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Public Geospatial Data in Wisconsin: Information Access, Data Sharing, and the University

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PUBLIC GEOSPATIAL DATA IN WISCONSIN: INFORMATION ACCESS, DATA SHARING, AND THE UNIVERSITY

by

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ABSTRACT

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by

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This research explores public geospatial data sharing in Wisconsin. The research is informed by literature on GIS and Society, Participatory GIS, Spatial Data Infrastructure, Information Justice, The Digital Divide, and Library and Information Science. Original research consists of a survey and follow up interview to public land information professionals in Wisconsin gauging their interest in a UW System-wide geographic information portal for distributing public spatial data to UW System users. The research finds that social and institutional rather than technical factors are major drivers of data-sharing activities in Wisconsin. However, technical aspects of geographic information are changing quickly with a move to more hosted services in the cloud. This research explores how this shift influences data-sharing, academic library GIS services, and university level education. While social and institutional influences are critical, GIS professionals, students, and educators must be ready for the cloud.

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I wish to say thank you to all the participants in the UW System Geospatial Data Survey and interviews including County Land Information Officers and representatives from regional planning commissions and municipal governments.

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I dedicate this thesis to my mother, Donna Appel, for her continued support of my education despite extreme hardships.

Sunlight is said to be the best of disinfectants;

electric light the most efficient policeman.

-Louis Brandeis 1913

Chapter 1:

INTRODUCTION

Public geospatial data is defined in this research as vector or raster spatial data produced by government agencies. To those outside the field of geographic information science, the value of these datasets may be unclear. To a typical member of the public, interacting with this data first hand is rare. Citizens may use a county web map viewer to view information on their property or the properties around them in the case of cadastral data. Governments large and small in scale use and share this data in order to manage land use planning, maintain utilities, and to increase the efficiency of services.

Maene (2011) finds that while the data is valuable to governments, it is also valuable to the private and academic sectors as well as the public. Private businesses use public geospatial data in order to access information about project sites or to get insight into demographics of an area targeted for advertisement or a profitable real estate investment. Academic users need public geodata for research into a plethora of topics. In addition to geographic information science, public geospatial data is popular source material for many natural and social sciences. Goodchild (2006)

states that any student studying sciences dealing with the surface of the earth would encounter GIS.

Geospatial data and geographic information lay in a grey area of intellectual property law. Federal government data is traditionally not eligible for copyright in the United States. State and local governments spend considerable portions of their budgets on dataset creation, management, and staff training. A tension emerges over the incentives of copyright, particularly the incentive to produce creative works, and the demand for free access to government records.

Geospatial data sharing takes place within what has become known as a spatial data infrastructure (SDI). This infrastructure comprises both technical and social relationships in a network of geographic information and knowledge sharing. Geographers and the larger academic community have taken great interest in SDIs. Research has shown that barriers to implementation of effective SDIs are becoming increasingly social and decreasingly technical in nature (Harvey *et al*, 2012, Harvey and Tulloch, 2006). There is, however, an extensive literature on technical issues of SDI implementation (eg. Masser, 2005). SDI literature has embraced the importance of organizational context in SDI success (Dessers, 2013 p. 217; *see also* e.g. Petrovic *et al*, 2013; Vandenbroucke *et al*, 2009; Crompvoets *et al*, 2008). Local government participation in spatial data infrastructures, measured by participation in a national spatial data clearinghouse, is highly varied. The reasons for low levels of participation

from local governments in government data portals are unclear (Maene, 2011). While this thesis does not contribute much to the larger spatial data infrastructure literature, it discusses the relevant topics in SDI and may be useful to those studying SDI in the context of local government data sharing as well as the place of the university within an SDI.

Study Motivations, Research Questions, and Contributions

The primary research questions for this thesis delve into how public geospatial information is created, shared, and used in academic settings. The literature review (Chapter 2) will lay out a theoretical framework of information justice and the idea that *access* to geospatial information is about more than access to spatial data. A key theoretical lens is that of information justice, leading to key questions: How have government open data initiatives stood up to issues of the *digital divide*? Is making public data available for download on the internet or use in web mapping applications enough to ensure that citizens have access to public information? How do local political contexts and issues of power relations effect how individuals or groups can participate in geographic knowledge production and decision making? The review of literature will also look into Critical GIS, GIS and Society, Participatory GIS, and Spatial Data Infrastructures. How do these areas of study inform work on public geospatial data and, vice versa, how does research on public geospatial data inform these topics? One of the most important conclusions drawn in this

research is that practitioners of participatory GIS methods must prepare for a shift in how geospatial information is distributed, particularly via web services and web mapping applications.

