Zoning and Land Use (ZoLa): One Stop Shop for Zoning Information

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Abstract

The Zoning and Land Use application (ZoLa) provides a new and simple way to find a wide range of information in interactive, highly-readable map layers pertaining to a particular property, or to the city at large. The user community includes staff at the Department of City Planning (DCP), the Department of Buildings, Housing Preservation and Development, the Department of Transportation and other NYC agencies as well as property owners, real estate and legal professionals, applicants for city permits and community groups.

This application has been an agency wide endeavor requiring new datasets and explanatory material to be developed. As a result new GIS workflows, standards, and processes had to be in place before the application was deployed.

This paper will present the methodology, the issues and lessons learned during the implementation of this project. This application has been well received by the targeted audience in the public and governmental agencies.

Overview

Zoning, the most prevalent land use planning tool in the United States, has substantial implication for equity and public health (Juliana, 2001). Zoning in New York City has played a vital role in preserving the city's diverse characteristics while encouraging development in underutilized neighborhoods.

According to our Director Amanda Burden, zoning shapes the city. Compared with architecture and planning, zoning has a relatively short history as a means of organizing the way land is used. Yet zoning determines the size and use of buildings, where they are located and, in large measure, the density of the city's diverse neighborhoods. Along with the city's power to budget, tax, and condemn property, zoning is a key tool for carrying out planning policy. New York City has been a pioneer in the field of zoning since it enacted the nation's first comprehensive zoning ordinance in 1916 (DCP Website: Zoning History).

City Planning's Agency GIS Role

City Planning was one of the early adopters of GIS technology in New York City. In 1981, it purchased state-of-art systems to map the city. Since then, GIS has evolved to include hardware, software, data and people. Today, GIS has become an integral part of the planning process.

DCP's GIS infrastructure is built on ESRI technology with over 200 desktop GIS users ranging from expert to intermediate and novice users. Our data is maintained on a centralized GIS data

repository. One of the main functions of the GIS team is to disseminate spatial datasets to the public through our BYTES of the BIG APPLE™ product line. The GIS team also builds and maintains internal ArcGIS Server applications for agency usage. The team also coordinates & supports development of feature classes and non-graphic data for zoning, land use and related features.

ZoLa – Why Now?

The Need

Zoning regulations are complex and dynamic. The latest edition of the New York City Zoning Resolution consists of 81 chapters, 8 appendices and 126 maps. Though there is lot of information with figures to explain zoning, it can sometimes be daunting and difficult for a layman to understand the whole process. Since 2002, over 116 DCP-initiated rezonings covering over 10,300 blocks, were adopted. That is almost a third of the city. While we have a lot of zoning and land use related information on our award winning website, we never had a GIS based comprehensive website that provided users easy access to all this information.

DCP has an internal ArcGIS server based application that provided most of the zoning related information to the employees. The main purpose of this application is to support the "Zoning Help Desk" that receives over 4000 inquiries from the public per year, often for routine zoning and related information.

However there was a need to develop a one-stop shop application for the public that would provide up-to-date zoning information, development opportunities, restrictions and regulations related to a property to the user community.

Maturity of DCP data sets

Staffs from Information Technology Division (ITD), Technical Review Division (TRD), Planning Coordination and other DCP divisions have built datasets with a commitment to quality assurance and continuing maintenance that would support an up-to-date public application. Many of these datasets were being presented to the public for the first time.

Zoning Handbook

In February 2011 DCP released a new edition of the Zoning Handbook, the ultimate guide to understanding zoning in New York City (DCP Press Release). The Zoning Handbook not only updated new zoning designations and special districts but also included a new chapter called the "Zoning Tools". This chapter focused on some of the features that are represented in ZoLa. Along with this there was also a commitment to maintain the online version of the handbook to support ZoLa.

DoITT's WebMap Framework

In 2008, Department of Information Technology and Telecommunications (DoITT) designed a new hybrid web mapping architecture called the WebMap framework that would overlay vector information on top of cached map tiles (City of New York: A Hybrid Architecture). This in-house

hybrid architecture was built using Geoserver and Oracle database, while the client/server framework was written in Java and JavaScript and utilizes the DoJo Toolkit.

Objective

The objective of the ZoLa project was twofold, first to develop and implement a new web-based GIS application that will provide the public with the geographic context of zoning and related information and second to suffice the need of the Zoning Help Desk that receives adhoc inquires about zoning related information all year round.

