URBAN LAND USES
IN
NOGALES, SONORA, MEXICO

By

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In memory of Kenneth Clark

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ABSTRACT

This master's report analyzes the urban land uses in the prosperous industrial and commercial city of Nogales, Sonora, Mexico. This city has had in the last three decades an accelerated growth which is expected to continue. Nogales is located in a narrow valley surrounded by small mountains ranges and its location is an obligated pass in the US-Mexican border. In 1995, this city had a population of 131,000 inhabitants with an urban area of 2,276 hectares. Historically, the city has had a linear urban development which is based a single linear core "El Centro" where commercial and institutional uses are concentrated. This linear urban development is impacted by the border setting of the city and this development is primarily occupied by residential land uses with a cluster organization followed by commercial and industrial land uses with also a cluster organization, then by institutional, educational, and recreational land uses that have a random organization. Although, the linear urban development and the urban land in Nogales have several advantages, they have failed to provide an adequate and fair supply of institutional, educational, and recreational land uses as well as to provide a balance urban development for the city. The alternative proposed to break this urban situation would be to develop subcenters in the city and to stimulate the development of the eastern part of the city, creating a new border crossing point and the building of a system of arteries that entirely connected the city. This alternative proposes an equitable distribution of the services and a strong interrelationship between the transportation system and the land uses in the city.

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Introduction

Urban planners consider the study of urban land uses to be an indisputable prerequisite to successful community planning. This study is based upon the firm knowledge of existing urban land uses, permitting the planner to know the aspects of supply and organization of the land as they relate to the city requirements. This knowledge reveals the failures, maladjustment, or success of the urban context to provide adequate amount, location, and spatial relationship of land for effective economic and social functioning of the community. Thus a clear understanding of the urban land uses supports a more rational and functional practice of planning.

Knowledge of urban land uses allows planers to obtain data to support the following objectives:

a) To forecast land for city requirements, to preserve key or prime land parcels for industrial, commercial, services, and institutional use

b) To balance land use and urban patterns, preventing the congestion of the transportation system

c) To maintain the character of the community and neighborhoods by preventing the intrusion of adverse land uses or preventing the exclusion of complementary land uses

d) To conserve fragile and valued ecological land

In addition, this land use study allows planners to develop a descriptive urban models (or at least schema) for the understanding of the organization and function of the city. These aspects support planning to conserve, organize, and develop land and to allow an ordered urban growth.

A firm knowledge of the existing urban land uses that are related with its context, is unquestionable, especially in the rapid urban growth regions of the Mexican-US border. However, our knowledge of urban land uses is still far from satisfactory. Such study does not appear to be a top priority for local authorities, at least not in Nogales, Sonora. No studies of urban land uses exist which can contribute to the success of the planning on the Mexican border cities. Thus, the research in this area is a challenge to urban planners to support successful planning in those communities.

Several studies have greatly contributed to my understanding of urban land uses in general. Among those works are the followings: those related to statistical analysis of urban land uses, those related to the location and spatial relationship of land uses, and those related to urban land uses and borderlands.

One of the most empirical important work concerning urban land uses was developed by Harland Bartholomew in 1935 and 1955 and were titled Land Uses in American Cities. In those studies, Bartholomew examined urban land use characteristics in central cities, satellite cities, and urban areas, those places varying in size, in the north-east region of the United States. Bartholomew provided basic data to practical application in urban planning. At present, several municipal governments employ basically similar

methodology to the one used by Bartholomew in 1955. For example, the City of Tucson in 1990 developed a land use survey which examined land use ratios and densities which were compared with other American cities. Moreover, this study of land use has encouraged the city to develop management polices more appropriate to the urban development of Tucson. These two studies will be the base of the system of measuring urban land use in Nogales, Sonora.

In the area of the location and spatial relationship of land uses are the studies of economic urban land theories, social urban land theories, and several descriptive urban models. These studies have basically contributed to the understanding of location and spatial relationship of land uses. Economic urban land theories have been principally derived from the agricultural land theories of David Ricardo (1817) and J.H. von Thunen (1826). In 1948 Edgar M. Hoover in his book Land Use Competition reported that downtown land is occupied on the basis of its position advantages. Another economic urban land theory that explains the location and spatial relationships of urban land uses is the theory of William Alonso (1962) in his book titled Location and Land Use . Alonso maintained that the patterns and shapes of residential land uses are fundamentally related with the cost of the land, the cost of transport, and zoning.

Social urban land theories also are related to land market theories. Sociologists Eshref Shevky, Marrilyn Williams, and Wendell Bell have shown how economic, culture, ethnic and family characteristics interrelated to produce the distinct spatial relationships

and locations of types of residential land uses within the city. Earlier, Walter Fired developed a sociological theory of land use in his Land Use in Central Boston (1947)

Descriptive urban models also contribute to explaining the location and spatial relationships of urban land uses. The Concentric Zone Model, developed in 1925 and attributed to E. W. Burgess, posited the business district at the center around which other successive zones are organized. Burgess established clearly the transition concept in his model. However this model failed to account for the impact of transportation routes on land use. This situation was later considered in the sector and ring models. Sector Model, developed in 1939 by Homer Hoyt, assumed that uses forms sectors following transportation corridors and uses once emerged remained in the same area and extend over time in the same direction as the city grew. This model is based on a single core. About 1950 Chauncy Harris and Edward Ullman developed the Multiple Nuclei Model which changed this premise of the single core and recognizes that uses form around several nodes. More lately, an Urban Realms Model, known as the "pepperoni pizza model", developed by James Vence in 1964, recognizes that the formation of self-sufficient sectors with a downtown independent of the traditional downtown and the central city. Those independent sectors are distinctive elements of this model. Definitively, these descriptive urban models have contributed to the conceptualization of the location and spatial relationships of the urban land uses, although they do not totally explain this phenomena. Recently, Philip Kivell (1993) in his book titled Land and the City explained the patterns and process of urban change principally in American and

England cities, establishing that the politic-economic system determines the allocation of land and other commodities. Kivell affirms that the market economy dominates the location and change of land uses in industrial societies with the needed intervention of government institutions to regulate social imbalance of the land use. Kivell sets the nature of urban land using economic theories and descriptive urban models. In addition , he analyzes how the decline of manufacturing, new economic activities, technology, and new social lifestyle trends are changing the traditional role of the city. He states that this phenomenon has caused new urban land uses and location requirements in American and European cities.

Although the study of urban land uses is an old research practice and there exists a wide number of studies on this theme, the use of these studies in border settlements has been particularly limited. Despite that, since 1963 J.V. Mingi in his article titled Boundary Studies in Political Geography identified urban land use in border cities as an important research area. He established that international boundaries impose particular features on the land use and urban patterns. Studies of urban land use in Mexican border cities have rarely been developed, but four important studies exist about the geography of border cites. These studies have contributed to broach of the present urban land uses in Mexican border cities. In 1964, Charles R. Gildersleeve published his study Land Use Contrasts in a Border Economy in which he examined the urban land use of Both Nogales in the framework of its unusual geographic and bi-cultural setting. Later, in 1978 the same author developed his PH. D. thesis titled The International Border City in which

he claims that Both Nogales form a specific spatial urban unit. His thesis is that a spatial unit formed by a Mexican city and an American city is a distinct one . This thesis was strengthened by the study of Lawrence A. Herzog in 1990 titled Where North Meets South he also argues that a metropolitan area is formed by the city of Tijuana and San Diego. Another basic study of Mexican border cites is the study developed by Daniel D. Arreola and James R. Curtis in 1993 titled The Mexican Border Cities. They examined eighteen Mexican border cities each one with its sister city on the American side, to support their claim that those Mexican cities, despite their proximity to the United States, are fundamentally Mexican places distinguished by landscape anatomy and place personality. In addition, Curtis presents the descriptive urban models of border cities of Gildersleeve and Hooffman, and developed a general descriptive urban model for Mexican border cities. These studies noted above provide the framework of urban land uses of Nogales, Sonora.

However, these studies suffer some limitations when applied to the specific border setting and current situation of Nogales, Sonora. Urban planners have presented convincing data of the relationships between urban land use and the particular framework of an analyzed community. Land use and urban patterns are inextricably related to physical, social, economic, and political characteristics which are in constant change in capitalist societies. (Bartholomew 1935 & 1955, Arreola 1993, Kivell 1993). When Charles R. Gildersleeve brought out his study in 1964 Land Use Contrasts in a Border Economy , Nogales had only 34000 inhabitants and was principally a city of commerce

and services. At present, the city has approximately 140,000 inhabitants and industry is its predominate activity. The circumstances in Nogales have radically changed from 1964 to 1995 producing changes in the amount, uses, location and spatial relationship of land utilized for the development the community. Because of this situation, a study of urban land use in Nogales, Sonora is fundamental to updating and increasing the knowledge of this area of its urban land use. This study is necessary to support the planning of the city in its current rapid and anarchic urban growth.

The main purpose of this study will be to develop a descriptive urban model for the City of Nogales, Sonora. This model should contribute to an understanding of organization and function of the city, and thereby promote an urban development adequate for the community. This model will present a specific shape which will be related to the growth characteristics and spatial distribution of the population, to social behavior and habits, to the location and physical aspects, and to economic functions in the city. Also, this model will present different arrangements from the descriptive urban model of Mexican border cities developed by Curtis in 1993. In addition, this study will present data of classification, ratios, density, location, and spatial relationship of urban land use, and an urban pattern of the city to be analyzed, interpreted, and compared in order to support this hypothesis.

The proposed organization will begin with a theoretical and methodological framework to develop the study of urban land uses in Nogales, Sonora. Introduction has been developed where literature was initially cited. Next, the examination of Mexican

border cities, particularly the city of Nogales Sonora will be developed. Then, the past and present urban land uses of Nogales Sonora will be collected, classified, and analyzed. Finally, the data of ratios, density, location, and spatial relationship will be compared, and summarized. The descriptive urban model of Nogales, Sonora will be developed and compared to descriptive urban model of Mexican border cities previously developed.

2

Theoretical Framework

In order to investigate urban land uses in Nogales, Sonora and these urban land uses are related to the city's context. This research has the main propose of the development of a descriptive urban model for that City. Thus, the theoretical framework of this research will require three main steps. First, a system of urban land use classification and evaluation will be developed. Second , economic urban theories, social urban theories, current descriptive urban models and concepts of urban structure will be presented. Third, the general context of Mexican border cities with United States and specifically, the context of Nogales, Sonora will be introduce and will be more broadly presented in the next two chapters. These steps will permit the planner to collect, classify, measure, understand, compare, and evaluate the urban land uses to obtain the ratios, density, location, and spatial relationships of these uses of this city. These tasks will also permit the researcher to develop a descriptive urban model, which will be compared with other descriptive urban models of Mexican border cities previously developed.

2.1 System of Classification and Type of Survey of Urban Land Uses in Nogales

The first step is to define the type of survey and the system of classification to order, collect, measure, compare and evaluate the urban land use of Nogales, Sonora. The type of urban land use survey that presents the greater major number of advantages for this research is the ground survey. This type of survey has the characteristic that the information obtained is more detailed and accurate. Mexican cities have an irregular

activity patterns underlying their urban land uses and it is difficult to apply aerial photography and remote sensing techniques in the urban land use studies. Although, in the analysis of government and institutional urban land uses, both ground and aerial techniques were used. For the system of urban land use classification in Nogales, Sonora the following aspects were considered to define its categories and organization. First, an inventory of the current urban land uses was required. Then, the system of classification used in descriptive urban models previously developed was considered. Next, the system of classification used in the Plan de Desarrollo Urbano de Nogales, Sonora and in the land use survey of the City of Tucson in 1990 were also examined and considered. These aspects defined the following urban land use classification to be used in this research.

Urban Land Use Classification of Nogales, Sonora in 1995.

- Industrial/Maquila
- Commercial
- Governmental/Facilities
- Recreation/Green Areas
- Residential
  - High Quality Residential
  - Middle Quality Residential
  - Low Quality Residential
  - Substandard Low Quality Residential
- Vacant

Ground and aerial photography surveys and the system of classification permit the planner to measure ratios and densities of urban land uses. Basically, the system to measure ratios and densities was the system used by Bartholomew in his study in 1954. It is precise in connecting each type of urban land use and population or each type of urban land use and the total urban area. He affirmed in his study "that the function of each city is in some respect different from that of all other cities, each tends to develop individual and intricate pattern of land use", although different cities have many features in common. He also claimed that land use patterns of each city are rational and essentially functional and land use data can be more useful when data for a large group of cities is studied. In 1990, a land use survey was developed in Tucson, Arizona where similar methodology to that employed by Bartholomew in 1955 was used. In that study, Tucson had significantly lower densities and industrial land use ratios, and higher vacant land use ratios than other American cities. For Nogales, Sonora, the density of population per hectare and the coefficient of use of the land per hectare also will measured in this Land Use Study. Also, maps of the location of the urban land uses will be presented which will be the basis for developing a descriptive urban model for Nogales, Sonora and its context. For this task, the knowledge of economic urban theories, social urban theories, descriptive urban models, and urban structures are required.

2.2 Economic Urban Theories and Descriptive Urban Models

In the second step, economic urban theories, social urban theories, descriptive urban models and urban structure will be presented. This will contribute to the

understanding of ratios, densities, location and spatial relationship of urban land uses. Economic urban land theories basically support the posit urban land uses are located where they can have the maximum profit. Economic urban land theories were originally derived from the work of David Ricardo (1817) and J.H. von Thunen (1826) whose agricultural land theories which assumed that the agriculture land use patterns around the city, and the market for farm goods, resulted from the demand and cost of farm goods. The land was assigned to the highest bidder in each case. These two studies recognized that rent varied with the fertility and situation (location) of the land. In the case of the location of urban land use, as in the agriculture case, it is decided by the convenience or nearness. The urban activities with the highest profit occupies the center or the most important communication nodes. Generally, this activity is commercial followed by residential and industrial uses which occur at greater distances from the center of the market. In 1948 Edgar M. Hoover in his book Land Use Competition reported that downtown land is occupied on the basis the advantages of its position. The ability of the center to offer a convenient accessibility attract activities with the highest "business" profit. Another economic urban land theory that explains the location and spatial relationships of urban land uses is the theory of William Alonso (1962) in his book titled Location and Land Use. Alonso principally explained that patterns and shapes of residential land uses are fundamentally related to the cost of the land, the cost of transport, and zoning. Alonso also established that residential land uses are especially impacted by the cost of friction (Transport), and residents, to minimize their cost obtained

lots smaller area but better accessibility. This situation explains how residential uses are located where theoretically there should be another type of urban land uses such as business which could obtain a higher profit. Alonso affirmed that the patterns of land uses and land values will be mutually determining. He also presents in this book the impact of a city with two centers and the impact of transportation in the values of the urban land uses. Alonso viewed transportation from an economic perspective. This situation the interaction between transportation system and land use patterns was more clearly explained by Terry Moore and Paul Thorsnes in 1994 their study The Transportation and Land Use Connection. They recognized that this relationship goes both ways: changes in land use have effects on existing transportation flows and travel times, and changes in road transit systems have effects on land use and transportation patterns.

