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This study examines the use of online geographic information systems (GIS) by North Carolina county governments. The study was conducted to investigate what web GIS services North Carolina counties offer, to determine how much these services are used and by whom, and to uncover how offering these services has impacted agency functioning. The counties examined were Wake County, Lee County, Guilford County and Robeson County.

Methods employed over the course of the study included analyzing trends in web traffic statistics and interviewing staff members of participating agencies to uncover organizational changes occurring post-deployment of a web GIS. Trends in web GIS use were not consistent across counties. The chief impact of offering a web service was a decrease in walk-in traffic to agencies. This has freed up staff members to work on other projects. Employees also have taken on new roles as technology educators for web GIS users.

Headings:

Geographical information systems.

Local government -- Information technology.

LOCAL GOVERNMENT USE OF WEB GIS IN NORTH CAROLINA

by
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Introduction

The advent of widely available and easy-to-use online, geographic information systems (GIS) and geovisualization tools has changed ways users interact with information (Arsenault 2007, Schoning 2008, Aucott et al. 2009, Jessop 2005, Scharl 2007). The georeferencing or geotagging of digitized materials, or assigning geospatial location information to items, has led to new ways of querying and analyzing data collections – such as earthquake records, news reports and crime records. Other uses of interactive maps as access tools for quick data visualization include patrons viewing archival materials or remotely tracking in real-time disaster relief efforts through updated, online maps of the crisis area infused with multimedia (Solar 2005, ESRI 2010). State and local governments – who increasingly have offered electronic government services including online voter registration, driver's license renewal and tax filing – also are using web mapping technologies as methods of allowing remote browsing of and access to digitized or digital government records.

For users of local government GIS systems, one of the chief uses of web mapping services (WMS) is to view cadastral data about parcels of land. Interactive, web mapping interfaces allow users to zoom and pan through the digital rendering of a terrain, select parcels and view information on ownership, mailing address, deed date, deeded acreage, assessed building value, total sale price, sale date and other data.

This study investigated how the offering of these data-sharing e-government services through a map interface linked to or housed on a government agency's website leads to some organizational reorientation of the agencies. The local government agencies examined are: Wake County and the City of Raleigh GIS agencies, Lee County Strategic Services, Guilford County GIS and Robeson County GIS. This study sought to chronicle the evolution of web GIS in these selected North Carolina local governments. The study relied on agency-supplied web traffic data to gauge the variation in use of online GIS applications. Semi-structured interviews were conducted with staff members of the investigated GIS agencies to uncover cross-organizational patterns of change. This study is modeled on a 2002 study by Dr. Gary Marchionini of organization and interface co-evolution [Marchionini, G. (2002). Co-Evolution of User and Organizational Interfaces: A Longitudinal Case Study of WWW Dissemination of National Statistics", *Journal of the American Society for Information Science and Technology*, 53(14)].

Literature Review

The Advent of Geobrowsers and the Geospatial Web

As seen in the rising use of personal, in-car navigation system and online mapping applications for finding driving directions or locating points of interests, advances in digital technology have made mapping technology easier to use and more ubiquitous. Developed over the last half a century, geography information systems (GIS) had been the domain of computer and environmental scientists, climatologists and geographers. On the transition of GIS use by this closed group at the nexus of computers, cartography

and statistics to the general public, members of the geology and geography faculty at the West Virginia University commented in a chapter in "The Geospatial Web":

> The availability of free Web mapping applications may now help break down many of the long-standing barriers to the public use of geospatial technologies. Anyone with access to an Internet-enabled computer or mobile device now has the ability to display and interpret geospatial data and even add to that information without expert intervention.
> (Rouse, 2007, p. 153)

Put concisely, the "Geospatial Web" "is an integrated, discoverable collection of geographically related Web services" (Lake and Farley, 2007, p. 15). The term is used to define the integrating of "cartographic geodata with geotagged hypermedia" and "allowing [users] to browse geospatial data from a satellite perspective" – by zooming in and out on a digital representation of the Earth's surface – and "refers to the global collection of general services and data that support the use of geographic data in a range of domain applications." The development of the "Geospatial Web" has taken two forms: 1) "stand alone" virtual globes (e.g., Google Earth); and, 2) web mapping services that are embedded on websites. Layers of elements such as documents and photos can be displayed on either surface by being "georeferenced" or linked to a position on the globe or map. This allows for repositories of data to "made aware" of the location of what they describe/depict. For example, the UNC University Library's Document the American South used a map interface for searching of their online "Going to the Show" collection, that chronicles the history of movie theaters in North Carolina from the late 1890s to approximately 1930 (http://docsouth.unc.edu/gtts/). Collection content includes newspaper ads and articles, photographs, postcards and Sanborn Fire Insurance maps – all of which are discoverable by panning across the North Carolina terrain in the browser and selecting particular cities and specific theaters. Historic Population Data also can be

integrated into the map display (Figure 1). After selecting a city and zooming into its historic area, the user can select a specific theater in order to access collection items about that theater (Figure 2).

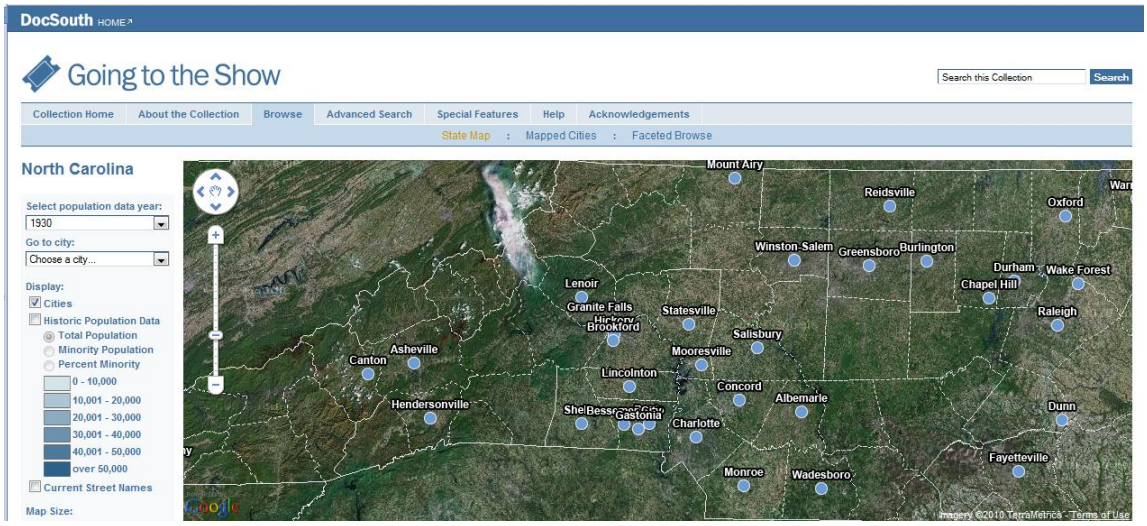

Figure 1: DocSouth "Going to the Show"

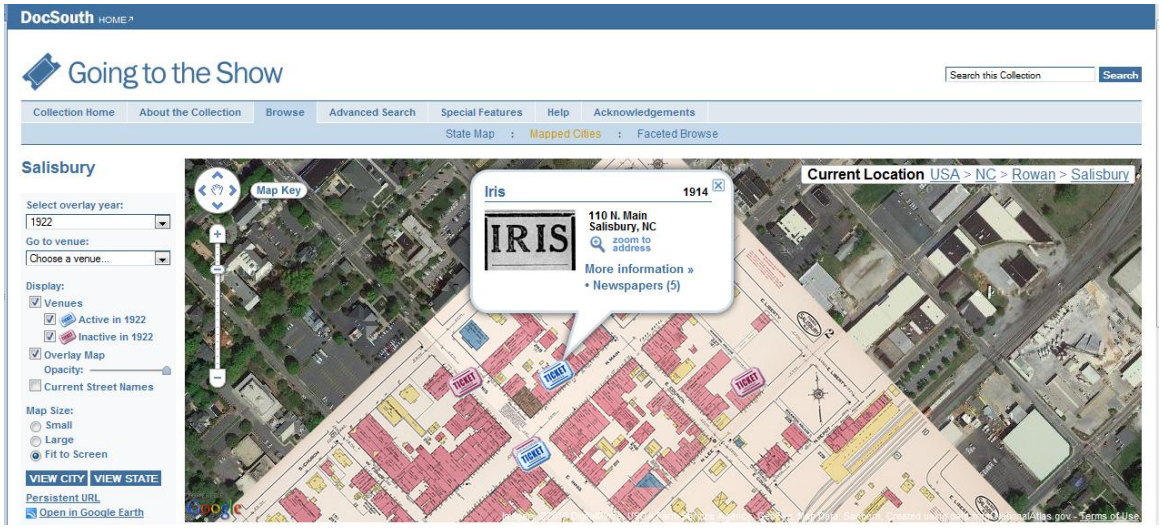

Figure 2: Georeferenced Sanborn Map

The growth in the use of maps as interfaces is a result of a conclusion that much of information is specific to geography and/or spatial relationships between different geographies. Jokingly two British researchers noted that "80 percent of all information has a geographical component" and that web developers – with application such as Google Maps and Yahoo! Local – are incorporating geographic awareness into search engine design to reflect this reality (Hart & Dolbear, 2007, p. 39). Information can be "geospatially peculiar". This development comes out of user demand and information sciences research:

> Information retrieval research has also discovered geobrowsers as an effective platform to identify and access relevant information more effectively. An increasing number of applications use geospatial extensions for specifying queries and structuring the presentation of results. (Scharl, 2007, p.4)

In a January 31, 1998 speech entitled "The Digital Earth", then-Vice President Al Gore called for a reimagining of how individuals interact with data and the development of a "multi-resolution, three-dimensional representation of the planet, into which we can embed vast quantities of geo-referenced data." The development of downloadable geovisualization applications such as Google Earth and ArcGIS Explorer is a partial realization of this idea (Goodchild, 2008) of "a mechanism for users to navigate and search for geospatial information - and for producers to publish it… [with] a browsable, 3D version of the planet available at various levels of resolution, a rapidly growing universe of networked geospatial information, and the mechanisms for integrating and displaying information from multiple sources." Twelve years after Gore's Los Angeles speech, user-generated, non-governmental organization-generated and government-generated information – such as U.S. Geological Survey earthquake and stream flow spatial data sets – downloaded in the form of Keyhole Markup Language (KML) files can

be draped onto a digital, virtual globe in Google Earth while users of NASA's World Wind can fly through NASA and USGS satellite imagery. In fact, within 15 months of its release, Google Earth had been downloaded 100 million times (Schoning et al., 2008).

Google Earth allows layers of data to be draped onto its virtual globe. In Figure 3, icons displayed on a portion of southern Africa link to content from the National Geographic Society, World Wildlife Fund, The New York Times, United Nations Environmental Programme and user-generated videos uploaded to YouTube. Selecting a point allows the user to view information and hypermedia. Once an icon is selected, a "pop-up" displays data about the location. "Pop-up" blocks may contain text, images, other media and hyperlinks to other resources (Figure 4).

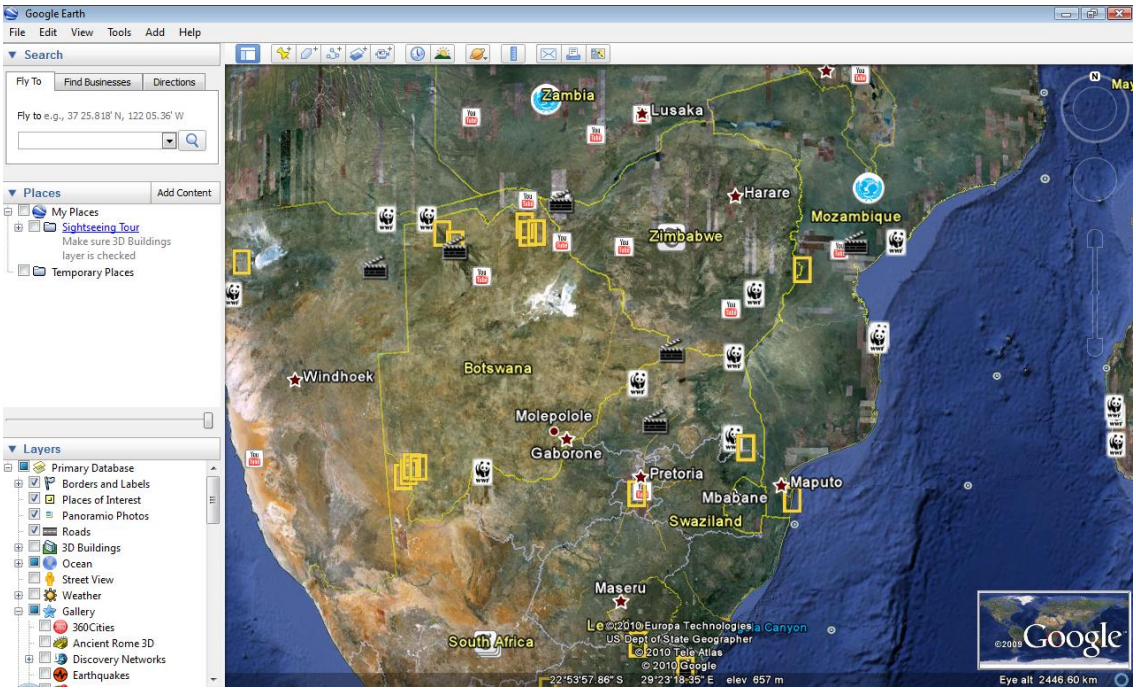

Figure 3: Google Earth

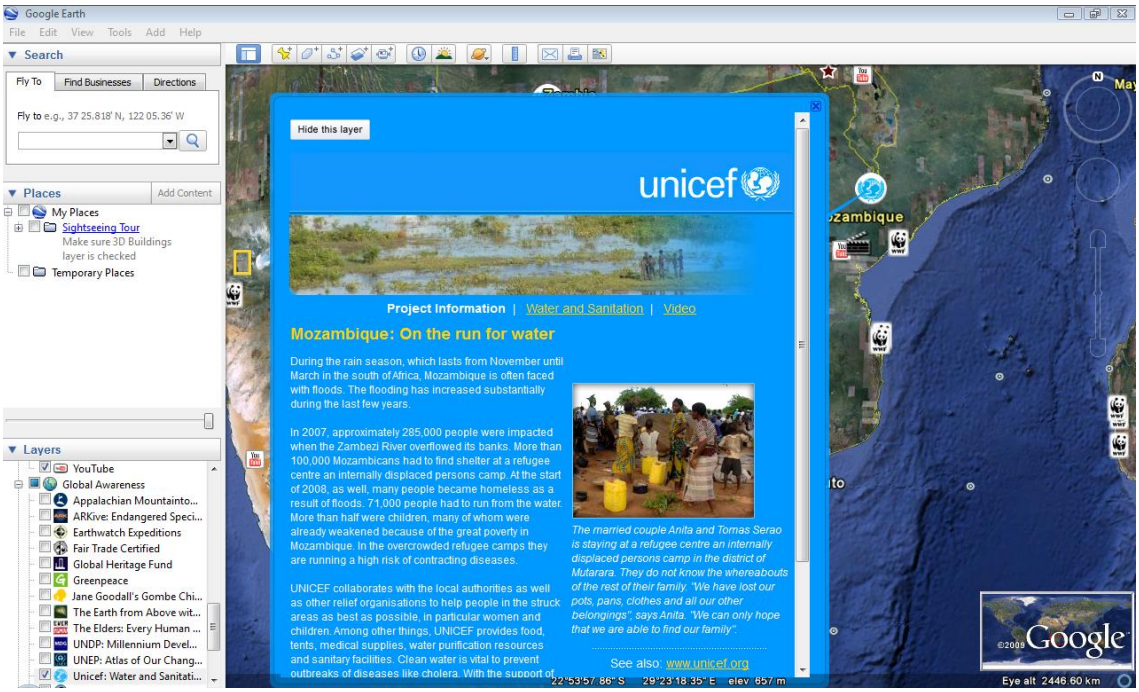

Figure 4: Pop-up in Google Earth

Inside the web browser environment, the federal government and state and local governments increasingly are using online, interactive and embedded map interfaces as data visualization tools to connect users to government-held data. Under the heading of "GIS Supports Gov 2.0", the Environmental Systems Research Institute, Inc. (ESRI) website reports, "Government are increasingly using GIS as a platform to build mapping applications that engage citizens, deliver transparency, and enhance policymaking." Based in Redlands, California, ESRI produces the ArcGIS software package and is a recognized leader in the GIS world. In his keynote address at the Gov 2.0 Expo held in Washington, D.C. in May 2010, ESRI President Jack Dangermond stated, "This technology provides a framework for open government… and also for civic engagement". Commenting on the pervasiveness of Web 2.0 technologies that allow for greater online civic participation, Dangermond stated the "serverizing" of data in the

form of maps through browsers and other data devices such as cellular phones and allow easier access to this data.

These non-static mapping interfaces may allow users to: 1) determine the data presented (e.g., crime statistics, location of medical facilities, electoral results); 2) determine the spatial extent of the map (e.g., 1:250,000); 3) define the granularity of the data (e.g., zip code, county, Census block, health district, watershed); 4) change the map symbology; 5) conduct minor spatial analysis (e.g., buffering waterways); 6) click on spatial units to access more data (e.g., median income of a Census tract or number of photovoltaic installations in a county); and 7) add user-generated content (e.g., citizen reporting). In addition to those included in Table 1, examples at the federal government-level include ESRI-designed Recovery.gov (2010) that tracks how American Recovery and Reinvestment Act of 2009 (ARRA) funds are used at state and local levels and a host of Department of Health and Human Services and Department of Homeland Security applications to support "a geospatial Web-enabled U.S. public health infrastructure" (Cromer, 2003). The utility of such services does not stop at national boundaries. Interest in the dynamic disease mapping also extends across national borders as seen in a disease mapping geo-portal prototype created by the State of Maine and the Province of New Brunswick (Gao et. al., 2008).

The National Renewable Energy Laboratory (NREL) OpenPV Visualization site allows for dynamic change charts and graphs also as a user zooms to finer spatial extents or from one region to region (Figure 5).

Table 1 *Federal Interactive Mapping*

Agency	Website	URL	Purpose
National Renewable Energy Laboratory (NREL)	OpenPV Visualization	http://openpv.nrel.gov/visualization/index	Displays data about photovoltaic installations by state, county, and zip code. Graphics change as user selects different spatial units for analysis
National Renewable Energy Laboratory (NREL)	In My Backyard	http://mercator.nrel.gov/imby/	Determines how much electricity a solar or wind power installation could generate at a user-determined location and size
Centers for Disease Control and Prevention (CDC)	Geographic Information Systems (GIS) at CDC	http://www.cdc.gov/gis/	Displays disease rate data (mortality, morbidity, hospitalization) cartographically for user-defined variables (e.g., spatial granularity, temporal range, gender, race/ethnicity)
Bureau of Labor Statistics (BLS)	Quarterly Census of Employment and Wages (QCE) State and County Map Application	http://beta.bls.gov/maps/cew/us	Users explore spatial spread of employment by define time period, color gradient, industry, interval type
National Oceanic and Atmospheric Administration (NOAA)	Geoplatform.gov/gulfresponse, Environmental Response Management Application (ERMA)	http://www.geoplatform.gov/gulfresponse/	Displays data related to BP Deepwater Horizon Gulf of Mexico oil spill including: wellhead surface location, fishing closures, aerial imagery of spill, surface wind velocity, critical habitats
U.S. Department of State	Interactive Travel Map	http://www.state.gov/secretary/trvl/map/	Displays information about the past, current and upcoming travels of the U.S. Secretary of State and links videos, photos and remarks to spatial locations

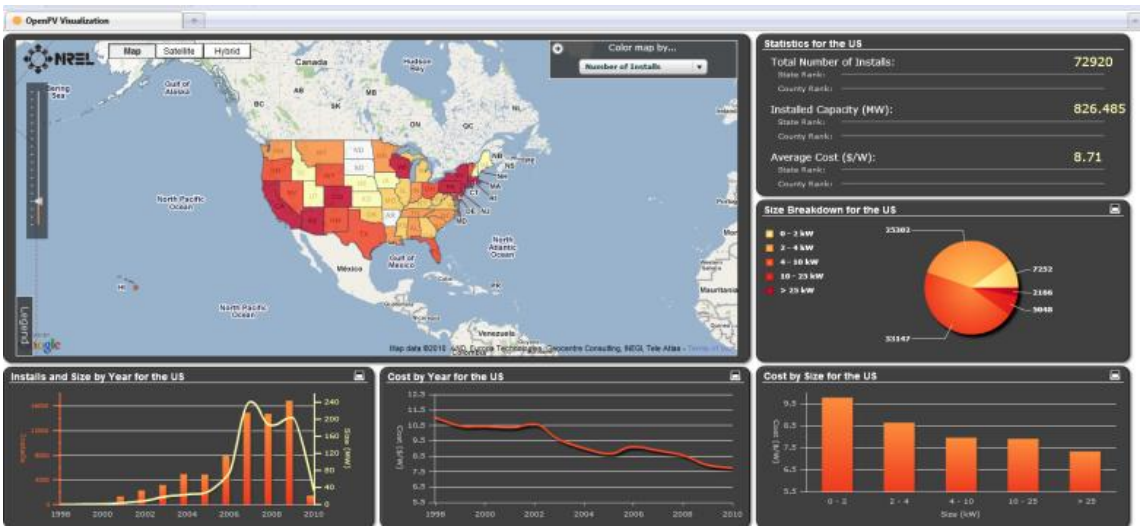

Figure 5: National Renewable Energy Laboratory (NREL) OpenPV Visualization

Like the federal government, many states have similar interactive ARRA funding maps (Table 2). For example, the Colorado Economic Recovery Mapping site (Figure 6), the user can view more information about a particular project by clicking on an icon. Graphs also change dynamically based on user behavior. States also have developed portals for the display of environmental and general demographic data (Table 3).

