

Reinventing 1961 New York City Zoning

Chris Rado and Uttam Bera
New York City Department of City Planning

Abstract: The New York City zoning map in its current form was established in 1961. Over the years, this map has been altered by more than 2000 individual zoning map changes, evolving as the city itself has changed. On the 50th anniversary of the original zoning map, we have begun a project to recreate the original 1961 zoning in GIS. The ultimate goal of this work is to create a continuous zoning dataset that can be rolled back to any date between today and December 1961. When completed, this “living” dataset will be available to the department’s planners for research and analysis and eventually incorporated into our public-facing web application. This paper will describe our methodology, our experiences editing a versioned, archived geodatabase, and the current state of the project.

Introduction

While the Department of City Planning was a pioneer in the adoption of GIS technology in the City of New York, a real wealth of potential GIS data remains to be created. The city’s Zoning Resolution itself is a storehouse of spatial descriptions and snapshot maps that would keep any GIS data developer busy for years. This project is just one of a number of concurrent projects we are undertaking to move these paper-bound data sources into the dynamic mapping environment of GIS.

The historical zoning GIS dataset

New York City established the current implementation of zoning in 1961. This zoning has been represented spatially to the public in a set of 126 zoning maps that cover the five boroughs of New York City. These maps were maintained by hand drafting techniques and continue to be produced by raster-vector CAD files.

The current zoning GIS dataset

We established early on that we eventually wanted to move the entire zoning map production system into GIS, but first we needed to have the GIS data to work with. From 2004-2007, my team undertook to convert the zoning information represented in the hardcopy zoning maps into a GIS dataset. (See Figure 1)



Figure 1: A current zoning map covering part of mid-Manhattan

This zoning GIS dataset was finally completed in 2007, tested and evaluated internally. In June of 2009, it was made available to the public as a free download, updated monthly. We have been maintaining that dataset ever since.

Our zoning GIS dataset consists of three main feature classes: zoning districts; commercial overlay districts; and special purpose districts. These features represent the city's zoning as it is shown on the zoning maps.

Zoning Districts: Zoning districts, at the most basic level, differentiate between residential (R), commercial (C), and manufacturing districts (M), but each of those three main classes contains further variation within it (e.g. M1-2, C7, R3A, and so on) (see Figure 2). Currently, there are some 150 different zoning district designations in use in the city. New ones are created from time to time and old unused ones are retired.



Figure 2: R5, R6, R7A, R7-1, and M1-1 zoning districts

Commercial overlay districts: Commercial overlay districts are subareas within residential zoning districts that allow certain commercial uses to occur. Picture a street with commercial storefronts on the ground floor and residential space above. (See Figure 3)



Figure 3: Three different commercial overlay districts

Special Purpose districts: Special purpose districts occur in areas of the city where unique sets of zoning regulations are created to accommodate special localized conditions or characteristics. The Figure 4 below shows the Forest Hills special purpose district which includes regulations to “promote and protect the public health, safety, general welfare and amenity of Forest Hills” in the borough of Queens. Special purpose district regulations account for more than half of the City’s 1700-page Zoning Resolution, the legal document that defines the zoning of the city. Recreating the 1961 zoning map only involves two of these feature classes- the zoning districts and the commercial overlay districts as the first Special Purpose District (the *Special Lincoln Square District*, for those of you keeping score at home) was not established until 4/24/69.



Figure 4: Special Forest Hills District

Currently the zoning GIS features are managed and maintained in an enterprise ArcSDE geodatabase on SQL server. A versioned editing model has been implemented to maintain these SDE feature classes. We enabled Geodatabase Archiving early on and have created historical markers for the dates of every zoning change adopted since June 29, 2008. This has given us the ability to roll back the zoning to any point between the present and June of 2008.

