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CURRENT ISSUE
SOLSTICE, VOLUME XII, NUMBER 1; SUMMER, 2001.

Richard R. Wallace
reviewer of:
High Technology and Low-Income Communities: Prospects for the Positive Use of Advanced Information Technology
edited by Donald A. Schon, Bish Sanyal, and William J. Mitchell, MIT Press, 1999.

Solstice archive.

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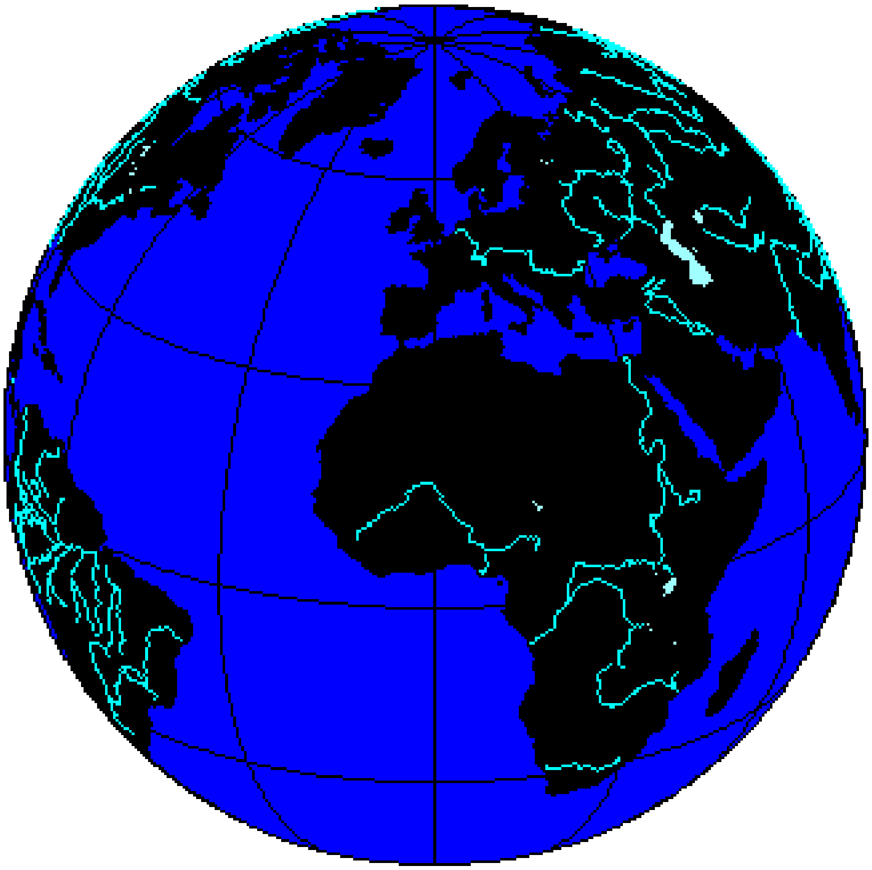

Earth: with 23.5 degrees north latitude as the central parallel.

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MISSION STATEMENT

The purpose of Solstice is to promote interaction between geography and mathematics. Articles in which elements of one discipline are used to shed light on the other are particularly sought. Also welcome are original contributions that are purely geographical or purely mathematical. These may be prefaced (by editor or author) with commentary suggesting directions that might lead toward the desired interactions. Individuals wishing to submit articles or other material should contact an editor, or send e-mail directly to sarhaus@umich.edu.

SOLSTICE ARCHIVES

Back issues of Solstice are available on the WebSite of the Institute of Mathematical Geography, http://www.imagenet.org and at various sites that can be found by searching under "Solstice" on the World Wide Web. Thanks to Bruce Long (Arizona State University, Department of Mathematics) for taking an early initiative in archiving Solstice using GOPHER.

PUBLICATION INFORMATION

The electronic files are issued yearly as copyrighted hardcopy in the Monograph Series of the Institute of Mathematical Geography. This material will appear in a Volume in that series, ISBN to be announced. To order hardcopy, and to obtain current price lists, write to the Editor-in-Chief of Solstice at 1964 Boulder Drive, Ann Arbor, MI 48104, or call 734-975-0246.

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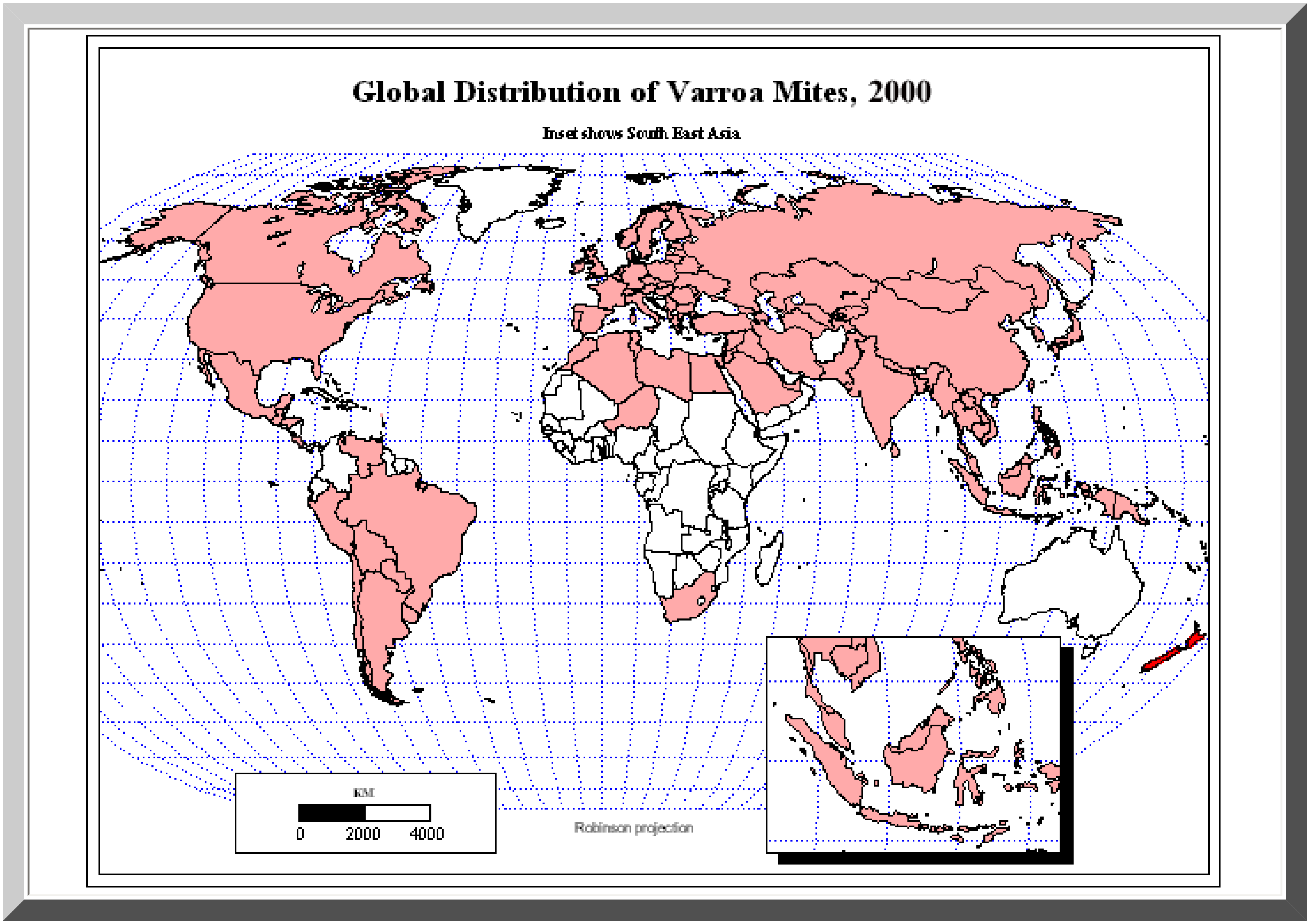
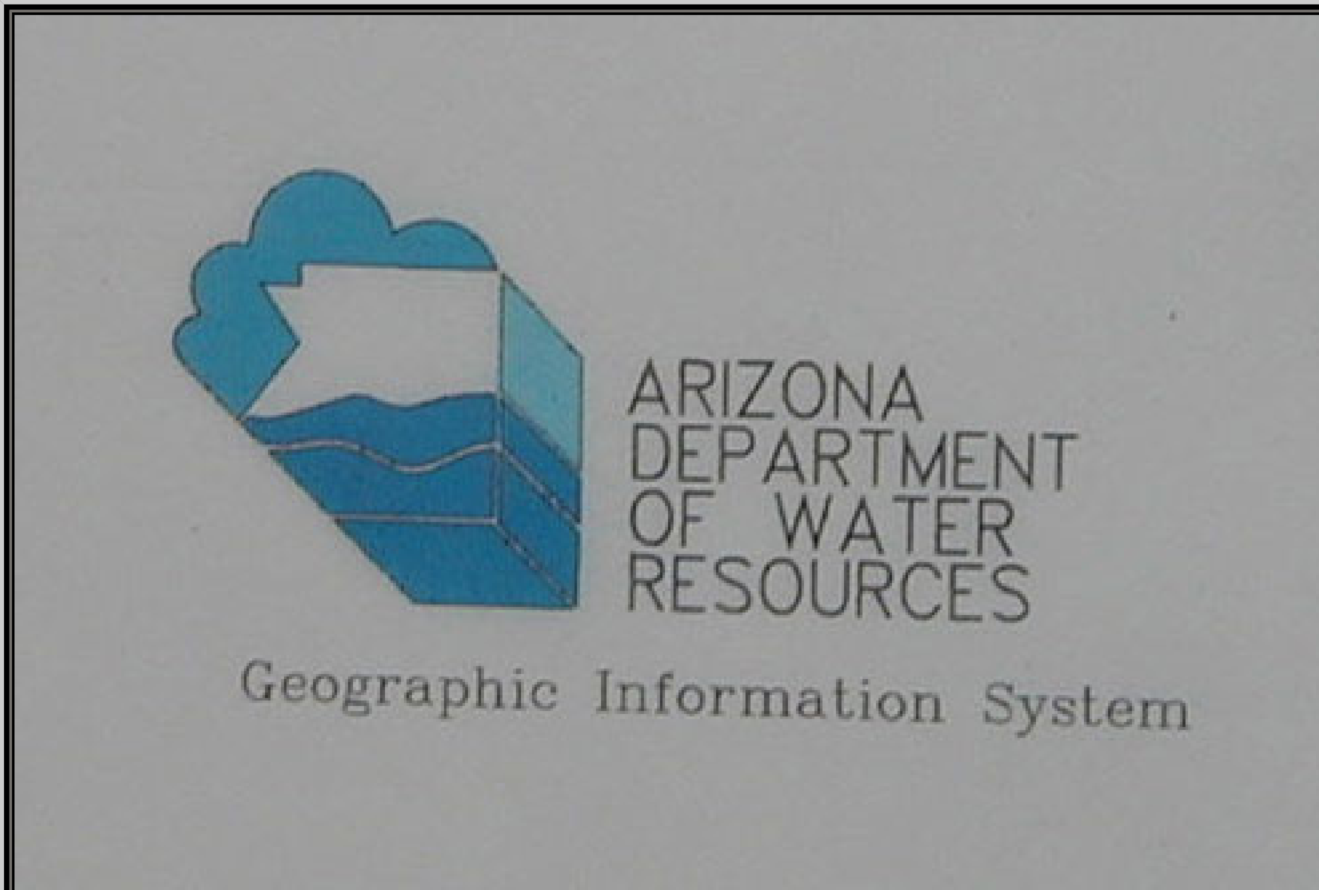
Updated Varroa Mite Map
of Data of Diana Sammataro.

One advantage of on-line publication is the capability to easily update files that depend on temporal data. *Solstice* author Diana Sammataro has been sending IMaGe current data for her Varroa Mite Map on a regular basis, since it first appeared in Volume IX, Number 1, 1998. The current form of the map is shown below.



Map by Sandra L. Arlinghaus and John D. Nystuen.

DETECTING ARIZONA WATER RUSTLERS



Water Rustlers in Arizona:
Detecting Possible Illegal Water Use in Arid Lands using Remote Sensing and GIS Methods

John D. Nystuen
Emeritus Professor of Geography and Urban Planning

Maps courtesy of the Arizona Department of Water Resources.

Outline

*** Purpose**

Describe an example of an operational use of remote sensing and GIS by the Arizona Department of Water Resouces

*** Problem**

The problem: water sources, water use, and water law in the Phoenix and Tuscon regions of south-central Arizona combined in a water management effort to sustain adequate ground and surface water resources

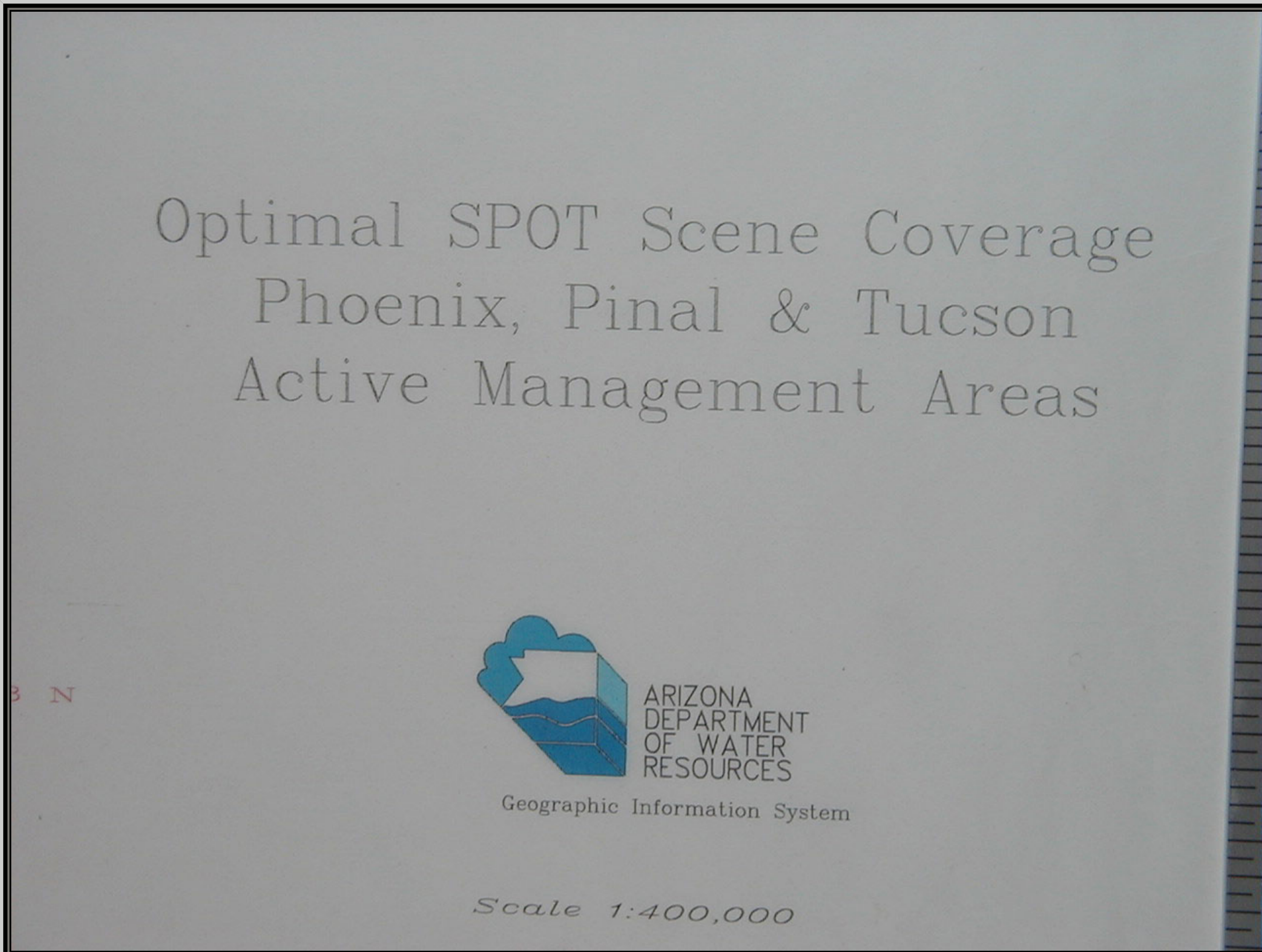
*** Monitoring Program**

The monitoring program: Use of multispectral SPOT color images and ArcInfo land ownership (parcel) maps and water rights records in appropriate time frame, spatial resolution and extent

*** Institutional Issues**

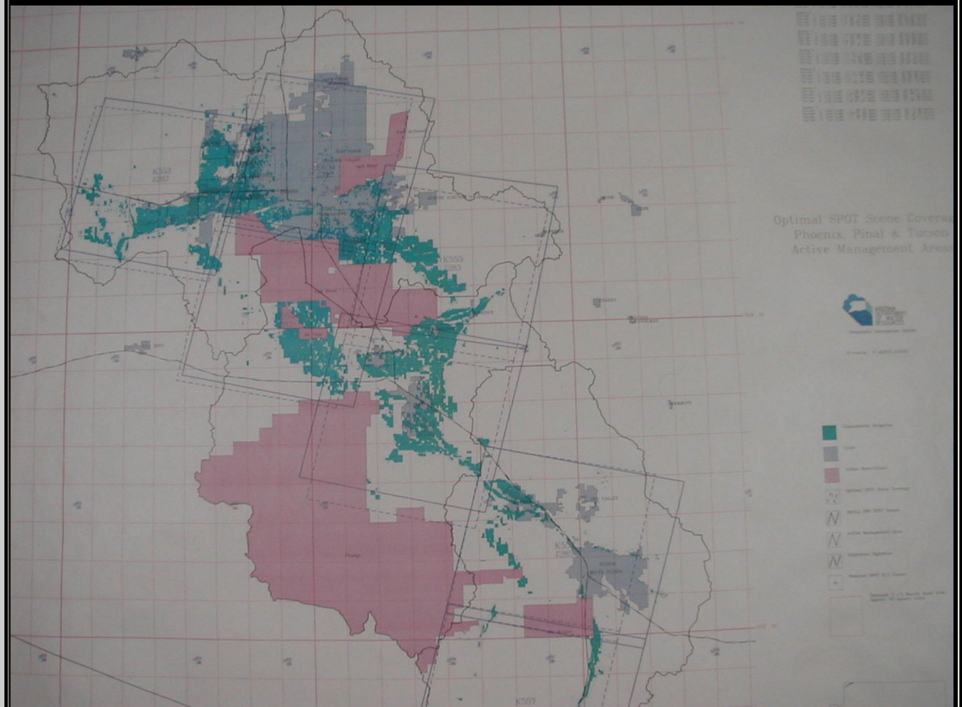
Institutional issues: Data management, multiple-purpose uses, departmental cost sharing, political issues and sustainable programs

Page 2.

