A RETRIEVAL SYSTEM FOR LAND USE PLANNING INFORMATION

by

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TABLE OF CONTENTS

LIST OF FIGURES

Chapter 1

INTRODUCTION

One of the primary reasons for the existence of regional planning commissions is the provision of a place for the execution of short- and long-range land use plans, in a setting aside from most of the everyday political pressures inherent to local government. In order to accomplish this purpose, it is first necessary to know how the land is presently being used, and various other facts about the land which, when aggregated, determine how the land can best be used in years hence.

It is then logical to use a computer to accumulate and store this information, since a computer can easily manipulate the data, aggregate them to various geographic levels and political subdivisions, and at the same time, provide part of the input to land use and transportation models. Many land use data retrieval systems have been designed and implemented (to varying degrees of success) in all parts of this country during the last ten years.

Early in 1967, work was begun at the then Metropolitan Planning Commission—Kansas City Region (Metroplan), now Mid-America Regional Council (MARC), on an establishment-level land use data file. That is, the file contained not

only a record for every parcel of land, but also records for each of the various partial uses of those parcels, both horizontally and vertically, as illustrated in Figure 1. Those who initiated the project, however, were unaware of the enormity of what they had begun. By the time the data had been extended only to the limits of urbanization (well inside the boundaries of the eight-county region), the data file consisted of more than three million records, and required fourteen hours to *sort* on the IBM 360/30 then in use at Metroplan.

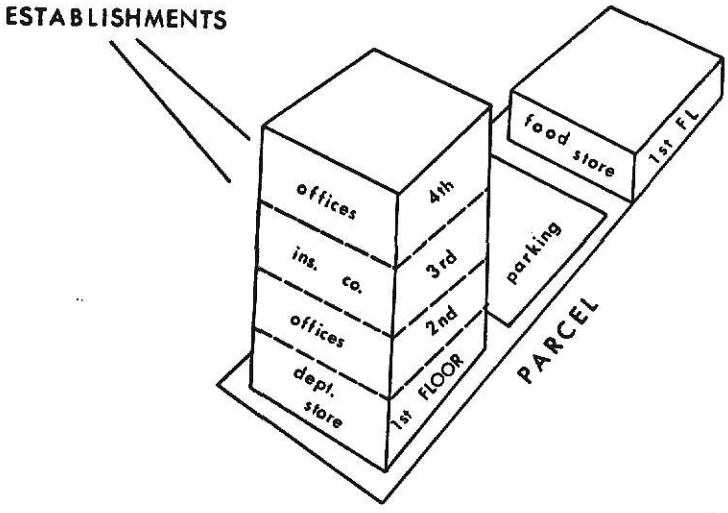

Figure 1

Establishments within a Parcel[1]

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[1]Metropolitan Planning Commission—Kansas City Region, *Existing Land Use Inventory Procedures*, Planning Guide No. 2 ([Kansas City, Missouri]: n.n., 1968), p. 22.

If money had been available to support that file, it might still have been in existence today, and the subject of this current work might never have been undertaken. Indeed, two or three metropolitan areas around the country have made a successful go of an establishment-level file; in every case, however, enormous sums of money have been involved. For example, the Metropolitan Washington Council of Governments (COG) maintains such a file for the District of Columbia and nine surrounding counties in Maryland and Virginia. The key to its success lies in the fact that the assessors of those ten jurisdictions rely on the COG for information needed in assessing real property, so that the assessors contribute both information and cash to the maintenance of the system.

In the Kansas City Region, due in part to the fact that a state line bisects the region through its heart, no such cooperation existed. For want of financial support, then, the Kansas City establishment-level file died a quiet death when it was only in its infancy.

Still, some kind of system had to be developed for the region. Though it must obviously provide less detail, its primary purpose could now be to satisfy the needs of regional planners, and not assessors or developers. The original file, in fact, probably would have never been highly useful in regional planning, due to the large amounts of processing required to aggregate the data to a broad enough scale for it to be of value. Reams of computer paper

full of numbers are of minimal value to a planner, who prefers his information in graphic form. Thus it was recognized that whatever form the new land use computer file took, it would have to be tied closely to a parallel system of maps.

The question then remained as to at what level the data should be maintained in computer-readable form. Again, the regional planner (dealing with some three thousand square miles) needs only a rough sketch of the existing land use. A grid system was overlaid on a map of the region, but arbitrary squares do not reflect the urban and natural fabrics, so the grid system was rejected. Investigation of available products from the Bureau of the Census revealed that they have a series of maps of the metropolitan area which contain census tract and block numbers. Since the total number of blocks in the eight-county region would not exceed 25,000, and because the Census Bureau maps were available as a base for half the regional area, the physical block was chosen as the logical geographic unit for maintaining existing land use information.

From that initial idea grew the Land Factors Atlas, and the Block-Level Planning File System—a set of maps and a simple, sequential computer-readable file which reflect and complement each other, and which are both valuable assets in the work of the staff of the Mid-America Regional Council.

Chapter 2

THE LAND FACTORS ATLAS

The Land Factors Atlas was designed to be as easily usable and easily updatable as possible. Since the amount of information store on the maps is extensive—twelve current items, with the possibility of expansion to twenty-one—it became readily apparent that some type of translucent or transparent overlays would have to be employed in order to separate the classes of information displayed. This, too, affords the planner the ability to overlay the various sheets upon one another in varying combinations for the analyses he must perform.

