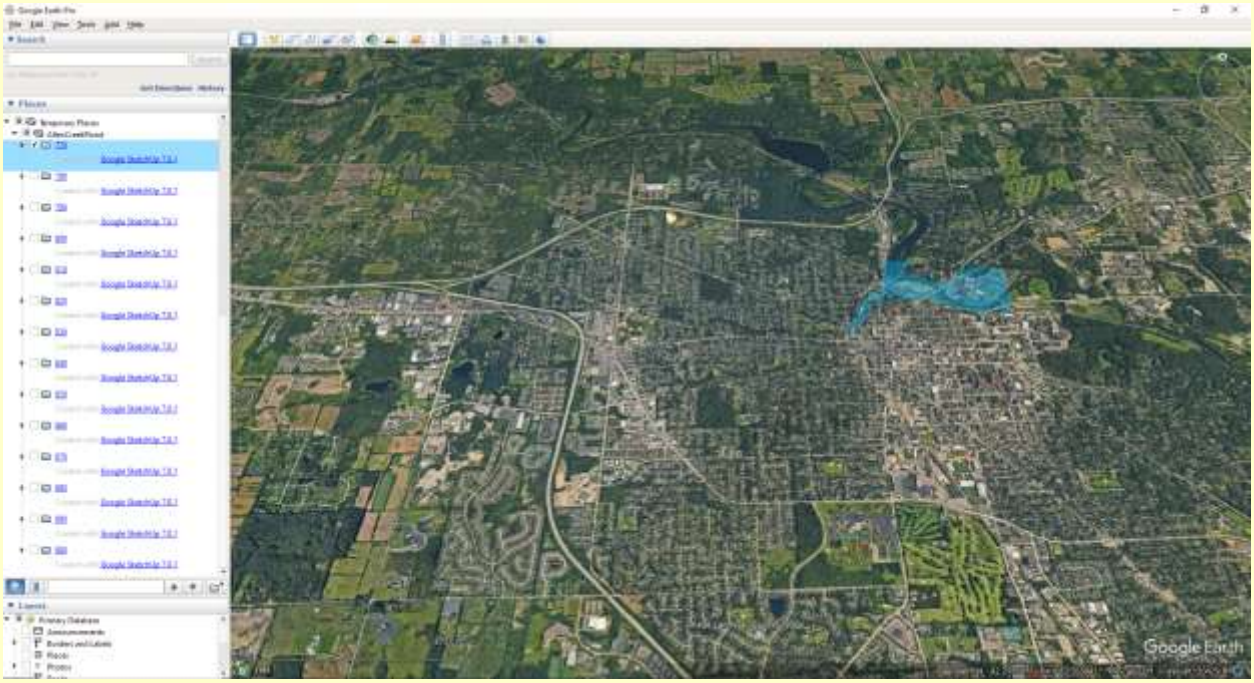
3D Atlas of Ann Arbor, 2nd Edition
2024 Revision

Editor and Principal Author, Sandra Lach Arlinghaus, Ph.D.; see credits at bottom of homepage.

Focus on 3D Models of downtown buildings in the Downtown Development Authority (DDA) of Ann Arbor, Michigan in association with an application of a simulated flood of Allen's Creek.



Unless otherwise noted, images created by S. Arlinghaus using Google Earth Pro®.

CREDITS:
...the second edition.

- Greatest thanks go to Prof. Klaus-Peter Beier, Ph.D., Director of the 3D Laboratory in the Duderstadt Center of The University of Michigan, for his ongoing advice and support associated

with various projects related to this one. The staff of the 3D lab, Lars Schumann, Scott Hamm, Brett Lyons, Eric Maslowski, and Steffen Heise have been helpful in so many ways:

- Peter Beier's remarkably clear and beautifully-conceived lectures in Engineering 477 taught the author concepts in 3D modeling that transcended individual software packages making it feasible for her to leverage a wide range of changing software to follow paths of interest. His graduate student instructors, particularly Thana Chirapiwat and Bonnie Bao, graciously aided her in learning to master the intricacies of modeling both in high-end graphics packages and in underlying source code (vrml) that later proved of great value in merging files created for the Google Earth® displays in this book.
- Lars Schumann offered wise suggestions concerning the display of the entire set of buildings. Not only did he initiate such suggestions but also followed through with the testing of their implementation. In addition he kept the author and others informed, through his constant monitoring of the Google Earth® site, of latest developments. Both he and Matthew Naud originally suggested to the author their interest in placing the existing 3D models into Google Earth®.
- Scott Hamm offered expert advice on giving demonstrations on the large size display screens available in the 3D Laboratory.

Without this group, this atlas would not be possible in its present form.

- Kris Oswalt, President of Community Systems Foundation, also helped to make the current work possible with his support of software. The importance of having Google SketchUp Pro® and Google Earth Pro® permitted the transition from GIS files to Google Earth Pro® and Google SketchUp Pro® files in a seamless manner using the GIS database to extrude sets of buildings from data appearing in the First Edition.
- Matthew Naud supplied files from the City of Ann Arbor and has been a constant participant in this project from its outset to its present form. His advice and support have been invaluable. Both he and Lars Schumann originally suggested to the author their interest in placing the existing 3D models into Google Earth®.
- Files generously supplied by IT folks, initially for the First Edition but which also play into the Second Edition:
  - Merle Johnson of the City of Ann Arbor ITS Department and Chandra Hurd (later Gochanour) of the City of Ann Arbor Planning Department both contributed maps and data: the former was generous in sharing aerials and maps from City of Ann Arbor files and the latter was helpful in sharing her expertise in analyzing city data and in checking selected files.
  - Donald T. Uchman, Coordinator of Space Graphics, Space Information and Planning, Plant Extension--AEC, The University of Michigan, generously shared official University map files on locations and sizes of buildings.
- Current files, and their immediate predecessors, were shown to, or discussed with, various groups to elicit feedback during 2006:
  - Community Systems Foundation Annual Conference
  - Eric Lipson (Vice-Chair, City of Ann Arbor Planning Commission) and Vince Caruso (Chair, Allen Creek Watershed Group).
  - City of Ann Arbor Planning Commission
  - Matthew Naud, City of Ann Arbor Environmental Coordinator
  - Community Systems Foundation group: John Nystuen, Gwen Nystuen, Fred Goodman, Barton Burkhalter, Ann Larimore
  - Board of Directors of local League of Women Voters (Shirley Axon, Judith Mich, and others).
  - Tracy Davis (Ann Arbor News), Vivienne Armentrout (Ann Arbor Observer)
  - Group including folks from the City and from the University.

- Many thanks to Prof. Michael Batty, Ph.D., of University College London (Director, Centre for Advanced Spatial Analysis) for his continuing encouragement in working with Google Earth®, both as a participant and as a co-author on related projects.
- Software and hardware used:
    - Google Earth Pro®
    - Google SketchUp Pro®
    - Adobe PhotoShop®
    - Adobe ImageReady
    - ESRI software: ArcView® GIS with Spatial Analyst® and 3D Analyst® (various editions)
    - Microsoft Office®
    - Windows XP®
    - Hewlett-Packard Pavilion® with Intel Pentium 4 Processor®

Finally, thanks to reviewers for constructive comment, to many others who have observed the development of this project, and to my family: husband, William C. Arlinghaus; son, William E. Arlinghaus; and, daughter-in-law, Kari Suffel Arlinghaus. Their patience and kindness have been critical to the development of these materials.

Please note the following caution--while donations of digital material were all current at one time, there is a lag in creating materials from them. Regular updating of material continues.

To all of the individuals mentioned here, as well as to those mentioned in the 1st Edition, goes deep appreciation. Remaining errors are those of the editor and principal author alone.

...the first edition

In addition to those above, there are a number of individuals who were either important in the development or the use of the First Edition:

- Development--students from Prof. Beier's course, Engineering 477, Virtual Reality, Fall 2005, 2004, and 2003:
    - 2005: A. Domzal, U. S. Hwang, K. J. Walters, Jr..
    - 2004: R. Ramesh, I. Shani, and N. Nolan.
    - 2003: T. Kwon, A. Lazzaro, P. Oppenheim, and A. Rosenblum

- Use--application employed by the Downtown Residential Taskforce:

  Douglas S. Kelbaugh (Dean, Taubman College of Architecture and Urban Planning, The University of Michigan), Fred J. Beal (President, J. C. Beal Construction, Ann Arbor), Susan Pollay (Executive Director, Downtown Development Authority), Karen Hart (Planning Director, City of Ann Arbor), Jean Carlberg (City Council), Wendy Woods (City Council), Steve Thorp (Chair, Planning Commission), Frances Todoro (Mayor's Office), Robert Gillett, and William D. Kinley. Their thoughtful comments have helped, in various ways, to shape selected images. Brian Barrick and Peter Pollack, both of Pollack Designs, followed this work with interest, as did Ray Detter, DDA Citizens Advisory Committee.

The First Edition, itself, is the best source of notation of other individuals who have participated in various ways over the past 6 years.

INTRODUCTION

The First Edition of the 3D Atlas of Ann Arbor captured six years of work on this topic prior to July, 2006. While the earlier files in that work are important to understand the development of the project and also to track how technological and planning development did or did not mesh, the more recent files in it appear of greater interest to most. The file that contains a great deal of detail of a few blocks of downtown Ann Arbor, coupled with music to make points that were, at the time, difficult to capture otherwise, seem of particular interest (to display this file, one needs to have installed some browser free plug-in to interact with the virtual reality--Cortona is one option). That file is actually three linked files and it was designed to suggest possible flooding/ponding scenarios in the downtown using a sort of "theatrical" approach. It also incorporated links on buildings, in the spirit of suggesting directions for various emergency management applications. At the time, it was very difficult at the time to create a model of the entire creek floodplain; hence, only a few blocks were shown.

The advent of good aerials of Ann Arbor in Google Earth®, in September of 2006, made it possible to overcome such difficulty. The earlier strategy of lifting a plane through modeled topography could now be employed on the existing terrain in Google Earth®. Terrain no longer needed to be modeled; previously, a Triangulated Irregular Network had been created from contour maps in GIS software and then imported to high-end graphics software. The resulting files were very large and precluded any possibility of showing a vast expanse of terrain. Still, Google Earth® did not become really useful until good aerials of Ann Arbor appeared already installed in Google Earth®. Then, the matter of pulling a plane through various elevations to simulate how contours fill with water became a strategy that could make some sense: one could at least have an aerial view of the urban context in which such filling was taking place. Beyond the general aerial context, showing considerable detail for the entire city, one might wish also to have 3D buildings modeled so that when one drives laterally through the city, the buildings appear upright and in fact might show, when coupled with the planes representing water, the elevation to which the water would reach on buildings.