Table 2 *Tracking ARRA funding cartographically*

State	Website	URL
Colorado	Colorado Economic Recovery Mapping	http://www.colorado.gov/recovery/RecoveryMapping_2/index.html
Connecticut	Stimulus Map	http://www.dir.ct.gov/opm/IGP/StateStatApp/map.htm
Maryland	One Maryland's Recovery and Reinvestment	http://mdimap.towson.edu/statestat/
Montana	Montana Reinvestment Act	http://recovery.mt.gov/default.mcpx

Figure 6: Colorado Economic Recovery Mapping

Table 3 *State-level Interactive Mapping*

State	Agency	URL	Purpose
State of Idaho	Department of Environmental Quality	http://www.deq.state.id.us/maps/interactive_mapping.cfm	Interactive applications to display air quality, surface water quality and ground water quality
Commonwealth of Kentucky	Kentucky Geography Network	http://kygeonet.ky.gov/kydemographics/index.html	Displays demographic data (e.g., unemployment rate, projected population change, median age, median net work). Data available at county, block group and tract level.

Municipal and county governments also have established geoportals (Table 4). An example of the use of web mapping services at the municipal level includes the Philadelphia Police Department's (2010) online crime mapping application that allows users to view locations of crimes after specifying temporal and spatial extents for selected offenses. Raleigh's Capital Area Transit (CAT) (2010) "Real Time Bus Route Info" application supplies users with information on current bus locations, expected arrival times and bus stop locations. On its official website, the District of Columbia employs a GIS viewer (DC Atlas All-in-One http://dcatlas.dcgis.dc.gov/dcgis_allservices/viewer.htm) that allows users to toggle on or off a range of datasets on city services grouped by theme such as: Business and Economic (Banks, Business Improvement Districts, High Technology Development Zones); Education (School Attendance Zones, School Election Districts); Health (Dialysis Clinics, Hospitals, Nursing Homes, Primary Care Centers); Planning, Land Use, and Zoning (Land Use- Existing, Land Use- Planned); and Aerial Photography and Scanned Maps (2002 Orthophoto, 2005 Orthophoto, 2008 Orthophoto).

The City of Boston's GIS Data Hub (http://hubmaps1.cityofboston.gov/datahub/) displays data on city services (e.g., police districts, fire districts), political boundaries (e.g., wards, city council districts, BRA Planning Districts), public safety (e.g., evacuation routes, neighborhood emergency shelters) and ARRA projects (e.g., "Greening Our City", "Increasing Public Safety and Public Health") (Figure 7). The City of Chicago and the City and County of San Francisco have similar online viewers: Chicago Maps, http://maps.cityofchicago.org/mapchicago/viewer.htm and SFViewer http://gispub02.sfgov.org/website/sfviewer/INDEX.htm.

Table 4 *Local government Interactive Mapping*

Jurisdiction	Agency	URL	Purpose
City of Savannah	Savannah Economic Development Authority	http://availableproperty.seda.org/	Allows users to search for available properties by Size/Access Requirements (e.g., Size from, Size to, Land Type, Rail Access), Maximum Distance to (e.g., Airport, Interstate, Container Terminal, Break-Bulk Terminal). Allows for some service area analysis
Lake County (FL)	Lake County GIS	http://gis.lakecountyfl.gov/CityView/	Displays zoning, proposed zoning and future land use data. Allows for buffering of features

Figure 7: City of Boston GIS Data Hub

Developing world nations have joined this push into web-based GIS services (Table 5). Abu Dhabi Systems and Information Centre (ADSIC) received the ESRI "Making a Difference" Award at the 2010 ESRI International Users Conference. ADSIC administers the Abu Dhabi Spatial Data Infrastructure (AD-SDI) – including the Abu Dhabi Geospatial Portal (Figure 8).

Table 5 *WMS applications in the developing world*

Country	Agency	URL	Purpose
United Arab Emirates	Abu Dhabi Geospatial Portal	http://geoportal.abudhabi.ae/mapviewer/index.html	Displays street, governmental services, points of interest
South Africa	City of Cape Town	http://map.capetown.gov.za/corporate_base_data/	Displays political divisions of city, streets

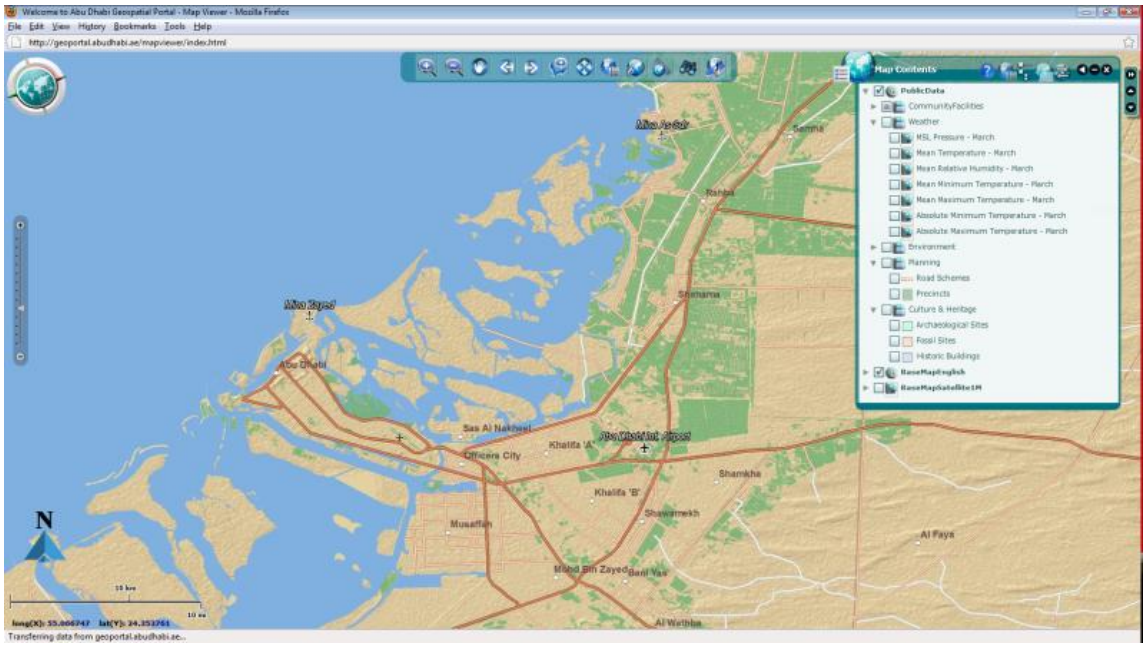

Figure 8: Abu Dhabi Geospatial Portal

In a step beyond the dynamic displaying of information based on user behavior and preferences, web-based public participation GIS (PPGIS) allows users to add data to a digital map that is shared by a community. Participatory GIS (PGIS) or "GIS2" applications – allow users to exchange views on, for example, planned construction projects (Zhao and Coleman, 2006).

> The basic precept of PGIS is the empowerment of communities through the facilitation of greater community input and access to geospatial data and technologies, community mapping and spatial analysis in support of project decision making.
> (Rouse, 2007, p. 153)

In such as environment, users could add the location of downed power lines or sites of environmental contamination. Under the banner of "Opening the world to everyone" at the opening plenary session of ESRI's July 2010 International User Conference in San Diego (http://www.esri.com/events/user-conference/index.html), Dangermond said along with technical developments, a new crucial data type is the anthropological "dimension of data – crowdsourcing – people and citizens coming into GISs" in real-time civic engagement. Highlighted during Dangermond's opening remarks, CitySourced (http://www.citysourced.com/) is one such tool through which citizens can report "graffiti, trash and other civic blight" through "smartphones" such as the Apple iPhone, Google Android or Blackberry. Once registered, reports are sent to relevant local government agencies in participating cities such as major cities of New York, Los Angeles, Dallas, Boston, Phoenix and Baltimore.

Figure 9: CitySourced

Rise of E-Government: A Sea Change in Service Provision and Citizen-Government Interaction

The proliferation of geobrowsers and embedded, online GIS applications as well as the increase in distribution of government data in emerging geospatial data formats such Keyhole Markup Language (KML) has occurred as part of an exponential growth in the offering of electronic government (e-government) services all over the globe – from the European Union and the United States to China and Sub-Sahara Africa (Schuppan, 2009). Edmiston (2003) defined e-government as "the use of digital technology in the management and delivery of public services, predominantly through the Internet" (p. 20). E-government services are promoted as increasing efficiency through remote service delivery (e.g., telemedical applications, distance learning, online automobile registration, and electronic submission of tax returns), remote procurement (e.g., comparative shopping, tracking orders, electronic purchasing) and the reduction of fraud (e.g., tracking food stamp transactions) (Edmiston, 2003).

Proponents of e-government frame its use as a not only as a way to provide less costly services but also as democratizing of information, empowering citizens by allowing them to engage in "fluid communication with government institutions", encouraging public participation in democratic processes, and increasing in transparency as citizens can access anytime and anywhere government-held information that is served online (Willoughby et al., 2010). Agencies are opening more data to citizens.

Advocates say that this is a break from "the old model of citizen-public administration interaction, where communication between the two was at best a lengthy process and at worst one dogged by miles of bureaucratic red tape and long hours of

frustration" (Willoughby et al. 2010, p. 51). In equally colorful language, major Gov 2.0 proponent Tim O'Reilly, president of O'Reilly Media and organizer of Gov 2.0 conferences, stated in an interview with Inc. Magazine, "We've come to think about government as a kind of vending machine – we put in our taxes and we get out services. And if we don't get the services we want, we shake the vending machine. We get to protest. We write our congressmen. We have a tea party… But there are better things we can build than vending machines" (Chafkin, 2010).

Considered "the Oracle of Silicon Valley", O'Reilly has championed government use of Web 2.0 platform technology. In his book Open Government, O'Reilly wrote:

> Now, a new generation has come of age with the Web, and it is committed to using its lessons of creativity and collaboration to address challenges facing our country and the world. Meanwhile, with the proliferation of issues and not enough resources to address them all, many government leaders recognize the opportunities Web 2.0 technologies provide not just to help them get elected, but to help them do a better job. By analogy, many are calling this movement *Government 2.0*. What the heck does that mean?
> Much like its predecessor, Web 2.0, "Government 2.0" is a chameleon, a white rabbit term, that seems to be used by people to mean whatever they want it to mean. For some, it is the use of social media by government agencies. For others, it is government transparency, especially as aided by government-provided data APIs. Still others think of it as the adoption of cloud computing, wikis, crowdsourcing, mobile applications, mashups, developer contests, or all of the other epiphenomena of Web 2.0 as applied to the job of government. (O'Reilly, 2010)

O'Reilly countered that Gov 2.0 is not only about service provision but also the encouragement of collective action.

> Government 2.0, then, is the use of technology—especially the collaborative technologies at the heart of Web 2.0—to better solve collective problems at a city, state, national, and international level.
> The hope is that Internet technologies will allow us to rebuild the kind of participatory government envisioned by our nation's founders, in which, as Thomas Jefferson wrote in a letter to Joseph Cabell, "every man…feels that he is a participator in the government of affairs, not merely at an election one day in the year, but every day." (O'Reilly, 2010)

With harnessing of the Internet for government services occurring at all levels of government, federal legislation – the E-Government Act of 2002 – was passed that defined e-government and stated goals for further integration of such services into

governmental life. Both the United States House of Representatives and Senate passed the bill by unanimous consent and President George W. Bush signed the bill into law on December 17, 2002. The bill became Public Law No. 107-347 and established the Office of Electronic Government (OEG) within the Office of Management and Budget (OMB). The bill's "Findings" section acknowledged "the use of computers and the Internet is rapidly transforming societal interactions and the relationships among citizens, private businesses, and the Government". Perambulatory language found in the "Purposes" section stated e-government programs should be employed "to promote the use of the Internet and emerging technologies within and across Government agencies to provide citizen-centric Government information and services", and "to promote access to high quality Government information and services across multiple channels". In the Act, "Electronic Government" was defined similarly to how the term is defined by scholars as:

> (3) 'electronic Government' means the use by the Government of web-based Internet applications and other information technologies, combined with processes that implement these technologies, to—
>
> > (A) enhance the access to and delivery of Government information and services to the public, other agencies, and other Government entities;
> > or (B) bring about improvements in Government operations that may include effectiveness

Belanger and Hiller (2006) proposed a categorization of e-government services into six buckets: 1) Government with individuals – delivering services; 2) Government with individuals – political process; 3) Government with business as a citizen; 4) Government with business in the marketplace; 5) Government with employees; and, 6) Government with government. Online mapping application can fall into all of these buckets because of geographic component of many types of governmental work and interactions including: firefighters locating houses; government's tracking the shipment

of needed supplies during a natural disaster; management of utilities and interagency cooperation on issues such as maintaining biodiversity; and, route finding for employees.

Because of the potential and perceived savings in resource expenditure and demands for transparency, the trend of greater e-government services is expected to continue. On his first day in office on January 21, 2009, President Barrack Obama signed a memorandum on Transparency and Open Government reaffirmed that "[e]xecutive departments and agencies should harness new technologies to put information about their operations and decisions online and readily available to the public" (White House, 2009). On March 5, 2009, President Obama appointed Vivek Kundra as the federal government's first Chief Information Officer. At Kundra's appointment, President Obama said, "I have directed him to work to ensure that we are using the spirit of American innovation and the power of technology to improve performance and lower the cost of government operations. As Chief Information Officer, he will play a key role in making sure our government is running in the most secure, open, and efficient way possible" (White House, 2009).

The Office of Management and Budget report FY 2010 Report to Congress on the Benefits of the E-Government Initiatives highlighted the value of federal e-government programs (Office of Management and Budget, 2010). The report is divided into "Government to Citizen" programs, "Government to Businesses" and "Government to Government" programs. "Government to Citizen Portfolio" programs recognized included:

- GovBenefits.gov – managed by the Department of Labor, this web portal provides access to information on federal benefit and assistance programs

- IRS Free File – managed by the Department of the Treasury, this program creates "a single point of access to free on-line preparation and electronic tax filing services" and is credited with saving the federal government $68 million since 2003 (p. 4)

"Government to Businesses" programs detailed included:

- Business Gateway – managed by the Small Business Administration (SBA), this service pulls together information on federal, state and local regulations, financing opportunities and licensing requirements in one resource portal
- E-Rulemaking – managed by the Environmental Protection Agency (EPA), this program allows for "one stop shopping" for federal regulations

"Government to Government" programs described included:

- DisasterAssistance.gov – this site allows users to "Learn what help you might be able to apply for from 17 government agencies", "Check the progress of your applications online", "Apply for help from FEMA" and other learn about and use other disaster-related resources
- Grants.gov – managed by the Department of Health and Human Services, this site is "a central storehouse for information on over 1,000 grant programs and provides access to approximately $500 billion in annual awards". Governmental, education, public housing organizations and non-profit organizations can apply for grants and check on the status of an application
- Geospatial One-Stop – allows users to search for and access governmental-held geospatial data

This implementation of e-government services has extended to local and state governments and developing nations (Willoughby et al., 2010). With the slogan "Connecting you to the Government", the Government of Singapore web portal (http://www.gov.sg/) allows citizens to engage in "fluid communication" with the government by providing feedback on governmental policy on a web form that allows file attachments. A 2004 article in The Virginian-Pilot on e-government adoption of Hampton Roads' municipalities (e.g., Chesapeake, Virginia Beach) reported that "services that once required residents to wait in Nile-length lines or endure six Yanni songs while on hold, can now be done online 24 hours a day" (Newton, 2004). These services included: applying for city employment, paying for parking tickets, reporting potholes, applying for building permits and scheduling bulk trash pick-up.

In addition to online, interactive GIS mapping, the counties used for this study have embraced e-Gov services. Wake County, North Carolina offers a range of e-government services including reporting a lost pet, registering to vote, viewing voting records, applying for county jobs, view restaurant sanitation inspection grades, applying for a marriage license and paying tax bills online (Wake County, 2010). Lee County (2010) government's webpage for "Electronic Government and Online Services" declares:

> The mission of Lee County E-Gov (E-Government) services is to improve the delivery of public services and achieve long term cost savings by offering online services that are structured to meet the needs of our customers. E-Gov is designed to offer information and services 24x7 to citizens and businesses in a reliable, secure and convenient manner.

On the site, users can pay taxes online, request to appear before Commissioners, renew library books, view available commercial sites and view live or archived Board meetings.

Some research has been done on the success of e-government services. For example, the national 2010 "Public Library Fundy & Technology Access Study" – conducted by the American Library Association (ALA) and the Center for Library & Information Innovation at the University of Maryland – stated 79 percent of libraries reported assisting patrons with accessing online government data or services. In 2009, only 54 percent reported providing such assistance. Agency-level case studies show similar increases in visits to governmental websites. Marchionini's (2002) trend analysis of the web log of the U.S. Department of Labor's Bureau of Labor Statistics (BLS) showed that total BLS website page requests in the month of October for 1995 and 2000 increased from 191,639 to 6,486,473. The BLS is "the principal Federal agency responsible for measuring labor market activity, working conditions, and price changes in the economy" and its mission is "to collect, analyze, and disseminate essential economic information to support public and private decision–making" (U.S. Bureau of Labor Statistics). The increase see in traffic on the BLS website mirrored a proportionally similar rise in traffic on the Library of Congress website during the same period. Library of Congress monthly page requests increased from 1,981,045 in 1995 to 58,268,221 in 2000. A more gradually upward trend was seen in online accessing of geospatial data provided by MetroGIS, a Minnesota-St. Paul area, voluntary GIS initiative through which participating agencies share data. MetroGIS's DataFinder website also experienced a significant rise in total visitor sessions between 2003 and 2008 – when events rose from 13,841 to 17,584. Over the same period, total data downloads increased 29.2% from 7,073 in 2003 to 9,137 in 2008.

Impacts of e-Government: Organizational Co-evolution and Concerns over Privacy and Social Equity

The deployment of these new technologies for data dissemination, collection and interaction with the public leads to changes in how agencies and governments function – from the federal government to municipalities (Marchionini, 2002). Speaking on the City of Virginia Beach's web presence from 1996 to 2004, chief information officer David Sullivan said, "It's literally transformed the way people deal with the city." Marchionini came to a similar finding in his work with the BLS – that changing an agency's user interface impacts how the organization evolves thereafter and that other components of an organization's interface co-evolve with changes made to an organization's user interface. The organizational interface is "data systems, policies and procedures, corporate culture, and public face of an agency or institution" – in other words, "the intersection of people, data, tools and policies specific to an organization" (p. 1193). In the world of e-government, an organization's public face is its website.

For example, the roll-out of a new BLS website led to changes to departmental policies, financial planning and design of future services. An important finding of the study was that the deployment of a BLS website that allowed online 24-hour-a-day access to labor data led to a shift in user population from academics, public officials and reporters to non-expert members of the general public. This change in turn impacted the culture of the institution as the agency revised its internal government orientation to become more general public "customer" oriented. Marchionini noted that with a greater web presence, the BLS evolved since the 1990s from an agency "from serving the needs of a few dozen companies, research institutions, and government agents who obtained

tapes of data sets to a broader group with sophisticated computer skill and systems who used the Internet to transfer datasets via ftp, to today's web-based dissemination to anyone with a personal computer and Internet access" (p. 1198, Marchionini, 2002).

An expanding user base with new demands in this new technological environment changed technical skills of BLS employees needed to perform work (shift from handling phone calls to HTML coding and emailing). The growth in activity on the BLS website further has led to greater resources being devoted to its maintenance and the addition of new services to the site (e.g., an inflation calculator, educational tools for kids, briefs on economic principles).

Despite demonstrated growth in use of such services, e-government services was and continues to be a contentious issue because of high costs and concerns some privacy groups, public administrators and those in academia have with the repercussions of vast amounts of government-held data being widely accessible and blurring of citizen-consumer identities.

Privacy concerns surrounding e-government services abound. Some citizens' groups are concerned that governmental bodies surreptitiously will collect data of users accessing governmental websites. Skeptical citizens see e-government initiatives as an "invasion of citizen privacy by government" (Belanger and Hiller, 2006, p. 49). Further, with more public information being made available online, some worry that too much information about individuals is too easily accessible now that it is served up online.