Sociological urban land theories also are related to land market theories. Social urban land theories were developed in the 1950's by the sociologists Eshref Shevky, Marrilyn Williams, and Wendell Bell. They established that economic, culture, ethnic and family characteristics interrelated to produce distinct spatial relationships and location of types residential land uses within the city. Definitively, the cost of the land, the cost of transport, and zoning are the fundamental factors stimulating the grouping of different social areas, basically related to residential land use in the city.

Descriptive urban models also contribute to explaining the ratios, densities, location and spatial relationships of urban land uses. These models are fundamentally supported by sociological and economic urban land theories and they also assume that

urban land uses have different needs of accessibility and transportation requirements. These requirements result in a gradient of intensities or clusters of urban land uses. Consequently, urban land use has the location where the maxim profit is obtained. The Concentric Zone Model, The Sector Model, The Multiple Nuclei Model, The Urban Realms Model, and The Models of the Mexican Border Cities are, historically the major descriptive urban model developed.

The Concentric Zone Model (Figure 1a), developed in 1925 and attributed to E. W. Burgess, posited the business district at the center around which other successive zones are organized. These successive zones are the following: the transition zone, the lower-income housing, the middle-income housing and the last zone which is the commuting zone. Burgess established clearly in his model the transition concept which refers to the tendency for old residential areas to be become commercial areas as the business district grows. Generally, in the zone of transition there are factories, slum, and lower housing areas, and frequently, land is held for speculation. The next zone is formed of lower-income housing. Zone 4 consists of higher-income housing and is surrounding by a commuter zone, which is the outside area in this concentric ring model. This model fails to account for the impact of transportation routes on the land use which has the effect of stretching the ring outward in the transportation corridors. This situation was later considered in the sector and ring models.

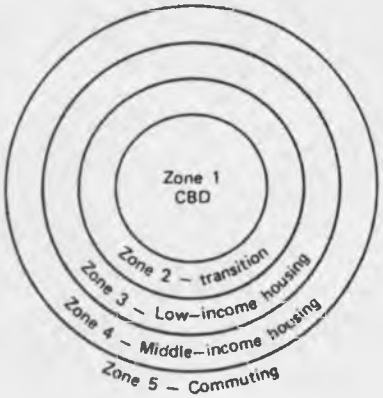
The Sector Model (Figure 1b) is also based around a single core, the central business sector, around which other sectors are organized. This model was developed in

1939 by Homer Hoyt, assumed that once uses emerged around the downtown, they remained in the same location and extended over time in the same direction as the town growth. Generally, these particular areas follow transportation corridors or clustering on the same location. The sectors in this model are the following: CBD, wholesale and industry, low income housing, middle income housing, and high income housing.

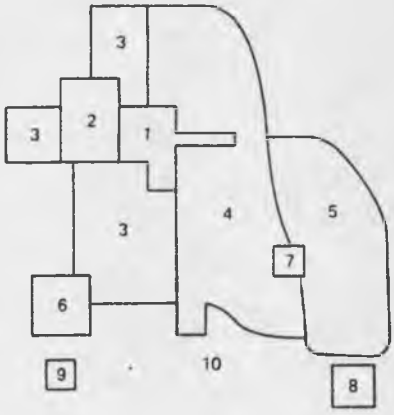
The Multiple Nuclei Model (Figure 1c), developed by Chauncy Harris and Edward Ullman, changes this premise of the single core and recognizes that uses form around several nodes. This model considers the formation of self-sufficient sectors with a downtown independent of the traditional downtown and the central city. These characteristics are its distinctive elements. In addition this model represents clearly the impact of the technology, basically the automobile, on the urban form and structure of the land uses.

The Urban Realms Model (Figure 1d), known as "the pepperoni pizza model", was developed by James E. Vance, Jr. in 1964. This model represents the culmination of the automobile era on the urban structure. The Urban Realms Models describes autonomous suburban sectors each focused on a downtown independent of the traditional central city, although in some cases suburban downtowns coexist and have an interconnection with the traditional or the older downtown of the system.

FIGURE 1. Descriptive Urban Models of Urban Structure

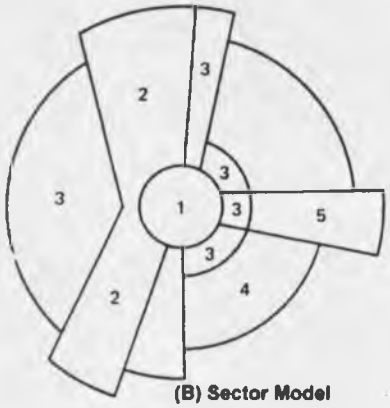


(A) Concentric Model

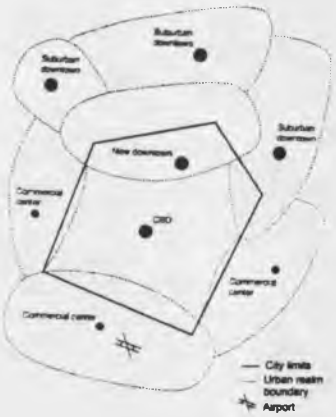


(C) Multiple Nuclei Model

1. CBD
2. Wholesale, light manu.
3. Low-class residential
4. Middle-class residential
5. High-class residential
6. Heavy manufacturing
7. Outlying business district
8. Residential suburb
9. Industrial suburb
10. Commuter zone



(B) Sector Model



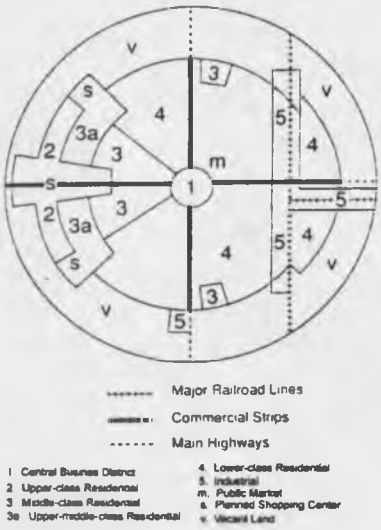
(D) Urban Realms Model

SOURCE: Interpreting The City

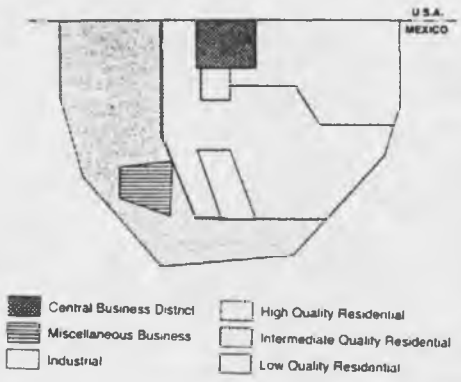
In 1970, Martin W. Beker developed a descriptive urban model of Mexican cities (Figure 2a). Baker based his model around a single core, the central business sector, around which the other sectors were organized. The model has a main system of transportation routes in the form of an "X" that emerges from the central business district to the periphery and commercial areas that are formed along these main transportation arteries. The main shopping centers are also located in the intersection that forms the main arteries routes and the high residential areas. The residential areas, in this model, have cluster organization. Lower-class residential, middle-class residential and upper-class residential areas are clearly delimited in the model. The industrial areas are principally found along the railroad lines and on the periphery of the city and on the main transportation routes. Mexican border cities have been specifically studied by Gildersleeve, Hoffman, and Curtis who have developed descriptive urban models of these cities. In 1978, Gildersleeve developed his descriptive urban model (Figure 2b) which was very abstract. This model was based on a simple core and sector areas. However, this model fails to account for the impact of transportation system. In 1983, Hoffmam developed his urban model (Figure 2c) which related the major transportation routes and railroads to the urban sectors. This model was less abstract than the Gildersleeve Model. The Hoffman Model was also based on a simple core with clustering areas. It combined in its structure concepts of the concentric and sector models.

Actually, one of the most precise descriptive urban models of border cities is the model of James R. Curtis (Figure 2d).

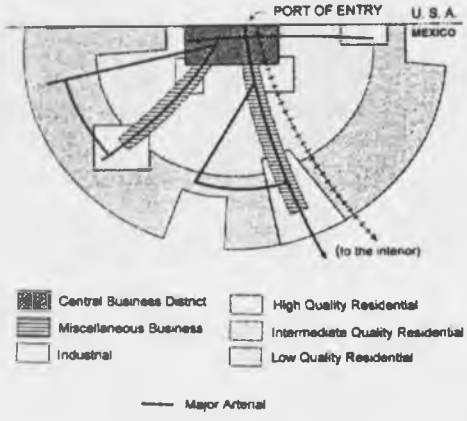
FIGURE 2. Descriptive Urban Models of Mexican Border Cities



(A) Baker's Model Mexican City



(B) Gilversleeve's Model of Mexican Border City



(C) Hoffman's Model of Mexican Border City

(D) Curtis's Model of Mexican Border City

SOURCE: The Mexican Border Cities

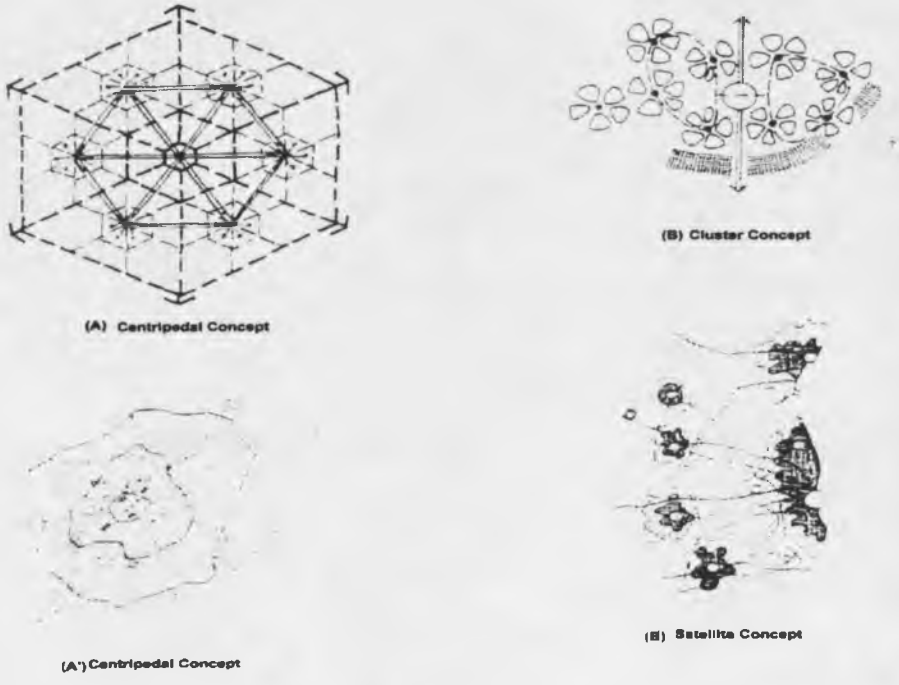
The Curtis Model was developed in 1993 and is also based on a single core, the central business sector, around which other sectors are organized. Although the model combined in its structure concepts of the concentric and sector models, the concentric concept dominates the structure of this model. In this model, the central business district surrounds a small tourist district which is connected to the old main border crossing point. Also, this crossing point interconnects with major transportation arteries which are the major commercial strips. In addition, the industrial areas are connected to the border crossing points by way of the main freeways and these areas are also located along the main arteries or form clusters along the railroad. Descriptive urban models of Mexican border cities have special characteristics that are distinctive of the cities of the region. There are an urban structure abruptly truncated by the international boundary, the transportation system oriented toward the ports of entry, maquiladora industrial parks, and the tourist district configurations. Definitively, these descriptive urban models contribute to the conceptualization of the location and spatial relationships of the urban land uses. However, these descriptive urban models do not completely explain the schema of Nogales, Sonora with its particular urban structure and context.

2.3 Urban Structure Concepts

In reference to urban structure, four basic ways to organize or reorganize urban expansion are known: concentric or peripheral, separate clusters, linear, and grid (A.D. Bull 1965-1966). In most cases, cities (or urban forms) can be produced by different arrangements of these basic urban structures. For example, a concentric city can be

internally structured by a grid arrangement. The concentric or centripetal urban structure (Figure 3a) has a strong central organization and subareas derive their function from their relation to the center of the town. Concentric urban structures could present satellite cities which all relate to the downtown area. Generally, the main traffic flow could be radial with ring roads in concentric structures. The cluster urban structure (Figure 3b) has an organization of independent and autonomous suburban areas which can be connected with each other by rapid traffic corridors. Each cluster can organize its own downtown and form equal clusters. However, the old downtown in the cluster system can have a dominant role and become the center of the urban structure.

