THE SPATIAL DEVELOPMENT OF BUDAPEST

by Alain Bertaud

This note summarized the work done during my stay in Budapest from January 18 to January 28, 1999

SUMMARY

OBJECTIVES

The primary objective of this note is to propose a methodology based on spatial indicators to monitor the spatial development of Budapest. The spatial indicators are linked to the development objectives contained in the report "Budapest City Development Concept" 1.

The secondary objective is to use the proposed indicators to conduct a preliminary analysis of the current structure of Budapest and to anticipate the spatial impact of the new zoning regulations on future development.

METHODOLOGY

The methodology used to prepare this note is described here after:

- Summary of the main spatial objectives – explicit or implicit – contained in the report "Budapest City Development Concept". These objectives will be called here after "Municipal Objectives".

- Selection of spatial indicators to describe the current spatial structure of Budapest and to compare it to other European cities. Does the spatial structure of Budapest provides an advantage or disadvantage to this city as compared to other European cities?

- Comparison of the current city's structure with the one implied by the Municipal Objectives. Quantitative evaluation of the structural changes that will have to take place in order to meet the objectives.

- Definition of the spatial envelope implied by the new proposed zoning regulations and comparison with the structure implied by the objectives.

- Definition of a simple spatial model linked to indicators to test various alternative spatial forms linked to indicators.

Because of the absence of data on real estate prices and on the spatial trends of current market demand (normally obtained by analyzing the location of recent building permits), an important

[1] "Budapest Városfejlesztési Koncepciója Osszefoglaló, Budapest City Development Concept" by Metropolitan Research Ltd, September 1998.

operational aspect of the methodology described in this note is missing. It is hoped that the essential data concerning real estate prices and the location of recent building permit requests will soon be made available to the Chief Architect's Bureau of Budapest.

ABSTRACT OF CONCLUSIONS AND RECOMMENDATIONS

The spatial development objectives and strategy described in the report "Budapest City Development Concept" could be summarized as follows:

- To maintain a high level of economic activity and resident population in the city core;
- To encourage the use of public transport, implicitly maintaining the monocentric shape of the current city;
- To recycle underutilized land within the immediate periphery of the urban core
- To protect green areas and the banks of the Danube (implying that most development should occur by recycling the current built-up area without encroaching on green areas)

"Budapest City Development Concept" report contains a number of projections for the year 2015, which can be summarized as follows:

- The population within the municipal boundaries will not increase, but the population immediately outside the municipal boundary is likely to increase.
- The core historical area will loose some population due to an increase in average floor space consumption (from a current 25 m2 per person to 32 m2) and a decrease in household size (from a current 2.4 person per household to 2.0). This projection implies an increase in the residential floor space within Budapest municipal boundary of about 23 million of square meters or about an increase of 28% of the current gross residential floor space.

To maintain the population constant within the municipal boundary while the household size drops and the floor consumption per person increases will require either a large increase in the intensity of use of existing residential area, or a significant increase in the residential areas at the expense of non residential areas, or preferably a combined increase in density and residential area. The questions to be answered are: where is this increase in the supply of residential floor space likely to take place? What is the present trend? Do regulations and infrastructure allow this increase to take place in areas whose location is consistent with municipal development objectives?

The current city structure is strongly monocentric. The high-density core of Budapest includes about 500,000 people or 26% of the city's population. The current mix of residences, business, and retail is similar to the type of land use encountered in the city core of Western European cities such as Paris or Berlin. This type of mixed land use, if it could be maintained, will ensure that the monocentric model implicitly recommended in the "Development Concept" is viable in the long term.

The absence of land markets in Budapest recent history has left its mark in the areas at the immediate periphery of the historical core. The density drops suddenly at a suburban level at only 4 kilometers from the center of the Central Business District (CBD). This density drop is caused by the large areas of non-residential use and by the low density of part of the housing stock located in this area. Farther than 8 kilometers from the CBD, the density level (from 50 to 25 p/ha) is consistent with the type of suburban densities encountered in market economies. To simplify, I will call "low density ring"

the area to the East of the Danube that is within a ring between 4 and 8 kilometer from the Central Business District (CBD). The area on the West bank of the Danube seems to have followed approximately the patterns of density expected in a market economy.

Because of the proximity of the CBD, the potential land value in the "low density ring" is probably quite high while the current occupation (industries and other low intensity use) is more compatible with low land value. The discrepancy between high potential land prices and low current intensity of use should provide opportunities for real estate investments with very high economic rate of return. The subsequent densification of this area would support the Municipal spatial objectives. Market forces would by themselves tend to densify the "low density ring" providing no legal impediment exists to do so and infrastructure is available to support increased density.

The municipality has recently approved a new zoning plan. The zoning plan is consistent with the development objectives and is "market friendly" in the sense that it allows in most part of the city a significant increase in floor area ratio above the current level. The current zoning plan, as designed, will allow the redevelopment by market forces of areas where demand exists and where the land is currently underdeveloped.

However, to be fully consistent with the development objectives, the zoning plan should allow more land conversions from current industrial use or from other uses into mixed used residential within the "low density belt". Mixed used development corridors linking the city core to the residential areas to the North, East and South East of the city should be allowed by the zoning. The Municipality might be required to make significant investment in primary infrastructure to permit the redevelopment of these corridors. Knowing current real estate market prices in or adjacent to this area would allow the municipality to calculate the impact fee it could charge developers to recover the costs of primary infrastructure investments.

The objective of the land conversion and redevelopment mentioned above is to increase the supply of land immediately adjacent to the city core. In the absence of coordination between infrastructure investments and the zoning regulations described above, it can be feared that a number of new commercial and residential developments will occur in the far eastern suburbs or even just outside the municipal boundary. The spatial dispersion of the urban population resulting from this development scenario will reduce the usefulness of the current public transport network and will make the private car the only viable transport alternative. The spatial consequences of this undesirable scenario are explored in the final section of this report.

The Municipality's urban planning department should routinely monitor a number of spatial parameters to ensure that the regulatory and investment tools, which have to be put in place to implement the city development concept, are working effectively. It is particularly important to monitor the spatial distribution of building permits and of real estate prices. A simple model is proposed in the last section of this note to illustrate and provide a quantitative dimension to the spatial strategy described in the concept. The next census, which will take place in the year 2000, will allow developing time series to measure the spatial development trends of Budapest.

SPATIAL ANALYSIS OF BUDAPEST POPULATION DISTRIBUTION

This note is based on the following reports and data made available by the Chief Architect's Bureau during my stay in Budapest:

- Report on "Budapest City Development Concept"
- Census data and census tract map in digital form
- Digital map of planned land use with range of regulated plot ratio and floor area ratio.

Unfortunately, a number of important data were not available at the time of my visit. This included a map of current land use, current real estate prices and, geographic distribution of building permits. Real estate data are difficult to find in Budapest and are not normally made available to the Planning Department. Building permits are processed by each District's administration and are apparently difficult to collect at the municipal level.

It is difficult to influence the spatial development of a city without knowing in which direction the market is pushing. Regulations are supposed to modify the outcome brought by free markets. In the absence of data on markets trends, it is therefore somewhat difficult to assess how effective is the regulatory framework in reaching the Municipality's spatial objectives. As the methodology used in this report would be incomplete without data on real estate prices and on market spatial trends, I have included a section on this topic but left blank the corresponding tables and maps. These table and maps and relevant analysis should be completed at a latter date. I have indicated also the type of maps and graph which should be included when the data are made available to complete the spatial analysis of Budapest.

A. OBJECTIVES OF SPATIAL INDICATORS

The spatial aspect of urban development has an important impact on economic efficiency and on the quality of the urban environment. However, the evolution of urban form, shaped by the complex interaction between market forces, public investment and regulations, is not often monitored. Consequently, the significant inefficiencies due to poor spatial structures are often ignored until it is too late to do anything about them. Municipal urban planning department should use spatial indicators to regularly monitor urban development and to propose regulatory or public investment action when necessary.

From an economic point of view, a city is a large labor and consumer market; the larger the size of the market and the lower the costs of transactions, the more prosperous is the economy. A deficient spatial structure fragments labor and consumer markets into smaller less efficient markets; it contributes also to higher transactions costs by unnecessarily increasing distances between people and places. A deficient spatial structure increases the length of the city infrastructure network and therefore increases its capital and operating costs. A deficient spatial structure can render a city economically uncompetitive.

From an environmental point of view, a deficient spatial structure decreases the quality of life by increasing the time spent on transport, by increasing pollution, and contributing to the unnecessary expansion of urbanized areas in natural sites. A poor environmental quality could also contribute to render a city economically uncompetitive.

A city's spatial structure is constantly evolving. Because of a lack of political consensus or a clear vision on spatial development, the combined effect of land use regulations and infrastructure investments may be inconsistent and contradict each other. It is therefore important that municipalities monitor the spatial trends of development and take regulatory remedial action if this trend contradicts municipal objectives.

In markets economies, municipalities can influence the shape of urban development, not through direct design, but by implementing a coherent and consistent system of land use regulations, infrastructure investments, and land related taxes. However, in the long run, the shape of a city will depend on the way the real estate market reacts to the incentives and disincentives created by these regulations, infrastructure investments and taxes. Because external economic conditions are continuously changing and are unpredictable in the long term, the planning department of municipalities should constantly monitor the evolution the urban spatial structure, and adjust eventually the balance and nature of regulatory incentives and disincentives.

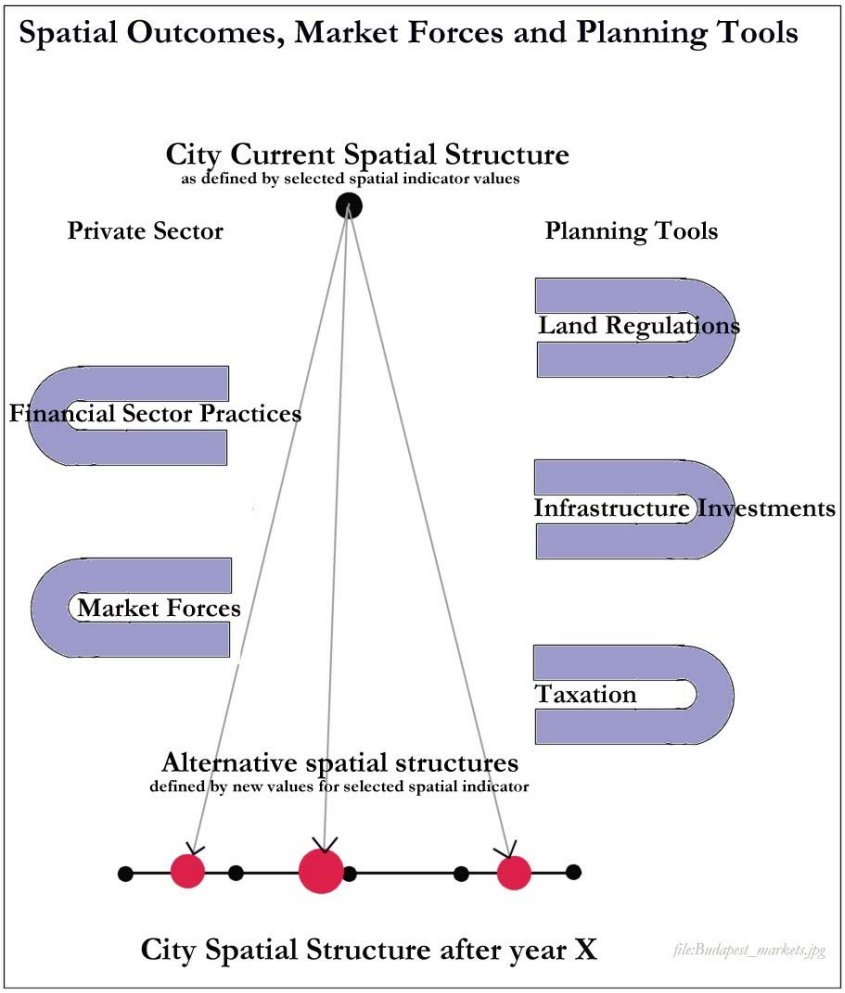

Figure 1:Alternative city structures

The diagram shown on Figure 1 illustrates the way market forces interact with the regulations, public infrastructure investments, and taxes to modify the current urban structure. Alternative urban

spatial structures can be obtained in the medium term, not through direct design, but by a clear understanding of the market incentives and disincentives created by the planning tools.

Municipalities could use the spatial development indicators presented below to monitor urban development and to adjust its regulatory policy and investment program to obtain the type of spatial development that best reflects spatial objectives. The examples given below are not comprehensive, alternative or additional indicators could be developed depending on objectives.

B. INDICATORS SHOWING THE CURRENT SPATIAL STRUCTURE

The values of the indicators are calculated for a territory limited by the current municipal boundary (508 km^2). The indicators would be more realistic if they were calculated on the basis of a metropolitan area including all settlements within a 30 km radius of Budapest's CBD (selected at the crossing of Karoly Krt. and Kiraly U.). Budapest's CBD is not at the center of the municipal area but very much to the West. The current municipal boundary range from 7 km to 21 km from the CBD. This dissymmetry creates an issue over development control (and taxes) for areas that might be as close as 7 km from the city's center but outside Municipal boundaries.