Links to files showing 'five-globe awards':

File 0
File 1

In Google Earth® one has simultaneously a browser, a 3D navigational tool, and more. Thus, it is important to attempt to capture all of the previous 3D Atlas work within the Google Earth® context. It is to this latter task that this second

edition is devoted. The reader of this book will need to download a free version of Google Earth® in order to understand the content. It is highly recommended that the reader do so right now, before proceeding with the remainder of the work.

Link to Google Earth®, version 4 beta, download.

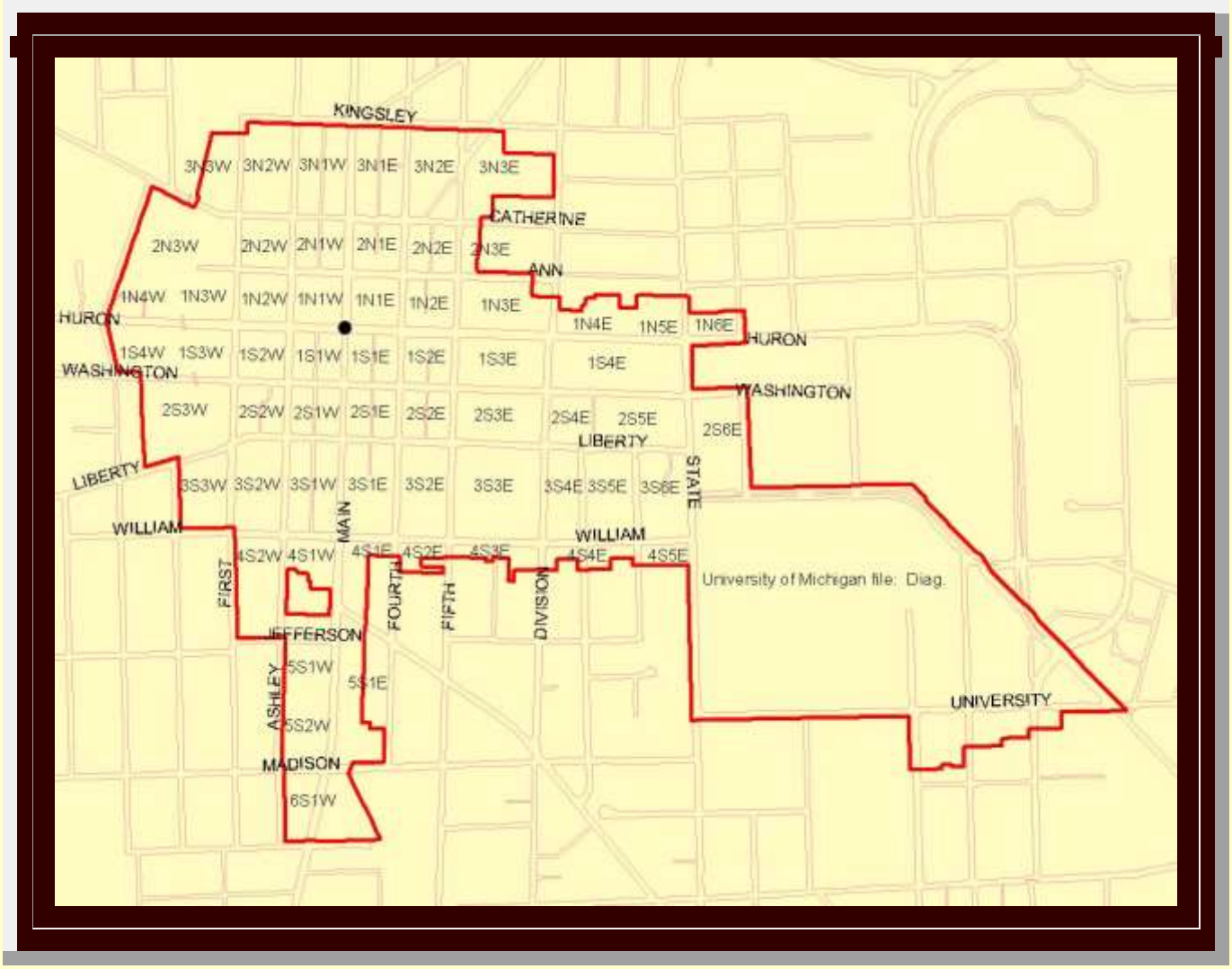
LIST OF PLATES AND 3D MODELS

The high quality aerials that come in Google Earth® are, by themselves, sufficient (for a number of purposes) for a good view of the entire city. When supplemented with 3D models of buildings, some with and some without textures, the Atlas becomes a more complete tool for analysis. Some buildings are modeled, as well, while others are merely extruded from the building footprint. All buildings within the Downtown Development Authority (DDA) boundaries appear as 3D models of one sort or another within this Atlas. So too do all buildings on the Ann Arbor campus of the University of Michigan. Please see the cover of the eBook for credits.

File showing all buildings, all non-textured and all the same color, to load into Google Earth: LINK
File showing all buildings, all non-textured and in two colors, to load into Google Earth. The University of Michigan (UM) buildings are colored cyan, and the Downtown Development Authority (DDA) buildings are colored maize: LINK
File showing all buildings with textured blocks within the DDA and others non-textured and plain, as above.

The emphasis in this book is on the textured buildings of the DDA, with secondary emphasis on all the buildings in the DDA.

- **Numbering of DDA Plates: the origin of the numbering scheme is from a point in the intersection of Main and Huron Streets. Thus, Plate 1N1W would cover elements of the block directly to the north and west of this intersection (in fact, adjacent to that intersection at the northwest corner). The Plates are generally numbered a block at a time so that the reader may choose according to the capability of his/her hardware. In some cases, a file will also have an "X" following the directional coordinates. In those cases, the "X-file" is simply "extra"--extruded buildings in a block to supplement the otherwise encoded textured buildings on the same block.**

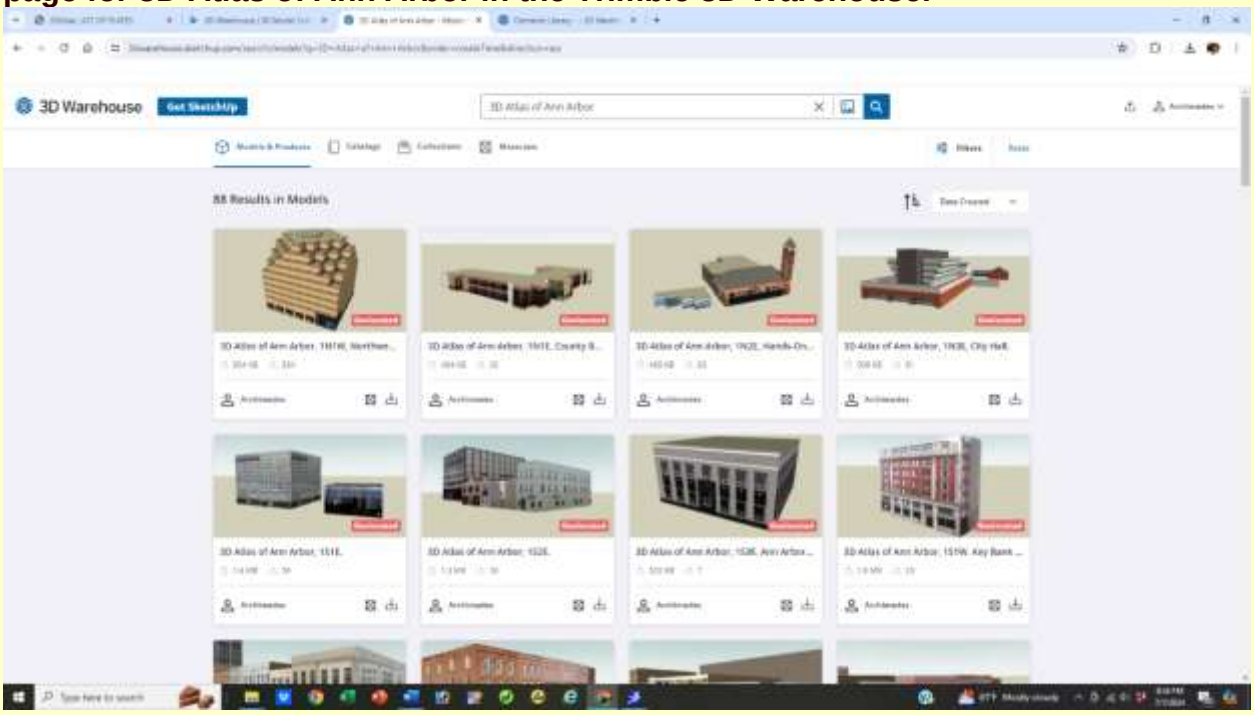


- **Catalogue pages from the Google 3D Warehouse.** **These contain all models in the *3D Atlas of Ann Arbor* and serve as a time-stamp for origination of materials. The author is listed as "Archimedes"--a pen name of the author of this document related to previous applications of the *3D Atlas of Ann Arbor* (Archimedes in Ann Arbor?) shown in the "Application" section of this document.**