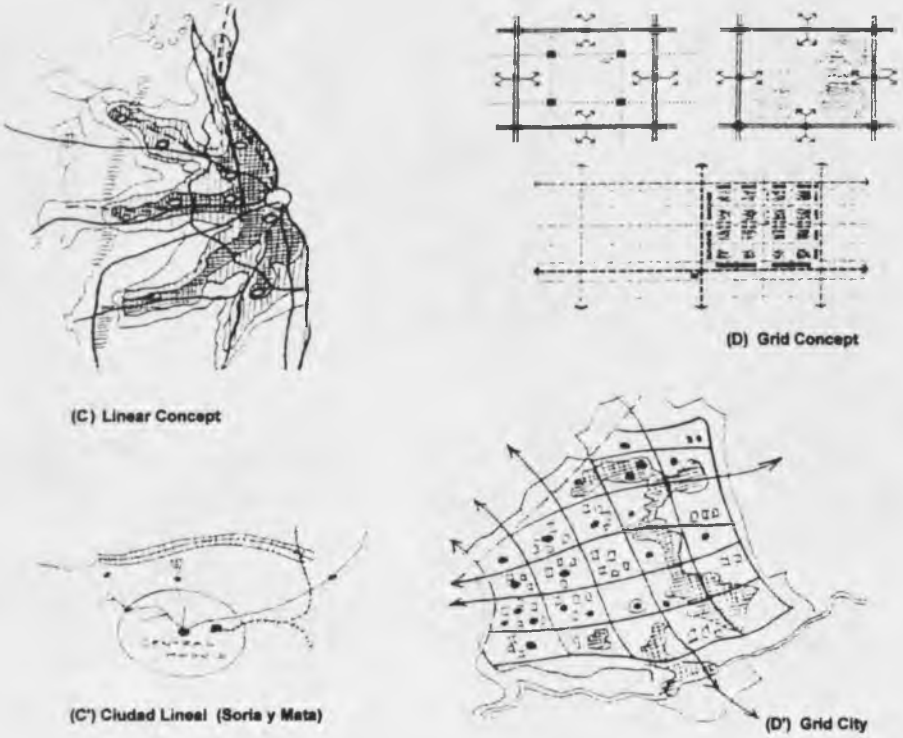
FIGURE 3ab: Concepts of Urban Structure



SOURCE: Urban Structure

The linear urban structure (Figure 3c) is organized as a continuous ribbon and generally, the downtown is a linear form based on the traffic patterns. Residential areas follow the ribbon on both sides. Linear structures are based on line haul transportation routes. An early example of this structure is the Ciudad Lineal near Madrid by Soria and Mata. The grid urban structure (Figure 3d) allows great flexibility in organization and distribution of urban systems, and the grid network can be composed of different categories of routes or grid nodes. The grid network achieves a more even distribution movement in the transportation system. This structure provides a great flexibility that allows facing growth and changing trends, as the subsystem requires.

FIGURE 3cd: Concepts of Urban Structure



SOURCE: Urban Structure

2.4 General Setting of Mexican Border Cities

The third step is to present in the next two chapters the general context of Mexican border cities and in particular the context of Nogales, Sonora. In this step, the rapid growth and planning of Mexican border cities will be presented and analyzed. Then, the city of Nogales will be especially analyzed with its growth and its planning practices. Next, The physical, natural, historical, economic, social, and political aspects of this city will be presented. Consequently, the theoretical framework presented in this step permits relating the settings of Nogales, Sonora to its urban land uses.

In summary, the theoretical framework that allows to analyze the urban land uses and develop the descriptive urban model is proposed. It includes these four basic urban structures, the descriptive urban models, the economic and social urban land use theories, the system of classification, the context of Mexican border cities, and particularly the context of Nogales, Sonora

3

Planning and Growth in Mexican Border Cities

Mexican border cities with United States have had rapid population and urban growth in last three decades (Figure 4). However they are barely organized to plan the urban development in this context (Arreola & Curties 1993; Herzog 1992). Specifically, Mexican cites at the border of the United States had high population growth rates of approximately 5 % per year in the period of 1960-1990. Now, Mexican border cities annual growth rates are approximately three to four times greater than the national average and they grow at faster rates than their US counterparts (Arreola & Curtis 1993).

FIGURE 4: Mexican Border Cities

Mexican border cities included are: Tijuana, Ciudad Juarez, Mexicali and especially, Nogales, Sonora(Table 1). Between 1960 and 1990, Tijuana experienced an impressive growth of from 165, 690 inhabitants and an urban area of 10,367 hectares to 743,000 inhabitants and an urban area of 36, 436.85 (Joulia-Lagares 1988). Ciudad Juarez had phenomenal growth during the same period , recording a population increase of from 276,995 inhabitants and an urban area of approximately of 1,800 hectares to 798,000 inhabitants and an area of 13,000 hectares (Padilla 1988). Mexicali has witnessed a phenomenal growth of from 281,333 inhabitants to 602,000 inhabitants and it now has a urban area of 13,000 hectares.

TABLE 1: Mexican Border Cities Population Growth.

Mexican Border City	1960	1970	1980	1990
Matamoros	143,043	186,146	238,840	303,392
Reynosa	134,869	150,786	211,412	281,618
Nuevo Laredo	96,043	151,253	203,286	217,912
Piedras Negras	48,408	46,698	80,290	98,177
Ciudad Juarez	276,995	424,135	567,365	797,679
Nogales, Sonora	**39,812**	**53,494**	**68,076**	**107,119**
Mexicali	281,333	396,324	510,664	602,390
Tijuana	165,690	340,583	461,257	742,686

SOURCE: INEGI, Censos Generales de Population y Vivienda, 1960,1970, 1980, y 1990

In Nogales, Sonora, the twin city of Nogales Arizona, there has been an accelerated growth in the last 30 years and is estimated to continue (Mann 1996). In 1960, Nogales, Sonora had 37,657 inhabitants in an urban area of 800 hectares; in 1990 the city had 105,873 inhabitants and occupied an urban area of 2,197 hectares (Plan Urbano 1994). This means that the population in 1990 was almost two and one half times the population in 1960, and the 1990 urban area was approximately two and one half times the urban area of 1960. Several researchers have forecast a population in Nogales, Sonora of 249,000 inhabitants and an area of 4, 400 hectares in the year 2010. (ENEGI 1994; Garcia & Lopez 1996). However, Mexican border cites, generally and especially Nogales Sonora, have not responded rationally to this accelerated urban growth. This is especially serious because this rapid growth is expected to continue in the borderland cities and particularly on the Mexican side, due to the economic asymmetry between the two countries, as well as regional factors in the borderlands.

Regional growth has been caused principally by factors, such as the changes in the global economic competition, labor costs, climate, public sector spending, and the meeting of two different sovereign nations. Lawrence A. Herzog (1990) wrote: "Border zones were once functional corridors of defense between nation-states; changes in technology, international politics, and the organization of the production have permanently altered their meaning. Now, large permanent urban centers are in the Mexican borderlands, which house more than one million inhabitants and with a vigorous economy". Mexican border cites function as prosperous sites for international

transit of goods and services, for manufacturing and processing, for labor interchange and tourism, with a impact resonating at the national level in both Mexico and United States.

World economic competition has generated changes in the urban composition of border-towns in Mexico. Specifically, electronics and manufacturing industries from the United States, Japan, Germany and other countries have stimulated the growth of Mexican border cites. These companies have moved to the Mexican borderlands searching for more favorable settings to produce goods with quality and competitive prices in order of continue competing in the free world market economy. American, Japanese and other international companies have changed their operations from labor expensive locations to cheaper ones such as the Mexican borderlands (Martinez 1988). Cities in this region present abundant cheap labor force. Besides, the labor force has the necessary high quality required for the electronics industry. People of this region, especially women, have the required manual dexterity to develop the predominant activities of these industries.

Another factor that has stimulated the growth of the Mexican border cities is the favorable climate of the border region. It has attracted people and industries from northern the United States and Canada to move from the severe winters to this sunbelt region. Industries lose less time and energy in the Mexican-US borderlands than in frostbelt locations. Tourists have also been attracted to the southern states of the United States by the friendly climate, and due to cross border tourism, Mexican border cities have benefited. Winter visitors are attracted to the Mexican border cities by the nearness

and particularly because Mexican border cities (despite their proximity to the United States) are fundamentally Mexican with their distinct food, customs, religion, and culture. These cities present a particular landscape anatomy and a place personality (Arreola & Curtis 1993). Through tourism, Mexico earned over one billion of dollars in 1980: Two thirds of this revenue occurred along the border.

In the 1960's Mexico developed the Programa Nacional Fronterizo (PRONAF) (National Border Program) and the Programa de Industrialization de la Frontera (PIF), known in the United States as the Border Industrialization Program (BIP). They have been major public expenditures by the Mexican government in the region and have propelled growth in the region. The Programa Nacional Fronterizo had the purpose of the beautification of border towns to stimulate tourism and to promote Mexican products. The Border industrialization program was also a public expenditure to establish assembly plants (Maquilas) in border cities giving them a pro-business environment (Mann 1997). They were planned to promote the economy of the region (Martinez 1988).

The meet of two different sovereign nations has been another factor that has stimulated the growth of the region. The laws in Mexico differ from those in United states. For example, the law on the Mexican side considers as an adult with all the rights and obligations any 18 years old person. This included permission to drink alcohol. Also, the law in Mexico is more flexible in regard to the sale of medicine. These are factors that bring many people into Mexican border areas. In addition, border cities are the strategic geographic locations for the transit of goods and services. Global economic competition,

labor cost, climate, public sector spending and the meeting of two different sovereign nations continue to stimulate the growth of the Mexican border cites. This phenomenon has caused several urban conflicts that are not being adequately planned for by Mexican government agencies (Herzog 1990; Dedina 1994; Padilla 1988).

Several urban conflicts in the organization and development of the Mexican border cites have arisen during this rapid urban growth. In recent years, border cities have witnessed a mayor destruction of sensitive and fragile natural environments and landscapes, an increases in land use conflicts, and a loss of the sense of place and time in the community. In his 1993 article Territory and Border Cities Mendez points out that natural resources in the border territories are not adequate to the requirements of the accelerated urban growth of the last three decades in the cites in these regions. The best natural areas in the cites, river basin lands, have been destroyed. They are used for transportation or new speculative city centers. These rich natural green areas have been covered by asphalt and building structures, destroying any species of flora and fauna unique to the place. For example, in the project developed in the city of Tijuana, the Tijuana river zone in the downtown was converted to an area of government office buildings, expensive restaurants, nightclubs, and a large shopping mall (Dedina 1990). In Nogales, Sonora the basin of the Santa Cruz River is the main axis of transportation in the city. Since 1882, the railroad has been on the banks of the river, and later the principal vehicular system was developed parallel to this corridor. Also, border cities have severe problems in the urban land uses, such as deficit, location, availability, balance and

compatibility. The land uses have not been properly defined to achieve requirements in the border. For example: the scarce urban land for housing in Tijuana with a deficit of close to 1,200 hectares, and Ciudad Juarez with 1,500 hectares. Also, historic buildings and landscapes have been little protected. Basically, buildings located in the center of the towns are continually altered or destroyed without considering their cultural heritage. For example, in the 1960's Nogales, Sonora lost one of the most important historic building, when the old customs facility was destroyed during the development of the National Border Program (Flores 1987). Also, in Ciudad Juarez in 1994 "El Cuartel" Mexican Army Building was destroyed (Chavez 1997). Urban planning is a powerful tool to solve or decrease several of those urban conflicts that Mexican border cities have had. However, the three levels of the Mexican government have developed only a superficial and limited planning activity for some urban aspects and only in few border cities.

The use urban planning practice to develop Mexican border cites is limited. The Mexican Government has focused principally on the planning practice of specific sectors, especially in the development of industrial plans and downtown redevelopment plans. In addition, a few master's plans have been organized for border cities and those plans have superficially been developed by the scarce research developed for border cities. The development of industrial plans included are the industrial parks in Ciudad Juarez and in Tijuana which are considered the most modern and largest of the border, the industrial park in the Mesa of Otay in Tijuana and the industrial park of Santa Teresa in Ciudad

Juarez. Those industrial parks were adequately planned close to the border crossing points and along major highways. They have been catalysts to the development of economic activity in the region. However, these industrial projects have caused increased urban growth and other urban conflicts in the cities of their respective regions. The development of the Tijuana River Valley is another partial planning project, where the primary purpose is to provide profit enhancement in property development for allies of the federal government (Herzog 1990). Unfortunately, this project has caused environmental degradation of the fragile shared ecosystem between the city of Tijuana and San Diego. Generally, planning is concentrated in Mexico city and state capitals in Mexico, and that is a risky centralization. These centralized national and state planning agencies create plans without adequate knowledge of the framework of the borderlands region.

Master plans have had little success in Mexican border cites due to inadequate studies of the particular contexts of these towns and the failure to develop effective land-use controls. In 1961, the Mexican federal government developed the first master plan for the city of Monterey, using a regional and national context, taking into account its demographic and economic development. The plan for Monterey, just as those of other cities, under estimated the population growth. The population was twice as much as estimated in the first year (Padilla 1988). Another case is The Master Plan of Tijuana in 1962, where population growth was underestimated. and public agencies and land use controls were not organized to control urban growth (Herzog 1990). The other factor for

the scant success of planning activity in border cites has been the limited research developed. "No conceptual or theoretical guidance exists for understanding the organization of urban space along borders" (Herzog 1990). Other writers affirm that Mexican border cites have been less studied and understood than American border cites (Arreola and Curtis 1993), especially, the city of Nogales, Sonora has been one of those Mexican border cities little studied and understood in spite of its serious urban problems, its role as maquilador and commercial center, its accelerated growth, and its strategic location.

4

The Setting of Nogales, Sonora, Mexico

Location of Nogales, Sonora

Nogales, Sonora, Mexico, is located at a strategic mountain pass on the US-Mexican border and joins with Nogales Arizona on the American side to form the twin cities of Ambos (Both) Nogales. This strategic point is situated in a narrow valley surrounded by low mountains ranges, and it is approximately where the Santa Cruz River and the Magdalela River natural corridors meet. This location has an elevation between 3,500 and 4,000 feet and it is a transition that divides the desert grassland and the oak woodland (Arreola & Curtis 1993). Nogales, Sonora has a competent regional system of transportation that permits rapid and efficient connections in both directions south and north. This location is showed in the figure 5.

FIGURE 5: Location of Nogales, Sonora

Nogales is connected to the capital of the state of Sonora (Hermosillo) by the Ferrocarril del Pacifico and the modern four lanes Mexican highway 15, and to the capital of the state of Arizona (Phoenix) by US Interstate 10 and the Southern Pacific Railroad. These connections and its strategic location have made Nogales Sonora a vital point in the economic corridor Sonora-Arizona (Mendez 1993, Herzog 1990). In addition, the fact that two sovereign nations meet at this point has signified economic, social, and cultural advantages for Ambos Nogales. The location, regional transportation systems, the meeting of two nations, and its physical aspects have made a Nogales, Sonora on a strategic place on the US-Mexican border for services, commerce, tourism and employment, despite, its scarcity of water and its hilly topography.

