METHODOLOGY AIMED AT EVALUATING URBAN LIFE QUALITY LEVELS.

Carlos Discoli. discoli@rocketmail.com; Irene Martini. irenemartini@conicet.gov.ar; Gustavo San Juan. gustavosanjuan60@hotmail.com; Dante Barbero. dantebarbero@yahoo.com.ar; Luciano Dicroce. dicroce_luciano@yahoo.com.ar; Carlos Ferreyro. cferrey@rocketmail.com; Jésica Esparza. jesicaesparza@hotmail.com

Research Group 1. IIPAC (Built Environment Policy Research Institute). FAU (School of Architecture and Planning). UNLP (National University of La Plata). La Plata. Street 47 N ° 162, DC 478. (1900), Argentina

ABSTRACT: The paper explores the theoretical and conceptual aspects of urban life quality (ULQ) synthesized in a model that includes the physical support of the cities, in our case of intermediate scales. This model considers the interactions between basic services, infrastructure and environmental aspects. Maps are shown which localize and define the state of basic needs in infrastructure, services and environment quality. The most vulnerable areas and trends in life quality are identified from the integration of different urban services and environmental aspects according to their consolidation. This allowed us to define homogeneous areas with significant differences in quality and singularities among urban services and environmental aspects. Finally, we make some methodological and operational considerations regarding advantages and limitations experienced in implementing the model.

Keywords: urban life quality levels; urban services and equipment; urban and environmental aspects.

1. INTRODUCTION

The neoliberal policies implemented in Argentina, whose ultimate expression was achieved in the last decade of the twentieth century, have deepened the economic, social, and territorial fragmentation, mainly in urban agglomerations in general and in our region in particular. The cities were part of the epicenter of these changes with consequences still existing despite the socio-economic evolution produced in recent years. This

situation has conditioned lifestyle in many parts of the city, a situation that has increased the gap, in terms of urban life quality (ULQ), between different social groups. Consequently it was considered necessary to produce conceptual and empirical tools to facilitate the visualization of the welfare and environmental state founded in the inhabitants of the cities. This is a complex way since they combine various dimensions in the process of identifying mechanisms that qualify and quantify it.

The management has shown a precarious state in the diagnosis structures, since these challenges, regional planners have few tools to scientifically reflect the situation of urban areas and their perception by the inhabitants. Therefore it is very important to have mechanisms and techniques that facilitate local planning and management, mainly on those dimensions that impact mostly on citizen satisfaction and can be held within the framework of state policies.

In this context the tasks preceding this work, carried out by our research group, were directed to the development of a methodology and a model to interpret and integrate aspects interacting in the concept of urban life quality of the inhabitants from the interpretation of interactions between urban and environmental systems, critical resources and their influence on the environment. This allowed analyzing the demands related to urban services and equipment (we refer to energy, sanitation, transportation, complementary, etc.) and the resulting environmental condition of urban areas according to their state of consolidation. Among the objectives of the life quality model developed, we can include: i. To study the urban and environmental quality life at a local and regional scale; ii. To integrate knowledge of urban services and environmental aspects, considering their coverage or influence areas, the users' opinion and environmental perception; iii. To develop indicators and index that allows measuring the urban aspects and their consequences together with the quality and equity between the services and urban demand. The results obtained were synthesized in qualitative and quantitative multidimensional model whose background and methodology have been exposed and explained in different scientific and academic areas (Rosenfeld, E. et al, 2000), (Rosenfeld, E. et al, 2003), (Discoli, C. 2005-07).

Given the magnitude of the dimensions involved, intermediate cities were adopted as a universe of analysis,

with the purpose of developing a methodology applicable to a large number of representative cities in our region. Its implementation, through an open and conceptually simple model, allowed us to obtain a significant amount of results, which, some of them will be developed in this work. As an example we can mention, urban and equipment services, such as basic infrastructure services (electricity, natural gas) Sanitation (water and sewer) and the main social services (health and education). Regarding environmental and urban aspects, dumps, flooding, air and noise pollution are analyzed.

2. UNIVERSE OF ANALYSIS AND TERRITORIAL UNITS OF APPLICATION

The universe of analysis considered corresponds to the city of La Plata, Province of Buenos Aires, Argentina, representing intermediate urban centers, with different scales and consolidations. It has a consolidated foundation town and surrounding areas of medium and low housing density.

La Plata has a total population of 664,930 inhabitants, of whom 453,419 live in urban area. The territorial unit considered for this study is the urban block (blk). The block was used for the purpose to formulate different urban consolidation sectors, identifying three areas well defined regarding the built density and existing services. The ranges calculated of built density vary from: A = > 72 dwellings / blk and with all basic services, B = 21 to 72 dwellings / blk and with more than two basic services, and C = < 20 dwellings / blk and with two or fewer basic services. For our area, a total of 4144 blk were computed, of which 1260 blk correspond to high consolidation areas, and 2884 blk correspond to medium and low consolidation areas. The population involved in each case corresponds to 200,617 inhabitants and 252,802 inhabitants respectively.

For a better visualization and interpretation of consolidation trends, maps are displayed in a disaggregated or integrated way using higher territorial units (Fraction and / or Radio Census). Figure 1 shows the maps that identify in a disaggregated way three levels of consolidation, obtaining a percentage by occupancy and type of services of each block in relation to the total blocks, and a map that integrates the three levels in a higher territorial unit (urban fractions), including the localization of the surveyed households to assess their opinions.