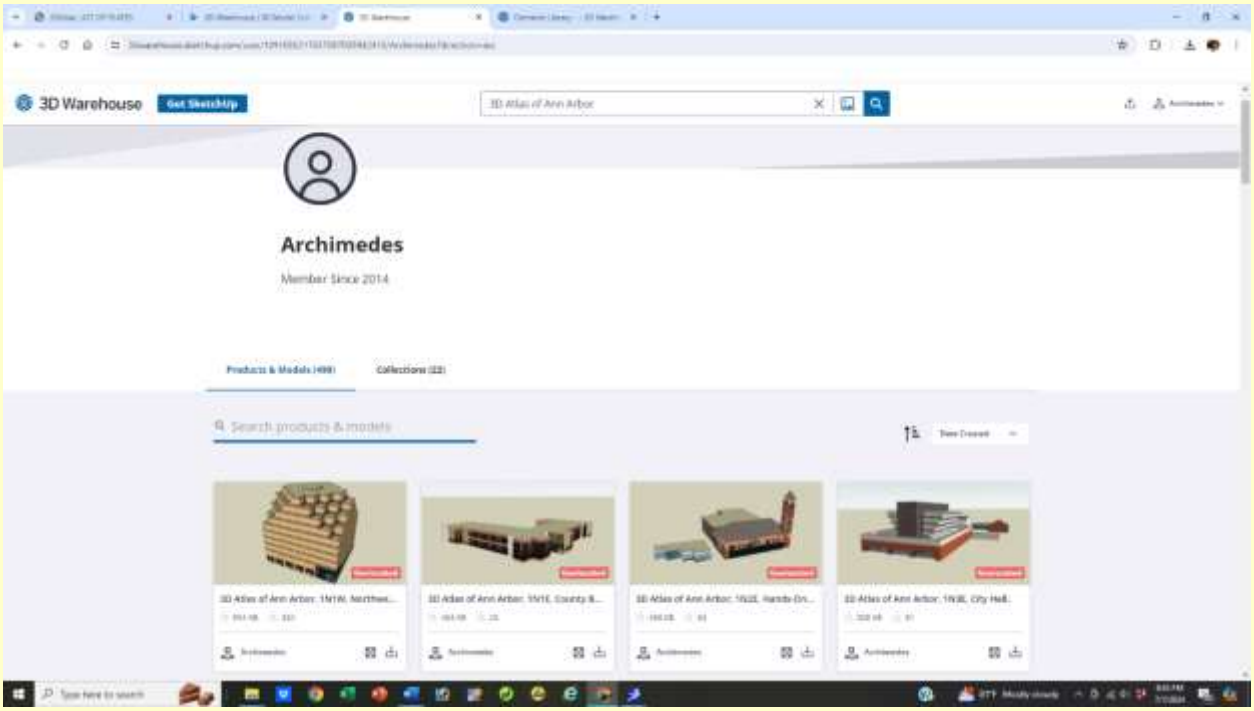
Page 1; Page 2; Page 3; Page 4; Page 5; Page 6 ; Page 7; Page 8; Page 9.

In 2014, Trimble took over the 3D Warehouse. All the models, created by previous developers were transferred to this new site, although not all formats may be available for free download (as they had been previously). S. L. Arlinghaus's models appear in the Trimble collections under the names of: 'Archimedes', 'Arlinghaus', 3D Atlas of Ann Arbor,' 'ModelYourCampus', and

multiple others. The set with the largest number of is by 'Archimedes' (aka S. L. Arlinghaus). The screen shot below, shows the interface of a collection index page for 3D Atlas of Ann Arbor in the Trimble 3D Warehouse.



'Archimedes' in the Trimble 3D Warehouse has 490 models and 22 collections (screenshot below).



The link below is to a pdf of Archimedes Selected Collection of models in that warehouse.

LINK

Notice that basements are also modeled on most buildings; that was done to prevent any appearance of floating building parts for structures built into uneven terrain.

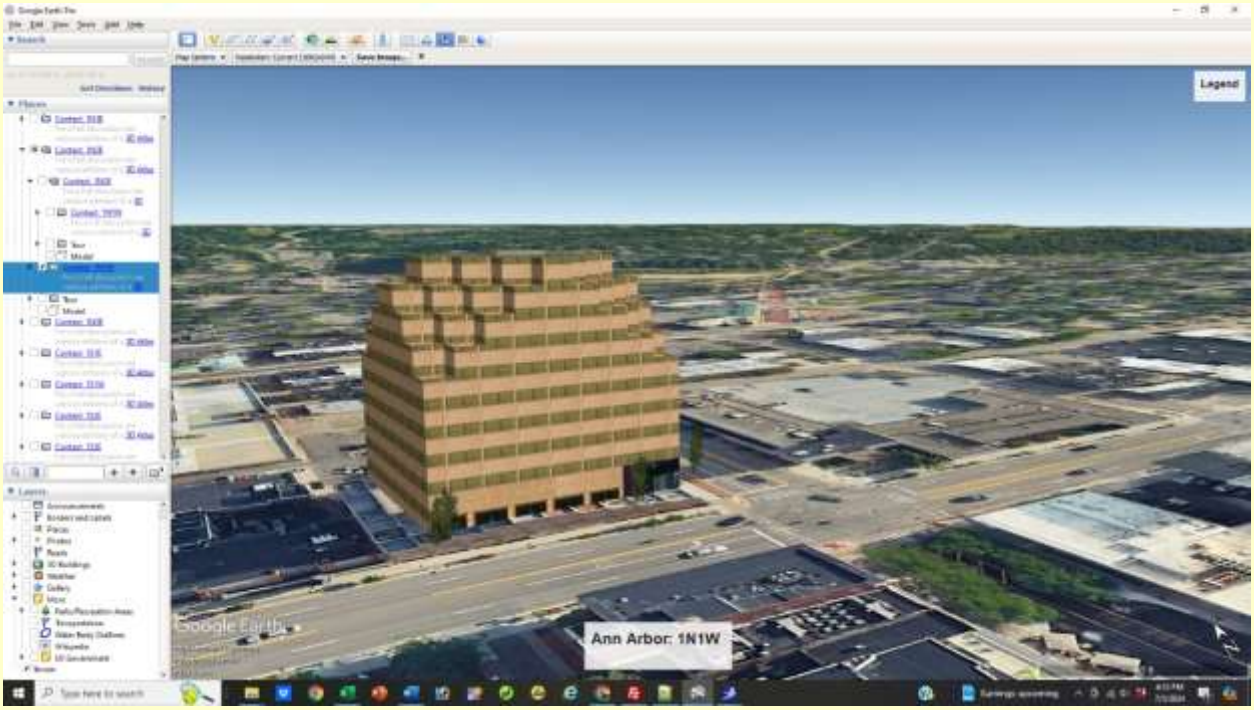
- **DDA Plates and 3D Models for Download, textured buildings.** **Textures are photographs of buildings with the foreground removed. Click on links and download files to load into Google Earth.**

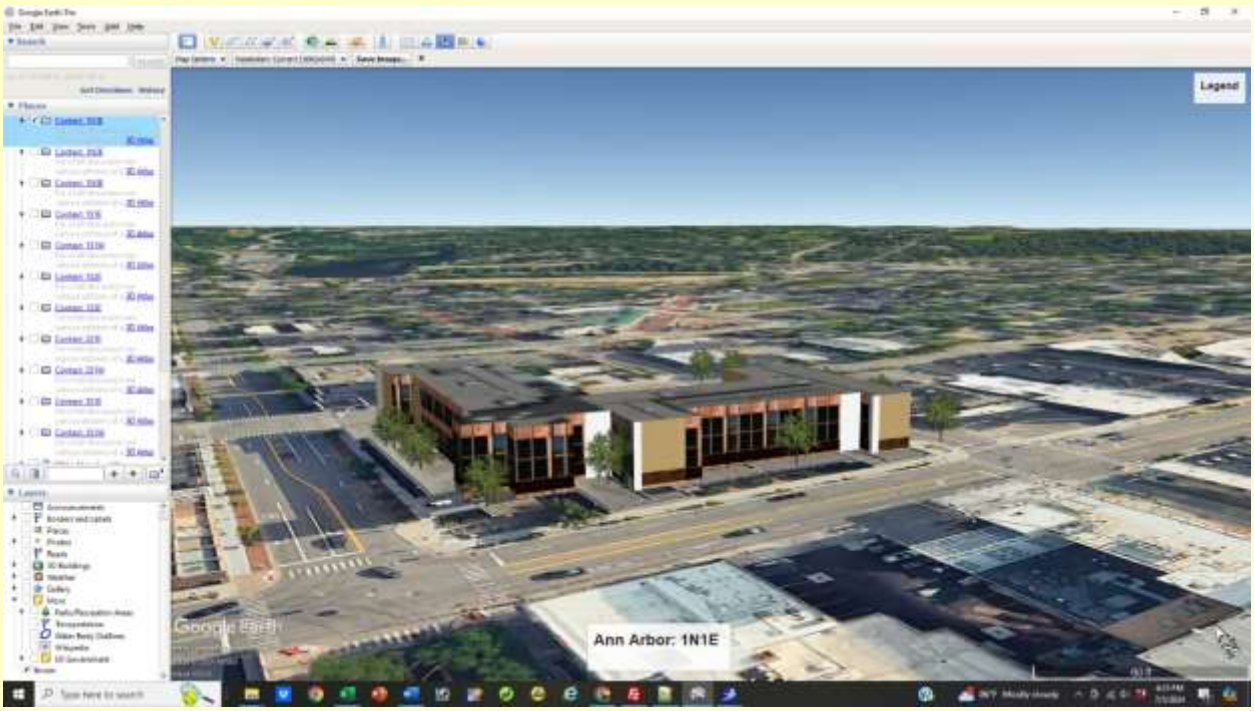
1N1W 3D model	1N1E 3D model	1S1W 3D model	1S1E 3D model
	1N2E 3D model		1S2E 3D model
	1N3E 3D model		1S3E 3D model
		2S1W 3D model	2S1E 3D model
		3S1W 3D model	3S1E 3D model