The atlas is also diazo reproducible, so that working copies are inexpensive and readily obtainable within the office. The overlays are made with rub-on lettering and colored patterns, which are removable where necessary for updating, and which are diazo reproducible. Use of blue-line prints, where possible, extends the life of the original overlays, since the patterns tend to peel off over a period of time.

Although the blue-line prints do not reproduce the color of the original overlays, multiple patterns are used on each overlay so that the various categories are still

readable when the overlays are printed.

Following is a discussion of the items of information which comprise the current set of overlays for the Land Factors Atlas. The key to the map patterns used to categorize each overlay is contained in the pocket with the atlas facsimiles (inside back cover).

THE BASE MAPS

For most of the areas designated by the Bureau of the Census as Standard Metropolitan Statistical Areas (SMSA's), the Bureau's Geography Division has prepared an atlas of maps it calls the Metropolitan Map Series. This series was derived from maps made by the United States Geological Survey, commonly referred to as USGS maps, which are produced directly from aerial photographs, and thus are extremely accurate.

Primarily designed for use by census enumerators, the Metropolitan Map Series contains streets and street names, but not address ranges. The maps contain, as was noted, census tract and block numbers. Railroads, and waterways down to the smallest streams are delineated. Additionally, the maps are available with overlays depicting congressional districts, enumeration districts, and other census-related geographic areas, but these were neither needed nor used in the base maps for the Land Factors Atlas.

The map image area for each sheet in the series is approximately 16" X 21½"; at a scale of 1"=2000', each sheet

covers an area of slightly more than 49 square miles. For the Kansas City region, the series originally consisted of 37 map sheets; it is, at this writing, being extended by the Census Bureau to the limits of the SMSA, though the extension maps are at a scale of 1"=3200'—not suitable for the Land Factors Atlas, which must be at only one scale in its entirety. With the exception of the retention of the 2000' scale, the Land Factors Atlas is being extended to the limits of the eight-county region through the same process as the Metropolitan Map Series: from the USGS maps. The areas of coverage of the Metropolitan Map Series and the Land Factors Atlas are illustrated in Figure 2.

Two changes were made to the base maps to make them more suitable for the new purpose. First was the delineation of expressways and freeways with a double 1/16" line, and state and federal highways with a single 1/16" line, along with the highway numbers for both those systems. The second was the addition of any airports, of whatever size, which were not shown on the Metropolitan Map Series. Both of these changes were required for particular ongoing studies conducted by MARC. A facsimile of a portion of the Land Factors Atlas base is marked as such and included in the pocket inside the back cover.

The key to the integrity of both the computer file system and the Land Factors Atlas is the accurate maintenance of the atlas base maps. Changes in definition of blocks, due not only to vacated streets, but more often to whole new