Physical Aspect of Nogales, Sonora

Physical aspects have played an important role in making Nogales, Sonora a strategic place for development. Specifically, the climate of the region is a catalyst for stimulating the growth of the city. Although, the topography and water supply are not totally adequate, those factors have not stopped this rapid urban growth trend. However, it has restricted the urban patterns in the town.

The mountain ranges surrounding Nogales create an irregular topography with strong slopes. On the east the average slope is between 15 and 30 %, on the west and south this average is between 10 and 20 % and to the north is Nogales, Arizona (Plan de Desarrollo Urbano 1994). These physical aspects have imposed several constraints on the

urban development of the city. The upper Santa Cruz River basin (Nogales arroyo) and the main streams are being used for urban development, principally for circulation routes, which has formed the skeleton of urban structure of this nearly perfect lineal city.

In their 1994 "Managing Transboundary Resources" article, Helen Ingram, Lenard Milich, and Robert G. Varady affirmed that the boundary between Mexico and United States of approximately 3,140 Kilometer (Km.) passes through regions of water scarcity. Water has been one of the most troublesome resources to the development of border cities. Specifically, this is true in Nogales, Sonora where the city's water system is insufficient to satisfy the water needs of the community. The main rivers and wash basins in the Nogales area are dry much of the year and they have been occupied by the urban development. Groundwater reservoirs are mainly in the northern end of the valley (Nogales Arizona). In addition, new problem affecting the water issue in Nogales, Sonora are surface and groundwater contamination. in 1990 an independent study affirmed that 50 % of the urban area was not served with water services. The other 50 %, only received water in limited schedule. The population explosion has increased the problem of the supply and distribution of water in the city. These issues exemplify how water has limited and deteriorated the urban environment quality of this border community. In order to face this issue, the municipal and state governments have developed the project "Aquaferico" which seeks to supply water to the entire city. However, parallel to this project, the city requires the development of a sewer system to avoid ruining the environment and the health of the community.

The natural landscape and climate of Nogales, Sonora provide outstanding features that have played an important role in its explosive growth in the last three decades. This area presents a rich vegetation in this northward extension of the Sonora Desert basically composed of mesquite, oak, cottonwood, catclaw, snakeweed, whitehorn, burrow, and walnut (the city its name from the Spanish word for walnut). In addition, this area has fertile soils that have made it a suitable region development of wildlife and for cattle raising (Ready 1973). The vegetation , and wildlife with mountain ranges separated by narrow alluvial valleys, shape this beautiful natural area in the northern of Sonora.

Nogales, Sonora, has an excellent, mild year-round climate that has made the city an important employment and tourist center in the region. On average, the city is characterized by approximately 219 clear days in the year (H. Ayuntamiento de Nogales 1994) and is rarely exposed to the extreme summer heat of the dessert. The average yearly temperature is 17.6 C. The highest average temperature is in July at 27 C. and the lowest average temperature is in January at 8.7 C (Source: INEGI 1996, Carta de Climas). The average annual rainfall is 428.4 mm and the months of major precipitation are July and August with 191.8 and 108.9 mm respectively (Source: INEGI 1996, Carta de Climas). Since the prehistoric Pueblos culture, the climate and natural resources have been strong catalysts to stimulate the growth of the region

Historic Aspects of Nogales, Sonora

The area where Nogales is located was periodically occupied by a prehistoric Hohakan village from 800 to 1350 A.D. The Hohakan culture developed along the Upper Santa Cruz River an intensive agriculture activity and it also created an important trade center during this period (Ready 1974). This area was part of what was called Pimeria Alta in the colonial period. Rancherias (small towns with agriculture and cattle activity) and Indian villages were basically situated in this area in that period (Flores 1987). Padre Eusebio Francisco Kino established twenty-one missions in northern Sonora and southern Arizona in which Nogales area is situated. Among those missions is San Gabriel de Guevari that is located only 6 miles up the Santa Cruz River north of present-day Nogales.

Specifically, the history of Nogales, Sonora as a town began in 1880 when the Mexican federal government established the first aduana (Custom House) (Flores) and it was consolidated with the arrival of the Santa Fe railroad on October 25, 1882 (Ready 1973). Basically, since the establishment of the first Aduana, five important periods have been identified in the history of Nogales, Sonora (Flores 1987).

The first period began when the President of the Republic, Porfirio Diaz, signed on August 2, 1880 the establishing of the first Aduana in the town, and this period finished in 1920. The establishing of the Aduana at a border point called Nogales was for the importation, exportation and transit of national and international goods. Another important event in this period was the construction of the railroad by the Atchison,

Topeka and Santa Fe company in 1882. This railroad project integrated the mining and agriculture regions of northern of Mexico with the Unites States and established communication with the Pacific region through the seaport of Guaymas, Sonora. This situation created a strong economic region in southwestern the United States and northwestern Mexico. By 1884, Nogales had the number of inhabitants needed to constitute a municipio and be the heading city. Later, Nogales, Sonora was also a strategic point during the era of the Mexican Revolution. In this, the General Venustriano Carranza had his headquarters and through this border crossing, this army supplied arms and ammunitions for the revolution. At this time, because of the high level of revolutionary hostilities in Mexico, the United States government built the fence that physically divides Ambos Nogales. During this period, the city was consolidated as one of the main cities in the state because of its location strategic for international commerce and its role in the revolution. The city grew from 3,172 inhabitants in 1910 to 13,475 inhabitants in 1920 .

The second period from 1930 to 1940 is characterized by a deep economic depression. The world economy crisis and the conflict with the Chinese who were thrown out of Mexico in 1931 from this municipio had strong effects on Nogales. A great number of commercial business were closed that provoked the near paralysis of activity even up to the beginning of the 1940's. During this second period, the population decreased slightly from 14,000 inhabitants in 1930 to 13,866 inhabitants in 1940 (Flores 1987).

The third period from 1940 to 1960, known as La Epoca Dorada (the Golden Era) of Nogales, began with the Second War World and was principally stimulated by the exportation of metals, increased tourism, and alcohol sales. The Second War World stimulated the exploration of metals, principally, tungsten and molibdeno that were used to manufacture the armaments and other equipment required in the war. Another activity that stimulated commerce on the border was the prohibition of alcohol in the United States. The selling of wine or tequila increased and American tourists also were attracted by Mexican food and holidays, such as the traditional famous parties of May where Ambos Nogales took part. Not only business grew in this decade but also the population had an increase of 60 %. There were 24,478 inhabitants in 1950 and by 1960 the city had a population of 37,657 inhabitants (Flores 1987).

The fourth period at the end of the 1950's was characterized by a deep crisis in the city. The United States passed the Jhonson law that restricted the importation of alcohol to only one liter per person. Also, the agricultural workers who were deported from the United States and a great number of peasants who migrated to the city searching for better conditions increased unemployment. The Mexican government was forces to develop the National Border Program. In Sonora, Governor Luis Encinas Jhonson confronted this problem with the Border Industrialization Program of 1964. Through the Department of Industrial Development with Armando Hopkins Durazo as director, they were able to resolve the problem of unemployment in this area.

In fifth period, starting in 1964, Nogales Sonora definitively began a new era, with the Border Industrialization Program. This program resolved the great unemployment and was the catalyst to stimulating the growth in the city. American and Japanese companies took the advantages of cheap labor costs to produce quality goods at competitive prices in order to continue competing in the free world market economy. The inclusion of industry in the economy increased and transformed the growth and development of the community. At present, Nogales, Sonora is considered one of the most dynamic and prosperous cites in the North American Hemisphere. Despite, its scarcity of water, hilly topography, and the scant planning activity. The city is functioning as a prominent site for manufacturing, labor interchange, commerce and services. In addition, the city offers a splendid opportunity for American citizens to get acquainted with Mexican culture, this has made Nogales an important tourist center in the US-Mexican borderlands.

Social, Economic, and Political Aspects of Nogales, Sonora.

Nogales, Sonora is a city that has witnessed accelerated growth in the past three decades, changing from a city characterized by commercial and services activities to one in which manufacturing is predominant. These phenomena of growth and economic structural changes have been accompanied by other economic and political transformations. In 1995, the city had 131,622[1] inhabitants, with an annual growth of 3.9

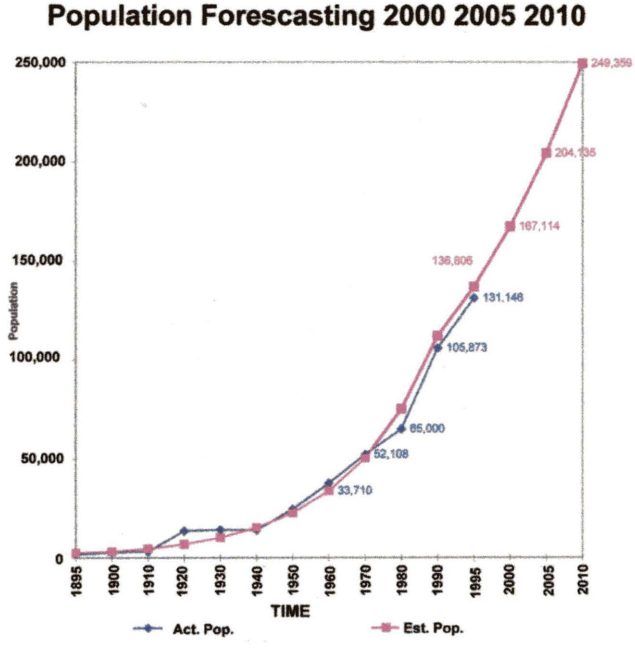
[1] All population figures are from the Mexican Census of the corresponding years. See [accurate reference for the Census, in Spanish]

percent. Nogales is the fifth largest city in the State of Sonora. Fully 98.6 percent of the municipal[2] population is concentrated in the city of Nogales Sonora. In 1960, Nogales had only 37,662 inhabitants. It was only the sixth largest city in Sonora and had only 94.1 percent of the municipality's population. There was nearly a fourfold increase in population in thirty years, or an average population multiplier of almost 1.35 each decade. Several researchers have forecast, showed in Table 2 a population of 249,000 inhabitants in Nogales, Sonora by the year 2010 (ENEGI 1996; Garcia & Lopez 1996).

TABLE 2: Nogales, Sonora Population 1895- 2010

Nogales Population

Year	Act. Pop.	Est. Pop.
1895	1,810	2,500
1900	2,738	3,054
1910	3,172	4,557
1920	13,475	6,800
1930	14,061	10,147
1940	13,866	15,140
1950	24,478	22,591
1960	37,657	33,710
1970	52,108	50,300
1980	65,000	75,056
1990	105,873	111,995
1995	131,146	136,806
2000		167,114
2005		204,135
2010		249,359



SOURCE: Plan de Desarroll Urban 1994, INEGI, Resultados Definitivos, Censos de Poblacion y Vivienda.

[2] The Mexican municipal is a spatial unit of a state, regardless of the urban status, resembling the U.S. County.

The 1995 population shows just a slight predominance of men, compared to women(a ratio of 50.5% : 49.5%). However, there is a predominance of young people (ages 5 through 35 years of age). In effect, Nogales has a high percentage of its population in the employable age cohorts, thus a potentially high labor force participation rate. It also has a lower than average mortality rate, below the Sonora State average of 3 percent (INEGI 1996).

The fundamental unit of organization in the community is, of course, the nuclear family. There are about five members per household unit on average about twice the size of the average household in Arizona.

Other important social factors in Nogales are religion and migration. The Roman Catholic religion is predominant, though more than ten percent of the population is Protestant or without religious affiliation. In-migration is the major source of growth in Nogales and migrants comprise more than 35% of the population. These in-migrations come mainly from other parts of Sonora, and from the Mexican states of Sinaloa, to the southwest, Chihuahua to east, and Jalisco (around Guadalajara), still further southwest. Attracted by the maquila[3] industry , these migrants are mainly of working-age, the 16-35 year-old cohort. The maquila indeed has been a strong factor in stimulating the in-migration from others parts of Sonora and from the other Mexican states indicated above.

[3] Maquiladora or maquila plans were, even before the North American Free Trade (NAFTA) treaty, custom-free assembly or fabrication installations, which could have part of their operation on the U.S. side. Contrary to some expectations, such plants have continue to develop and may even accelerated their rate of employment growth in some border centers , including Nogales.

It has become the most important economic activity in Nogales. However, commerce and services are still considered basic in the city's economic structure.

Nogales is the most important center of maquiladora in Sonora, as measured by the total number of manufacturing plants-though rivaled in total employment by San Luis Rio Colorado, far to the west. There are 103 maquila plants in Nogales, having a total of 24,770 employees in 1996 (SECOFI 1996). The dynamic growth of this kind of manufacturing in Nogales is attested to by the fact that there were only 27 maquilas with only 3,014 employees in 1970 (SECOFI 1996). That amounts to a bit more than a fourfold increase in plants , but an astounding nine-fold increase in employment in just 26 years.

Nogales recorded 94,667 tourists lodged in city hotels. Of these, 80,467 were Mexican and 14,200 were from the United States. In addition 1994 figures show an average of 3,500 day visitors to Nogales per day (Nogales Arizona, Office of Economic Development 1994).

The average wage per day is about four dollars, or very nearly the minimum hourly rate in the United States. To summarize, economic analysis indicates that manufacturing is the most important activity, followed by services and retail trade. The Sonoran state government expects these sectors to continue growing rapidly. Thus the outlook is for a prosperous economic environment in Nogales. The general Nogales employment structure is shown in Table 3

TABLE 3: Percentage distribution of Nogales Sonora Employment by Sector

SECTOR	(PERCENTAGE)
Maquiladora Manufacturing	46%
Services	22%
Retail Trade	14%
Public Administration	5%
Transportation	5.25%
Construction	5.25%
Financial Services	1%
Agriculture	1.46%
Mining	0.04%
TOTAL (Rounded)	100%

Source, INEGI 1990.

Will the political outlook be equally strong? Nogales is a PRI (Partido Revolucionario Institutional) city, led locally by Wensceslao Cota. The national political context of the PRI controlling the national government would seem to indicate that some Federal funding for infrastructure projects would be available to Nogales on a preferential basis. However, in fact, the present municipal government lacks programs and plans to guide the community. Faced by this situation, independent organizations have been developing several proposals and projects to meet community requirements. Three political parties and two independent organizations are principally working for community development.