> The increase in the availability of this information, however, has led one constituency, citizens, to complain that the information is readily available to anyone around the world, including those who would use social security numbers, addresses and maiden names to perpetrate identity theft. What has always been publicly available becomes publicly accessible once posted on the web, and citizen complaints have affected this effort of e-government. (p. 56-57)

Prior to digital copies of land records being provided online, citizens had to travel to a central governmental office to view such records. Now someone can access information about a resident's home – including the type of exterior walls and heating system and the number of full bathrooms and additions – from the other side of the globe through the integration of GIS and property records (Franklin County, NC – Parcel Map Search). Another concern is the security of electronic exchanges as e-government services move from simply displaying and allowing interaction with data to online transactions of financial and personal information (Horst et al. 2007).

Also in dispute in some literature is the value of importing private sector concepts into the realm of public administration and treating citizens as consumers (Mosse and Whitley 2008).

> While the metaphorical recasting of citizens as customers is understandable in terms of the need to provide more responsive services, the consequences and dangers of this re-identification are manifold. Fundamentally, the idea of citizen as customer is embedded within the idea of government acting in a market. (p. 165)

Such writers posit that economic laws of supply and demand cannot be applied to governmental work since the its ostensive mission involves equitable treatment of all classes of citizens and providing public goods – often because of market failure.

Further, some social geographers are concerned with the impact online GIS will have on notations of citizenship and the extent community members are able to participate in this digital civic engagement since not all societal members have equal access to the Internet. The "informatization of neighborhoods" – or the relating of massive amounts of demographic and socioeconomic data with specific geographies – will accelerate what they describe as the increasingly fragmentation of social geography or a "splintering urbanism" (Burrows and Ellison, 2004, p. 323). Users now can use

online GIS to “find ‘their’ place within complex and dynamic urban spaces” placed on neighborhood characteristics (p. 326).

> It is not hard to imagine parents using Internet search facilities to identify areas where particular types of schooling (specialist status, privately managed) are being developed and, more importantly, being able to interpret the information they discover. From here it is a short step towards using online GIS more generally in order to negotiate the dynamic social geography of splintering urbanism strategically, substituting online search capacity for what was hitherto intuition and loosely organized 'anthropological evidence'. (p. 330)

In short, for these geographers, the question is one of access to digital technology:

> [A]ccess to new digital technologies, particularly online GIS, is beginning to alter the nature of urban space as the aggregated decisions of privileged social actors increasingly affect the social and political patterning and characteristics — the social politics — of their chosen neighbourhoods. (p. 335)

While this study focuses on organizational change in an agency deploying new data-sharing technologies, it is important to remember these services can impact greater society by their use and real or perceived misuse.

The three research questions for this study were:

1. What web GIS services do North Carolina counties offer?
2. How much are these services used and by whom?
3. How has offering these services impacted agency functioning?

Question 1 was addressed by examining participating agency web GIS services. To answer Question 2, the researcher examined trends in web traffic statistics for web GIS sites. Answering Question 3 required the researcher to interview staff members of participating agencies to uncover organizational changes.

Significance

The expected result of this study was that online, interactive mapping interfaces do lead to structural changes in the operations of local GIS agencies. Results of this study illuminate the effect of offering such services on an agency’s user population,

internal functioning and future direction. Patterns of changes are identified as are areas deserving of future research.

Methods

Participants

The participants for this study were chosen from the North Carolina Geographic Information Coordinating Council-maintained list of North Carolina County GIS Contacts (http://www.ncgicc.com/Portals/3/documents/County_GIS_Contacts.pdf). Thirty-six county agencies were invited to participate in this study. The four agencies who agreed were Wake County, Lee County, Guilford County and Robeson County. They were asked to submit web analytics reports for their agency's main web GIS site.

Three additional counties agreed to participate, but their data were not complete enough to be used. For example, one respondent only was able to send the prior month's web analytics because her practice was to delete prior report upon receiving a new report.

The sites considered to be a county "main web GIS" were the interactive web mapping services that display cadastral data. For the study participants, these sites were: City of Raleigh & Wake County's Internet Multi Access Parcel System (iMAPS); Lee County's ConnectGIS, Guilford County's Data Viewer and Robeson County's ConnectGIS. The Guilford County site also maintains links to separate sites that were not included in the study. Guilford County also supplied web traffic data for its GIS FTP site. This data was not included in this study.

Financial information included in this report came from individual county governments' financial reports. Demographic information was gathered from the U.S. Census Bureau's American FactFinder.

Metrics

The metrics used to measure traffic to digital government records were those that are established web analytic measures – visits, unique visitors and page impressions (Alpar 2001, Sterne 2002). The Interactive Advertising Bureau (IAB) (2004) defined these terms for the business community as follows.

> Visit: one or more text and/or graphics downloads from a site qualifying as at least one page, without 30 consecutive minutes of inactivity, which can be reasonably attributed to a single browser for a single session. A browser must "pull" text or graphics content to be considered a visit.
> Unique Users: the number of actual [individual IP addresses], within a designated reporting timeframe, with activity consisting of one or more visits to a site or the delivery of pushed content
> Page Impressions: measurement of responses from a web server to a page request from the user browser, which is filtered to remove robotic activity and error codes prior to reporting, and is recorded at a point as close as possible to opportunity to see the page by the user

Page impressions – or page views – often are characterized by views, average views per day, average per unique visitor and document views. Visits often are characterized by visits, average per day, average visit length, median visit length, visits from United States, visits referred by search engines (Jana, 2004). Metrics collected by Google Analytics include pages per visit, percent of direct traffic, percent of referring sites traffic, and top content – determined by page views (docsouth.unc.edu 2010).

Interviews

Following Marchionini (2002), the web log analysis was augmented with agency personnel. The University of North Carolina at Chapel Hill's Institutional Review Board approved the study on September 24, 2010 (Study #: 10-1714). Semi-structured interviews were conducted with seven staff members at the participating agencies.

Agency directors supplied lists of staff members and their email addresses. Only Wake County did not provide a complete listing of staff members and their contact information. Staff members were contacted individually via email and asked to participate in the study (Appendix B). Participants were provided an information sheet outlining the goals of the study and their rights as participants (Appendix C)

Interview questions centered on the role of the interviewee in the organization and their perceptions of how the agency's role and user base had changed since the deployment of the web mapping application (Appendix D). Interviews were conducted via telephone and lasted between 20 and 30 minutes. Six of the seven interviews were recorded and the researcher took notes.

GIS in North Carolina

GIS is an evolving field in North Carolina local government and as such, the state has created agencies and structures to promote its use. The North Carolina Center for Geographic Information and Analysis (CGIA) serves as the chief coordinator of GIS services in the state and the main clearinghouse for geospatial information in the state (http://www.cgia.state.nc.us/). The agency began in 1977 when the General Assembly initially created it as the Land Resources Information Service within the Department of Administration's Office of State Planning (Shanley, 2007). After most recently being housed in the Department of Environment and Natural Resources (DENR), CGIA moved to the Office of Information Technology Services (OITS) and the Office of the State Chief Information Officer (CIO) in August 2009. The CGIA Director reports to the Senior Deputy State CIO.

In 1991, through Executive Order No. 147, Governor James Martin created the Geographic Information Coordinating Council (GICC) to "develop policies regarding the utilization of geographic information, GIS systems and other related technologies" and be responsible for "strategic planning", "coordination, direction, and oversight of State, local, and private GIS efforts", and "advising the Governor, the legislature, and [Information Technology Commission] as to the needed directions, responsibilities, and funding regarding geographic information". The Governor created the Coordination Program to encourage data-sharing and reduce redundancy in services across state and local governments. Governor Jim Hunt's Executive Orders No. 16 (in 1993), No. 124 (in 1997), No. 142 (in 1999), and No. 166 (also in 1999) expanded the GICC's membership (Shanley, 2007).

In August 2001, the General Assembly passed N.C. Session Law 2001-359 that contained similar language to the previous executive orders and permanently established GICC (www.ncgicc.com). Both the executive orders and enacted legislation mandated that the CGIA provide staff support to the GICC and its subcommittees. The GICC's five standing committees include the Federal Interagency Committee (FIC), the Local Government Committee (LGC), State Government GIS Users Committee (SGUC), the Statewide Mapping Advisory Committee (SMAC), and the Management and Operations Committee (M&O). The CGIA Director serves as lead staff for the GICC.

Since 1991 because of legislative action and technological advances, the need for CGIA's support role has grown. GICC has grown from 12 to 35 members appointed by the Governor, General Assembly or Executive Office. Ad hoc committees and working groups also have been spun off of standing committees to examine narrow issues such as

long-term digital preservation and perform narrow roles such as document drafting for orthoimagery business plans. The CGIA supports these subunits as needed. The governor, NC House or NC Senate appoint GICC membership or members serve by virtue of their executive office. The GICC consists of representatives from municipal, county, state and federal government as well as the private sector. Performing the bulk of Council's work are standing committees such as the State Government GIS Users Committee, the Statewide Mapping Advisory Committee and, most relevant for this study, the Local Government Committee. North Carolina's CGIA-mandated data clearinghouse is NC OneMap (www.nconemap.com/).

As of March 2010, 94 of North Carolina's 100 counties had an online mapping site. In 2002, this number was less than 10 and as late as 2007, less than 50 counties had such web mapping services (Next Generation Archives, 2009). The NC Department of Administration's State Property Office website (Figure 10) also maintains a list of county and municipality GIS sites (http://www.doa.state.nc.us/spo/county.htm). County websites included are (Figure 11): Currituck County (http://www.co.currituck.nc.us/Interactive-Online-MappingDup2.cfm); Caswell County (http://arcims.webgis.net/nc/caswell/default.asp); and Ashe County (http://ashegis.ashecountygov.com/webgis/). Municipal web GIS sites (Figure 12) include the Town of Creedmoor (http://maps.thewootencompany.com/creedmoor/viewer.htm) and the Town of Southern Pines (http://maps.sppl.net/TownSite4/default.aspx).

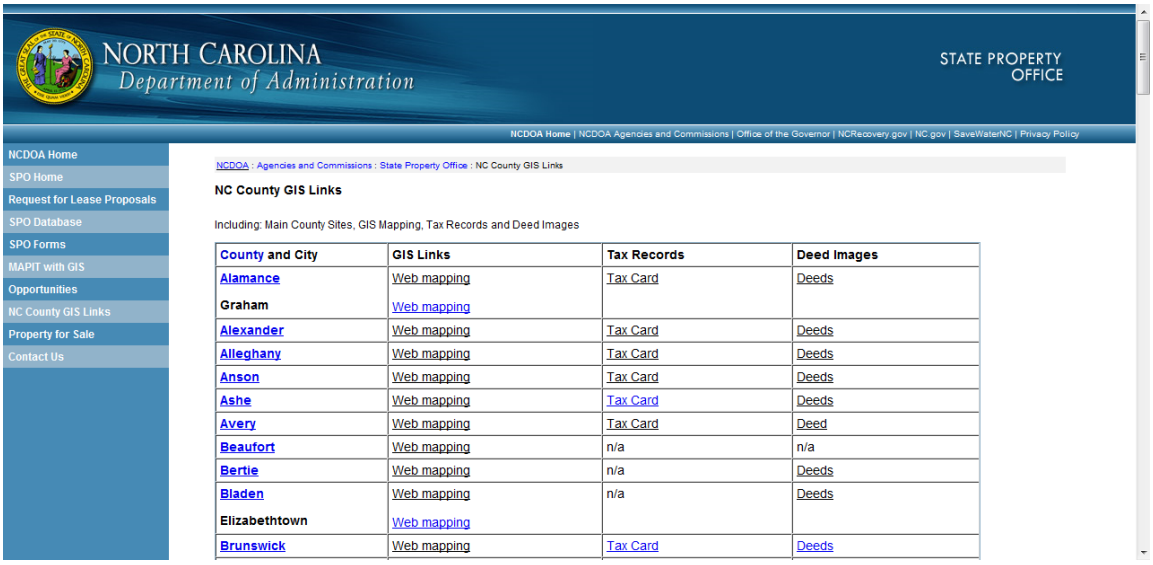

Figure 10: North Carolina Department of Administration website

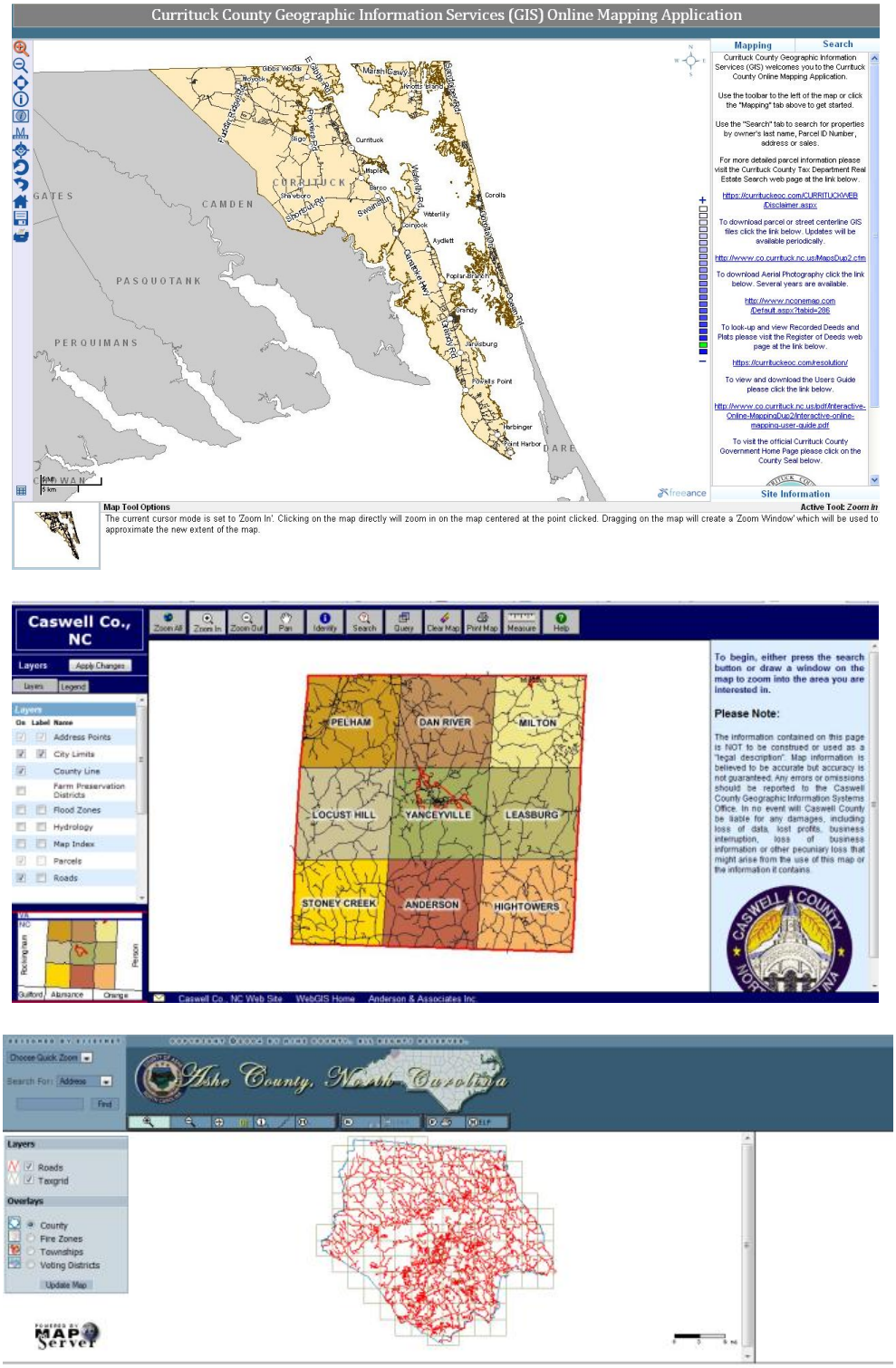

Figure 11: Other NC county web GIS sites

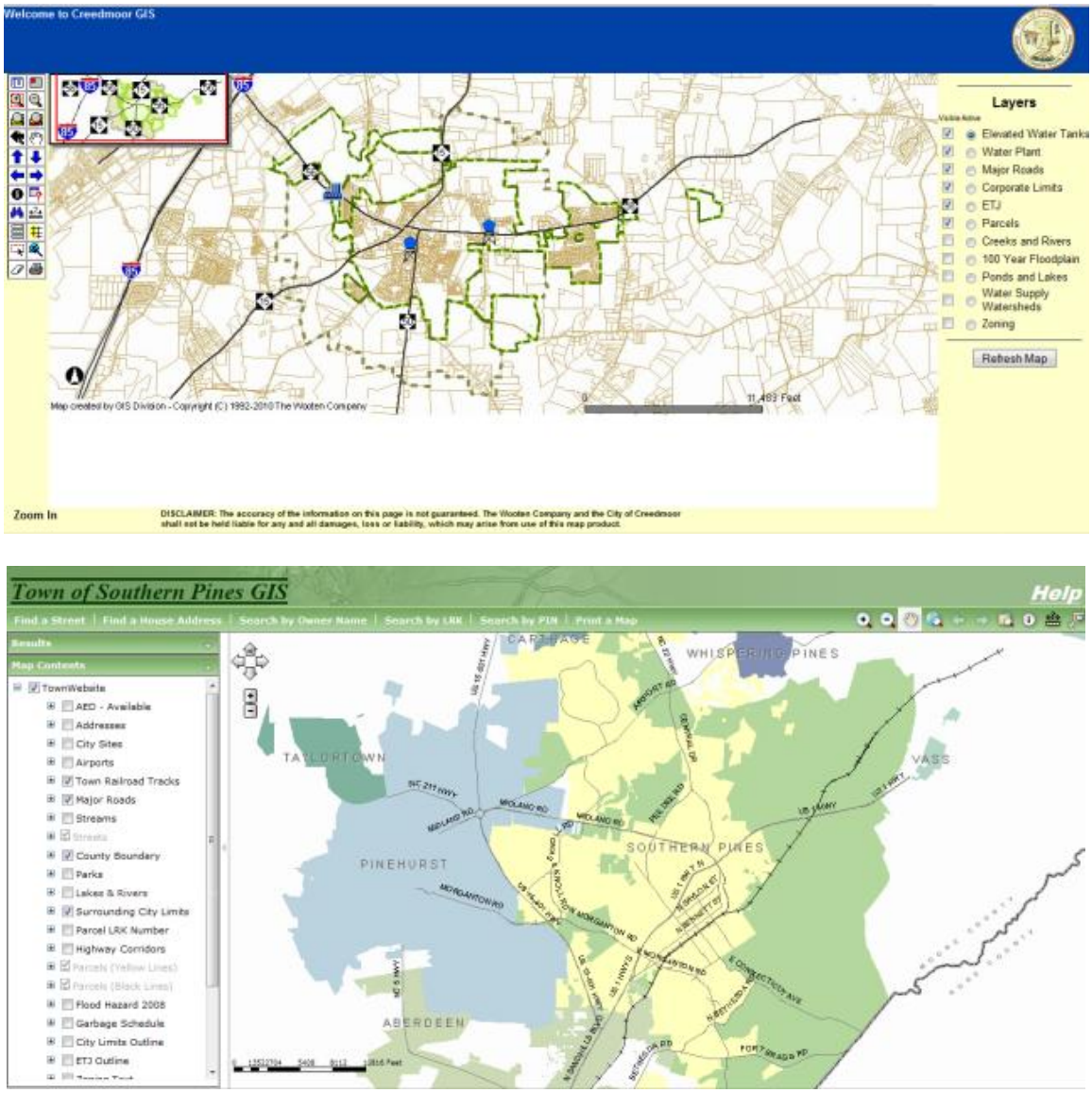

Figure 12: NC municipal web GIS sites

Non-governmental GIS organizations in the state include the North Carolina Arc Users Group (http://ncaug.com/) and the Carolina Urban and Rural Information Systems Association (CURISA) (http://www.carolinaurisa.org/home.php). The CGIA and CURISA are the sponsors of the 2011 NC GIS Conference (www.cgia.state.nc.us/ncgis2011). NCAUG is a co-sponsor along with AT&T North

Carolina, NC Property Mapper Association, NC State University and other educational institution, private companies and professional associations.

GIS in Wake, Lee, Guilford and Robeson Counties

The four agencies examined in this study are Wake, Lee, Guilford and Robeson Counties (Figure 13). The GIS agencies in these counties serve populations of varying sizes and demographic make-up (Table 7). Serving the biggest population, Wake County is the largest agency included in this study, and the agency was able to provide the most complete web traffic data for its web applications (Tables 6 and 7).