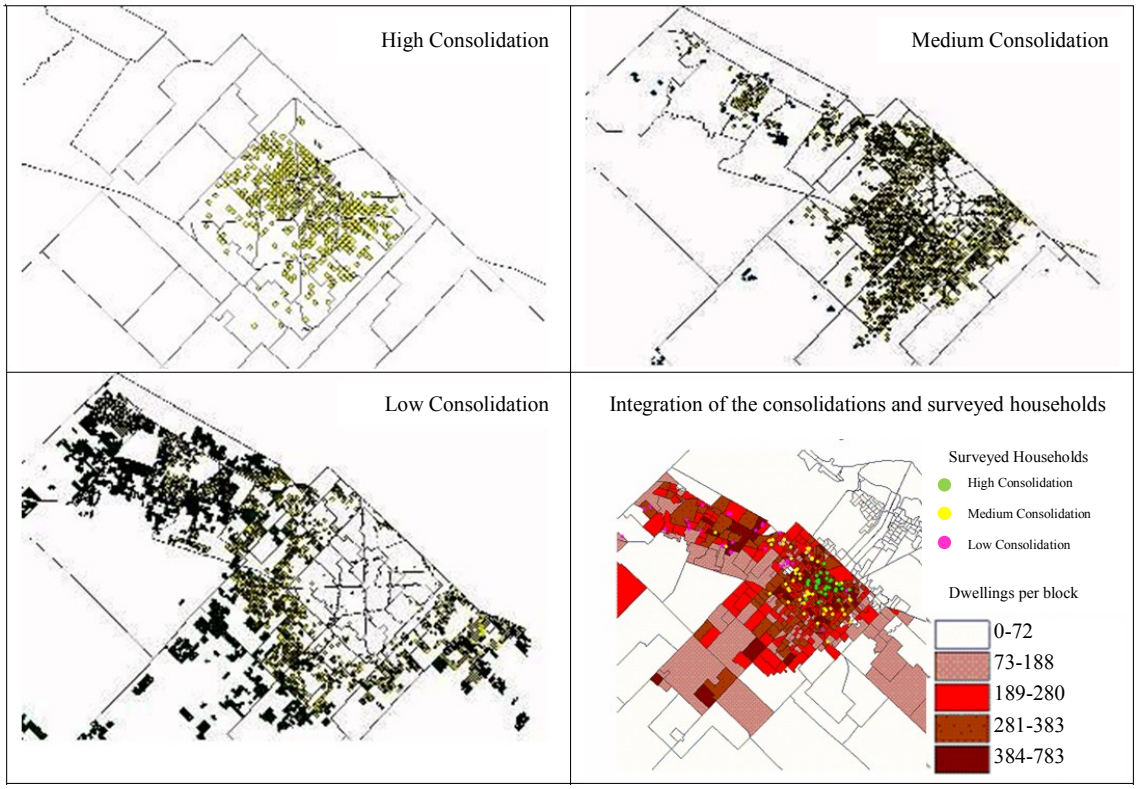

Figure 1. Urban consolidation levels and localization of the surveyed households.

Defined the territorial units, the following step is to develop the methodology for assessing urban life quality levels (ULQ).

3. METHODOLOGY FOR ASSESSING THE URBAN LIFE QUALITY LEVELS.

We believe that the Urban Life Quality (ULQ) is strongly influenced by satisfaction levels that reach the collective needs and demands of different groups of population. We understand that much of the satisfactions are related to urban supply, which we consider from the interactions of material and immaterial resources based on objective needs. Unlike other conventional models (CAM, G. 2005), (Velasquez, GA 2001), among the urban infrastructure and services variables we have incorporated energy and environmental variables involved in the functioning of the city, the evaluation and assessment of the urban-regional services, the opinion / perception of the users understanding them as the demand, as well as the geographical localization of each dimension. The systematization of the information has allowed us to study the behavior of each variable from the interaction of a number of indicators that enable an integral evaluation. The results define

differences and quality levels through georeferenced maps related to matrices with alphanumeric information. The urban services and environmental aspects considered can be grouped into:

• Urban Services and Equipment (ULQuse) constitute the offer, and are evaluated based on their qualities (attributes valuation), territorial coverage and the users' opinion (as a correction factor for the demand side). With the normalization of the results and the interaction of the dimensions considered, disaggregated profiles on quality levels were obtained (homogeneous areas of ULQuse). The services considered can be grouped and summarized in the following levels of integration (Ni): N1 infrastructure basic services (electricity network, natural gas network, and alternative services: electricity by generator, bottled gas, liquid fuels, firewood); N2 sanitation basic service (sewage sanitation by network, drinking water network, and alternative resources, such as soak away, ditch effluent, water by electric pump, water by manual pump) N3 communication services (transportation, railways, main roads, telephony, public telephony, and satellite TV) and N4 social services (health, education, security, firemen, garbage collection, additional resources: pluvial, lighting, green spaces, sidewalks, wooded).

• Urban Environmental Aspects (ULQuea): For their analysis, equivalent criteria of valuation were considered (qualification of the impact, area of influence and perception) and are grouped into the following levels of integration: N5 Urban Aspects (existence of dumps, existence of precarious settlements, existence of dangerous places, flooded areas, industries or inactive residences, incompatible activities with residential use, dangerous and pathogens waste, spatial barriers, advertisements on public roads, transit risk points) and N6 Environmental Aspects (noise pollution, air pollution, soil contamination and water pollution).

As it was mentioned previously, in all cases, "N" hierarchical integration levels are adopted. Figure 2 summarizes the structure of the Urban Life Quality model.