Explicit and Implict Projections contained in "Budapest City Development Concept"

Year		1990	2015
Built-up Area	km2	309	309
Population	p	1,937,154	1,937,154
Average buitl-up density	p/ha	63	63
Household size	p	2.40	2.00
Number of households	hh	807,148	968,577
Average net floor area/person	m2	25.00	32.00
Average floor area/household	m2	60.00	64.00
Total net floor area \[1]	Km2	48.43	61.99
Ratio net/gross floor area	%	60%	60%
Total gross residential floor area	km2	81	103
Increase in gross residential floor area	km2		23
% increase in gross residential floor area	%		28%
Total residential land area	km2	169	169
Average net residential density	p/ha	115	115
Average FAR		0.48	0.61

1. The net floor area is the floor area directly usable by a households like rooms, internal corridors, bathrooms and kitchens; this is the floor area used to calculate the floor area per person. The gross floor area is usually used to calculate the floor area ratio and includes staircase, corridors and all common spaces, including occasional ground floor commercial area and garages.

Buda_dens2.xls table 1]

Table 1 :Projections from "Budapest City Development Concept"

Population increase/ decreases: According to the 1990 census, the population within the municipal boundary of Budapest was 1.94 million. It is estimated ("development concept" p22) that in 2015 the population within the municipal boundaries will range between 1.94 million and 1.62 million while the metropolitan population would increases outside the current municipal boundaries. However, the number of households will grow as households' size is projected to decrease (p 22 of "development

concept") from 2.4 to 2.0. In addition, households are projected to increase their current consumption of floor space from 25 m2 per person to 32 m2. If we select the first demographic hypothesis of the concept and assume that the population of Budapest will stay constant within municipal boundaries, this means that the current area of residential floor space will have to increase by 28% or 23 km2). If the built-up area within municipal boundaries does not increases, as recommended in the concept, then these 23 km2 will have to be obtained through densification of the existing areas and/or conversion of land from non residential use into residential use. If these projections are roughly correct, then the implementation of the spatial objectives requires answering two important questions: (i) where are the 23 km2 of additional residential floor space likely to be located? And, (ii) what are the regulations and infrastructure investments that will allow this floor space to be built in a location consistent with the overall objective of the "concept"?

Total built-up area: the built-up area is evaluated at 309 km², or about 63 % of the land within the municipal boundary. As calculated in this report, the total built up area includes all settlements within the municipal boundaries, industrial and transport zones and road area within these settlements. It does not includes airports, large parks (more than 4 ha) green belts, agricultural areas, large unbuilt areas and large body of water. Because the population is not projected to increase and because one of the objectives is the reconversion of underused industrial and railway areas, the total built up area should stay constant in the future. The projected increase in floor area due to an increase in demand for services and an increase in the consumption of residential floor space per person should be absorbed by the reconversion of underused land at a higher floor area ratio.

Average Density. The average density within the built-up area of Budapest (based on the 1990 census) is equal to 63 persons per hectare, or equivalent to an average land consumption of 159 meters per person. This average density is within the normal range for Western European cities. However, it hides the fact that the land use categories are differently distributed within the average consumption figures. For instance, only 7.7% of the built-up area of Paris is under industrial use as compared to 33.8% in Moscow. The current area under industrial use in Budapest has not been made available, but it is suspected to be much higher than the maximum of 10% encountered in market economies. Because of the reconversion of underused land, the average density should not change over the years, in spite of the increase in floor consumption per capita. Figure 2 shows that the average density of Budapest (and Cracow) is closer to the one encountered in western European cities than the ones found in formerly socialist cities. This relatively low average density is the result of the difference in housing policy in Hungary (and to a lesser extent in Poland) under socialism as compared to the policy followed in the cities of the former Soviet Union. Hungary retained a large amount of low rise, more demand driven housing than the high rise panel flats prevalent in other socialist countries. Consequently, the current spatial structure of Budapest is more compatible with a market economy than is the case in other cities in reforming economies.

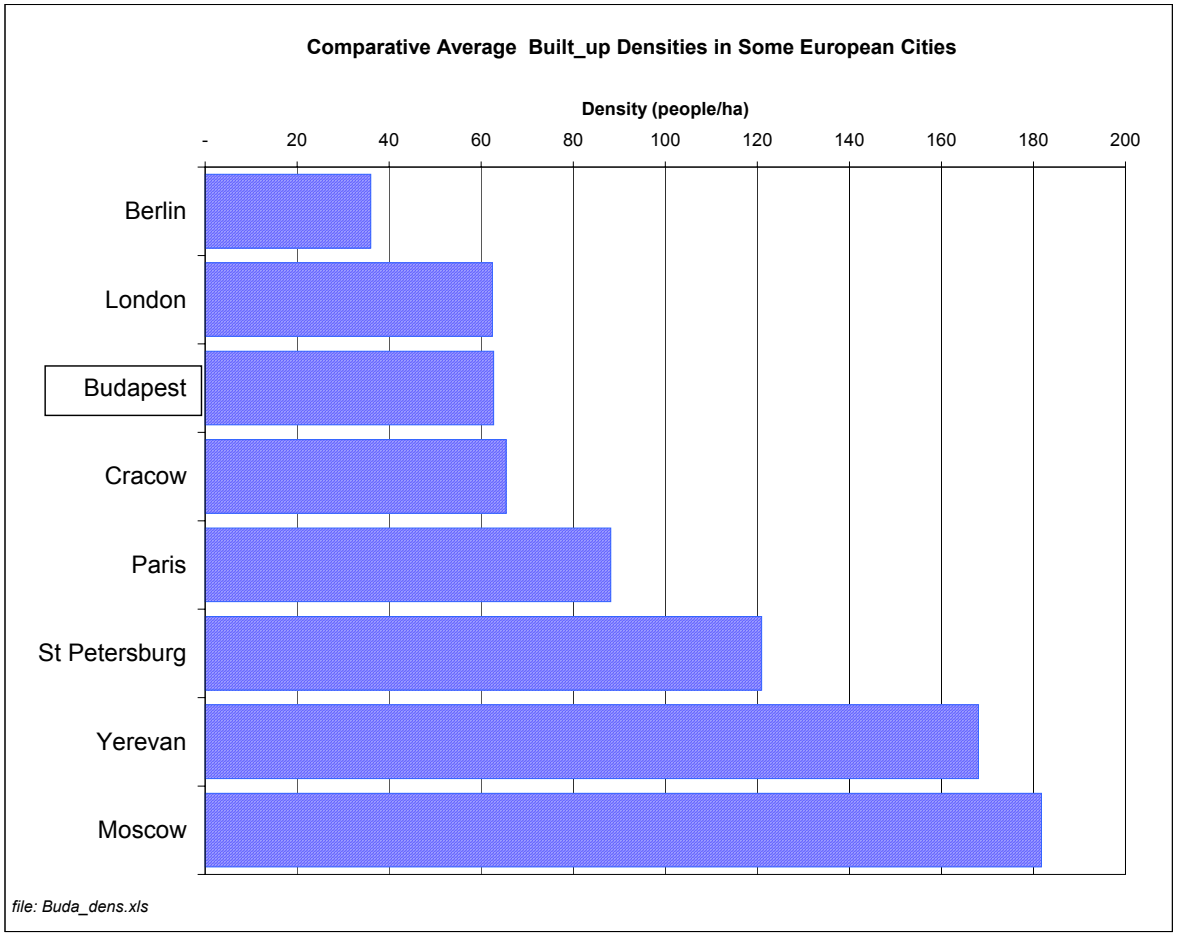

Figure 2: Average density in various European Cities

The map of gross densities on Figure 3 shows the dominance of the core and the areas of very low density on the East Bank of the Danube at only 3 km from the CBD. The high density apartments developed in the Eastern suburbs are not the dominant type of land use and are relatively isolated. As we will see in the following graphs, these apartments do not significantly increase the density of the suburbs.

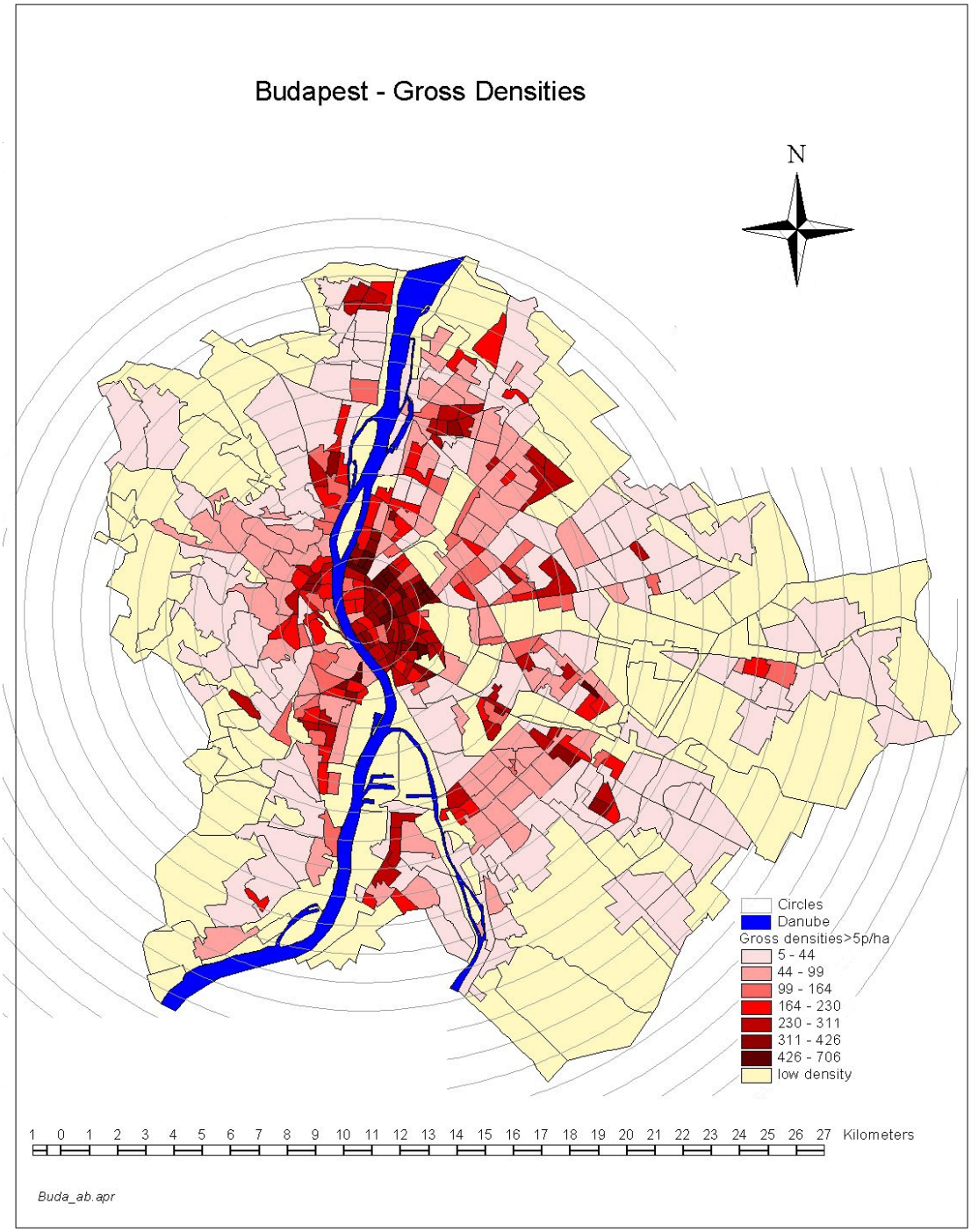

Figure 3: Budapest – Map of gross densities (1990 Census)

The three-dimensional view of Budapest density (Figure 4) shows the dominance of the core and the dispersion of some high density apartments among extensive much lower density residential developments.

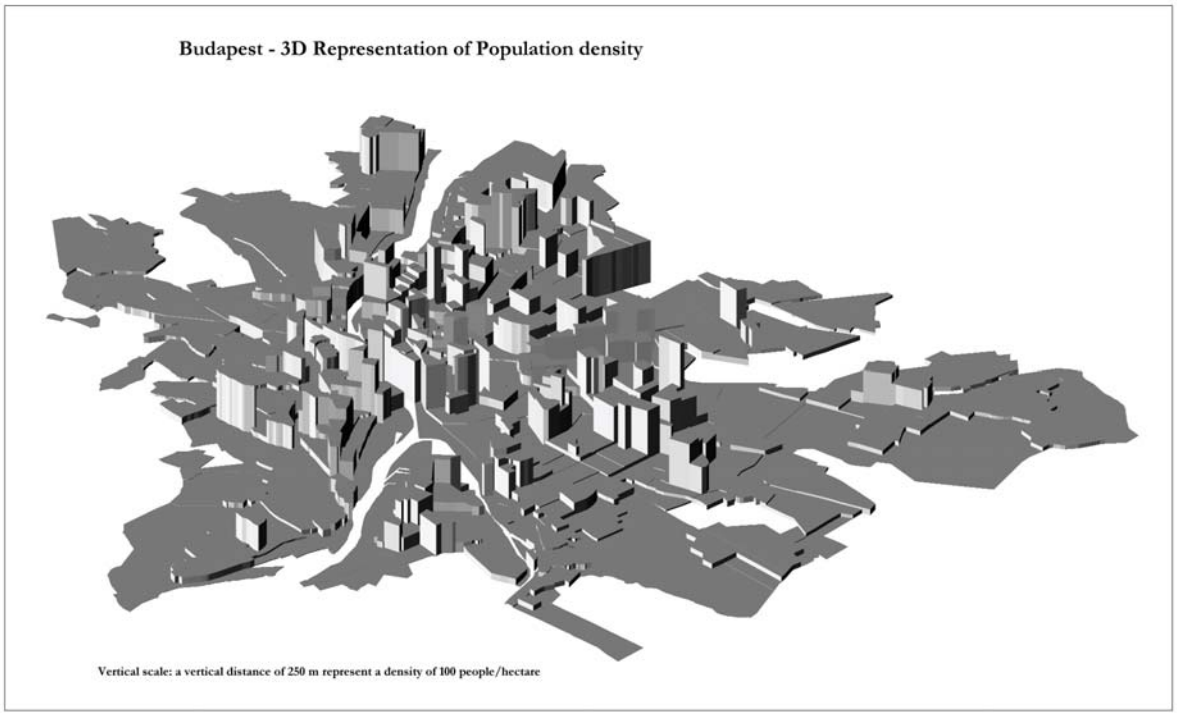

Figure 4: Budapest – 3Dimensional view from the South of built-up densities

Spatial distribution of density and of population. The control of the spatial distribution of density is an important part of the objectives set in the "development concept". According to the "concept" the population density is projected to decrease in the center and increases in underutilized areas to accommodate the increase in floor space consumption. Figure 5 shows the current distribution of density within the metropolitan area. Its main features are: (i) the dominance of the core, and (ii) the abrupt drop in density at 4 km from the CBD. The pockets of high density residential areas developed in the suburbs and seen on the map of Figure 3 during socialist time have very little influence on the gradient, which is uniformly flat around 50 p/ha until km 11. Budapest does not show the symptoms of the spatial inefficiency caused by high densities in suburban areas, as it is the case in many formerly socialist cities of Central and Eastern Europe. The spatial structure advocated in the "development concept" implies a change in density gradient. Densities should increase between 4 and 8 km from the city center. Changes in the density gradient should be regularly updated to monitor the implementation of the objectives.