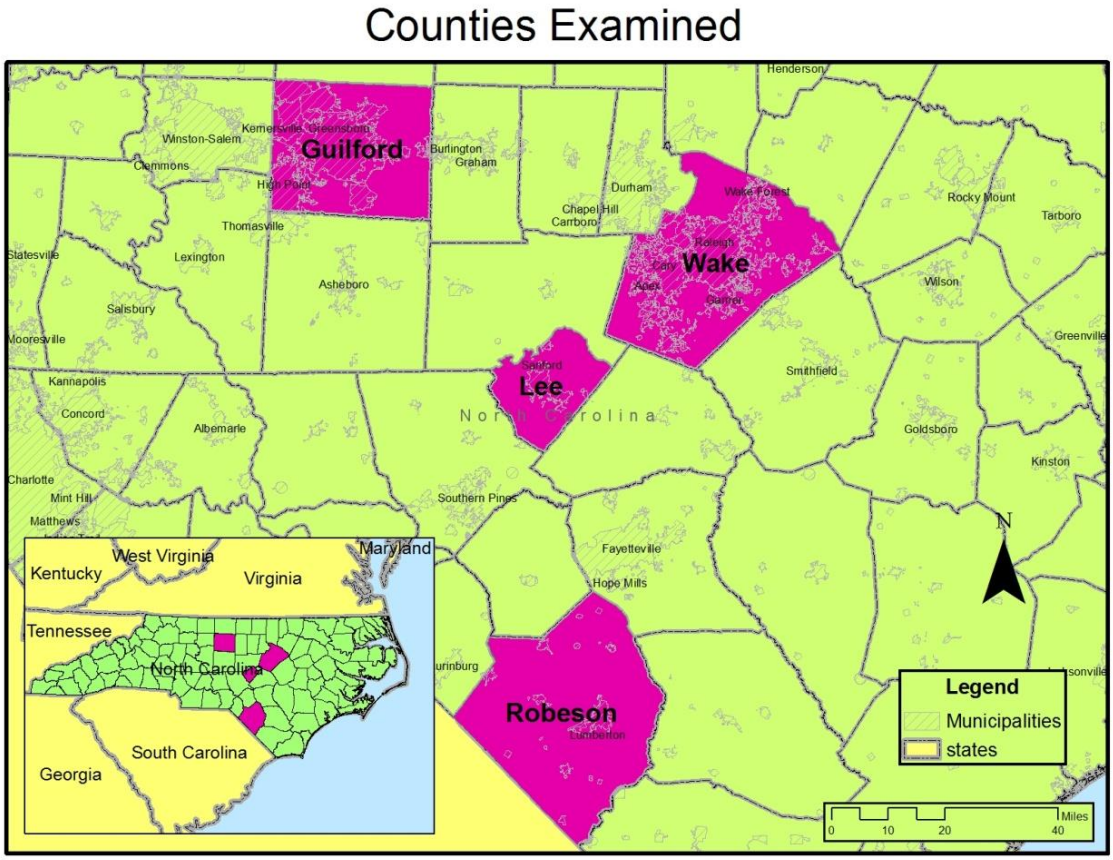

Figure 13: Counties examined

Table 6 *Characteristics of Agencies Studied and Data Collected*

	Wake County	Lee County	Guilford County	Robeson County
Size of GIS staff (FY 2009-2010 Budget)	19*	5	5	7**
Date range of monthly traffic data provided	May 2003 to June 2010	July 2006 to June 2010	May 2009 to June 2010	February 2007 to June 2010
Number of months of data examined	86	48	14	41
FY 2009-2010 Appropriations	$1,662,887	$354,036	***	***

*This number does not include the 8 staff members of Wake County's iMAPS partner – the City of Raleigh.
**Department does tax mapping as well as GIS. Staff includes: three mapping technicians; one tax clerk; one E911 Addressing Coordinator; and, one GIS Technician.
***Unable to separate GIS budget from parent departmental budget

Table 7 *Demographics of North Carolina and the Examined Counties*

	North Carolina	Wake County	Lee County	Guilford County	Robeson County
Population (2009)	9,036,449	897,214	60,477	480,362	129,559
Population, percent change, April 1, 2000 to July 1, 2009	16.6%	42.9%	22.9%	14.1%	5.1%
High degree graduate or higher (2000)	82.9%	91.1%	77.7%	86.2%	68.6%
Bachelor's degree or higher (2008)	25.6%	47.0%	15.7%	32.1%	12.5%
Median household income (2008)	$46,107	$64,527	$43,046	$47,308	$36,133
Median value of owner-occupied housing units (2008)	$145,600	$217,700	$129,800	$151,700	$72,900

Source: U.S. Census Bureau

Wake County

Wake County is home to the City of Raleigh, the state's capital and second most populous city after Charlotte in Mecklenburg County. Raleigh's population was estimated at 405,791 in 2009; Charlotte's population was estimated to be 709,441. The

county is part of the Triangle region which also includes the Town of Chapel Hill – to the west in Orange County – and the City of Durham – in the adjacent Durham County. The presence of three large research universities in the Triangle – the University of North Carolina at Chapel Hill, Duke University in Durham and North Carolina State in Raleigh – fueled economic development in the latter 20th century and this corresponded with a rapid population growth. With the creation of the Research Triangle Park (RTP) and the boom in biotechnology pharmaceutical industries, the Triangle became home to a highly skilled and educated workforce, and since the 1950s, the municipal boundaries of Raleigh and other Wake County jurisdictions steadily have crept outward with urban sprawl as populations have swollen.

The U.S. Census estimated the population of Wake County in 2009 at 897,214. In addition to Raleigh, Wake County municipalities include Cary (2009 pop. est.: 112,414), Garner (2009 pop. est.: 27,525), Holly Springs (2009 pop. est.: 21,743), and Fuquay-Varina (2009 pop. est.: 17,905). When considering population size and characteristics, Wake County is an outlier along with Mecklenburg County in the state because of their large populations and affluence.

Lee County

Lee County is the state's most recently formed county (in 1907) and is situated in the center of the state. A member of the Triangle J Council of Governments, Lee County is located in the southwestern portion of this high growth region. Like Wake County between 2000 and 2009, population growth in Lee County (22.9%) outpaced the rest of the state (16.6%). The largest city in the county is Sanford (2009 pop. est: 29,922).

Guilford County

Guilford County is located in the Triad region of the state, formed by the cities of Greensboro, Winston-Salem and High Point. With a population estimated at 255,061, Greensboro is the county's largest city and is the third largest in the state. Also in the county, High Point is the state's eighth largest city with a population of 103,396 – 101,618 of whom live in Guilford County.

Robeson County

Located in the southeast corner of the state, Robeson County borders South Carolina and is home to a significant population of Native Americans – the Lumbee. The largest city is Lumberton (2009 pop. est: 21,923).

The location of GIS in local government

GIS operations are located in a variety of locations in the organization structure of local governments – according to a May 2010 GICC survey (http://www.ncgicc.com/Portals/3/documents/Location_of_County_GIS_Operations.pdf). Of the 100 North Carolina counties, 29 governments include GIS functioning as part of the Tax Administration/Assessor, 19 in Information Technology/MIS and 13 as stand-alone GIS agencies. The location of GIS agencies varies across the counties included in this study.

Wake County Geographic Information Services

Wake County Geographic Information Services (GIS) is a part of the Community Services department of the Wake County government. From 2004 to 2009, the GIS department employed 20 full-time equivalents (FTEs). In the adopted 2010 budget, the

department lost one position. In that budget document, the mission of the office was described:

> Geographic Information Services has a primary responsibility to develop and maintain core geographic databases needed by our customers. Once the data is accurate, current, and complete, GIS serves as a central distributor for the data and a clearinghouse of the data to and from other agencies. In order to accomplish these two business services, GIS staff provides technical support to our users. This support includes needs analyses, programming/application development, hardware/software support, database development, training, project management, and coordination with other agencies concerning the technical infrastructure and support needed to provide and maintain the information, services, databases, and capabilities that our customers need.
> p. 154, Adopted Operating and Community Improvements Budgets (FY 2010)

Because its staffing has been constant, the percentage of Community Services employees that are GIS personnel has steadily declined over the last six years and the department's funding as a percentage of Community Services funding also slipped downward. In 2004, the GIS department made up 8.08% of the Community Services staff and its expenditures accounted for 9.23% of Community Services expenditures. By the 2010 budget, only 5.96% of the Community Services staff was in the GIS office and in 2009, only 7.01% of Community Services expenditures were on GIS. In real terms, GIS expenditures only increased 8.37% from FY 2003 to FY 2009 (2009 dollars) – from $1,559,971.98 to $1,690,493.00.

City of Raleigh GIS

Wake County GIS offers its interactive, online GIS application in partnership with the City of Raleigh. GIS services are a part of the City of Raleigh's Information Technology (IT) Department. In 2003, seven of 59 departmental employees were designated as geographic information services. In 2004, this number increased to eight of 59. After a departmental reorganization, "geographic information services" was dropped in budget documents as a designation of service area within IT. Currently, the agency has eight employees.

In the FY 2010 budget, GIS services were under the Business Applications Support, one of five divisions with the department. A description of the section's work stated:

> Business Applications includes planning, development, implementation and maintenance of software systems. Web Services manages the city's intranet and internet. The GIS program is responsible for the city's geographic data, as well as the dissemination of GIS technology to other city programs, including Stormwater. Database Services designs and maintains the City's databases. (City of Raleigh, 2010).

Other divisions within the IT department are Customer Relationship Management, Enterprise Infrastructure Management, Administration and Shared Services and Strategy and Planning. Between 2003 and 2010, the number of IT employees increased from 59 to 74.

The FY 2010-2011 budget touts the department's collaboration with Wake County GIS in updating the web application iMAPS.

> Partnered with Wake County to upgrade and enhance the existing iMAPS online mapping application using the latest technologies. The new application includes improved cartography, intuitive navigation, new and improved searches, and access to additional data and enhanced integration to other City and County applications. (City of Raleigh, 2010).

The location of GIS agencies in the other examined county governments varied (Table 8).

Table 8 *Other location of GIS services in study area*

County	Agency	Title of head	Department
Lee County	Lee County Strategic Services	Strategic Services Administrator	Community Development
Guilford County	GIS Department	GIS Manager	Information Services
Robeson County	Tax Office	GIS Coordinator	Tax Administration

Source: County websites, County budgets and interviews

Study Findings

Web Applications

The web application employed by the agencies examined included in-house creations and vendor-created applications.

Wake County and the City of Raleigh

iMAPS (March 2003 to July 2010): http://imaps.co.wake.nc.us/imaps/main.htm?msize=525

iMAPS (April 2010 to present): http://maps.raleighnc.gov/imapsraleigh/index.html

In a joint effort with the City of Raleigh, Wake County deployed an ESRI-created online GIS in May 2001. The first version of the Internet Multi-Access Parcel System (iMAPS) replaced the initial web GIS in March 2003. This version of iMAPS was housed on the Wake County government server.

To explore different groups of data, users could select a view from a list box (Figure 14). Once a view was selected, a list of available layers of data would appear in a right side table of contents and a user could toggle on and off layers. The views available are listed below along with some of the layers contained by each.

- Property (Parking, Vegetation, Parcels, Streets, Zipcode Boundaries)
- Property 2
- Environmental – Septic (Solid Waste Facilities, Septic Points, Soils)
- Environmental – Topo (Creeks and Rivers)
- Aerial Photography (2006 Color Orthos: Raleigh only, 1999 Color Orthos: County-wide)

- County Zoning (Angier Zoning, Apex Zoning, Morrisville Zoning, Cary Watershed Zoning Overlay)
- Raleigh Zoning (Airport Overlay District, Downtown Overlay District, Pedestrian Business Overlay District)
- Electoral Districts (Polling Places, Voting Precincts, Wake County Commissioner Districts, Raleigh City Council Districts, Wake County Superior County Judge Districts, US Congressional Districts)
- Administrative Districts (Townships, Corporate Limit Boundary)
- Park and Greenways (Wake Count Openspace, Raleigh Greenways, Raleigh Parks)
- Cultural Facilities (Libraries, Schools)
- Demographic (Census Tracts – 2000, Census Block Groups – 2000)
- Public Safety (EMS Stations, Fire Stations, Sheriff Zones, Garner Police Beats, Fire Insurance Districts, County Fire Response Districts)
- Transportation (Rail lines, Airports, Major Roads, Streets)
- Raleigh Planimetrics (Raleigh Trails, Raleigh Railroads, Raleigh Communication Features, Raleigh Building Footprints, Raleigh Utility Structures)
- Raleigh Trash and Recycling Collection (Yard Waste Collection Routes, (Trash Collection Routes, Collection Day)
- Raleigh Development Plans (Raleigh Development Plans)
- Raleigh Crime Data (Arson, Larceny, Motor Vehicle Theft, Robbery, Homicide, Raleigh Police Beats)

In a property view, a user was able to zoom in and select a parcel. The right-side sidebar then would display information about the property including: Building Footprints; subdivision information; parcel number; and to what planning jurisdiction the property belongs. Clicking on the hyperlink "Surveys, Plats & Deeds" would take the user to the Wake County Register of Deeds website Books where they could type in the parcel number and view ownership information and digitized versions of deeds (Figure 15).

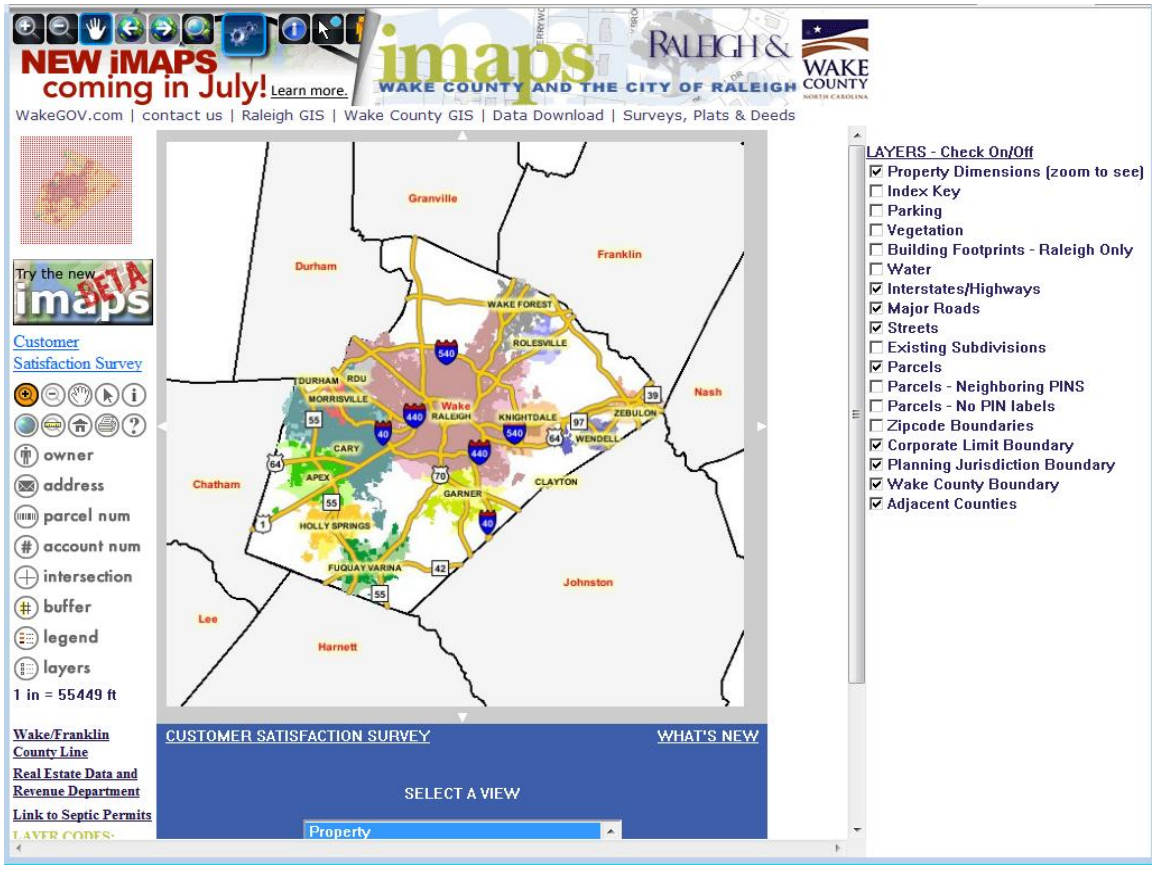

Figure 14: "Old" iMAPS

Figure 15: Wake County Register of Deeds website

In April 2010, the City of Raleigh and Wake County GIS rolled out an improved iMAPS web application in beta (Figure 16). In July 2010, the "new" iMAPS site became the main application while the "old" iMAPS was planned to be retained until the end of July. The newer version is hosted on the City of Raleigh government server.

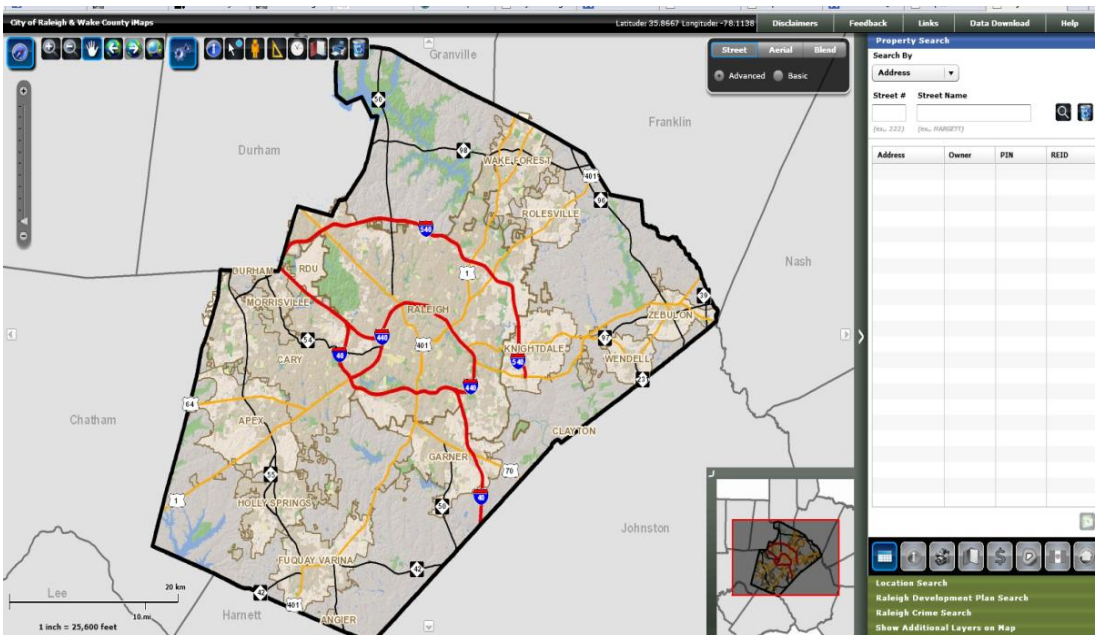

Figure 16: The "new" iMAPS web application

The improvements made included:

- Link to the Wake County Real Estate website with your selected parcel's record selected
- Link to the Register of Deeds application showing scanned documents available for the selected parcel
- Links to related websites from within the application
- Measure Distance & Area Tools
- Print to PDF
- Print to Scale
- Spatial Bookmarks
- Resizeable Map (when you click the arrow between the map and the search panel, the map will resize to fill the whole screen)
- Improved cartography
- Improved Searching:
    - Improved Address Search
    - Improved Find Intersection Tool
    - Search by Subdivision
    - Search by Common Place Name (RBC Center for example)
- Latitude & Longitude (reported as you scroll over the map)
- Intuitive navigation
- Improved Help Document

Source: http://imaps.co.wake.nc.us/imaps/

Property details are displayed in a side toolbar when a property is selected (Figure 17). Users can toggle on other layers. Clicking on a location's icon will bring up a pop-up with more information (Figure 18).

