RESEARCH HIGHLIGHTS

Socio-Economic Series Issue 26

INFRASTRUCTURE COSTS ASSOCIATED WITH CONVENTIONAL AND ALTERNATIVE DEVELOPMENT PATTERNS

Introduction

This study was completed by Canada Mortgage and Housing Corporation (CMHC), in partnership with the Regional Municipality of Ottawa-Carleton (RMOC). Its purpose was to compare the cost-effectiveness of two patterns of development: (i) a conventional suburban development pattern, and (ii) a mixed use, more compact development, planned according to the principles of "New Urbanism." The analysis considers the long-term life-cycle costs of various linear infrastructure and community services, and differentiates between public and private (i.e., developer) costs.

An existing development in Ottawa-Carleton was chosen as the test site. The site exhibits all of the characteristics of a conventional post-war suburban development pattern, including a curvilinear street pattern, relatively low residential densities, homogeneity and separation of land uses, and an emphasis on the private automobile over other modes of travel. Typical planning standards in the conventional site include 20 m local right-of-way widths, single family lot frontages of 10.7 m to 15.2 m, lot depths of 30 m to 34 m, frontyard setbacks of 6.0 m, and rear-yard setbacks of 7.0 m to 9.0 m.

An alternative development, planned according to the principles of New Urbanism, was overlaid onto the existing site, and the life-cycle infrastructure costs of the two plans, including emplacement, replacement, and operating and maintenance costs, were calculated and compared.

The more compact New Urbanism plan features a finer mix of land uses, higher residential densities, narrower right-of-way and pavement widths, a modified grid system of streets, transit supportive design, and so on. The plan is organized around a series of individual neighbourhoods, each defined by a 400 m radius (a five-minute walk) from edge to centre. Each neighbourhood has a central green, or neighbourhood park, surrounded by a mix of land uses, including commercial, office and higher density housing.

There are some significant differences between the two plans:

- The alternative plan has more than twice as much land devoted to commercial uses, and 20 per cent more recreation and open space lands.
- The alternative plan contains 71 per cent more dwelling units than the conventional plan, due, in part, to significantly smaller lot sizes.
- There are over 500 more apartments in the alternative plan, centred around the neighbourhood squares, and mixed in with commercial, retail and office uses along the main street.

CMHC SCHL

HOME TO CANADIANS

Canada

- Net residential densities for the conventional and alternative plans are 21.7 and 43.3 units per hectare respectively.
- The alternative plan has a 16 per cent greater length of roads (not including the rear lanes), and almost 15 per cent more asphalt road surface area (not including the rear lanes).

Some Key Findings

Emplacement Costs

Table 1 illustrates that the initial capital cost of emplacing the infrastructure is approximately $5,300 per unit less in the alternative plan. In other words, it is 16 per cent cheaper per unit to construct the infrastructure in the alternative plan than in the conventional plan. This includes both public and private costs.

While the linear cost of constructing local roads is slightly less expensive in the alternative plan ($505/metre) than in the conventional plan ($518/metre), due to a 0.5 metre reduction in pavement width, in absolute terms, it is still more expensive to construct the road network in the alternative plan because, compared to the conventional plan's curvilinear street pattern, the grid pattern of streets produces more length of roads, more intersections, and so on. On a per unit basis, however, there is a net savings of approximately $2,000 for road construction in the alternative plan for two reasons: (i) the increase in residential density in the alternative plan spreads the cost of roads over more dwelling units; and (ii) the higher proportion of non-residential land uses (7.5 per cent more) in the alternative plan lowers the percentage of total road costs apportioned to the residential sector. Significant cost savings in the areas of storm and sanitary sewers, water distribution, and other services which parallel the road network arise for the same reasons.

Table 1
Comparison of Per Unit Emplacement Costs ($)

	Service Component	Conventional Site	Alternative Plan	Difference	%
1.	Roads (inc. utilities & service connections)	5,272	3,311	-1,961	-37
2.	Sidewalks & Streetlighting	498	636	+138	+28
3.	Sanitary Sewer	1,885	1,191	-694	-37
4.	Stormwater Management	3,491	2,210	-1,281	-37
5.	Water Distribution	1,758	1,258	-500	-28
6.	Transit	1,059	881	-178	-17
7.	Fire Protection	348	301	-47	-14
8.	Police Protection	362	313	-49	-14
9.	Parkland	3,591	3,368	-223	-6.2
10.	Recreational Facilities	3,335	3,183	-152	-4.6
11.	Libraries	522	489	-33	-6.3
12.	Works & Parks Department	417	358	-59	-14
13.	Garbage Collection	0	0	0	0
14.	Hydro-Electric Services	1,992	1,731	-261	-13
15.	School Facilities/Transportation	10,034	10,033	-1	0
	Total	**$34,564**	**$29,263**	**$-5,301**	**-16**

