even engineers with responsibility for different aspects of the municipal infrastructure have traditionally worked in isolation. Taking a systems approach to creating new neighbourhoods or retrofitting old ones is more complex than addressing infrastructure questions as discrete tasks.

Design issues include:

1.1 Sustainability and Asset Management (1.1) – are these principles in the MMCD Draft Design Guidelines detailed enough to assist users to screen design considerations? What would be a more effective way to spell out these principles and demonstrate in each section how they are considered? What is an appropriate statement about best management practices that could be included here? How can line-by-line Design Guidelines be transformed into a holistic prescription for continuing ecological functioning using integrated and multiple objectives?

1.2 Design Criteria – What are the overall criteria through which decisions about green infrastructure should be made?

1.3 Utility Rights-of-Way (1.3) – How can the Green Infrastructure Supplement resolve the conflicts between green infrastructure goals (trees and integrated rainwater management) and other spatial demands on the rights-of-way (utilities, conventional drainage, sanitary, fire access, etc.)?

2. Water Distribution

Smart growth and taking the green infrastructure into account require a demand management approach to the provision of water to ensure long-term ecological functioning in light of new growth.

Design issues include:

2.1 Metering (2.2) – What further details are required here to provide guidance to municipalities?

[1] The numbers in brackets reflect where this topic can be found in the MMCD Draft Design Guidelines.

2.2 Per Capita Demand & Minimum Pipe Diameter (2.3 & 2.9) – When high performance (green building) design is used for new neighbourhoods and buildings, how can the Design Guidelines take the lower demand for water and sewer infrastructure into account, recognizing that water infrastructure sizing is governed by fireflow protection requirements at the neighbourhood and subdivision scales?

3. Sanitary Sewers

Design issues include:

3.1 Per Capita Flows & Minimum Pipe Diameter (3.2 & 3.10) - When high performance (green building) design is used for new neighbourhoods and buildings, how can the Design Guidelines take into account the lower demand for water and sewer infrastructure, recognizing that sewer infrastructure sizing is governed by peaking factors?

4. Rainwater Drainage

A significant cost of the infrastructure for new development is to ensure that water drains away from buildings and roads. Covering over natural vegetation with hard surfaces means less water naturally infiltrates into the ground, creating more surface runoff that needs to be removed and delivered through conveyance systems comprising underground pipes and ditches to receiving watercourses. Rainwater runoff from developed areas flows to the receiving waters much faster and in greater volume than under natural conditions. This causes channel erosion, flooding, loss of aquatic habitat, and water quality degradation. As more development occurs, more municipal infrastructure must be built to deal with the increase in rainwater runoff.

Because of the liability, cost and problems associated with conventional detention and conveyance approaches to rainwater management, over the past decade municipalities and the provincial government have been developing an integrated rainwater management approach. The key to reducing risks to property damage, water quality and to aquatic habitat is to minimize the volume of runoff that is conveyed to streams. The concept is to preserve the water balance of a naturally vegetated watershed by controlling rainwater at its source – that is, where it falls onto the ground. This new approach of source control seeks to capture rainfall (on lots or within road rights-of-way) and return it to its natural hydrologic pathways by ensuring that it infiltrates into the soil or is returned to the atmosphere as evapotranspiration from landscaping. This reduces the volume of water and speed at which rainwater flows into watercourses.

Design issues include:

4.1 Overall Approach - The design, planning, installation and monitoring of drainage and other utilities and roads require a multi-disciplinary vision. No longer the realm of strict engineering or hydrology, aspects of aquatic and terrestrial ecology, geomorphology, groundwater management and other perspectives are becoming recognized as part of understanding the effects of land use decision making. How can this interdisciplinary perspective be incorporated into the Design Guidelines?

4.2 Natural Systems Approach – How can a 'natural systems approach' to rainwater management be integrated into the Design Guidelines to achieve low impact development objectives?

4.3 Three Scales – How can the Design Guidelines be structured to reflect the integration of practical strategies for rainwater management at three scales: site, subdivision (i.e. road rights-of-way) and neighbourhood (i.e. public green spaces).

4.4 Total versus Effective Imperviousness[2] – Should the Green Infrastructure Supplement address the difference between total and effective imperviousness, and suggest solutions to lowering total imperviousness? Or should the focus be on how to achieve performance targets for rainfall capture and runoff control?

4.5 Water Balance Model – How can the Design Guidelines most effectively reference and/or incorporate the web-based Water Balance Model tool that has been developed by an Inter-Governmental Partnership that has representation from all levels of government?[3]

4.6 Minor System Design (Flow Velocities 4.12.3) – Storm sewers should not discharge directly into a watercourse. What design guidelines are needed in this area?

4.7 Minor System Design (Service Connections 4.12.14) – Can roof drains discharge to rain barrels or cisterns for later reuse? To where do splash pads drain?

4.8 Major System Design (Watercourses 4.13.6) – To what extent are watercourses rainwater conduits or should the focus of rainwater management be on infiltrating water into the soil and detaining it?

[2] Total imperviousness is the amount of a watershed or site covered in hard surfaces. This includes driveways, parking lots and buildings. Effective imperviousness refers to the impact of those hard surfaces. For example, the effective imperviousness of a site can be less than the total imperviousness if water is directed from hard surfaces back into the ground. This can be accomplished, for example, by disconnecting rain leaders from the rainwater system and directing them into front yards and onto gravel splash pads, or constructing an infiltration trench for parking lot runoff.