The Partido Revolucionario Institucional (PRI) has had the direction of Nogales' municipal government for the past thirty years. Also, this leadership is supported by the national structure of government. The support to PRI has provided social stability and control of unemployment. But it has also resulted in strong dependence on the federal and state governments.

The present situation in Nogales is one characterized by low unemployment and a prosperous economy. Nevertheless, the city has several problems of security, finance, organization, and planning. These conditions have been emphasized in the recent mayoral election by the competing parties, the Partido Accion Nacional (PAN, conservative free enterprise) and the Partido de la Revolucion Democratica (PRD, left of center). Additionally, those two parties have been fighting against the centralization of power in the federal and state governments. Neither of these parties has been well enough organized to offer a real alternative, to control political power in the Nogales municipal government and to develop municipal autonomy, great security, more "open" financial transactions, and organization of meaningful planning for the city. At present, several social organizations are working on planning tasks. El Colegio de Arquitectos and El Centro de Investigaciones y Estudios Ambientales, A.C. are two of the more important of those groups working on projects for downtown redevelopment, on projects for security in the city, a project for the management of solid waste, and some other planning projects. However, developing a comprehensive plan or a land use code requires resolution within the institutional framework of the state, a situation that is not fulfilled by non-

governmental organizations. Planning of the community is a legal responsibility of the municipal government, requiring participation of all social sectors and organizations. Despite those legal responsibilities, the accelerated growth, and the serious urban problems, the three levels of government have not addressed adequately the planning of the community.

5

Planning in Nogales, Sonora, Mexico.

planning activity and research in this field have been really limited in Nogales, Sonora. The capacity of planning has been little valued as a way to increase the organization and development of the community. The main planning projects developed, basically in the capital of the state and Mexico City, have been oriented towards the promotion of economic development of the community without considering the city in a holistic framework. Also, the few master plans developed have been inadequately developed and the research in the area of planning is practically inexistent. In spite of the fact that Nogales, Sonora is the most important border city of the State of Sonora with an accelerated growth in the last three decades, this growth has increased or created several urban problems.

During the 1960's two successful urban projects were executed as part of the National Border Program. One project was the relocation of the railroad infrastructure, basically the railroad yard, from the center to the south of the city. The other project was the creation of the industrial park to the south of the city, called Parque Industrial de Nogales, Sonora. This project had an extension of 57.06 hectares and was a successful strategy to stimulate economic development and employment in the city. However, this program also stimulated an explosive population and urban growth, a situation that increased several urban requirements in the city such as the deficit of housing, basic infrastructure, facilities, and services, (COCEF 1993; Lara 1993). During

the 1970's, two important projects also were developed. One was the building of a new highway on the west side of the city parallel to Obregon Avenue. This project and the development in the system of transport in the period (from the railroad to trucks) allowed the heavy traffic from Obregon Avenue to change to this new route. The other project built was the Mariposa gateway which permitted this change (Lara 1993).

In the end of the 1970's, during this period of municipal president Sr. Hector Monroy Rivera, the Secretaria de Asentamientos Humanos y Obras Publicas (SAHOP) initiated the first activity of urban planning in this town. It was a superficial inventory that consisted of four pages regarding city conditions. The main questions were related to the image of the city, conditions of the transportation system, and the conditions of the services and basic infrastructure. This superficial inventory showed how far behind the city was in water and sewer systems. Nogales, Sonora in that period was called "Heroica Nogales ,Sonora", that is how it is referred in that inventory.

Only, two master plans were developed from 1960 to 1995 and they were inadequately developed and enforced. Never has the city of Nogales, Sonora had a land use code to enforce its "zoning"[1]. This situation has contributed to the lack of success of the master plans. The first master plan developed for the city was in 1988 by a federal planning agency, "the Secretaria de Desarrollo Urbano y Ecologia" (SEDUE). This plan was called Programa de Desarrollo Urbano del Centro Urbano de la Poblacion de Nogales, Sonora. The second master plan was developed in 1993 and in that period also

[1] Though the word in Spanish "zonificacion" would seen to translate directly into the North American "zoning" that is deceptive. "Zoning" in the United States is a land Use Code, while the usage in Mexico is best translate as "use districting."

the local planning agency of Nogales was created with the name of "Direccion de Planeacion y Control Urbano". These plans are helpful for a understanding of the urban problem. However, they have not contributed sufficiently to the organization and guidance of the development of the community. The context of the city was not adequately addressed. Social, economic, cultural and political aspects were not really understood and analyzed. These short comings were basically caused by the lack data and by the institutions that supported the planning. One continuing strong controversy is, what the real population size of Nogales, Sonora is?. In 1979, the survey that the Secretaria de Asentamientos Humanos y Obras Publicas published an estimated of 145,000 inhabitants in the city, while the census of 1980 established a population of 68,076 inhabitants. In 1988 the Secretaria de Desarrollo Urbano y Ecology developed a master plan which considered a population of 130,000 inhabitants while the official census of 1990 marked a population of 107, 119. This controversy continues as the official census indicated a population of 137, 000 inhabitants in 1995. On the other hand, Alberto Suarez Barnett and the non-governmental organization, Centro de Investigaciones y Estudios Ambientales A.C. affirmed that Nogales in 1994 had a population of approximately 250,000 inhabitants. This is only one of the observation in the development of master plans. Another observation is that planning has been understood as a simple technical task whereby social, economic and political participation is excluded to the development of these masters plans. On the other hand, the political and economic sectors that control the power structure have not valued the benefits for

community planning. The local government has not given physical and political conditions to stimulate planning in the city. Definitely, no planning activity was developed from 1994 to 1997 in the city of Nogales, Sonora.

Also, a great part of the lack of success in planning is the limited planning research in Mexican border cities, specifically in Nogales, Sonora. Basically, Four research works were found regarding planning research in Nogales. One important work related to the development of Nogales is the book Nogales a Siglo en la Historia by Silvia Raquel Flores Garcia. Although, this book is not directly related to urban planning research, it book provides useful knowledge of the history, some aspects of the urban growth, and the main economic projects developed in the community. Another study was Industrialization y Urbanizacion en la Frontera: El case de Nogales, Sonora developed in 1993 by Francisco Lara Valencia. in his article, Lara compared the relationship between the industrial development and the levels of supply of basic infrastructure and services. Lara affirmed that in spite of the impressive growth of the maquila industry, the supply of basic infrastructure and services in the city continues being deficient, principally in substandard and low quality residential areas that have had a explosive growth in the community with the development of the maquila industry. Lara compared the level of basic infrastructure and services before the industrialization era and in 1994 when the maquila sector was the predominant economic activity in the city. However, the only study specifically related to research in urban planning and land use is the study Land Use Contrasts in a Border Economy developed in 1963 by Thomas McCllenegHan and

Charles R. Gildersleeve. In this study McCleneghan and Gildersleve analyzed the urban land uses of Ambos Nogales in 1963 when tourist, commercial, and services activities were the base of the economy of the community. After, the McCleneghan and Gildersleve study, no urban land use studies were developed in Nogales, Sonora between 1964 and 1997. Despite the fact that urban planners consider the study of urban land uses to be an indisputable prerequisite to support successful community planning. Basically, urban land use data of Nogales, Sonora was completely ignored information in the development of the master plans of 1988 and 1994. Urban land use that came from a markedly different context was used in those plans. In the 1960's, J.V. Mingi pointed out that international boundaries impose particular features in the land use and urban patterns on border cites. Urban land uses are related to growth characteristics, to the spatial distribution of the population, to physical features, to social behavior and habits, and to economic functions of the community (Kivell 1993). In short, the past and present land use and urban patterns surveys are essential data that should be useful knowledge to guide the community development in this era of accelerated urban growth. A urban land uses study would permit planners to know the aspects of supply and organization of the land to the city. Also, this study should show the failures, maladjustment, or success of the urban context to provide an adequate amount, location, and spatial relationship of land for the effective economic and social functions of the community. Thus, a clear understanding of the urban land uses supports a more rational and functional practice of planning.

6

Past Urban Land Uses in Nogales, Sonora.

In 1963, Thomas J. MacCleaghan and Charles R. Gildersleeve developed the study Land Uses In a Border Economy. In this study, they presented the urban land uses of Ambos Nogales. Since, these two communities reported an accelerated urban growth, being higher in the Sonora side than on the Arizona Side. Ambos Nogales were considered as a single urban entity and bicultural community. MacCleaghan and Gildersleeve affirmed that urban land use of Ambos Nogales were basically impacted by its natural, social and economic settings. Specifically, the urban land uses in Nogales, Sonora in 1963, showed in Table 4 and Figure 6, were related to its location in a narrow valley surrounded by small mountains ranges and to its economy as an international trade and services city (INEGI 1970).

TABLE 4: Urban Land Use in Nogales in 1963

URBAN LAND USE	AREA (Acres)	PERCENT
Residential	318.80	62.51%
Commercial	31.42	6.16%
Industrial	100.42	19.69%
Public and Quasi-Public	59.36	11.64%
Total Developed Land	510.00	100.00%

SOURCE: Land Use Contrasts in a Border Economy 1964

FIGURE 6: Land Uses in Nogales Sonora in 1963

SOURCE: Land Use Contrasts In a Border Economy

The study of urban land uses in Nogales, Sonora in 1963 was divided into four main categories to its study, and land uses in Nogales were basically arranged in relation with the border crossing point, the railway, and the main north-south avenue known as Obregon Avenue. In that period the city of Nogales was based around a single core, the central business sector which was linked to the border crossing point. The main economic and social activities were organized around these points that are situated in the only practical route through of the city. The CBD, the railway, and Obregon Avenue were the basis of the organization of Nogales and its residential, commercial, industrial, and public urban land use (Gildersleeve 1964).

Urban land uses in Nogales, Sonora were distributed in an urban area of 510 acres with a population density of 88 persons per residential acre while Nogales, Arizona had a population density of 33 persons per residential acre. MacCleaghan and Gildersleeve established that the difference of population density was a testimony of the asymmetric economy that existed between two Nogales. The residential areas in Nogales, Sonora were mainly divided by Gilversleeve in the fine homes and substandard homes, and these residential areas were 62.51 % of the total urban area with a cluster organization. This high percent of residential uses in the city was attributed to a the large population that worked on the Arizona side but lived on Nogales, Sonora. The fine homes were located on relative flat land within easy walking distance of the Catholic Cathedral and close to the border crossing point. Although in the last few years new fine house have been built on hilltops with a view of the city. On the other hand, substandard homes were

segregated on the east side of the railroad and they filled the bottoms of the narrow canyons, and these housing areas lacked public services and utilities. MacCleaghan and Gildersleeve affirmed that the financial status of the owners deteriorated as one ascended the hills. Basically, the clusters of fine residential areas were in the west with better services, while substandard homes were on the east side of the town without public services. Clearly, its population density established a bedroom city tendency, and its the cluster organization of residential land uses reflected the contrast of the social and economic status of the population of Nogales, Sonora.

Public and quasi-public services, generally mixed with commercial activity were fundamentally located along Obregon Avenue (or a few feet west of this avenue) and in the CBD beside the border crossing point. They were the 11.64 % of the total urban area. Basically, public and quasi-public services consisted of the aduana (custom house), post office, schools, police station, fire department and hospitals. The aduana was the most important public services established in the city and it was the node to the economic and social organization of the city. In general, public services were scarce but especially, on the east side of the railway, only one school was situated in that area in 1963.

Industrial activity in Nogales, Sonora in 1963 was relatively unimportant. Gilversleeve affirmed that only a few home or craft industries existed and they had a random organization. Nevertheless, Gilversleeve in this study included wholesaling in the industrial category showed in table 4 though wholesaling should be classified as a commercial activity. Gilversleeve reported that the inclusion of wholesaling in industrial

group classification permitted him to compare his statistics with the statistics developed by Bartholomew. However, the inclusion of wholesaling in industrial activity was incongruent with the thesis that Nogales, Sonora in 1963 was a tourist, commercial and services city. Consequently, in this present treatment, wholesaling was incorporated with the commercial group classification, and its percentage was added to commercial group.

Commercial activity had a strong significance in the economy of Nogales and was located in strategic places in the city. Business and services were considered the main economic activity at that time and they had an important interrelationship with Nogales, Arizona even to the point of considering Ambos Nogales as a single entity. The commercial land uses had 25.85 % of the total urban area and they were basically divided into wholesaling, general business , and tourist business.

Wholesaling activities are situated with ready access to highways or along the railroad tracks. This activity consisted of the distribution of farm products from Sinaloa and Sonora to the United States, and from the other way, large amounts of farm machinery and parts were imported from the United States to be distributed into Mexico.

General businesses were situated in two locations that were linked. One, the central business district, was situated next to the border crossing point and the other along Obregon Avenue, although a cluster of small stores existed on the 5 de Febrero street. In addition, in the central business district there was an area to serve the national and foreign tourists, and it also had functions for the local inhabitants. This tourist area was in the northern part of the CBD, starting just at the gateway. In the CBD there were banks, a

post office, government offices, drugs stores, nightclubs (cantinas), alcoholic beverages stores, a school, hotels, and restaurants. Fundamentally, in the tourist area there were curio shops, liquor stores, jewelry shops, leather goods stores and other establishments that in general existed in the CBD. Business in the CBD of Nogales, Sonora was complemented by its sister central business district in Nogales, Arizona. In 1963, the manager of Safeway (just a few feet from the border) in Nogales Arizona affirmed that 90 % of his business was with Mexican nationals. Both central business districts had a strong pedestrian character. The other retail area was situated along the major north-south avenue, Obregon Avenue, and on this avenue were located large businesses such as automotive distributors, supermarkets, furniture stores and other establishments. In general, these activities were strategically located beside the crossing point, along Obregon Avenue, and the railroad to create a prosperous and vibrant image of the city.

In summary, Nogales , Sonora until 1963 was based on a single organization "El Centro" which was clearly linked to Obregon Avenue and the railway. El Centro and those two routes were the basic factors in the organization of the city and where the majority of the economic and social activities were conducted. Basically, these places and the substandard homes gave the tourists their perception of the city. The substandard homes presented a cluster organization and formed the major areas in the structure of the city. Another characteristic of the city in this period was its pedestrian orientation. Because the city had as the main axis in its structure the railway and Obregon Avenue, this structure permitted the inhabitants to travel and walk through the city. The city was

compact, and the mixture of urban land use permitted the inhabitants to travel short distances to have access to the services even the commercial services on the American side. These aspects formed the Mexican border environment of Nogales Sonora in 1963.

