JAMES TAYLOR CHAIR
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Case Study:
Conventional Development Standards versus Green Infrastructure for Cumbria Woods
- *Two development standards compared*

I. Introduction

In discussions of alternative and sustainable design standards, there remain few comparisons of more sustainable versus conventional community design options. This technical bulletin provides a comparison of the street pattern, stormwater system, and the parks and open space of two different development standards proposed for the same 35-acre residential site: Cumbria Woods, located in the Village of Cumberland, Vancouver Island, BC. The first standard, which we term 'conventional,' uses the 'curb and gutter' approach to stormwater management typical of our region. The second and more sustainable standard is a 'green infrastructure' standard, which is comprised of an alternative development pattern and stormwater management system – including an interconnected street, park, and open space network – that captures and infiltrates stormwater on site. The bulletin concludes with a cost analysis that compares stormwater infrastructure for 1-hectare study sites as determined by these two different development standards.

II. Cumbria Woods – 'Conventional' Development Pattern and Standards

Street pattern

In our first scenario (Figure 12-1), conventional development standards have been applied to the 35-acre residential site of Cumbria Woods. The streets of this pattern resemble the disintegrated dendritic hierarchy of typical suburban landscapes. There is a single street south of the site that provides connectivity between the Village and the new residential development. Local streets and paved lanes branch off from this single 'collector' street. (Unlike most other conventional developments, this development standard does have some lots serviced by rear lanes.) The development standards for this status quo pattern call for paved streets (without sidewalks or street trees) with widths from 10.0 – 33.0 metres, and paved lanes with widths of 6.0 metres.

Figure 12-1
Plan view of conventional, status quo development pattern for . Cumbria Woods.

Stormwater Infrastructure

Stormwater is handled in a sub-surface piped system. Curbs and gutters capture and channel stormwater runoff to pipes below the street. Roof runoff from each parcel is directed to the stormwater system via tie-ins from the homes on each lot. All the stormwater runoff from the site is directed through a series of pipes until it eventually reaches a single large outfall on a stream channel offsite.

Parks and Open Space

The required 7.35 acre environmental buffer on the northeast side of the site is retained. Public access onto this site is available through two 3-metre wide pedestrian private, fenced backyards line the edge of this open space zone. In addition to the private backyards, exists along the eastern edge of the site. A total of 2.60-acres has

been designated as park space. A 1.70 acre park lies north central to the site and is accessed via a public entrance off the street and two 3-metre wide pedestrian pathways. This park space is not accessible via public sidewalks or pathways to the rest of the Village. A second 0.90-acre park lies at the southeast corner of the site, adjacent to two existing public right-of-ways, and is accessed from within the site via a back lane. Neither park space nor open space plays a role in stormwater management.

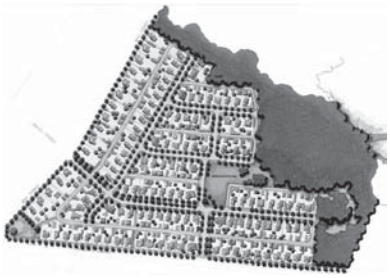

Figure 12-2
Plan view of 'green infrastructure' development pattern for Cumbria Woods.

III. Cumbria Woods – 'Green Infrastructure' Development Pattern and Standards

Street pattern

A second scenario (Figure 12-1), offers alternative development standards for the 35-acre Cumbria Woods site. The alternative pattern is comprised of an integrated street network that closely resembles the original street pattern of the Village of Cumberland developed prior to the Second World War. Small set backs place homes closer to the street; front doors are visible from the sidewalk. Car access and storage is handled at the back of each lot via gravel lanes. The streets of Cumbria Woods' alternative pattern have sidewalks on both sides, gravel parking verges, and are lined with appropriate street tree species to meet urban forestry and stormwater management objectives (see *Technical Bulletin No. 6: the Hydrological Effects of Urban Forests, with reference to the Pacific Northwest www.sustainable-communities.agsci.ubc.ca/bulletbody.html*). The paved travel lane width varies from 5.5 – 6.0 metres.

Stormwater Infrastructure

Stormwater from the site is handled through a naturalized, surface drainage system. Gravel roadside verges and rear lanes capture and infiltrate street and roof water runoff lot by lot, block by block. During heavy storm events, overflow is directed through the roadside swales to the environmental buffer/open space and central neighbourhood park where water is detained and slowly released back into the soil through infiltration basins.