Critical Success Factors (CSFs)

Since the initiation of the project life cycle key CSFs were identified for the project to be successful. These CSF's were as follows:

- *The ZoLa project will result in the creation of new datasets and functionality.*
- *The ZoLa project will set up procedures for development and maintenance of datasets.*
- *Decrease the number of inquiries to the Zoning Help Desk.*
- *Document all tasks, deliverables, and lesson learned etc. that would be available after the project completion.*

Advisory Group

In April 2010, our executive director established an Advisory Group (AG) to assist the ZoLa team in setting policies for the presentation of zoning and related information via the new GIS application. The AG comprised subject matter experts from various part of the agency to provide the team guidance concerning the appropriate features to display, the creation of new explanatory web content related to zoning and land use, ownership, legal and workflows necessary for keeping the information current and accurate.

Project Management Approach

According to Project Management Body of Knowledge (PMBOK) guide, Project Management (PM) is the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements. Like any information technology project, GIS projects should adhere to certain standards. Using these standards the project manager can answer the "5Ws" i.e. Who, What, When, Where and Why's of a project. The methodology also give the project manager a road map to plan, develop scope, time, quality, identify requirements and ensure the most efficient and effective use of resources for completing the project.

The successful implementation of a GIS project requires careful planning and depends on a number of crucial decisions (Thomas et.al, 2001). This project incorporated the PMBOK methodologies and best practices to achieve its goal. The high level approach of the project life cycle followed a standard progression of phases which included the following:

Initiating & Planning Phases

The Initiating and Planning Phase defined the overall requirements of the project. During this process the GIS project team and the AG identified feature datasets to be added to ZoLa. This phase also included the process of creating and approving the project management brief document for the project.

- Project Management Phase (DCP)

Execution Phase

In the Execution Phase, the project requirements that were identified in the Initiation and Planning Phase were evaluated in depth and, where appropriate, developed for the ZoLa deployment. The execution phase included the following sub phases.

- Data Evaluation and Creation Phase (DCP)
- Application Development and Testing Phase (DoITT and DCP)
- Implementation and Training Phase (DoITT and DCP)

Closing Phases

This is the final acceptance phase where maintenance and support processes were put in place to ensure ongoing success. It also included project assessment through which lessons learned and best practices were derived, documented and archived for future projects.

Maintenance Phase

During this phase both DCP and DoITT maintained and supported the application. The maintenance process included:

- Maintenance of datasets displayed on the application
- Maintenance of any technical issues related to the application

Data Evaluation and Creation Phase (DCP)

The Data Evaluation and Creation Phase was one of the critical phases of the whole project, as an in-depth analysis of the datasets was required to identify quality issues and schema changes that have to be implemented before they could be incorporated into a public-facing application.

The success of the ZoLa project was dependent upon the modification of data sets and the commitment of DCP's divisions to maintain these data sets and related website content.

Data Evaluation

From the start of the project it was decided that the first version of ZoLa would focus more on the data and the establishment of an effective workflow. During the data evaluation process the ZoLa team identified all the different dataset that would be included in ZoLa. The team also identified all the datasets

that currently exist in either a draft or operational version. Many of these datasets are maintained by DCP staff in various divisions. Other datasets originated from other city agencies.

This project provided us an excellent opportunity to:

- *Evaluate existing data sets, issues and data owners*
- *Evaluate existing workflow processes for data maintenance*
- *Establish a centralized repository for collecting and storing of information.*

The initial step of the ZoLa team was to meet with the different stakeholders to discuss the issues related to each dataset. While this process was laborious and time consuming, it brought forth some key questions that needed to be answered.

- *What existing data resided within each division at DCP that would be useful to the public?*
- *What potential data could be needed in the future?*
- *What resources are needed to maintain the data?*
- *Are there any legal constrains or issues related to the data?*

It was important to understand the workflow process within each division and how they related to other divisions. Detailed discussions led us to discover how various divisions were working in silos. Due to the lack of a centralized workflow process each division was using various means to retrieve and update information.

In order for the team to establish a standard workflow process, it was crucial to understand how the data originated and also determine a way to identify all the stakeholders involved in the process. Once all the stakeholders were identified and brought to the table it was easy to come up with a new workflow for processing the information. The most difficult part of establishing the new workflow was to change the mind set of users to use the new system.

In addition other issues related to workflow, policy and legal had to be addressed during this discovery process. One such issue was when a new zoning district was proposed by the planners during a rezoning process. There was no established workflow between the divisions to keep each other informed. This information needed to flow to the TRD division which maintains the zoning GIS data; the Zoning division that creates descriptive content for the web, the GIS team that updates the lookup table and finally the Web team that updates the information on our website (see Figure 1). For example, one of the critical issue that was identified during the process was the need for descriptive content on DCP's website for seamless navigation from the application to the content via hyperlinks.

Through constructive dialogue between all stakeholders the ZoLa team was able to establish workflows for each of the datasets that was being displayed in the application. A new ZoLa data form was created for the planners to fill out from the beginning of the process to inform all relevant stakeholders about any upcoming changes.