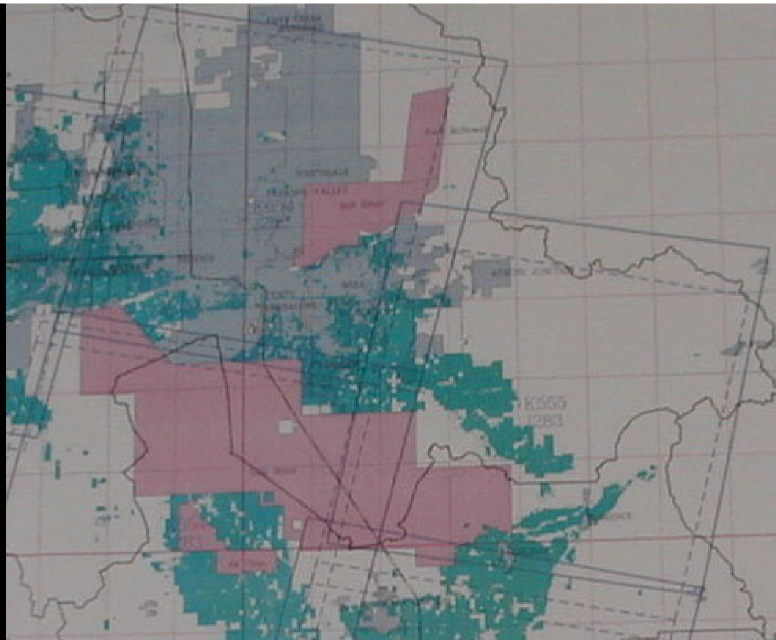

Optimal SPOT Scene Coverage
Phoenix, Pinal & Tucson
Active Management Areas
ARIZONA
DEPARTMENT
OF WATER
RESOURCES
Geographic Information System
Scale 1:400,000

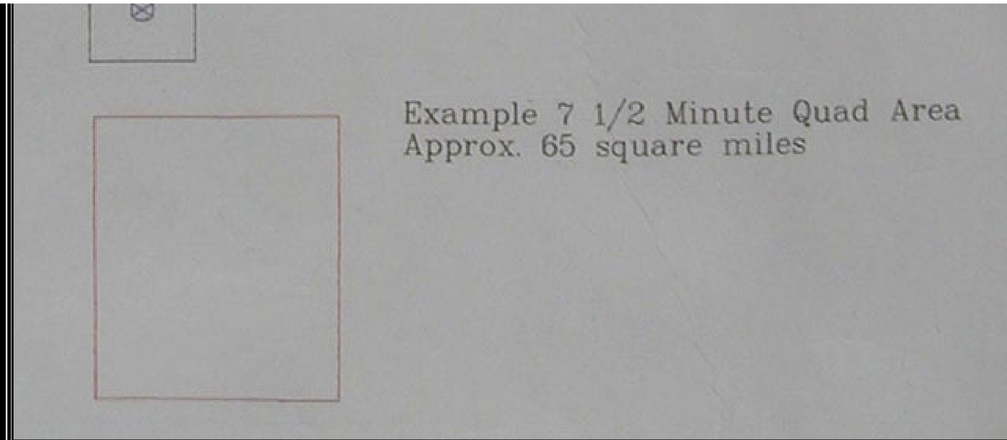
Page 3.

CENTRAL ARIZONA WATER MANAGEMENT REGION



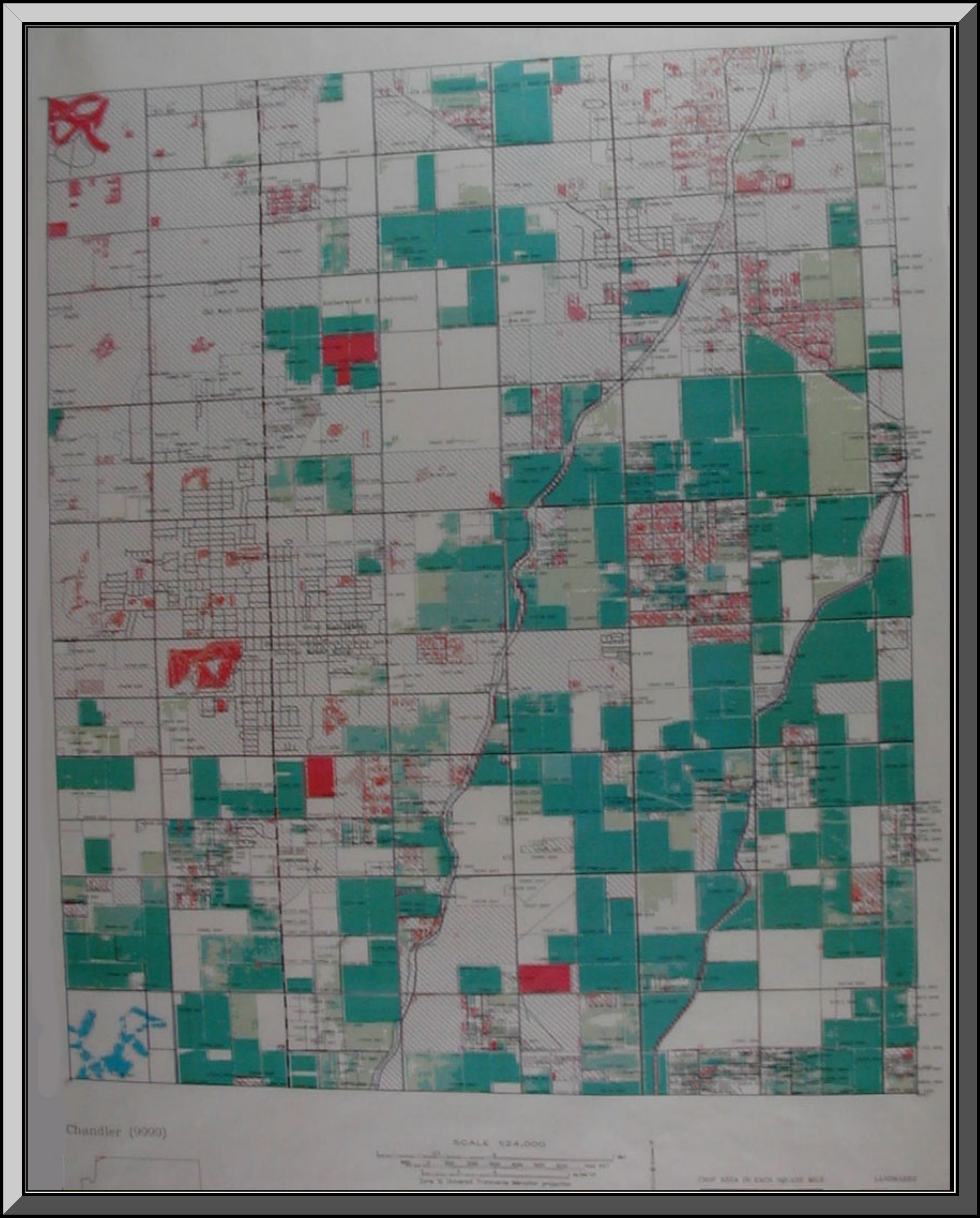
SPOT IMAGE OF PHOENIX AREA:
IMAGE REQUESTED (BOXES MADE OF DASHED LINES)
AND IMAGE DELIVERED (BOXES MADE OF SOLID LINES)

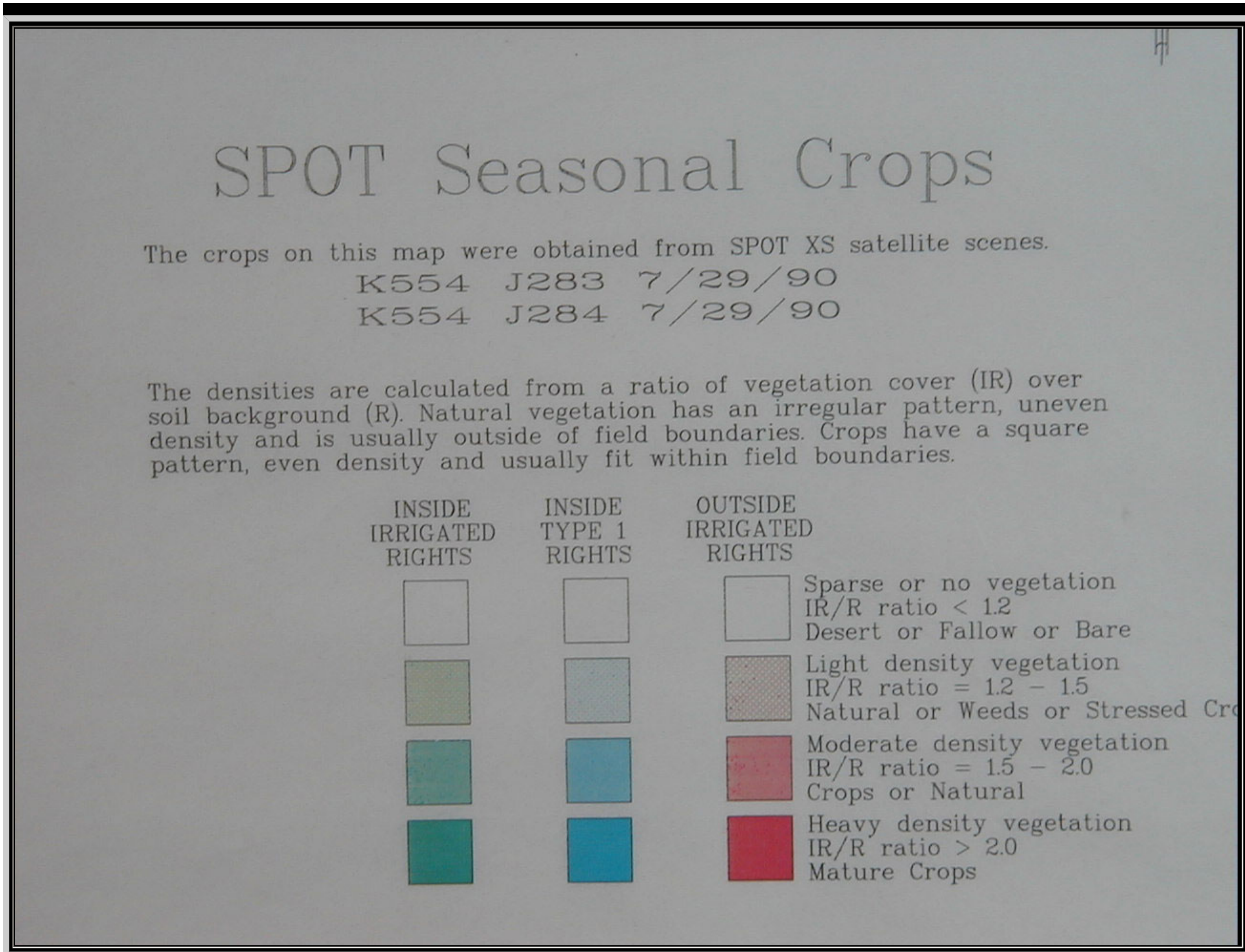




Page 4.

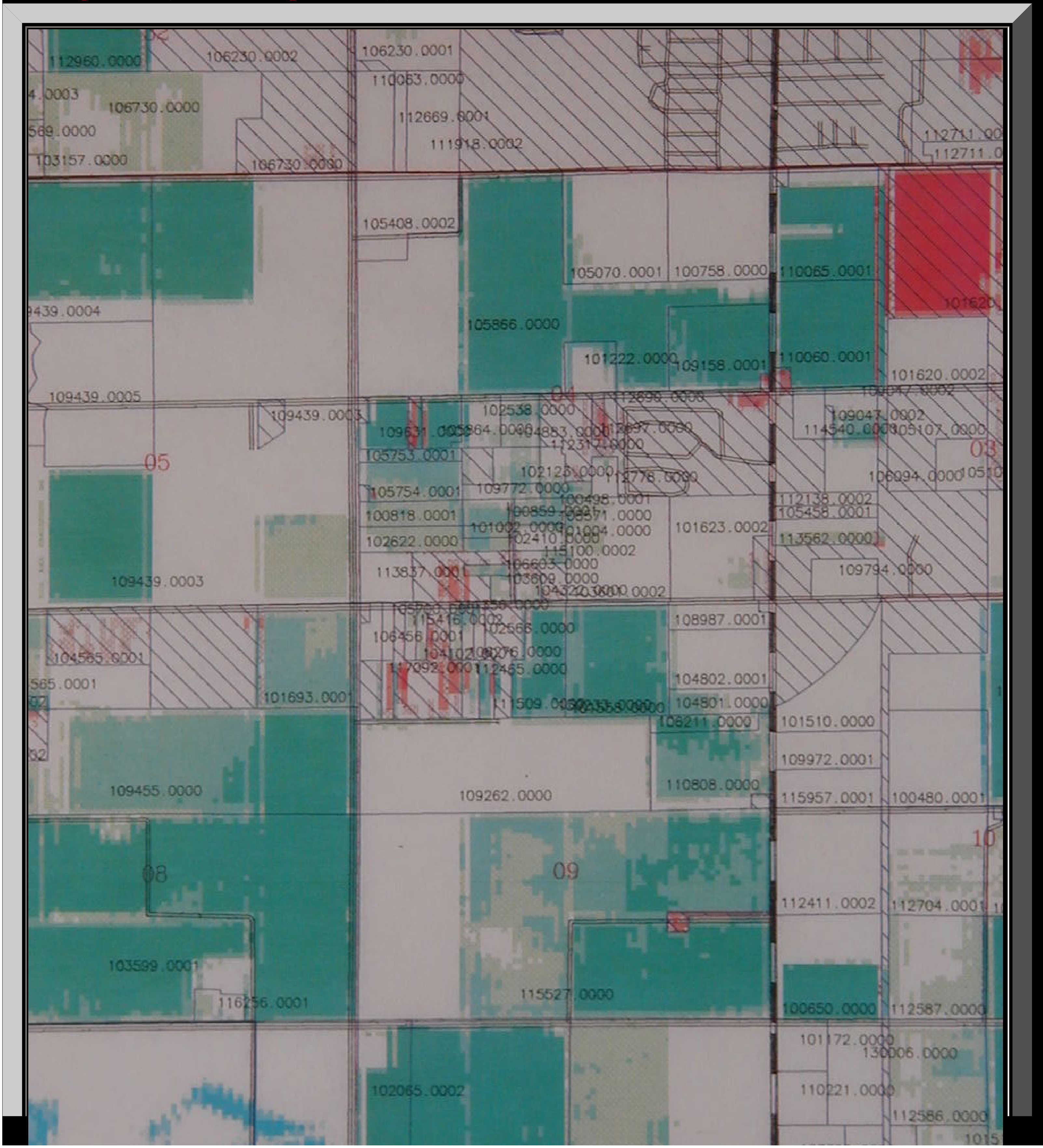
Using GIS to combine SPOT image with parcel map. USGS topographic sheet backdrop. The ribbon-shaped land use parcels at the upper and lower left corners are golf courses. Read the legend below for further detail.