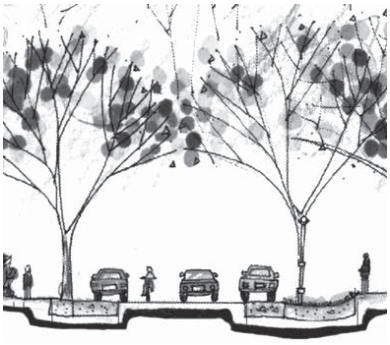

Figure 12-3
Typical street section for the Cumbria Woods 'green infrastructure' pattern. The streets in the alternative pattern feature a narrow paved travel lane with pervious gravel shoulders, grass swales, street trees, and pedestrian paths.

Parks and Open Space

In the green infrastructure pattern, the required 7.35-acre environmental buffer is an important part of an integrated park and open space system. In addition to the environmental buffer, the pattern offers 3.30 acres of park space – a central neighbourhood park that is seamlessly attached to the larger open space; a 0.29-acre park north of the site that again extends from the larger open space; and, a 0.40-acre park at the southwest corner of the site.

The parks and open space are designed as an integrated network. Public sidewalks, pedestrian paths, and park trails provide residents from within Cumbria Woods, as well as the rest of the Village of Cumberland, with pedestrian access to the lagoon trail and other greenway systems beyond the site. They also provide an important detention and infiltration function for the naturalized stormwater system – and in so doing, help to protect streams and ground water quality and quantity both on and off the site. Alongside 'pedestrian friendly' green streets, the parks and open space systems are key social and green infrastructure elements of this alternative development pattern.

Table 12-1: Cost Comparison of Coventional versus Green Infrastructure Pattern

Study Site Characteristics		**Green Infrastructure**	**Conventional**
study site area[1]	hectares	1.14	0.96
	acres	2.81	2.38
	sq m	11356.53	9625.00
total lots		14	13
total dwelling units[2]		19	14
parking[3]	stalls per unit	1	2
	Total stalls	19	28
gross density	du/ha	17	15
	du/acres	7	6
lot coverage	net	0.37	0.31
total pavement[4]	sq m	1837.98	2982.00
	sq m/du	96.74	213.00
	sq ft/du	1040.88	2291.88
	% of study site	16.18	30.98
Infrastructure Cost Estimates for Study Site:			
asphalt paving		$27,569.70	$44,730.00
sub-base gravel		$11,679.66	$13,419.00
base gravel		$10,381.92	$11,928.00
curb and gutter		n/a	$35,555.00
storm sewer & catch basins		n/a	$98,460.00
excavation, cut & fill		$22,393.60	$21,880.00
Swale		$15,175.65	n/a
Sidewalk		$31,297.70	n/a
sanitary sewer and services		$18,937.50	$18,750.00
Watermain & services		$69,374.40	$64,640.00
utility services and street lighting		$60,702.60	$56,560.00
street trees[5]		$15,000.00	n/a
Total Infrastructure Costs	study site	**$282,512.73**	**$365,922.00**
	per hectare	**$247,818.18**	**$381,168.75**
	per unit	**$14,869.09**	**$26,137.29**
	per lot	**$20,179.48**	**$28,147.85**
Infrastructure Cost Estimates for Entire Site[6]		**$2,452,417.36**	**$3,747,915.54**
Total Cost Difference for entire site			***$1,295,498.18***
Approximate Savings per lot using Green Infrastructure			***$7,968.37***
Approximate Savings per unit using Green Infrastructure			***$11,268.19***

[1] To evaluate infrastructure costs, a comparable 'one block' study site of approximately 1 hectare was selected for each development pattern. Each study site consists of single family and duplex lots, and public right-of-ways typical to the development pattern.

[2] The green infrastructure pattern study site includes 19 units: 12 single family units; 4 duplex units; and 3 accessory apartments. Accessory apartments are an integral part of the green infrastructure pattern and are estimated at 1 accessory unit for every 4 single family units. The conventional pattern study site includes 14 units: 12 single family units and 2 duplex units. Accessory apartments are not a part of the conventional pattern.

[3] The alternative pattern accommodates on-street parking in the form of permeable gravel roadside verges for residents and guests. Guest parking in the conventional pattern is provided at asphalt-paved parking bays at the end of blocks.

[4] For the green infrastructure pattern, total pavement includes sidewalks and paved vehicular travel lane. The conventional pattern does not require sidewalks on local streets; thus, total pavement includes vehicular travel lane only.

[5] Street trees are an important component of the green infrastructure pattern. Street trees are generally not found along local roads of the conventional pattern.

[6] The cost estimate for the entire site assumes the 1 hectare study site (the typical single family, duplex lot, and right of way pattern) is replicated across the entire developable area of 9.85 hectares. (This developable area excludes the designated open and park space of 4.31hectares of each development pattern.)