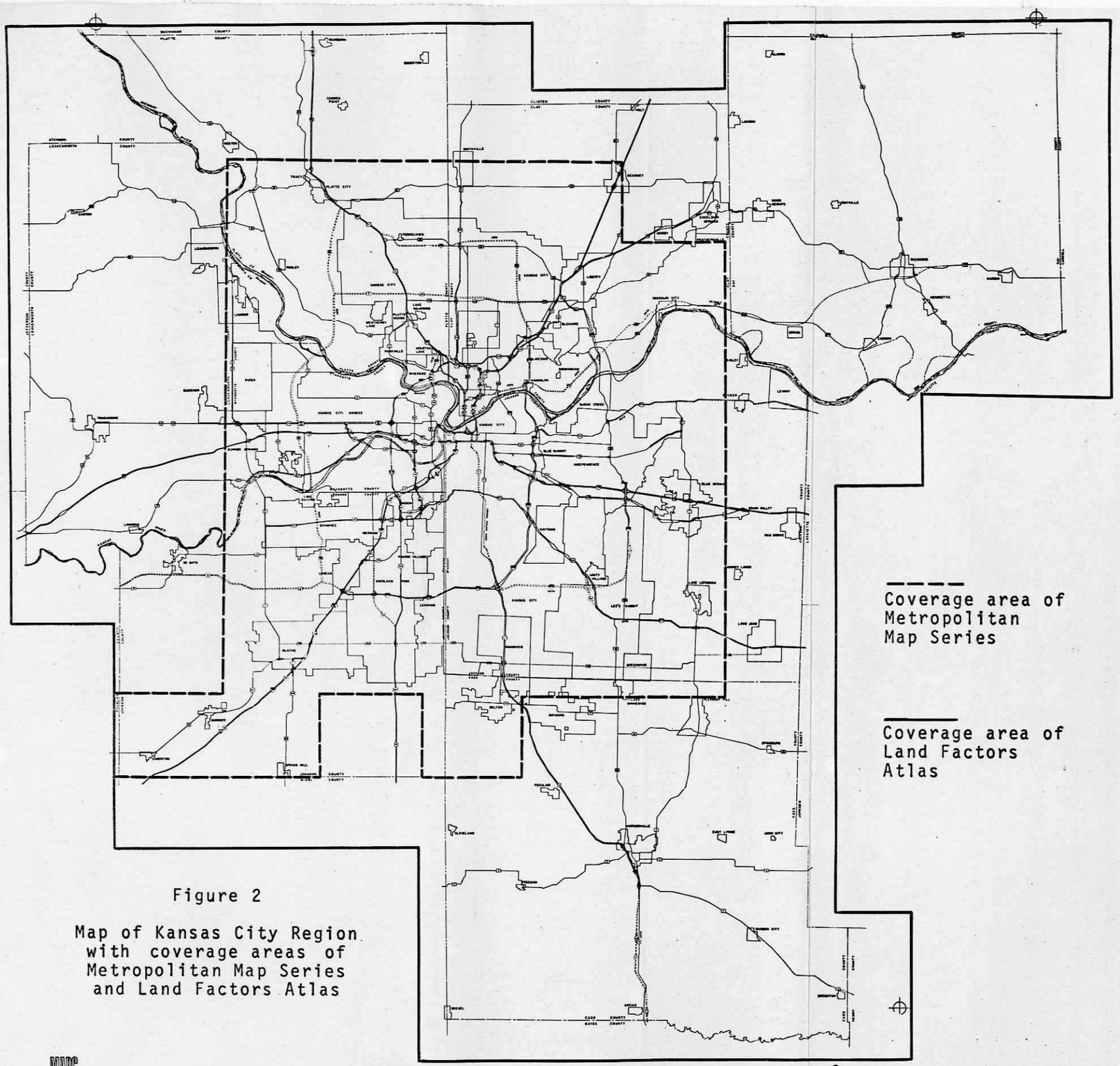

Figure 2

Map of Kansas City Region with coverage areas of Metropolitan Map Series and Land Factors Atlas

MARC
MID-AMERICA REGIONAL COUNCIL
KANSAS CITY REGION

DATE	REVISION	BY	DRAFTED BY:
			APPROVED BY:
			DATE COMPLETED:

MAJOR HIGHWAYS — Kansas City Region

subdivisions, must be accurately recorded in order to have a viable system.

It is usually possible to transcribe new streets to the atlas base from aerial photographs, or, where that is not possible, legal plats can be utilized, since the plats contain accurate dimensional information. Block numbering change procedures are outlined by the Bureau of the Census[2] for use on the Metropolitan Map Series, and these have been adopted by the MARC staff for use on the Land Factors Atlas. Basically, two procedures are involved, one each for blocks combined and block splits. In the former case, the lowest of the former numbers is used, with a fractional part of .99 appended. For example, if block numbers 101 to 103 are combined, the new number for that entire area would be 101.99. Block splits are easily solved by assigning a fractional part to the former block number, adding increments of .01 as needed.

EXISTING LAND USE

Every other year, MARC commissions a complete set of aerial photographs of the eight-county region, in order to allow an in-house comparison of apparent changes in the use of land over the two-year period. Oftentimes, the aerial photos themselves can be interpreted to reveal enough infor-

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[2]U.S., Bureau of the Census, *Procedures for Defining and Numbering Census Blocks and Block Groups*, Geography Division Publication, No. GEO-102 (Washington: Department of Commerce, 1972). (Mimeographed.)

mation to allow the land use to be updated with no field reconnaisance. Where necessary, though, field surveyors are sent out to determine exactly what is occurring in particular parts of the region. The surveyors make their field notes on prints of the aerial photos they take with them in the car.

Those prints are returned to the draftsman in charge of maintaining the land use overlay, who makes the necessary changes, prints the atlas overlay, and sends the blue-line print to coders who prepare information for the computer.

Although only six categories of land use are mapped, the information transcribed on the aerial photos in the field is much more extensive. The field-marked aerials are retained for use in studies of small areas which may require more information than can be maintained on the Land Factors Atlas itself. The aerials are at scales of 1"-400' in the urbanized area, and 1"=800' on the periphery of the region.

The single family residential category consists of one-family dwellings, and mobile homes not in mobile home parks. Duplexes are included in the multi-family category in the 1970 census and on the Land Factors Atlas. All structures constructed to house more than one family and mobile home parks are represented in the multi-family classification.

The commercial classification consists of areas and establishments which are primarily retail in nature. This includes such services as professional offices, and even

automobile services, but few wholesaling activities, and no manufacturing of any kind.

Industrial land uses are those which are primarily not suited for close proximity to residential areas—uses which in some way bother man or his environment. Oil refineries, automobile manufacturing, and railroad-related activities are primary examples of industrial uses of land. A fine line sometimes separates industrial and commercial uses. Oftentimes a primarily industrial activity, albeit light industrial, such as the manufacturing of clothing, may be located in the same structure as the retail sales of that clothing. That situation would be separately identified in the computer file, discussed later, but as industrial (the "lower" use) on the Land Factors Atlas.

Public and semi-public land uses, the fifth category, comprise a potpourri of services rendered for the community. Most of them are further identified on the community facilities overlay, described next. The list is formalized as follows: all schools, public, private, and parochial; public services such as police and fire stations, hospitals, and libraries; all recreational uses; airports; governmental offices and post offices; churches; and cemeteries.

Lands used for agricultural pursuits are considered in the same category as vacant land, since in most cases they are the prime candidates for future urbanization, unless modified by some other land factor.

COMMUNITY FACILITIES

Ninety-five percent of the time, this overlay is used in conjunction with the existing land use overlay to further identify public and semi-public lands. It is, however, on a separate sheet of acetate so that it may be used to quickly pinpoint the locations of particular community facilities.