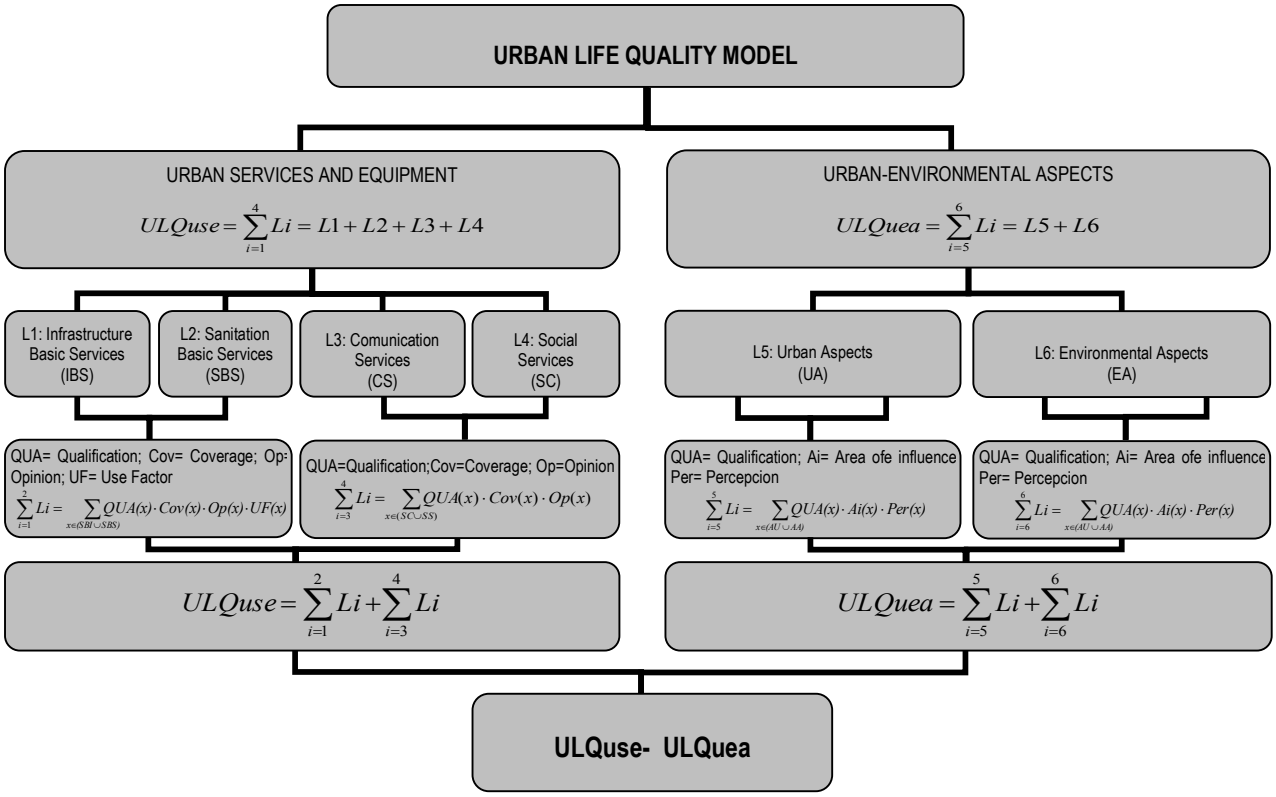

Figure 2: Model structure

The result of each expression will depend on the components valuation of each algorithm and of the interaction of different integration levels (N). One or more services can participate according to the urban area analyzed as well as one or more environmental aspects. The achievable degree of satisfaction of the residents significantly influences the rate of ULQ. In it, objective aspects are included related to the technical, subjective and scientific evaluation of the intangible urban systems, which belong to the social constructions of socio-cultural nature.

Thus the model allows: i. evaluating and qualify each of the involved services, ii. including its influenced geographic area, and iii. evaluating the quality perception by the inhabitants (opinion / perception factor) in a space-time framework.

i. To evaluate and qualify urban services and environmental aspects a set of qualities or attributes of valuation are proposed in order to establish a mechanism of relative weights between services and / or aspects. For its weighting, optimal levels (acceptable) are defined (in the case of services), and of low impact (in the case of

the environmental ones) within existing urban systems. We refer to those urban / environmental systems which count with safe, reliable and regular skills and do not necessarily represent the most efficient. These are the ones that in a social, urban and technology context provide the best answers to the context needs. We refer to those systems whose qualities cover almost all expectations. Consequently, those that meet with these requirements are used as a reference system weighting other systems within a numerical ranking between 0 and 10. The results were verified by alternative evaluation mechanisms such as fuzzy logic. In environmental aspects, weighting includes environmental impact assessment and variables are qualified based on the impact intensity, the sign, its significance and temporality (Discoli, C. 2005a), (Viegas, G. et. al 2006).

ii. Regarding the coverage degree of the services, such as infrastructure, its coverage is considered in the territory (supply or distribution networks), and in the case of other urban services such as health or education, its existence and distribution in the territory is considered. Regarding environmental aspects, an influence area is defined from the affected area by the pathology.

iii. In relation to the users' opinion and the inhabitants' perception, the results are systematized from the declaration, identification and / or disturbance degree that they express. This information can be obtained from different tools of data collection: structured surveys, news media under different supports (written, virtual), citizen advocacy organizations, etc. The use of different sources or recollection tool will depend of the availability of information in each case, since each of them can be applied independently or complementary. With the obtained results maps were generated from the coverage / influence area, opinion / perception and quality of each service defining homogeneous areas.

The various components of each expression (service qualification, coverage / influence area and opinion / perception) are included, and the results are evaluated and normalized in alphanumeric databases (SPSS13) and georreferenced in GIS (ARC Gis 9). The resulting maps allow identifying in the territory life quality levels for the urban components analyzed. These show different trends in relation to their urban consolidation and to the integration levels of different systems, network services, and environmental aspects. The next step

is to show the resulting maps for urban services and equipment as well as urban-environmental aspects disaggregated into some significant integration levels Ni.

3.1. Urban services and equipment. Analysis of the opinion, coverage and Urban Life Quality levels.

The results obtained in the application of the ULQ model in La Plata city, Argentina, are synthesized in maps where the reached levels for urban components for N1 (infrastructure) and N2 (sanitation) and its integration are registered.

Under the urban consolidations described, disaggregated outputs are obtained from the model, for each service where the users' opinion, their coverage and the quality of each urban service are shown in a detailed and standardized way. The latter can identify on one hand, the degree of unmet needs in those maps registered with ULQ lower levels, and on the other hand, through the components of the model (qualification, coverage and opinion) if the dissatisfaction is due to the lack of service (coverage), or to problems of each quality, evidenced both in the qualification as in the users opinion. In both cases the model can generate and view maps with specific data. Figure 3 shows an example of ULQ levels trends for basic infrastructure services (N1). Users opinion maps, coverage maps and ULQ maps for electricity services (EE) and natural gas network (NG) were calculated in a disaggregated way.