A survey and follow up interviews are used to investigate the current climate of public geospatial data sharing in Wisconsin. Wisconsin has a rich history of being on the forefront of geospatial technologies. The City of Milwaukee, Wisconsin in particular was an early leader in the modernization of land records and remains an example of effective open data policy. This access to rich geospatial datasets during my tenure as an undergraduate and graduate student at UW-Milwaukee was an important factor in shaping my research interests leading to this thesis. As a GIS Student Assistant at the American Geographical Society (AGS) Library, responsible for assisting patrons in finding and using geospatial data for their research, I have witnessed first-hand some of the dramatic differences in obtaining data from various government and non-governmental agencies.

The data collected from surveys and interviews were intended to answer questions about how public geospatial data is shared in Wisconsin. Why do data producers, such as local government agencies, use license and data-sharing agreements? Is this an increasing or declining trend? Do data producers tend to share their raw data online or are they more likely to share information via a web mapping application? UW System actors are interested in the creation of a UW System-

wide geoportal for distributing Wisconsin public geospatial data to students, staff, and faculty. What barriers are likely to be faced in the implementation of such a geoportal? Are counties interested in this type of system or are they more likely to pursue individual data agreements with institutions or individual users? What are the motivations behind sharing or not sharing geospatial data resources with both academic users as well as the public?

Finally, drawing off of my experiences at the AGS Library and a review of contemporary literature regarding GIS services in academic libraries, I make recommendations for how libraries can keep up with rapidly changing geospatial technologies. How do open data policies influence geospatial data collections and the maintenance thereof? What can library GIS services do to prepare for a migration to hosted geospatial web services and GIS in the cloud? Beyond the data collection itself, how can libraries keep up with digital and physical collections involving ever-changing geospatial technologies? What influence will the *open culture* movement have on GIS services? Will libraries and specialized staff need to be trained in using popular open source software? How can geographic collections assist users in using these open source technologies effectively? Finally, beyond the library, how do these topics influence GIS education at the university level?

I argue that GIS services in academic libraries need to prepare for the increasing influence of web services and the cloud. Obtaining data is becoming easier in

some ways, but some datasets may still require negotiation of data-sharing agreements, licenses, and even fees. The maintenance and sometimes even creation of metadata is an important role of academic library GIS services and more research on effective metadata for cloud services should not be overlooked. GIS educators must not underestimate the importance of computer and information science in the GIScience curriculum. And as neoliberal governments push for workforce development in public universities, the GIS curriculum cannot overlook computer programming, application development, and scripting—all of which are in high demand in the GIS field. In short, although GIS is becoming a popular tool in a surprising range of academic disciplines, it is important to understand the underlying technologies that make the tool possible. Tomorrows cartographers and geographers will be expected to be proficient with web mapping, *spatial media* (Elwood and Leszczynski, 2013), and cloud computing.

This research contributes to Geography by expanding on the interest in Geographic Information Science and focusing specifically on public geospatial data. GIS and Society research focuses on the social implications of Geographic Information Systems and it is critical to study the influence of open data movements, changing geographic information technologies, legal issues surrounding data-sharing, and the range of geographic knowledge available to the modern GIS practitioner. The field of Library Science can also benefit greatly from this research. Academic libraries are

an important resource for supporting GIS activities at the university and play a key role in helping academic users find and use geospatial information. While much research has focused on metadata and collection development, I found little research on how web services, volunteered geographic information, and Open GIS should be handled by GIS professionals in libraries. As governments increasingly use geospatial data and also expand their use of geographic web services, it is critical that geospatial information literacy remains a key driver in the development of GIS services at the library and the university.

Thesis Organization

Within the following chapters, some *GIS* and *geographic information* jargon is used without explicit definition of the plethora of terms used by *geographic information science* scholars. In fact, even *GIS* can be defined in many ways. *Geographic information systems*, *geographic information science*, and *geographic information services* all are embedded in the social construction of the term *GIS*. When "*GIS*" appears in the literature, contextual clues are often necessary to determine which definition or definitions are implied. *Geographic information* can take the form of *digital geospatial data*, interactive web mapping applications, *cyberGIS* applications, written descriptions of geographic phenomena, photographs, paper maps, and beyond. *Digital geospatial data* is also known as *GIS data*, *geodata*, *spatial data*, or simply *geographic data*. These

terms come in and out of style. For example, UW-Milwaukee recently replaced Geographic Information *Systems* with Geographic Information *Science* in course titles to more accurately reflect the scope of these courses.