"Community facilities" are defined as those buildings and lands required by contemporary society for education, protection and recreation. All of those structures and land uses defined as community facilities are delineated with the green vegetation pattern, for public, on the existing land use overlay; a single symbol is used at the location of these facilities on this overlay. The complete list is: all schools, elementary, junior high, senior high, and college; fire and police stations; hospitals; libraries; airports; golf courses; parks; and cemeteries.

Churches were originally to have been included in the list but their very abundance precluded the delineation of all of them. Churches normally do not change the character of residential neighborhoods, and oftentimes do not occupy enough land to separately note on the 2000' scale Land Factors Atlas.

No provision is made for noting the difference between public and private golf courses, since the use of the land is precisely the same, and distinction between

public and private is usually vague. In the case of schools, however, it was noted that some studies require information on public, or private and parochial schools. Therefore, all private and parochial schools are specially called out with a 5/16" diameter circle around the appropriate school symbol. Public schools must be planned according to where the populace resides, but private and parochial schools, like churches, are not the concern of public officials, since the need for public schools is a function of the general population independent of the availability of non-public schools.

Parks include only those lands actively used by the public and not such areas as game preserves, other conservation areas and lands held for future park use but not yet developed.

COMPREHENSIVE PLANS

Although many of the same patterns are used on the existing land use overlay and the comprehensive plans overlay, the two are quite different in appearance. The pattern of blank areas are radically different on the two overlays, since blank areas denote vacant or unused lands on the former; and on the latter are either areas for which no municipal or other comprehensive plans exist, or lands designated only for agricultural pursuits. The current overlay, while being a composite of many formal plans for individual municipalities with widely differing target years, is geared as closely as possible to the year 1990.

Residential land uses are divided into three density ranges on the future land use overlay: 0-6, 6-15, and above 15 dwelling units per acre. Population projections can thus be made by simply multiplying the number of acres alloted to each density by the density itself to determine the number of persons projected for a given area at a given point in the future. The three densities are also related to the densities on the zoning overlay, discussed next, since zoning today determines how lands will be used in the future.

As noted above, this overlay is a composite of many plans, most done by private consultants for many of the smaller cities in the region and by the staffs of the cities large enough to have their own planning departments. Other plans are included, however. The United States Army Corps of Engineers has plans to build several reservoirs in the region for flood control. In one county, the county parks and recreation district has a comprehensive parks plan, so it was included.

Most housing developers will not reveal where they have plans to build subdivisions, so it is only possible to include that information in cases where the developers already own the tracts and are holding them for development. That situation usually occurs only within three years prior to the start of actual construction, so the land in question is usually zoned and considered prime for development near the time the developer takes ownership.

Crown Center, the largest privately-financed urban

redevelopment in the country, is now being constructed by Hallmark Cards on approximately 85 acres near downtown Kansas City, Missouri. It is an example of a location of a high density of population and employment in the near future.

ZONING

In order to achieve a common base of information throughout the numerous zoning jurisdictions in the area covered by the Land Factors Atlas, all zoning classes from those various jurisdictions are transferred by conversion tables to a single set of classifications, established by MARC, solely for use on the zoning overlay. The classes used on the zoning overlay are correlated to both existing land use and comprehensive plans.

The three residential classes are based on dwelling unit densities equivalent to the population densities delineated on that overlay; most zoning codes have residential classes based on the allowed number of dwelling units (DU's) per acre. The three classes used on the zoning overlay are: R1, 3.0 DU's/acre or less; R2, above 3.0 DU's/acre but not greater than 9.0 DU's/acre; and R3, greater than 9.0 DU's/acre.

Three industrial classifications are utilized. The first two, light (IL) and heavy (IH) industrial, are based on the types of industries allowed in those areas which are in turn determined by how they affect the environment. The third class, planned industrial (IP), is typically included

in a zoning ordinance to indicate an area where most types of industries are allowed, but none other than industrial uses are permitted. In most classifications, any use "higher or better" than that designated would also be allowed. To illustrate, a low density residential subdivision would normally be permitted in an area zoned commercial or industrial, but the reverse would not be true.

Since many zoning ordinances contain classes unique to the municipality or jurisdiction involved—classes which are not readily transferable by table to a common schedule, a special zoning class (S) has been included for the overlay. The user thereby has the capability of using the conversion table in the reverse direction to determine from the particular ordinance what is permitted in special zoning districts. Some of the more unusual zoning categories found in the Kansas City region are classes for parks or conservation (public lands are usually not zoned), automobile parking, and water treatment plants.

This overlay is, unfortunately, one of the most difficult to use when printed, because the individual zoning districts are not delineated by a pattern, but by colored tapes on district boundaries. Tapes of all colors print as dark blue lines. To partially alleviate this problem, one- or two-character abbreviations are located within each district on the overlay. In addition to the seven classes discussed above, the other two classes mapped are commercial (C) and agricultural(A).

UTILITIES

Water and sewer systems are the only utilities included in the Land Factors Atlas, since they are the only utilities paid for directly by public funds. The 2000' scale of the Land Factors Atlas induced a slight problem in the delineation of these systems, for it is impossible at that scale to even begin to accurately reflect the complete utility networks. The problem was solved by illustrating areas served by the systems, and not the actual water and sewer lines themselves. Again, the prime reason for the existence of the atlas is its use in regional planning, so the information delineated on this overlay is more than sufficient for that purpose.

Areas are shown which are served by two ranges of line sizes for both water and sewer service; the two utilities are delineated on physically separate overlays.