The historical zoning maps and other Reference data sources

Historical zoning maps: (The 1961 maps were the reference data source that made this project even possible. These maps were part of a larger set of around 2000 paper zoning maps stored in binders. The complete set included a copy of every individual (updated) zoning map printed since the very first edition of the city's modern zoning map in 1961. Each of the 126 individual maps that cover the city has been updated somewhere from zero (there are still one or two which haven't changed) to 82 times (Map 8c covering part of midtown Manhattan). We had these maps scanned and georeferenced in 2004. The original 1961 zoning is shown on the first map in each one of these 126 sets of historical zoning maps. We continue to add maps to these sets today and they are all available for viewing and download (PDF format) on our website (see Figure 5) http://www.nyc.gov/html/dcp/html/zone/zh_historical_maps.shtml

In order for us to use the georeferenced maps as an overlay during the editing process, we had to undertake an additional step of removing the unwanted text such as the title, map number and index. A VBA script was developed to automatically trim only the map portion of the georeferenced map. This was especially useful during the edge-matching of the maps.



Figure 5: Map 6a from 1961, featuring parts of Manhattan and The Bronx. Can you find Yankee Stadium?

Alteration Maps: Alteration maps are the main reference source for the official city street map. They are created for streets that are officially added or removed from the city's mapped streets and also for parks that are create or removed. These were valuable in establishing historical city park locations and former city-block configurations. Both the streets and parks have changed since 1961 and they continue to do so. An example of an alteration map is shown below in Figure 6.