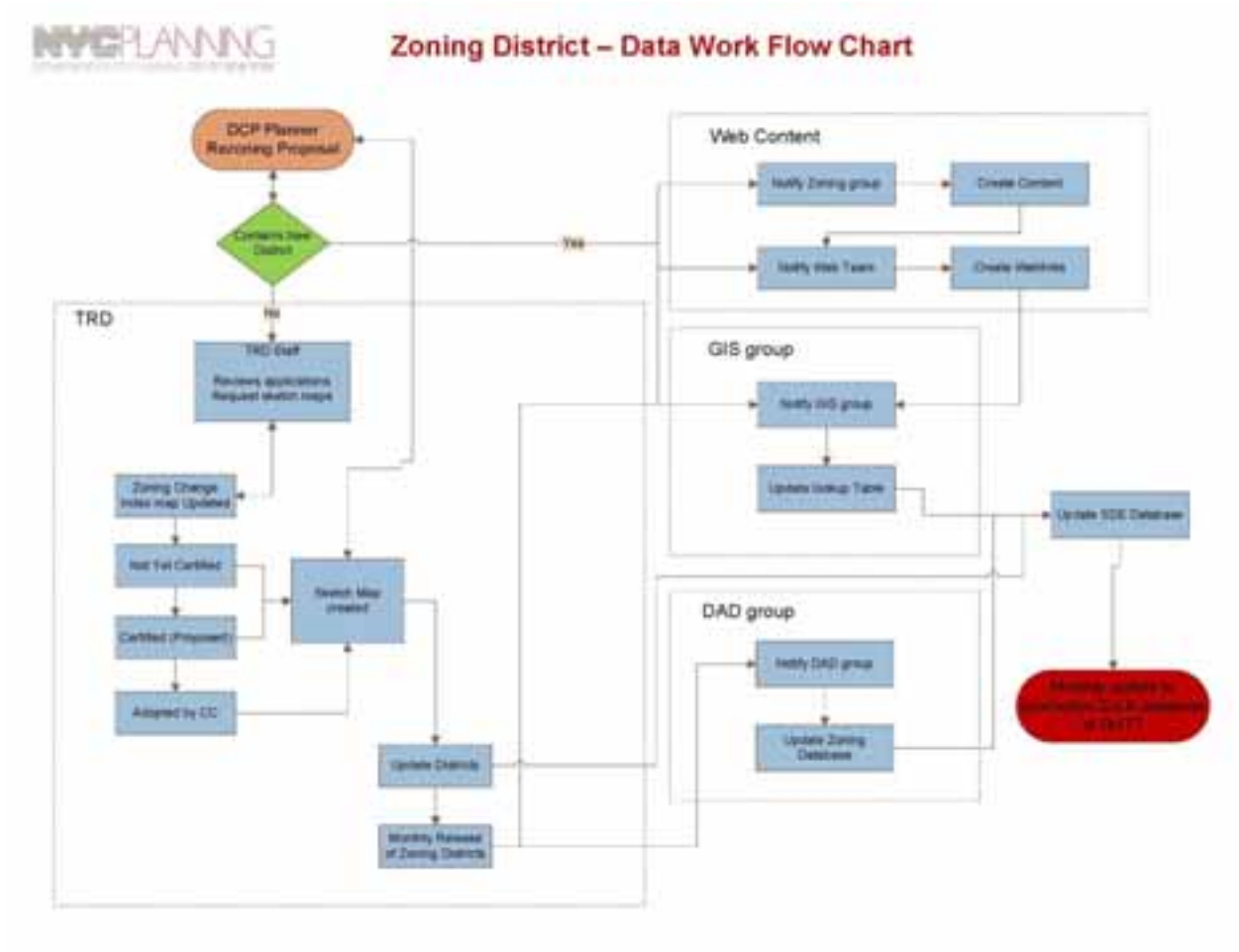

Figure 1: Zoning district data work flow process

GIS Database Design and Development

Designing a geodatabase is a critical process that requires the necessary planning and revision to reach a design that meets an organization's requirements (ArcGIS 9 Documentation). DCP already had an existing ArcSDE geodatabase on an SQL server that primarily served data to the internal user using the ArcGIS Server web application. There were few users that used the database for editing the data.

Versioned Editing Model

A versioned editing model was established for the GIS group and other power users to leverage the power of ArcSDE. Using this model a uniform workflow was setup for all users to manage and edit their datasets. As part of the process, user permissions were set up for users to be able to view or edit the data.

The workflow was that each feature dataset had an edit version which was a child of the default SDE version. This allowed the editors to create their own child versions from the master edit version to edit the feature class (see figure 2).