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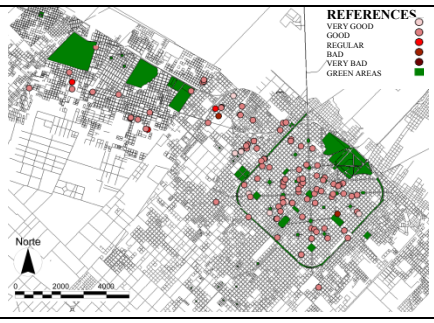
<td> 
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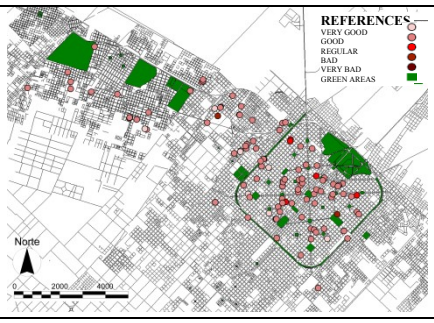
<td> 
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<td>Electricity Service. Opinion map.</td>
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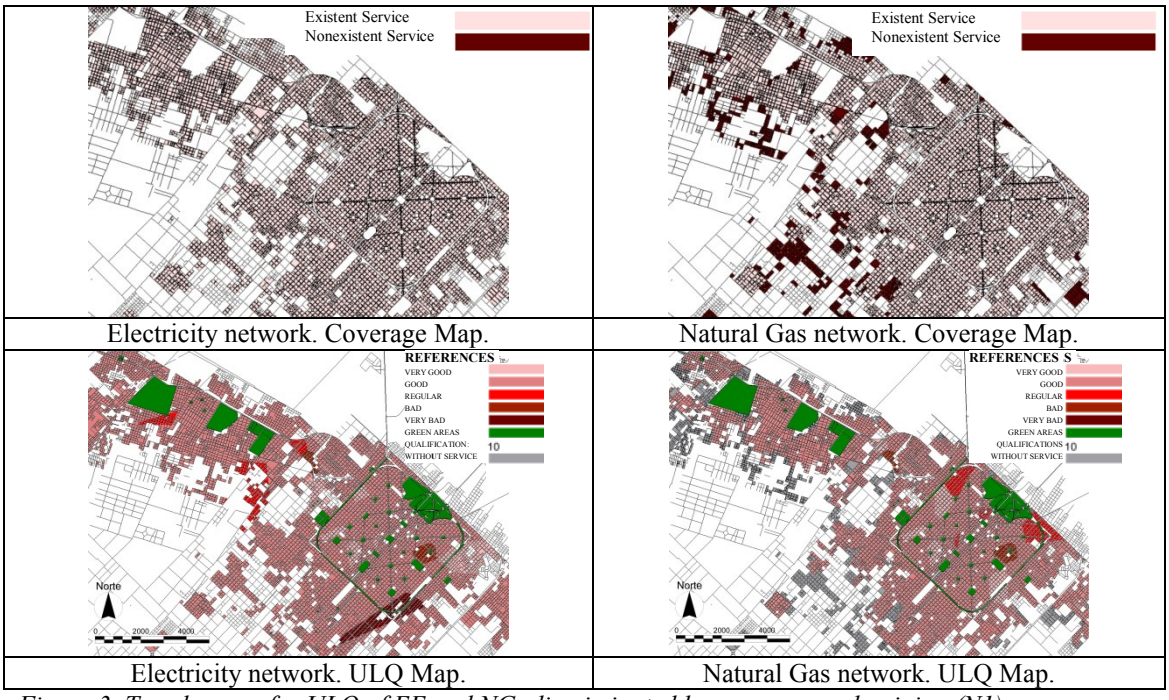


Electricity network. Coverage Map. | Natural Gas network. Coverage Map.