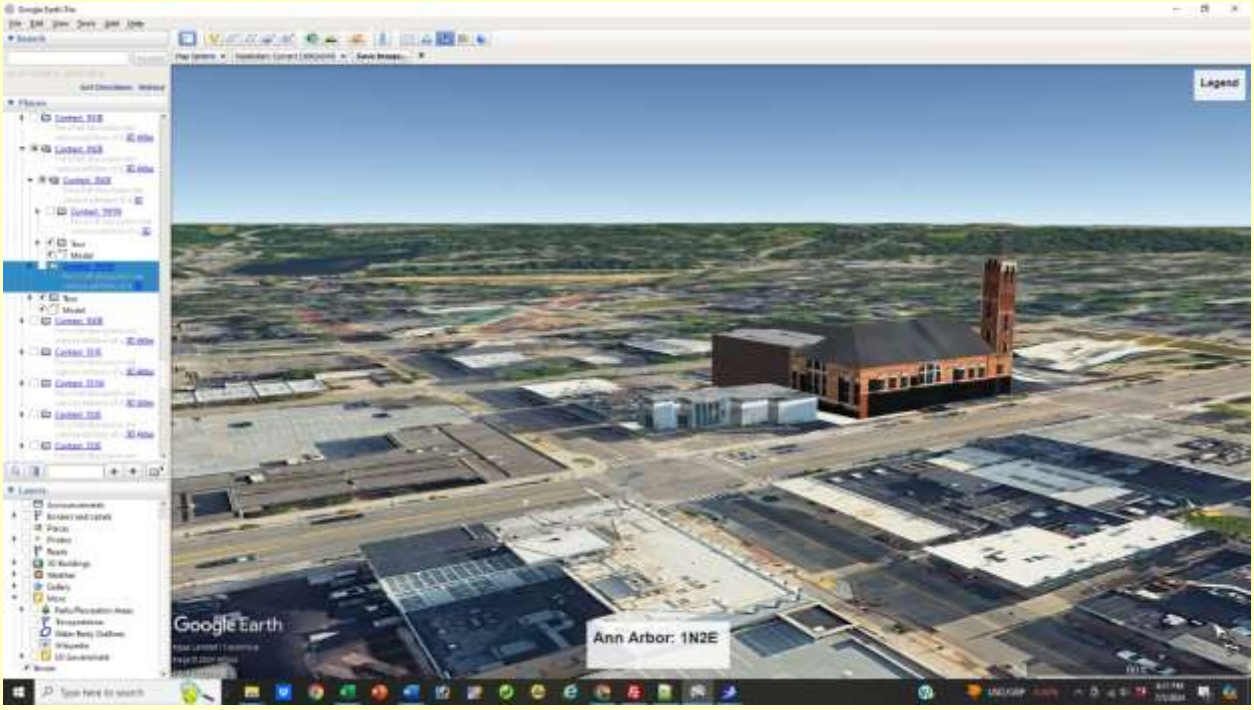
- **1N1W: 101 N. Main, high-rise mixed use residential and commercial located at the Northwest corner of Main and Huron Streets.**
- **1N1E: County Building occupies entire block, on the north side of Huron Street between Main Street on the West and Fourth Avenue on the East.**
- **1N2E: Block containing the Hands-On Museum in the old firehouse (with tower) on the north side of Huron Street between Fourth and Fifth Avenues.**
- **1N3E: Guy C. Larcom City Hall, 100 N. Fifth Avenue. Inverted stepped building houses city functions; located on north side of Huron Street between Fifth Avenue and Division Street**
- **1S1W: Key Bank Building, Southwest corner of Main and Huron Streets.**
- **2S1W: All four sides of block bounded by Main Street on the East, Ashley Street on the West, Washington Street on the North, and Liberty Street on the South.**
- **3S1W: All four sides of block bounded by Main Street on the East, Ashley Street on the West, Liberty Street on the North, and William Street on the South.**

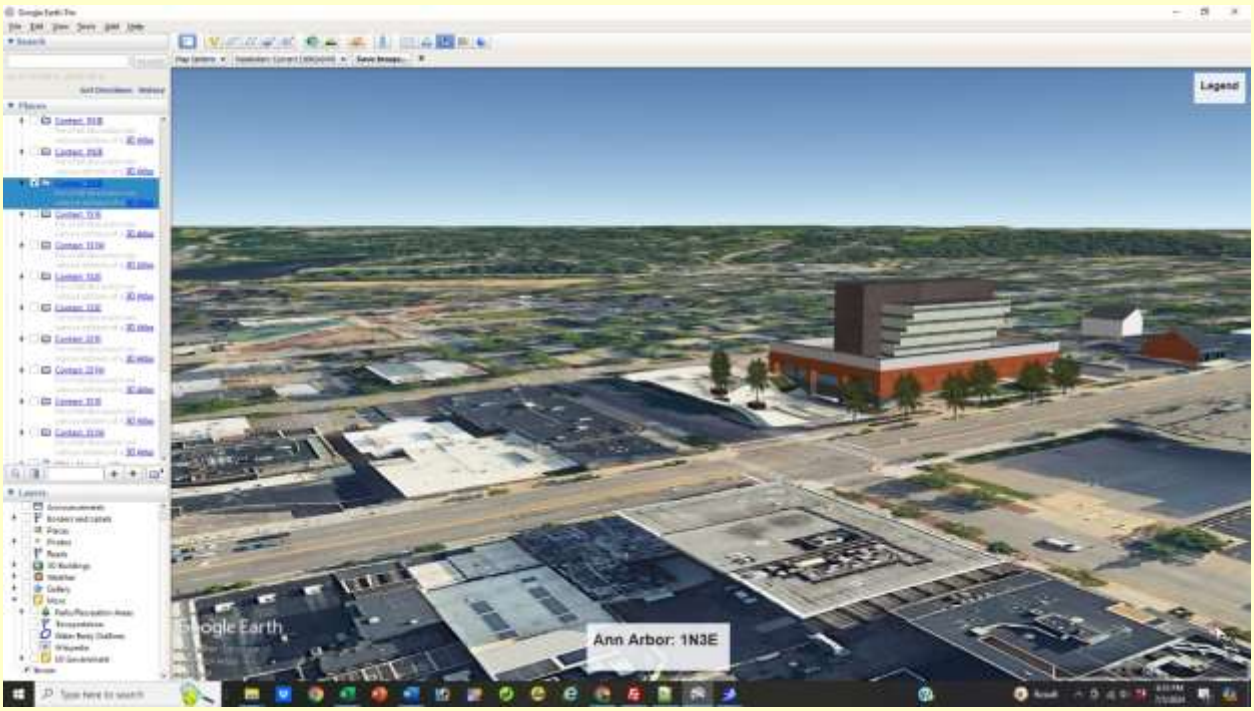
- **1S1E: South side of Huron Street between Main Street on the West and Fourth Avenue on the East.**
- **1S2E: South side of Huron Street between Fourth Avenue on the West and Fifth Avenue on the East.**
- **1S3E: Ann Arbor News Building, Southwest corner of Huron Street and Division Street.**
- **2S1E: All four sides of block bounded by Main Street on the West, Fourth Avenue on the East, Washington Street on the North, and Liberty Street on the South.**
- **3S1E: All four sides of block bounded by Main Street on the West, Fourth Avenue on the East, Liberty Street on the North, and William Street on the South.**

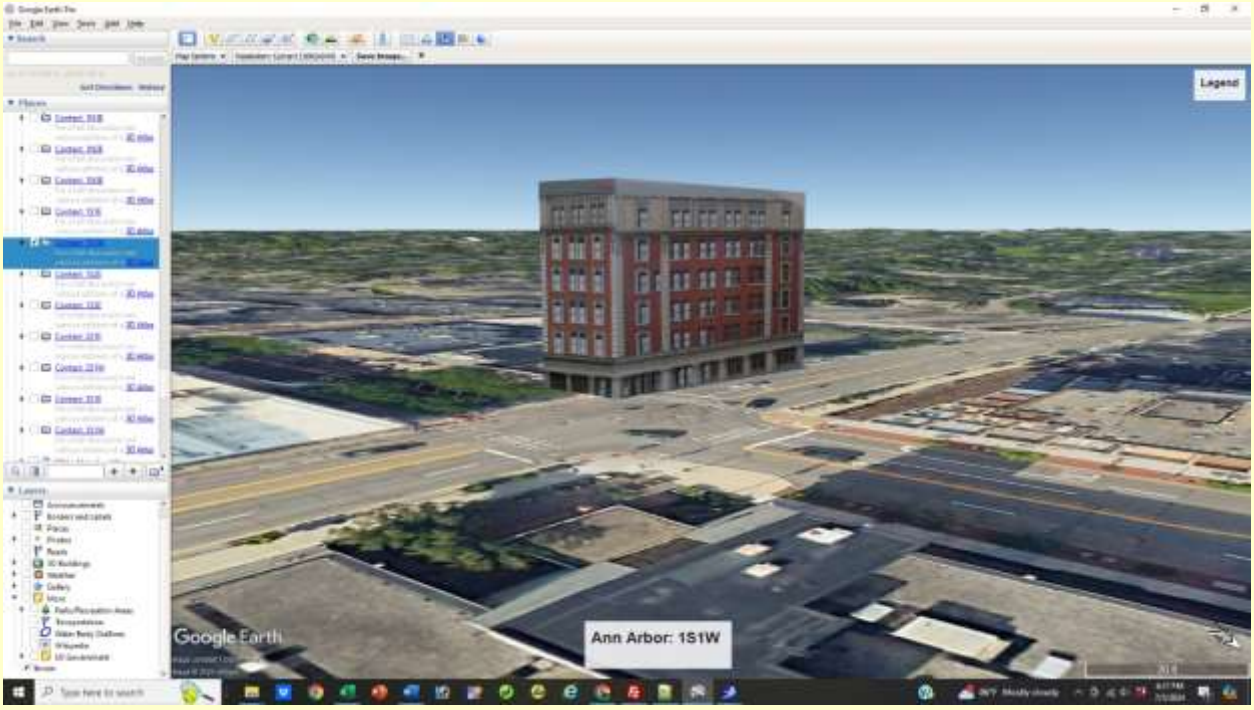
Screen captures of 2006 3D models in the context of 2024 Google Earth. Here layers are turned off and on, as suitable, in the Google Earth file, AnnArborTownGown, contained in the 2024 .zip file (where formatting should be preserved). That file is also available directly in Deep Blue (where the formatting may become eroded through the download process, necessitating its download and extraction from the .zip file). Notice that the changes in the terrain file, over the years, and other adjustments to the datum in Google Earth, have resulted in a lack of alignment of model with Earth, present in the models of 2006 with Google Earth of 2006.