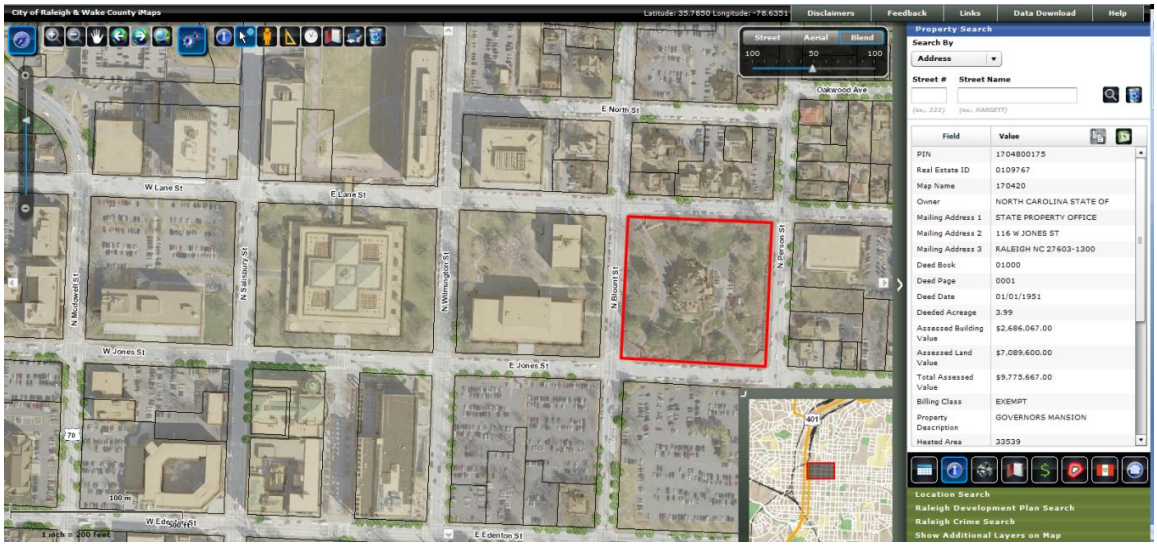

Figure 17: Downtown Raleigh (the North Carolina Executive Mansion selected)

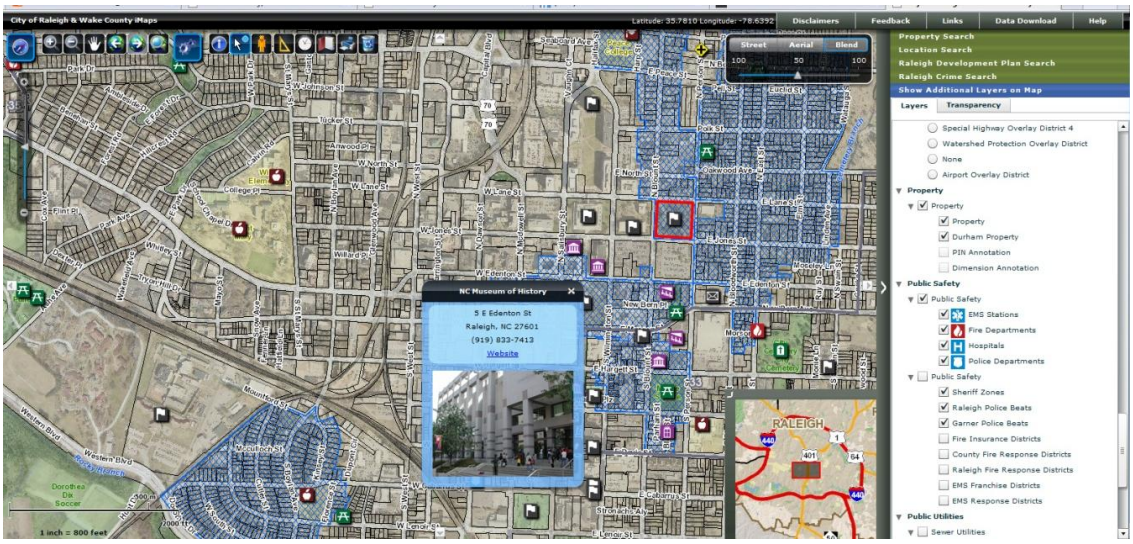

Figure 18: iMAPS pop-up (North Carolina Museum of History selected)

Lee County

Agency URL: http://www.leecountync.gov/Departments/GISStrategicServices.aspx

Lee County ConnectGIS: http://lee.connectgis.com/Default/Default.aspx

Lee County began using a web GIS in 2002 (Figure 19). Items on the main toolbar allow a user to zoom in and out, pan, view information about a feature, print map, download currently displayed data (as a shapefile), download georeferenced image of currently displayed data, measure an area of the map and zoom to a specific scale (Figure 20).

Layers included:

- Infrastructure (Water Mains, Water Main Appurtenances, Broadway Waterlines, Sewer Mains, Sewer Manholes, Thoroughfare Plan, Gas Line, Railroad, 421 Bypass, Sidewalks, Driveway)
- Info Layers (Parcels, Parcel Text, Streets, Zoning, Brownfields, Volunteer Ag District, 10 Mile EPZ)
- Jurisdiction (Lee County, Sanford City Limits, Broadway Town Limits, Extra Territorial Juris, Townships, State Development Zone, Central Business District, Annex Historical, Historic Districts)
- Schools (High School Districts, Middle School Districts, Elementary School Districts, School Locations)
- Census (Census Tracts, Census Block Groups, Census Blocks)
- Political (Voter Precincts, Commissioner Districts, Council Wards)
- Natural (Hydrography, Soils, Watersheds, Land Use, 2ft LIDAR Contours)

- All Other Layers (Zipcode, Public Parks, Building Footprints, Law Beat, Fire District)
- Aerial Photography (2009 Orthophotos, 2006-2008 Orthophotos, Orthophotos)

Figure 19: Lee County's web GIS

Figure 20: Downtown Sanford (historic Railroad House Museum selected)

Guilford County

Agency URL: http://www.co.guilford.nc.us/departments/gis/

Guilford County GIS Data Viewer (since 2002):

http://gcgis.co.guilford.nc.us/guilford_new/

Guilford County has had an interactive, web presence since 2002. Guilford County's Data Viewer went live in 2003 (Figure 21). Toolbar options allow the user measure distances, identify, zoom in and out, pan, measure, and print screen (Figure 22). User also can search for parcels by owner name, parcel address, parcel number, legal description and PIN. The select by attribute tool on the Selection menu allows the user to create complex selection queries. A user can toggle on a variety of layers (Figure 23).

Layer included:

- Administrative Boundaries (County Boundary, Surrounding Counties, City Limits, NCGS County Line Proposal)
- Aerial Photography (2008 Guilford County Aerial Photography, 2008 Greensboro Aerial Photography, 2007 Greensboro Aerial Photography, 2002 Aerial Photography, 1995 Guilford County Aerial Photography)
- Elected Representation (Polling Places, Voting Precincts, US Congress, NC Senate, NC House of Representatives, Commissioner & School Board, Superior Court)
- Elevation/Topography/Contours (2' Contours, 5' Contours, 20' Contours, 10' Contours)
- Environmental Health (Septic Evaluation Sites, Soil Core Site, Well Inspections)

- Hydrology/Water (Detailed Streams, Streams, Flood Zones, Major Lakes, Watershed Tier Boundaries, General Watershed Areas)
- Land Records (Parcels)
- Map Grids & Control (State Plane Grid – 400’ Scale Map Index, State Plane Grid – 200’ Scale Sheet Index, ACL Grid – Used for Parcel Numbering)
- Soils/Geology (Detailed Soils)
- Transportation (Highways, Urban Loop, Railroads, Streets, Proposed I-73 Corridor, Proposed US 311 BYP Location, Proposed Urban Loop I-840 Location)
- Zoning and Land Use (County Zoning, County Zoning – Lines, Land Use, Voluntary Agricultural District)

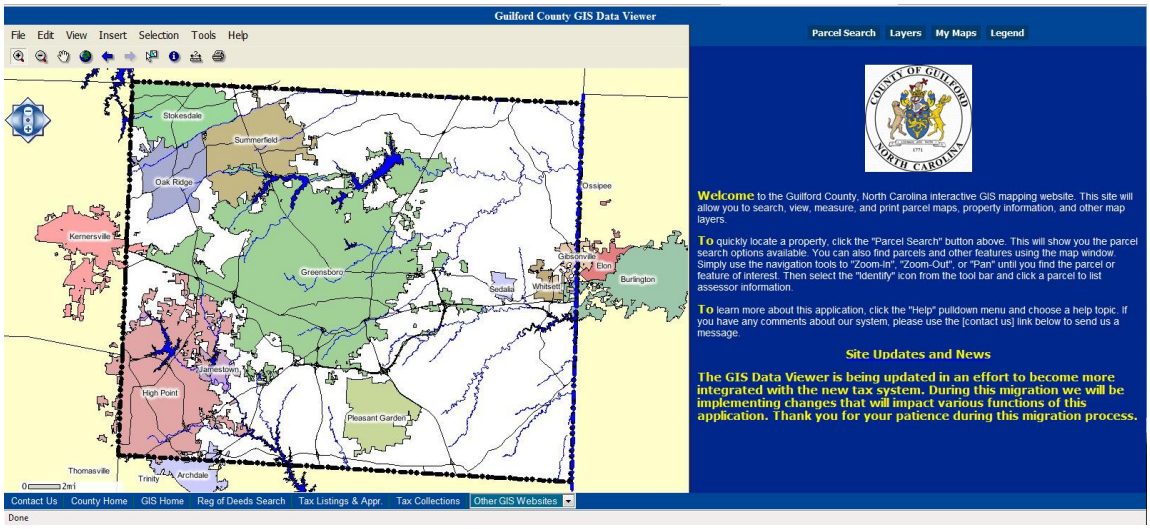

Figure 21: Guilford County Data Viewer

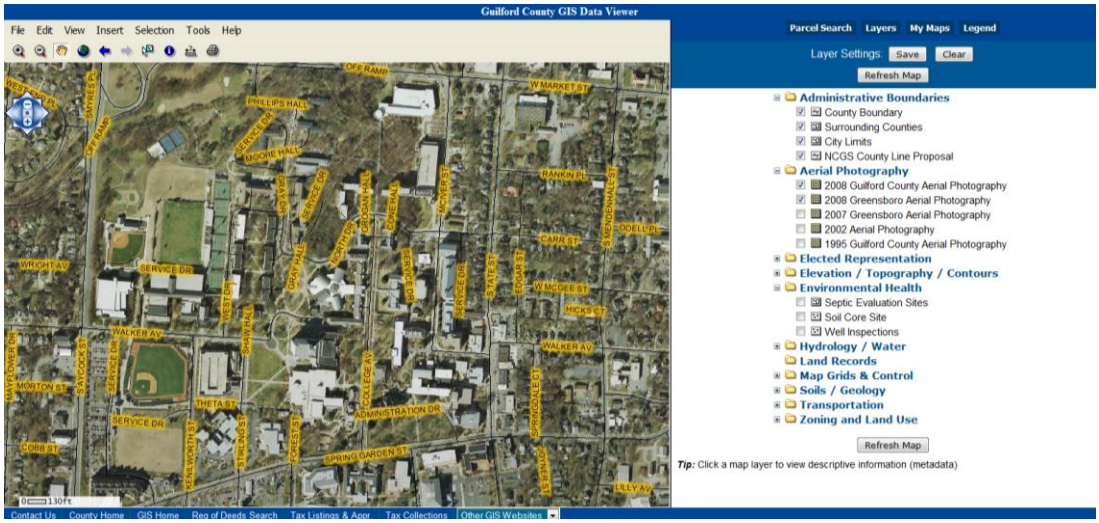

Figure 22: The University of North Carolina at Greensboro

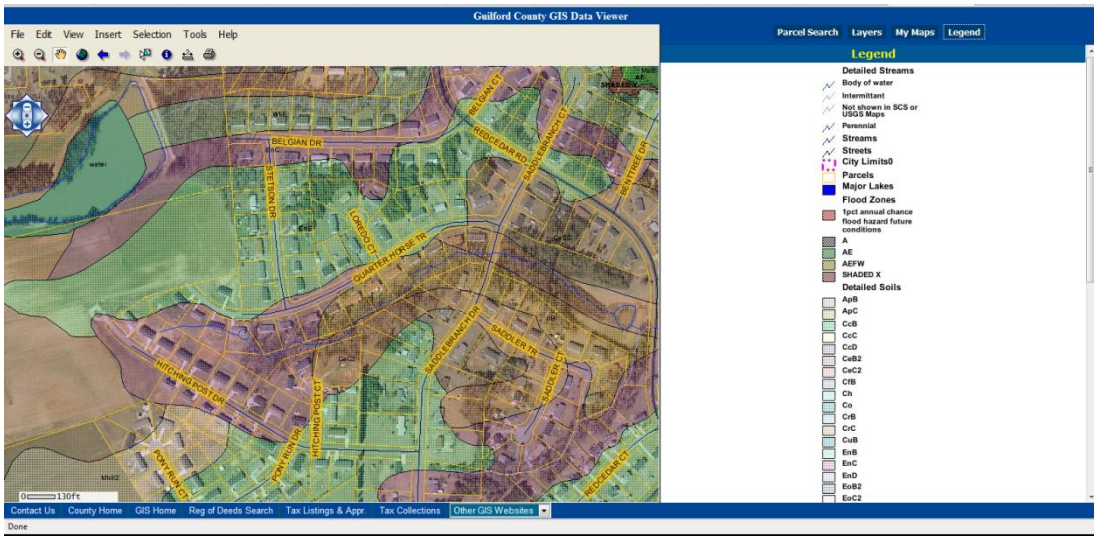

Figure 23: Guilford County. Flood Zones, Detailed Soils and Streams Layers On.

Robeson County

Agency URL: http://www.co.robeson.nc.us/taxgis.htm

Robeson County ConnectGIS (since 2005):

http://www.gis.co.robeson.nc.us/ConnectGISWeb/Robeson/

Robeson County introduced a web GIS in 2005. On the current interface, items on the main toolbar allow a user to zoom in and out, pan, view information about a feature, print map, download currently displayed data (as a shapefile), download georeferenced image of currently displayed data, measure an area of the map and zoom to a specific scale (Figure 24 and 25). User also can toggle on map layers (Figure 26).

Layers included:

- Orthophotography (2008 Orthos, 100 Scale Orthos, 200 Scale Orthos, 400 Scale Orthos)
- Parcel Information (Parcels, County Zoning, Dimensions)
- Base Data (Streets, City Limits, Zoning ETJ, 5 ft contours, Flood Hazards, Canals, Drainage, Schoolboard Districts, Commissioner Districts, Public Schools, Fire Stations, County Line)
- Overlays (Subdivisions, Fire Districts)

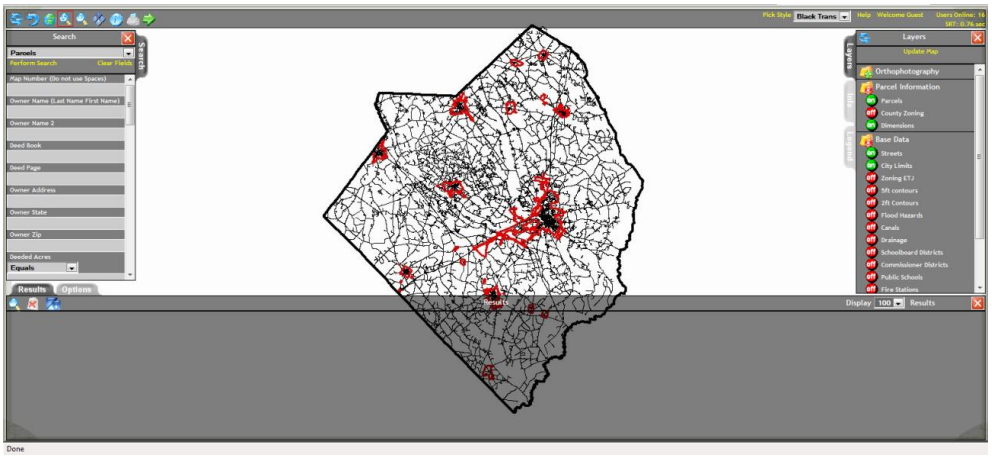

Figure 24: Robeson County's web GIS

Figure 25: A Robeson County parcel selected

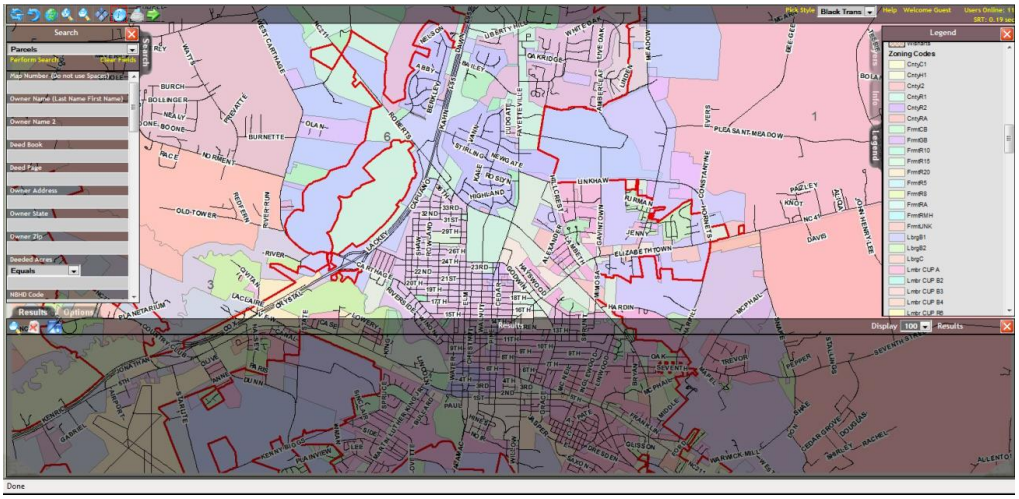

Figure 26: Lumberton. County Zoning Layer

Analysis of website traffic

Web traffic data for examined web applications were collected by directly contacting each agency. Formats submitted included portable document format (pdf) reports and Microsoft Excel workbooks. Collected data were analyzed using Microsoft Excel 2007.

Analysis of web traffic data showed no consistent pattern across the examined counties. Variations in traffic patterns between counties are likely the result of differing real estate market conditions over the time periods considered. Variation in traffic over time within a county similarly is likely the result of changing economic condition and specific events – like property revaulation. North Carolina General Statue 105-286 mandates counties reappraise real property at least every eight years.

Wake County and City of Raleigh

The data for this paper – monthly web traffic reports – were downloaded from a county FTP site after being placed on the site by a Wake County GIS staff member. Between May 2003 and February 2010, Wake County received monthly WebTrends reports on web traffic. These reports were submitted as Microsoft Word documents. Statistics included in these 47-page per month reports included: Top Pages; Top Documents; Top Entry Pages; Top Geographic Regions; Most Active Cities; Activity Level by Day of the Week; Top Browsers; and other metrics.

Beginning in March 2010, the county began receiving Google Analytics web traffic reports. These reports were submitted as pdf documents.

The WebTrends report included the following definitions of its metrics:

> **Unique Visitors**- Individuals who visited your site during the report period. If someone visits more than once, they are counted only the first time they visit.
> **Visits** - Number of times a visitor came to your site. If a visitor is idle longer than the idle-time

limit, WebTrends assumes the visit was voluntarily terminated. If the visitor continues to browse your site after they reach the idle-time limit, a new visit is counted. The default idle-time limit is thirty minutes.
Views - Number of times the specified page was viewed by a visitor. Each page can be viewed more than once by the same visitor, and each view is counted. If you want to ignore repeated page views by the same visitor, look in the Visits column.

Total traffic on the original iMAPS site – including pages other than the interactive map – increased over its 7-year deployment (Figure 25).

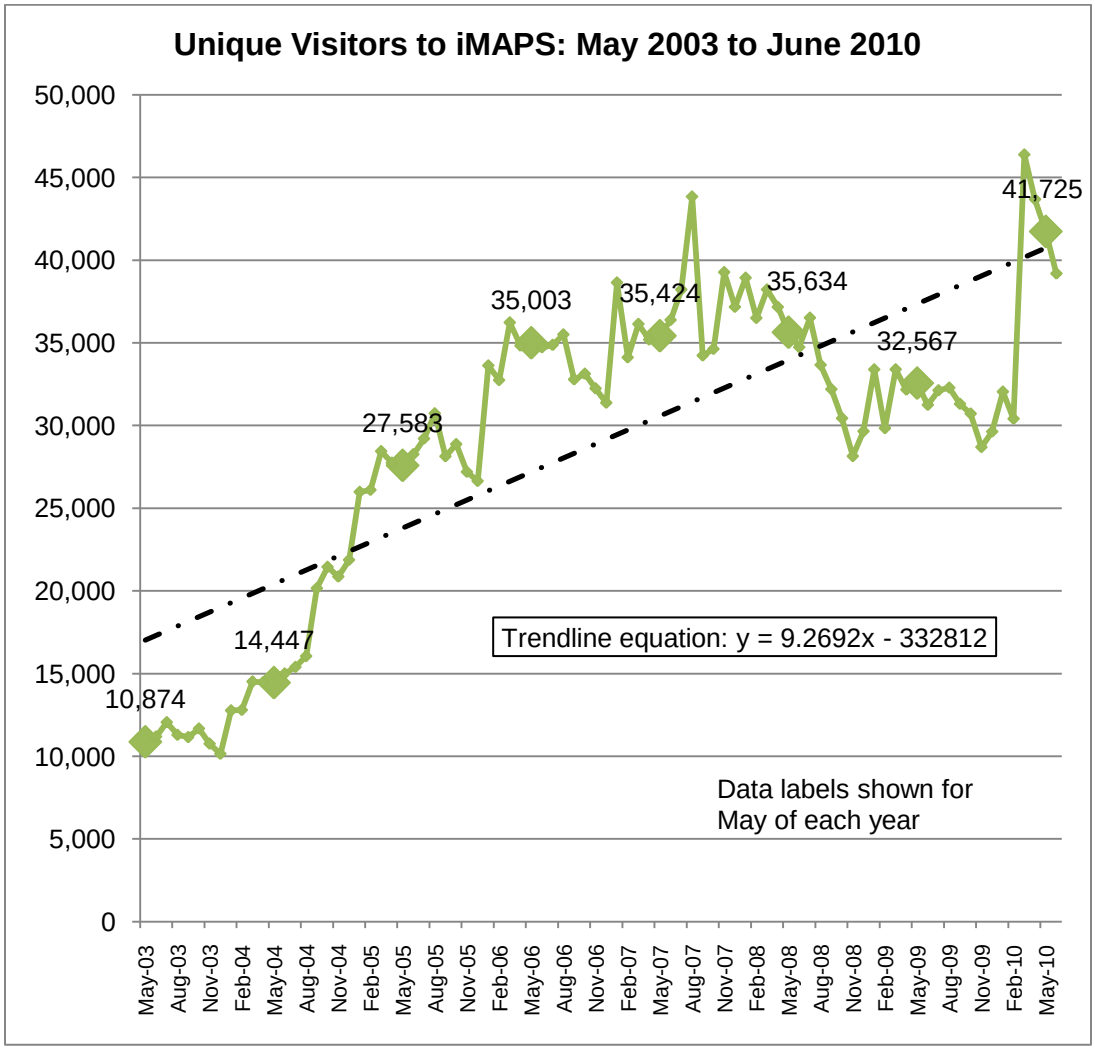

Figure 27: Unique Visitors to iMAPS site

The visits to the iMAPS map interface generally increased between May 2003 and February 2010 and the page was the most popular dynamic page on the iMAPS site (Figures 26 and 27). WebTrends reports define "Dynamic Pages" as "Pages that are generated from a database based on values selected by a visitor… [t]hey are generated with variables, and do not exist anywhere in a static, predictable form." The peak of the traffic in visits corresponded with discussion of the 2008 revaluation of Wake County property values. In the 2008 revaluation, Wake County property values rose by an average of 43 percent (WRAL). With the switch to Google Analytics monthly, the views of individual pages were no longer tracked. The last month for such data was February 2010.