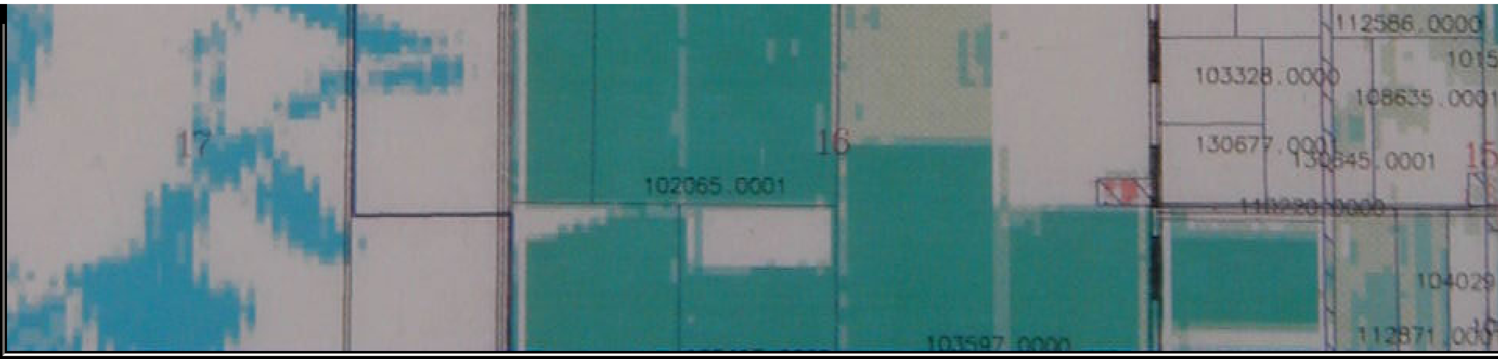



SPOT Seasonal Crops
The crops on this map were obtained from SPOT XS satellite scenes.
K554 J283 7/29/90
K554 J284 7/29/90
The densities are calculated from a ratio of vegetation cover (IR) over soil background (R). Natural vegetation has an irregular pattern, uneven density and is usually outside of field boundaries. Crops have a square pattern, even density and usually fit within field boundaries.
INSIDE IRRIGATED RIGHTS
INSIDE TYPE 1 RIGHTS
OUTSIDE IRRIGATED RIGHTS
Sparse or no vegetation
IR/R ratio < 1.2
Desert or Fallow or Bare
Light density vegetation
IR/R ratio = 1.2 - 1.5
Natural or Weeds or Stressed Cr
Moderate density vegetation
IR/R ratio = 1.5 - 2.0
Crops or Natural
Heavy density vegetation
IR/R ratio > 2.0
Mature Crops

Page 5.

Territory marked by diagonal lines is inside city boundaries where municipal water service may be available. Parcels outside of irrigated rights but within city boundaries thus may purchase water from the city water service but at higher cost than parcels with direct irrigation rights. The patchy pattern of dark red near the center of the map below suggests residential lawns watered by drinking water (i.e., municipal water).

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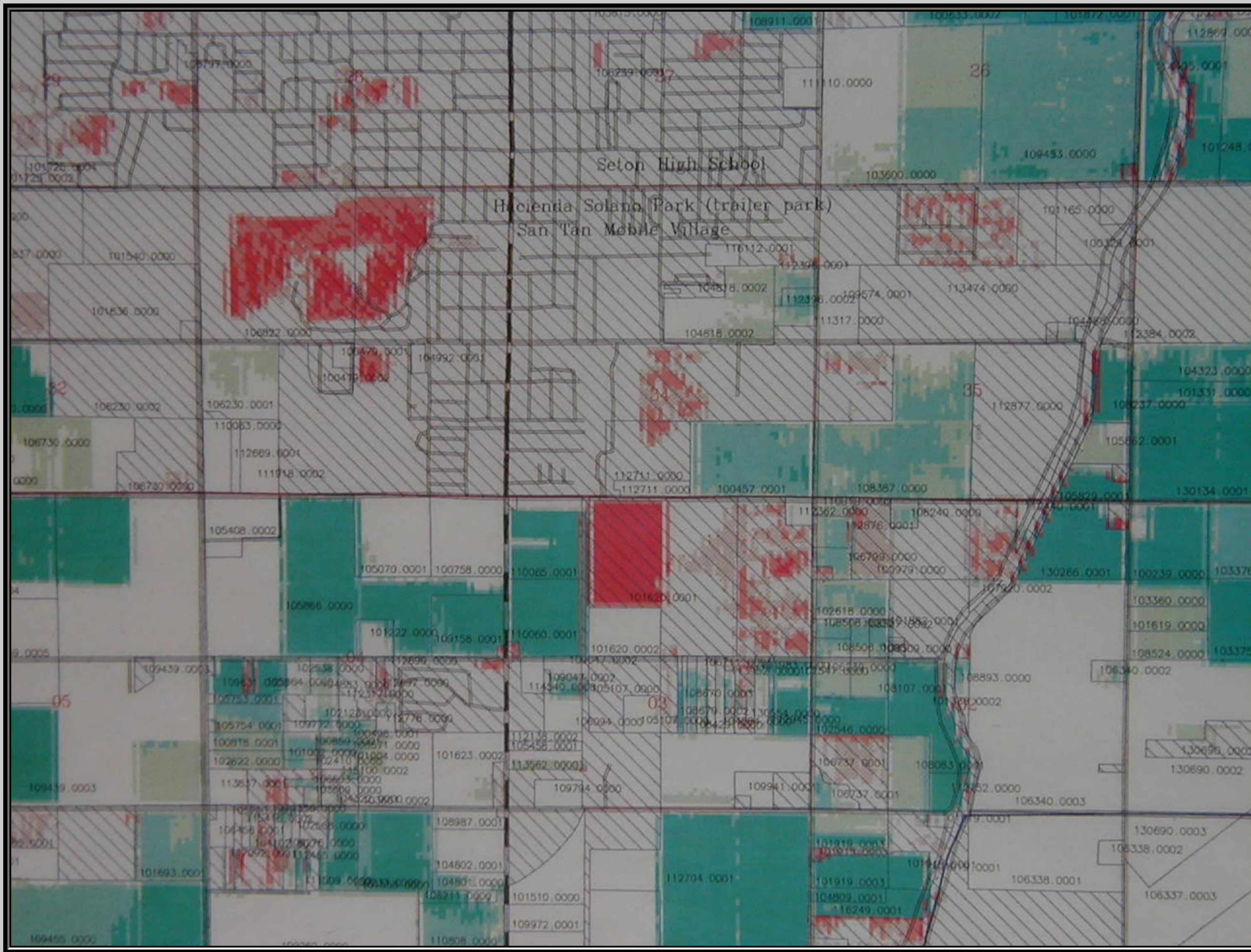
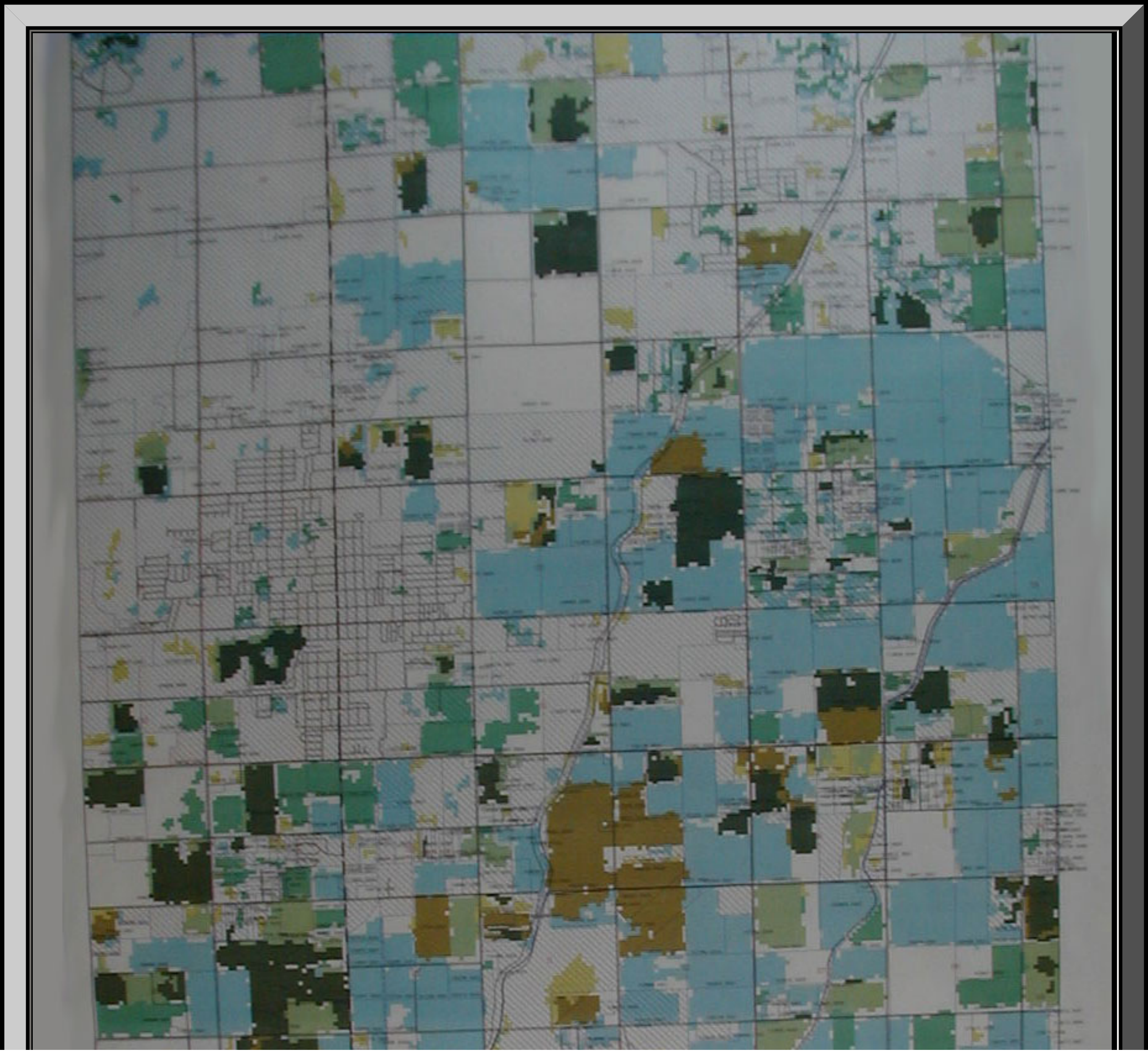
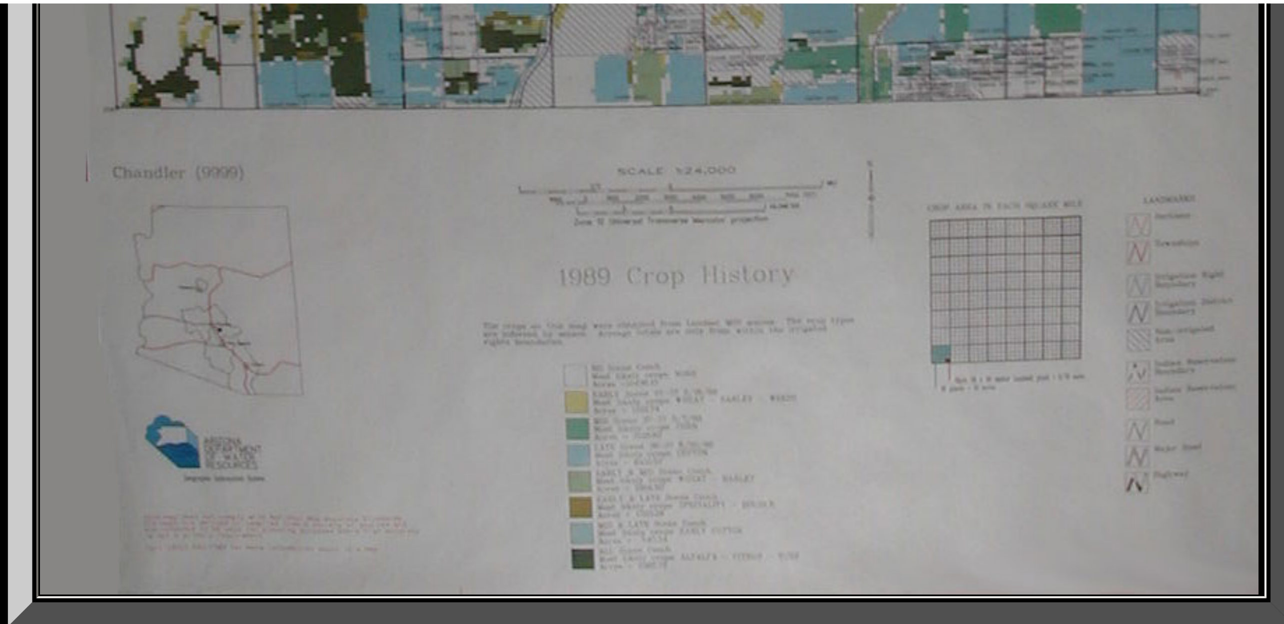
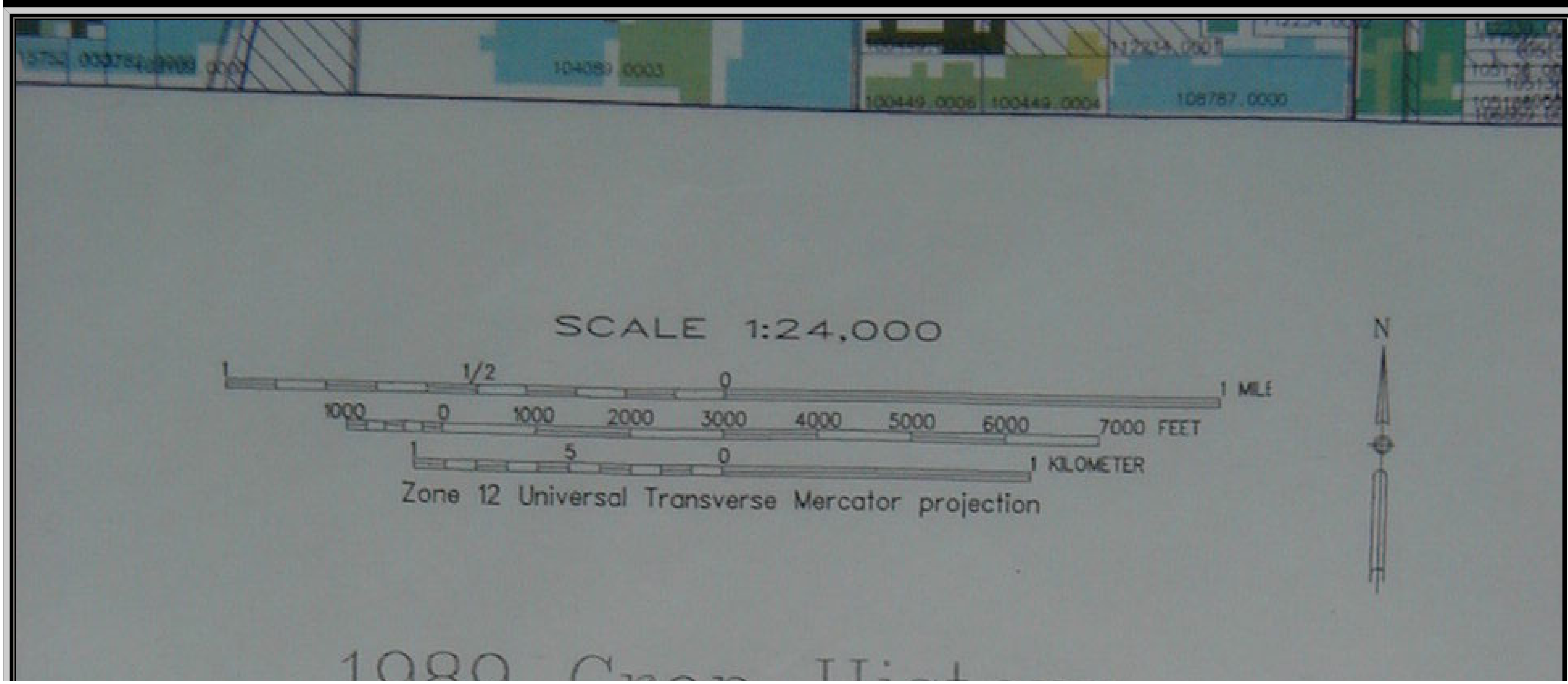

Seton High School
Hacienda Solano Park (trailer park)
San Tan Mobile Village
26
35
111110.0000
109453.0000

Page 6.