[3] The Water Balance Model is a web-based interactive tool that replicates how impervious surfaces, absorbent landscaping, infiltration facilities, green roofs and rainwater harvesting affect water behaviour under different development circumstances. It assists local governments to monitor water balance volumes at the site level to determine how best to control flows at the source to minimize runoff volumes. The Model provides an interactive means for local governments to integrate land-use planning with rainwater management and evaluate the potential for developing communities that function hydrologically like naturally forested or vegetated systems. www.waterbalance.ca. Other useful tools include the Greater Vancouver Regional District Preliminary Design Guidelines.

4.9 Runoff Controls (4.14) – What is the link between ecological and hydrological impacts and how best can the Design Guidelines address this connection? Should the Design Guidelines set out vegetation retention requirements to reduce the amount of site control methods needed?

4.10 Soil Layer Thickness – Should the Design Guidelines provide guidance for maintaining a minimum soil layer depth in all landscaped and lawn areas on development sites?

5. Roads

The layout and design of streets shapes the culture of a neighbourhood, with road rights-of-way typically accounting for about 30% of a typical residential area. Streets affect mobility choices, safety in public places, and the quality of human interaction. They form the largest segment of public space in a community. The issue is how to design streets to increase the mobility of people and goods, the accessibility of transportation, and the quality of streetscapes. The best street standards create a pleasant streetscape where walking and cycling infrastructure is built in, and cars travel at safe speeds. Public amenities, such as sidewalks, transit shelters, and bike parking support the desired users. Parking is limited but other transportation modes are efficient and comfortable. It also means managing the demand for roads by prioritizing investment in infrastructure for non-automobile transportation.

Smart street design includes:

- A street and block pattern of an interconnected grid or web network that provides many routes for travel in the neighbourhood and disperses the impact of automobile traffic. Block lengths are between 90 and 240 metres (300 and 800 feet), with an average of 150 metres (500 feet). With rectangular-shaped parcels, a rear lane can provide rear garage access and eliminate curb cuts and driveways on the street;

- An hierarchy of streets within the interconnected network grid with right-of-way width, pavement width, number of lanes, sidewalks, landscaping, and design speed clearly described;

- Streetscape features such as sidewalks, street trees and other landscaping, lighting and crosswalks shown with clear graphics. Sidewalks should be at least 1.5 metres (5 feet) wide in residential areas and between 2.4 and 5 metres (8 to 16 feet) in mixed-use and commercial areas. Parkway strips of at least 2.4 metres (8 feet) buffer pedestrians from traffic and allow tree planting. Crosswalks should be provided mid-block if the blocks are longer than 215 metres (700 feet).

Design issues include:

5.1 Low Impact Development – What are the low impact development techniques that should be set out and integrated between the rainwater section above and this section, including permeability and width? Should roadways be designed to be 'self-mitigating' rather than simply collecting and concentrating runoff? What is the appropriate performance standard for storm drainage (i.e. 1 mm per hour infiltration)?

5.2 Landscaping – Should this section include tree canopy and landscaping coverage criteria to achieve multiple objectives such as rainwater management, heat attenuation, an habitat goals?

5.3 Road Cross Section Elements (Table 5.1) – revisit right-of-way width, curb types and parking. Are the roads too wide and do the curbs prevent a source control approach to rainwater management?

5.4 Intersections (5.5) – do the Design Guidelines limit block length to 150 metres and provide for sidewalk bulges and other tailored road treatments in appropriate areas?

5.5 Cul-de-sacs (5.7) – Are cul-de-sac's prohibited except for developments adjacent to working lands?

5.6 Sidewalks and Bikeways (5.8 & 5.9) – Is more detail needed to make these effective standards?

5.7 Driveways (5.10) – What are the driveway maximums for different types of development? Are different paving materials that promote water infiltration allowed?

5.8 Hillside Standards (5.14) – From recent experience, how can these standards be improved?

6. Roadway Lighting

The glare from streetlights makes stargazing difficult in urban areas and is a waste of light. The glare from some outdoor lights can also hamper visibility. Several jurisdictions, including Saanich and Tempe, Arizona, have adopted street lighting standards aimed at shielding the sky from light pollution, and directing the light downwards to where it will be most effectively used.

Design issues include:

6.1 Light Loss – What designs most effectively project light downwards to where it is needed and prevent loss to the sky?

6.2 Energy Efficiency – do the Design Guidelines suggest the most energy efficient lighting mechanisms?

7. Traffic Signals

Design issues include:

7.1 Signal Coordination (7.16) – What standard design considerations promote transit, bike and pedestrian priority of circulation?

8. Additional Sections

What other sections are required to reflect a comprehensive approach to sustainability and the green infrastructure? Suggestions include:

8.1 Landscaping Standards – These would include "Naturescape" and native plant land care principles.

8.2 Trail and Open Space Management – This reflects the principle that natural capital and ecosystems are as much a form of community infrastructure as are roads and light standards.

8.3 Cost Benefits (socio-environmental and financial) – should the design guidelines point to parameters for evaluating infrastructure decisions? Should they list resources that could assist municipalities with this decision-making?

8.4 Risk Management – does concerns about risk management for design that has a focus on sustainability go beyond traditional "life and property" concerns and include long-term ecosystem functioning? If so, how can this be incorporated into the Design Guidelines, particularly in the adaptive management approach?

8.5 Indicators and Monitoring – What types of monitoring should be built into infrastructure programs and design details that allow for an adaptive management approach?

8.6 Expedited Approvals – If a designer or project uses the Green Infrastructure Supplement should that project receive expedited environmental approvals?

8.7 Process – Does using the Green Infrastructure Supplement require a different type of project approvals process at the municipal and project level to most effectively implement the standards contained in the Supplement?