For sewer service, the ranges are 8" to 24" diameter, or equivalent rectangular cross-sectional areas, and 24" diameter or greater. The eight-inch size is a legal minimum for use as a sewer collection line. For water service, the minimum size on the lower range is 6" diameter, and 24" is the minimum size for the larger range of water lines. Most fire-fighting equipment requires a minimum 6" line in order to obtain enough pressure to operate successfully, so for that reason, no lines smaller than six inches are shown.

Normally, "area served" is defined to include the area within 150' of a line of that size designated. Some flexibility is allowed, especially in the vicinity of the larger lines, since the conduits can be easily extended.

CONDITION OF STRUCTURES

This information is essential to the process of pinpointing areas where redevelopment is likely to occur, or where it *should* occur.

In most prior land use studies, four classifications of structural condition were used: sound, need of minor repairs, deteriorating, and dilapidated. For this atlas, the first two classes are combined, for it was found that the very background of the field surveyor involved would temper his decision on which category a particular structure should be coded. That is, a surveyor who grew up in the suburbs would tend to rate a borderline case lower than a surveyor who grew up in the inner city. That problem was not entirely eliminated, but diminished through the elimination of the "minor repairs" category. The following are instructions for classification of structures by condition during a windshield survey.

> "Sound - Structures in this category can contain some minor defects which require some modifications or alterations to bring them up to acceptable standards. Examples of minor defects include: Lack of paint; slight damage to porch or steps; small cracks in walls, plaster or chimney; broken gutters or downspouts; slight wear on floors or doorsills.
>
> "Deteriorating - 'Deteriorating' structures need

more repair than would be provided in the course of regular maintenance. Structures have one or more defects of an intermediate nature that must be corrected if the structures are to continue to provide safe and adequate shelter. Examples of those defects include: Shaky or unsafe porch or steps; open cracks or missing materials over a small area of the exterior floors, walls or roofs; rotten window sills or frames; deep wear on stairs, floors or doorsills; broken or loose stair treads or missing balusters. Such defects are signs of neglect which lead to serious structural deterioration or damage if not corrected.

"Dilapidated - Structures in this category do not provide safe and adequate shelter. They generally have one or more critical defects, or have a combination of intermediate defects in sufficient number to require extensive repairs or rebuilding, or are of inadequate original construction. Critical defects result from continued neglect or indicate serious damages to structures. Examples of critical defects include: Holes; open cracks or missing materials over a large area of exterior floors, walls, roofs or other parts of structures; sagging floors, walls or roofs; damage by storm, fire or other causes. Inadequate original construction includes structures built of makeshift materials and inadequately converted cellars, sheds or garages not originally intended as living quarters."[3]

CITY LIMITS

Municipal boundaries are illustrated for many reasons; for example, making it easier to distinguish boundaries between various zoning jurisdictions and comprehensive plans. The ability to add corporate limits to any of the other overlays is helpful when doing studies for or interpreting data based on particular cities.

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[3]Metropolitan Planning Commission—Kansas City Region, *Land Factors Atlas Procedures Manual, Kansas City Metropolitan Region* ([Kansas City]: n.n., 1971), pp. II-6 to II-7. (Mimeographed)

FLOOD PLAINS AND EXCESSIVE SLOPES

The United States Army Corps of Engineers has published maps of areas which flood on the average of no more infrequently than once every one hundred years. These areas should be reserved for types of development which are not adversely affected by flooding. Railroad yards, though expensive to replace, are often located in the flood plain since the main lines themselves often follow rivers from city to city. Parks and recreational areas are encouraged along rivers.

Slopes in excess of 25 percent, or a rise of one foot in each four feet horizontally, are unbuildable for many different land uses, and so must be identified. This information is not difficult to obtain; it can be read directly from contour maps in locations where the contour lines are close together—those areas tend to stand out to the first glance.

Because flood plains and areas of excessive slopes are almost mutually exclusive, they are shown on the same physical overlay.

AIRPORTS

Airport runways and names are drawn on the map base, which was discussed earlier. Mapped on this overlay are airport approach zones and clear zones, as defined by the Federal Aviation Administration. Approach zones are used

by MARC to indicate areas of potential high levels of noise; therefore, those approach zones which were longer than five miles were truncated to that distance. In clear zones, all development is prohibited.

ORIGIN-DESTINATION ZONES

OD zones, as they are commonly called, are zones used by transportation planners for purposes of studying desired trip movement from place to place within the region. Since a large portion of funding for regional planning comes from transportation planning grants, much data is reported on an OD zone basis. The Block-Level Planning File, discussed in the following chapter, has a field for the recording of the OD zone number for every block. In the Kansas City Metropolitan Region, there are at this writing a total of 837 zones.

Surprisingly enough, the series of origin-destination zones changes every few years when the state highway departments, who are primarily responsible for their definition, feel that the distribution of population warrants such a change in the size or number of zones. In fact, the current OD zone overlay contains two series of numbers, though this is not reflected on our facsimile. Through a number of studies, the changes made in the numbering system have proved to be unfortunate, indeed, for the ability to correlate the results of one study with those of a subsequent study is diminished due to the incompatibility

of successive sets of zonal areas and numbers.

SYNOPSIS OF THE ATLAS

Excluding the base maps themselves, which pose the greatest problem in the process of keeping the atlas current, the land use overlay is the most difficult to update. The defined, biennial check on its validity should provide the needed key the MARC staff needs to maintain that overlay. The continuance of that process, too, will provide an almost automatic update of both the community facilities and the condition of structures overlays.