THE FOLLOWING IMAGES IDENTIFY CROP TYPES BY SEASONAL VARIATION. THREE SPOT IMAGES WERE PURCHASED PER YEAR: EARLY SPRING, EARLY SUMMER, AND LATE SUMMER. BY COMBINING IMAGES FROM DIFFERENT SEASONS WITHIN THE YEAR, THROUGH THE USE OF GIS METHODS, INFERENCES ABOUT CROP TYPES ARE POSSIBLE (SEE LEGEND BELOW). MONITORING CROP TYPES USES THE SAME SPOT IMAGES AS MONITORING WATER USES. BY SHARING SATELLITE IMAGERY THE DEPARTMENT OF WATER RESOURCES ENLISTED THE PARTICIPATION OF THE STATE DEPARTMENT OF AGRICULTURE. THIS APPLICATION CONTRIBUTED TO THE EFFICIENT USE OF THE SPATIAL INFORMATION.




Chandler (9999)
SCALE 1:24,000
Zone 12 Universal Transverse Mercator projection
1989 Crop History
ARIZONA
DEPARTMENT
OF WATER
RESOURCES


104089.0003
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1
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5000
6000
7000 FEET
1
5
0
1 KILOMETER
Zone 12 Universal Transverse Mercator projection
N

1989 Crop History

The crops on this map were obtained from Landsat MSS scenes. The crop types are inferred by season. Acreage totals are only from within the irrigated rights boundaries.

NO Scene Comb.
Most likely crops: NONE
Acres =10496.15

EARLY Scene 37-37 2/16/89
Most likely crops: WHEAT - BARLEY - WEEDS
Acres = 1103.74

MID Scene 37-37 5/7/89
Most likely crops: CORN
Acres = 2128.82

LATE Scene 36-37 8/20/89
Most likely crops: COTTON
Acres = 8410.57

EARLY & MID Scene Comb.
Most likely crops: WHEAT - BARLEY
Acres = 1904.50

EARLY & LATE Scene Comb.
Most likely crops: SPECIALITY - DOUBLE
Acres = 1353.29

MID & LATE Scene Comb.
Most likely crops: EARLY COTTON
Acres = 545.54

ALL Scene Comb.
Most likely crops: ALFALFA - CITRUS - TURF
Acres = 2365.75

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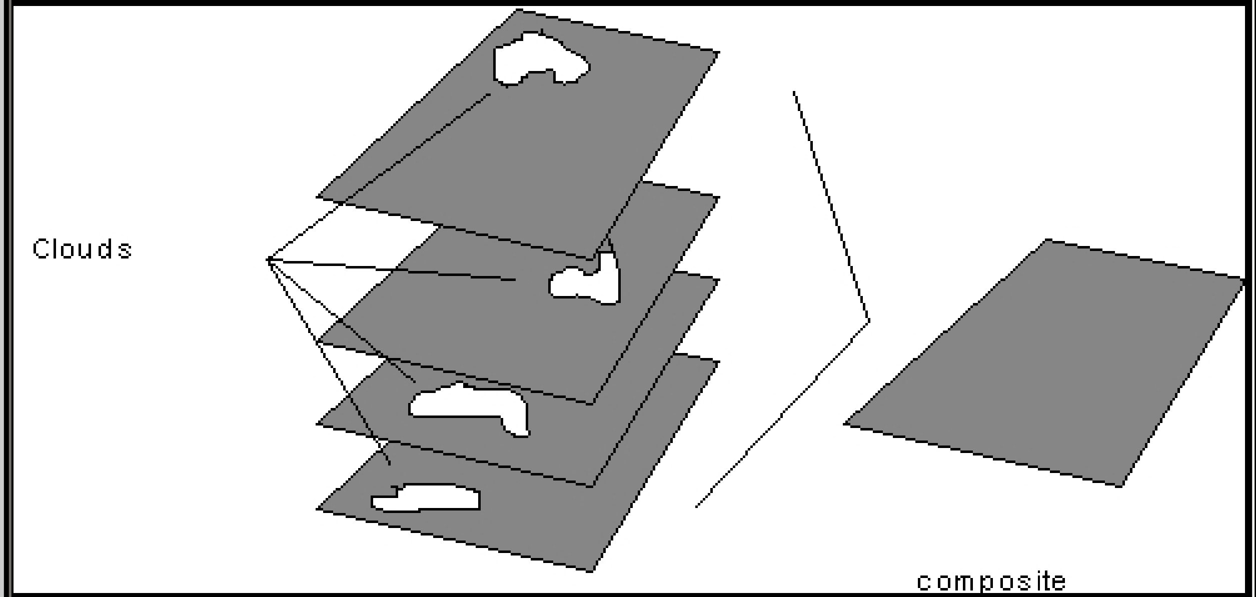
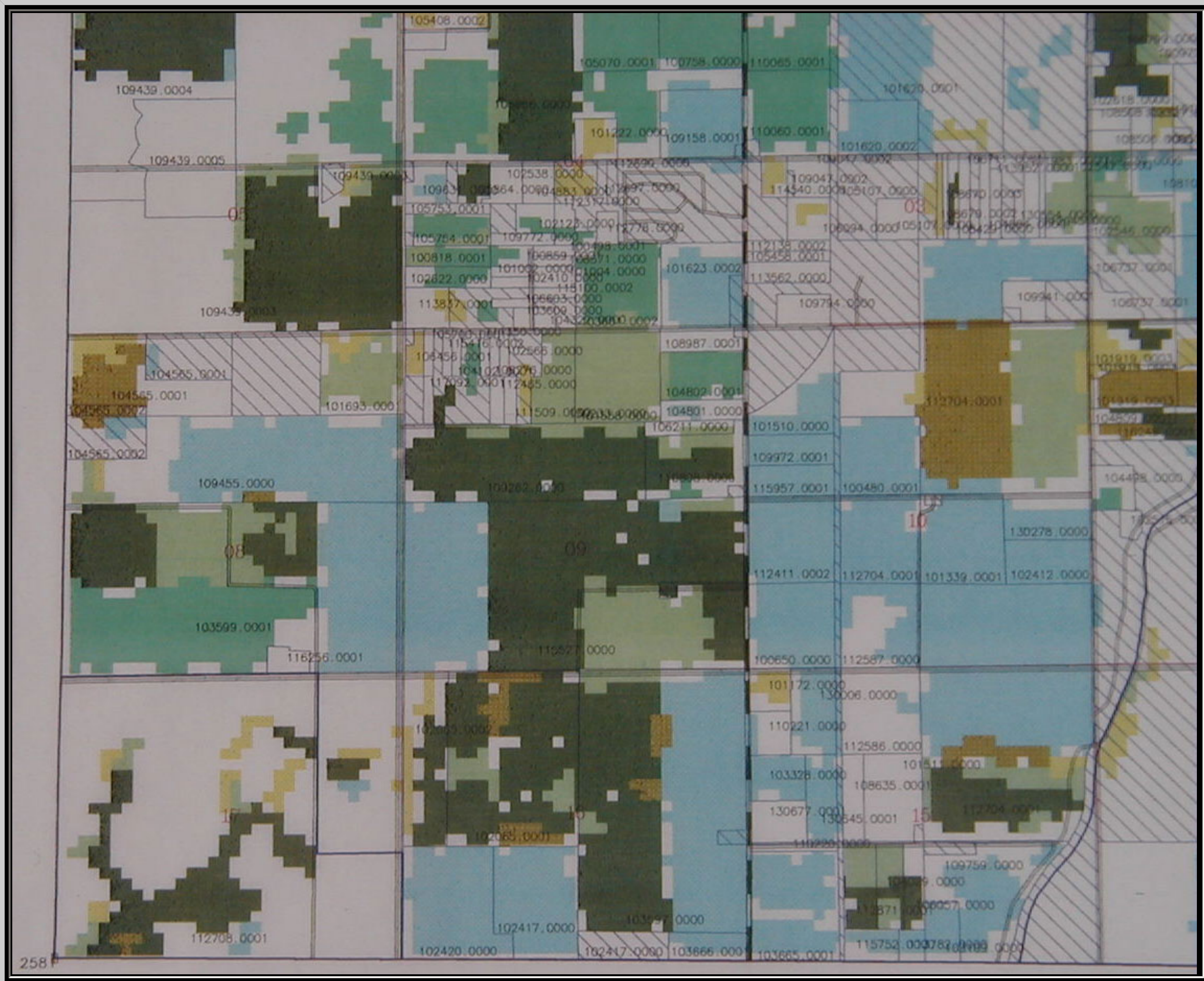
Space/Time Context of GIS Analysis

Time composites shown below are used to filter out cloud images from a scene; the same concept is employed here to identify crop patterns with particular seasonal time frames.



[Space, Time, Object Types]

Space = same
Time = different
Objects = same



Back to the beginning.

Links to Related Articles:

S. Arlinghaus, W. Drake, J. Nystuen, A. Laug, K. Oswalt, D. Sammataro, Animaps.

K. Sims, The Fiji Islands and the Concept of Spatial Hierarchy.

The Neglected Relation

Sandra L. Arlinghaus, The University of Michigan
William C. Arlinghaus, Lawrence Technological University

Mathematics, like musical composition and other fine arts, is purely a human creation. Without us, does it exist? This sort of "meta" question has long interested scholars with multidisciplinary interests (readers are referred to the references section at the end for a few of the numerous references to ideas of this sort that have appeared in the literature over centuries). Indeed, does the societal culture in which the predominant mathematics is developed and embedded in a particular historical epoch influence the kind of mathematics that is developed? Again, this question has been studied in many ways: we consider one case here--that of the mathematical relation and selected real-world interpretations. These are displayed in a number of visual formats not merely as curiosities but more significantly for the suggestion they might offer as to why or why not certain types of formal structures get created. It is important to attempt to understand deeper processes such as these: the mathematics we use in the real-world often influences the decisions we make.

Municipal authorities might use demographic forecasts based on curve fitting to guide the direction of urban land use planning. A City Administrator might use a rank-ordered set of priorities to decide how valuable taxpayer funds will be allocated over a period of years to develop (or not develop) infrastructure. The way in which the mathematics is used will influence the outcome of the analysis and, therefore quite likely, the policy that is set in place. We also invite feedback, using the capability of the internet, so that readers might share other cases with each other (near the end of this document).

One-to-many transformations between two mathematical sets are an often neglected class of relationships. Much of modern mathematics, for example, considers only functions. A *function,* mapping a set X to a set Y permits an element x in X to be sent to an element y in Y, or it permits a number of elements, $x1$, $x2$, $x3$ in X to be sent to a single element y in Y (Figure 1, left side). The former situation is one-to-one and the latter is many-to-one. Functions may be one-to-one or they may be many-to-one; they may not be one-to-many. They are "single-valued." Graphically, the idea is represented as in Figure 1. When one element of X is permitted to map to many elements of Y, as in x mapping to $y1$, $y2$, $y3$ (Figure 1, right half) the associated mathematical transformation is often referred to as a *relation*.

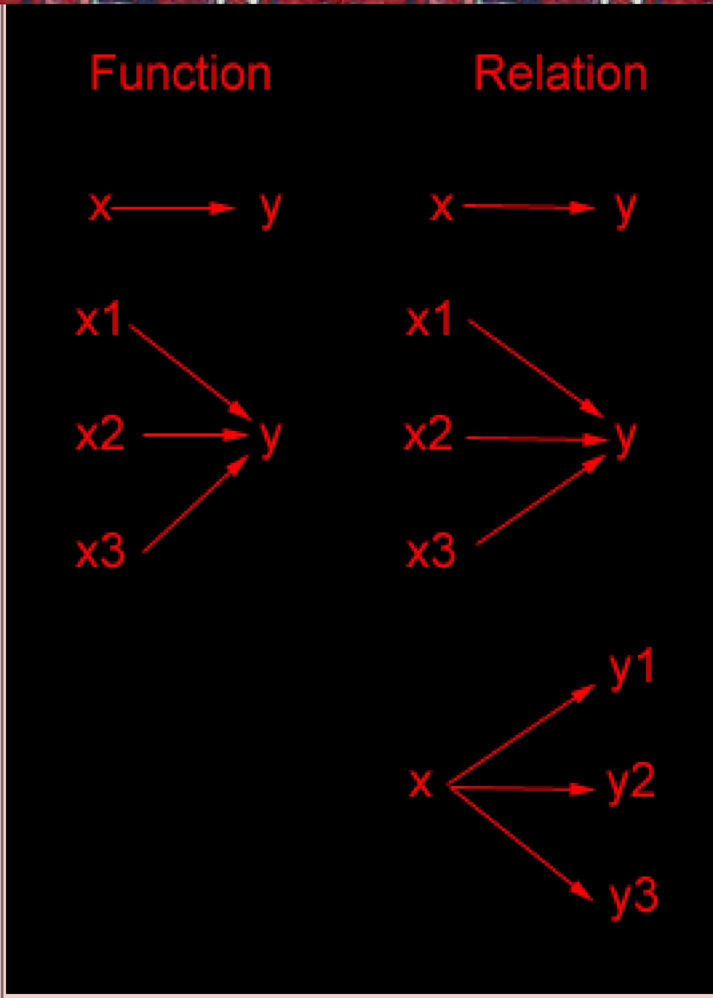


Figure 1. A function requires that each element of *X* be associated with only one element of *Y* (although many different elements of *X* may be associated with the same element of *Y*). A relation removes this restriction, allowing one element of *X* to be associated with many elements of *Y*. Thus, every function is relation, but not every relation is a function.

In the Cartesian coordinate system the same idea may be visualized as in Figure 2. In the case of a function, a vertical line cuts the graph of the function no more than once (Figure 2a shows a one-to-one function and Figure 2b shows a many-to-one function). In a graph that is not a function (not "single-valued"), the vertical line may cut this curve (that is not the graph of a function) in more than one place (Figure 2c shows such a graph).

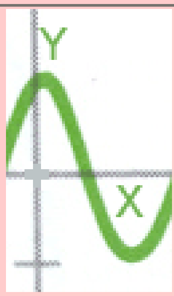


Figure 2a. One-to-one function.

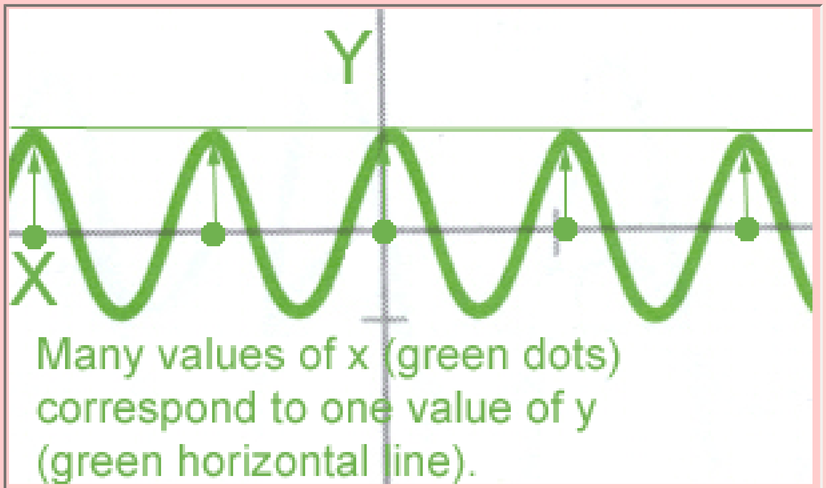


Figure 2b. Many-to-one function. Many x-values (green dots) correspond to one y-value (height of horizontal line).