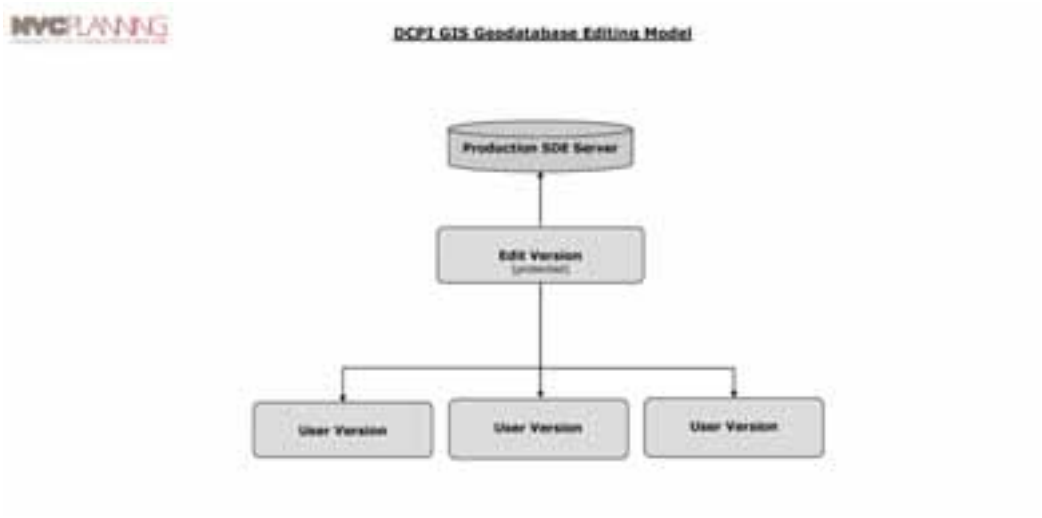

Figure 2: DCP GIS geodatabase editing model

ZoLa Dataset Work flow

There were large numbers of datasets that had specific requirements on how they were represented on ZoLa application. For example, all the attributes for each feature classes within the ArcSDE database did not needed to be replicated to the production server. For certain feature classes new field had to be populated with the hyperlinks through a lookup table which were then referenced in the web application. To accommodate all the different scenarios number of python workflow scripts were written to automate the processes.

Another work flow issue that we encountered was with labeling of two feature classes zoning district and commercial overlay in the web application. In order to increase the performance of the application these features were cached as image tiles. We had to come up with a strategy with DoITT to identify only the features where changes occurred. This was achieved this by using the Global ID's that ArcSDE uses track all edits in the database. Anytime there was a change to the feature class or an attribute value, ArcSDE created a new Global ID. The IDs were maintained and replicated to the DoITT server, where a python script compared the Global IDs of both new and old version to identify the areas that have changed. Then this information would be sent to another python script that initiated image caching for the changed areas within the layers and not the entire dataset (see figure 3).