7

The Urban Land Uses in Nogales, Sonora 1995.

The city of Nogales, Sonora in 1995, thirty one years after the Land Uses In a Border Economy study, has a population of 131,146 inhabitants (INEGI 1996) in an urban area of 2,276 hectares and its economy, traditionally based on trade and services, now includes the new activity, the maquila industry. Nogales' setting, its border location, the physical and natural elements determined the urban land uses and organization of the city. The city remains with a spatial structure based on a single center around which the city sectors were arranged. Although, new lineal axes with a new border crossing point have been developed, creating new industrial and commercial sectors, they have not had the impact that the axis of the Obregon Avenue and the old gateway have in the organization of the city. Obregon Avenue, the border crossing point, and the new highway are the main axes of the organization of the residential, commercial, industrial and institutional sectors. Residential and commercial land use continue to dominate the urban area, although the industrial areas are having an accelerated growth. The institutional urban land uses related to the customs function continue being vital in the development of the community and in the case of the green and open urban land uses, they were really scarce in the urban area of Nogales, Sonora (See Table 5).

TABLE 5. Areas and Percentages of Urban Land Uses In Nogales, Sonora in 1995.

URBAN LAND USE	AREA (Hectares)	PERCENT
Residential	1681.00	73.86%
Industrial/Maquiladoras	130.00	5.71%
Institutional/Educational	76.50	3.36%
Open/Recreational	19.75	0.88%
Commercial	149.75	6.58%
Vacant	218.75	9.61%
TOTAL	2276.00	100.00%

The city continues to have a compact urban structure, although it has changed more from a pedestrian to more of an automobile orientation. In addition, the mix of urban land use in the center and in some nodes of the main arteries are a characteristic of the city. These aspects, as a whole, maintained a Mexican environment in Nogales, Sonora in 1995.

The city basically maintains a structure based on a single center around which other city sectors were arranged. This center is formed by the historic downtown and much Obregon Avenue. The social, services, industrial, and commercial activities have had an accelerated expansion along Obregon Avenue in the last three decades, producing an linear expansion. (The commercial development is related to the growth of the metropolitan areas of Tucson and Phoenix). This expansion has formed a linear downtown that is ordered from the border crossing point to Tepic Street with a length of 4,000 meters and a width of 230 meters. In this linear center remains the historic urban center next to the gateway, which is the most vibrant social and economic area, and in this linear downtown, the traditional pedestrian tourist district also remains. The linear

center is an urban band where commercial, social, industrial and recreational activities are developed, and this central spine has perpendicular roads at the intersections of the main canyons to connect the peripheral, particularly residential, areas with this center. In 1976, a new border crossing point, called the Mariposa gateway, and a highway that runs parallel to Obregon Avenue, were built. The building of this highway opened new areas to industrial development and customs agencies, which are highly related to the border crossing points, and can function more independently from the rest of the city's other activities. This situation permits the city to clear the heavy traffic and trucks from Obregon Avenue and the old crossing point as well as to open new industrial and commercial areas along this road. However, the width of the highway and the hilly topography along that route has restricted the development in these areas. The role of this route and crossing-point do not present the impact that the axis of Obregon Avenue and the old gateway have in the organization of the city. Another important route in the city is Technologico Street, perpendicular to Obregon Avenue, which has become a vital road particularly linking residential clustered areas with the lineal center of the city. These residential clustered areas basically present a grid pattern organization and join with the main lineal axis, basically Obregon Avenue, to form a compact urban area, occupying residential uses in the major part of this area in 1995.

The city of Nogales, Sonora has a compact urban structure, dominated by the residential land uses with a cluster organization, followed by commercial and industrial land uses, also with a cluster organization. Institutional, recreational and open space

basically have a random organization in the city (Figure 7). In 1995 , Nogales, Sonora had a population density of 57.62 inhabitants per hectare (The population density would be higher if we considered the population figures by non-governmental organizations). The population density of Nogales, Sonora is significantly higher than that of Tucson. The city of Tucson in 1990 had a population of 405,390 persons with an area of 160 square miles (1990 Census) with a population density of 2,600 persons per square mile (9.4 persons per hectare). Also, the average area of a lot covered by a structure in Nogales, Sonora is significantly higher than this area in Tucson . In Nogales the average area of a lot covered by a structure is pretty high. The average proportion of the lot covered by a structure in the linear downtown sector in Nogales is 95%. In the residential area that is totally built-up is it 85%, and in the industrial zones is 70%. In Tucson, the average proportion of a lot covered by a structure in the commercial spines is approximately 50 %, while the major part of the residential areas have a low average area of 25-30 % of lot covered by structure. Basically, Mexican cities have a lower average proportion of the lot covered by a structure in the urban fringe, considering that these areas are in a process of consolidation, and generally residential uses occupy and dominate these areas. This situation clearly establishes the compact urban development in Nogales, Sonora relative to the sprawl development in the U.S. southwest city, Tucson Arizona. This phenomenon was characterized by Gilversleeve as a evidence of asymmetric economies.

FIGURE 7: Urban Land Uses in Nogales, Sonora in 1995

In 1995, residential land use continues occupying the largest proportion of the urban area of Nogales, Sonora and have a cluster organization (Figure 8). Residential land use had 1,681 hectares, occupying the 73.86% of the urban area. In 1964, the proportion of residential land use was 62.31%. Arreola and Curtis in 1993 reported that the residential average ratio in Mexican border cities was 80%. In 1964, the proportion of residential use in the city of Nogales, Sonora was high and it was attributed to the large population that work on the Arizona side but live in Nogales, Sonora (Gilversleeve 1964). Nogales is characterized by a large population waiting to cross to the American side (Lara 1990) and another factor is the great number of workers that are required in the maquila industry. The proportion of residential land use in Nogales, Sonora is significantly higher than the average ratios reported in 1992 in selected southwest cities with 46%, and Tucson, AZ with 48% (See Table 6). Despite the fact that southwest cities are places with large winter visitor population (City of Tucson 1993).

TABLE 6. Land Use Ratios of Selected Southwest Cities.

CITY	RESIDENTIAL	COMMERCIAL	INDUSTRIAL	PUBLIC, PARKS, INSTITUTIONAL
Alburquerque, NM	57%	15%	5%	23%
Austin, TX	48%	7%	5%	38%
El Paso, TX	42%	6%	10%	42%
Long Beach, CA	48%	12%	22%	18%
Reno, NV	36%	8%	5%	51%
Tempe, AZ	41%	8%	10%	41%
Tucson, AZ	**48%**	**10%**	**7%**	**35%**
Average	46%	9%	9%	36%

Source: PAS Memo, American Planning Association, 1992.

In Nogales, Sonora, residential areas are mainly organized in four main categories: high quality residential, intermediate quality residential , low quality residential, and substandard low quality residential (See Table 8). The economic and social characteristic of the population are the fundamental factors affecting the grouping of different residential areas in the city.

TABLE 8. Residential Land Use Categories Percentages in Nogales 1995

RESIDENTIAL CATEGORY	AREA (HECTARES)	PERCENTAGE
High Quality Residential	201.72	12.00%
Middle Quality Residential	470.68	28.00%
Low Quality Residential	732.91	43.60%
Substandard Quality Residential	275.68	16.40%
TOTAL	1681.00	100.00%

SOURCE: DIRECT SURVEY

High quality residences are built in strategic locations and served with superior infrastructure and municipal services. The high quality residences occupy 201.72 hectares representing 12% of the total residential area. These areas are basically situated in two places. One is close to the border crossing points and the second in the middle of the city. Both sites are located west of Obregon Avenue on hilltops with a view of the city and have easy automobile communication to the border crossing point, the center, commercial, and industrial areas of the city. These residential areas are served with all services such as water, sewer, electricity, phone systems and a good road system (Villa 1998). The lot sizes in these areas are bigger than other residential areas. The average lot

size is 600 square meters. In addition, the houses present high quality design and construction.

Intermediate quality residences are basically located beside the main commercial areas and are served with basic infrastructure and municipal services. These areas occupy 470.60 hectares representing 28% of the total residential area. They are situated along Obregon Avenue next to commercial areas, on the west side beside the downtown area, and in some new residential areas that are being developed in the periphery. These residential areas are served with water, sewer, electricity, phone systems and a regular road system and in several cases intermediate quality residences are located close within easy walking distance from commercial areas. In theses areas, the proportions of the lot size present several contrasts. Lots have areas from 150 square meters to 350 square meters and the standards in the design and construction quality are lower than in high quality residential areas, although several of these intermediate quality residential areas have better accessibility to cultural and government services than the high quality residential areas.

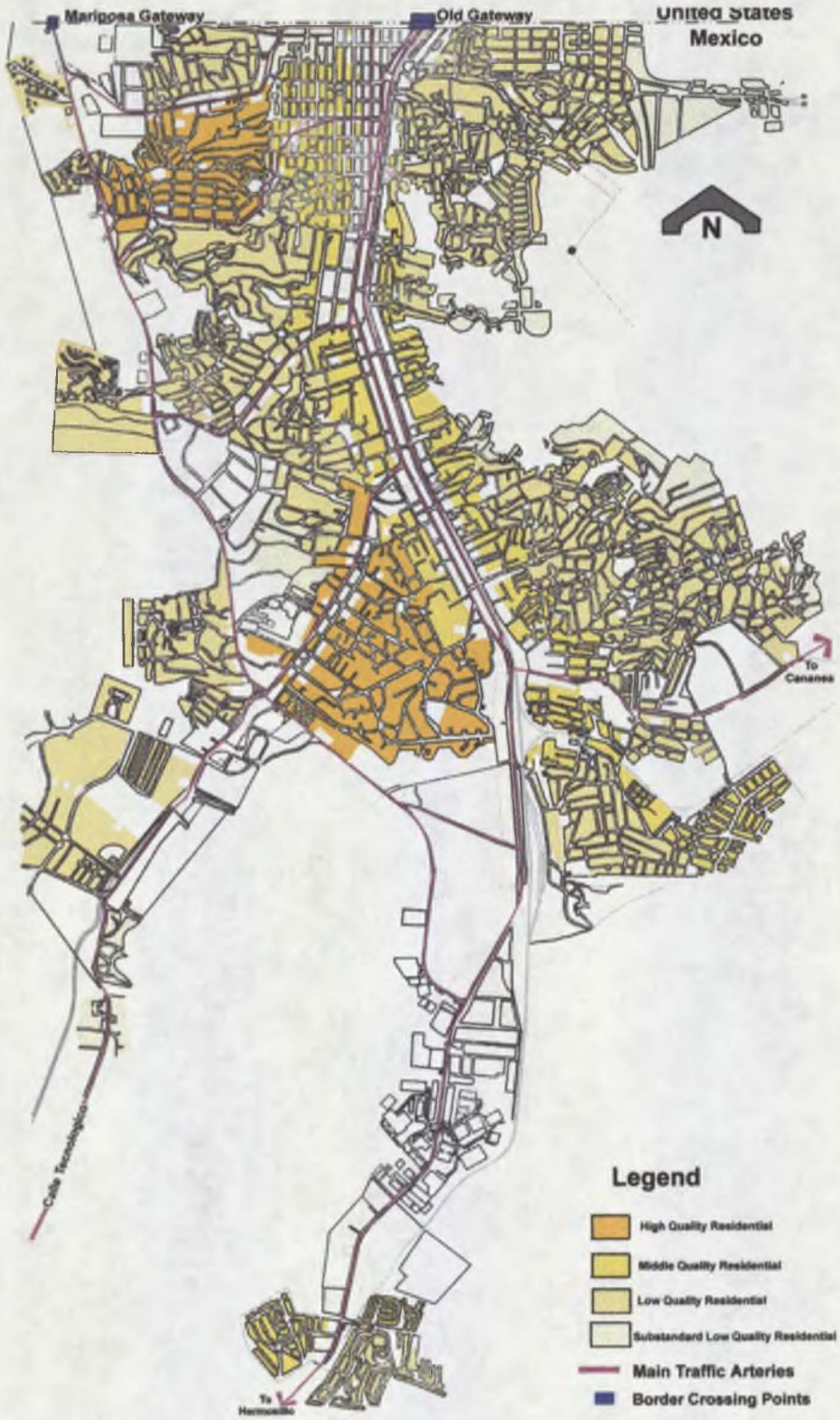
Low quality residences are basically situated on the west side of the railroad and in the periphery of the city. This residential land use group occupies the largest proportion of residential area in Nogales, Sonora with 732.91 hectares representing 43.6%. Generally, low quality residences are situated in places with difficult accessibility and hilly topography (Gilversleeve 1964, Lara 1994). This situation complicates the supply of infrastructure and municipal services, and generally, these areas have only pedestrian

access. These residential areas are rarely served with electricity, water, sewer, and they have a deficient road system. In low quality residential areas, the proportions of the lot size has several restrictions by the topography. Lots have areas from 140 square meters to 200 square meters, and housing construction responds to standard models previously developed in these low quality residential areas which have low accessibility to cultural and government services.

Substandard low quality residences are segregated on the periphery, in an old residential area of the historical downtown, and in ravine areas. This group of residential land use occupies 275,684 hectares representing 16.4% of the total residential area. The sewer system is non-existent in these residential areas which are only served by piped water service and electricity. Lots are small on a hilly topography with an average size of 160 square meters; the construction area is 30-40 square meters. Standard low quality residential areas are generally segregated from the cultural and government services. In the case of the substandard low quality residential areas in the downtown area, housing is in deplorable conditions. Houses are unhealthy with inadequate space, situated in inner-city slums. Although these areas occupy a small proportion of the urban land use of Nogales, Sonora, they provide a strong image in the perception of the city.

In general, all residential land uses in Nogales, Sonora occupy the largest proportion of the urban area and present a cluster organization (Figure 8) which is related to the economic and social status of the population.

FIGURE 8: Residential Land Uses in Nogales, Sonora in 1995



Residential land use is 73.86% of the urban area in Nogales, Sonora and this percentage is similar to that of other Mexican border cities which are between 70 and 80% (Arreola and Curtis 1993). However, the Nogales land use percentage is higher than that of American Southwest cities which is 46% (City of Tucson 1993). In 1964, Gildersleeve reported a bedroom tendency of Nogales, Sonora and established that the different cluster organizations of residential land uses reflected the great contrast of the social and economic population groups of Nogales, Sonora.