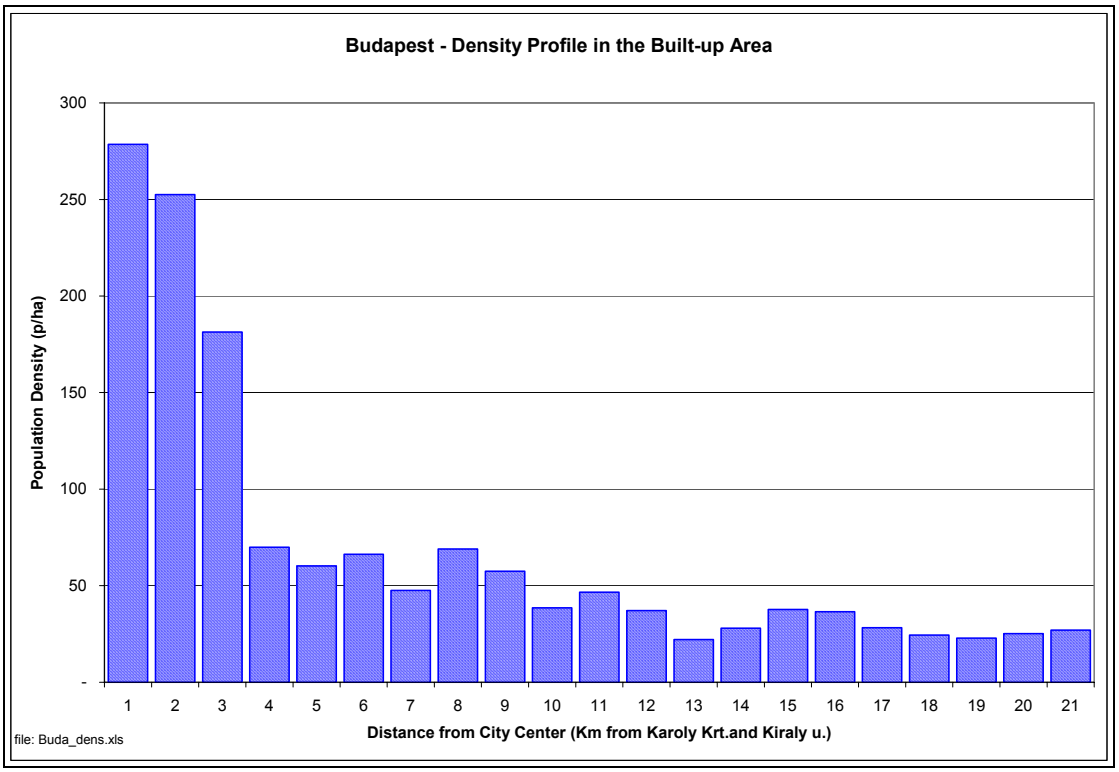

Figure 5: Budapest – Density profile

Budapest - Distribution of average densities
and population per distance from the CBD

(based on the population of 1990 census)

Distance (km)	Built-up Area (km2)	Population	Density (people/ha)	Cumulative Number of people	% of Total population
1	2.63	73,209	279	73,209	3.8%
2	7.87	198,701	252	271,910	14.0%
3	12.88	233,548	181	505,458	26.1%
4	18.78	131,234	70	636,693	32.9%
5	23.66	142,551	60	779,243	40.2%
6	26.54	176,087	66	955,330	49.3%
7	27.87	132,507	48	1,087,837	56.2%
8	30.34	209,290	69	1,297,128	67.0%
9	31.62	182,009	58	1,479,136	76.4%
10	30.34	116,904	39	1,596,040	82.4%
11	25.98	121,112	47	1,717,153	88.6%
12	21.24	78,690	37	1,795,843	92.7%
13	13.15	29,160	22	1,825,002	94.2%
14	10.00	27,985	28	1,852,988	95.7%
15	9.44	35,577	38	1,888,565	97.5%
16	5.90	21,554	37	1,910,119	98.6%
17	3.31	9,333	28	1,919,453	99.1%
18	2.89	7,056	24	1,926,508	99.5%
19	2.93	6,695	23	1,933,203	99.8%
20	1.24	3,127	25	1,936,330	100.0%
21	0.31	824	27	1,937,154	100.0%
		8		1,937,162	100.0%
	308.92	**1,937,162**	**63**		

Table 2: Budapest – Distribution of densities by distance to city center

The above table shows the current compactness of Budapest (or rather the compactness during the Census year 1990). About 50 % of the population (955,000 people) is within 6 kilometers from the city center. This compactness provides Budapest with a sizable comparative advantage in terms of labor and consumers markets.

Average distance per person to the CBD: **6.36 km**. This is an important indicator to monitor as it is directly related to the efficiency of urban networks and to the viability of the public transport system in a monocentric city.

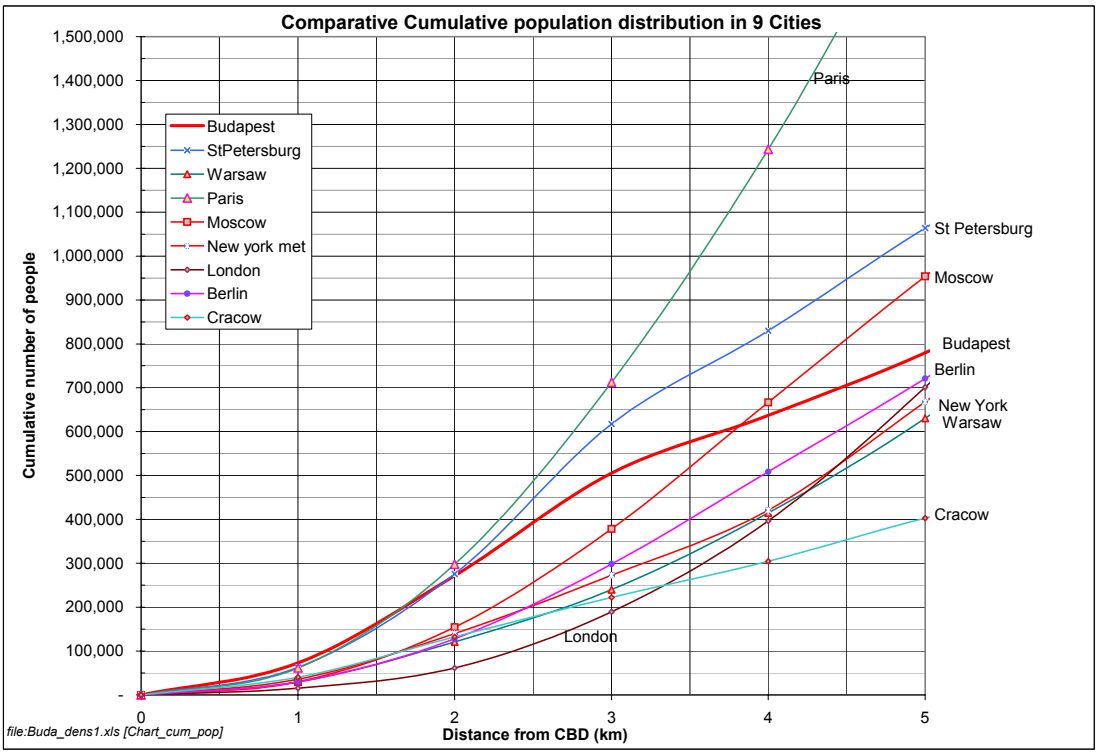

Figure 6 : Comparative cumulative population per distance from the city center

Budapest has one of the highest city core density among European cities. The figure above shows the absolute number of people at different distance from the Central Business District (CBD) for 9 different cities. Budapest has close to 300,000 people within a radius of 2 km from the CBD, about the same as St Petersburg and Paris, and about 500,000 people within 3 km from the CBD ranking 3rd in accessibility among the 9 cities shown on the graph. Allowing an increase in the number of people between 3 and 6 km from the core should be feasible and would reinforce the use of public transport and the attractiveness of the CBD for services and retail.

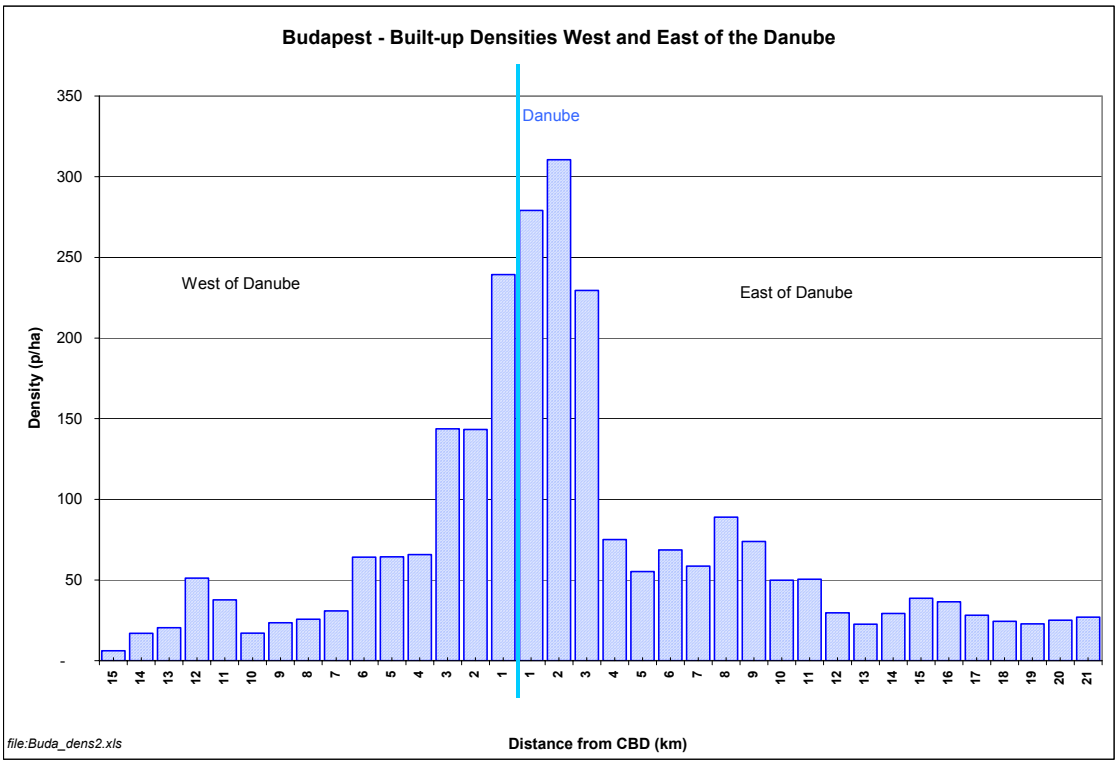

Figure 7:Built-up density profile East and West of the Danube

The Danube divides Budapest into two parts which are very dissimilar in term of land use and topography. Figure 7 shows the difference of density profile West and East of the Danube. Because, very few industrial areas were built on the West bank of the Danube, the progressive drop in densities is nearly similar to what would be expected in a market economy. By contrast, on the East bank, the drop of density between km 3 and 4 is brutal. This drop corresponds to a sudden decrease in residential area and to the preponderance of industrial sites and other uses. In a market economy, high land prices at 4 km from the CBD would have progressively pushed industries in a more remote location toward the periphery, or even possibly toward a smaller provincial town.

Analyzing the 2 banks of the Danube separately makes sense from an operational point of view. Most of the land use transformation and land recycling should occur on the East bank. Not much change is either expected or required on the West bank. Whether the density profile of the 2 sides of the Danube are analyzed separately as shown above or aggregated together as was done in Figure 5, the monocentric profile of Budapest remains very strong and the general diagnosis need not be altered.