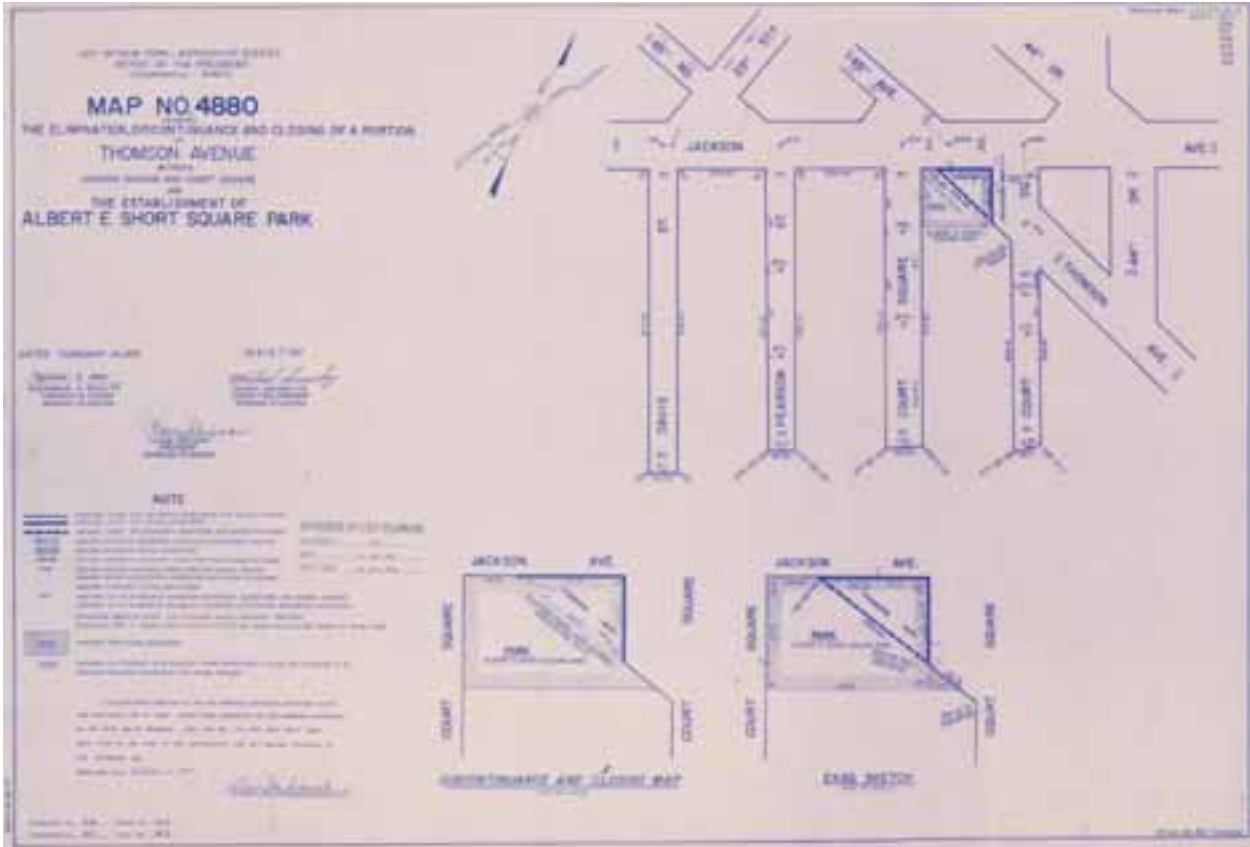


Figure 6: Alteration map showing changes to streets and park areas

much of this work involved simply merging smaller zoning districts into larger ones. For the commercial overlays we used “cut and delete” or “reshape feature” for the polygons that needed edits or “create feature” for new overlays we needed to add, all basic polygon edit operations that require no further explanation.

Versioning and permissions: This was a collaborative project with multiple editors from three different division of the department so we set up as a versioned enterprise feature dataset to hold the editable layers. Geodatabase Archiving was enabled from the start. We intended to set up a permissions structure that would allow all editors to reconcile, but only two to post changes. The idea was to avoid any catastrophic postings. This worked well for awhile, but then we started to notice duplicate features appearing in the data. I’ll explain more about this later on. Ultimately we changed back to a simpler permissions system where all editors could reconcile and post.

Source data preparation: To minimize the conflicts that can occur with multiple editors in a versioned dataset, we used an INTERSECT with our Zoning Map Index feature class to segment the data into 126 map-sheet “edit units”. (See Figure 8)) Each editor would work only on the polygons that fell within their assigned zoning map. We created a tracking chart to keep track of who was working on which map and how far along it was to completion and final checking. (See Figure 9))



Figure 8: Zoning districts segmented by zoning map

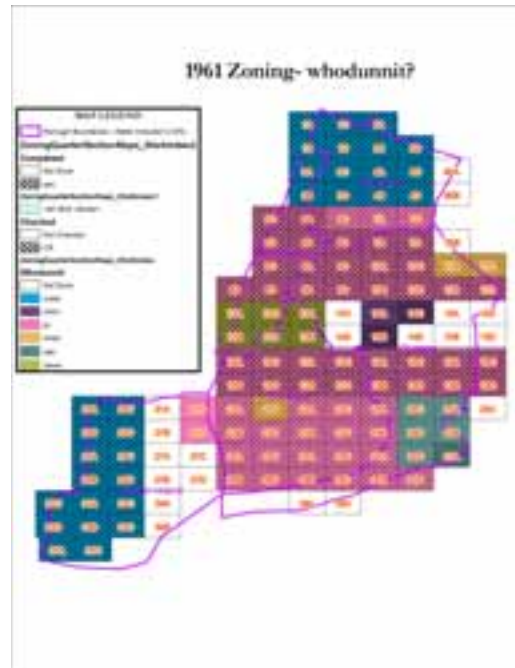


Figure 9: 1961 zoning editing tracking chart

Order of editing: The topological relationships between the feature classes meant that the order that we performed the edits was significant. Zoning district and commercial overlay district polygons are often coincident along one or more edges. However, the zoning district polygons are continuous across the city while the commercial overlay polygons are not. By editing the zoning district polygons first we could later use their edges as a snapping guide for editing the commercial overlay polygons, in places where the two feature classes shared edges.

The other factor we considered in determining the edit order were the areas representing city parks in the zoning districts. While the value “PARK” is one of the zoning district designations we employ, it is not really a zoning district. City parks have no zoning. While inspecting the data we noticed that there were many commercial overlay polygons present over park areas. Also, the parks on the 1961 maps were not always the same as the current park polygons. Parks were added, removed or changed since 1961. These changes to the park polygons affected zoning districts, commercial overlays and sometimes both.

In light of these considerations, we started by editing the zoning districts citywide, then edited the commercial overlay districts citywide and finally dealt with any adjustments to zoning or commercial overlays that were due to city parks changes.

-Issues and Solutions:

The work on this project went fairly smoothly. Working with a versioned dataset allowed us to work simultaneously on our own areas of the city. This set-up also allowed for flexibility in scheduling the work. Editors could do as much or as little work as their own schedules permitted. There were a few unanticipated problems we ran into, though.