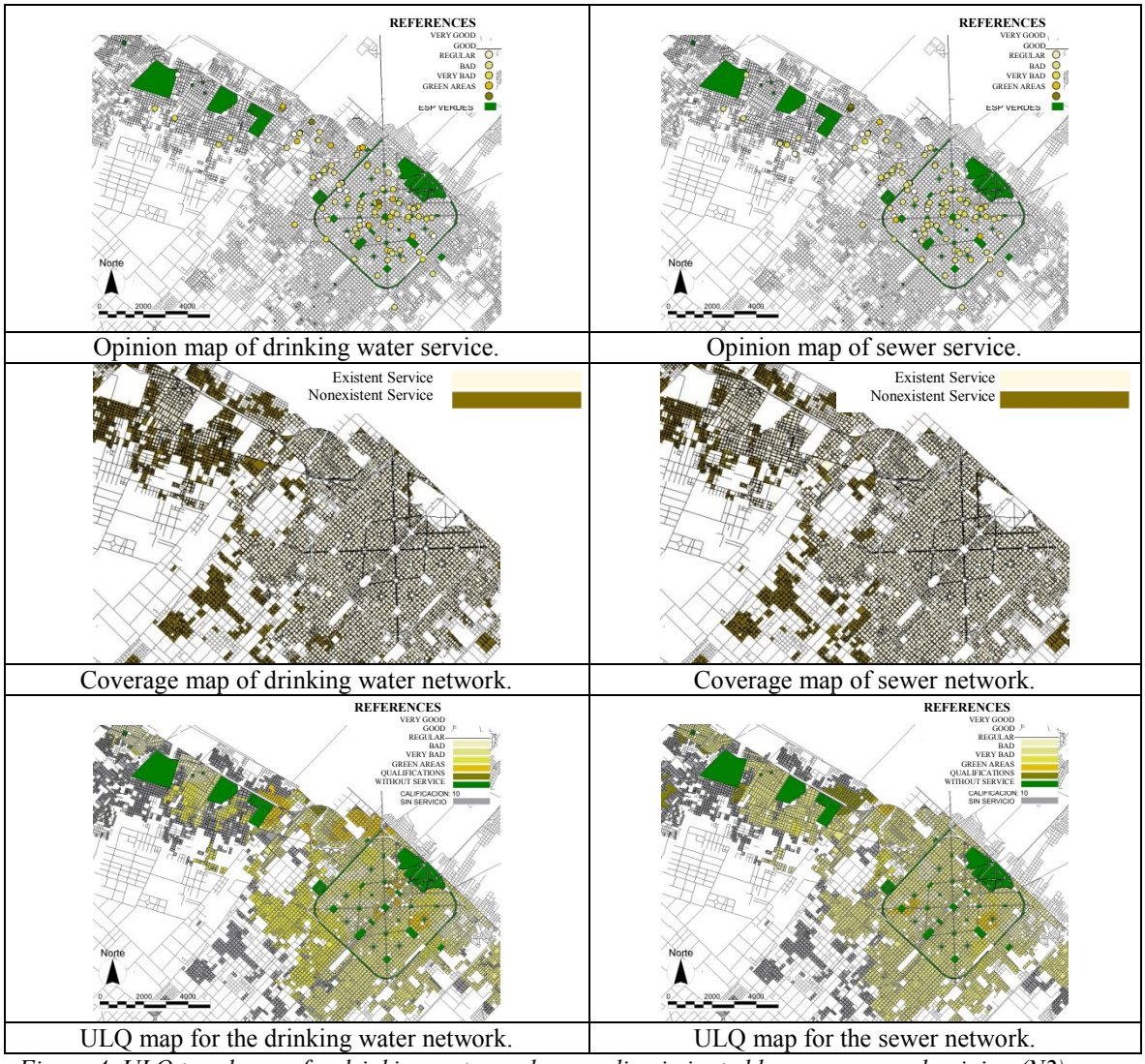
Electricity network. ULQ Map. | Natural Gas network. ULQ Map.

Figure 3. Trends maps for ULQ of EE and NG, discriminated by coverage and opinion (N1).

It is observed that ULQ levels of EE present some differences mainly justified by the opinion component of the model since the coverage of this service is practically 100% of the territory. The differences expressed by the opinion arise primarily from problems related to the divestment, cut off frequencies, voltage quality, etc.; mainly in those areas where distribution networks are obsolete or are in an over consumption situation. As for the natural gas (NG) services, low levels of ULQ, are observed, coinciding with smaller consolidation areas, in particular the more peripheral locations. This service verifies areas without coverage (gray areas), in which energy substitutes vectors are used (bottled gas, solid fuel, etc.). In these cases, although the maps are not exposed in this work, ULQ levels become substantially worse, mainly due to the discontinuity of the services (bottled gas distribution) and because of their higher costs. For areas of higher consolidation, homogeneous areas with higher levels of ULQ exist, although with some variations in their results, adjudging in these cases low pressure problems caused by the high population density, and problems in the offices customer service.

In the same way, other basic sanitation services (N2) were studied, such as drinking water, sewer, and social services related to health and education. Figure 4 shows the characteristics of each service. Less coverage is verified in drinking water with respect to sewers. In the case of drinking water, ULQ levels show dispersed homogeneous areas, with significant inequalities in different consolidations. In the centre of the city (high and

middle consolidation), despite of registering a better service, significant fragmentation are identified with significant areas of very low ULQ level. This map advertises the critical situation of the drinking water service in the region, mainly caused by the obsolescence of the supply networks. The sewer service presents fewer difficulties than the drinking water service in the intermediate and high consolidations, since it is a service, which its qualities or valuation attributes register lower difficulties. As for the opinion, it expresses less conflict (except in cases of obstruction). It should be noted that it presents major inequities in urban peripheral consolidations as the lack of networks maximizes environmental conflicts. In a similarly way, all services are studied, respecting in each case, hierarchical levels (n) and its peculiarities (qualification, qualities, coverage and users opinions).



Opinion map of drinking water service. | Opinion map of sewer service.

Coverage map of drinking water network. | Coverage map of sewer network.

ULQ map for the drinking water network. | ULQ map for the sewer network.

Figure 4. ULQ trend maps for drinking water and sewer discriminated by coverage and opinion (N2).

Using the same methodology and criteria of analysis, social services (N4) were calculated, where, in this instance, health and educational network were considered. In these cases we also evaluate each service according to their qualities or attributes of valuation (accessibility, continuity, professionals' availability, availability levels and availability of infrastructure, among others). Coverage is analyzed in terms of the following criteria: for hospitals, clinics and nursing a radius of coverage of 2000m was adopted, and for medical units, 500 m. These distances were defined by the Ministry of Health considering the accessibility by different means. In the case of the education network, an influence radius of 1500m was considered in relation to school Criteria and Basic Architecture Standards. As for the opinion, maps are obtained with its location in the territory. With such information maps are defined with the ULQ results for each mentioned service, which are shown in Figures 5 and 6. Some differences are observed in the territory on both networks. In the health network, weakness is attributed to the coverage, mainly on the preventive services (first aid), located primarily in areas of medium and low consolidation. And in the education network failures have been observed mainly in the opinion, admitting that despite they count with the coverage, there is some disagreement as to the quality of the service, awarded to problems of access, infrastructure, etc. in certain areas of the city.

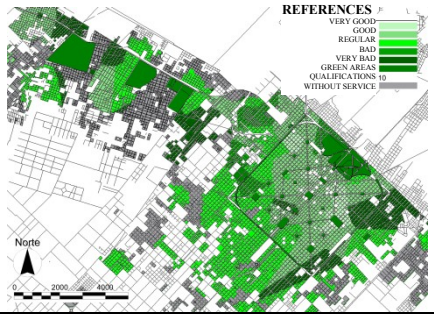


Figure 5. ULQ level map. Health.