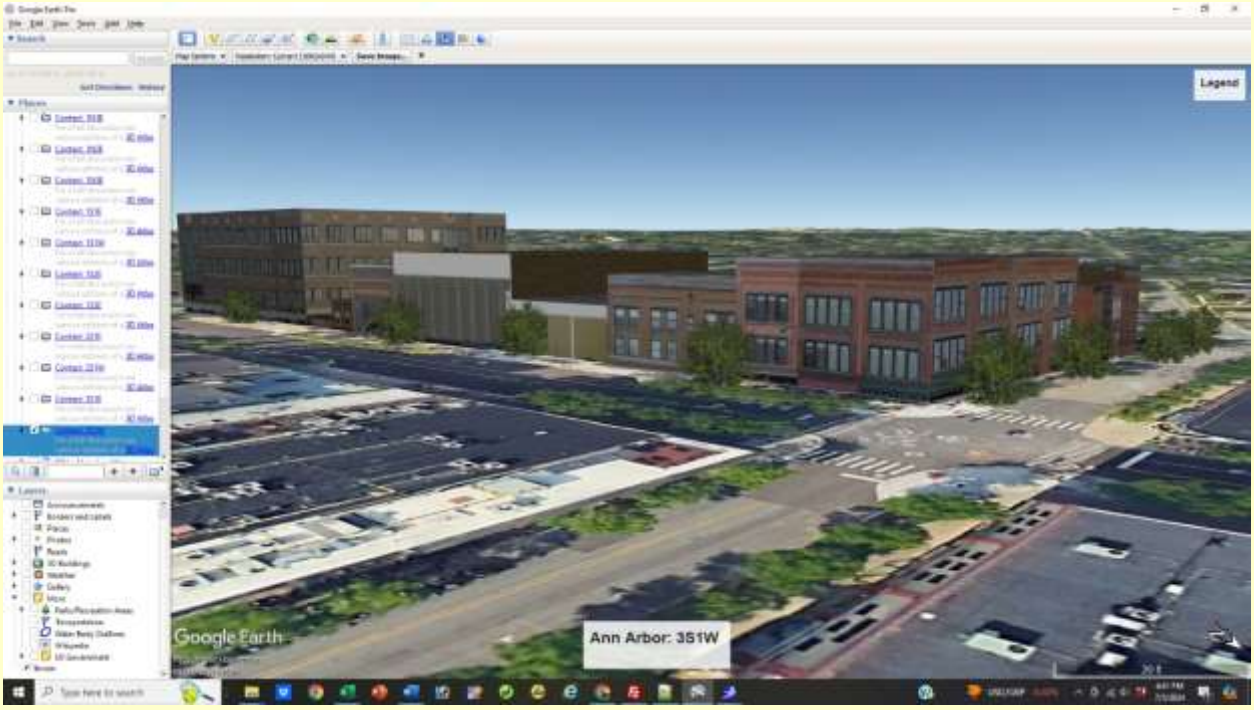

Legend
Ann Arbor: 1N1E
Google Earth

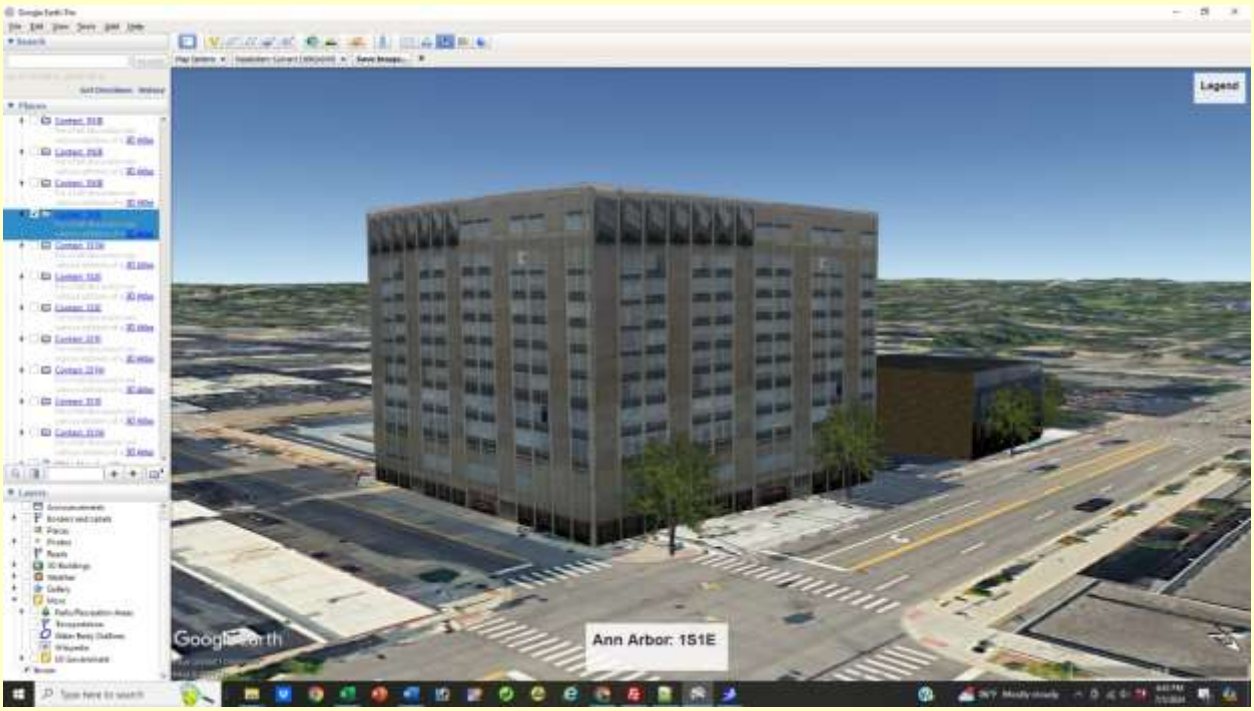

Legend
Ann Arbor: 1N2E
Google Earth

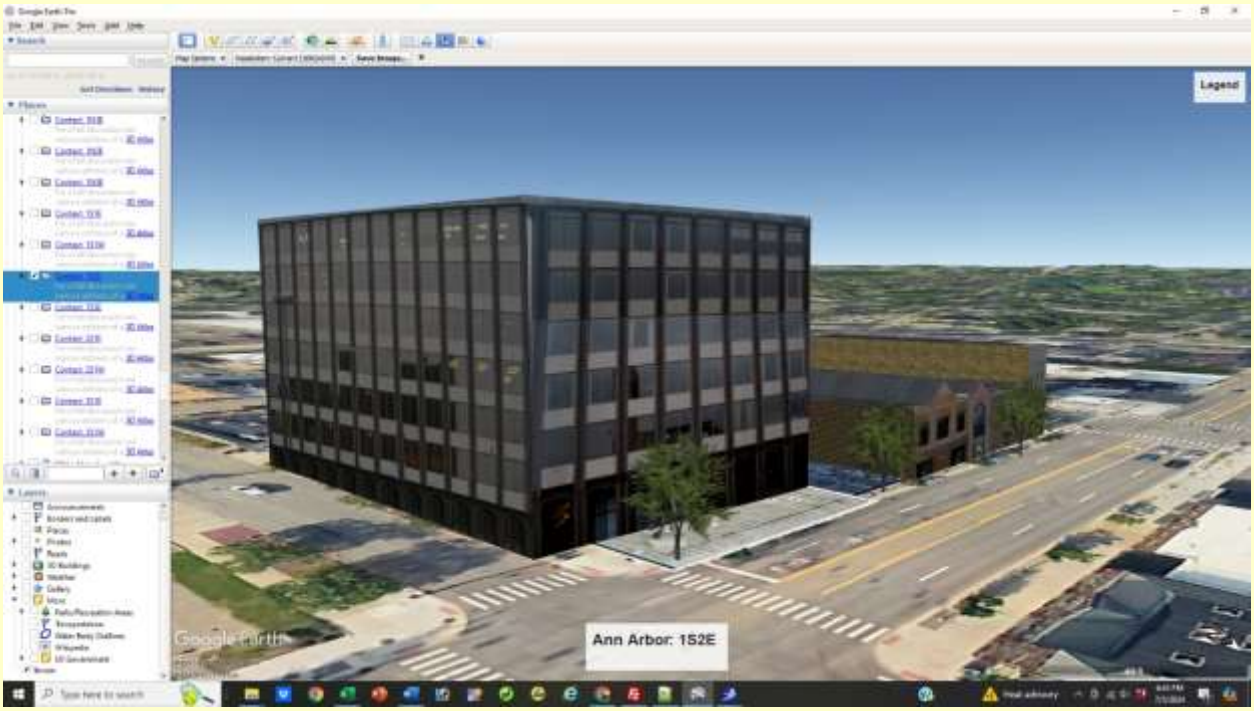

Legend
Google Earth
Ann Arbor: 1N3E


Legend
Google Earth
Ann Arbor: 1S1W


Legend
Google Earth
Ann Arbor: 2S1W


Legend
Google Earth
Ann Arbor: 3S1W





<img

<img

<img

- **DDA Plates, no textures on buildings.** **Blocks without textures are the structures to which photographic textures are applied. They are a critical first step. These blocks are referenced according to the map above. Most blocks are linked to the original material from the Google 3D Warehouse of 2006. For those where that is not available (although they were initially created in 2006), these are linked to the equivalent material (possible in all but four cases) in the Trimble 3D Warehouse of 2014.**

1N1W-X		1S1W-X	1S1E-X
1N2W	1N2E-X	Parking	1S2E-X
1N3W		1S3W	1S3E-X
1N4W	1N4E	1S4W	1S4E
	1N5E		
	1N6E		
2N1W	2N1E		
2N2W	2N2E	2S2W	2S2E
2N3W	2N3E	2S3W	2S3E
			2S4E
			2S5E
			2S6E
3N1W	3N1E		
3N2W	3N2E	3S2W	3S2E
3N3W	3N3E	3S3W	3S3E
			3S4E
			3S5E
			3S6E
		4S1W	4S1E
		4S2W	4S2E
			4S3E
			4S4E
			4S5E

		5S1W	5S1E
		5S2W	
		6S1W	

- **The University of Michigan Plates.** **These buildings are colored "cyan" and are labelled by groups as the street pattern is not a grid pattern**

  - **Stadium**

<img

  - **Athletic campus**

<img

  - **Law Quadrangle**

In 2006, the Law Quadrangle had already been modeled, elsewhere and had become part of the Google Earth default loadset of the time--as these buildings did, as well.

  - **"The Diag", Central Quadrangle**

An overview of many buildings on the central campus, including on the central quadrangle.