Mysterious overlapping features: This problem consisted of duplicate features appearing in the data. Zoning district polygons that we edited in the individual “editor” versions were being found in the parent version overlapping with parts of their original features, which mysteriously remained. At first we believed this was related to some aspect of the way we set up our versions and reconciling/posting system. We suspect now that this may actually have been caused by a combination our edit methods, specifically the merging of features, and the fact that we were doing our quality control checking directly in the parent version. As explained above, our edit methods involved mainly cutting and merging existing polygons. In some cases, though, we created entirely new polygons (with new Object IDs) from existing features. These new features were overlapping with features in the parent version, but because they had completely new OIDs they reconciled with the parent version without causing conflicts and resulted in overlapping features. In the end we are still not really sure what happened. We switched to a simpler permissions setup where everyone could reconcile and post and only edited in the “editor” versions (and never in the parent version). This seemed to resolve the problem.

Sticky Move Curse: At some point while we were editing the zoning districts to accommodate the differences in PARK areas, we upgraded from Arc 9.3 to Arc 10. When this software change was implemented we didn’t realize immediately that, in new installs, the default Sticky Move tolerance, found under the Editor Options is **zero**. This editor setting affects the amount of conviction (measured in pixels) the editor needs to have to physically “move” a polygon using the mouse. Zero means that any slight tap will move the polygon; higher values mean you have to knock the polygon a bit harder to show you are serious about moving it. After a week of editing, we started noticing that the shared edges of polygons looked a little blurry. On closer inspection, these blurry areas were small gaps or overlaps created by small shifts in the polygon’s position that occurred while editing. With a zero sticky move tolerance it is very easy to move polygons slightly by mistake- while panning the view, for instance- and wreck the topology. Running a topology check came up with close to 1000 gap or overlap errors. We suspected the Sticky Move tolerance was the villain and so it was. Fixing the errors was relatively simple to do, though. By moving one sprawling polygon that covered a tenth of the city, we fixed several hundred of the errors. The “Curse” part is for all the cursing we did while fixing these errors.

Current state of the data

We completed the last edits to the dataset, the adjustments due to city park changes, in the beginning of June of this year. All that remains to be done is a final topology check to fix any unintended gaps or overlaps we may have (I mean definitely have) introduced in to the data.

Future plans

Begin adding changes post 1961 to 2007-08: And now we will move on to the rest of those old, paper zoning maps from the binders. This project dealt only with the first map in each set. The full archive contains 126 map “sets”; each consisting of from one to 83 changed maps. Each of the changed maps in each set has at least one and sometimes up to 5 zoning changes shown on it. These maps have also been scanned and georeferenced. For the next phase of this project we will take each of those maps and apply the zoning changes to our 1961 dataset. We will add them in exactly the same way we add them to our current “live” zoning dataset. We will edit the polygons of the changed feature classes and add an historical marker to bookmark the change dates. When we have completed these edits we will then have

an archived geodatabase containing all the zoning changes from 1961 to the point where our current zoning dataset begins. We will be able to go to any area of the city and any point in time back to 1961.

Merge this historical data with our current data: We will ultimately want to incorporate the two zoning datasets, the historical one and the current “live” one, to create one continuous source, a complete record of spatial and temporal zoning change for the city. We are open to ideas on how to accomplish this...

Work on pre-1961 zoning: And there is pre-1961 data as well... Bound sets of maps exist for the city’s zoning in its pre-1961 implementation going back to the 1920s. We’ll get to that eventually, too.

Conclusion

For the first time users both internal and external will have access to historical zoning districts in a spatial format. This would open the door for researchers, planners and other users to use GIS to do spatial and temporal analysis of New York City’s zoning.

This dataset will ultimately be available to the public through our Zoning and Land use (ZoLa) application.

Contact Information

This project has provided with important lessons learnt and follow up discussion would be required the intricacies of the project. Please feel free to contact us and we will be happy to discuss any aspect of the project. Our contact information is below.

Chris Rado
CAD – GIS Team Leader
212-720-3309
C_rado@planning.nyc.gov

Uttam Bera
Project Manager/GIS Specialist, PMP
212-720-3293
U_bera@planning.nyc.gov