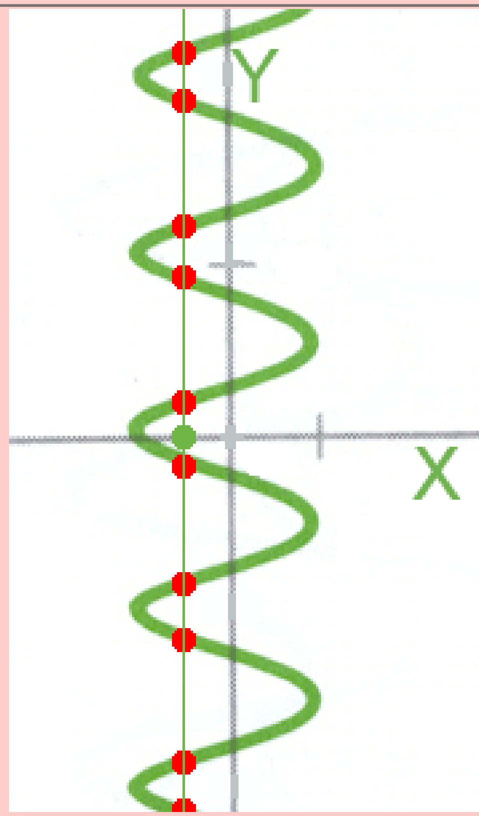


Figure 2c. One-to-many relation. One x-value (green dot) corresponds to many y-values (red dots)

The visual display of the difference between function and relation, the many-to-one and the one-to-many, is clear in the Cartesian coordinate system because the ordering of the function from X to Y is clear in our minds. In a coordinate-free environment, such as the world of the Applet (TM, Sun Microsystems), all that is evident is the structural equivalence of many-to-one and one-to-many transformations (Figure 3). In Figure 3, note the stability of the one-to-one transformation as the graphic moves; the many-to-one and the one-to-many never quite settle down to a totally stable configuration. This lack is a function of pattern involving length of edges joining nodes and dimension of the square universe of discourse in which the Applets (TM Sun Microsystems) live. In the case of Figure 3, it may simply be a function of a particular commensurability pattern of edges and underlying raster; nonetheless, the general consideration as to what sorts of configurations exhibit geometric stability is an important one, particularly as in regard for looking for points of intervention into process (see varroa mite mapplet). K. Sims has noted the importance of such lack of stability in anthropological contexts building on island networks found in Hage and Harary.

Figure 3. Applets (TM, Sun Microsystems) show one-to-one, many-to-one, and one-to-many transformations. Note the structural equivalence between the many-to-one and the one-to-many applets.

The relation is often ignored in mathematical analyses of various sorts. Perhaps that is because the definite nature of single-valued mappings is regarded as important. Is the world, however, single-valued? We consider a few real-world situations in which relations can be observed to be the underlying conceptual force.

Postal Transformation

A simple, convenient example often given to students studying functions for the first time is the following postal example.

> Given a set of hard-copy handwritten letters in envelopes that are to be sent through the conventional U.S. Postal Service network by regular first-class mail.
>
> - My letter can be sent to a single address (one-to-one).
> - My set of three different letters can be sent to a single address (many-to-one).
> - My one letter cannot go to three different addresses (not one-to-many).

Some might argue that the invention of the printing press permitted one page to go to many. Yet, there is variation from page to page--there are ink splatters, broken type, and so forth.

Still others might assert that photocopying of a page will enable one letter to go many different addresses, as long as the original as distinct from the rest is not included--hence the rise of junk mail. Someone else might argue, however, that any two photocopies differ from each other on account of diminishing the amount of toner available for copies later in the process.

Further, if one considers virtual messages, rather than hard copy messages, then a single e-letter can be sent to a single address (one-to-one), a set of three different e-notes can be sent to a single address (many-to-one), and a single note can go simultaneously to three different addresses (one-to-many). The electronic revolution of our "information age" offers a true postal transformation from the functional to the relational.

Perhaps a common theme in all these refinements of argument will be that to move from one style of mathematical transformation to another in the real-world requires some sort of underlying real-world transformation through invention, revolution, or other remarkable event. Hence, the argument for the printing press, the photocopying machine, and the e-mail/ computer all have merit. Indeed, *Solstice*, itself, takes advantage of this one-to-many relational capability!

Home Ownership

As we look around our environment today, of midwestern United States of America, we see a variety of dwelling types and of ownership of them.

- One-to-one ownership: one family owns a single parcel of land, often in a suburban area and elsewhere when land is plentiful and land values are relatively low.
- Many-to-one ownership: many families own a single parcel or building. This style of ownership is often "condominium" or "cooperative" ownership. In the landscape it is evident mostly in more densely populated areas or where land values are relatively high.
- One-to-many ownership: one family owns many

residences. This particular situation, not represented as a mathematical function but only as a relation, is perhaps not as common as the two above. Typically, one might expect families with excess wealth to own more than one residence. Our colleague John Nystuen asked where such individuals cast votes. We explore the dynamics of that situation below.

Composition of Transformations

If one were to map the relations listed above for home ownership, a figure similar to Figure 3 would be the result. When voting is added on, the situation becomes more complicated, given that voting is done and counted locally and not nationally.

- In the one-to-one situation, the homeowner registers to vote from his or her single address and there is no difficulty counting the vote.
- In the many-to-one situation, the homeowners register to vote from their single address and there is no difficulty counting the vote. All go to the same polling place to vote.
- In the one-to-many situation, however, a person who owns property in Michigan and in Florida, for example, might attempt to vote in two places even though he/she is only entitled to one vote. Figure 4 shows that when only a single vote is cast, as it should be, the system remains closed, bounded, and manageable (in some sense). When more than one vote is cast, the system may rapidly fall out of order, especially when there are thousands or hundreds of thousands of people who own more than one residence from which they might vote. Some sort of nationalized database on voter registration and residency might make the problem more tractable.

What is important in this case is the composition of mappings: one followed by another. In this case, the two mappings are home ownership followed by voting. When the first is a function, the composition works well in the real-world interpretation. When it is only a relation, there is room for serious manipulation that was not present in the functional characterization. Extra care is appropriate when composing mappings.

Figure 4a. Voter *x* owns three residences, *y1*, *y2*, and y3 and casts the one legal vote, *z*, to which he/she is entitled. Voter *a* owns three residences, *b1*, *b2*, and *b3* and casts one legal vote *c1* (from residence *b1*) and two illegal votes (from residences *b2* and *b3*), *c2*, and *c3*. Note that the legal case is visually manageable in some sense while the illegal case sprawls across the map and is more difficult to track.

Figure 4b. When homeownership and voting become more complicated, the closure and sprawl noted above (in the caption to Figure 4a) become more evident.

Other One-to-Many Situations

- One copy of material may be photocopied according to certain legal constraints; however, when a "single" copy is sold to many, there is likely copyright infringement--one-to-many is once again problematic when the transformations of "single copy" and "selling" are composed.
- In the state of Michigan, the same driver license number can be assigned to two or more individuals. Two individuals with the same month and day of birth, the same first and middle names, the same first letter of last name, and initial parts of the last name the same, have the same Michigan driver license number. For example, James Edward Smithsonian, born July 1, 1900, and James Edward Smithson, born July 1, 1950, would have the same Michigan driver license number.
- Recently a Detroit police officer was discovered to have

two different driver licenses under two different names, an impermissible one-to-many relation.

- ArcView GIS v. 3.2 (ESRI) contains a sample script designed specifically to deal with one-to-many situations. Scripts are small add-on programs that address issues not addressed in the main program and that must be separately compiled and run.
- Quadratic Probing is used to resolve collisions, situations where many pieces of data are initially assigned the same data location. Again, this is an undesirable one-to-many situation, as one data location cannot store many pieces of data.
- Marital relationships (men and women):
    - One-to-one: one woman is married to one man (monogamy: customary practice in part of world predominant in mathematical development)
    - Many-to-one: many women are married to one man (polygamy: known, but not customary; some examples exist in European history, in the idea of a harem, and in certain religions).
    - One-to-many: one woman is married to many men.

  Various cultural taboos might lead one to ask what kind of mathematics would have been developed in the 20th century had it been done so predominantly by a society in which fundamental societal relationships are one to many. (One could of course switch the order of men and women in this example.)

The broader societal environment in which mathematics develops may well influence what mathematics gets created. As our human environment changes, what changes do you see that might produce substantial shifts from one transformation to another? Please use the interactive feature of this article.

Share Your Thoughts!

Enter your e-mail address:

☑ Send a copy of this message.

Please enter comments in the text area below. Your constructive ideas will be noted in the next issue of *Solstice*.

Send Message

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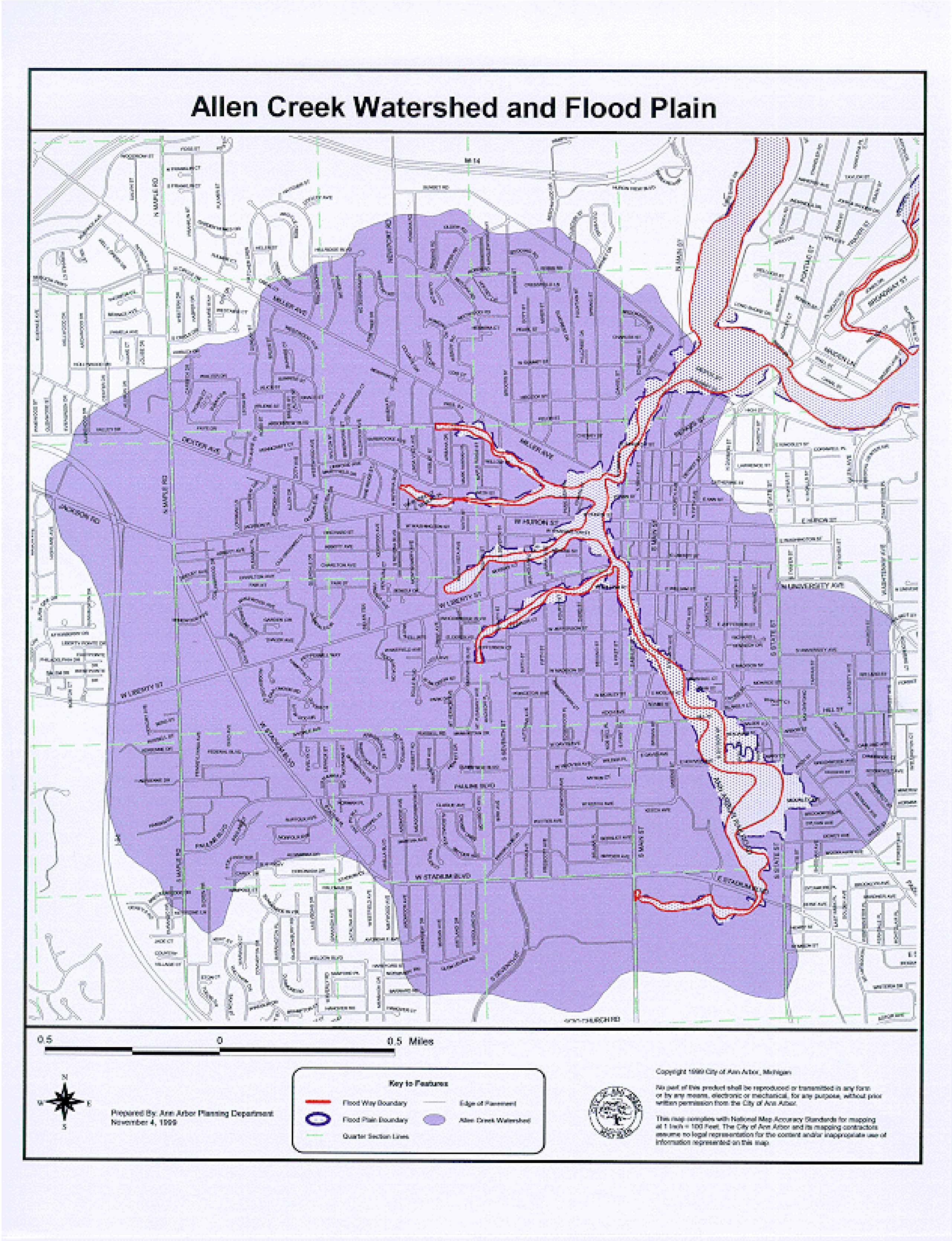
Maps and Decisions: Allen's Creek Flood Plain, Opportunity or Disaster?

Sandra Lach Arlinghaus

Maps supplied by the City of Ann Arbor (with particular thanks to Merle Johnson, Karen Popek Hart, and Wendy Rampson), as noted (http://www.ci.ann-arbor.mi.us) and by the Southeast Michigan Council on Governments (thanks to Gwo-Wei Torng) (http://www.semcog.org).

- **Link to article.**
- **Link to online map (by author, using ArcView coupled with Image Mapper): eGovernment sample.**
- **Link to maps with aerials, created by the Planning Department, City of Ann Arbor.**
- **Link to related steep slopes Triangulated Irregular Network.**
- **Link to Neighborhood Information System using clickable maps.**



Follow the links to the City of Ann Arbor Planning Department and then to "Public Involvement" and then "Registered

Associations" and then "Residential Associations" for example to see contact information displayed using a clickable map. This site, developed in 1998, is an early example of eGovernment.

(Developed on a grant from the City of Ann Arbor to the Planning Department to work in conjunction with the University of Michigan: Wendy Rampson, Rosalyn Scaff, Sandra Arlinghaus, Chandra Hurd).

Map to the right created by the Planning Department of the City of Ann Arbor, November 4, 1999 (Alexis Marcarello).

Maps and Decisions: Allen's Creek Flood Plain, Opportunity or Disaster?

(Please look at the online linked map)

Allen's Creek is a tributary of the Huron River, which bisects Ann Arbor, Michigan, into north and south sides. Allen's creek rises on the south side of Ann Arbor. It flows north to the Huron past residential neighborhoods near the University of Michigan stadium as well as past residences, businesses, and industries in the downtown and nearby west side areas. For much of its length, Allen's Creek is confined in an underground pipe. The sequence of maps shown below, in Figure 1 (left), shows the outline of the creek shed in red (with a stippled red pattern inside the creek shed). The backdrop behind the creek shed shows surface hydrology (shades of blue), parks (green pattern), street pattern, and soil types (shades of earth tones). This sequence is presented, as an animated abstract, to suggest some elements of the complexity of this particular creek shed. A more detailed picture of complexity would need to reflect the degree of accuracy of the maps: flood plain boundaries are plus or minus 40 feet, contours are plus or minus 5 feet, and so forth. The flood plain is the area into which water spills out when the creek rises out of the flood way--the direct channel containing the surging water. The map to the right of the animated map is a static close-up of the same region; it shows the parcel map (Figure 1, right).

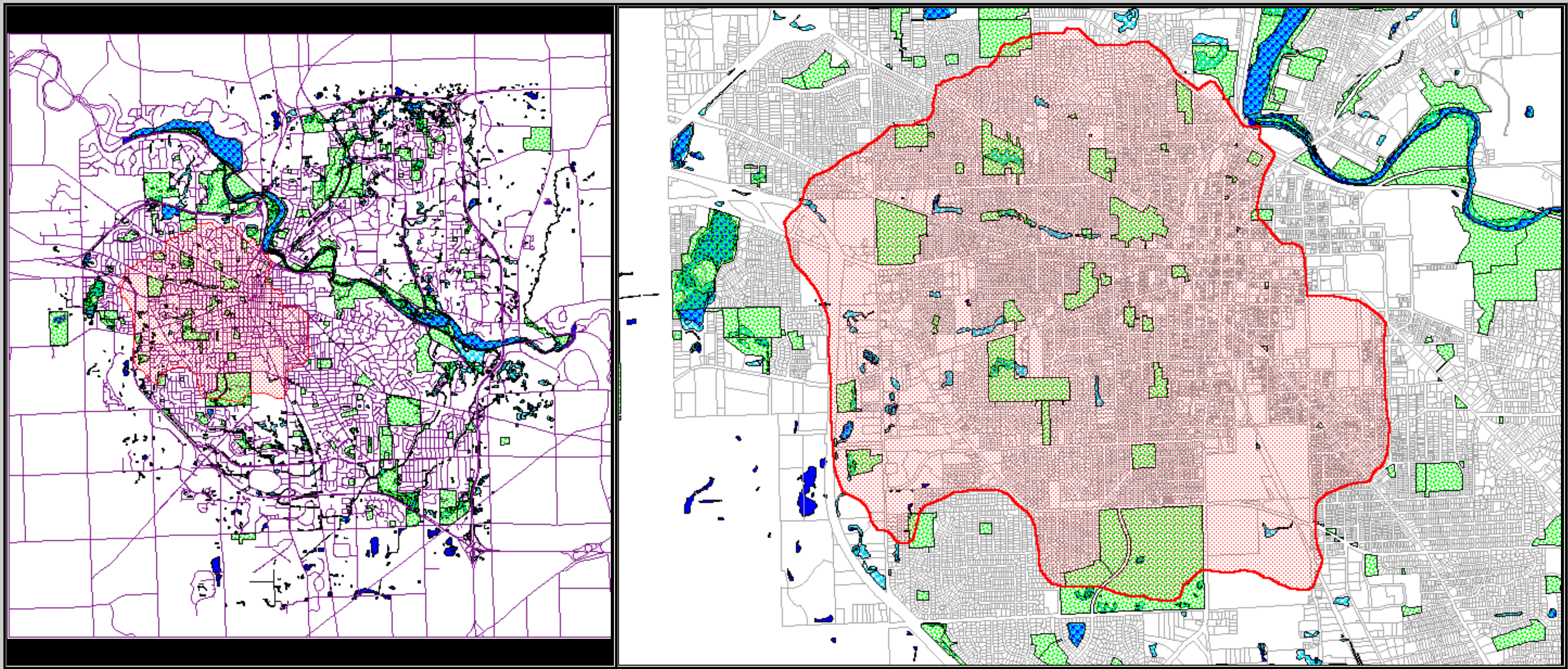


Figure 1. Left: Animated abstract, to illustrate some of the complexity, of the Allen Creek shed showing surface hydrology, parks, streets, and soils. Right: Static close-up of Allen Creek shed, parks, surface hydrology, and City parcels.