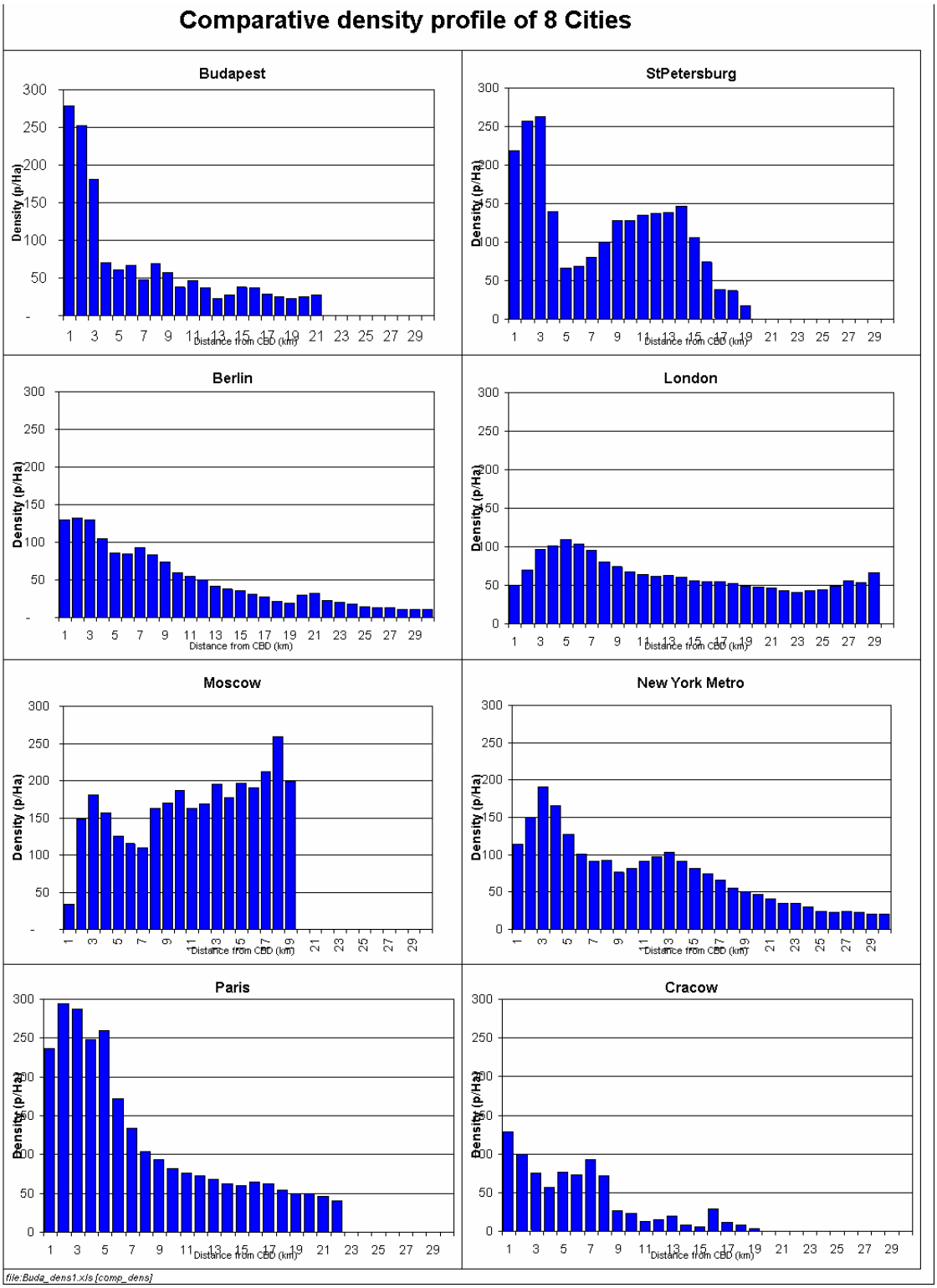

Figure 8: Comparative density profile of 8 cities

The density profile of Budapest is compared to other European cities and to New York (Figure 8). The density of Budapest core (around 250 p/ha) is very similar to the one of Paris and St Petersburg. The drop of density in Budapest, at 4 km from the CBD, is much more abrupt than in Paris or any other market economy cities. Note that the density gradient of Budapest does not show the density "camel hump" typical of former socialist cities as Moscow, St Petersburg, and Cracow. This difference can be attributed to the different housing policy practiced during socialist time. In Hungary the design of a large part of the housing stock was much driven by demand than was the case in other socialist economies.

Budapest - Distribution of people per density range in census tracts and per distance from the CBD

	Density range				Density Range				
distance from CBD (km)	>100p/ha	>200p/ha	>300p/ha	**total people**	<100 p/ha	100-200 p/	200-300 p/	>300 p/ha	**total people**
1	72,048	61,398	45,036	73,209	1,161	10,650	16,362	45,036	73,209
2	192,107	161,169	116,309	198,701	6,594	30,938	44,860	116,309	198,701
3	211,166	147,879	89,092	233,548	22,382	63,287	58,787	89,092	233,548
4	62,696	23,270	11,389	131,234	68,538	39,426	11,882	11,389	131,234
5	77,538	31,721	13	142,551	65,013	45,816	31,708	13	142,551
6	121,311	71,204	25,496	176,087	54,777	50,107	45,708	25,496	176,087
7	67,383	49,085	2,997	132,507	65,123	18,298	46,089	2,997	132,507
8	141,058	114,374	26,772	209,290	68,232	26,684	87,602	26,772	209,290
9	94,516	83,602	19,569	182,009	87,493	10,914	64,033	19,569	182,009
10	35,653	22,660	2,431	116,904	81,252	12,993	20,229	2,431	116,904
11	70,029	32,631	8,681	121,112	51,083	37,398	23,951	8,681	121,112
12	40,028	28,111	1,408	78,690	38,661	11,917	26,703	1,408	78,690
13	-	-	-	29,160	29,160	-	-	-	29,160
14	5,214	5,214	-	27,985	22,771	-	5,214	-	27,985
15	12,493	5,616	-	35,577	23,085	6,876	5,616	-	35,577
16	5,256	-	-	21,554	16,298	5,256	-	-	21,554
17	-	-	-	9,333	9,333	-	-	-	9,333
18	-	-	-	7,056	7,056	-	-	-	7,056
19	-	-	-	6,695	6,695	-	-	-	6,695
20	-	-	-	3,127	3,127	-	-	-	3,127
21	-	-	-	824	824	-	-	-	824
22	-	-	-	8	8	-	-	-	8
	1,208,497	837,935	349,193	**1,937,162**	728,666	370,562	488,742	349,193	**1,937,162**
	62%	**43%**	**18%**	**100%**	**38%**	**19%**	**25%**	**18%**	**100%**

Table 3: Budapest – Distribution of people per density range

While the average built up density of Budapest is "normal" by European standards, a large proportion of the population live in high density neighborhoods. About 43% of the population live in neighborhood with a density of more than 200 people per hectare (Table 3).

The distribution of population per range of densities (figure 9) show the "hole" located between km 4 and 5 due to the large amount of unused land in the industrial belt. This is the area where land conversion should take place in the future to meet the objectives set in the "development concept". One should also note the relatively large number of people living in high-density settlement at 9 or 10 km from the CBD. The high-density residential housing located farther than 6 or 7 km from the CBD will probably loose market value in the future, while the high-density residential areas in or around the CBD will increase in value.

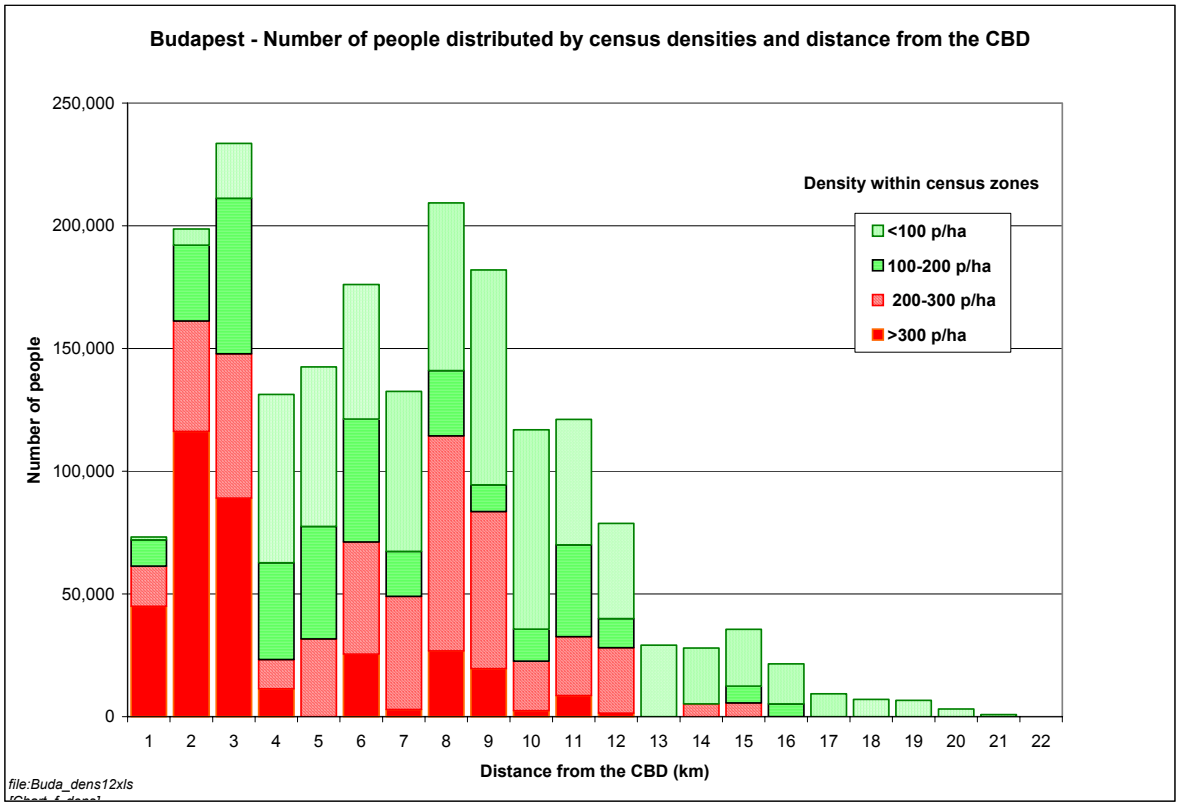

Figure 9: Budapest – Distribution of population by distance to the city center and by census tract densities

Sprawl index. (See annex 2 for a definition of the sprawl index) The sprawl index quantifies the dispersion of population within a metropolitan area. Budapest, with a sprawl of 0.96 is performing well compared to many other European cities. It is one of the objective of the "development concept" to keep this index low in the future..

The low sprawl index of Budapest as shown can be attributed to the high-density historical core. The current sprawl index correspond to an average distance per person to the core of 6.4 km. The spatial objectives prescribed in the "development concept" would require to keep the index low in the future. This could be done only by allowing industrial land to be converted into mixed residential in the immediate periphery of the core. The spatial model presented at the end of this report shows that under two different development scenarii the sprawl index could increase from the current 0.96 to 0.99 (development at the fringe of the CBD) or could reach a high 1.12 (under an unwanted scenario involving more intensive development in the eastern suburbs).

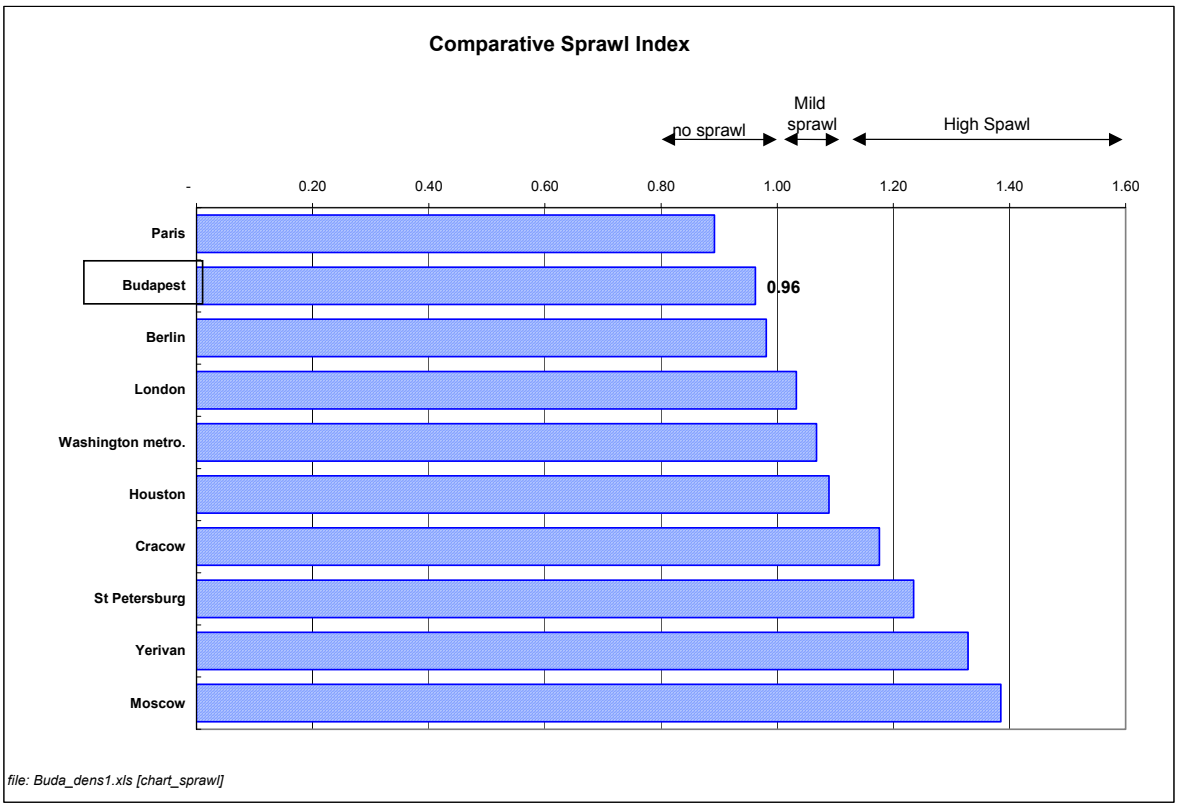

Figure 10: Comparative Sprawl Index of 8 cities

Former socialist cities have a high sprawl index because of the high density of their suburbs. This high density of suburbs contributes to lengthen the average distance per person to the CBD. By contrast, the same high density in the CBD decrease the distance per person. The sprawl index is independent of the population size and average density of cities, but it is sensitive to the pattern of densities within the built-up area.