Chapter 2 reviews the literature surrounding access to geospatial data, information justice, open GIS, and relevant theory. Questions of geospatial information justice are about more than simply access to data. What are the social and organizational reasons that influence data producers' decisions regarding data sharing? Does public geospatial data represent all stakeholders equally? How has *Open Culture* (eg. *Open Source* software) influenced GIS, government geospatial data sharing, and the availability of government data sets? Critical GIS research is reviewed to argue that injustices in geospatial knowledge are about more than just access to data, but mirror social disparities of knowledge production. Research on geospatial data can be informed by literature on GIS and society, the digital divide, and spatial data infrastructure, and Open GIS and that these fields of research can be informed by discussion of geographic knowledge production. Spatial data infrastructure studies can provide a framework by which to study the social networks surrounding data production and sharing. Finally, the open GIS movement and related open source, open data, and other components of what has become known as *Open Society* can help guide key ethical and practical considerations of geographic knowledge production and access to geospatial information.

Chapter 3 presents research on local government geospatial data sharing in Wisconsin. The American Geographical Society Library at the University of Wisconsin-Milwaukee serves as the geospatial data clearinghouse for the university. Much of the data distributed is obtained through data sharing agreements and arrangements between the library and government data producers. The AGS Library is investigating a collaborative project with other University of Wisconsin (UW) System actors to create a geographic information portal (geoportal) to host and distribute data across all campuses in the state. In association with other staff at UW-Milwaukee and other UW System schools, a short survey was distributed to land information professionals representing county and municipal governments as well as regional planning commissions in Wisconsin.

A geoportal is a web portal for the distribution of geographic information. Web portals are generally understood as a website where information from multiple sources are conglomerated and organized for easy access. Geoportals can offer advantages to those seeking geospatial information because of the ability to search by area and the specifications for unique file formats. Vockner *et al* (2013) propose that geoportals have the potential to be more than just access portals for geospatial information, but can act as *geographic knowledge portals* by including links to scientific articles and technical guides, access to metadata, links to web services, and beyond.

The UW Geospatial Data Survey, and subsequent interviews, were designed to uncover and plan for barriers for the implementation of the UW System geoportal. What data producers require legal agreements as part of their data sharing process? What data producers make their geospatial data available for download on the Internet? Which data producers would be willing to participate in a UW System geoportal, and if implemented, would they make their data available to the public or just for educational use? Follow up interviews were conducted in order to clarify survey answers and to speak to individuals making decisions about data sharing about what factors influence their actions.

It is found that local government data sharing is not a simple topic and the motivations surrounding sharing (or not sharing) are based on policy, statue, organizational culture, politics, finances, and the influence of other agencies. Legal, social, and technical concerns are summarized in the context of this research. Most often, local governments are happy to share data for educational use and understand the importance of these sharing agreements to workforce development and GIS education. Some respondents are concerned that data shared with universities will be redistributed and devalued; others believe that sharing data is the only way it has value at all.

Chapter 4 focuses on the University and public geospatial data. This chapter draws from my experiences obtaining, managing, and distributing geospatial data;

assisting library patrons in obtaining proper data, articulating research goals, and navigating complex technical issues; and investigations of new trends in geographic information including geoportals, web services, open source software, and GIS programming. The AGS Library at UW-Milwaukee is one of the largest collections of geographic materials in the world and has been involved in the curation and distribution of geospatial data for more than two decades. Most of the geospatial data collection is public geospatial data, the majority of which comes from local governments, regional planning commissions, and state agencies in Wisconsin. Some of the data can be downloaded directly from producers' websites, some require the AGS Library to make a data request on the behalf of patrons, some require a formal licensing agreement, and yet others are available only after paying a fee. Datasets such as the base map data from the Milwaukee County Automated Land Information System were purchased for considerable fees and were only distributed under a sub-license agreement signed by the patron. This dataset is discussed in detail as the copyright is no longer being enforced and the full dataset is available for download—by anyone.

The shift to downloadable datasets is not the only change the GIS services at the AGS Library have encountered. Some data is only available via web services such as a web mapping application or an information portal. Because the AGS Library also provides GIS reference services to patrons, helping users access data that

is hosted rather than downloaded is becoming more prevalent. The AGS Library has always included metadata with data requests; some metadata is packaged with the data when it is obtained from the source and other metadata is created or modified in order to help patrons use it effectively. Metadata documentation is critical for all data. In the case of web services such as hosted layers not available for download, metadata can inform the user on the capabilities of the service (such as the ability to copy, manipulate, and perform geoprocessing operations), the currency and update frequency, and restrictions on derivative products (i.e. if it be used to produce a map that is published.)