The animated abstract and static maps in Figure 1 show only surface hydrology at a gross level; Allen's Creek, itself, is not evident within the water shed. The animated map sequence in Figure 2 shows Allen's Creek, its flood plain, the City parcel map and clipped portions of the parcel map (the theme of shades of yellow is based on parcel size; it could be based on any information for which data was available). Depending on how the clipping is done, various pictures are portrayed. The first clip truncates parcels in the flood plain with the flood plain boundary. Thus, one does not know how much of any particular parcel lies in the flood plain and therefore that view is supplemented with a grayed backdrop of the entire parcel map. More effective, from a standpoint of parcel percentage within the flood plain, is to select all parcels from the parcel map that touch the flood plain boundary. The resulting map is then one that overlaps the flood plain boundary. Yet another parcel map can be created if the creek itself is used, rather than the flood plain, to create such maps. All maps in this sequence have merit; yet which one might a municipality choose to use as a policy statement from which to help in allocation of funds? Each will lead the community in different directions. The different maps shown in Figure 2 select different sets of parcels as "flood plain parcels." Planners of all sorts (professionals and others) should consider this fundamental issue prior to allocating tens of millions of taxpayer dollars for improvements. The maps we draw influence the decisions we make; the decisions we make influence the maps we draw. Maps and decisions, together, influence the conclusions we draw and the policies we make.

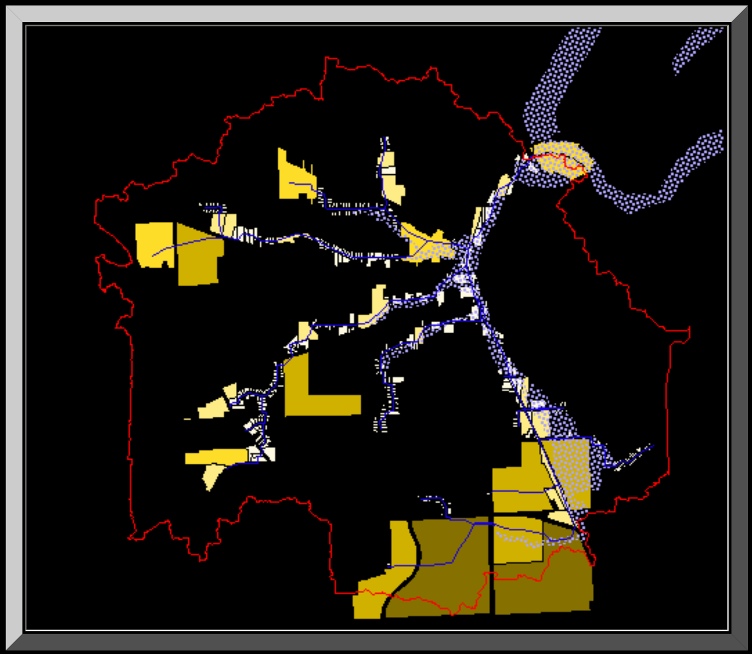


Figure 2. Animated map sequence of different styles of maps that might be made employing Allen Creek, Allen Creek flood plain, and City of Ann Arbor parcels. Which parcel map clipped by hydrology might be viewed as the "official" statement--all have merits and drawbacks and each one selects a set of parcels different from the other.

If one owns the GIS used to make the maps and has access to the base maps, then it is a relatively straightforward matter to create a variety of maps and consider the merits and drawbacks of each. The average taxpayer, however, may not own such software. How, then, might that person, who wishes to participate in a public process, do so? One answer is to distribute the materials using the Internet in such a way that not only can already-prepared maps be distributed, but so, too, can some of the capability of the GIS software be distributed through free software, such as a browser. The linked map shows an Internet map of Allen's Creek and its flood plain. It also shows the City parcel map and street centerlines; the map has some degree of user interaction available. Use the inset map as a context guide; zoom in on the large map; and, use the inset map to navigate around the large map (click on the inset map to do so). Click on the large map to bring up the database that is interactive with the map.

The interactive, online linked map is created using ImageMapper (TM) software applied to maps made in ArcView GIS 3.2 (TM, ESRI) from City of Ann Arbor base maps. The material that is put into the internet map is, of course, the choice of the person who owns the mapping software and the server account on which such maps are distributed. Internet mapping is attractive for a variety of eGovernment possibilities (Randy Deshazo, student College of Architecture and Urban Planning, University of Michigan, first drew my attention to these maps as useful for eGovernment interaction).

Opportunity

As a city, Ann Arbor is reliant on (among other things) taxpayer dollars to keep the City going. The University contributes, of course, to opportunities of various sorts, but as a state university does not contribute directly to the tax base. Thus, the tax base that is drawn upon comes from an unusually small percentage of land within the city: Ann Arbor has high property tax rates in relation to other Michigan cities. Most of the land within the city is already developed. One way to continue to raise funds is to do so through dollars from developers. With sky-rocketing property values, and little available land, developers turn an eye to creative uses of existing land within the city. Some proposals are sensitive to environmental costs; others are less so. Some see Allen's Creek flood plain and flood way as a source of substantial tracts of land that they believe could be successfully developed, sometimes citing arguments that promoting density in the downtown area (where there is substantial existing infrastructure) can reduce sprawl. For them, the flood plain and flood way offer opportunity: their arguments are often couched in terms that suggest opportunity for others as well (sprawl reduction through promoting density, affordable housing, or needed dollars for the city). Peter Allen, local real estate developer and University of Michigan colleague, comments in a note to James Nicita (Allen's Creek Watershed Group and Wayne State University) that we keep in mind the following items:

> "1) An engineering study should include an economic study. The repair and redevelopment of the Allen Creek must look at the options for new construction wherever possible, partly to serve the demand for not only open space but also for office, housing, neighborhood retail, artists, non-profits, etc.
> 2) ...improvements will cost $80 million according to one study. Who will pay for this? Creating a[n]... overlay district to capture the taxes from the new development should be considered.
> 3) Allen Creek goes under several buildings...Daylighting is not an option in places such as this.
> 4) Keep in mind that the city is the biggest landowner in the creekway...."

Ordinances may be revised to allow extra height in exchange for donation of flood plain and flood way segments of existing parcels to parkland: to create continuous build-up of green space for natural hydrological and biological activity. This approach is just one example of a strategy that may have merit. No matter how the issue is argued, however, it is clear that there are substantial economic benefits, to businesses and to the broader community (in terms of wise expenditure of the tax base), to developing and redeveloping parcels of land already in the City. The challenge is to do so in a manner that does not add to the existing environmental burden and to do so in a manner that will help to remedy that burden.

Disaster

On the other side of the issue are environmental arguments. Should one ever build in the flood plain or flood way? These belong to the river and the river will take and use them whenever it needs to do so. To build in them is to offer eventual disaster to residences and businesses located in them. There are already hundreds of structures in the Allen Creek flood plain or flood way (*Ann Arbor Observer*, November, 1999). To build new structures may increase the threat to those already there. Because Allen's Creek is confined within a pipe in the more densely built-up areas of town, there are already reports of spectacular events with manhole covers over Allen's Creek popping like corks during heavy rains (interview of Ethel Potts long-time city resident; also, *Ann Arbor Observer*, November, 1999). The extreme position here might see removal of all structures from the flood plain and flood way parcels, conversion of them into parkland that could serve as a buffer between adjacent non-flood plain properties, and an unearthed ("daylighted") Allen's Creek allowed to follow its natural channel. City of Ann Arbor Planning Director, Karen Popek Hart, notes, however, that "a huge issue... is contamination of soil the pipe lies in--daylighting may not be environmentally 'good' without massive excavation and disposal." If the economic issues dominate, might they tend only to defer the inevitable long-range environmental issues? In the total build-out scenario, after all the flood plains and flood ways are built upon, what next? Redevelopment of parcels offers one promise for continuing funds and if the environmental issues dominate, such sources of funding will be sorely needed.

Conclusion

This local issue points to an obvious need to reconcile economic and environmental needs, not as separate issues but as the complexly intertwined knot of challenges that they are. Viewed more broadly, this local controversy might be seen as a difference in reconciling issues involving long-range and short-range planning. Central to many arguments is a "belief" as to whether the worst case (or even bad case) environmental scenario can occur. This "belief" often rests on maps: what is a flood plain and do the maps represent the situation in a realistic fashion? Some say no: the evidence of experience is what should guide land use. Others say yes: the map is a scientific tool that is applied uniformly across the city and does not play neighborhood favorites (*Ann Arbor Observer*, November, 1999). The heart of the matter is to determine what constitutes a highest and best use of tax payer dollars--one simply cannot know in advance, despite highly persuasive arguments advanced on all sides. Thus, a middle of the road action might arise as the prudent political action--as so often seems to happen in situations involving dilemmas.

Factors that might play into an answer to reconciling the disaster with the opportunity include (but are not limited to):

- Spatial concerns
  - Spatial analysis in assessing risk--use of GIS
  - Map accuracy and creation/updating/enhancement of dynamic maps (GIS) from current data. There may well be gaps, resulting from jurisdictional differences, in existing GIS maps; the flood plain and flood way do not necessarily fall within political boundaries
  - Understanding the evidence of maps. Use of media to educate people that a map is a scientific tool of merit in guiding policy; a map is not merely a pretty picture of a hypothetical forecast.
- Resource concerns
  - Implement a cost-benefit analysis to assess the current fiscal situation: economic and land use issues and costs

- To the average citizen
- To affected citizens
- To affected businesses
- To the city
- To the environment

- Implement a hydrological study to assess the current environmental information: hydrological issues and costs
  - To the average citizen
  - To affected citizens
  - To affected businesses
  - To the city
  - To the environment
- Policy concerns
  - Ordinance review--of city, state, or federal concern?
  - Impact of planning on residents and businesses already there--a property rights/regulatory takings issue (with generic "justice" fundamental).
  - Possible purchase of development rights (interview of Randy Deshazo) or fee simple purchase.
- Educational concerns
  - Getting people to understand the science of the issues.
  - Promoting geographic (and other) literacy. One way might be to use maps with great frequency and to do so in imaginative and interesting ways in a variety of settings.
- Preparing for the future by planning--how to avoid similar, linked situations involving substantial fiscal and environmental cost. One answer could center on master planning by creek shed, rather than by manmade boundaries. Thus, a hypothetical "new" urban area would have, for example, Allen's Master Plan, Mallett's Master Plan, Creek Shed #3 Master Plan, Creek Shed #4 Master Plan, and so forth. While this approach might solve the problem for a brand new hypothetical city, how might a built-up region implement such an approach? A few issues to consider include the policy and other concerns noted above. In addition, one might also consider:

  - Annexation issues and regional planning.
    - In 2007, a boundary agreement between the City of Ann Arbor and neighboring Ann Arbor Township permits the city to annex township "islands" contained within the manmade freeway ring outlining Ann Arbor. Some of these parcels lie in flood plains. What sorts of rights should they have?
    - Regional planning offers a powerful tool for addressing matters of broad interest to the larger human community. An eventual challenge with creek sheds as master planning units is to piece together a puzzle of creek sheds across the entire land mass that might serve the world well. How to do so without causing great fear of snatching of territory is a severe difficulty. City of Ann Arbor Planning Commissioner Donna K. Tope suggests overlay legislation adopted by all jurisdictions in the creek shed as one possible legal tool for implementation of creek shed planning at the local regional level.
  - Increases in impervious surface and related environmental issues such as rate of stream flow, erosion issues, and water quality.

    This linked map (base map courtesy of SEMCOG) shows amount of impervious surface in Washtenaw County, Michigan. The percentages are percentage of impervious surface by Southeast Michigan Council on Governments (SEMCOG) land use parcels.

The wise use of maps (or other models) can lead us to make wise decisions.

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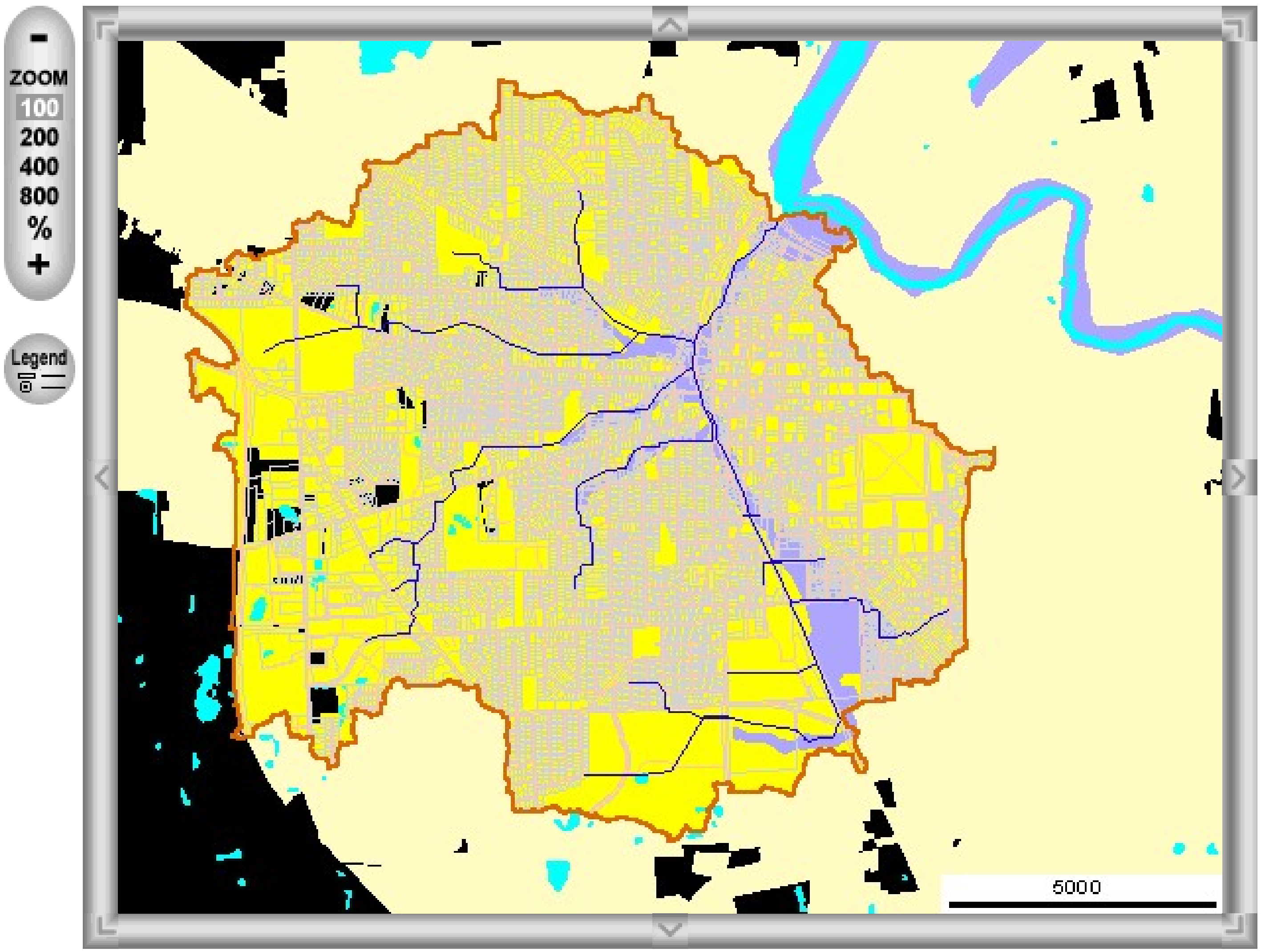
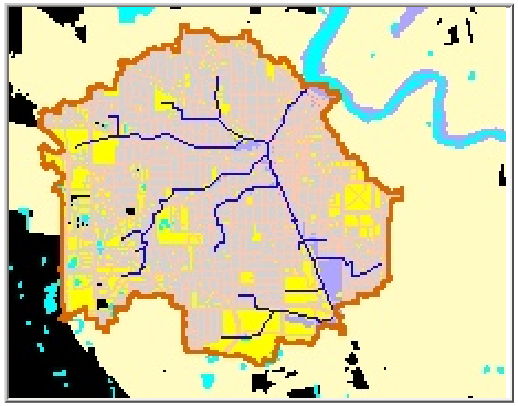
Ann Arbor Parcels in Allen Creek Watershed