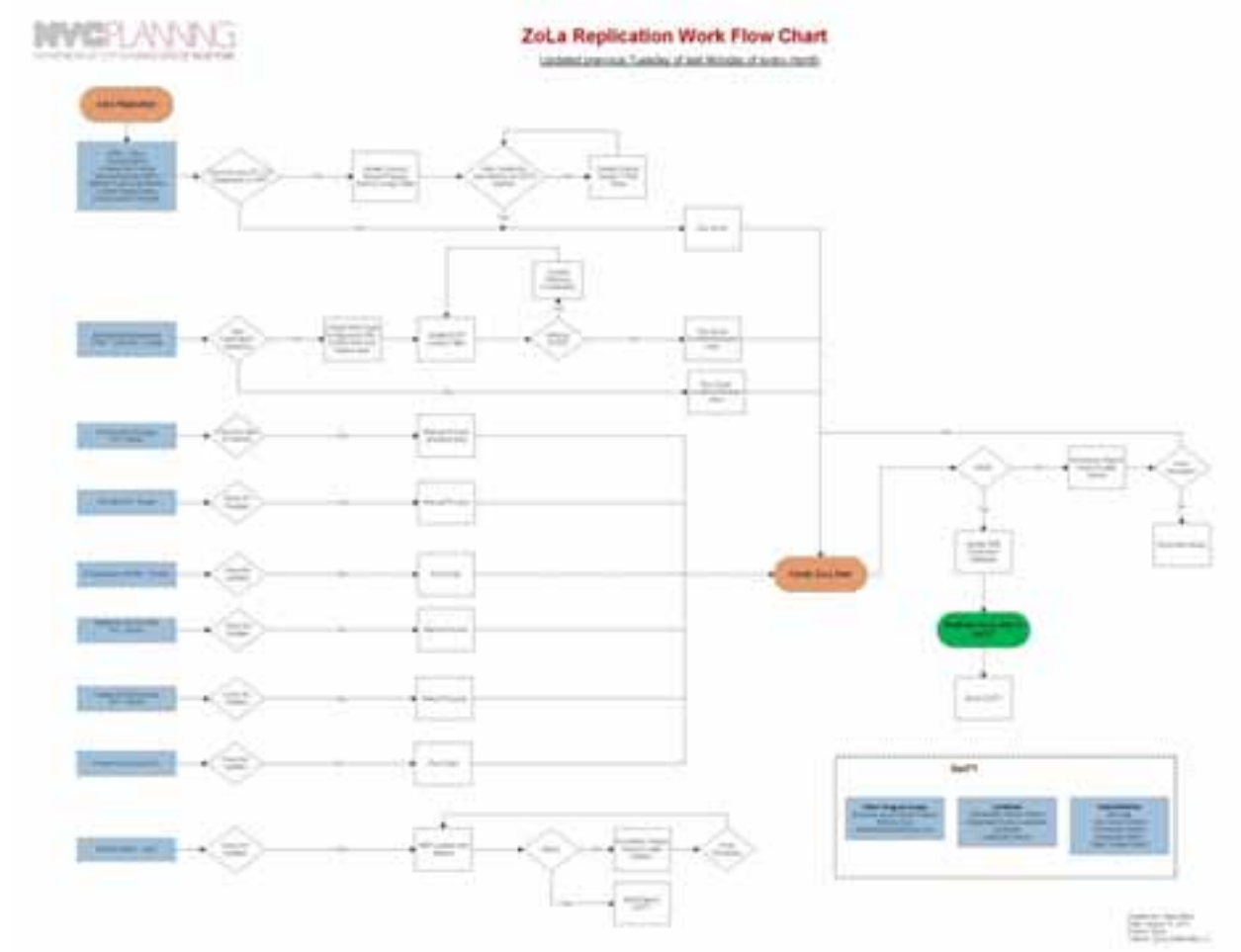

Figure 3: ZoLa replication work flow chart

Data Quality Control and Quality Assurance

At DCP we are very particular about the quality of data that is being disseminated internally or to the public. In order to keep up to that standard for all the ZoLa feature datasets new quality control operating procedures were put in place to ensure a vigorous quality check of the datasets. There were up to three GIS analysts that would review the datasets before they were replicated to the production server.

ZoLa - DCP to DoITT GIS Data Replication Architecture

The final step of the data creation and quality assurance and quality control process was replication of the data from DCP ArcSDE server to DoITT's GIS Server. A python script was used to automate the replication process (see Figure 4). Once the data was loaded on to DoITTs maintenance server additional processes such as creation of the image cache etc needed to be run before the data could be transferred to the production server.

In order to protect against schema changes, both DCP and DoITT scripts would use TRUNCATE and RELOAD rather than DELETE and RECREATE SQL commands to load data on to the server. To ensure this DoITT created a special user for DCP that only had INSERT, DELETE, and UPDATE access to the GIS maintenance database.

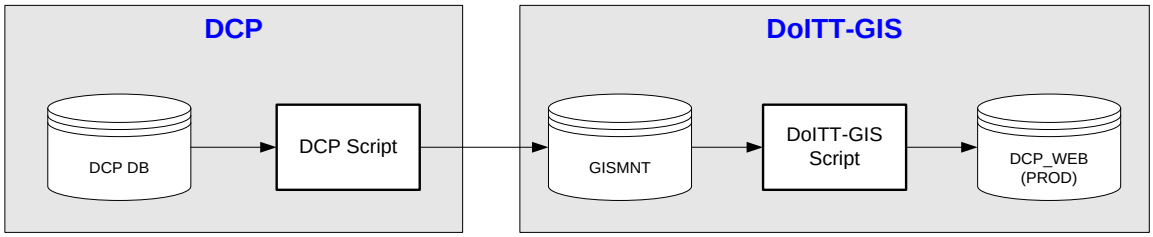

Figure 4: DCP-DoITT replication architecture

As this process was being run on a monthly basis a more dynamic solution was needed for the update cycle. DoITT proposed using a database trigger to trigger a python script that automatically run several different processes. In order to communicate updates between the DCP and DoITT-GIS scripts, a *last_update* table in the DoITT GIS maintenance schema was created which contained the following columns:

- *table_name* (containing a row for each table in the schema)
- *agency_update* (date of last DCP update)
- *doitt_update* (date of last DoITT update)

DCP was responsible for populating the *agency_update* column for all tables (i.e., row in the last update table) that were updated. This indicated to the DoITT-GIS script the tables that need to be migrated to production server. The DoITT-GIS script then checked the *agency_update* date and compare to the *doitt_update* date. If there is no *doitt_update* date or the *agency_update* date is newer, then DoITT will migrate the data into production and update the *doitt_update* date on completion.