Chapter 4 also discusses these changes in geospatial information access and how it influences university level GIS education. As increasingly diverse academics embrace GIS and geographic analysis, geographic information science as a discipline must form collaborations and foster relationships with disciplines such as computer and information science on topics including application and web development, scripting, database management, cloud computing and storage, big data, usability and accessibility, and information literacy. It is important that library GIS services are more than just a source of data, but encourage such collaboration by recognizing the unique needs of researchers from different disciplines. “If the software used in a research study is a ‘black box’ and the code and algorithms cannot be scrutinized,

then the results will not be verifiable and reproducible in the long run" (Petras et. al., 2015, p.2).

While resources on JavaScript, .NET application development, or relational database management systems may not immediately seem relevant to GIS at the university level, employers are increasingly demanding these or similar skills for entry level GIS positions. In short, the library must recognize and embrace the breadth and variety of geographic analyses and provide resources not only for GIS users but also for geographic information scientists. Much has been written on how these factors influence collection development, but I argue that it is also critical that when patrons visit the library GIS services, they leaving having accomplished something.

Chapter 2:

GEOSPATIAL INFORMATION JUSTICE: BEYOND ACCESS

Introduction

Despite the heralded diffusion of the internet worldwide, there are still data shadows cover marginalized populations that contribute considerably less to geospatial knowledge production. It is argued that no matter how open the access to data, if marginalized populations are underrepresented in the data production, injustices can remain embedded in the data (Johnson, 2013). Critical GIS research is reviewed to argue that injustices in geospatial knowledge are about more than just access to data, but mirror offline disparities of knowledge production. Geospatial technologies have exploded in recent years with the diffusion of internet access, technology, and location based services. Answering the call for open data, governments and other data producers are increasingly sharing data with the public, but this is not universal. Critical literature on open data argue that simply opening data for public use is not enough to correct injustices in data construction and knowledge production. This literature represents the framework that will be used to interpret the results of research on geospatial data sharing in Wisconsin in Chapter 3.

The aim of this chapter is to show that research on geospatial data can be informed by literature on GIS and society, the digital divide, and spatial data infrastructure, and Open GIS and that these fields of research can be informed by discussion of geographic knowledge production. GIS and society literature challenges the positivist assumptions behind much work in GIS and has encouraged movements towards participatory GIS. Literature on the digital divide, especially in the context of geospatial information, can help direct focus on the populations underrepresented by the current geodata environment. Participatory GIS research has focused on access to technologies and power struggles but could be enhanced by work on geospatial data access specifically. Information justice is introduced and applied to geospatial information. Spatial data infrastructure studies can provide a framework by which to study the social networks surrounding data production and sharing. Finally, the open GIS movement and related open source, open data, and other components of what has become known as *Open Society* can help guide key ethical and practical considerations of geographic knowledge production and access to geospatial information.

This chapter leads to inquiry on the openness of public data. How have government open data initiatives stood up to issues of the digital divide? Is making public data available for download on the internet or use in web mapping applica-

tions enough to ensure that citizens have access to public information? How do local political contexts and issues of power relations effect how individuals or groups can participate in geographic knowledge production and decision making? While this literature review may not be able to answer all these questions explicitly, it will serve to guide the theoretical frameworks by which issues of geographic information can be studied in the context of public information, the digital divide, and participatory planning and governance. It will be shown that scholars are challenging the assumption that simply making public data available on the internet leads to more democratic knowledge production and therefore a more democratic society.

GIS and Society

Geographers have been interested in how GIS is adopted and how GIS influences society. The social context of GIS was investigated in the influential volume *Ground Truth: The Social Implications of Geographic Information Systems* (Pickles, 1995) and has since developed into research under the banner of GIS and Society. *Ground Truth* is essential reading for geographic information science scholars, including those who use strictly quantitative methods. Among the most important arguments in Pickles' introduction: the rest of the discipline (of geography) increasingly rejected positivist assumptions of science but GIS was born and its foundations constructed in the worlds of quantitative geography, computer science, and the military. Although most view *Ground Truth* as the start of a more social view of GIS in

the geography literature, Warren cites Chrisman's (1987) *Fundamental Principles of Geographic Information Systems* as an early social critique of GIS from a GIS programmer (Warren, 2004), a more unlikely critic than a social theorist. Despite the vastly different technical context of today, his words are in tune with critical geographers,

> I am convinced that the future of geographic information systems will lie in placing our technical concerns in their proper place, as serious issues worthy of careful attention. These technical concerns must remain secondary to the social goals they serve. (Chrisman, 1987 p. 40-41).