In April 2010, the new iMAPS site was launched. The original iMAPS site and the new version were deployed contemporaneously between April 2010 and July 2010 (Figure 28).

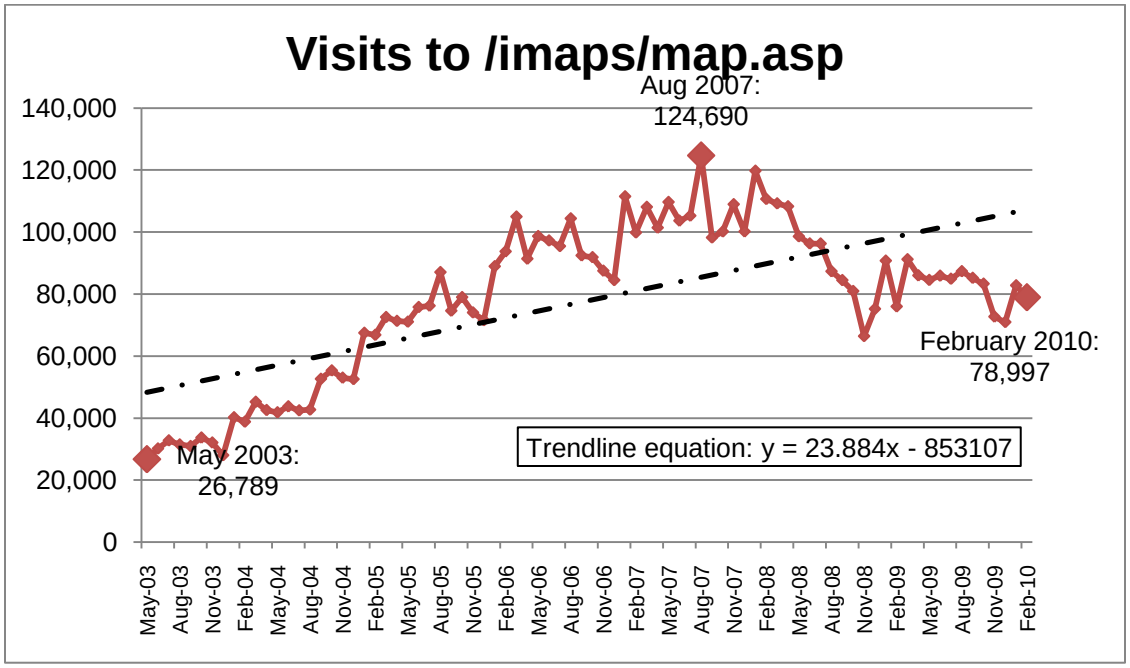

Figure 28: Visits to /imaps/map.asp

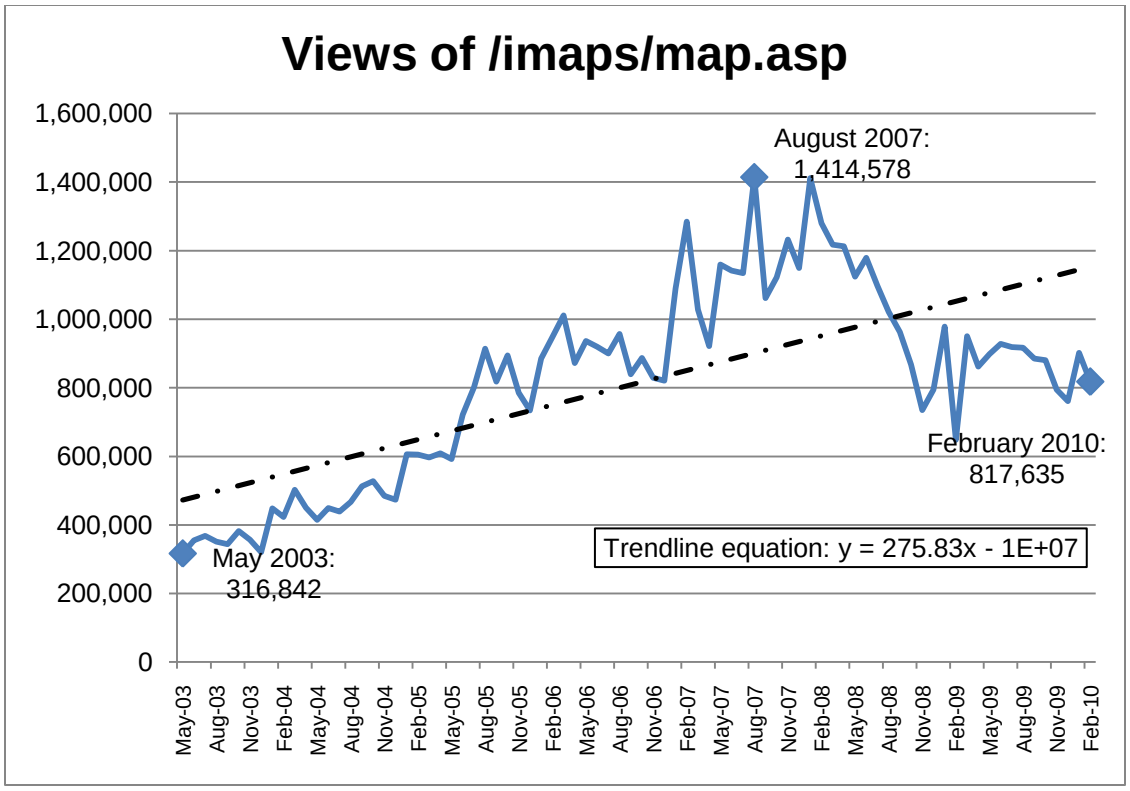

Figure 29: Views of /imaps/maps.asp

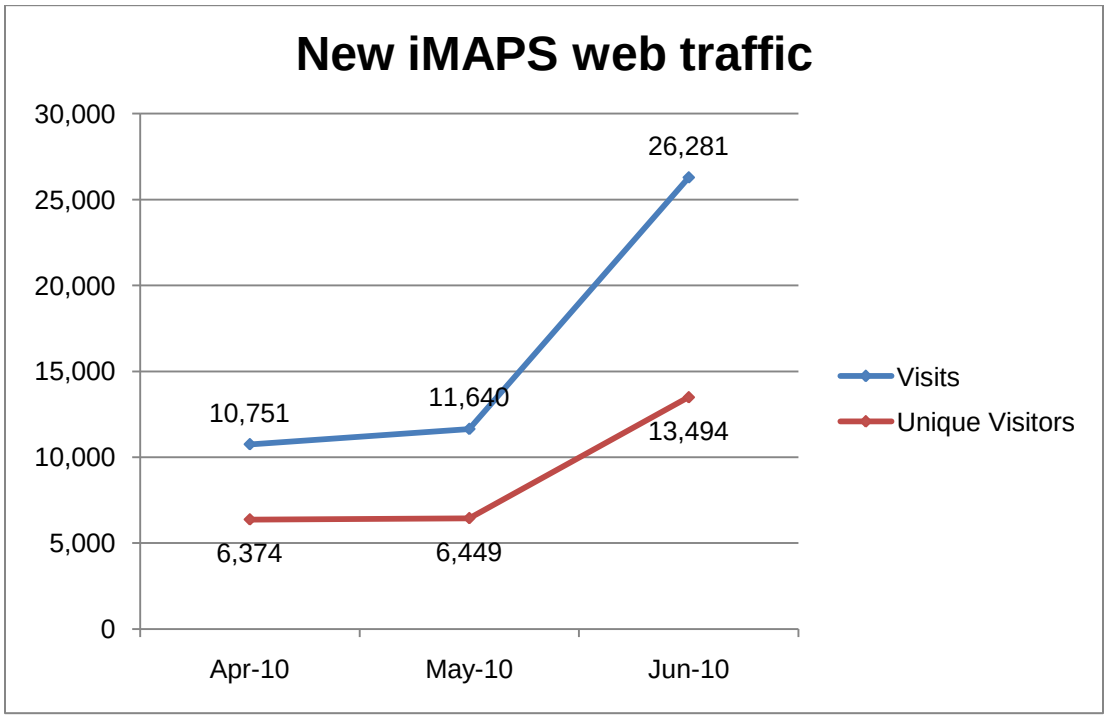

Figure 30: New iMAPS web traffic

Lee County

Lee County web traffic data was supplied via email in the form of a Microsoft Excel spreadsheet. Data range was July 2006 to June 2010, and the data supplied to this study only included "visitors" and "hits". In web traffic analytics, a "hit" refers only to a request for a file – including requests for images – and so "hits" are not seen as a reliably indicative of site traffic as individual pages may contain varying amounts of graphics.

The spreadsheet also included total hits and user per fiscal year as well as average hits per month, cost per hit, cost per user and hits per user.

The hump in the web traffic on the Lee County GIS site also corresponds with revaluation (Figure 29). Lee County's revaluation of property went into effect on January 1, 2007.

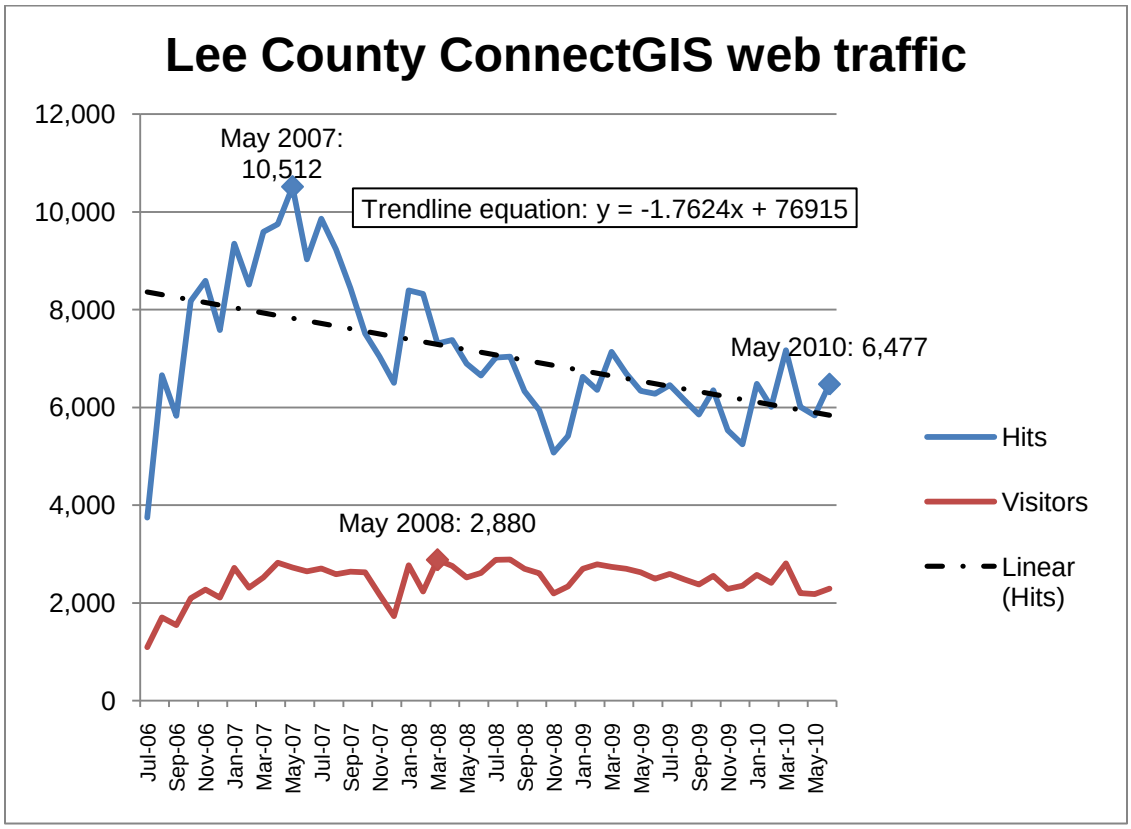

Figure 31: Lee County Connect GIS web traffic

Guilford County

Guilford County also supplied its data via email. The agency supplied weekly Google Analytics reports in pdf form from the week of April 27, 2009 to July 19, 2010. The agency also submitted a Microsoft Excel workbook containing data on other Guilford County sites including the GIS FTP site in addition to the data contained in the pdf reports. Data was grouped by month to produce Figure 30.

Traffic on the Guilford Data Viewer website generally remained flat between May 2009 and June 2010. The county did not undergo revaluation during this 14-month span. Real property in the county last underwent revaluation in 2004 and is scheduled to be revalued in 2012.

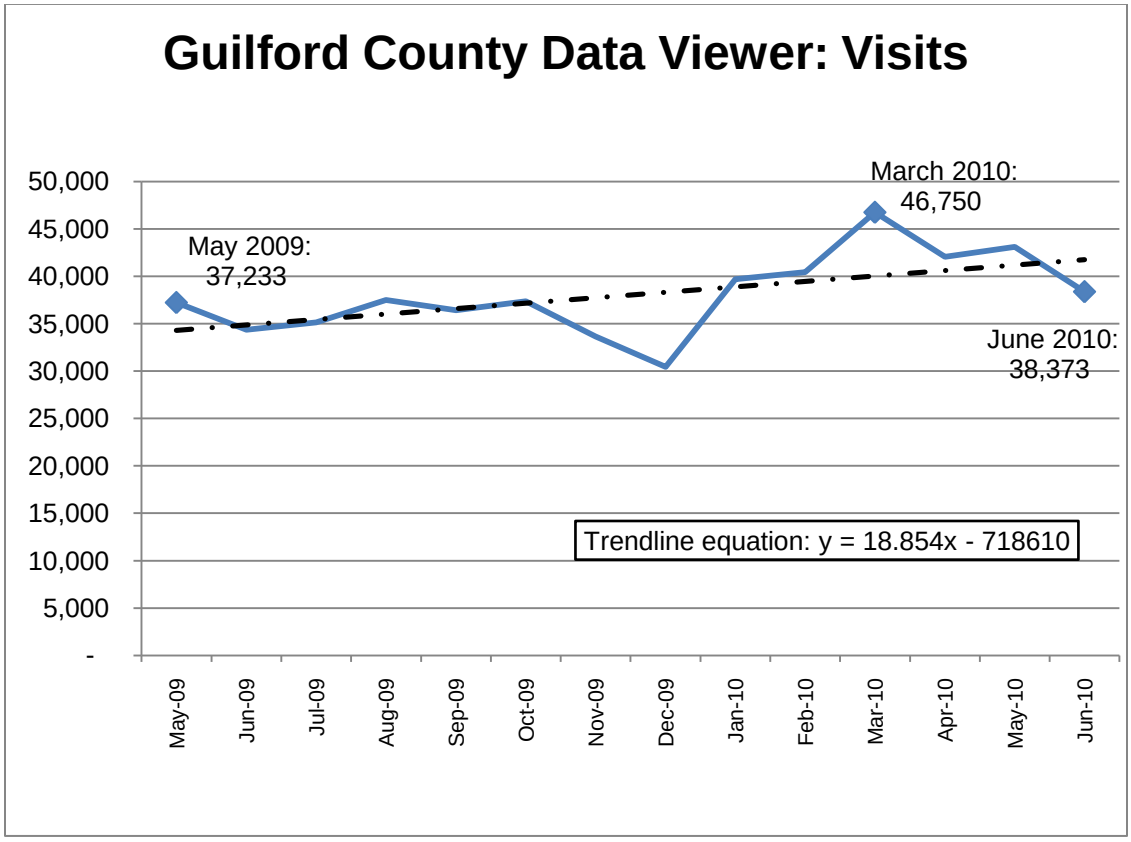

Figure 32: Guilford Data Viewer: Visits

Robeson County

Web traffic data for Robeson County also was received via email in the form of a Microsoft Excel workbook. The workbook contained a record for each visit the site received that included the date of the visit. Dates ranged from February 22, 2007 to July 29, 2010. The records were grouped by month to produce Figure 31.

Traffic on the Robeson County GIS site remained constant between February 2007 and June 2010.

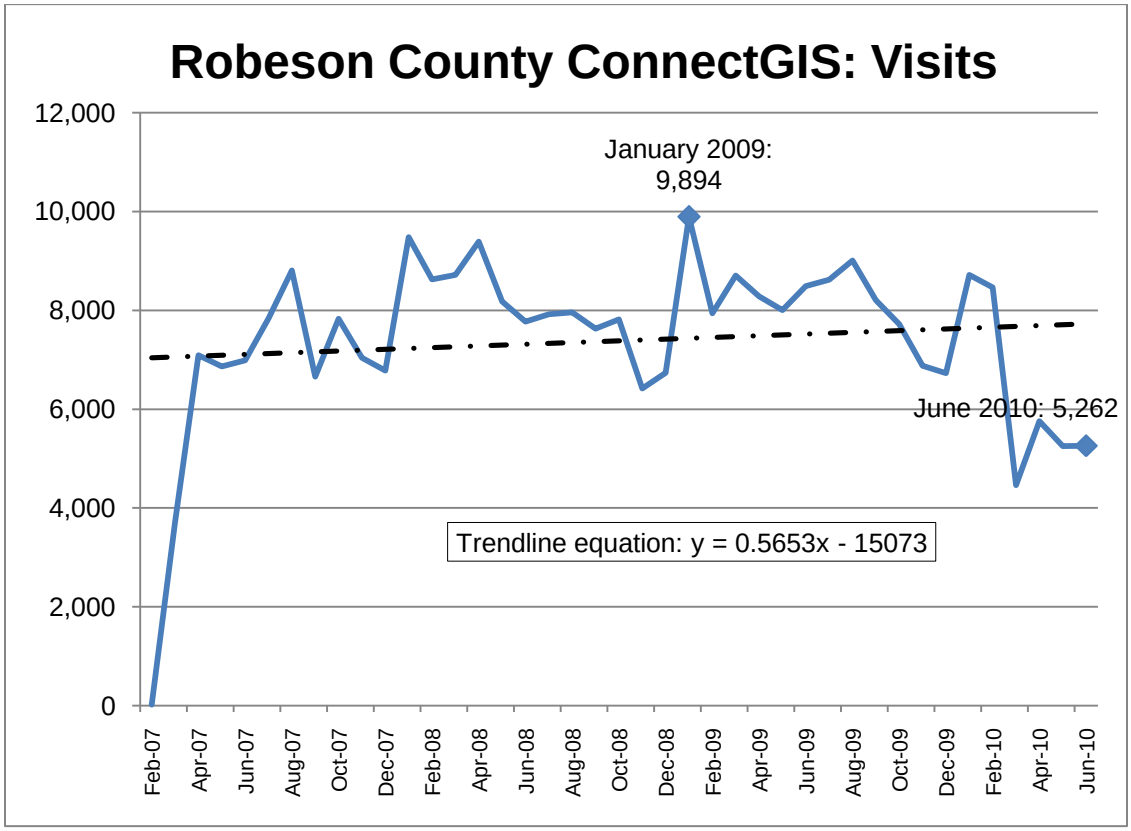

Figure 33: Robeson County ConnectGIS: Visits

Changes to organization

Staff members of all four examined local GIS agencies and the City of Raleigh participated in interviews during October 2010. The seven interviews were semi-structured and conducted over the telephone. Questions centered on five main areas: 1) the impetus for deploying a web GIS service; 2) the impact of this change on staff functioning; 3) the impact of this change on agency users; 4) changes in technical and human resources; and 5) anticipated future directions for the web mapping site.

The impetus

Interview participants frequently stated that a major reason for deploying a web GIS was to decrease walk-in customers and the amount of time spent on in-person customer service. A decrease in walk-in traffic to the GIS office has been achieved across all four agencies, according to interviews. For example, the number of Wake County's walk-in customers has fallen precipitously over the last seven years although the number of telephone calls with employees has remained constant (Figure 32). Lee County has experienced a decrease in walk-ins and telephone calls. Prior to the agency deploying the web GIS, "The phone rang constantly", a Lee County interviewee stated. Now phone call volume has declined. Guilford County's walk-in traffic fell greatly as well. The agency has seen an uptick in telephone calls.