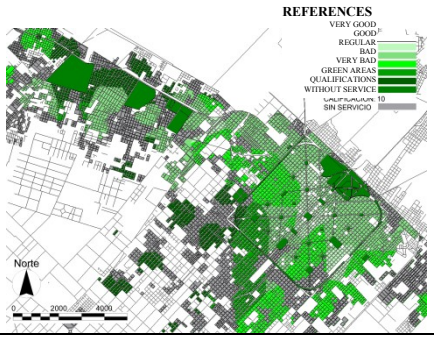


Figure 6. ULQ level map. Education.

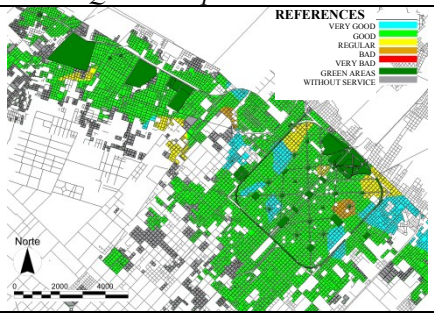


Figure 7. ULQ map integrating N1 (EE y NG).

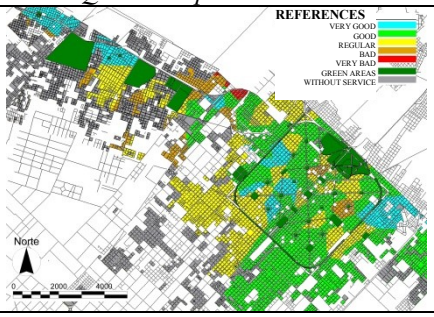


Figure 8. ULQ map integrating N2 (Drinking water and sewer).

With the partial results of ULQ of the urban services and equipment, Ni levels were integrated, taking into account the different basic infrastructure services (EE, NG), and sanitation (drinking water and

sewer), obtaining partial maps of ULQ for N1 and N2. It is observed that ULQ levels are enhanced or minimized depending on the matches or dissent of each component of the model (qualification, coverage and opinion). Figures 7 and 8 show the integrations for N1 and N2 highlighting areas which have changed the ULQ levels based on the juxtaposition in each level and results. Areas with improvement trends and others that maintain their situation are observed.

In a new integration, we group the basic infrastructure services and of sanitation calculated in a single map, making juxtaposition between levels, and providing ULQ maps for N1 + N2. Figure 9 shows the output map of the model, in which large areas with good ULQ level are identified, specific sectors with regular and bad levels, and those sectors that do not count with the coverage. As we have already mentioned, the service´s overlay allow visualizing those areas in which good performances or problems are juxtaposed, generally evidenced by the general opinion of users. The irregularities in areas of highest consolidation have to do with the obsolescence of some services, while in the peripheral sectors we can find unforeseen growth with problems related to divestments (generally, exceeded coverage demand).

Continuing with the integration process and under the same criteria, social services (N4) were considered, in which health and education network were included. Figure 10 shows social services integration representing in the map the ULQ level results for N1 + N2 + N4.

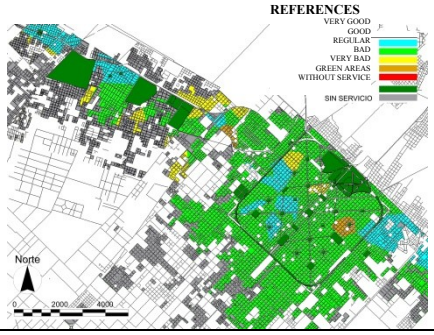


Figure 9. ULQ map. N1 + N2 level ((EE+NG)+(Drinking water+Sewer)).

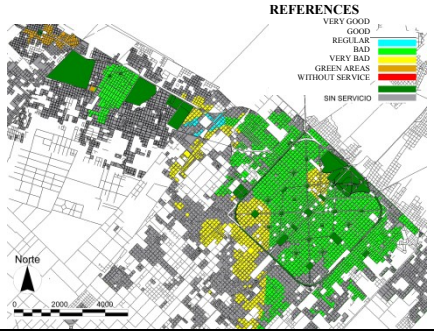


Figure 10. ULQ map. N1+N2+N4 levels ((EE + NG) + (Drinking water + Sewer) + (Health + Education)).

It is noted that in the integration process some urban areas modify its results in relation to the ULQ levels incorporated. They can improve or worsen, but quality displacements are observed in the urban area and greater inequities in the periphery. This shows that the incorporated sectors (health and education) are strengthened in terms of good quality in higher consolidations and failures occur in remote areas, defining

more precisely the areas with unmet needs. We also have to keep in mind that different ULQ areas are indicative, whose boundaries depend on the precision level and location of the base information.

3.2. Urban-environmental aspects: Analysis of the perception, area of influence and Urban Life Quality levels.

To study Urban-Environmental Aspects and to quantify the quality index (ULQuea), various pathologies are evaluated and the evaluation criteria are applied stated in the general methodology (impact qualification, area of influence and perception, see Figure 2). In this case, integration levels correspond to N5 which include Urban Aspects (dumps, among others already mentioned) and N6 covering environmental aspects (noise pollution, air pollution, soil contamination and water pollution). Just as in urban services and equipment, the participation of one or more of them will determine the characteristics of the urban area under study.

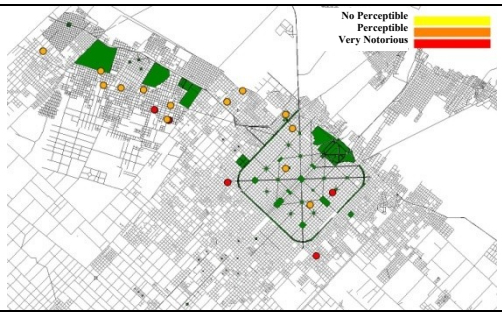
To obtain ULQuea index, each pathology is affected by the following indicators:

i. Qualification (QUA): it is evaluated from the study of decision matrices. For each pathology, the impact intensity, the sign, its significance and temporality is analyzed (VIEGAS G. et. al, 2006) (Discoli, 2005).