Critical studies of GIS were not accepted without criticism. For example, Openshaw (1997) offers criticism of *Ground Truth* in a defense as a quantitative geographer. While conceding that GIS users should be conscious of the potential social implications of their work, he equates the critique of Pickles' volume (1995) and subsequent critical GIS writings to attacks on quantitative geography. Ultimately he finds the suggestions of Pickles and other critical GIS scholars to be unjustified. In response, he calls for the need for development of social applications of GIS. A glimpse at the work that Openshaw has published demonstrates that he was willing to expand on social GIS methods (See Openshaw 1998 ; Openshaw and Turton, 2001). For example, of critical importance to social applications of GIS is an understanding of *The Modifiable Areal Unit Problem* which Openshaw thrust into spatial sci-

ence (Openshaw and Taylor, 1979; Openshaw, 1983). He also wrote insights on spatial analysis of census data (Openshaw, 1984), a critical public data source for social sciences in the U.S.

Openshaw (1997) was critical of the idea of social construction of GIS. Francis Harvey and others have written on this topic (e.g. Harvey, 2000; Harvey and Chrisman, 2004; Sieber, 2000), and found that political context and the social networks surrounding GIS construction were influential in project outcomes and success. This leads to the question of the importance of the social networks of construction of geospatial information, such as the political and social context of data producers.

With the proliferation of social media and location based applications, the idea of the social construction of GIS lives on in more recent literature, especially that on Web 2.0 and neogeography (e.g. Turner, 2006; Warf and Sui, 2010) which broadly describe a major shift from users simply using the internet to download content to the situation today where the average internet user is contributing information.

Erik de Man (2003) argues that, like GIS, geographic information is also socially constructed. Goodchild (2007) describes the shift in content production to users as a new research opportunity for geographers using *citizens as sensors* in the analysis of user generated geographic information. Warf and Sui (2010) argue that

geospatial information is shifting from a *top down* to a *bottom up* system and this is causing a subsequent shift in the "standards of truth" (p. 197). Volunteered Geographic Information (VGI), spatial information that is volunteered by a user (such as a geotagged tweet), especially in the context of Web 2.0, provide new opportunities for user content production that neither Pickles nor Openshaw could have imagined when the fate of GIS was most contested. VGI is seen as playing a critical role in neogeography and has been the topic of much recent geographical study (e.g. see Flanagin and Metzger, 2008; Elwood, 2008; Elwood and Leszczynski, 2013; Elwood, Goodchild, and Sui 2012; 2013; Sui, Elwood, and Goodchild, 2013; Haklay, 2013) with important research guiding questions of who is contributing content and why. These questions have been addressed by geographers in studies of the digital divide and calls for more participatory geospatial technologies have been articulated. Community organizations in particular have been studied because of their use of geospatial technology in order to "systematically analyze neighborhood conditions and plan for revitalization (Ghose, 2011 p. 424)." Blighted communities and marginalized populations could be empowered by GIS and visualization, but many face barriers to successful implementation of such technologies and struggle to compete against actors with financial and political power.

The Digital Divide and Participatory GIS

> Like many other terms adopted into development discourse over the past few centuries, the 'digital divide' is frequently used to describe an obstacle to movement of people and places temporally along a pre-defined path of development (Graham, 2011 np).

Rowena Cullen uses the phrase "digital divide" to describe disadvantage of people who, for one reason or another, lack access to information and communication technologies (Cullen, 2001). The digital divide has been studied in contexts such as low income urban communities (Araque *et al*, 2013), marginalized groups in general (Laituri, 2002), race (Hoffman, 1998; McClelland, 2001), gender (Cooper, 2006; McClelland, 2001), community groups (Sawicki and Craig, 1996), and others. In the context of geospatial information, the digital divide can be conceptualized not just as a lack of access to data and advanced technologies, but exclusion based on a lack of familiarity with geospatial technology and terminology. As an example, some community organizations are interested in geospatial technologies, but lack the financial and technical resources to effectively use them to influence decision making (Ghose and Huxhold, 2001). Public Participation GIS (PPGIS) projects, such as university partnerships and collaborative planning initiatives, have emerged as a response to such divides.