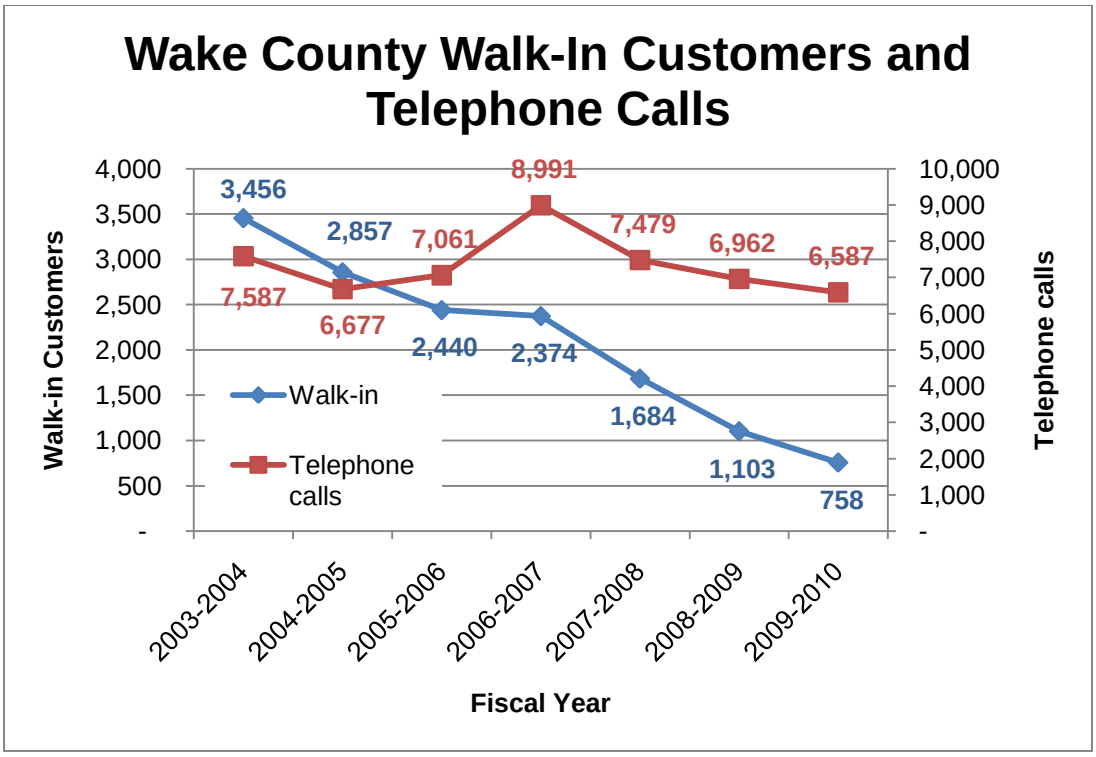

Figure 34: Wake County Walk-In Customers and Telephone Calls

Chief external users of local GIS agency services are developers, real estate professionals, surveyors, lawyers and insurance companies. Interviewees reported that most of the pre-web GIS time spent on face-to-face customer assistance was spent pulling data such as flood plain maps or topographic maps. The need for this work has diminished because now customers can view data at "8 p.m. on a Saturday night" and from "anywhere in the world". Reduced foot traffic also decreases pressure for more office space and parking lots for visitors.

Reasons for "going online" and improving online offerings often were linked to customer expectations and the activity of other local GIS agencies. The movement to web GIS was a "logical next step" for agencies since "everyone was going online". Another interviewee said concisely, "It was how everybody was going". Many linked the

shift to customer expectations. As technology moves forward, government web services must keep up with Google, one interviewee said, since customers are often well-acquainted with the functionality of Google Maps and Google Earth.

Impact on staff

The most immediate impact of the decline in walk-in visits was the freeing up of staff members' schedules to work on special projects. Projects mentioned as benefiting from more staff hours included putting online digitized historical orthoimagery for eight different years since 1938 and providing additional service to other county departments. A Lee County interviewee reported that, with the drop in foot traffic, more staff time can be devoted to creating new layers and ensuring the quality of existing layers. Other interviewees echoed this appreciation of the greater ability to focus staff time on quality assurance/quality control (QA/QC).

Beyond freeing up of staff to engage in more projects, some agencies reported little additional change in organizational functioning since deployment. Others reported an augmentation of staff roles. These agencies indicated that staff members had taken on new customer service roles and data integration roles because of the offering of web GIS services. One interviewee broke these new roles into four hats: 1) information broker; 2) hardware/software/application troubleshooter; 3) information integrator; and, 4) data and application educator/trainer. Others in their comments used similar language in describing new staff roles, and this four part frame provides useful buckets for chunking reported agency experiences.

- With the web GIS serving as a portal to many government services, staff members have become *information brokers* and now must match users

with geospatial data and other government data that meets customer needs. Like a reference librarian, employees must help pinpoint an user's need and direct them to the appropriate source – even if the source is a non-GIS agency offering. This role requires staying abreast of other agency services. All the web GIS sites examined link out to other government services such as the Register of Deeds website. In the words of one interviewee, this connection makes the GIS agency "responsible" for data that "we don't have control over" and necessitates an understanding by staff members of where the other data comes from and who to contact if data quality issues are raised.

- *Technical troubleshooting* is another new role for staff as they need to diagnose whether an error being encountered by a site user is a flaw in the website or a software issue for the user. Issues on the user's end could be an outdated version of WinZip, a missing Flash Plug-in or old operating system. New users often sometimes are unaware of what technology is required to use web GIS sites.
- Staff members also served as *information integrators* because the web map interface can serve as a portal for citizens seeking information about county services. Staff members now must work with other agencies to link data from the distributed system of local government information silos into a single user interface.
- Given the potential for new users to become bewildered with the evolving web interfaces and functionality, staff member have become *data and*

> *application educator and trainers* and often must coach users on how to use the web GIS. GIS technicians in some departments have held training sessions for internal and external users.

Because of this new educator role taken on by staff members, agencies themselves are trying to get "ahead of the game" and supply site users with information on how to use the web GIS applications. Interviewees reported that agencies do provide "how to" guides on their sites but users often ignore these documents (Table 9). Wake County interviewees said that they planned on responding to user need by providing video tutorials on the site. The agency also has begun a quarterly iMAPS newsletter to publicize application updates and an online survey to collect user feedback. Survey questions ask: 1) about what site the user is providing feedback (new or old iMAPS); 1) how often the user utilizes iMAPS; 3) whether the user plans to use iMAPS again; 4) overall satisfaction; 5) user profession or status (appraiser, citizen/personal use); and 6) what the user would like seen changed or added to iMAPS. The final question is a free response. The survey is done through Survey Monkey (http://www.surveymonkey.com/).

The need for such outreach comes from the fact that web application development is fundamentally different than developing an application for in-house use. One interviewee referred to this process as "non-traditional application development" because programmers are "developing for anonymous people" – the mass general public. In "going external", agencies' lose control of a user's experience. There is little prototype and beta testing before the site is live. In web browser application development, developers engage in "reactive development" in which enhancements are made after input from "real" users.

One member of an agency without formal user surveying practices signaled a desire to explore such methods.

Table 9 ***User help tools and documentation and other outreach efforts***

Agency	Customer interaction tool	URL
Wake/Raleigh	iMAPS Help Doc	http://www.wakegov.com/gis/iMAPS.htm
Wake/Raleigh	iMAPS Quickstart	http://www.wakegov.com/gis/iMAPS.htm
Wake/Raleigh	iMAPS Newsletter	http://www.wakegov.com/gis/iMAPS.htm
Wake/Raleigh	iMAPS Survey	http://www.wakegov.com/gis/iMAPS+Survey.htm
Guilford County	Guilford County GIS Data Viewer	http://www.co.guilford.nc.us/departments/gis/notices.php
Lee County Strategic Services	Lee County GIS Help Page	http://lee.connectgis.com/Help/Default.aspx
Robeson County	Robeson County GIS Help Page	http://www.gis.co.robeson.nc.us/ConnectGISWeb/Help/

Impact on users

Web GIS has not led to a dramatic shift in the type of local GIS users. The users generally have remained land developers, attorneys, and insurance agents. One interviewee estimated that post-development the "vast majority" of site hits were from developers looking for information on soils or the extent of water and sewer services. While developers remain a core user group, the same interviewee said, "I am sure that we have lots of people checking to see what the tax value is of their neighbor's house".

One interviewee characterized the public's response to interactive mapping site as "overwhelmingly positive" as websites allow for 24 hour a day, 7 days a week access to data. Although foot traffic to agencies has decreased, some agencies reported that they receive more calls about how to use the interactive maps. Users also have taken on a new

role – data quality checkers when they alert agencies to inaccuracies in the data. The agencies also benefit from having "more eyes" on the data, according to interviewees.

Only one interviewee spoke about concern about privacy. These concerns are "less than you would think" but "does make some people nervous". The interviewee reiterated that all the data posted online always have been available from the courthouse. In the age of web GIS, the effort required to view property information is much lower than the world of paper maps and brick-and-mortar buildings. Belanger and Hiller (2006) noted this potential for unease when public information is too easily accessible.

Changes to human and physical resources

The number of staff members at each agency has not changed significantly since web GIS deployment. One interviewee said his agency's staff was "remarkably stable". While job roles may have changed in some instances, on the whole agency staff levels have varied little over the last decade. As budgets allow, agency staff members do attend trainings to keep up with changing best practices.

Like any popular and well-used technologies, web GIS technologies continue to evolve. Initial costs incurred in deploying a web GIS included software licenses and servers. To maintain services in a changing technical environment, interviewees spoke of the need to invest in some database upgrades and investigate new development platforms (e.g., Microsoft Silverlight). Recently this continual technical evolution and agency adjustment can be seen in the replacement of ESRI's ArcIMS (Internet Map Server) with ArcGIS Server (ArcIMS: http://www.esri.com/software/arcgis/arcims/index.html; ArcGIS Server: http://www.esri.com/software/arcgis/arcgisserver/index.html). ESRI

released ArcGIS 10 in summer 2010. ESRI's October 2010 "Deprecation Plan for ArcGIS 10.0 and ArcGIS 10.1" stated:

> ArcGIS 10.0 was the last release of ArcIMS; we will no longer ship ArcIMS in releases after ArcGIS 10.0. With the adoption of ArcGIS Server and the move to 64-bit servers, ArcIMS is no longer the recommended product for producing web maps. While no longer shipped as part of ArcGIS, the current version of ArcIMS (version 10.0) will be continued to be supported as part of the ArcGIS 10.0 lifecycle. (ESRI, 2010, p. 2)

Such evolution requires upgrades. In its explanation published online on why it had changed iMAPS, Wake County GIS stated the decision was made because:

- We strive to maintain stable products and services for our customers. We haven't changed the design of iMAPS for seven years.
- Our GIS software vendor (ESRI) is moving away from the technology upon which the old site was designed (ArcIMS) to the technology upon which the new site is built (ArcGIS Server). In order to keep the site available to our customers, it needs to run on technology that is vendor supported.
- In the past several years, we have received an increasing number of requests from our customers for functionality that could not be offered using the old (ArcIMS) development platform.

As agencies upgrade their systems, other agencies feel the need to keep up. Other interviewees stated that redesigns were in process or under consideration.

The technical skills needed to work with counties' systems varied depending on the complexity of the service. A City of Raleigh programmer created the new Wake County/City of Raleigh iMAPS site using Adobe Flex (http://www.adobe.com/products/flex/overview/). Flex is an open source programming language that can be used to build "highly interactive, expressive web applications that deploy consistently on all major browsers, desktops, and operating systems". Websites using Flex include NASDAQ, SpatialKey, and The New York Times Reader 2.0 (http://flex.org/showcase). Those interviewed from the City of Raleigh and Wake County said they were "lucky" to have had hired someone with Adobe Flex programming

skills when the redesign was going forward. Without the expertise of this staff member, the iMAPS team would have had to hire a contractor for the redesign.

Keeping the application "in-house" allows agencies to complete control of the look and feel of the application and the timeliness of the data. "The public is looking at the same data as staff is", one interview said. "We try to make it as close as being real, live data as possible."

Other agencies only maintain the backend database while a vendor maintains the frontend. Two of the agencies use the Cary-based firm Withers & Ravenel (http://www.withersravenel.com/web/) to implement their web GIS. Interviewees at these agencies said that they chose the firm and its ConnectGIS front-end (http://www.mobile311.com/Products/ConnectGIS.aspx) because of the company's large presence in North Carolina and its quick uploading of submitted content to their sites. One interviewee said that the connection between agency and vendor "was basically a live link" and that the vendor allows the agency customize the site to make it "our site". Other Withers & Ravenel clients in North Carolina include Moore County, Rowan County and Person County.

Working with a vendor does have what one interviewee characterized as a minimal recurring cost for the ability to pass on interface maintenance issues to an outside entity. One interviewee said that dividing the annual cost by the number of hits the site received equaled approximately five cents per hit. In not hosting the site, the agency avoids responsibility for solving maintenance issues. This interviewee stated, "Our main purpose is to have the most updated, quality data out there."

All counties reported the ability to maintain service in spite of the spikes in web traffic that were noted above during revaluation years.

Cooperation with other agencies

The two counties with the largest number of municipalities – Guilford and Wake – reported ongoing cooperation between the county and cities. The City of Raleigh and Wake County iMAPS staff members meet biweekly. Longstanding relationships between the agency directors aid this cooperation. Cooperation can allow for elimination of redundant layers and for opportunities to cost-share or share data in a distributed network system.

Future directions

Interviewees said that they foresaw a continued commitment to web GIS. They spoke about adding more data and using the map as a general portal for government services and allowing citizens to "go a lot of different directions from the map".

New site features/agency practices suggested included:

- Surveying of customers to determine what new layers to add or functionalities to improve
- Smaller agency-specific mapping application embedded on other agencies' websites (e.g., Board of Elections)
- A layer of land sales information

One interviewee pointed out that development of the county's web GIS presence would be subordinate to other pressing county technology upgrades needs however.

All agencies indicated interest in pursuing PPGIS features to their current or future sites. The speed in which such functionality could be added and the types of

services that might be added differed. One interviewee stated that given budget limitations and other needs, PPGIS may be "pie in the sky" thinking. Others were more optimistic about integration and planned to test such data-gathering applications with government employees – such as public sanitation workers – before opening the application to the general public.

Under North Carolina law, cities and counties have different powers and responsibilities. North Carolina General Statutes Chapter 153A governs counties; Chapter 160A governs cities and towns. Among the powers given to cities – and not given to counties – are: maintenance and regulation of streets (Article 15); and, the authority to operate public enterprises such as water supply and distribution systems, wastewater collection and treatment and stormwater management programs (Article 16). Interviewees said that these responsibilities would guide how PPGIS web services evolve. As one interview stated, "Cities handle infrastructure items; counties handle taxation and human services".

Because the governments have limited resources, local officials make sure services meet core missions first. Under this legal framework and political reality, agencies serving municipalities thus have more of an interest in applications for citizen reporting of pot-holes because cities maintain city streets. A PPGIS web service at the county-level might allow for the reporting of environmental concerns or public health issues such as restaurant cleanliness or rabid animals.

Discussion and Summary

Governments continually are looking for ways to push information to citizens – whether in the event of a natural disaster or a new regulation or zoning. The use of web

GIS has spread across local government GIS agencies in North Carolina over the past decade. This trend is true for counties and municipalities. This study investigated to what extent citizens use web GIS services and how this use impacts the functioning of the agency hosting the services.

Rise in web traffic was not seen in all agencies for the period examined. The chief finding of this study was that with or without increases in web traffic, the offering of a web GIS has impacted agency functioning to some degree. Of the examined agencies, this impact ranged from needing to stay abreast of technology development and planning for future functionality to complete overhauls of the web GIS in-house and regular outreach to users. The most frequently mentioned benefit to offering a web GIS was a decrease in the amount of walk-in customers. This decline has allowed for staff members to work on quality assurance and quality control and special projects. Future directions for web GIS discussed include public participatory GIS and an increase in the number of layers available.

The agencies in this study did not experience the sea change in users that Marchionini (2002) noted occurred when the U.S. Bureau of Labor Statistics (BLS) enhanced its web presence. Marchionini wrote that changing the BLS website's user interface led to a shift in the types of users accessing data. BLS data users went from being almost exclusively public officials, reporters and academics to more general public users. According to those interviewed for the study reported here, users post-deployment of a web GIS have remained the same as pre-deployment – those involved with the exchange and development of land (e.g., attorneys, developers, surveyors) and insurance companies. The change seen in the BLS study and the lack of change in this study could

be due to differences in the public's awareness of what data-sharing services are available at different levels of government. BLS statistics frequently are cited in news reports. Local government GIS agencies do not benefit from this same, no-cost marketing. Public awareness of local government web GIS services could be a topic of further research. The types of data presently included in local government web GIS services also could be a contributing factor to an unchanging user base. Many included GIS layers contain information of the most interest – on a day-to-day basis – to real estate professionals. Agencies have added and are adding more layers of interest to general public users (e.g., historic aerial photographs). Outreach to citizens could yield ideas to make local government GIS a more valuable resource to other population segments.

Unlike the BLS employees interviewed in Marchionini's study, those interviewed for this study did not indicate that the movement to an augmented online presence necessitated a big retooling of employees' skill sets. GIS professionals and database administrators already had experience with high functioning digital technologies whereas BLS employees had to make a more dramatic shift in work patterns.

However, like work at the BLS, local GIS agency work has been restructured because of the implementation of a new web interface. Again the biggest change because of the web GIS has been the "freeing up" of agency employees to work on special projects because of the decrease in foot traffic to the agency's office. Also GIS staff members have taken on new roles as "information brokers", "technical troubleshooters", "information integrators", and "data and application educators and trainers".

Aside from these study-specific findings, this study raised two other issues of interest to the larger local government GIS community: 1) the complexity of agency sites

versus the size of the agency and agency mission; and, 2) the seamlessness of a user's experience with web interfaces versus the bright-lines of control in government.

Variation in website complexity

Agency websites were more sophisticated when the county's population had higher educational levels, higher median household income and higher median value of owner-occupied housing units (Table 7). "Sophistication" is a subjective opinion of the researcher that takes into account each web GIS's look-and-feel, number of layers and integration with other county or partner government data sources. The variation suggests that the general strength and size of government revenues impacts the amount of human and fiscal resources that can be devoted to information technology services and digitally integrating county government.

The "rich" may get "richer" if this dissimilarity persists and web GIS becomes the county's welcome mat and portal for government services. Active, complex web GIS systems may attract new businesses and potential residents because of the volume of information available to a remote user and a potential lower cost of doing business in the county because of this information flow.

The breadth of agency missions seemed to impact how staff members mapped their futures. Agencies with larger resources and larger declared missions were more optimistic about further integrating other county services into web GIS services. For example, Lee County's GIS staff is a part of the county's Strategic Services and supplies GIS services to all county agencies. Those tasked with limited function – such as tax mapping – said that they envision a time when GIS staff could assist in enhancing other

service provision. However, that time is not now because of limited funding and agency capacity.

Obscuring of real world political boundaries

Many interviewees discussed the distributed nature of their web GIS. Different data accessed through the web application "lives" in different agencies' databases. The user does not see this "silo-ing" because all the necessary data is aggregated in a web interface. This integration was a point of pride to interviewees.

While the data integration appears seamless, government functioning is not. As noted above, North Carolina law delineates some local government responsibilities as being the domain of cities and others as the domain of counties. These "bright lines" of responsibility may not be immediately evident to users of a web GIS that is a combined city and county project. Such situations exist when either an agency is a city-county agency (Lee County) or two or more agencies partner together to offer a web GIS (City of Raleigh and Wake County).

If such agencies move toward more PPGIS services, citizen confusion could rise if users saw some services were available to other users – but not them. For example, cities maintain city roads. A city resident could report a pothole through a city-county web GIS because city roads are the city's responsibility. However, if a county resident who lives 10 minutes outside of the city wants to report a pothole in front of his house, a web GIS would need to do one of the following:

1. Clearly indicate through text which services are available to which citizens and provide links to services that are not a part of city or county government

2. Allow a user to report any type of concern but kick the user out to the appropriate agency based on the location of the complaint. In the example, the county resident would need to report the problem to the N.C. Department of Transportation (NCDOT). The state maintains county roads, and in fact the NCDOT website's contact page allows for user to report "maintenance concerns such as potholes" after a resident selects his or her county (http://www.ncdot.org/contact/) (Figure 33).