<img

  - **Rackham**
  - **L.S. and A.**

LSA serves as an anchor for a grouping of untextured buildings, including the Michigan Union.
<img

  - **Medical**

<img

- **Power Center**

<img

- **Music**

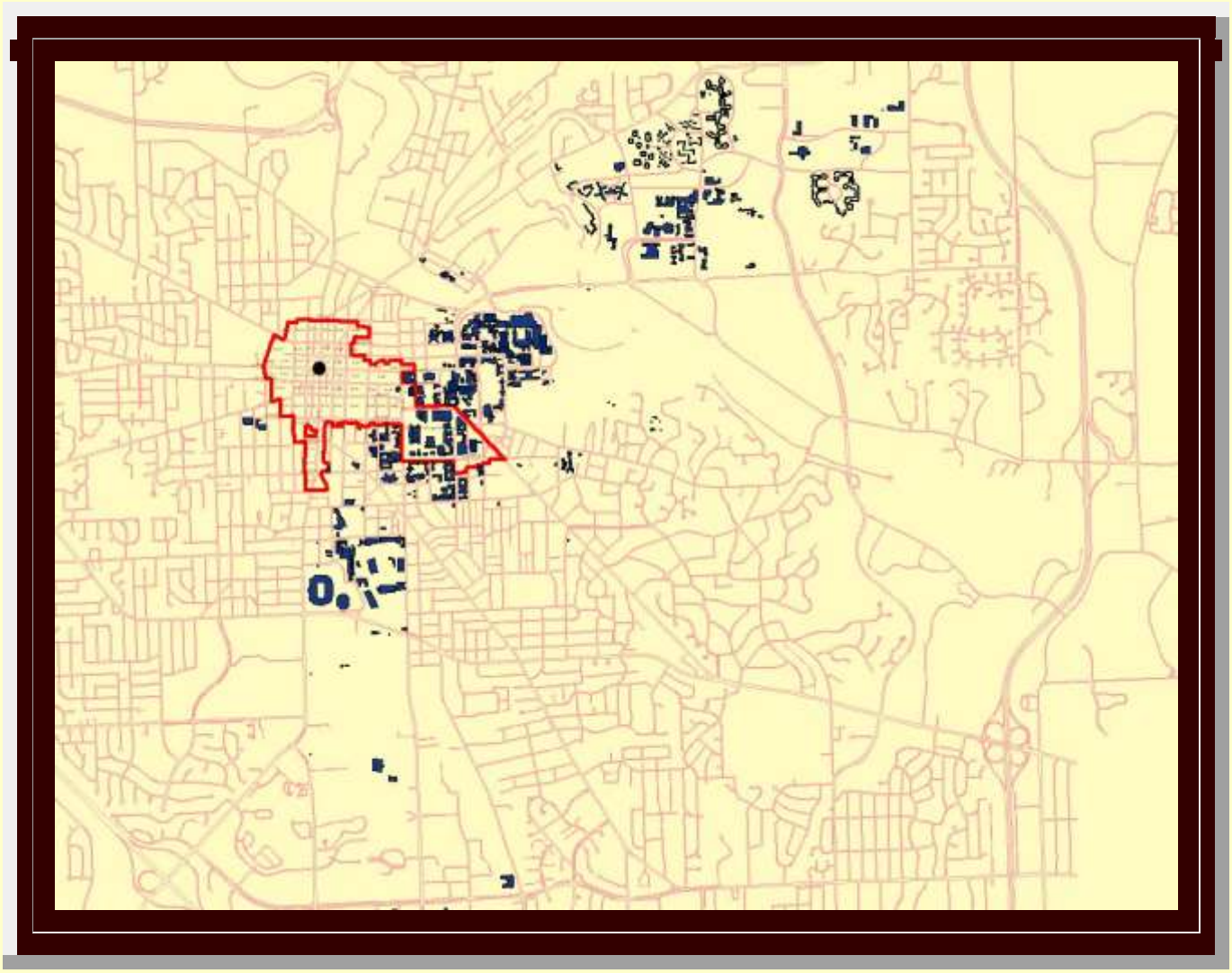
<img

- **Duderstadt Center**

<img

- **North campus dorms, north**
- **North campus dorms, east**
- **Outliers, north and east**
- **Outliers, north and east 2**
- **Outliers, south**
- **Outliers, west**
- **Parking**
- **Additions**

The map below shows the overall pattern of building placement in relation to the map of the DDA, above.



APPLICATION

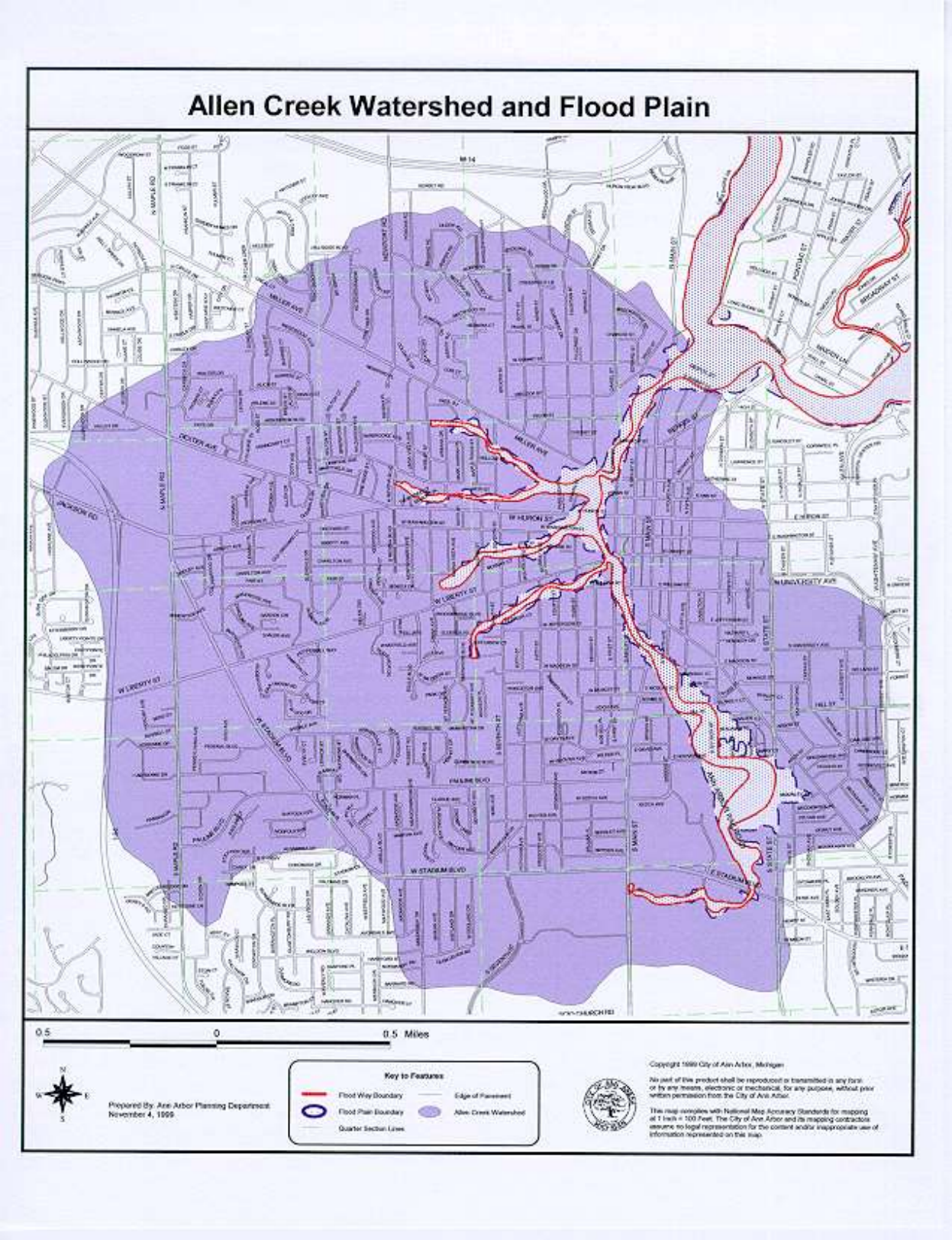
The following files were provided to Ann Arbor City Planning Commission in 2006 as they considered drafting a floodplain ordinance. The main point here is to illustrate the added capability that Google Earth® offers: to visualize, realistically, water in relation to terrain, and to the built environment, at a variety of geographical scales. That capability had not been readily available in previous approaches.

The files that appear below show the extent to which water fills contours (in Google Earth®, the cursor position will also give elevation readouts, along with latitude and longitude, at the bottom of the screen if that option is enabled). Thus, these images mimick ponding effects: the images show where water accumulates according to topography. These models serve to illustrate Archimedes Principle of Displacement--the bathtub is filled to various levels--a simple blue plane segment was inserted at various elevations, as a level plane. Land above that elevation remains as is; at or below that elevation, it is covered with the semi-transparent blue plane, representing flooding.

In a flood situation, there is some of the Archimedes effect but there are numerous other effects that true hydrological modeling takes into account. Generally, runoff goes from high to low elevation so that there is a "natural flow" from the places farther from the river toward the river. That natural flow is movement; there is no movement in these models (one might imagine such, but it is not there). The pattern of movement might be influenced by a number of factors beyond elevation and gravity: local and prevailing winds, local variation in rainfall, soil permeability and saturation levels, and so forth. Other factors beyond natural climatic and topographic factors may also enter the picture. Amount of impervious surface may add extra ongoing directional effects (or, more generally, flow being channeled down steep streets toward gullies). One-time disasters, such as the failure of a dam may introduce "estuary" action from the flood surge going from the river upstream into a creek bed.

One suggestion for permitting development in the floodplain is to cut away the bank elsewhere, or create a constructed pond elsewhere, to account for any volume of water supplanted by a building in a floodplain. In terms of accounting for sheer volume, this solution appears attractive. When placed upstream from a proposed building site, one might imagine such a constructed pond as useful in providing extra detention in the natural flow as water moves from high to low elevation. One might question, however, what role an upstream pond would play when a estuary surge or a directional flow problem enters the picture and that problem enters downstream from the new building. When the water backs up to the level of the new building where there is now less volume, still the water may flow outside the existing floodplain and flood residential (or other) areas before

reaching the level of the constructed pond designed to accommodate extra volume.