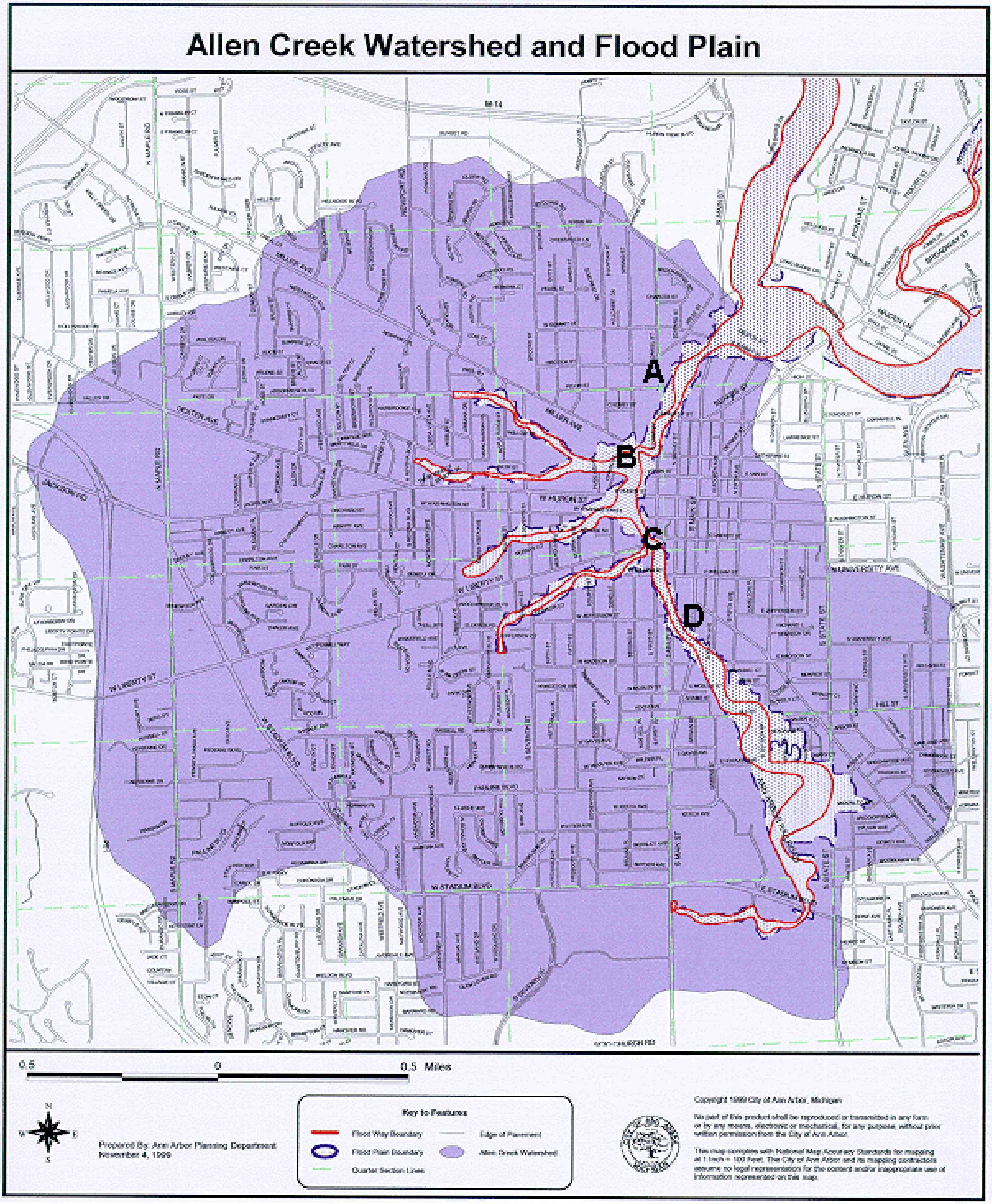


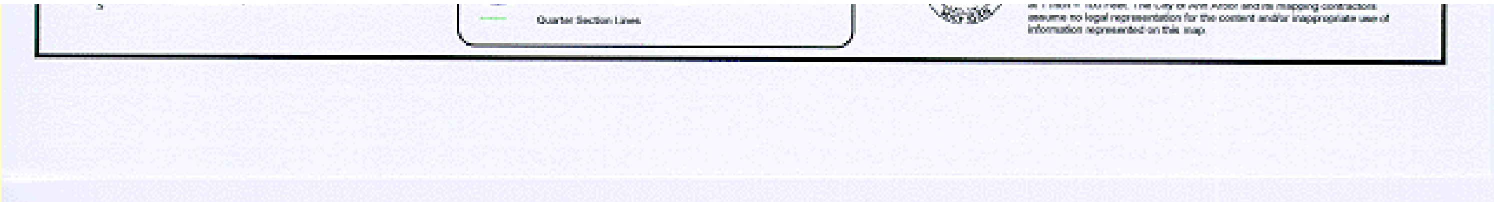


Click on the map on the left to receive more information about objects on the map.

Sandra Arlinghaus
Created with ImageMapper 3.0 by alta4.

On the map below, click on the letters A, B, C, and D to see an attached aerial view of Ann Arbor with the parcel map and Allen Creek Floodway and Floodplain superimposed on each aerial.



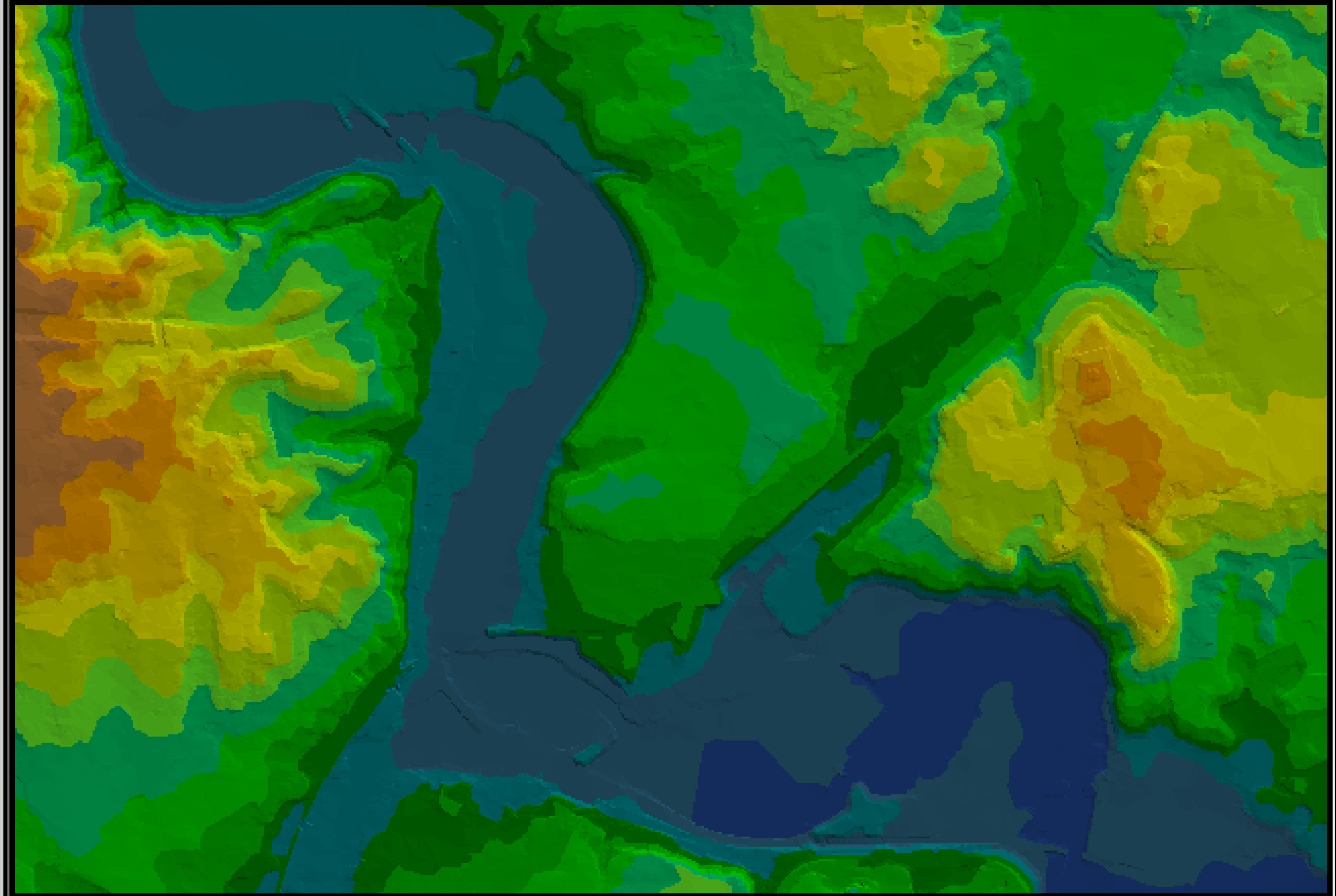


Hard copy of image and GIS work done by the City of Ann Arbor Planning Department (Karen Hart, Wendy Rampson, and Alexis Marcarello).

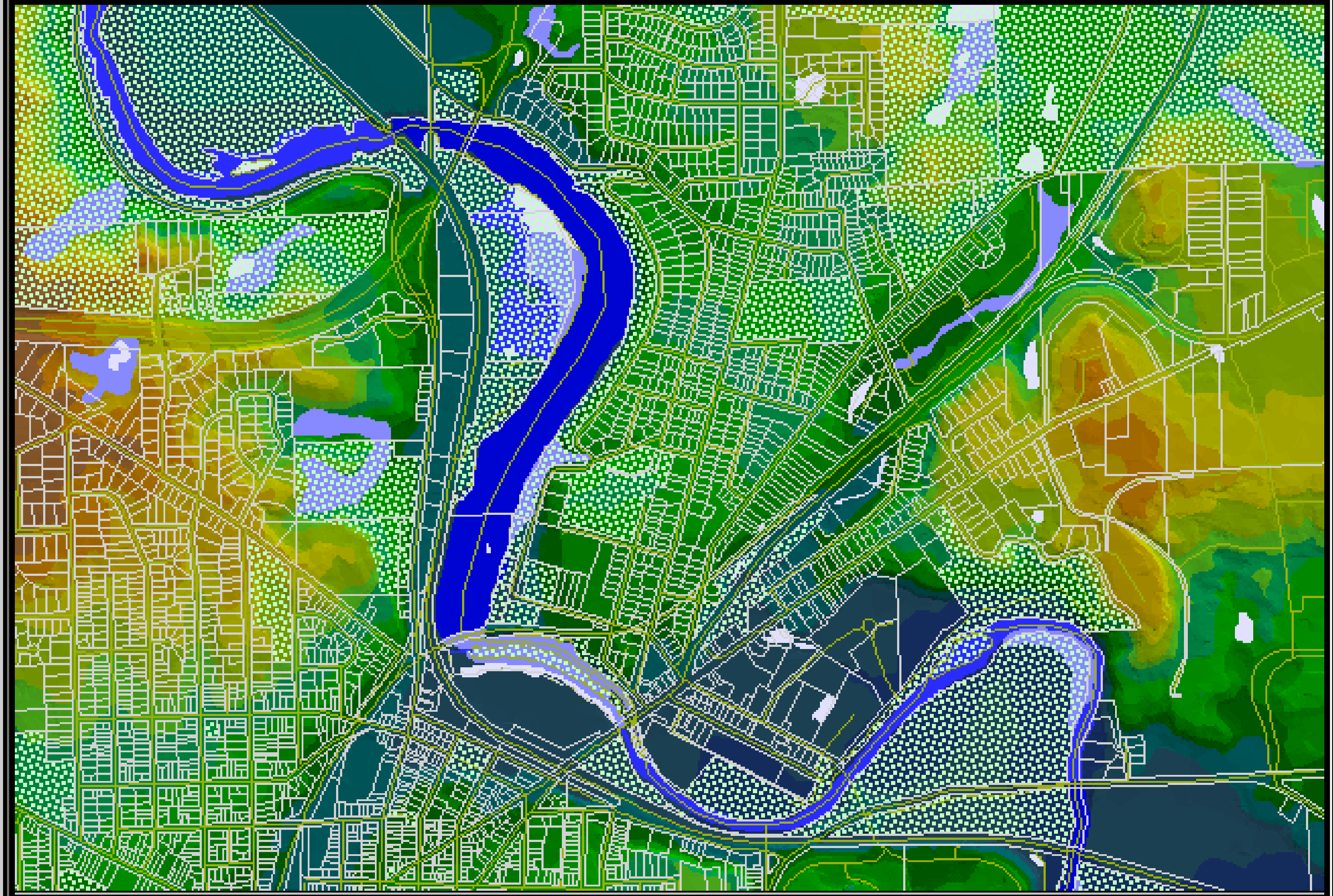
Triangulated Irregular Network
Ann Arbor, Michigan

City of Ann Arbor contour map, with contours at a five foot interval, is used to create a triangulated irregular network in ArcView GIS, 3.2, Spatial Analyst Extension. Steep slopes can be readily visualized and creeks and swales become evident. When this sort of spatial analytic tool is used in conjunction with other existing maps, guidelines for policy of where to develop and not to develop may emerge. Base maps from City of Ann Arbor (thanks to Merle Johnson). Legend is measured in feet above mean sea level. The interval in the legend is five feet. The TIN was calculated from the five foot interval creating 45 separate layers in which to perform calculations. The GIS software, in selecting a default color ramp, did not select 45 colors to show change in grade. It grouped the data into subgroups of 15 to 20 feet by color. Thus, each individual color represents 15 or 20 feet of elevation, ranging from deep blue at 750+ feet to rust color at 975 feet. In particular,

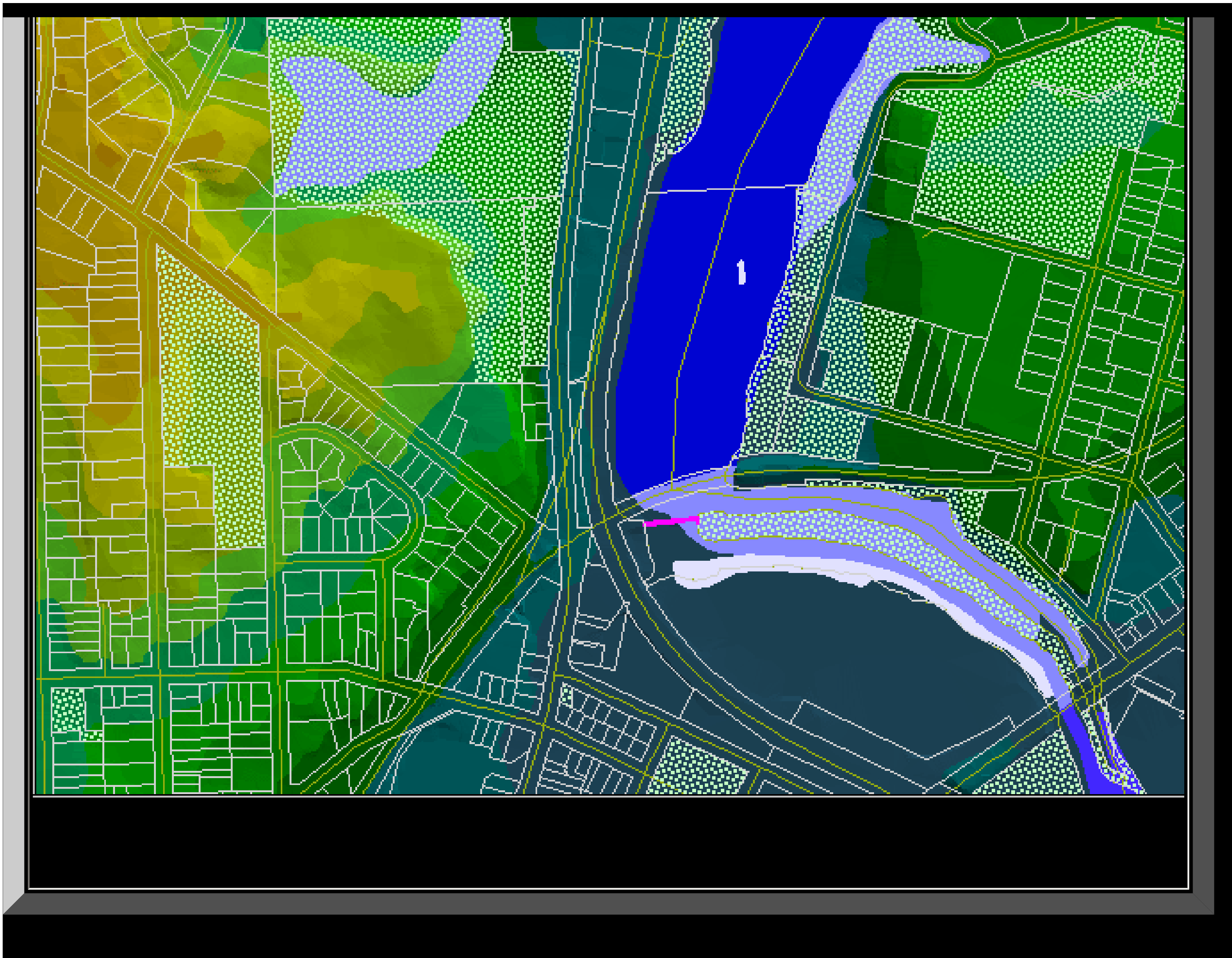
750 to 800 feet: deeper blue to lighter blue, respectively;
800 to 850 feet: deeper green to lighter green, respectively;
850 to 900 feet: blue-green to chartreuse, respectively;
900 to 950 feet: yellow to orange, respectively
over 950 feet, rust.