Application Design and Development Phase

The ZoLa web application design was based on the NYCityMap template. In order to keep the same look and feel for all GIS application in New York City, it was decided that the ZoLa application would not undergo any major design changes except for certain aspects for the type of searches that needed to be available and how attribute data were displayed on the console.

The WebMap framework already provided a map-based interface that allowed users to easily and quickly find locations by address, intersection, Borough Block Lot (BBL) and points of interest (see Figure 5). Users are able to display zoning and planning related information for those locations.

Figure 5: ZoLa user interface

Through ZoLa's "Show Zoning & Related Data on Map" tool, one can click on a number of layers to reveal more data and features on the ZoLa map, giving New Yorkers a visual snapshot of how zoning affects their neighborhoods.

If you are interested in learning about how your neighborhood is zoned, the **Zoning** layer will show all of the zoning districts in a selected area, as well as the option to view special districts (see Figure 6).

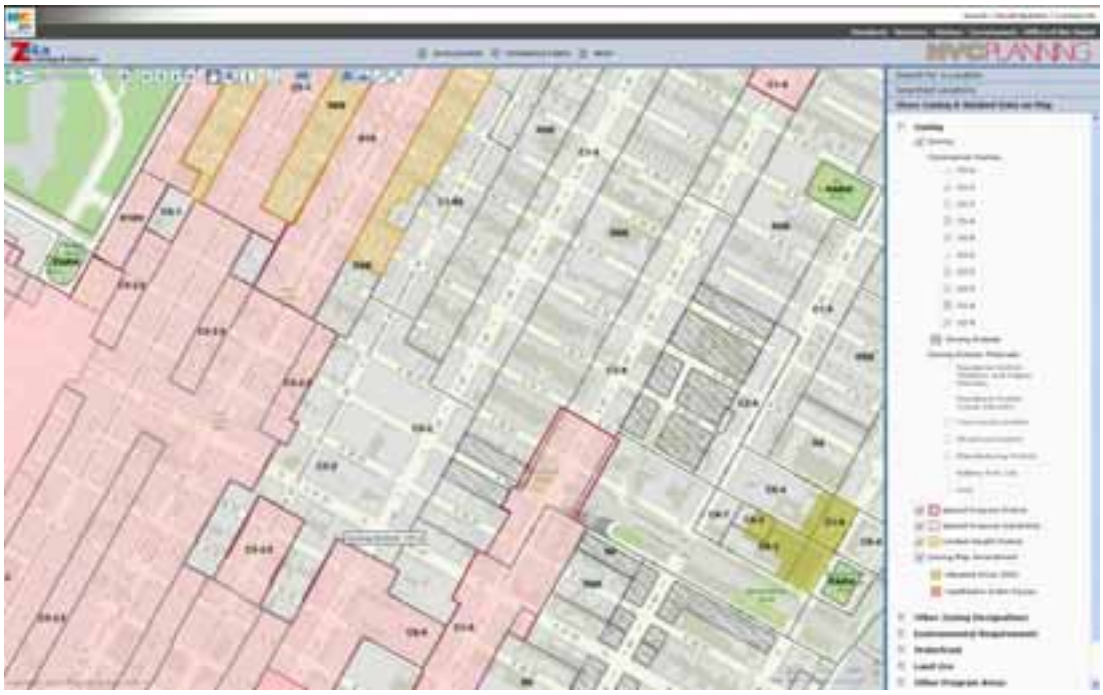

Figure 6: Zoning layers

For residents wondering if there are any new or recent applications that might affect an area of interest, ZoLa will reveal proposed Zoning Map Amendments that are in public review, as well as those that have been adopted since January 2002 (see Figure 7).