Table 2
Comparison of Per Unit Total Life-Cycle Costs ($)

	Service Component	Conventional Site	Alternative Plan	Difference	%
1.	Roads (inc. utilities & service connections)	10,446	7,392	-3,054	-29
2.	Sidewalks & Streetlighting	936	1,225	+289	+31
3.	Sanitary Sewer	2,652	1,677	-975	-37
4.	Stormwater Management	4,105	2,606	-1,499	-37
5.	Water Distribution	3,534	2,446	-1,088	-31
6.	Transit	9,104	7,774	-1,330	-15
7.	Fire Protection	5,204	4,496	-708	-14
8.	Police Protection	7,466	6,450	-1,016	-14
9.	Parkland	4,735	4,325	-410	-8.7
10.	Recreational Facilities	7,794	7,434	-360	-4.6
11.	Libraries	2,934	2,752	-182	-6.2
12.	Works & Parks Department	772	663	-109	-14
13.	Garbage Collection	2,453	2,301	-152	-6.2
14.	Hydro-Electric Services	6,270	5,893	-377	-6.0
15.	School Facilities/Transportation	56,804	56,799	-5	0
	Total	**$125,209**	**$114,233**	**$-10,977**	**-8.8**

Infrastructure replacement, and operating and maintenance costs were also found to be more economical in the alternative plan. As Table 2 illustrates, the alternative plan generates life-cycle savings of approximately $11,000 per unit over a 75-year period. Expressed as a percentage, the linear infrastructure, including roads, utilities, sewer, water, and stormwater management, represents the greatest per unit cost savings.

Other salient findings include:

- A reduction in infrastructure emplacement costs of approximately $5,300 per unit represents the largest life-cycle cost savings in the alternative plan. Developer-emplaced infrastructure (roads, street lights, piped services and parks) accounts for roughly 60 per cent of these savings (over $3,000 per unit). Government-emplaced infrastructure accounts for approximately 40 per cent of the savings (over $2,200 per unit). Emplacement cost savings represent an opportunity to reduce housing costs by approximately $5,000 per unit, assuming the savings are passed on to the consumer.
- Operating and maintenance costs are over $3,700 per unit less in the alternative plan, all of which are public savings. Infrastructure replacement is just over $2,000 per unit less in the alternative plan (also public savings).
- Over 70 per cent ($8,000) of the per unit life-cycle cost savings are public savings; approximately 30 per cent ($3,000) are private savings.
- Ranking the per unit life-cycle cost savings by service component, the largest life-cycle cost savings in the alternative plan are as follows: roads ($3,054); followed by stormwater management ($1,499); transit ($1,330); water ($1,088); policing ($1,016); and sanitary sewers ($975).
- Schools and school transportation (i.e., busing) represent approximately one-half of the total life-cycle costs in both plans. Of this school cost, approximately 60 per cent is associated with transportation (i.e., buying, maintaining and replacing buses). Schools and school buses account for approximately one-third of total

infrastructure emplacement costs, and between 57-60 per cent of total operating and maintenance costs in both plans.

- Emplacement, replacement, operating and maintenance costs, as a proportion of total life-cycle costs, remain relatively constant in both plans, at approximately 26 per cent, 7 per cent, and 65-68 per cent, respectively.
- Life-cycle savings of approximately $11,000 per unit generates approximately $77 million in savings when spread over a community of 7,000 dwellings. Over a 75-year period, this translates to annual savings of over $1 million for the alternative plan.

CMHC Project Manager: David D'Amour

Research Reports: *Conventional and Alternative Development Patterns Phase 1: Infrastructure Costs*

Research Consultants: Essiambre-Phillips-Desjardins Associates Ltd.

A full report on this project is available from the Canadian Housing Information Centre at the address below.

Housing Research at CMHC

Under Part IX of the *National Housing Act*, the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

This fact sheet is one of a series intended to inform you of the nature and scope of CMHC's research.

This **Research Highlights** fact sheet is one of a wide variety of housing-related publications produced by CMHC.

For a complete list of **Research Highlights**, or for more information on CMHC housing research and information, please contact:

The Canadian Housing Information Centre
Canada Mortgage and Housing Corporation
700 Montreal Road
Ottawa, ON K1A 0P7

Telephone: 1 800 668-2642
FAX: 1 800 245-9274

OUR WEB SITE ADDRESS: www.cmhc-schl.gc.ca/Research