In the map below, the parcel map is overlain on the TIN as are layers for parks (stippled green), for water (blue), for street centerlines (green lines), and for dams (magenta). Allen Creek enters the river just south of the dam (north is at the top of the map)



A closer look allows more of the TIN to show through.



Book Review of ***Fast Food Nation: The Dark Side of the All-American Meal***
(Eric Schlosser, New York: Houghton Mifflin, 2001. Available only in hardcover: $25.00)

Kameshwari Pothukuchi, Ph.D.
Wayne State University

If we are what we eat, then we are not well. Fast food is destroying us: individuals, communities, work and family life, and indeed, our very connections with the world. This is the alarming yet prodigiously researched message of the best-selling new book by Eric Schlosser, *Fast Food Nation: The Dark Side of the All-American Meal*.

Fast Food is a significant part of contemporary culture and economy: in 1970, Americans spent about $6 billion on fast food; in 2000, more than $110 billion. Americans drink soda at the annual rate of 56 gallons--or nearly 600 12-ounce cans-- per capita. McDonald's employs about 1 million people in the US, more than any other organization, public or private. McDonald's earns the majority of its income not from food sales, but from rental income from its vast property holdings. The golden arches that signify the firm are arguably the best-recognized symbol across the world, rivaling even the Christian cross.

The book chronicles, with vignettes, statistics, and engaging journalistic prose, the rise of fast food restaurants as they applied industrial practices of mass-production, specialization, and mass-marketing. To turn kids into faithful, long-term consumers, fast food has forged alliances with toy companies, sports leagues, Hollywood, and our nation's school districts. Exclusive contracts with chains such as Burger King and Pizza Hut have added to schools' budgets; although as the book documents, the costs of corporate presence in our schools are by no means small. Fast food's employment of teenagers has accompanied the de-skilling of work, low-wages without benefits, elimination of employee training (even as corporations simultaneously accept hundreds of millions of federal dollars in the name of employee training), union-busting, and the frequent violation of child labor laws. The book also takes up the industry's little-known practices that keep us hooked: chemicals that are added to flavor the burgers, fries, and milk-shakes, to add to their attractiveness, for example, and the practice of frying potatoes in fat that is 7% soy oil and 93% beef tallow.

By far the most engaging part of the book deals with the suppliers of fast food—the meatpacking industry--and their social and health impacts. The four largest corporations--ConAgra, IBP, Excel, and National Beef--today slaughter about 84 percent of the nation's cattle, up from only 21 percent in 1970. The industry has now relocated to anti-union states with cheap labor, such as Iowa, Kansas, Texas, Colorado, and Nebraska; wages in plants here are fifty percent lower than union-worker earnings in the old-style slaughterhouses of Chicago and New York.

The industry, like others, benefited from the Reagan-Bush era of lax anti-trust regulation, weakened federal oversight by OSHA (Occupational Safety and Health Administration), and food safety and environmental inspections. The book documents many cases of fraud committed by industry leaders in price-fixing, cheating, and under-representing worker injuries and safety violations. For example, between August 1992 and December 1995, Archer Daniels Midland, "supermarket to the world," conspired with its foreign rivals to over-charge farmers by as much as $180 million. ConAgra, the third-largest chicken processor was forced to pay $17.2 million in damages when it was found to have deliberately mis-weighed 45,526 truckloads of birds over an 8-year period at a plant in Alabama, systematically cheating thousands of the state's growers. Corporate officials considering new locations for plants also are not above lying to host communities: in a public forum in July 1988, in Lexington, KY, IBP officials promised worker stability; salaried, not hourly, workers; and smells not unlike "those emanating from your kitchens" (p 166). As in other communities that are home to meat-packing plants, Lexington residents complain of pervasive odors of burning hair and blood, animal grease, and rotten eggs.

Meat-packing is among the nation's most dangerous jobs. With line-speeds at 400 cattle per hour--up from 175 cattle/hour in 1980--and as workers wield large knives and cleaners hose water and chlorine heated to 180 degrees F, a third of the meatpacking workforce annually suffers injury that requires medical attention beyond first aid. Many meatpackers admit to using methamphetamine to feel charged and self-confident to confront their gruesome work. Turnover in processing plants, according to industry reports, is as high as 80%; the author found that during one 18-month period, the Greeley, CO, ConAgra plant hired more than 5,000 different people to fill roughly 900 jobs. By industry claim, such turnover has little negative effect on productivity and keeps insurance costs low. Transient labor is easy to control and hard to unionize. Death rates, however, are high in this work: "[Meat-packing] workers are the ultimate in disposable workers: illegal, illiterate, impoverished, untrained. The nation's worst job can end in just about the worst way. Sometimes these workers are literally ground up and reduced to nothing." In one IBP plant in which two workers died, OSHA imposed a fine on the company of $480 for each worker (p. 178). Workers face strong pressure not to report injuries; injured workers are often brought back from the hospital to the plant to understate lost work-days; and plants are known to keep two sets of logs--the more optimistic one reported to government health inspectors.

The meat-packing industry, notwithstanding the free-market rhetoric that emanates therefrom, is subsidized by all of us--meat-eaters, vegetarians and environmentalists alike. In 1987, IBP exacted taxpayer subsidies from the state of Nebraska to the tune of between $13,000 to $23,000 per job. Despite this, IBP, a company that was launched in 1960 by C J Holman and A D Anderson, with a $300,000 loan from the federal Small Business Administration, moved its headquarters in 1997 to South Dakota, a state without corporate taxes or personal income tax. Along with other fast food trade groups, it has lobbied to prevent raising the minimum wage, restrict union-activity, and minimize health and safety regulation--all stressed by conservative political agendas especially as epitomized in the 1994 "Contract with America." Former U.S. Rep. Newt Gingrich (R, Georgia), the Contract's main author, received more money from the restaurant industry than any other congressman; of the top 25 House recipients of restaurant industry funds, only four were Democrats.

The huge feedlots, slaughterhouses and hamburger grinders, and the overall centralization of meat production have provided the means to disperse pathogens that cause severe illnesses more widely than ever before. E. coli 0157:H7, an especially virulent form of bacteria that now is the leading cause of kidney failure among children in the US, is largely spread through contaminated food. But it is not the only one. A USDA (United States Department of Agriculture) study in 1996 found that 7.5 percent of ground beef samples were contaminated with Salmonella, 11.7 percent with Listeria monocytogenes, 30% with Staphylococcus aureus, and 53.3% with Clostridium perfringens. Furthermore, 78.6 percent of the ground beef samples contained microbes that are spread primarily by fecal material (p 197). It will surprise many to know that, by law, the USDA cannot demand a recall of contaminated products; it has to rely on the offending company for information on amounts and locations. Once a company voluntarily decides to pull contaminated meat from the market, it is under no legal obligation to inform the public, even if consumers may continue to be at risk from contaminated products.

Reading this far, the shock of the knowledge that some of the most questionable ground beef in the US is purchased by the USDA for school cafeterias (to go into the free and subsidized meal programs), is probably somewhat tempered. USDA is required to purchase from the vendor with the lowest price, with no additional safety requirements. The book reports on plants that supply to the USDA, processing diseased cattle and those dead before arrival to the plant, and mixing rotten meat returned from retail operations. The meat purchased for schools has standards less stringent than even those imposed by the fast food industry. Meat exported to the EU is subject to tougher processing standards than for local consumption, thereby requiring slower line-speeds at plants; unsurprisingly, workers appreciate more producing for Europeans than Americans.

In turn, fast food's impacts on the American--and global--landscape and culture have been huge. For example: restaurant signs became taller and more garish as they competed for the attention of drivers on the emerging highways of the 1950s. Today, McDonald's uses commercial satellite photography to predict sprawl from outer space so as to be among the first to bid for cheap land along highway exits. Seven years after it opened its first restaurant in India, McDonald's established a supply network there, teaching Indian farmers to grow iceberg lettuce with seeds specially developed for the nation's climate. Today, in the US, obesity rates are the highest of any industrialized nation in the world. Obesity is spreading to China and Japan, countries that have adopted the "Big Mac and large fries" culture. Germany is home to over 1,000 McDonald's, and is the most profitable overseas market for what has become the biggest restaurant chain in the country. Across the world, fast food restaurants are targets for anti-globalization and anti-USimperialism demonstrations.

The book proposes solutions, but without devoting the length to document the ills of the industry. Free-range, grass-fed cattle production; family restaurants, independent processors, farm-land preservation efforts, and chains with worker-friendly practices ($8/hour wages with health and retirement benefits, sick and vacation leave, etc.) are offered albeit with little conviction as alternatives to the highly concentrated, vertically integrated fast-food industry. On the policy side, more systemic proposals seek to curb industry malpractice and strengthen consumer, labor, and environmental regulations: ban advertising of foods high in fat and sugar targeted to children; strictly enforce minimum wage, overtime, child-labor and other labor laws; eliminate employee training subsidies to chains that churn workers and maintain low-skilled work; increase safety of school food; integrate food safety responsibility into one federal agency; improve sanitary conditions in the nation's slaughterhouses; improve working conditions in plants; place tougher sanctions on poor industry practices related to worker safety and health; and perhaps equally importantly, view livestock and land as values in their own right, not simply commodities. These are important proposals; the book falls short of addressing the question of how these are to be implemented. It is, however, no less valuable for such a lack.

Engaging, with a wealth of detail, and a finely modulated sense of outrage, the book is an important contribution to analyses of the global food system. It should be useful to students of globalization, corporate control, space and place, culture, urban and rural areas, and sustainable living. In its documentation of the corrupting nexus of money and power, it is not unlike two other recent books in its genre: *A Question of Intent* by David A Kessler (2001; New York: Public Affairs), an inside look at efforts to uncover Big Tobacco's lies, and *Dispensing with the Truth* by Alicia Mundy (2001; New York: St Martin's Press), which examines the battle over the diet drug Fen-Phen.

Consumers have made the fast food industry what it is today. This book gives us--as consumers and citizens--some of the tools we need to demand accountability from those in charge of its oversight and, at least partially, to reclaim our food system.

Review of *High Technology and Low-Income Communities: Prospects for the Positive Use of Advanced Information Technology*, edited by Donald A. Schön, Bish Sanyal, and William J. Mitchell, MIT Press, 1999.

Richard Wallace
University of Michigan

Does information technology represent a major transformation in human economic interactions or merely the latest step along a gradual continuum? Will new information technology widen the gap between rich and poor or will it provide low-income communities with the tools to close the gap? According to the various contributors to *High Technology and Low-Income Communities: Prospects for the Positive Use of Advanced Information Technology*, the answer to both questions is "yes." In other words, at this time we cannot conclude with much confidence how high technology will affect low-income communities in the long run; we cannot even conclude with certainty that it will have an important effect at all.

Emerging from a colloquium held at MIT in the spring of 1996, this anthology, edited by the late Donald A. Schön, to whom the book is dedicated, and his former MIT colleagues Bish Sanyal and William J. Mitchell, brings together the insights of urban planners, social activists, and technological pioneers. While the first two of these groups are interested primarily in the plight of cities and low-income communities, the latter is interested primarily in the evolution of high technology. Out of the juxtaposition of these viewpoints arises not a consensus, but both pessimistic and optimistic views on how high technology (used more-or-less synonymously with information technology in the book) is affecting and will affect low-income communities.

For the most part, the most pessimistic views are offered in Part I of the book and authored by leading academics, such as Manuel Castells, Peter Hall, and Leo Marx. These contributors examine historical, sociological, political, and economic trends to suggest that access to information technology is, and is likely to remain, restricted by class, race, and geography. Schools in isolated inner-city communities, for example, are less likely to offer high-tech training to their students and their students are less likely to graduate, etc. With the exception of the chapter by Mitchell, Part I presents largely theoretical arguments that high technology will serve to widen the gaps between rich and poor, creating communities that are as isolated from informational opportunities as inner cities today are often isolated from economic and educational opportunities.

In contrast to the other chapters in Part I, Mitchell's chapter presents a range of contrasts between physical presence and "telepresence" and generally finds much to recommend the latter. In so doing, however, he seems to have neglected all the negative possibilities that could arise for low-income communities, such as greater social and geographic isolation, from a telesociety. For

Mitchell, the mere possibility of positive outcomes seems to be good enough; we need not consider the political and economic realities of technological diffusion. Fortunately, the other authors in Part I are more sensitive to the potential for new technology to differentially benefit those at the top of the socio-economic ladder.

The contributors to Part II of the book are less interested in possibilities and theories and more in documenting the positive use of high technology in low-income communities. Thus, overall Part II presents a somewhat more optimistic viewpoint, offering concrete examples of how high technology is being used to better life in low-income (and often minority) communities. In these chapters, we learn about how computers are already being used as tools to improve neighborhoods' access to planning data, empower local communities, and foster improved technological fluency and self-confidence among inner-city youth. The story in these chapters is not exclusively rosy, however, and within we also hear concerns for technological equality (for example, equal access to the electronic world, especially in the schools, and the technological modernization of the inner city) and how failure to address these concerns will hinder the ability of low-income communities to use high tech to improve their lot.

Absent from Part II, however, and from the book altogether, are empirical comparisons of the use of high technology in low-income and high-income communities. Without such comparisons, we cannot evaluate whether the positive examples from Part II represent the closing of digital and economic divides or whether they are a few outlying cases preventing even faster growth in the magnitudes of these divides. Quite possibly, while low-income communities are advancing via high tech as spelled out in Part II, wealthier communities are speeding ahead even faster.

As a result of this important omission, the policy recommendations that emerge in Part III (which consists of a single chapter co-authored by Sanyal and Schön) are fairly modest in tone, focusing on equal opportunity in the high-tech realm. Although the authors do acknowledge that the

> differential capacity to access and manipulate information between upper- and lower-income communities is likely to continue because of the fast pace of technological innovation and the higher-income resident's greater ability to purchase new hardware and software (p. 388),

they do not recommend policies designed to eliminate such mismatched capacities. Rather, the authors call on government to support minimum data and information needs. My fear, however, is that such minimums will become increasingly obsolete and inadequate as the well off continually upgrade their technological skills and informational access. In this scenario, the more pessimistic views expressed in Part I of the book may well prove accurate even if high technology infiltrates and is used in low-income communities. Much like the supposed equal access to housing, merely regulating equal access to information technology may result in increasingly segregated telecommunities. My suspicion is, despite the claims of some authors that high technology renders geography less relevant, that the correlations between spatial, economic, and digital segregation will be positive and high. Little in this volume suggests otherwise.