All of the remaining overlays are updated when the information is received. Only the updating of the zoning overlay is not trivial; this is due to the frequency of zoning changes and the need to convert the external zoning classes by table to a common internal notation. Both of these problems are further complicated by the number of zoning jurisdictions in the Kansas City Region: more than one hundred and ten. None of the others really poses any difficulty in maintenance. One, which contains both flood plains and excessive slopes, is almost never changed after it is initially created. About the only change which could be made to it would be subsequent to the construction of new flood protection levees or a new reservoir, which could alter both those categories of information. Only slightly more frequent in its changes is the airport overlay, which is only altered when an airport opens or closes.

Chapter 3

THE BLOCK-LEVEL PLANNING FILE SYSTEM

When the name was chosen for this system, a more highly involved series of computer files was foreseen than actually evolved. At that time, projections were for the inclusion of an employment file, a detailed housing file, a file of parks and recreational facilities, and possibly others, all of which were to have been coded to census tracts and blocks, and integrated into the system presently under discussion. The probability of any of those additional files being implemented as a part of this system is now diminished; the files which are implemented will probably be totally separate series of programs.

While that is not seen by computer scientists as being the most efficient approach, the present lack of definition and the possibility of frequent change in the record layouts of those files make it preferable to maintain the greatest simplicity at all times. Thus, a more accurate title for this system would be the "Block-Level Land Use System", but its relationship to the Land Factors Atlas and the inclusion of several other items in the file have led to the retention of the original system name.

Simplicity in design was, and is, important to MARC,

for two reasons. The current size of the data processing staff at MARC is one person, so the time that one person has available for any single project is necessarily limited. Too, the need for portability of the system is essential; three computer sites have been utilized during the past two years. The present, partially complete implementation is tape oriented, on an IBM 360/40, with main storage of 256K, and operating under the Disk Operating System (DOS). That portion of the system which has not been written is the program for general printing of the file at the block, tract, or origin-destination zone levels. To date, use of the system has consisted solely of specialized reports generated for specific projects and correlated with other files.

The completed system, as illustrated in Figure 3, consists of three ANS COBOL programs: one to edit system transactions, one to update the master file with valid transactions, and the report generator mentioned above. No further discussion of the programs themselves will be entertained—the topic of this report is the total system, not its parts.

The use of the history file, requiring several years' processing of transactions prior to its existence as a usable volume, has not been defined, nor has any programming been done to accommodate processing of the file. The updating program has been designed, at this point, to do nothing more than merely add new historical records to the