Hargittai (2002) has proposed a *second level* digital divide which addresses differences in internet and technology competency rather than simple access to

hardware, software, and the internet. GIS represents a modern and complex technical field and while some have embraced geospatial technologies that have accompanied Web 2.0, some may be left behind because of their resistance to (or exclusion from) rapidly changing technology. In regards to GIS specifically, there has been work on usability (Haklay and Skarlatidou, 2010; Haklay and Jones, 2008; Haklay, 2006; Haklay and Tobon, 2003), dominance of proprietary software in GIS education (Haklay, 2010) and women in GIS (Kwan, 2002).

Mark Graham (2011) summarizes geographical conceptions of the digital divide, and provides a framework on which to discuss the inherently geographical *digital divide.* As illustrated by the quotation at the beginning of this section, he is critical of the linear trajectory that development narratives impose. The idea that there is one way to properly use GIS has been reinforced by the influence of government and corporate applications of GIS. It is clear that geospatial technologies have not coevolved alongside grassroots organizations, neighborhood activists, or non-profit groups. Literature on Participatory GIS and Public Participation GIS is relevant to the access of spatial data in the context of empowerment through geospatial technologies. Participatory GIS research has focused on GIS activities involving community organizations (e.g. Leitner *et al*, 2002; Harris and Weiner, 1998), environmental conservation (Harris and Hazen, 2005), and the grassroots (Seiber, 2007; Lin and Ghose,

2008) as groups that can be empowered by geospatial technologies but may struggle for power in debates of public policy and decision making.

Literature discusses barriers faced on the implementation of GIS by organizations or individuals (Ghose; 2007; 2011; Ghose and Elwood, 2003; Ghose and Huxhold, 2001; Barndt, 1998; Harvey and Chrisman, 1998; Obermeyer, 1995). Many of these barriers are identified at the intersection between society and technology emerging out of concepts of the digital divide. Financial barriers may include data, software, or hardware costs, hiring of trained staff, and system maintenance. Social barriers include restricted datasets, high staff turnover, and organizational priorities. More recent work on the subject (especially in work on Spatial Data Infrastructure discussed below) has proposed that barriers are becoming increasingly social and non-technical (Castelein *et al*, 2013; Laituri, 2002). This is well demonstrated by Day (2012) in her discussion of licensing and prohibitive fees as a legal control mechanism over geospatial data and work by Ghose (2007, 2011) and Ghose and Elwood (2003) have discussed the importance of local political context in geographic information access (such as requesting data from government agencies) as well as the capacity to be involved in the decision making process. Using geospatial technologies can help community organizations to be on a level playing field with powerful state actors using GIS for decision making. However non-governmental organizations, as

well as marginalized individuals, may struggle to keep pace with GIS planning activities by the state or other powerful actors (Ghose, 2011). Erik de Man (2003) asks "whether increased access to geospatial information also increases public participation; if not: reinvigorates democracy and benefits society at large" and concludes simply: "It depends" on local and institutional culture (p. 33).

PPGIS research has focused on access to spatial data specifically (Hoffman, 2003; Sieber, 2007; Tulloch and Shapiro, 2003; Tombs, 2005). Two special issues of the URISA Journal (*Urban and Regional Information Systems Association Journal* 2003, vol. 15 I & II) have focused on the issue of geospatial information access for PPGIS applications, some contributors are cited in this review (Erik de Man, 2003; Ghose and Elwood, 2003; Tulloch and Shapiro, 2003; Rugg, 2003) but the special issues also focus on international PPGIS studies and evaluation frameworks for PPGIS. A central focus of many projects informed by PPGIS and GIS and society literature is the increased access to geospatial technology by the marginalized. Johnson draws a distinction between citizen open and enterprise open, arguing that corporations and other powerful actors have access to the tools necessary to deal with big data, while citizens lag behind. As *big data* becomes a common term to describe the collection and mining of unfathomably large datasets, this begs the question of whether ordinary citizens have the capability to confront powerful actors with considerably more resources (Johnson, 2013).