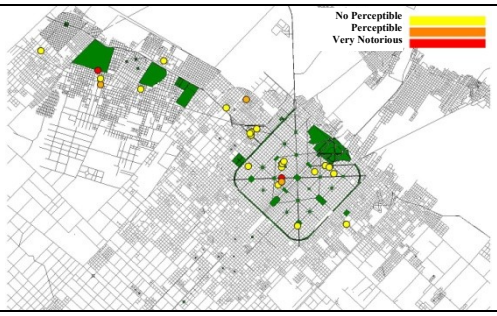
ii. Area of Influence (Ai): it is dimensioned from the affected area of each pathology.

iii. Perception (Perc): it is evaluated from the identification degree and / or disturbance of each pathology expressed by the inhabitants.

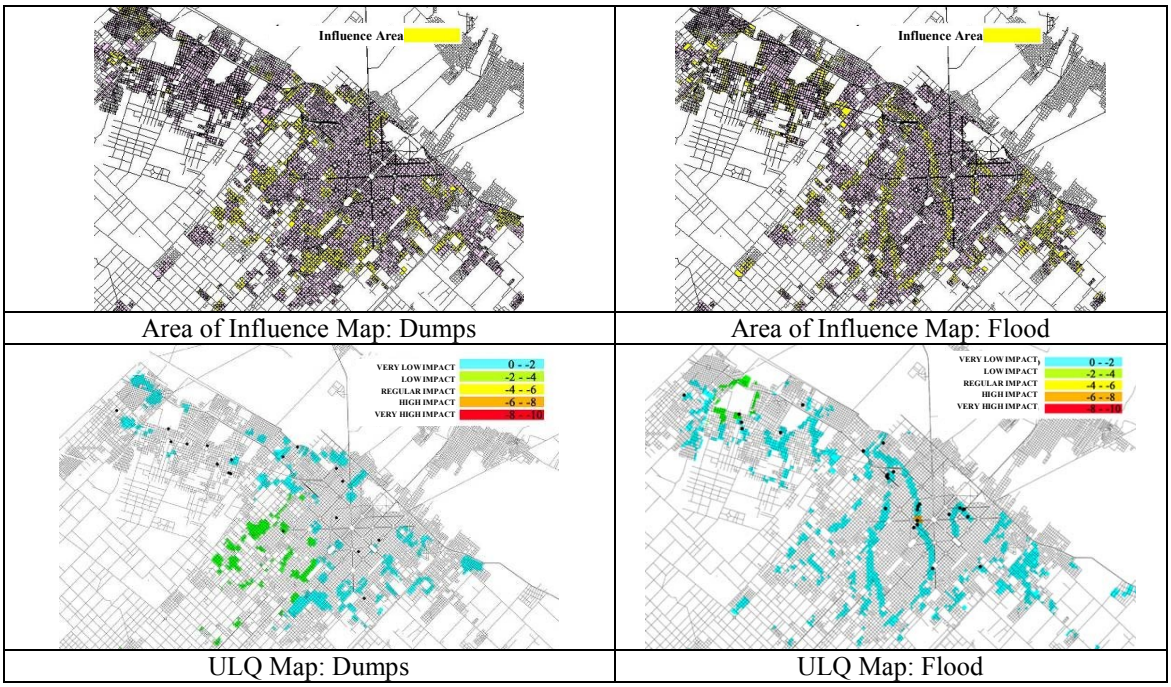
Figure 11 shows an example of the results obtained in terms of qualification, perception, area of influence and ULQ levels for urban aspects (N5). They were calculated in a disaggregated way for Dumps and Flood.



Perception map: Dumps



Perception map: Flood



Area of Influence Map: Dumps	Area of Influence Map: Flood
ULQ Map: Dumps	ULQ Map: Flood

Figure 11: Trend maps of ULQ for Dumps and Flood, disaggregated by perception and area of influence. (N5).