C. INDICATORS RELATED TO REAL ESTATE MARKETS

No data on real estate markets were available at the time when this note was prepared. However, no useful analysis of land use regulations can be done without real estate indicators. For instance, the feasibility of promoting land use transformation and opening mixed land use corridors depends on the current market land value closest to the corridors. By monitoring systematically the location of building permits, planners can assess whether the urban development objectives are being met. If they are not, the planning tools (land use regulations, infrastructure investments, and taxes) have to be adjusted.

Figure 11: Budapest - map of land value and dwelling transaction price per m2 (to be prepared)

Figure 12: Budapest: Comparison between density and land price gradient (to be prepared)

Figure 13: Spatial distribution of building permits (to be prepared)

D. INDICATORS RELATED TO REGULATIONS

The zoning categories shown on the map of Figure 15 correspond roughly to the existing land use. However, because land use transformation is so important for meeting the spatial development objectives of Budapest, it is essential to have a map of existing land use to measure the progress made in land recycling.

Figure 14: Budapest - map of existing land use (to be prepared)

Table 4 : Budapest - Current land use distribution compared to planned zoned land use (to be prepared)

Budapest Zoning Regulations

Range of Floor Area Ratio (FAR) Allowed in Residential Areas

Floor Area Ratio Range permitted	L1- Low Density	L2- medium density	L3 - Low Density Condominium	L4 - Housing estate	L5 - High Density	L6 - High density Mixed used
Low max.	0.25	0.70	0.75	2.50	4.00	5.50
High max.	0.50	2.50	1.20	2.50	5.00	5.50
Average	**0.375**	**1.60**	**0.975**	**2.50**	**4.50**	**5.50**

file: Buda_zoning.xls [Zoning_tab]

Table 5 : Budapest - FAR corresponding to various zoning categories

The following tables are showing an distribution by distance to the CBD of the areas zoned residential, the theoretical total floor area allowed by the regulations in these zones, and finally the number of people which could be theoretically accommodated in areas zoned residential if these areas were fully built under the maximum allowed and assuming a floor space consumption of 32 m2 per person as projected by the "city development concept" for the year 2015. Finally, an estimate of the current residential FAR is made, based on the current average floor consumption per person.

Budapest - Spatial Analyzis of Zoning Regulations

	Area zoned residential (km2)								Estimate of Total Residential Floor Space Allowed by Zoning (Km2)						
Distance from CBD (km)	L1- Low Density	L2- medium density	L3 - Low Density Condominium	L4 - Housing estate	*L5* - High Density	L6 - High density Mixed used	Total Zoned residential (km2)	Average FAR	L1- Low Density	L2- medium density	L3 - Low Density Condominium	L4 - Housing estate	*L5* - High Density	L6 - High density Mixed used	Allowed Floor Space (Km2)
15	-	-	-	-	-	-	**-**	-	-	-	-	-	-	-	-
14	0.09	0.10	0.00	-	-	-	**0.19**	1.01	0.03	0.15	0.00	-	-	-	0.19
13	0.87	0.28	-	0.10	-	-	**1.25**	0.82	0.33	0.45	-	0.25	-	-	1.02
12	3.97	0.17	-	0.76	-	-	**4.90**	0.75	1.49	0.27	-	1.90	-	-	3.66
11	5.04	0.59	-	0.32	-	-	**5.95**	0.61	1.89	0.95	-	0.79	-	-	3.63
10	6.35	1.29	0.02	0.10	-	-	**7.76**	0.61	2.38	2.06	0.02	0.26	-	-	4.72
9	4.76	1.05	-	0.23	-	-	**6.04**	0.67	1.78	1.69	-	0.58	-	-	4.05
8	3.04	0.24	-	0.36	-	-	**3.64**	0.66	1.14	0.38	-	0.89	-	-	2.42
7	5.21	0.15	0.04	0.46	-	-	**5.86**	0.58	1.95	0.24	0.04	1.15	-	-	3.39
6	5.96	0.19	0.55	1.29	0.03	-	**8.02**	0.80	2.24	0.30	0.53	3.22	0.15	-	6.44
5	4.01	0.07	1.67	0.75	0.26	-	**6.76**	0.93	1.50	0.11	1.63	1.88	1.16	-	6.29
4	0.94	0.08	3.37	0.31	0.25	-	**4.95**	1.15	0.35	0.12	3.28	0.77	1.15	-	5.68
3	0.00	-	1.24	0.18	1.37	0.36	**3.16**	3.11	0.00	-	1.21	0.46	6.17	2.00	9.83
2	-	-	0.58	-	0.44	0.24	**1.25**	3.05	-	-	0.57	-	1.96	1.29	3.82
1	-	-	-	-	0.01	-	**0.01**	4.50	-	-	-	-	0.03	-	0.03
0															
1	-	-	-	-	-	1.48	**1.48**	5.50	-	-	-	-	-	8.12	8.12
2	-	-	0.03	0.01	1.25	1.68	**2.97**	5.03	-	-	0.02	0.03	5.61	9.25	14.91
3	-	-	0.29	0.19	1.89	0.22	**2.59**	4.04	-	-	0.28	0.49	8.50	1.21	10.48
4	-	0.26	0.55	0.47	0.70	0.08	**2.06**	2.78	-	0.42	0.53	1.17	3.15	0.44	5.71
5	-	0.25	0.57	0.75	0.85	-	**2.42**	2.75	-	0.39	0.56	1.88	3.81	-	6.64
6	-	1.14	0.79	2.02	0.57	-	**4.52**	2.26	-	1.83	0.77	5.06	2.57	-	10.22
7	-	3.40	1.14	1.44	0.15	-	**6.14**	1.77	-	5.45	1.11	3.61	0.68	-	10.84
8	-	5.43	0.62	2.81	0.02	-	**8.88**	1.85	-	8.68	0.60	7.04	0.09	-	16.41
9	-	9.44	-	2.12	-	-	**11.56**	1.77	-	15.10	-	5.31	-	-	20.41
10	-	9.89	0.09	1.27	-	-	**11.25**	1.70	-	15.83	0.09	3.17	-	-	19.09
11	-	8.13	0.46	1.90	0.01	-	**10.50**	1.74	-	13.01	0.45	4.76	0.04	-	18.26
12	-	7.78	0.29	0.63	-	-	**8.69**	1.64	-	12.45	0.28	1.56	-	-	14.29
13	-	6.65	-	0.08	-	-	**6.73**	1.61	-	10.65	-	0.19	-	-	10.84
14	-	7.34	-	0.18	-	-	**7.53**	1.62	-	11.75	-	0.46	-	-	12.21
15	-	6.75	-	0.42	-	-	**7.17**	1.65	-	10.80	-	1.04	-	-	11.84
16	-	5.05	-	0.16	-	-	**5.21**	1.63	-	8.08	-	0.39	-	-	8.47
17	-	2.63	-	-	-	-	**2.63**	1.60	-	4.20	-	-	-	-	4.20
18	-	2.44	-	-	-	-	**2.44**	1.60	-	3.91	-	-	-	-	3.91
19	-	2.69	-	-	-	-	**2.69**	1.60	-	4.30	-	-	-	-	4.30
20	-	1.34	-	-	-	-	**1.34**	1.60	-	2.15	-	-	-	-	2.15
21	-	0.21	-	-	-	-	**0.21**	1.60	-	0.34	-	-	-	-	0.34
	40.25	**85.04**	**12.29**	**19.33**	**7.79**	**4.06**	**168.75**		**15.09**	**136.06**	**11.98**	**48.31**	**35.06**	**22.32**	**268.83**
	24%	50%	7%	11%	5%	2%	100%								
Far Low	0.25	0.7	0.75	2.5	4	5.5									42.44
Far High	0.5	2.5	1.2	2.5	5	5.5									
Average	**0.375**	**1.6**	**0.975**	**2.5**	**4.5**	**5.5**	**1.59**								
				Total floor space permitted:			**269**	1.59							

Buda_zoning.xls [sum_table]

Table 6 : Budapest - Area zoned Residential by distance to the city center

This table shows the intermediary calculations which allow to calculate the average regulated Floor Area Ratio in residential areas per km from the CBD (this result is shown in Figure 17.) . The floor area ratio per km is then converted into the total area of residential floor space permitted by the zoning. This floor area is used to calculate the potential number of people by using an average floor space per person based on projections contained in the development concept. The number of people is then used to calculate the maximum implicit densities allowed by the zoning regulations. The result is shown on Figure19.

Budapest - Spatial Analyzis of Zoning Regulations

Estimate of Potential Number of People Allowed by Zoning

average floor space/person at perifery (20km) =	45 m2
average floor space/person at center =	30 m2
Gradient of floor consumtion decrease=	-0.3
Usable floor space ratio	60%
Loss of Far due to set backs and site ratio	20%

Distance from CBD (km)	Floor space per person	Potential nb. of people	Gross Area (including non residential) km2	Max. Implicit Permitted Density (p/ha)	Current gross densities(p/ha)	gross far	% Residential
15	44.8	**-**	0.30	-	6		
14	44.8	**2,000**	1.10	18	17	0.17	17%
13	44.7	**11,000**	2.95	37	21	0.35	42%
12	44.6	**39,400**	7.27	54	51	0.50	67%
11	44.4	**39,300**	7.98	49	38	0.46	75%
10	44.3	**51,200**	10.48	49	17	0.45	74%
9	44.0	**44,200**	10.29	43	24	0.39	59%
8	43.6	**26,600**	9.55	28	26	0.25	38%
7	43.2	**37,700**	11.15	34	31	0.30	53%
6	42.5	**72,600**	13.51	54	64	0.48	59%
5	41.7	**72,400**	13.02	56	64	0.48	52%
4	40.5	**67,300**	10.49	64	66	0.54	47%
3	38.9	**121,300**	7.23	168	144	1.36	44%
2	36.8	**49,900**	2.73	183	143	1.40	46%
1	33.9	**400**	0.04	99	239	0.69	15%
0	30.0	**-**					
1	33.9	**115,100**	2.59	445	279	3.14	57%
2	36.8	**194,700**	5.14	379	310	2.90	58%
3	38.9	**129,400**	5.65	229	229	1.86	46%
4	40.5	**67,700**	8.29	82	75	0.69	25%
5	41.7	**76,600**	10.64	72	55	0.62	23%
6	42.5	**115,400**	13.03	89	69	0.78	35%
7	43.2	**120,600**	16.72	72	59	0.65	37%
8	43.6	**180,500**	20.78	87	89	0.79	43%
9	44.0	**222,700**	21.33	104	74	0.96	54%
10	44.3	**207,100**	19.86	104	50	0.96	57%
11	44.4	**197,200**	18.00	110	51	1.01	58%
12	44.6	**153,900**	13.97	110	30	1.02	62%
13	44.7	**116,400**	10.21	114	23	1.06	66%
14	44.8	**130,900**	8.90	147	29	1.37	85%
15	44.8	**126,800**	9.14	139	39	1.30	78%
16	44.9	**90,600**	5.90	153	36	1.43	88%
17	44.9	**44,900**	3.31	136	28	1.27	79%
18	44.9	**41,800**	2.89	145	24	1.35	85%
19	44.9	**45,900**	2.93	157	23	1.47	92%
20	45.0	**22,900**	1.65	139	25	1.30	81%
21	45.0	**3,700**	0.31	121	27	1.12	70%
		3,040,100	**309**			**0.87**	55%

Table 7 : Budapest - Potential number of people which could be accomodated in areas zoned residential if the FAR was fully used

The FAR allowed by the zoning would theoretically allow up to a maximum population of about 3 million in residential areas for an average consumption of floor space of 42 m2 per person. This figure is of course theoretical, but it demonstrates that the zoning shows a large margin of tolerance for redevelopment within the municipal boundaries.