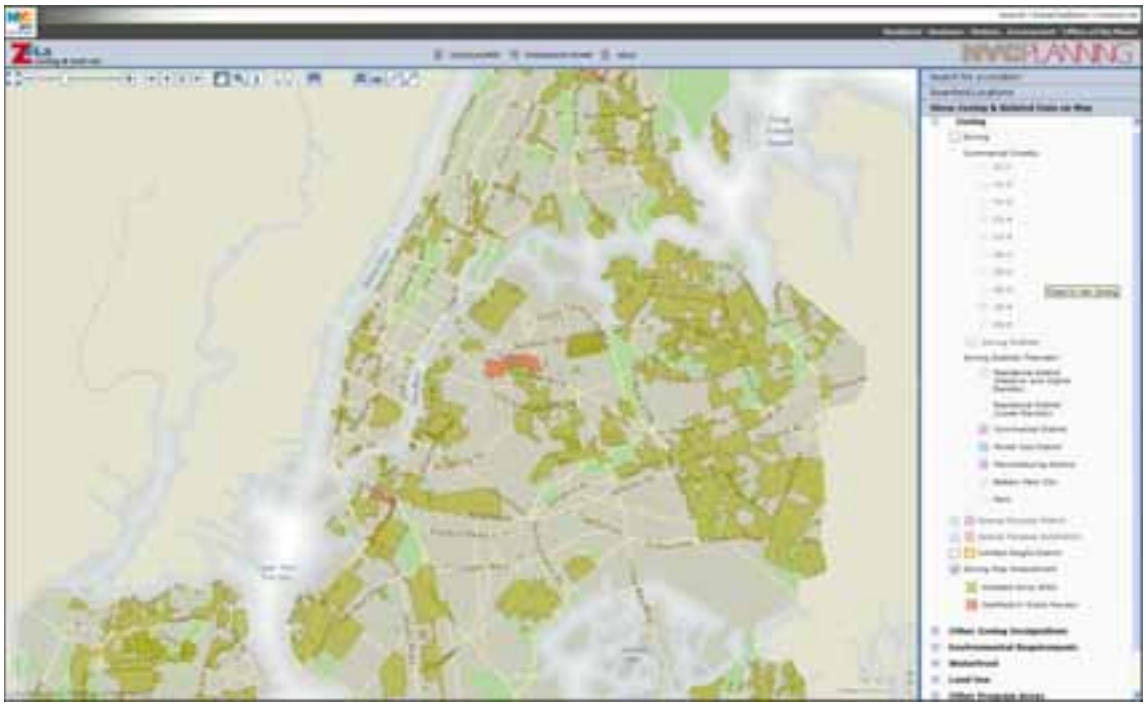

Figure 7: Zoning map amendments layer

Clicking on Land Use will display a color-coded view of a selected area identifying the primary land uses, such as one- and two-family residences, commercial uses or open space (see Figure 8).

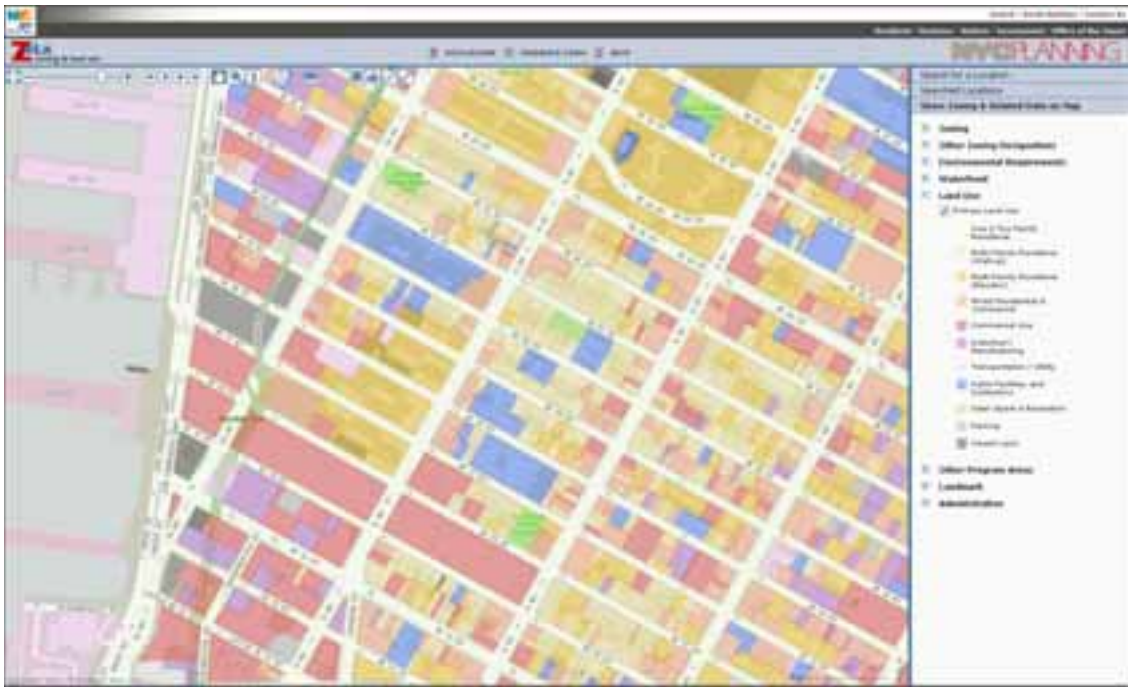

Figure 8: Land use layer

Other Zoning Designations highlights three popular zoning incentives. The Inclusionary Housing program promotes the creation and preservation of permanently affordable housing, the Lower Density Growth Management Areas (LDGMA), is a special zoning control to match future development to the capacity of supporting services and infrastructure, the Food Retail Expansion to Support Health (FRESH) program offers zoning incentives and financial benefits create grocery stores that provide fresh food in underserved communities (see Figure 9).