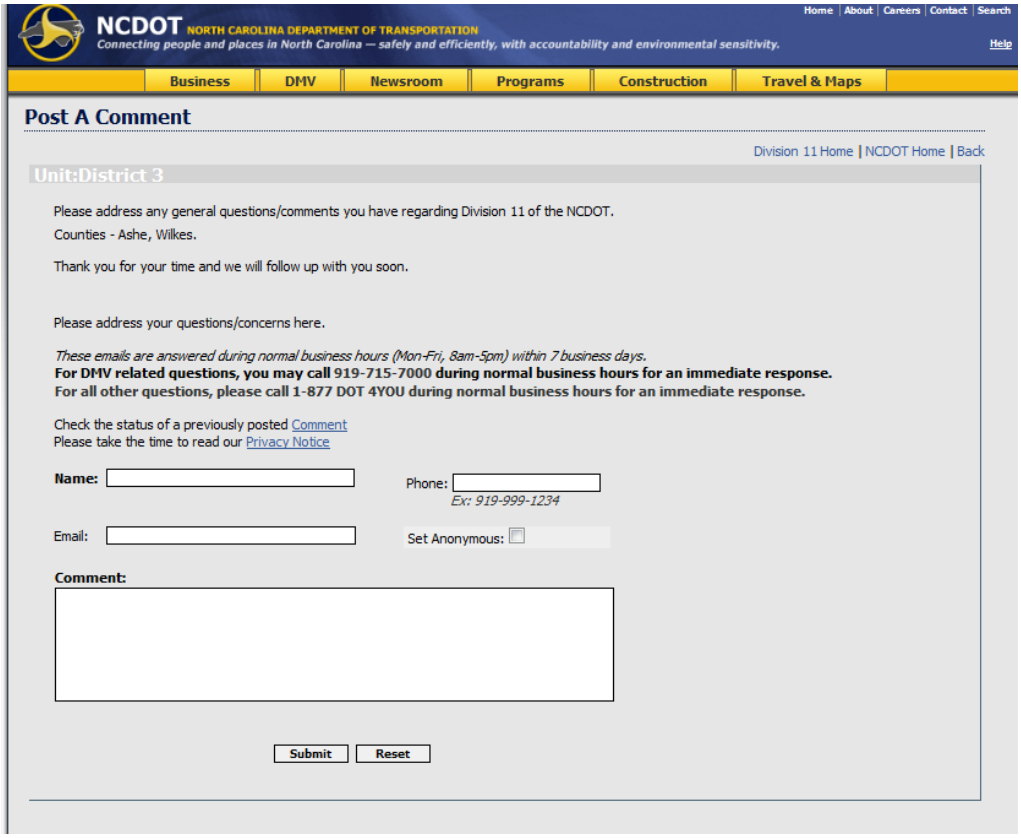

Figure 35: NCDOT reporting site

The NCDOT contact page also links out to the Office of Beautification Programs' "Swat-a-Litterbug" program's page that allows users to report via email motors

who litter (http://www.ncdot.org/doh/operations/dp_chief_eng/roadside/Beautification/Litterbug/).

The system described in option 2 would require greater connections to service providers external to the county or city such as the state or the federal government. While the user does not see the domains of control, governments do and monies are attached to agencies meeting specific needs for specific populations.

Limitations

There are several potential limitations to this study. First, only a small number of counties were examined. Examining a different set of four counties could lead to different findings.

A second limitation is that organizational change may occur for a host of reasons other than the implementation of a web mapping system/geobrowser. Other factors that could lead to organizational change could come from a push from county administration to be more "citizen-oriented". Also technology upgrades seen in GIS agency could have been a part of general county-wide upgrades in hardware and software. Some interviewees noted that tech upgrades occurred across county government.

Another limitation is the reliability of web statistics to accurately describe site usage (Alpar 2001, Sen 2006). Web statistics can suggest use patterns; a more definitive description would require alternative methods of determination of use patterns.

References

Al-Shafi, S. & Weerakkody, V. (2010). Factors Affecting E-Government Adoption in the State of Qatar. *European and Mediterranean Conference on Information Systems 2010*. April 12-13, Abu Dhabi, UAE, 1-23.

Alpar, P., et al. (2001). Measuring the efficiency of Web site traffic generation. *International Journal of Electronic Commerce*, 6(1), 53-73.

American Library Association. (2010, June 21). Libraries report increased use of e-government, job resources; reduced operating hours. Retrieved from http://americanlibrariesmagazine.org/news/ala/libraries-report-increased-use-e-government-job-resources-reduced-operating-hours

Aucott, P. J. et al. (2009). Exposing the history of Europe: the creation of a structure to enable time-spatial searching of historical resources within a European framework. *OCLC Systems & Services: International digital library perspectives*, 25(4), 270-286.

Belanger, F. & Hiller, J. S. (2006). A framework for e-government: privacy implications. *Business Process Management Journal*, 12(1), 48-60.

Burrows, R. & Ellison, N. (2004). Sorting Places Out? Towards a social politics of neighbourhood informatization. *Information, Communication & Society*, 7(3), 321-336.

Capital Area Transit (2010). Retrieved from http://www.raleighrides.org/

Carter, L. & Bélanger, F. (2005). The utilization of e-government services: citizen trust, innovation and acceptance factors. *Information Systems Journal*, 15(1), 5-25.

Chafkin, Max. (2010). The Oracle of Silicon Valley. Inc. Retrieved from: http://www.inc.com/magazine/20100501/the-oracle-of-silicon-valley.html

City of Raleigh (2010). Finance Reports. Retrieved from http://www.raleighnc.gov/home/content/Finance/Articles/FinanceReports.html

Croner, C. M. (2003). Public Health, GIS and The Internet. *Annual Review of Public Health*, 24, 57–82.

docsouth.unc.edu (2010). Dashboard Apr 1, 2010-Apr 30, 2010. Retrieved from http://docsouth.unc.edu/support/about/analytics_04_10.pdf

Detlor, B. et al. (2009). Successful Community Municipal Portal Diffusion: Internal Government Factors and Individual Perceptions. *Proceedings of the Fifteenth Americas Conference on Information Systems, San Francisco, California August 6th-9th 2009*, 1-8.

Edmiston, K. D. (2003). State and Local E-Government: Prospects and Challenges. *The American Review of Public Administration 2003*, 33, 20-45.

ESRI. (2010). Abu Dhabi Systems and Information Centre Receives Making a Difference Award from Esri. Retrieved from http://www.esri.com/news/releases/10_3qtr/info-centre.html

_____. (2010). ArcGIS Explorer. Retrieved from http://www.esri.com/software/arcgis/explorer/index.html

_____. (2010). Deprecation Plan for ArcGIS 10.0 and ArcGIS 10.1. Retrieved from http://downloads2.esri.com/support/TechArticles/ArcGIS10and101Deprecation_Plan.pdf

_____. (2010). Gulf of Mexico Oil Spill. Retrieved from http://www.esri.com/services/disaster-response/gulf-oil-spill-2010/index.html

The Fifth International Symposium on Digital Earth (2007). The Digital Earth: Understanding our planet in the 21st Century. Retrieved from http://www.isde5.org/al_gore_speech.htm

Franklin County, NC – Parcel Map Search. (2010). Retrieved from: http://maps.roktech.net/franklintax/franklin.html

Georgiadou, Y. et al. (2006). Spatial Data Infrastructure (SDI) and E-governance: A Quest for Appropriate Evaluation Approaches. *URISA Journal*, 18(2), 43-55.

Goodchild, M. F. (2008). The use cases of digital earth. *International Journal of Digital Earth*, 1(1), 31-42.

Google Earth (2010). Retrieved from http://earth.google.com/

Hart, G. & Dolbear, C. (2007). What's So Special about Spatial?. In Scharl, A. et al (Eds.), *The Geospatial Web: How Geobrowsers, Social Software and the Web 2.0 are Shaping the Network Society*. (pp. 39-44) London: Springer.

Horst, M. et al. (2007). Perceived usefulness, personal experiences, risk perception and trust as determinants of adoption of e-government services in The Netherlands. *Computers in Human Behavior*, 23, 1838-1852.

Interactive Advertising Bureau (2004). Interactive Audience Measurement and Advertising Campaign Reporting and Audit Guidelines. Retrieved from http://www.iab.net/media/file/US_meas_guidelines.pdf

Jana, S. & Chatterjee, S. (2004). Quantifying Web-site visiting using Web statistics: an extended cybermatics study. *Online Information Review*, 28(3), 191-199.

Jessop, M. (2005). The Application of a Geographical Information System to the Creation of a Cultural Heritage Digital Resource. *Literary and Linguistic Computing*, 20(1), 71-90.

Lake, R. & Farley, J. (2007). Infrastructure for the Geospatial Web. In Scharl, A. et al (Eds.), *The Geospatial Web: How Geobrowsers, Social Software and the Web 2.0 are Shaping the Network Society*. (pp. 15-26) London: Springer.

Lee County (2010). 2009-2010 Adopted Budget. Retrieved from: http://www.leecountync.gov/Departments/Finance/20092010AdoptedBudget.aspx

Marchionini, G. (2002). Co-Evolution of User and Organizational Interfaces: A Longitudinal Case Study of WWW Dissemination of National Statistics. *Journal of the American Society for Information Science and Technology*, 53(14), 1192-1209.

Mossee, B. & Whitley, E. A. (2008). Critically classifying: UK e-government website benchmarking and the recasting of the citizen as customer. *Information Systems Journal*, 19, 149-173.

NASA. (2008). World Wind for Java. Retrieved from http://worldwind.arc.nasa.gov/java/

Newton, B. (2004). In Hampton Roads' cities, e-government is clicking. *The Virginian-Pilot*, pp. D1.

Next Generation Archives: The NC Geospatial Archiving Project. (2009). Retrieved from http://www.geomapp.net/docs/200903_geotools_JE_ZN.pdf

North Carolina General Statutes. (2010). Retrieved from http://www.ncleg.net/gascripts/Statutes/Statutes.asp

North Carolina Geographic Information Coordinating Council. (2010). About the GICC. Retrieved from http://www.ncgicc.com/AbouttheGICC/tabid/174/Default.aspx

_____. (2010). County GIS Contacts. Retrieved from http://www.ncgicc.com/Portals/3/documents/County_GIS_Contacts.pdf

_____. (2010). Location of GIS Operations in North Carolina County Government. Retrieved from http://www.ncgicc.com/Portals/3/documents/Location_of_County_GIS_Operations.pdf

Office of Management and Budget. (2010). FY 2010 Report to Congress on the Benefits of the E-Government Initiatives. Retrieved from

O'Reilly, Tim. (2010). Government As a Platform. Retrieved from: http://opengovernment.labs.oreilly.com/

Philadelphia Police Department (2010). Map Crime. Retrieved from http://citymaps.phila.gov/CrimeMap/StepByStep.aspx

Rapp, K. R. & Parker, R. (2008). Alaska Mapper: A Web-based Tool to Access Land Ownership and Other State-Wide Geospatial Data. Digital Mapping Techniques '07. 83-87.

Recovery.gov. (2010). Retrieved from http://www.recovery.gov/Pages/home.aspx

Reddick, C.G. (2005). Citizen interaction with e-government: From the streets to servers?. *Government Information Quarterly*, 22, 38-57.

Rouse, L.J. et al. (2009). Participating in the Geospatial Web: Collaborative Mapping, Social Networks and Participatory GIS. In Scharl, A. et al (Eds.), The Geospatial Web: How Geobrowsers, Social Software and the Web 2.0 are Shaping the Network Society. (pp. 153-158) London: Springer.

Scharl, A. (2007). Towards the Geospatial Web: Media Platforms for Managing Geotagged Knowledge Repositories. In Scharl, A. et al (Eds.), The Geospatial Web: How Geobrowsers, Social Software and the Web 2.0 are Shaping the Network Society. (pp. 3-14) London: Springer.

Schoning, J et al. (2008). Improving interaction with virtual globes through spatial thinking: Helping users ask "why?". *IUI: International Conference on Intelligent User Interfaces*, 8, 129-138.

Schuppan, T. (2009). E-Government in developing countries: Experiences from sub-Saharan Africa. *Government Information Quarterly*, 26, 118-127.

Shanley, L. (2007). GIT Governance: State Models and Best Practices, North Carolina. Retrieved from http://www.fgdc.gov/grants/2006CAP/relateddocs/NC_Profile.pdf

Sen, A. et al (2006). Current Trends in Web Data Analysis. *Communications of the ACM*, 49(11), 85-91.

Solar. R. & Radovan, D. (2005). Use of GIS for Presentation of the Map and Pictorial Collection of the National and University Library of Slovenia. *Information Technology and Librarie*s, 24(4), 196-200.

Sterne, J. (c2002). *Web metrics: Proven methods for measuring Web site success.* New York: Wiley.

U.S. Bureau of Labor Statistics. (2010). Retrieved from http://www.bls.gov/

U.S. Census Bureau. (2010). Retrieved from http://www.census.gov/

Wake County (2002). Fiscal Year 2002. Comprehensive Annual Financial Report. Retrieved from http://www.wakegov.com/budget/annualfinancialreports/fiscalyear2002.htm

_____. (2003). Fiscal Year 2003. Comprehensive Annual Financial Report. Retrieved from http://www.wakegov.com/budget/annualfinancialreports/fiscalyear2003.htm

_____. (2004). Fiscal Year 2004. Comprehensive Annual Financial Report. Retrieved from http://www.wakegov.com/budget/annualfinancialreports/fiscalyear2004.htm

_____. (2005). Fiscal Year 2005. Comprehensive Annual Financial Report. Retrieved from http://www.wakegov.com/budget/annualfinancialreports/fiscalyear2005.htm

_____. (2006). Fiscal Year 2006. Comprehensive Annual Financial Report. Retrieved from http://www.wakegov.com/budget/annualfinancialreports/fiscalyear2006.htm

_____. (2007). Fiscal Year 2007. Comprehensive Annual Financial Report. Retrieved from http://www.wakegov.com/budget/annualfinancialreports/fiscalyear2007.htm

_____. (2008). Fiscal Year 2008. Comprehensive Annual Financial Report. Retrieved from http://www.wakegov.com/budget/annualfinancialreports/fiscalyear2008.htm

_____. (2009). Fiscal Year 2009. Comprehensive Annual Financial Report. Retrieved from http://www.wakegov.com/budget/annualfinancialreports/fiscalyear2009.htm

_____. (2009). *Adopted Operating and Community Improvement Budgets For the Fiscal Year July 1, 2009 through June 30, 2010*. Retrieved from:

http://www.wakegov.com/NR/rdonlyres/C2F6D61A-B4E9-4816-9E97-14199D3DBDDC/0/fy2010.pdf

_____. (2010). Online Services. Retrieved from: http://www.wakegov.com/departments/services/default.htm

The White House. (2009). *President Obama Names Vivek Kundra Chief Information Officer*. Retrieved from http://www.whitehouse.gov/the-press-office/president-obama-names-vivek-kundra-chief-information-officer

The White House. (2010). *Transparency and Open Government*. Retrieved from http://www.whitehouse.gov/the_press_office/TransparencyandOpenGovernment/

Willoughby, M. et al. (2009). Making e-government attractive. *Service Business*, 4, 49-62.

WRAL. (2007). Jump in Wake Property Values Average 43%; Taxes Bills Could Follow. Retrieved from http://www.wral.com/news/local/story/2056644/

Zhao, J. & Coleman, D. J. (2006). GeoDF: Towards a SDI-based PPGIS application for E-Governance. *GSDI-9 Conference Proceedings, 6-10 November 2006, Santiago, Chile*.

Zhu, K. & Kraemer, K. L. (2002). e-Commerce Metrics for Net-Enhanced Organizations: Assessing the Value of e-Commerce to Firm Performance in the Manufacturing Sector. *Information Systems Research*, 13(3), 275-295.

Appendix A: Glossary of Acronyms

ADSIC	Abu Dhabi Systems and Information Centre
AD-SDI	Abu Dhabi Spatial Data Infrastructure
ARRA	American Recovery and Reinvestment Act of 2009
CAT	(Raleigh) Capital Area Transit
CDC	Centers for Disease Control and Presentation
CGIA	(N.C.) Center for Geographic Information and Analysis
CIO	Chief Information Officer
CURISA	Carolina Urban and Rural Information Systems Association
BLS	Bureau of Labor Statistics
DENR	(N.C.) Department of Environment and Natural Resources
ESRI	Environmental Systems Research Institute, Inc
FIC	Federal Interagency Committee
FTE	Full-time equivalents
GICC	(North Carolina) Geographic Information Coordinating Council
GIS	Geographic Information System
IAB	Interactive Advertising Bureau
iMAPS	Internet Multi Access Parcel System
IT	Information Technology Department
KML	Keyhole Markup Language
LGC	Local Government Committee
M&O	Management and Operations Committee
NCAUG	North Carolina Arc Users Group
NCDOT	N.C. Department of Transportation

NOAA	National Oceanic and Atmospheric Administration
NREL	National Renewable Energy Laboratory
OEG	Office of Electronic Government
OITS	Office of Information Technology Services
OMB	Office of Management and Budget
PGIS	Participatory GIS
PPGIS	Public Participation GIS
SGUC	State Government GIS Users Committee
SMAC	Statewide Mapping Advisory Committee
WMS	Web Mapping Service

Appendix B: EMAIL SOLICITATION

To: Individual staff member email addresses

Cc: shaas@email.unc.edu

Subject: UNC study: The impact of Web GIS on local government agencies

Good morning,

My name is Brooks J. Breece, and I am conducting a study of North Carolina local government geographic information system (GIS) agency use of public-facing interactive, online web applications and how these applications have impacted agency interactions with the public and agency functioning.

I am emailing you to request permission to interview you about your agency's use of Web GIS applications. The interview will take 30 minutes of your time and may occur in person at a place of your choosing or over the telephone at a mutually convenient time. I will record the interviews and take notes. You also may request that the interview may not be recorded.

Please see the attached information/consent form that details your rights as a study participant. This study has been approved by the UNC Behavioral IRB (IRB Study No. 10-1714).

Please reply to this email if you are willing to participate in this study. Interviews will take place from the end of September through the beginning of October. In order to participate, you only will need to give verbal consent to participate after reviewing the attached Information Sheet/Consent Form.

Thank you very much for your time. Have a nice day.

Researcher: Brooks J. Breece, Masters of Library Science Student | bjbreece@email.unc.edu

Supervisor: Dr. Stephanie Haas, Faculty Advisor | shaas@email.unc.edu

Appendix C: INFORMATION SHEET / CONSENT FORM

What are some general things you should know about research studies?

You are being asked to take part in a research study. To join the study is voluntary. You may decline to join, or you may withdraw your consent to be in the study, for any reason, at any time, without penalty.

Research studies are designed to obtain new knowledge. This new information may help people in the future. You may not receive any direct benefit from being in the research study. However, if you choose, you may receive further information about the subject of the study after its completion. There are no foreseeable risks to being in this research study.

Details about this study are discussed below. It is important that you understand this information so that you can make an informed choice about being in this research study.

If you are unwilling to participate after reading this informational sheet, then you are free to leave the study without penalty. In fact, you are free to leave the study *at any time* should you decide to withdraw your consent. In this study, you will be asked to answer questions in a verbal interview. You are free to decline to answer a question.

What is the purpose of this study?

The purpose of this study is to the examine the impact of offering interactive, online geographic information systems (GIS) applications on local government GIS agency's work flow, interactions with the public and budgeting.

How many people will take part in this study?

It is anticipated that 12 to 15 people will take part in this study.

How long will your participation in this study last?

Your participation in this study will take approximately 30 minutes.

What will happen if you take part in this study?

If you take part in this study, you will be asked to participate in a semi-structured interview with me. Please send the attachment for a detailed list of what topics may be discussed. I will take notes during the interview and record the interview. You may decline to answer any questions that you do not wish to answer. You also may request that the interview not be recorded.

What are the possible benefits from being in this study?

Research is designed to benefit society by gaining new knowledge. You may not benefit personally from being in this research study.

What are the possible risks or discomforts involved in being in this study?

There are no foreseeable risks to being in this study. However, there may be uncommon or previously unknown risks. You should report any problems to the researcher. Please use the email address or phone number provided if problems arise after you have completed participation.

How will your privacy be protected?

You will not be identified by name in any report or publication about this study. Participants only will be identified by their agency.

Will you receive anything for being in the study?

You will not receive anything for taking part in this study.

Will it cost you anything to be in this study?

There will be no costs for being in this study -- other than 30 minutes of your time.

What if you have questions about this study?

You have the right to ask, and have answered, any questions you may have about this research. If you have questions, or concerns, you should contact the principal researcher listed at the top of this form.

What if you have questions about your rights as a research participant?

All research involving human volunteers is reviewed by a committee that works to protect your rights and welfare. If you have questions or concerns about your rights as a research participant, you may contact (anonymously if you wish) the Institutional Review Board at (919) 966-3113 or at IRB_subjects@unc.edu.

Thank you for helping me with this study.

Appendix D: INTERVIEW TOPICS

Interaction actions with the public

- Have the users of your agencies' services changed since the deployment of your agency's interactive, online GIS application?
- If yes, how?
- If yes, to what do you attribute this change?

Job roles

- How has the offering of online, interactive mapping applications impacted job roles at your agency?
- What new roles have emerged?
- How have the technical skills needed for agency work changed?

Budgeting

- Have funding priorities changed since the deployment of your agency's interactive, online GIS application?