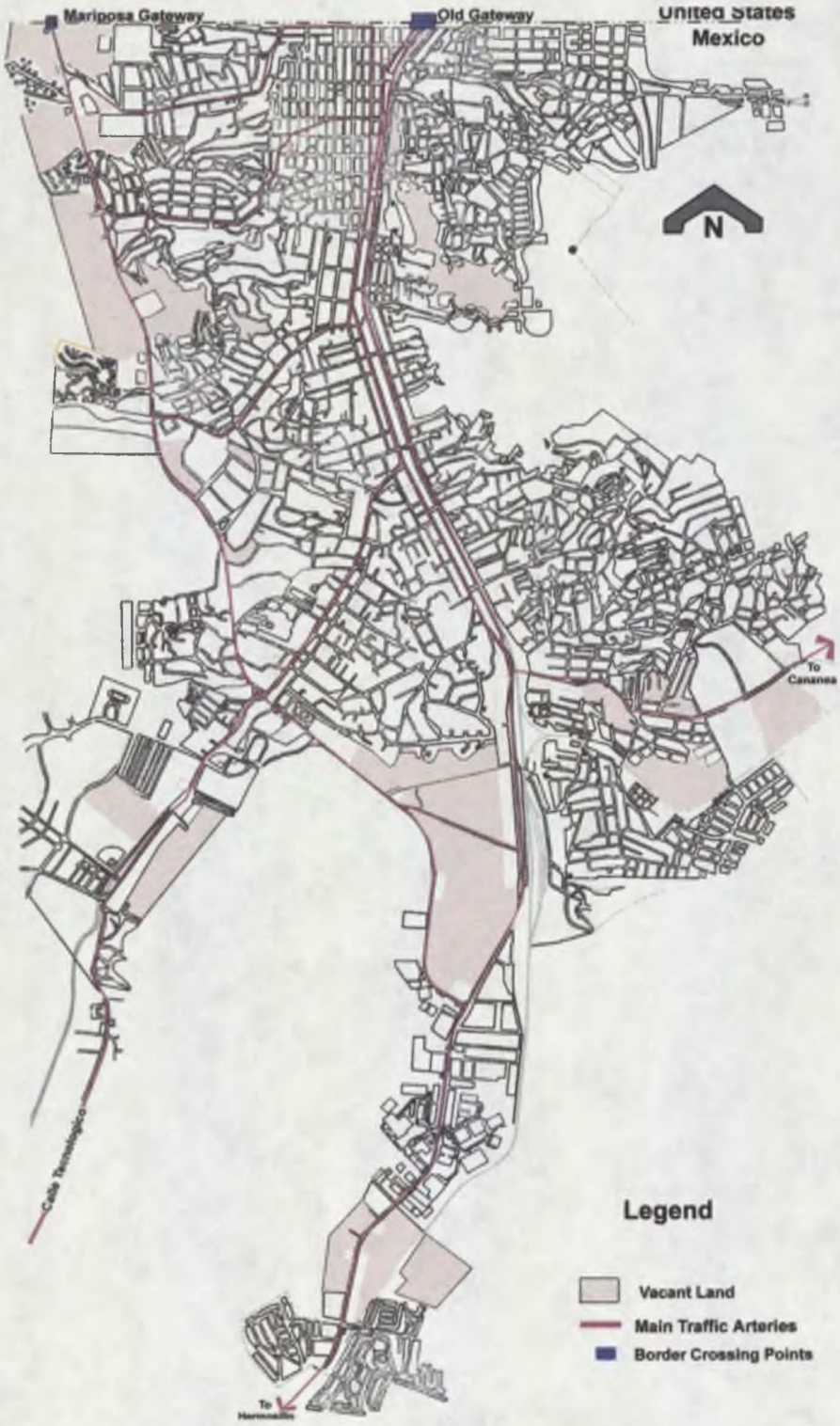
Institutional, educational, open and recreational land uses are a small part of the Nogales urban area and present a random organization (Figure 9). However, they have been strategic for the economic development of the Nogales community. Institutional and educational land uses only occupy 76.50 hectares representing 3.36% of the total city urban area; and open and recreational uses occupy an area of 19.75 hectares representing 0.88%. Institutional, educational, open and recreation land uses are basically dispersed along the main transportation routes of the city and located next to the border crossing points. This percentage of institutional, educational, open and recreational land uses is significantly lower than 36% percentages in southwest cities and the 35% in City of Tucson (City of Tucson 1993). However, federal services, basically the customs situated at the border crossing points, have been basic, in stimulating the industrial and commercial development of the city. The customs function permits the exportation and the importation of goods that are required in the maquila industry and in the development of Nogales as the most important commercial border city of the state Sonora. Also, the

location of public services create strong nodes around which commercial activity is intensely attracted. The old Aduana is a catalyst in the organization of the main commercial area of the city. Public services along Obregon Avenue, Luis Donaldo Colosio Boulevard, Technologico Street, and other main road arteries of the city stimulate commercial activity in their surroundings. In general, these land uses are mixed, with commercial activity. Although the role of public services is fundamental in the organization and development of the community, strong deficiencies of public services exist. Basically, open and recreational services are non-existent; the only significant recreational area is sport center (the unidad deportiva) beside the intersection of the Luis Donaldo Colosio Boulevard and Calle Technologico, although a large number vacant lots exist in the city. Public services such as parks, green areas, postal services, schools, station of polices, fire departments and hospitals are rare specially, on the east side of the railway, in the low, and in the substandard-low-quality residential areas. (Lara 1993).

Vacant urban land areas in Nogales, Sonora are large lots located on the periphery and along the Luis Donaldo Colosio Boulevard (Figure 10). Basically, those vacant areas are being held for big commercial or industrial developments. The vacant area in Nogales is 218.75 hectares representing 9.61% of the total urban area. This percentage is lower than the 35% vacant land area in Tucson in 1990 (City of Tucson 1993). In addition, the vacant land use patterns are different; the vacant land in Tucson is distributed throughout the entire urban land and the lots are variable in size.

FIGURE 9: Institutional, Educational, and Recreational Land Uses Nogales 1995

FIGURE 10: Vacant Land Uses in Nogales, Sonora in 1995



Industrial land use in Nogales, Sonora is totally dominated by the maquila industry and presents a cluster organization. The industrial land use area has had a surprising growth from 1964 to 1995, while these uses in other parts of the world have had a dramatic decrease in the same period. In 1963, there were no maquiladoras in Nogales but in 1995 the city has 100 industrial maquiladoras (Table 8 shows the growth of the maquiladora industry in the city).

TABLE 8. The Growth of the Maquiladora Industry in Nogales, Sonora.

YEAR	NUMBER OF MAQUILADORAS
1970	27
1980	52
1990	72
1995	100

Source: INEGI

Industrial activity in Nogales, Sonora was practically non-existent in 1964 (Gilversleeve 1963) but in 1995 industrial use occupies 130 hectares representing 5.71% of the total urban area (Figure 11). This percentage is relatively lower than the Tucson percentage which is 7 % while Southwest cities have 9%(City of Tucson 1993). On the other hand, Philip Kivell reported in his book Land Use and The City in 1993 that the older industrial quarters of many large cities in Western and Eastern Europe and the USA have dropped by 47%.

The industrial land uses in Nogales, Sonora are basically located in the southern part of Obregon Avenue, along of the new highway, called Luis Donado Colosio, and on the west of the Calle Tecnologico. Only, a few number small areas are located on other important road arteries of the city. At end of the 70's, the municipal government of Nogales, Sonora built and leased the first industrial area in the history of the city which was situated in the south part of Obregon Avenue. This industrial area known as Parque Industrial de Nogales, Sonora is the most important cluster industrial area in the city with an area of 57.06 hectares. The building of the new highway or Luis Donaldo Colosio Boulevard opens new areas to industrial development. Along this route there are great of number industrial areas that occupy an area of approximately of 65 hectares.

In addition, there is a small industrial cluster area on the west side of Calle Technologico. In general, all industrial locations have excellent road communication with the border crossing points and the regional road systems. Also, industrial activity in this decade is having an accelerated growth stimulated by the climate, the excellent and cheap labor force, and the magnificent opportunities that the Mexican government concedes to industrial investment in its border region with the United States.

FIGURE 11: Industrial Land Uses in Nogales, Sonora in 1995

Commercial activity in Nogales, Sonora is basic sector in the urban land use of the city, with vibrant growth in the last three decades, and it maintains a strong significance for the economy of Nogales. This activity is basically developed in the most important strategic locations of the city with a cluster organization (Figure 12). In 1963, commercial land use occupied an area of 53.35 hectares. By 1995 this activity has developed into an area of 149.74 hectares that represents 6.56 % of the total urban area of the city. This percentage is relatively lower than the percentage in southwest cities and specifically, in the City of Tucson. Commercial areas in Mexican cites have a lower parking area compared to American commercial parking areas. Commercial land use in southwest cities occupies 9% while in Tucson this percentage is 10% (City of Tucson 1993).

Commercial activity in Nogales, Sonora is formed by the wholesale business and basically, small retail stores. Both types are generally mixed, forming cluster areas. Although, commercial activity is basically developed in clusters areas, reduced small neighborhood stores exist, dispersed in residential areas and for each hectare of residential land use exist 6 squares meters of neighborhood store area.

In recent years, wholesaling activities have principally developed along Boulevard Luis Donaldo Colosio, although some wholesaling areas remain on Obregon Avenue and other locations. All wholesaling houses are located on main transit arteries or ready access to them. This activity consists of large amounts goods that are imported from the United States to be distributed in Mexico. In the past, wholesale houses for the

distribution of farms products from Sinaloa and Sonora to United States were located on the Nogales, Sonora side, However, now wholesale houses are situated on the U.S. side. Although, the domestic commercial activity in the city is more independent from the American side than it was in 1960's when it was totally linked with the commercial activity of Nogales, Arizona.

Retail commercial land uses are principally situated in El Centro and on the main traffic arteries of the city. El Centro has the greatest retail area of the city and El Centro is situated along a great part of Obregon Avenue from the border crossing point to Tepic Street. El Centro has followed a lineal expansion towards the south as a resulted of the frontier restriction on the north and the hilly topography on the east and west sides. This linear center in its northern part next to the border crossing point maintains the tourist district in which there are banks, a post office, government offices, drugstores, nightclubs (cantinas), alcoholic beverages stores, a school, hotels, curio shops, liquor stores, jewelry shops, leather goods stores, and restaurants.

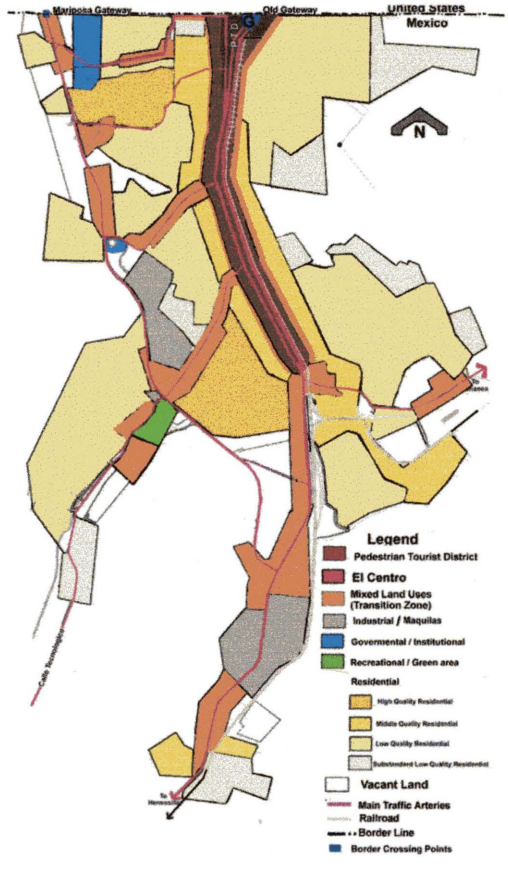
This tourist district area and the rest of the El Centro mix functions of the foreign tourists and of the local inhabitants, although the tourist district areas is more orientated to foreign tourists and have a strong pedestrian character. Although, cluster areas of small business stores are situated on the main transit arteries of the city, El Centro has the major concentrated commercial area in the city and is the skeletal core in the organization of Nogales, Sonora.

FIGURE 12: Commercial Land Uses in Nogales, Sonora in 1995

Basically, Nogales, Sonora has had historically a linear urban development, where El Centro has been the base of its organization. Nogales is based on a single linear core (El Centro) around which other sectors are arranged. El Centro occupies the land with better accessibility in this linear development and commercial land uses are the major uses in this core area. This linear core is an expansion of the historic urban center that is located beside to the old gateway (Old Aduana), where the pedestrian tourist district is also situated. There is clearly a "transition zone",(as the established by Burgess in the Concentric Zone Model), which surrounds El Centro, especially towards the south of Obregon Avenue. The next sector is irregularly formed for middle quality residences, although there is a low quality residential sector on the east side of the historic center and there are also high quality residential land use sectors on the west side of Obregon Avenue. Generally, residential quality decays with the distance from El Centro, and high quality residential areas are located in the west side of Obregon Avenue. On the periphery of the city there are substandard low quality residential sectors that are growing in an irregular pattern, although some substandard-low-quality residential sectors are also situated in the historic downtown area. Industrial parks or maquila areas are situated along the main arteries which have an excellent transit communication to the trucks or railroad ports of entry. Basically, the main transit roads are originated from the border crossing points. This linear urban development presents some characteristics of the Concentric Zone Model, Sector Model, and Multiple Nuclei Model, although some characteristics are related to the Nogales settings. The Nogales urban structure shows

clearly the transition zones and the central core pointed out by Burgess in the Concentric Model. Also, the Nogales urban structure shows that once land uses emerged around downtown, they remained in the same location and extended over time in the same direction as the town growth. This situation is clearly established in the Sector Model developed by Hoyt. In addition, Nogales shows clearly impact of the technology, basically the automobile, on the urban form and structure of the land uses. The changes in road transit systems have had effects on land use and transportation patterns in the city. Generally, growth areas in Nogales follow transportation corridors. This urban structure of Nogales is graphically summarized and displayed in Figure 13.