Estimate of current residential FAR based on floor consumption per person

Distance from CBD (km)	population	assumed floor consumption m2/person	Total usable floor area (m2)	Gross Floor Area (m2)	Residential area (km2)	Estimated Current FAR	Regulatory FAR
West Bank							
16	34	28.4	968	1,614			
15	185	28.2	5,222	8,703	-		
14	1,875	28.0	52,463	87,438	**0.19**	0.46	1.01
13	6,044	27.7	167,589	279,316	**1.25**	0.22	0.82
12	37,232	27.5	1,022,186	1,703,643	**4.90**	0.35	0.75
11	30,086	27.1	816,750	1,361,251	**5.95**	0.23	0.61
10	17,895	26.8	479,626	799,376	**7.76**	0.10	0.61
9	24,240	26.4	640,332	1,067,220	**6.04**	0.18	0.67
8	24,573	26.0	638,493	1,064,155	**3.64**	0.29	0.66
7	34,379	25.5	876,602	1,461,003	**5.86**	0.25	0.58
6	86,659	25.0	2,162,547	3,604,246	**8.02**	0.45	0.80
5	83,794	24.3	2,039,983	3,399,971	**6.76**	0.50	0.93
4	69,013	23.7	1,633,002	2,721,671	**4.95**	0.55	1.15
3	103,885	22.9	2,378,651	3,964,419	**3.16**	1.26	3.11
2	39,094	22.0	861,588	1,435,981	**1.25**	1.15	3.05
1	967	21.1	20,372	33,953	**0.01**	5.48	4.50
East Bank		20.0	-	-			
1	72,243	21.1	1,522,702	2,537,837	**1.48**	1.72	5.50
2	159,607	22.0	3,517,588	5,862,646	**2.97**	1.98	5.03
3	129,663	22.9	2,968,876	4,948,127	**2.60**	1.91	4.04
4	62,221	23.7	1,472,302	2,453,837	**2.99**	0.82	2.03
5	58,757	24.3	1,430,445	2,384,075	**6.43**	0.37	1.27
6	89,428	25.0	2,231,638	3,719,397	**10.49**	0.35	1.19
7	98,128	25.5	2,502,093	4,170,155	**11.35**	0.37	1.13
8	184,717	26.0	4,799,575	7,999,291	**11.92**	0.67	1.47
9	157,769	26.4	4,167,643	6,946,072	**16.32**	0.43	1.36
10	99,009	26.8	2,653,682	4,422,804	**17.60**	0.25	1.22
11	91,026	27.1	2,471,076	4,118,459	**15.54**	0.26	1.30
12	41,458	27.5	1,138,197	1,896,994	**12.67**	0.15	1.25
13	23,116	27.7	640,979	1,068,298	**7.60**	0.14	1.47
14	26,110	28.0	730,387	1,217,311	**7.62**	0.16	1.61
15	35,392	28.2	997,769	1,662,949	**7.17**	0.23	1.65
16	21,520	28.4	610,880	1,018,133	**5.21**	0.20	1.63
17	9,333	28.6	266,562	444,271	**2.63**	0.17	1.60
18	7,056	28.7	202,609	337,681	**2.44**	0.14	1.60
19	6,695	28.9	193,173	321,954	**2.69**	0.12	1.60
20	3,127	29.0	90,621	151,036	**1.34**	0.11	1.60
21	824	29.1	23,956	39,926	**0.21**	0.19	1.60
22	8	29.2	241	402			
Total	**1,937,162**	**25.00**	**48,429,369**	**80,715,615**	**209**	0.39	
	average floor space/person at periphery (20km) =					30	m2
	average floor space/person at center =					20	m2
	Gradient of floor consumption decrease =					(0.11)	
	Usable floor space ratio					60%	

file:Buda_zoning.xls [tab_curr_FAR]

Table 8 :Estimate of current Floor Area Ratio

The estimate of the current FAR is derived from the floor space consumption per person and the distribution of people per distance from the city center. It is assumed that the consumption per capita average is 25 m2 but varies between 20 m2 per person at the center and increases to 30 m2 in the farthest suburb. Between two points, the consumption follows an exponential curve.

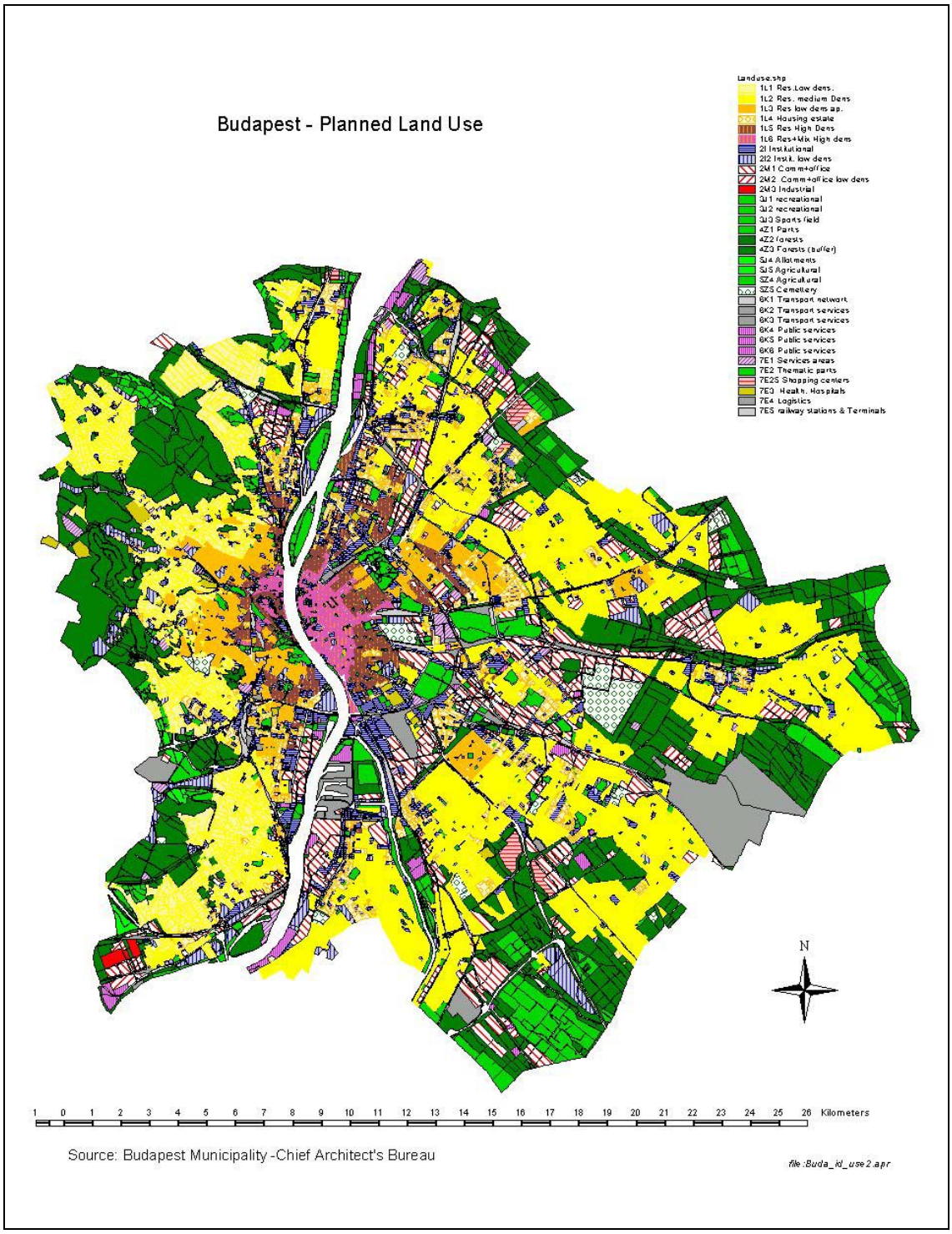

Figure 15: Budapest – Zoning Map

On the map of figure 15 the areas zoned 2M1 and 2M2 projected for commercial use are currently for the most part obsolete industrial areas. Some of these areas the closest from the CBD might be adequate for conversion to mixed residential, in particular along transport corridors. The regulated FAR in the residential areas are given in Table 5.

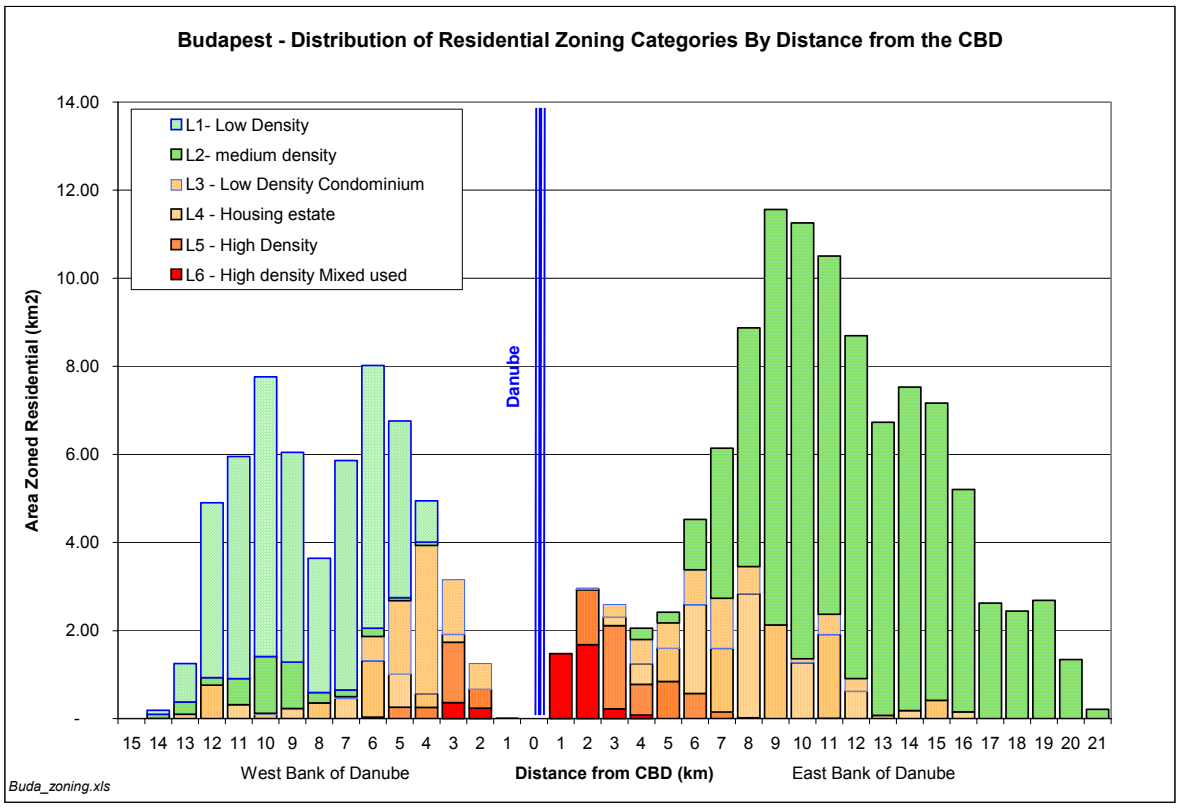

Figure 16: Distribution of Residential zoning categories by distance from the CBD

The distribution of zoning categories by distance from the CBD is consistent with the functioning of a market economy, i.e. high density categories are clustered close to the CBD. However in the 4 to 8 km ring, an increase in the total area zoned residential would improve the implementation of the objectives contained in the "development concept". For instance, on the East side of the Danube, at 5 km from the CBD the total residential area is only around 2 km^2, it should be at least 6 km^2 to maintain a continuity between the suburbs and the city core.

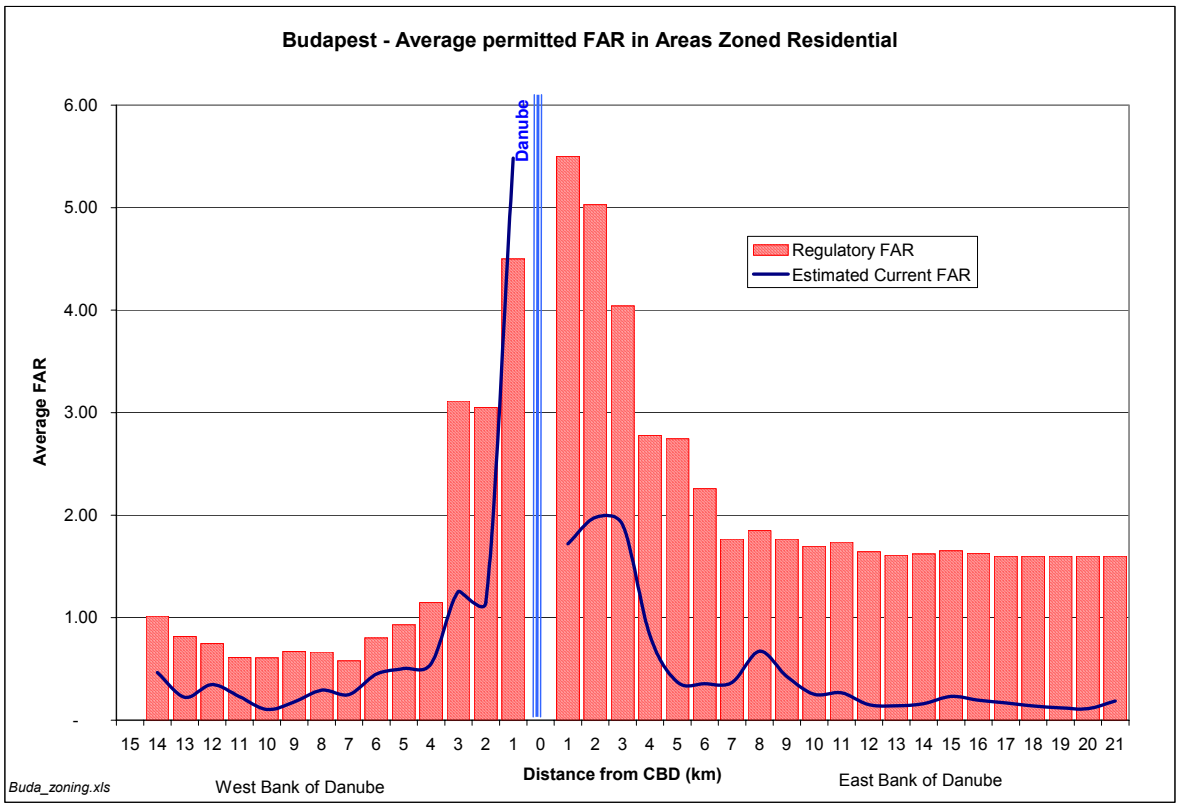

Figure 17: Budapest – Floor area ratio allowed by distance to city center, compared to estimate of current floor area ratio.