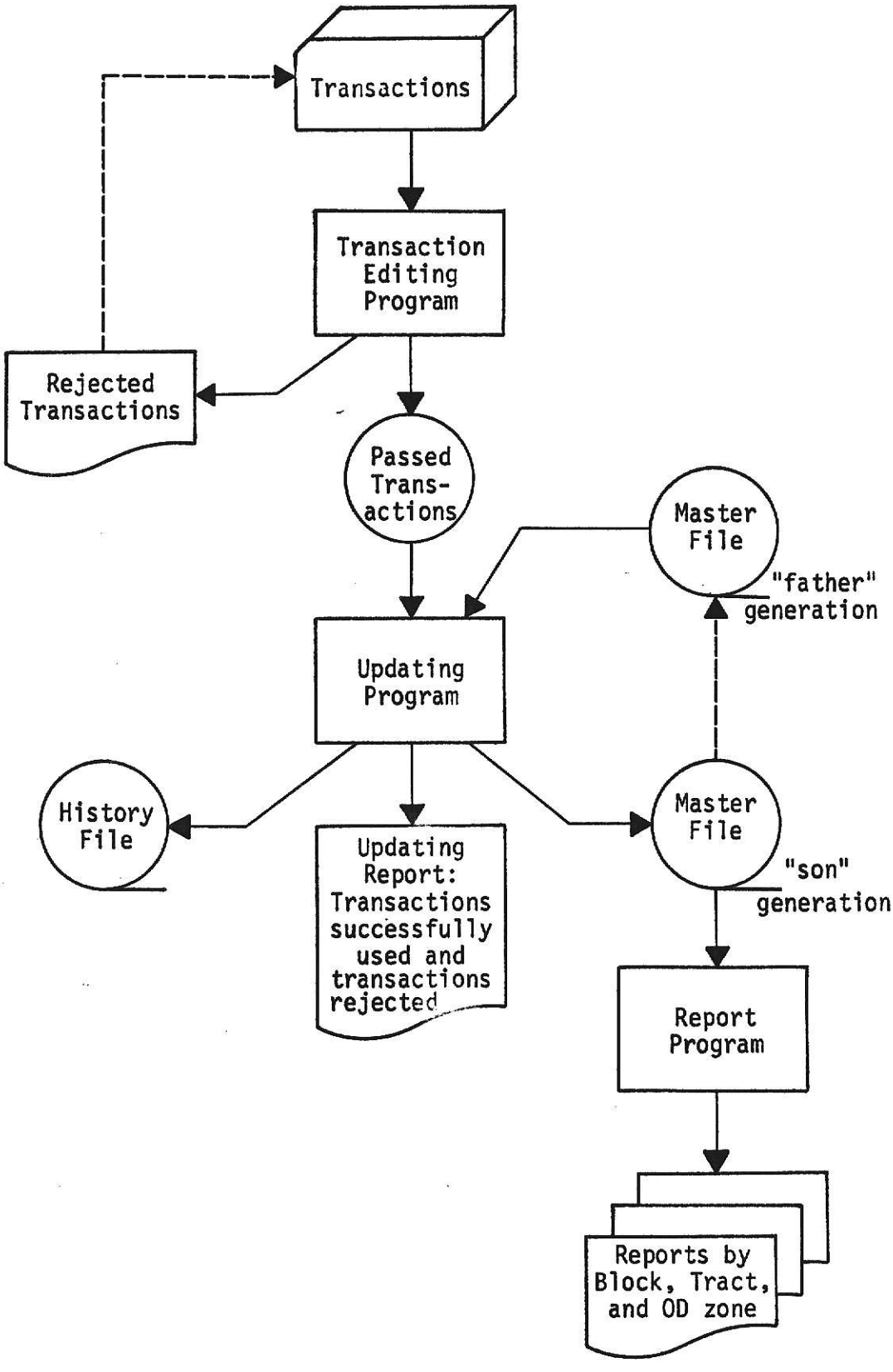

Figure 3

Information Flow in
The Block-Level Planning File System

end of the history file—including, of course, the date the record was put there. Then, at the time processing of historical information is required, the file can be sorted into sequence and used. Again, this was selected as the simplest and most direct approach to a solution of the problem of a lack of definition of program requirements—which definition will not occur for at least two years.

Though it was recognized that many specific, individualized reports would have to be prepared, and that the file would on occasion be correlated with other files from outside sources, no effort was made to design a system which would by itself accommodate any of those needs. Those needs were, in short, consciously left unfulfilled; rather than purchase a packaged information-retrieval system at enormous cost, this is a way to defer the cost of individual projects until the time they can be defined and to charge those projects for that cost at the time they are funded.

The standard listings of file contents will be at the block level, and at the census tract and origin-destination zone levels of aggregation. At the block level, listings will be produced of land use by both percentage of the block (for coders' use) and acreage in each land use category (for professional use). Only acreage reports are generated at aggregated levels, since percentages cannot be summed (nor is there a need for them to be).

LAND USE FILE RECORD FORMAT: EXTERNAL AND INTERNAL

The individual block record has an internal length of 122 characters, or bytes, thus requiring two 80-column card formats for transactions. The record identifier, the census tract and block number, comprises the first two fields of each card. The third field of each card, the transaction code, is a two-character field which identifies the type of transaction and the card format to the card editor program.

Five types of transactions are required in this system: 1) add a census block, or record to the file; 2) update a record; 3) delete a record; 4) correct a record; and 5) remove a record. The first three are obvious enough. Correcting a record differs from updating a record in that the information previously in the master file is not obsoleted, but incorrect; that is, the prior record image should not be moved to the history file, but simply replaced. Removing a record is related to deleting a record, then, as a correction relates to an update. If a record is inserted with an incorrect block number, it should be removed, and not moved to the history file. Census blocks are eliminated when combined with other blocks, for example, when streets are vacated.

The last field (card columns 78-80) on each card is used to identify the person who coded the transaction.

Staff turnover is quite high in the coding section, and the ability to identify who created a bad transaction allows further instruction to be given that individual and mistakes are less frequently repeated. The coder identification is also used as an authorization code for removal transactions, in order to maintain the integrity of the file. It is not, of course, included in the master file.

All of the first card (format LU1, Figure 4) is used for coding land use information. Land uses are coded by percentage of the block directly from prints of the Land Factors Atlas. Coders are given transparent grids and fraction-to-percentage conversion tables to use in determining the portion of the block devoted to each category of land use. The coder also uses the field-marked aerial photographs to further identify mixed residential/commercial and commercial/industrial land uses. Associated with each percentage is a column (except vacant/agricultural, and recreational) for marking generalized condition of all structures in each use category; again, the Land Factors Atlas is used as a coding information source.

The educational, public, and special uses fields have sub-fields for further identification of those community facilities involved. The current use of those sub-fields is the coding of a "1" or "0" (zero) to indicate presence or absence of each facility designated. In the educational portion, a "1" is used to indicate a public school, and a "2" to indicate a private or parochial school.

DATE ______			SINGLE FAMILY		MULTI-FAMILY		MIXED R/C		COMMERCIAL		MIXED I/C		INDUSTRIAL		VACANT OR AGRI.	EDUCATIONAL							PUBLIC						SPECIAL USES									RECREATIONAL			CODER
																		ELEMENTARY	JR. HIGH SCHOOL	SR. HIGH SCHOOL	COLLEGE	OTHER			POLICE	FIRE	HOSPITAL	LIBRARY			CHURCH	CEMETERY	AIRPORTS	ADMINISTRATIVE	RIGHT-OF-WAY	BUS/TRAIN	OTHER	PUBLIC	PRIVATE		
TRACT	BLOCK	TC	%	C	%	C	%	C	%	C	%		%	C	%	%	C						%	C					%	C								%	%		
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LU1

Figure 4

Coding Form LU1

In the "right-of-way" sub-field of the special uses category, a "1", "2" or "3" is coded to indicate a freeway, parkway, or railroad, respectively. City streets and other thoroughfares are included proportionately in surrounding blocks, and not specifically coded as such.