Information Justice

> Datized moments occur most often in the interaction of an individual with a bureaucratic organization such as the state or a business. But people and groups differ in their propensity to interact with such organizations. This difference provides and important point by which privilege can enter into data. Data over-represents some, and where those over-representations parallel existing structures of social privilege, it over-represents those already privileged and under-represents those less likely to be part of the data producing interactions. (Johnson, 2013 p. 3)

Johnson argues about the importance of social privilege being imbedded in datasets as they are constructed through what he calls *datized moments* when some interaction or activity is recorded. Citing the undercount of minority populations by the U.S. Census, he uses the idea of *garbage in, garbage out* whereby regardless of accessibility, injustices remain embedded in the data due to the conditions surrounding their production. Johnson argues that normativity in systems of data collection "enforce conformity to a standard of normalcy (p. 9)." He follows with an example of the evaluation of public universities by the U.S. Department of Education in which hierarchical structures of record requirements induce self-disciplinary actions by the universities. In this case, the *normal* amount of time required for a *normal* student to complete a *normal* program (Johnson, 2013). Such studies often exclude non-traditional students, students of color, veterans, and anyone else who doesn't fit into their strictly defined cohorts. If data collection is unjust, use of this data for decision making can further systematic injustices in planning and decision making activities.

Ghose (2011) addresses spatial knowledge production from the bottom up. She argues that inclusion of citizen groups in the decision making process is largely influenced by power and politics. Examples in the following paragraphs demonstrate how inclusion in the information production process can lead to more just decision making.

Map Kibera is a project designed around participatory mapping that is helping to map the Kibera slum in Nairobi, Kenya. It is argued that slums are often viewed as illegal by the state, and therefore state mapping activities exclude these areas (Donovan, 2012). The exclusion of these people on the map represents how exclusion of the marginalized in the data production can lead to data that over-represents those involved, and under-represents those excluded. Cartographic visualization can be powerful as it allows individuals and organization a geographic perspective of a problem, seek geographic solutions, and use visualization to communicate ideas. Citizens in the slums of Nairobi had found that data used for decision making cast a shadow over the places they lived.

Governments are increasingly using geospatial technologies for governance activities. Rose-Redwood (2006) describes geo-coding as a mechanism for the implementation of the Foucauldian idea of governmentality arguing that "the practice of geo-coding (broadly defined) provided the geographic foundation which linked governmental knoweldges (both statistical and cartographic) with the governed

population by constructing a 'geo-coded landscape' (p. 470)." Ideas of democratic society require that the governed population is able to challenge the governing agents. Are citizens able to access and use information on government in the same way that the government is able to access and use information about citizens? It is easy to argue that by limiting access to information used for governing activities, citizens can be limited in their ability to confront power structures. What is less straightforward is how (and which) citizens are included in the production of information used for governance.

With Internet access now literally in the hands of the masses the (technical) ability of the lay citizen to participate has swelled (Seeger, 2008). Central to this is the shifting of the Internet from a unidirectional system where users consume information to what has been termed Web 2.0 where the distinction between producer and consumer becomes precarious (Haklay, 2008). Crowd sourced geospatial information is exemplified in the Ushahidi (*Swahili, "testify")* project to collect information from rescuers and victims in real time via SMS, map the information, and deliver the product back to those on the ground (Okolloh, 2009). The opportunity for an emergency worker on the ground to be working hand-in-hand with volunteers located continents away represents a major shift in how society responds to natural disasters in the context of geospatial information. Less heartwarming uses have

emerged as well. In light of the exposure of mass data collecting activities of the intelligence services in the United States, one can start to imagine the ways in which they volunteer geographic data and how that data can be used by the state. Sui (2011) discusses many ethical issues of GIS and warns that geospatial technologies are a central component of *surveillance infrastructure*. I would argue that information technologies in general are frequently used by government and increasing volume and complexity of data will require a rethinking of how governments use and share information, and who is able to use that information in a meaningful way to participate in decision making.

Open Data… Open Government?

The enablement of citizens to meaningfully participate in the decision making process is without doubt influenced by the flow of information out of the public sector. The US Federal government produces a large amount of the spatial data available including physical, economic, and social population information. The Freedom of Information Act has been commonly cited as a rationale for the government sharing all geospatial data to the public, as it exists as the product of taxpayer funded government work. The general ethos of open government has been a selling point of the current administration's platform.