The graph above confirm the diagnosis made in the above paragraph. The zoning regulations are generally market friendly as they allow a much higher FAR than the current one. The increase in the permissible floor area ratio East of the Danube between km 4 and 12 provides a strong incentive for redevelopment, consequently improve the reinforcement of the core and avoid futher dispersion of the population. However, because of the scarcity of residential land in this area, the increase in FAR will not be sufficient to have the desired spatial impact. An increase int eh area zoned residential is also necessary.

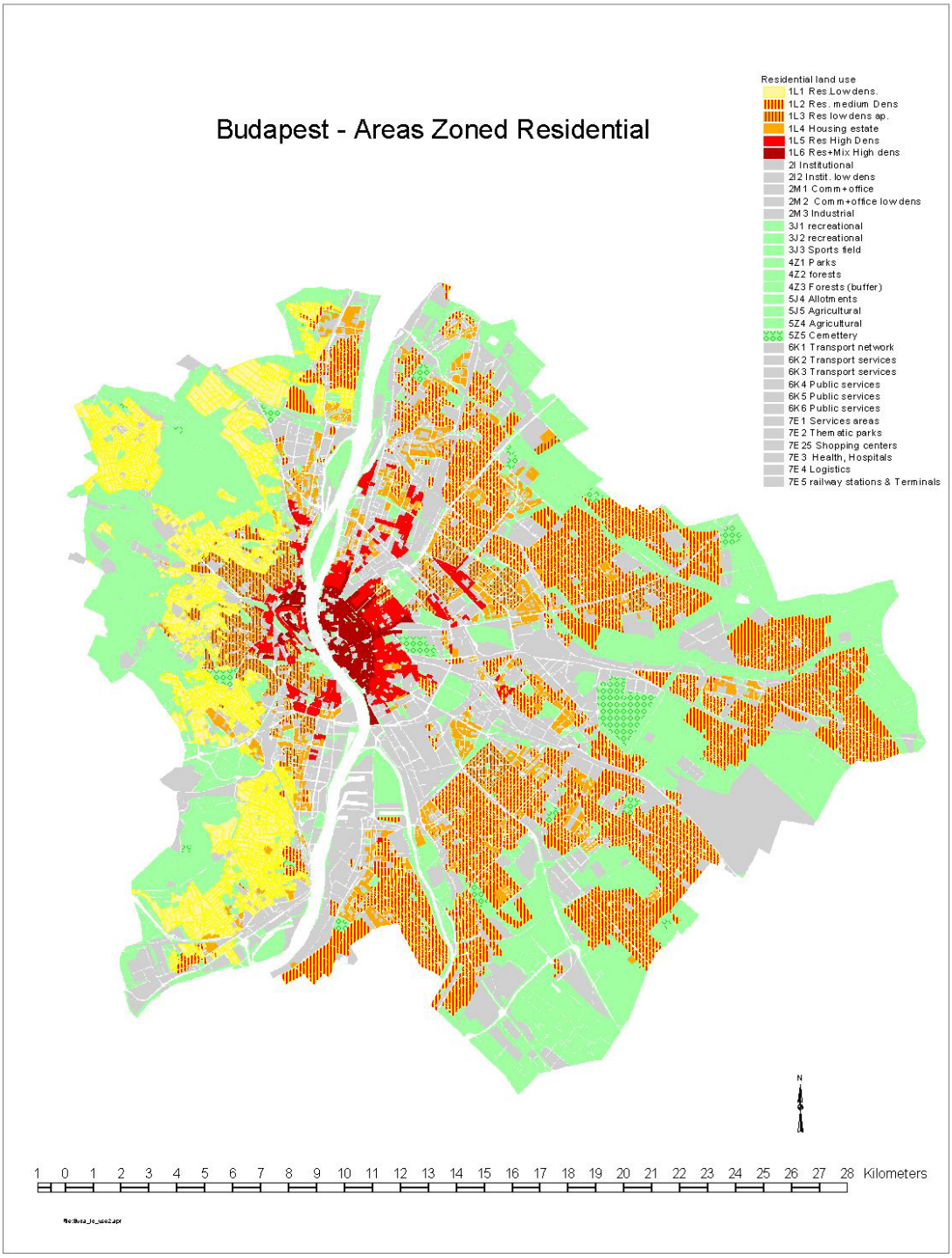

Figure 18: Budapest – Areas zoned residential

The map of the areas zoned residential shows the lack of continuity between the high density core and the Eastern residential suburbs. Because of the few areas zoned residential immediately adjacent to the core, raising the permissible density would not be sufficient to increase the core accessibility. Conversion between non residential to residential might be indispensable to make a difference in this area. Some infrastructure investments may be needed to allow this conversion.

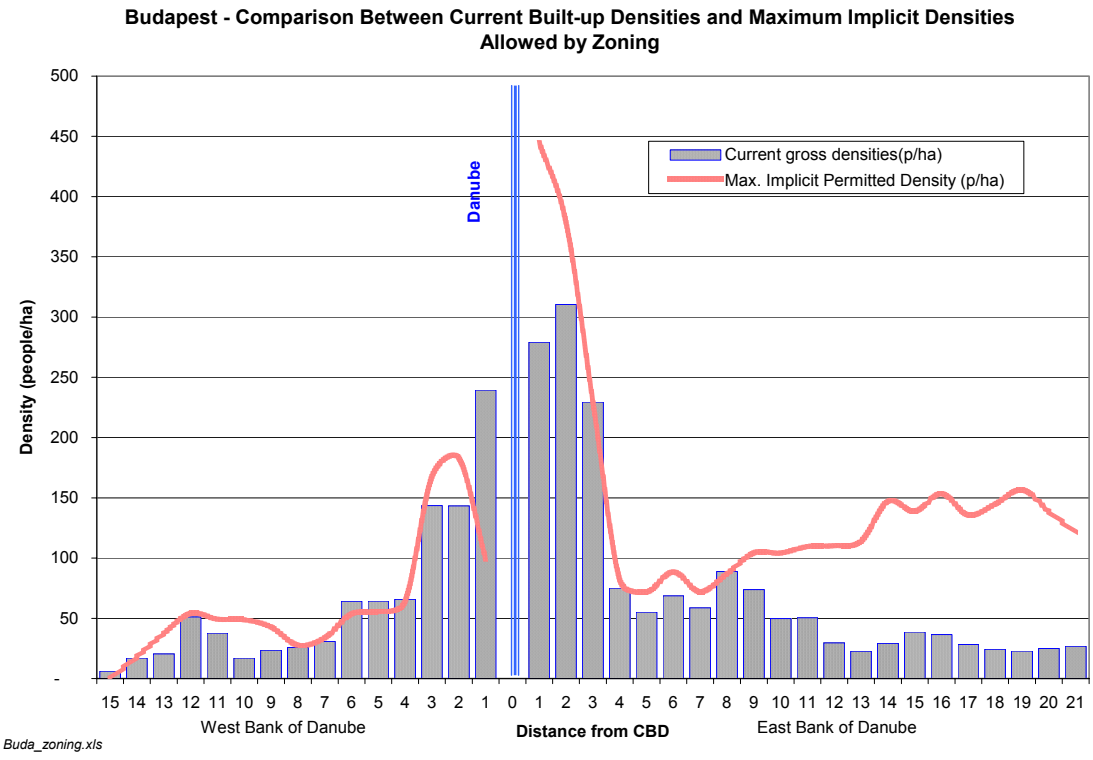

Figure 19: Budapest – Comparison between current built-up densities and maximum implicit densities allowed by the zoning

Figure 19 shows that the zoning regulations are adequate for the West bank of the Danube. However, on the East Bank, built-up densities at 5 km from the CBD are at a low 75 p/ha, barely more than the current 60p/ha in spite of the gerous increase in FAR. This illustrates the points made earlier, that an increase in residential FAR alone will not be sufficient to alter the spatial structure inherited from socialism. The conversion of non residential land into residential is essential for the fulfillment of the municipal objectives.. Densities are higher in the suburbs because of the higher percentage of residential land in these areas. The higher densities allowed in the suburbs beyond 12 km might prevent the flight of developers toward adjacent municipalities where regulations might be more lenient.

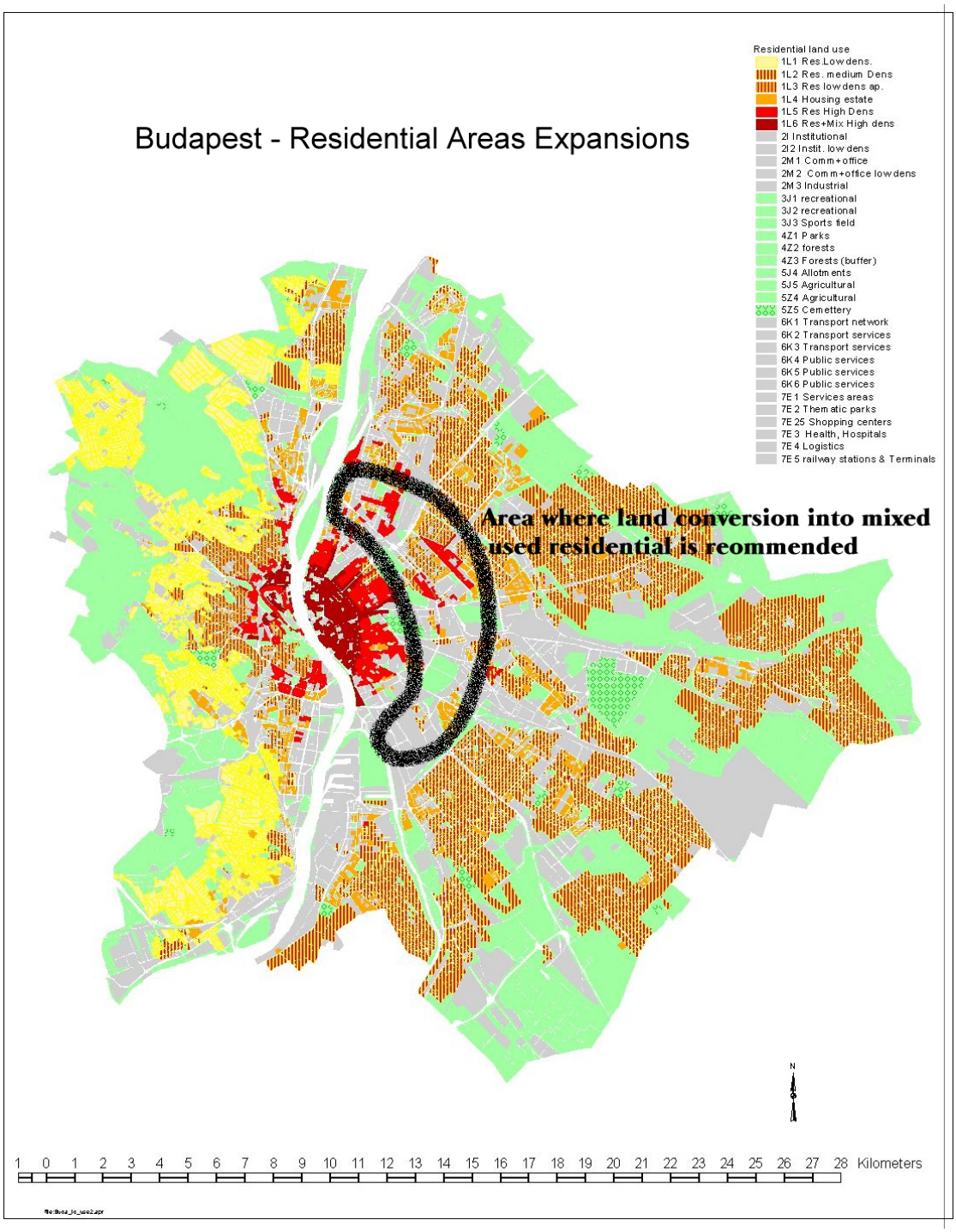

Figure 20: Map of recommended residential areas expansion to maintain the development concept objectives.

This map summarizes the comments made for the preceding graphs. It shows the area where increase FAR and land conversion should be allowed. It is probable that a zoning change might not be sufficient to create higher residential densities in this area. The municipal government may consider an upgrading of infrastructure and a phasing strategy along transport corridors.

E. THE LINKAGE OF INDICATORS WITHIN AN URBAN SPATIAL MODEL

The model presented on Figure 21 shows the linkage between densities, developed areas, population spatial distribution and a number of indicators such as average distance from the CBD per person, Average density and sprawl index. The model presents 2 scenario. The first one correspond to the objectives of the development concept. The second depart from the objectives and show the consequence of a densification of the suburbs rather than a densification of the area immediately adjacent to the core. The sprawl index is 0.99 in the first case and 1.12 in the second case. The average distance to the CBD increases by 18% under the second scenario, although no increase in population is envisaged.