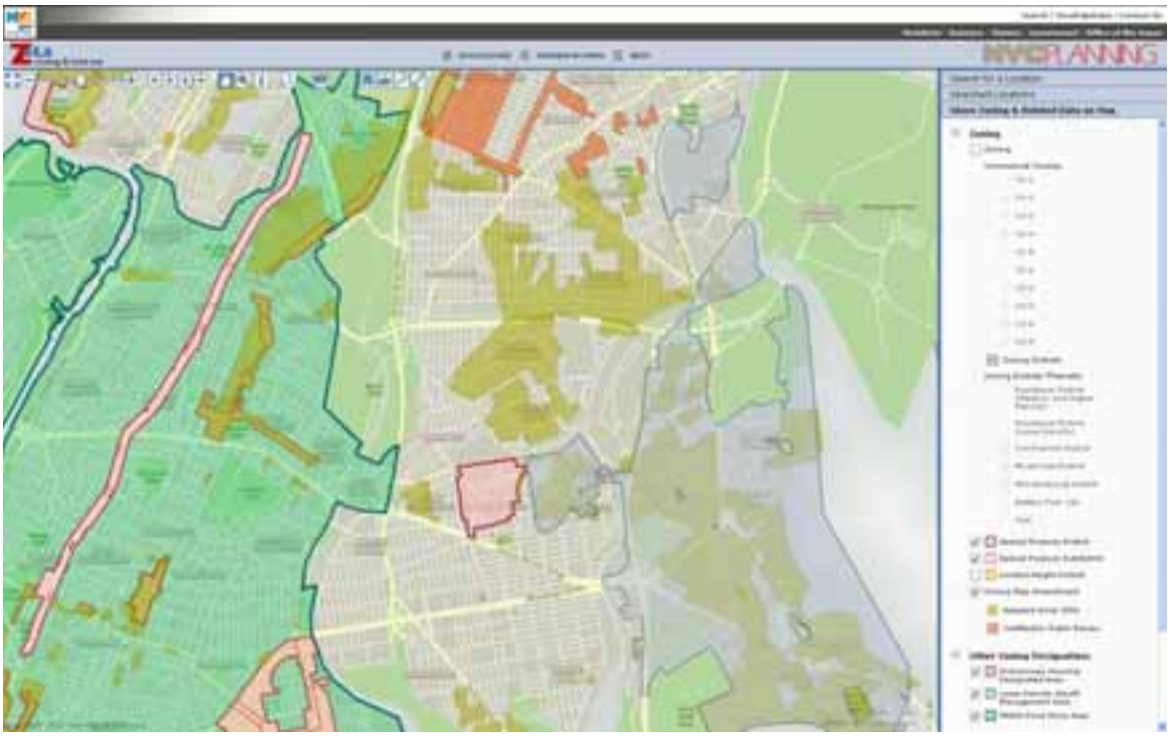

Figure 9: Other zoning designations

The Waterfront layer shows areas along the coastal zone boundary and properties affected by the Waterfront Access Plan. Environmental Requirements pinpoint all of the environmental designation areas pertaining to potential hazardous materials contamination or noise and air quality impacts, and link to the NYC Office of Environmental Remediation's website for more information (see Figure 10). Other information available on NYCityMap is also included in ZoLa, such as boundaries for City Council and Community Districts, detailed building information, property ownership, as well locations of landmarks and historic districts.

Figure 10: E-Designations and Waterfront layers

Conclusion

To date, the ZoLa application has been a huge success for DCP. It has enabled users to access up-to-date zoning and land use in a easy, readable and seamless way and has become the destination for property owners, developers, architects and community planners.

This agency wide endeavor would not have been a success without the team effort of all the stakeholders both internal and external. The project met the critical success factor to ensure the success of the application.

Since the release we were able bring down the number of adhoc zoning inquiries by almost 20 percent. We also have trained over 300 internal and external users on how to use this application. The application received positive feedback from the targeted audience in the public and governmental agencies. It was also featured on well known news media such as "The Wall Street Journal", "Daily News" and real estate websites such as "The Real Deal" and "Curbed".

Next Steps

The next steps are to provide user's access to an additional wealth of information that DCP holds that was not available during the initial release of the application. This includes historical zoning information, land use data and other new datasets that will make it easier for the public to understand zoning. We are already in the process vetting out the datasets that would be included in the next version of the application. In order to ensure success, the same amount of commitment and continued support will be required from all stakeholders to maintain the data to its highest quality. As our Commissioner Burden

said, “Zoning is the language of the physical city”, and the Department of City Planning is committed to making zoning and other important land use information readily accessible to the public.

Contact Information

The project has provided us with important lessons learned and follow-up discussions will be required to understand every aspect of the project. Please feel free to contact me and I will be happy to discuss any aspect of the project. My contact information is below:

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