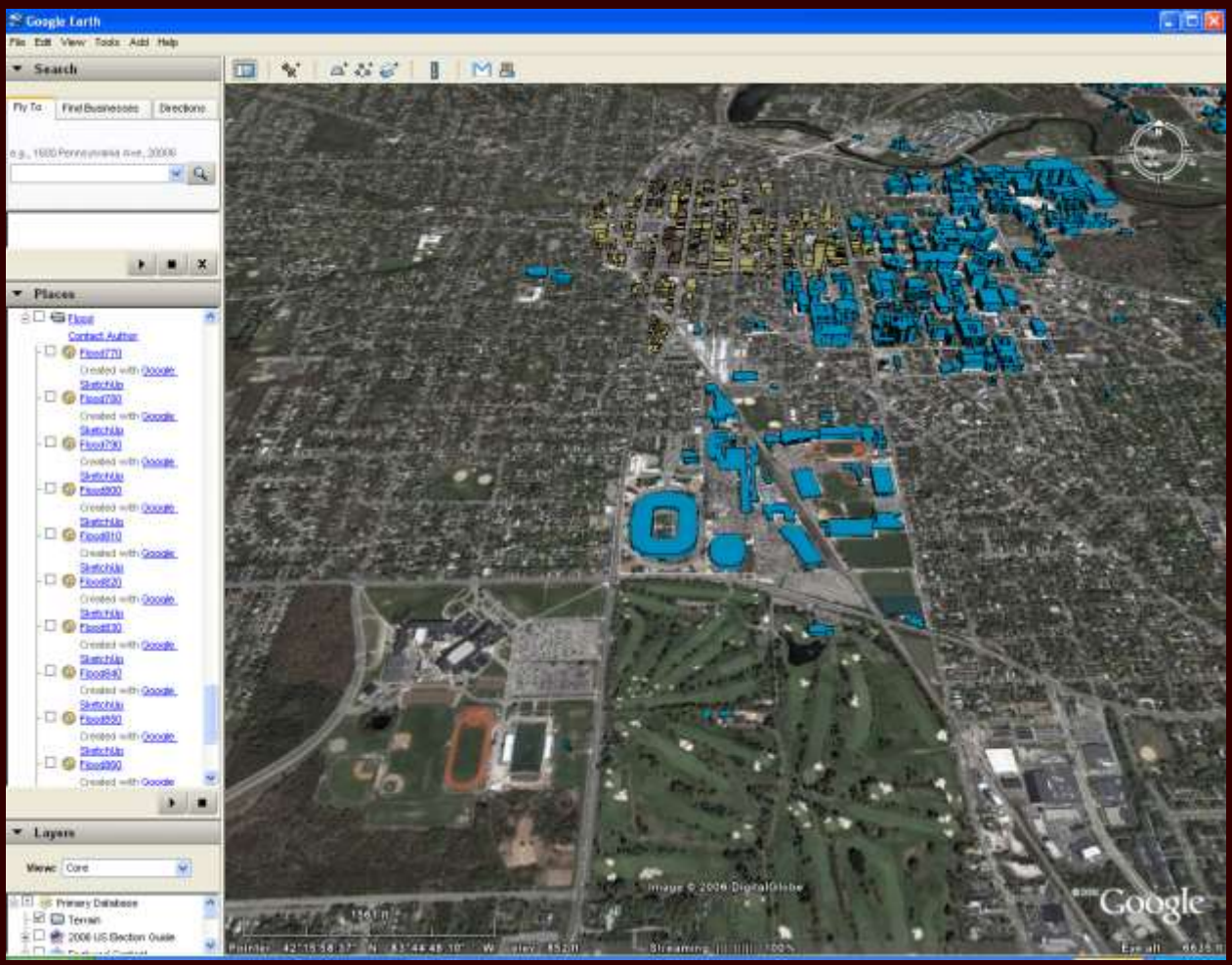
The material below introduces a 'flood' into the Allen Creek floodplain in Ann Arbor, Michigan. In it, water is imagined to enter the floodplain, shown above,

from the Huron River. A level plane is inserted into Google Earth, with the 'terrain' switch on, at various elevations (measured as contours). In addition, buildings created as 3D models are also inserted. They, as well as terrain variation, will cause displacement of water. The simple Archimedean models offer one view of displacement related to the hypothetical flood; remember, these are models and models are not reality. The passage of time and the support of related field work, guided in part by evidence of models, will offer municipal authorities a gauge on planning development. What is reality is Archimedes Principle of Displacement. The laws of physics precede political and developmental concerns. They have endured and they will prevail.

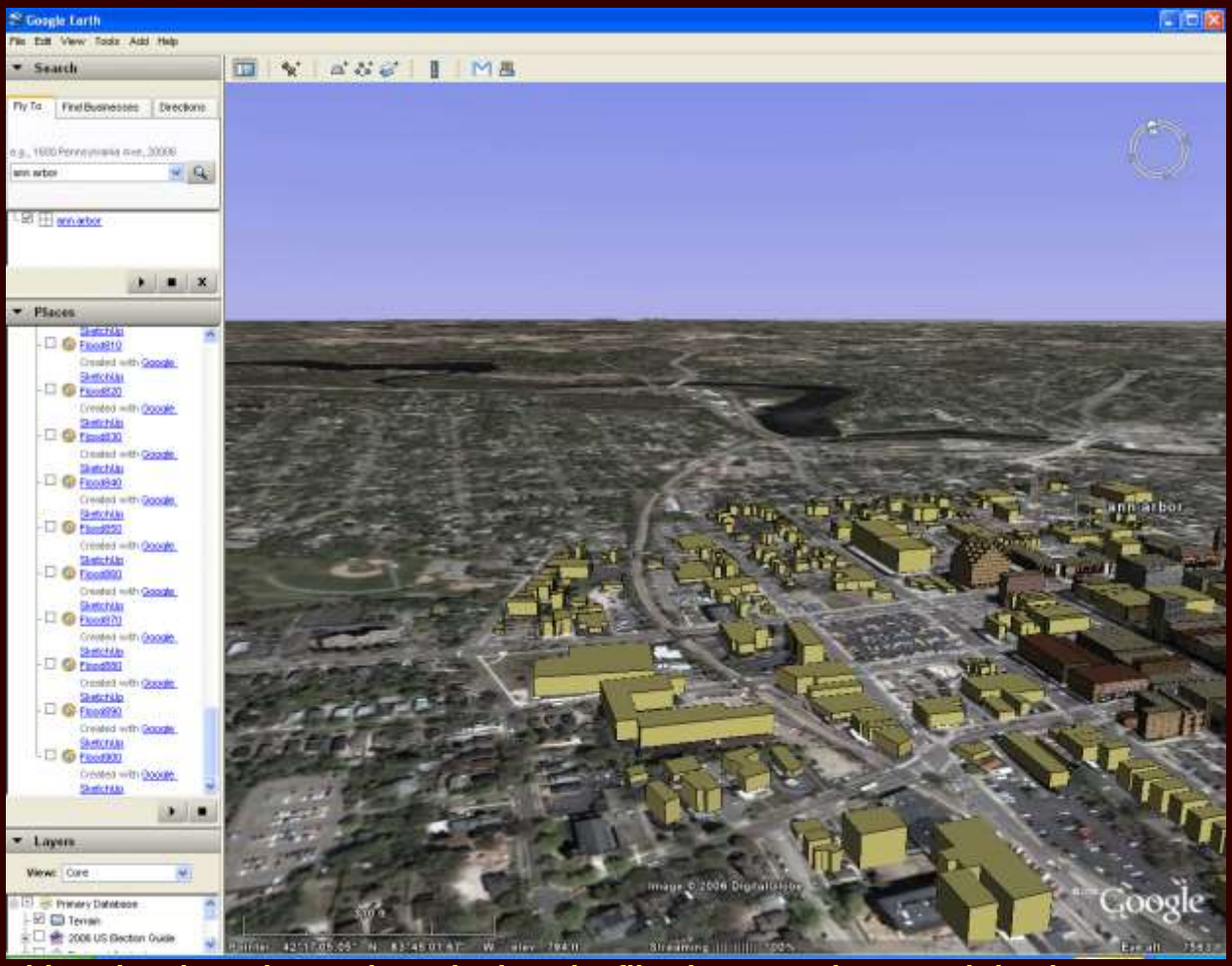
Files from the 3D Warehouse to view in Google Earth® in conjunction with building files present in the List of Plates in this eBook (selected according to reader interest):

- **Water to the 900 foot contour; 3D model**
- **Water to the 890 foot contour; 3D model**
- **Water to the 880 foot contour; 3D model**
- **Water to the 870 foot contour; 3D model**
- **Water to the 860 foot contour; 3D model**
- **Water to the 850 foot contour; 3D model**
- **Water to the 840 foot contour; 3D model**
- **Water to the 830 foot contour; 3D model**
- **Water to the 820 foot contour; 3D model**
- **Water to the 810 foot contour; 3D model**
- **Water to the 800 foot contour; 3D model**
- **Water to the 790 foot contour; 3D model**
- **Water to the 780 foot contour; 3D model**
- **Water to the 770 foot contour; 3D model**