MODEL OF THE SPATIAL DISTRIBUTION OF POPULATION OF BUDAPEST UNDER ALTERNATIVE DENSITY PROFILES AND BUILT-UP AREAS

	Population spatial distribution in Year 1990						Alternative 1 Year 2015					alternative 2 Year 2015				
Distan	Population	Area	density	Cumul_pop	Cumul %	Average D	Population	Area	density	Cumul_pop	Cumul %	Population	Area	density	Cumul_pop	
1	73,209	2.63	279	73,209	3.78%	0.5	49,413	2.63	188	49,413	3%	51,253	2.63	195	51,253	
2	198,701	7.87	252	271,910	14.04%	1.5	125,911	7.87	160	175,323	12%	129,058	7.87	164	180,311	
3	233,548	12.88	181	505,458	26.09%	2.5	172,626	12.88	134	347,950	20%	181,644	12.88	141	361,955	
4	131,234	18.78	70	636,693	32.87%	3.5	200,899	18.78	107	548,848	28%	129,551	18.78	69	491,506	
5	142,551	23.66	60	779,243	40.23%	4.5	201,113	23.66	85	749,961	37%	144,328	23.66	61	635,834	
6	176,087	26.54	66	955,330	49.32%	5.5	191,072	26.54	72	941,033	46%	175,150	26.54	66	810,984	
7	132,507	27.87	48	1,087,837	56.16%	6.5	172,400	27.87	62	1,113,433	53%	136,568	27.87	49	947,552	
8	209,290	30.34	69	1,297,128	66.96%	7.5	203,263	30.34	67	1,316,696	66%	203,263	30.34	67	1,150,815	
9	182,009	31.62	58	1,479,136	76.36%	8.5	173,902	31.62	55	1,490,598	79%	173,902	31.62	55	1,324,717	
10	116,904	30.34	39	1,596,040	82.39%	9.5	118,341	30.34	39	1,608,940	86%	118,341	30.34	39	1,443,058	
11	121,112	25.98	47	1,717,153	88.64%	10.5	101,321	25.98	39	1,710,261	92%	132,497	25.98	51	1,575,556	
12	78,690	21.24	37	1,795,843	92.71%	11.5	80,698	21.24	38	1,790,959	93%	80,698	21.24	38	1,656,254	
13	29,160	13.15	22	1,825,002	94.21%	12.5	30,251	13.15	23	1,821,211	94%	30,251	13.15	23	1,686,505	
14	27,985	10.00	28	1,852,988	95.66%	13.5	28,011	10.00	28	1,849,222	96%	28,011	10.00	28	1,714,516	
15	35,577	9.44	38	1,888,565	97.49%	14.5	37,759	9.44	40	1,886,981	97%	48,143	9.44	51	1,762,659	
16	21,554	5.90	37	1,910,119	98.60%	15.5	21,554	5.90	37	1,908,535	99%	37,778	5.90	64	1,800,437	
17	9,333	3.31	28	1,919,453	99.09%	16.5	10,918	3.31	33	1,919,453	99%	37,950	5.50	69	1,838,387	
18	7,056	2.89	24	1,926,508	99.45%	17.5	7,056	2.89	24	1,926,508	99%	37,230	5.10	73	1,875,617	
19	6,695	2.93	23	1,933,203	99.80%	18.5	6,695	2.93	23	1,933,203	100%	31,020	4.70	66	1,906,637	
20	3,127	1.24	25	1,936,330	99.96%	19.5	3,127	1.24	25	1,936,330	100%	21,450	3.30	65	1,928,087	
21	824	0.31	27	1,937,154	100.00%	20.5	824	0.31	27	1,937,154	100%	9,067	1.60	57	1,937,154	
Total	**1,937,154**	**308.92**	**63**	p/ha			**1,937,154**	**308.92**	**63**	p/ha		**1,937,154**	**318.44**	**61**	p/ha	
						Difference	(0)	-	(0)			-	10	(2)		

Indicators		Indicators		Indicators	
Average distance from CBD	**6.36** km/person	Average distance from CBD	**6.55** km/person	Average distance from CBD	**7.52**
equi.circle radius	9.92	equi.circle radius	9.92	equi.circle radius	10.07
Constant	0.67	Constant	0.67	Constant	0.67
Spawl Index	**0.96**	Spawl Index	**0.99**	Spawl Index	**1.12**

Table 9 : model with 2 scenarii for the year 2015

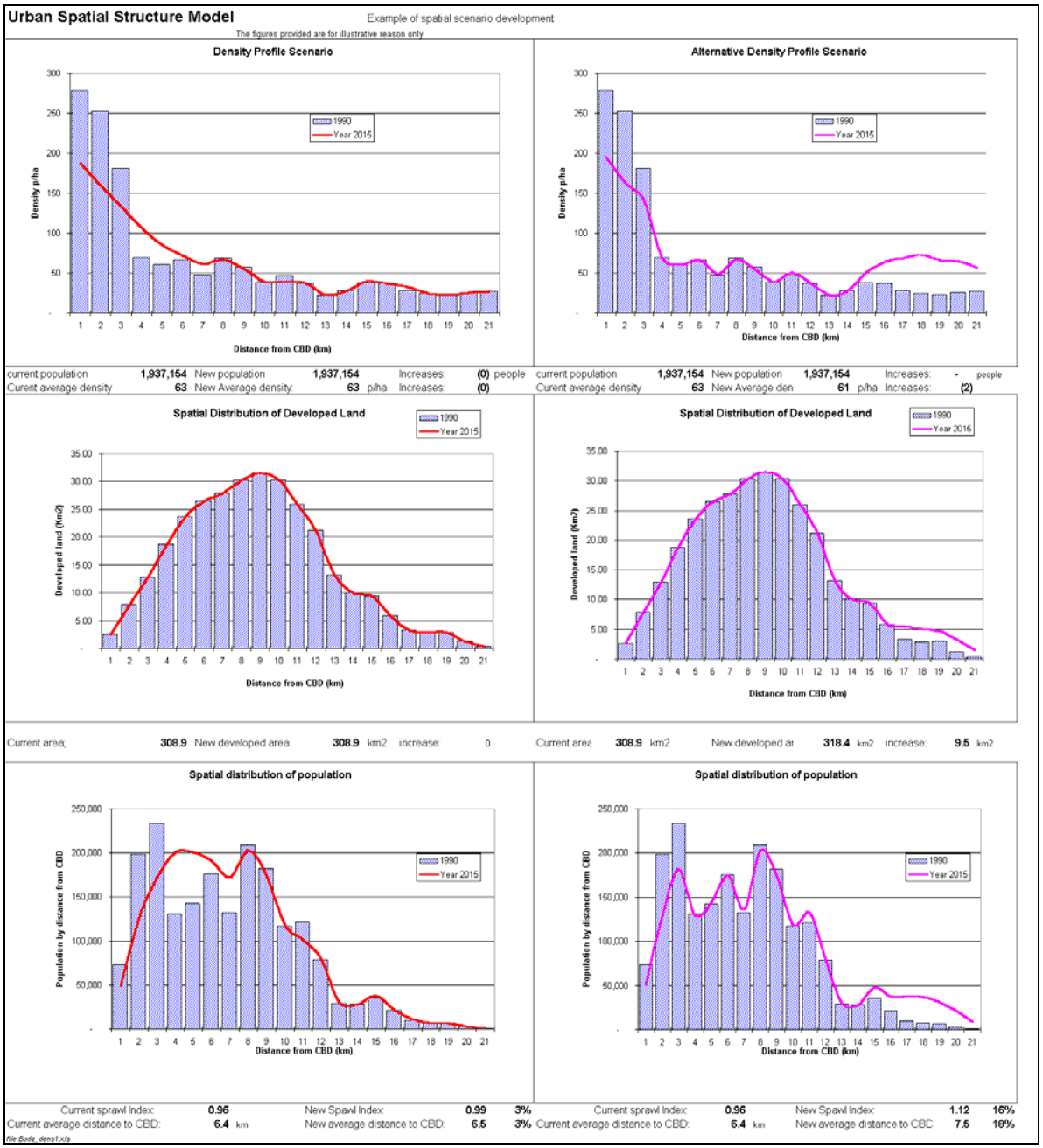

Figure 21: Example of a simple urban spatial model illustrating the effect on spatial indicators of 2 different density scenario.

F. RECOMMENDATION FOR FURTHER WORK ON INDICATORS

1. Expand data base up to 30 km from the CBD
2. Identify and quantify land use changes proposed in the land development plan
3. Add real estate data and regularly monitor changes and number of transactions spatially distributed;
4. Monitor commercial rents along pedestrian streets
5. Monitor building permits
6. Monitor changes in peak hour traffic (cars and public transport)

ANNEX 1: NOTES ON THE QUANTITATIVE ASPECT OF SOME MUNICIPAL OBJECTIVES

The spatial indicators proposed in this note are linked to the spatial implications of the Municipal objectives extracted from the report "Budapest City Development Concept"[2]. Quantitative indicators gives operational credibility to development objectives. Without indicators to show to which degree development objectives are being achieved, the formulation of objectives alone is unlikely to have any operational impact. Indicators are also useful to insure the consistency of policy between sector. In this case particular attention is given to the consistency between the development objective and the land use legislation aimed at controlling land development.

The municipal development objectives are:

1) Development of the economy, "increase economic competitiveness of the region" p 6: spatial indicators:

    (i) Price and Rent/m2 of prime office space

    (ii) Residential median price/ income ratio

2) "Elimination of ruins". Elimination of... the former industrial and transportation areas which have been vacated and are out of use. P.6. Spatial Indicators:

    (i) area to be reconverted

    (ii) histogram of area to be reconverted by distance from CBD

    (iii) estimate of current market price of land to be reconverted

3) "The population in the internal part of the city will decline significantly.." p.9

    (i) by how much? See model below.

4) "9% employment increase can be expected by 2010" p 9

    (i) How much new employees, hypothesis of amount of floor space, land area to be converted from other use?

5) "a very important task is the elimination of deserted industrial sites and finding ways of re-utilisation of the vacant facilities and eliminate the environment damages." P 12

    (i) How much land is involved? How much can be reconverted and to what?

[2] "Budapest Városfejlesztési Koncepciója Osszefoglaló, Budapest City Development Concept" by Metropolitan Research Ltd, September 1998.

6) " Retaining, improving the standard of public transport" p15

   (i) Current share of public transport trips over total trips ? What share is to be retained ?

7) " The improvement of parking situation" p 15

   (i) should public parking increase, decrease or stay constant in the down town area?

8) " improvement of the drainage and treatment of sewerage is imperative"

   (i) area undrained ? where?

9) "put a brake on the social regional differentiation within Budapest?" p 16

   (i) How do you propose to measure it? Mean income per areas?

   (ii) What is implied by this statement?

10) "Retain the compact character of the city… and limit the current extensive growth of the city." p19

   (i) measure density, sprawl index, built-up area.

11) "Radical protection of the existing green areas" p 19

   (i) no extension of current built-up area within municipal boundaries?

12) "The set objective of the concept aims at the maintenance of the dominace of public transport" p 20

13) "Area requirement for newly built flats in Budapest up to 2015 from 1540 to 5150 ha" p 22

   (i) within municipal boundaries? How much should be recycling of already developed land ? how much on green field?

ANNEX 2 : CALCULATION OF THE SPRAWL INDEX

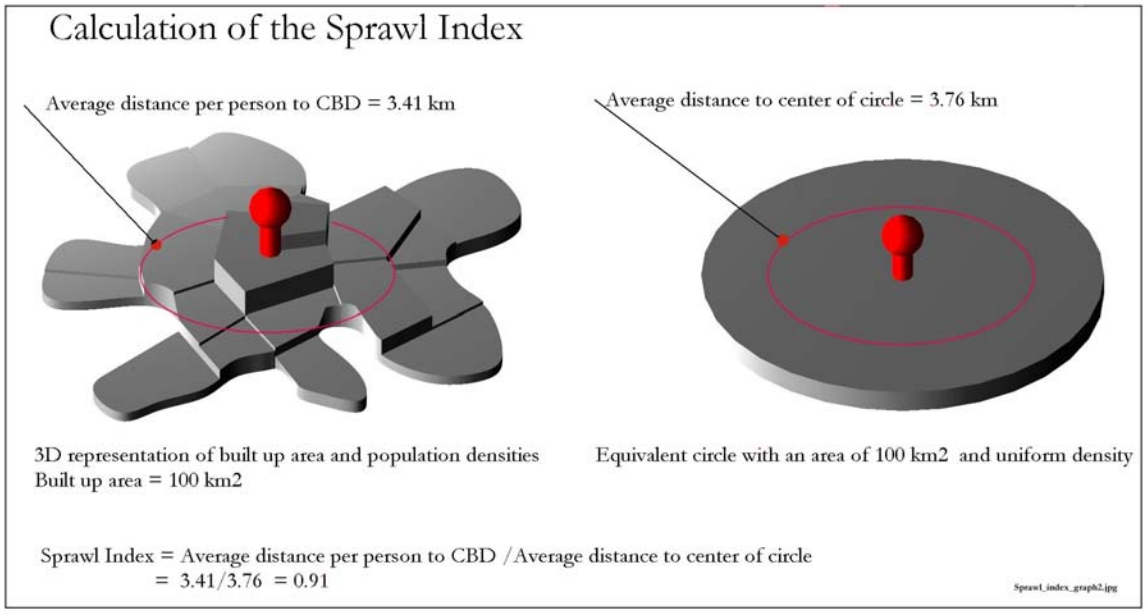

Figure 22: Calculation of the sprawl index

The sprawl index of a urban area is the ratio between the average distance per person to the CBD and the average distance to the center of gravity of a standard arbitrary shape constituted by a cylinder whose circular base would be equal to the built-up area, and whose height will be the population density considered uniform.