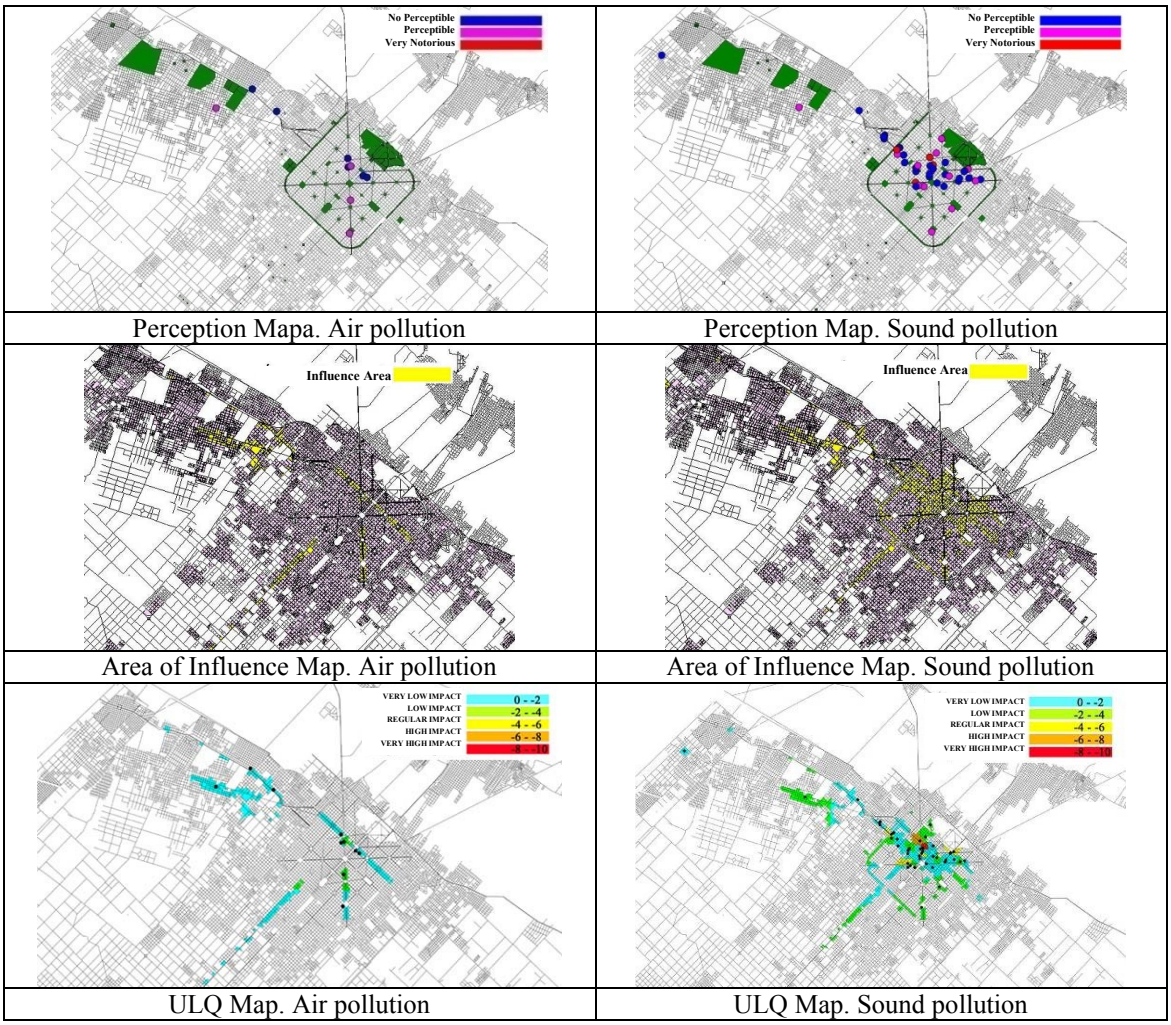
In relation to the obtained ULQ levels, the maps identify the balance of the environmental aspects in the territory. Different responses are identified in relation to the origin and type of pathology, and of different sensitivities of the habitants regarding their perception. In this case, for example in Dumps, the origin and type of waste respond to low impact urban waste (organic and inorganic), with a low level of perception. In this particular case the methodology considers it necessary to count with an opinion against test or contrast (qualified person) as it is verified in the inhabitants certain level of adaptation to the pathology, situation that leads to minimize its perception.

In the case of flood areas, watersheds and natural drainage of the region are analyzed, noting that some of them are piped mainly in the urban area. To assess the affected areas, a risk map, determined by the CISAUA (CISAUA 2006), was considered which is overlaid on the urban map with differentiated urban sectors (residential, education, health, etc.) delimiting for its assessment the risk areas according to hydric hyght, affected habitants and perception in relation to the sector (Discoli, C. et al. 2007), (Discoli, C. et al. 2008).

With regard to the environmental aspects (N6), we mainly evaluate noise pollution problems and air quality affected by the emissions from the public and private transportation system. For its assessment,

gases concentrations were analyzed those that are emitted in transport corridors and distributed in residential areas. Regarding to its perception, habitants are surveyed in different areas of the city.

Figure 12 shows that Air Pollution is observed throughout the region, but the morphological and hygienic characteristics of La Plata minimize its impact. Which shows a greater diversity of responses is Noise pollution, since they are very present in the most affected areas. These results justify the need for deepening in the aspects related to the perception, since there is a significant interest in the algorithm calculation and in the sensitivity of the results.



Perception Mapa. Air pollution	Perception Map. Sound pollution
Area of Influence Map. Air pollution	Area of Influence Map. Sound pollution
ULQ Map. Air pollution	ULQ Map. Sound pollution

Figure 12: Trend Maps of ULQ. Air and sound pollution, disaggregated by area of influence. (N6).

It is also observed in this case, that the ULQ levels are enhanced or minimized depending on the matches or dissent of each component of the model (Qualification, Area of Influence and Perception).

CONCLUSIONS

The Urban Life Quality Model integrates a wide set of aspects and variables, and allows assessing quality in terms of the different sectors of the city. This will allow identifying homogeneous areas with satisfactions and dissatisfactions regarding basic needs in infrastructure, services and environmental quality.

Assessing the quality of urban services and equipment and of the urban-environmental aspects with the Urban Life Quality Model, has allowed us to qualify and quantify the results with an acceptable approximation to the reality. This methodology provides necessary information for the evaluation of actions in each urban intervention, thus establishing the basis for defining Urban Life Quality levels. Areas with inequalities provide relevant information required to establish new mitigation scenarios in each vulnerable area.

The results obtained show significant sensitivity to the conformation of homogeneous areas descriptive of each situation. These can be analyzed in a disaggregated way, considering the detailed information of the different components of the model (qualification, coverage / area of influence and opinion / perception), in order to establish the causes of each situation.

In summary, the results obtained show a significant sensitivity from the diversity of the evaluated variables. The values warn, in relative terms, significant differences, demonstrating the reality of each situation.

To count with indexes of Urban Life Quality (ULQ) and its geographic location, allows evaluating qualitatively and quantitatively the basic needs of the habitants. Incorporating a set of dimensions to the ULQ model, that constitute important components of everyday and future life of a city, allows analyzing and evaluating the current situation in order to consider the possible actions for situation problems and future planning.

It is clear that ULQ levels show significant sensitivity to the peculiarities of each urban service and to its

consequent environmental aspects. It is also clear that from the territorial aspects, strong contrasts are identified, very permeable to the type of offer localized in each sector (we refer to the technological and coverage circumstances of urban services in general), to the expectations of demand expressed through the opinion / perception, and to the environmental consequences caused by this interaction.

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