On the second card (format LU2, Figure 5), the first portion consists of zoning information, which is coded in precisely the same manner as land use. The two-character zoning categories are coded directly from the zoning overlay of the Land Factors Atlas; the percentages are, in general, easier to code than land use percentages, since individual blocks do not tend to be fragmented into as many zoning categories as land uses. Dwelling unit counts can be hand coded or, as when the file was created, obtained from 1970 census tapes. Block areas are hand-calculated and balanced to control totals at the census tract and county levels. When that process is once completed, it will not have to be repeated—further block definition changes will necessitate only an arithmetic manipulation of the areas of the block or blocks concerned. The block population, too, was obtained on the first round from the 1970 census.

The next four fields are normally calculated by the file updating program: densities are recalculated when block area, population, or housing unit counts change. The date is the month and year (no further accuracy is necessary) the record was last updated; and the "trend" is the

DATE ____________________

TRACT (1–6)	BLOCK (7–12)	TC (13–14)	ZONING: CLASS (15–16)	ZONING: % (17–19)	ZONING: CLASS (20–21)	ZONING: % (22–23)	ZONING: CLASS (24–25)	ZONING: % (26–27)	ZONING: CLASS (28–29)	ZONING: % (30–31)	DWELLING UNIT COUNT: SINGLE FAMILY (32–34)	DWELLING UNIT COUNT: MULTI-FAMILY (35–37)	BLOCK AREA (38–42)	BLOCK POPULATION (43–46)	DWELLING UNIT DENSITY (47–50)	POPULATION DENSITY (51–54)	DATE: MO (55–56)	DATE: YR (57–58)	TREND (59)	(60–77)	CODER (78–80)
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LU2

Figure 5

Coding Form LU2

change in the average structural condition of land uses in the block from one round to the next: "0" (zero) for stable conditions, "+" for improved and "-" for deteriorating conditions.

The origin-destination zone number was not included in the original definition of the file, since a cross reference file was to have been built relating many geographic identifiers to the census tract and block. The fact that implementation has been delayed, and the use of the OD zone number more than any other geographic identifier, led to the inclusion of the OD zone in this file.

All of the record is maintained internally in extended binary-coded-decimal interchange code (EBCDIC). Internal manipulation of the data which requires conversion to internal code is not done as frequently per record as reporting the file, which would otherwise necessitate conversion *back* to EBCDIC for printing. Each of the files, master and history, are sequential and therefore can be maintained on either disk or tape. The original design, under IBM's OS operating system, would have involved cataloged, generation data sets on disk, for the ultimate ease in maintaining the system and automatic generation of back-up copies of the file. As was noted, the present implementation is under DOS, so that computer operators must be relied upon to perform certain of these functions.

Nonetheless, to the ultimate users—the planners and those who maintain the data—the information system is easy, reliable and inexpensive in both time and dollars.

Chapter 4

SUMMARY

Though the information system described here is oriented more toward the Land Factors Atlas series than to the use of computers, the system illustrates the use of a computer in a particular situation where the computer can take a subservient role and yet remain an integral part of the total package. In the situation the system serves, the graphic display and retention of information is at least as important as the retention of information in machine-readable form.

This is not, either, to underestimate the value of the computer in this application, since the aggregation and manipulation of the vast amounts of data could not be attempted without electronic help. It is foreseen that in the not-so-distant future a computerized land use model may be implemented, which will accept data already stored, and make predictions about the future use of land, given present trends or more ideal plans. Several models have already been designed and implemented by others, and study shows that MARC's land use file could be easily adapted to provide the input to at least one of those models.

Under particular consideration is PLUM, the Projective Land Use Model. "Initially implemented for computerized use by the Bay Area Transportation Study Commission (BATSC) in 1968, PLUM has been expanded and applied elsewhere during the past few years."[4] Some supportive work is still being conducted on PLUM by the Institute of Transportation and Traffic Engineering of the University of California. The second volume of the work cited below contains a discussion of the history of land-use models, and an excellent bibliography on the subject.

Both the Land Factors Atlas and the Block-Level Planning File are used in almost every study conducted by MARC, and never a week goes by without an outside request for copies of the atlas or retrievals from the file. The total system fulfills its every requirement, and does so inexpensively, and at the greatest ease for those who must maintain it.

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[4]Goldner, William and others, *Plan Making With a Computer Model*, Vol. I in *Projective Land Use Model—PLUM* (Berkeley: University of California, 1972), p. 2.

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A RETRIEVAL SYSTEM FOR LAND USE PLANNING INFORMATION

by

ROBERT HOWARD WILLER

B. Arch., Kansas State University, 1970

AN ABSTRACT OF A MASTER'S REPORT

submitted in partial fulfillment of the

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MASTER OF SCIENCE

Department of Computer Science

KANSAS STATE UNIVERSITY
Manhattan, Kansas

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This report describes a regional planning information system now being implemented by the Mid-America Regional Council, the regional planning body for the Kansas City Metropolitan Region. Two major criteria held for the design of the system were that it be easy to maintain and inexpensive to operate.

This information system involves storage and retrieval of information from computerized sources and from an atlas of maps, with overlays. The computer system and the map atlas are related to each other. Only part of the information is held on both the atlas and in the computer; most is maintained in one medium or the other so that the two together comprise the whole.

This report describes the atlas, the computer system, and the manner in which the two relate to each other; it describes the methods by which both are maintained and updated, and the methods through which each evolved.