FIGURE 13: Descriptive Urban Model of Nogales, Sonora in 1995



This Mexican border city present some elements of urban structure similar to those of other border cities. One is that Nogales' shape is abruptly truncated on its northern edge by the border line between the United States and Mexico. Second, the pedestrian tourist district is located adjacent or within easy walking distance to the border crossing port and situated within the downtown area. Third, the location of industrial parks along of the main arteries of the city with an excellent road communication to the trucks port of entry or the railroad port of entry. Fourth, the main transit roads are oriented toward the border crossing points.

However, The city of Nogales presents specific characteristics that distinguish it from other Mexican border cities. The most important characteristic of Nogales, Sonora is its linear development which has been affected by its location in a narrow valley with its surrounding hillsides. Historically, the main transportation roads and the old crossing have occupied the bottom of this narrow valley, creating the main axes of the skeleton core of the settlement (Arreola and Curtis 1993). This situation has caused the formation of a linear downtown area, El Centro, which is an urban band where commercial, social, industrial and recreational activities are developed, and where in its northern part beside the port of entry there is the pedestrian tourist district. This linear spine has perpendicular roads at the intersection of the main canyons to connect the peripheral, particularly residential, areas with this center. Also, this linear center is the skeleton core around which the residential sectors are basically organized. Residential quality decay with distance from this linear center, especially towards the east side where large areas of

substandard low quality housing and low quality housing are situated. Basically, a continuous middle quality residential development goes along the both sides of this linear center. Industrial and some commercial areas function more independently from the main linear spine. The building of a highway, parallel to old main north-south avenue, and the Mariposa gateway, permits industrial and some commercial areas to have a independent truck traffic communication with the United States. In addition, the size of its pedestrian tourist district and El Centro sectors are relatively bigger than in other Mexican border cities. This situation is related to the strategic location of the city on the Arizona-Sonora corridor and the growth of the metropolitan regions of Tucson and Phoenix which stimulated a strong impact on the development of these commercial areas in the city (Arreola and Curtis 1993). In general, the linear urban development is the most important factor that distinguishes this border city from the rest of them.

8

Conclusions

The city of Nogales , Sonora has had in the last three decades an accelerated growth which is expected to continue. This rapid growth of this city is created by a vibrant and prosperous economy based on trade, services, and maquila industry. Nogales, Sonora is situated in a narrow valley that is a strategic obliged pass in the US-Mexican border. In 1995, Nogales city had a population of 131,000 inhabitants in an urban area of 2,276 hectares.

In 1995, Nogales , Sonora had an compact linear urban structure which was primarily occupied by the residential land uses that had a cluster organization followed by the commercial and industrial land uses that also had a cluster organization, then by institutional, recreational and open spaces that had a random organization. The city has three quarters of its urban area dedicated to residential land uses, which forms clustered areas and where the economic and social contrast of the community residents can be observed. Institutional, educational, and recreational areas comprise a small part of the Nogales urban area and have a random organization. These uses have been strategic in the development of the community. Institutional, education and recreational uses are nonexistent in the periphery and poor land uses areas of the city, mostly there are large vacant lots in the periphery. These large lots are being held by their owners for future industrial and commercial activities. These sectors have major economic capacity through acquisition and development. Specifically, industrial land use areas in Nogales, Sonora

have had surprising growth, which before 1964 was relatively nonexistent (Gilversleeve 1963). In 1995, industrial uses represented 5.71% of the total urban area of the city. Basically, Nogales has been characterized by a vibrant commercial activity which even today occupies an important area of 149.75 hectares representing 6.58% of the total urban area. The major commercial area is situated in El Centro.

Historically, Nogales, Sonora has had a compact linear urban development, where El Centro has been the base in the organization of the city and around this linear core, other urban sectors are arranged. This explosive linear urban development in Nogales, Sonora has resulted from the economic, political, social, physical, and natural border conditions and this growth is expected to continue in this border community.

The land use patterns and this linear urban development that have evolved in Nogales are essentially functional, although they do not necessarily represent the most efficient patterns and urban structure. This land use pattern and urban structure basically reflected the demand of the economic forces over the land and the inertia of urban planning in the organization of the city. Despite the fact that the actual land use patterns present several success elements for an effective economic functioning of the community. They also reveal the failures or maladjustment of the urban context to provide a more effective and efficient social and economic organization in the city.

The city has a functional urban structure for commercial and industrial development of the community. Basically, The pedestrian tourist district beside the border crossing points and El Centro along Obregon Avenue have an easy access for the

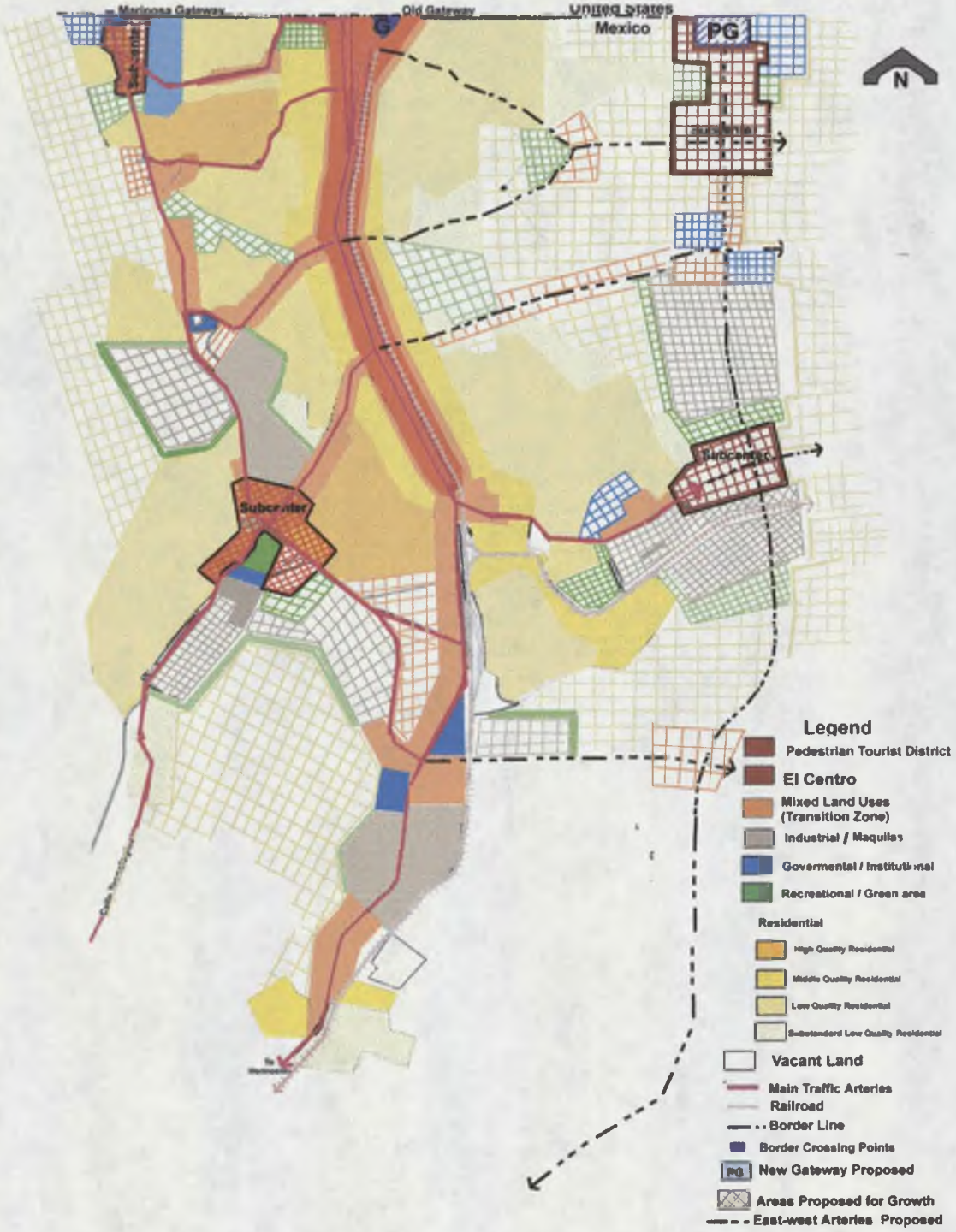
users from American side. Also, customs agencies and industrial parks have excellent and easy road communication to the border crossing points and regional transportation systems. Another aspect that has permitted a notable success in the downtown area is the mix of commercial, institutional, educational and recreational land uses. Also, the mix of activities for local and foreign users is another factor that has contributed to this success of El Centro. The mix of activities and land uses forms in El Centro an atmosphere of constant activity and security. In addition, Nogales, Sonora reflects a strong atmosphere of prosperity and development which formed the character that distinguishes Mexican border cities.

However, the land uses and the urban structure have failed to provide a more efficient social and economic organization for the community. For residents, this linear development creates long trips, approximately 8 to 10 kilometers, from residential areas to employment centers in the town. Also, the linear urban development has a strong centralization of commercial and service land uses along Obregon Avenue which forms the linear core of the town. This centralization of commercial and service activities along Obregon Avenue has caused a bad congestion of the transportation system over this route. Also, this route and the railroad basically divided the city in to two zones where the east part across the railroad is specially segregated. In general, the city has a strong deficit of institutional, educational, and recreational areas, and in the east part of the city these land uses areas are nonexistent. Parks and open areas are nonexistent in substandard and low quality residential sectors. Another problem in the organization of

the city is the scale or proportions of this linear development. The urban core has a longitude of 4 kilometers and only 200 meters of width, creating an strong automobile dependence. Also, the city shows some cases of the intrusion of adverse land use (industrial with highly dangerous products) in residential land use areas or commercial areas. Another problem is the lack of preservation of key or prime land for commercial, services, and institutional uses in the area of the Mariposa gateway and Luis Donaldo Colosio Boulevard which were built in 1976. The building of this new highway and border crossing point stimulated the growth on the west side of the city and opened areas to industrial and commercial activities in the city, although the narrowness of the highway and the hilly topography along that route have restricted the development in these areas.

In summary, although that border crossing point and the highway have created new areas of development in the city, they do not stop the explosive linear urban growth in the city. An alternative to stopping this linear urban growth could be developed by several urban strategies. Basically, those strategies should combine adequate land uses and an improved transportation system as well as an equitable distribution of the services in the city. This alternative plan is graphically shown in figure 14.

Figure 14. Alternative Strategies to the Nogales Urban Growth



One strategy to achieve this alternative would be to create a new border crossing point on the east side of the town. This new gateway would increase the economic development and contribute to a balancing of the urban structure of the city, opening new industrial, commercial, residential and institutional areas in the eastern part of the town. The opening of a new gateway would require the building of a new highway with four lanes in the eastern part of the city. This new highway should be linked to the Mexican Freeway 15 of four lanes at the same location at the point where it is connected with the west highway . The west highway is the Luis Donaldo Colosio Boulevard which also is connected with the Mariposa gateway . This highway should be expanded to 4 lines. This strategy of building three main highways perpendicular to the border line should be complemented with the building of road arteries that would connect these highways in horizontal direction and in that way form a grid pattern which allows great flexibility to face growth and changing trends as the urban system requires. This grid pattern would contribute to balancing the urban structure of the town. This strategy of developing west-east arteries should be based on existent major road arteries perpendicular to Obregon Avenue and this strategy should include also the building of bridges over Obregon Avenue if that is required. At this time, these arteries end or start in Obregon Avenue but they do not connect both parts of the city. These roads are the Calle Technologico, the Road to Cananea, the Calle 5 de Febrero, the Boulevard del Ensueno, the Calle Reforma, and the Calle Buenos Aires.

Another strategy is to develop four subcenters. One subcenter could be in the intersection of the Calle Technologico and the Luis Donaldo Colosio Boulevard, Another subcenter could be at the intersection of the Camino to Cananea and the new highway proposed in eastern side the city, another could be beside the Mariposa gateway and another could be beside the new gateway that is being proposed. Generally, those transit nodes that are created by the intersections of main roads or beside the border crossing points are natural places for commercial and services areas. Those locations could have excellent accessibility. At present, in those places proposed to be subcenters, there exists a mix of residential, and commercial land uses. Also, at those intersections are located large vacant lots that can be developed. The arrangement of land use in those four subcenters should be similar to the arrangement in the actual urban core of the city where there is a mix of commercial, institutional, educational and recreational land uses. In the current urban core, there is a mix of activities for local and foreign users which have been factors contributing to the success of El Centro. However the linear core of Nogales does not have a space in its organization where there could be large organized rituals, dance, sports and music that could contribute in the integration and identity of the community. The city requires a park, a plaza, a stadium, or a church to develop those social and cultural requirements and those projects should be integrated in El Centro or subcenters in the city. Institutional, educational, open space and recreational land uses are really nonexistent in the city and those uses should be inevitably considered and required in any urban plan developed for the city. Also, these land uses would have a balanced

distribution in the town area and especially, key or prime land should be preserved for institutional land use, considering that institutional uses are basic for the community development.

Another strategy to balance the urban structure would be to plan employment centers closer to residential areas. In this way the distances would be shorter and excessive use of the automobile could be avoided. This strategy was used in the San Carlos residential and industrial development, although commercial and public services could also have been considered the San Carlos project. New industrial areas could also be opened in the eastern side of the city taking advantage of the new highway that is proposed in that sector of the city. In this way, this industrial area would have excellent road communication with the border crossing point and also this industrial area would be close to the residential sectors that are located in this east sector of the city. One industrial location could be situated at the intersection of the railroad to Cananea and the new eastern highway and another at the intersection of this highway and the Calle Technologico (the main artery perpendicular to this highway that has been proposed). Also, the current industrial areas of the city would be consolidated, basically those industrial areas situated at Luis Donaldo Colosio Boulevard and in the western part of the Calle Technologico.

Another strategy would be to consolidate and develop the current residential patterns in the city, at the same time that, the growth in the southern side of the city is being prevented.

Definitively, this alternative in balancing the urban structure of the city would stimulate an equitable distribution of the services in the city and a strong interrelation of the transportation system and the land uses. Also, this alternative would especially increase the supply of institutional, educational, and recreational land uses because of their rare existence in the city. Basically, this alternative would avoid centralization of the Nogales urban structure on Obregon Avenue and the residents would not have to travel long distances to the work places, and they would have access to commercial areas and services without having to travel to Obregon Avenue. This alternative would break the explosive linear urban development of Nogales, Sonora.

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