IV. Conclusion

Infrastructure costs for the entire site using the green infrastructure pattern are 35% less than the costs involved in the status quo pattern – resulting in a savings of nearly $8,000 per lot. In addition to reduced infrastructure costs, which encourage more affordable dwelling units, this alternative pattern provides for integrated park and open space; increased recreational and social amenities; improved stormwater management; and protected water quality. Ultimately, the Cumbria Woods green infrastructure pattern offers an economically viable, and socially and ecologically rich approach to residential development for the Village of Cumberland.

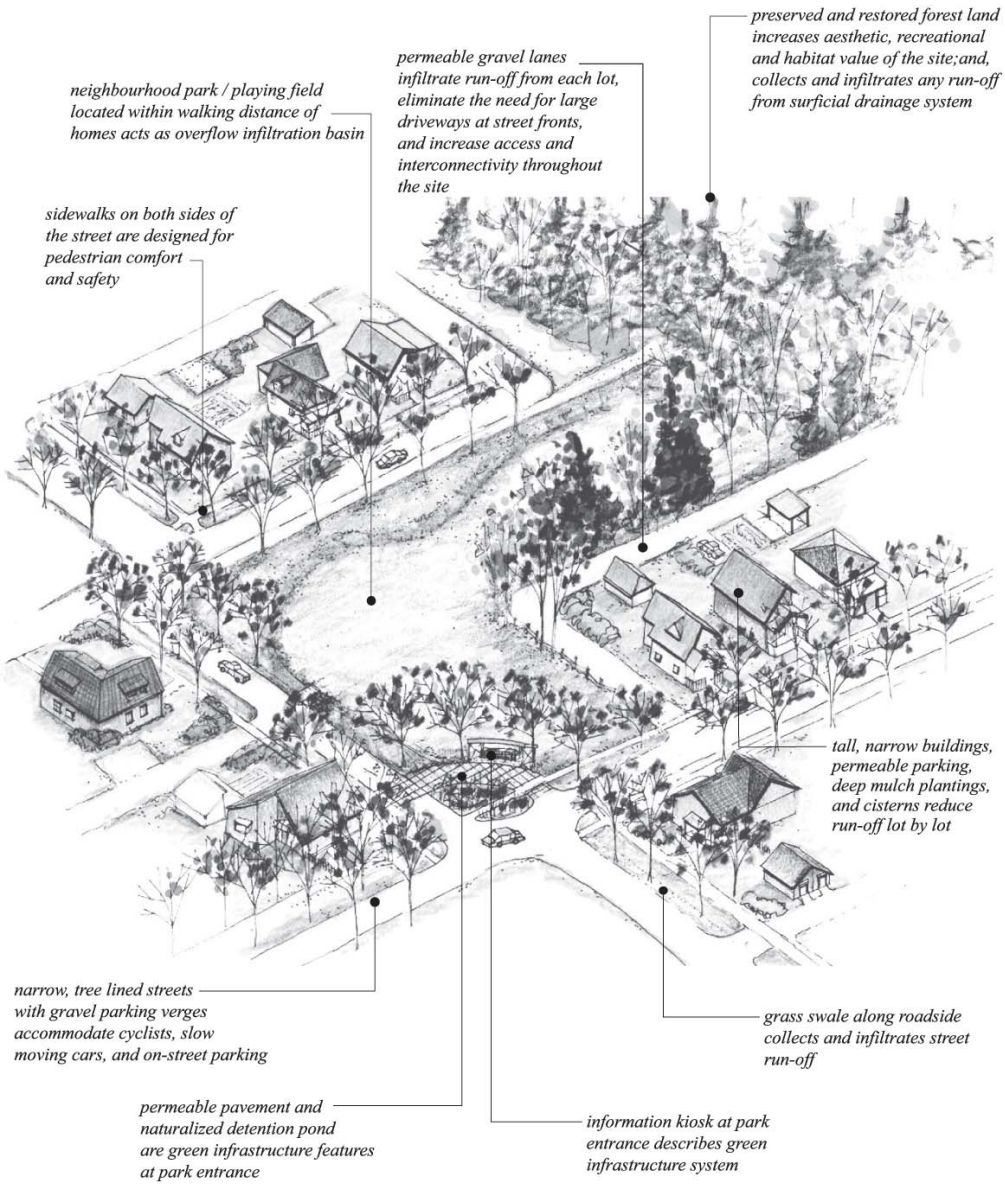

Figure 12-4
Central neighbourhood green and other important site characteristics of the Cumbria Woods 'green infrasructure' pattern

Contact Us:
JAMES TAYLOR CHAIR
IN LANDSCAPE & LIVEABLE ENVIRONMENTS

University of British Columbia
Landscape Architecture Program
2357 Main Mall
Vancouver, BC
V6T 1Z2

For more information please visit our site:
www. sustainable-communities.agsci.ubc.ca

or email us at:
jtchair@interchange.ubc.ca

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