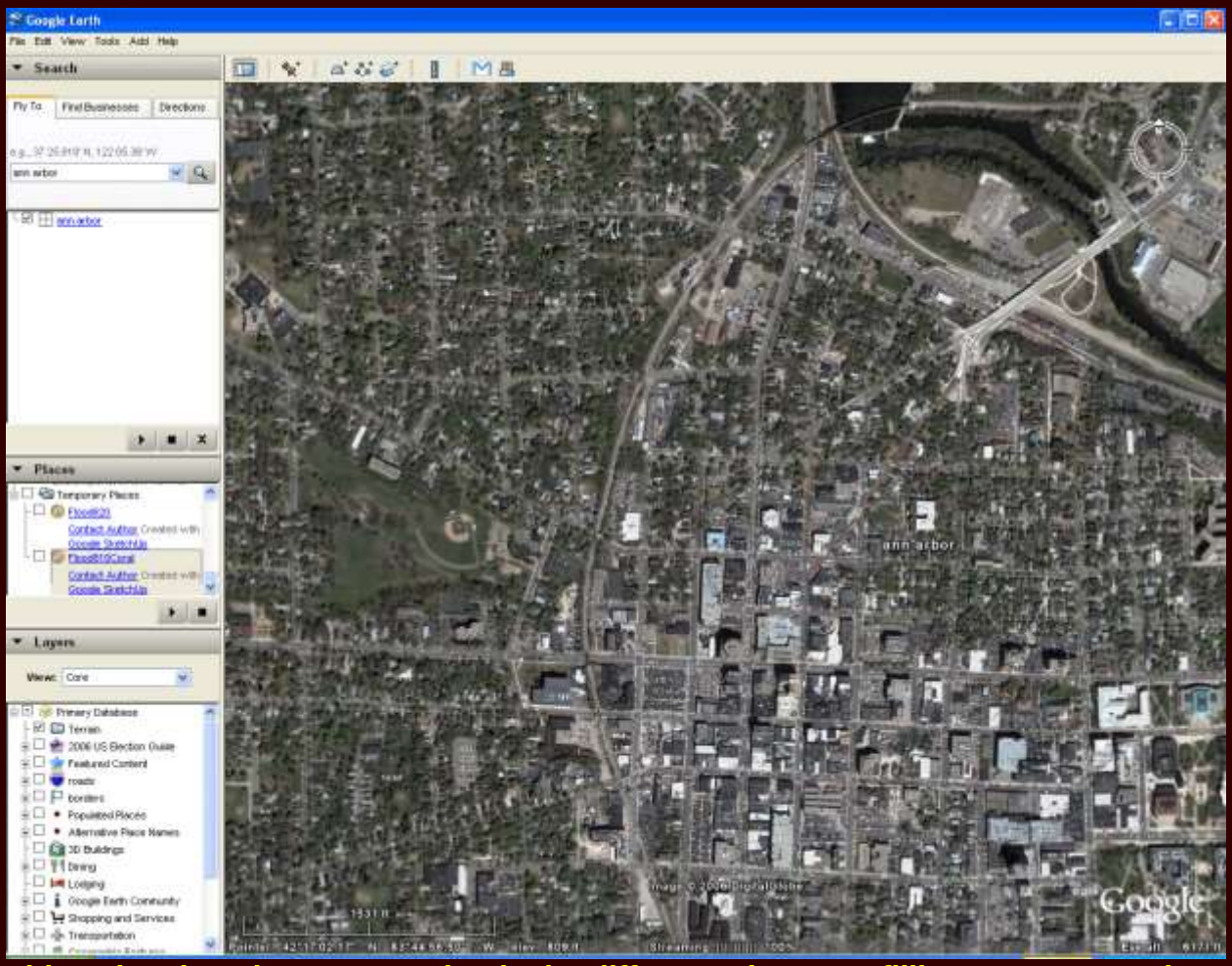
These files and others have been viewed by individuals from a variety of backgrounds. Nonetheless, what appears to be the case is that it is mainly individuals who already understand the issues who are most willing to study the files...in essence, preaching to the choir. To attempt to reach others (particularly those who do not have high-speed computer access or who are not comfortable using the internet), a variety of different visual effects involving simple animation and color overlays have been presented to municipal authorities. A few samples appear below. They are all based on files from 2006 displayed in contemporary software. As software changes over time, we hope that compatibility of files and loadsets also change in constructive ways.



This animation represents the general filling of contours surrounding the Allen Creek bed in increments of 10 feet. Link to a movie in which the reader can control the animation rate. The 3D models of buildings are those from the previous chapter--cyan for University buildings and maize for downtown buildings. Not all buildings, throughout Ann Arbor, are modeled.



This animation takes a closer look at the file above. It shows, subtly, the difference between filling the contours to 810 feet and to 820 feet. Notice that some of the buildings have textures and some are modeled. These make convenient reference points for tracking the flood; textures or their lack does not influence displacement. Link to a movie in which the reader can control animation rate.

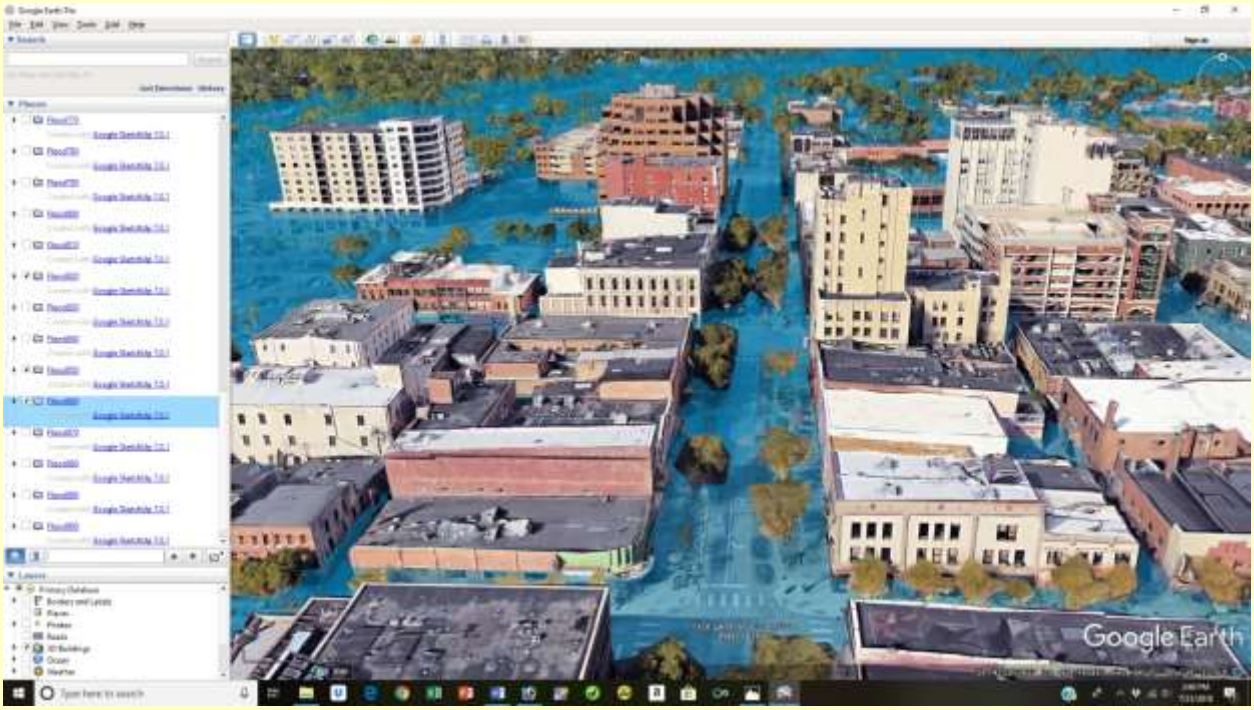


This animation shows more clearly the difference between filling contours to the 810 level and to the 820 level by employing contrasting colors for each level.

The question remains:
Will municipal authorities in Ann Arbor permit building in floodplains?

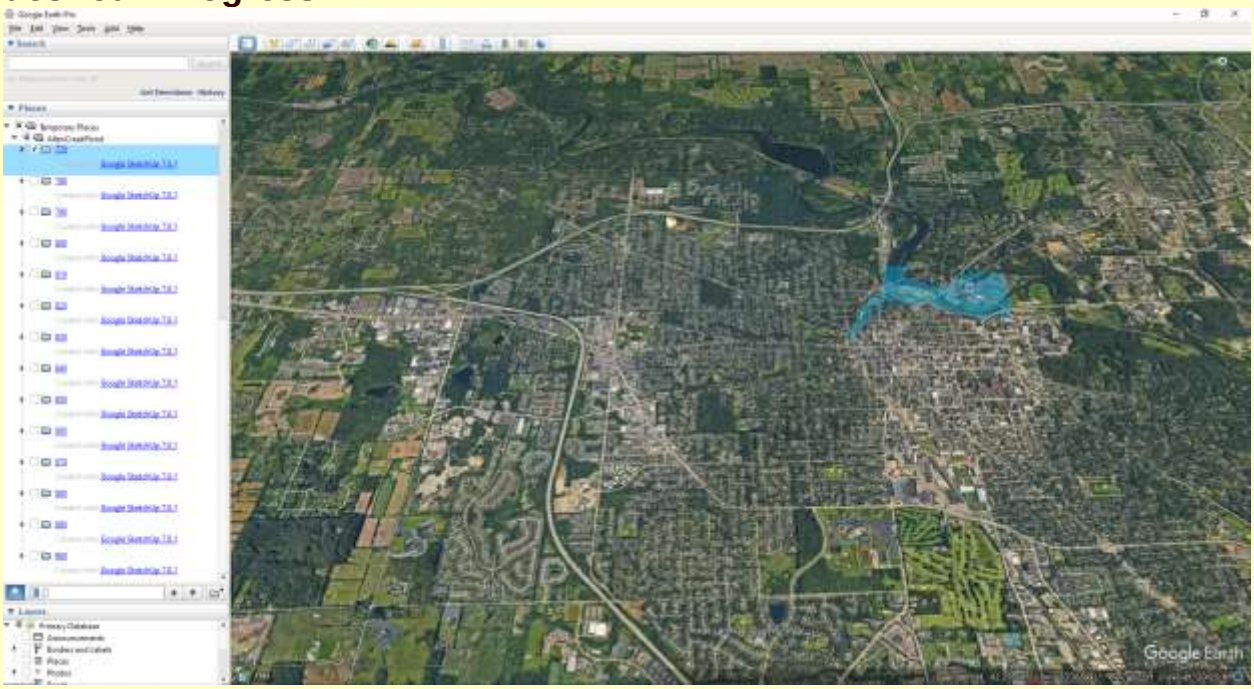
The image below shows a 2006 file loaded into Google Earth from 2018. All buildings are now modeled by Google and come as part of the default loadset. Is there accelerated runoff down Liberty Street toward the Allen Creek floodplain? One might ask a host of questions, suggested by varying viewpoints of the

models.



The animation below, shows the 2006 level plane inserted into a contemporary view in 2024. A significant change that seems to be continuing over time, is that Google models all the buildings and that these are updated along with the software. Hence, there is no need for an individual researcher to create models as I did in 2006. Simply use the existing Google Earth software, load the terrain and load the 3D models that come on board. Then insert the level plane where

desired. Progress!



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The references that were cited in the First Edition continue to be useful and are cited, again, here. In addition, the centered list below sets forth selected references of particular interest to readers of the Second Edition.

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