Open, machine readable data from government has been championed by the current U.S. administration. The White House Open Data Initiative (whitehouse.gov/open) has stemmed from the *Memorandum on Transparency and Open Government* signed on the president's first day in office. In regards to spatial data, an NSDI effort was spurred by executive order 12906: *Coordinating Geographic Data Acquisition and Access: The National Spatial Data Infrastructure* which was signed by President Clinton in 1994 and placed the responsibility of the NSDI on the Federal Geographic Data Committee. One obvious effect of this initiative is the widespread use of the FGDC metadata standard for spatial datasets. The FGDC proposes that the intention of this metadata standard to improve data sharing activities between and within the public and private sectors (Tennessee Valley Authority, 1998). Recent advances in data sharing at the level of the U.S. Federal Government include data.gov and the geospatial one stop. Goodchild *et al* (2007) assess the GOS and argue that it must fail in its goal to become a one stop for geospatial information as, at the time of assessment, represented only a fraction of GI. At the time of the present review, GOS has been removed from its domain at geodata.gov and appears to have been integrated with the more general data.gov that features a geographic search feature and a filter for spatial datasets. Developments in national spatial data clearinghouses, broadly defined, have been analyzed by Crompvoets *et al* (2004; 2007), finding that "the main factors [that] will have positive impacts on developments

[are] the inclusion of web services, stability of funding, and creation of user friendly interfaces (Crompvoets *et al*, 2004 p. 665)". On the national level in the United States, data sharing prospects seem to be looking good for open data advocates, particularly in the case of geospatial data available for free from a plethora of .gov domains. Local and state government data sharing in the U.S. is a different ballgame. Data.gov and geodata.gov are examples of how the federal government is attempting to make data available to the public. In Europe, the Infrastructure for Spatial Information in the European Community (INSPIRE) directive has guided geographic information sharing. In Kenya, an open data movement has led to much higher than average data sharing for an African country (Williams *et al*, 2014; Rahemtulla *et al*, 2011)

Harvey and Tulloch (2006) analyze data sharing by local government. They find that data sharing among local government agencies is essential to the proper coordination of governing functions. They propose four models of local government data sharing that should be used to assess data sharing activities. Resistance of local governments to the NSDI was characterized as fear of a loss of control and autonomy. Low levels of data sharing was found to be an attractive way to ensure against data misuse and unlicensed distribution (Harvey and Tulloch, 2006). The social contexts of local government geospatial data distribution are as varied as their policies. In a study of geospatial data sharing in Wisconsin, it was found that the political context of Land Information in the state resulted in 72 different data sharing policies

for the 72 counties. In this case, the political structure supporting the land information network is relevant, with state government mandating county controlled land records modernization projects (Day, 2012). Financial hardships and neo-liberal fiscal policies have led to cost recovery models which can lead to prohibitive fees on geospatial data (Ghose, 2011; Day, 2012). Such cost recovery models have been found to restrict progression of GIS development in Europe (Sui, 2011). In the investigation of geospatial data-sharing in Wisconsin (Chapter 3), the topic of cost recovery emerged as being less important than I expected. In fact, some evidence points towards an open data policy being beneficial for cash strapped government agencies because of the reduction in staff time spent dealing with requests. Some counties in Wisconsin have few or no staff members assigned specifically to GIS activities, and as a result many have contracted components of their spatial data infrastructures to the private sector.

Web 2.0 technologies such as geoportals and crowd sourced maps are changing how geospatial information is produced and accessed today, researchers are increasingly interested in user generated content. Geospatial data at the federal level is distributed effectively by a variety of geoportals and finding aids using popular and familiar mapping interfaces. Web Mapping applications are popular with local governments, and they vary from simple data display to query, download, and analysis tools. The line between what is available and what is restricted is not clearly defined

and varies dramatically. But governments have an unanticipated competitor in geographic information production as geospatial technologies, web 2.0, and user generated *spatial media* (Elwood and Leszcynski, 2013) converge.

A much talked about open geospatial platform is Open Street Map (openstreetmap.org) which uses crowd sourced volunteered information to create a map of the world. However, internet crowd sourced information in a crisis are not free of inequality, as Crutcher and Zook (2009) found in their study of Google Earth after Hurricane Katrina. Offline disparities were present in the distribution of geotagged place marks in New Orleans with significantly more place marks in affluent neighborhoods. In the case of Hurricane Sandy, geotagged tweets were clustered around the areas most affected, but Shelton *et al* (2014) warn against making an assumption that the locations of reports reflect the locations of the events described. Mathew Zook (2006) conceptualized internet geographies that are experienced as virtual places. If cyber space can be conceptualized as places than geographic patterns of inequality and inequity (see Chrisman, 1987 for discussion of these terms in GIS context) may also be present in cyberspace. Eric Sheppard's use of the feminist term *positionality* (Sheppard, 2002) seems an appropriate descriptive language of different experiences of the internet and its cyberspaces. How individuals or organizations differ in ability to meaningfully participate in the process of knowledge production on the internet is an important factor. Divisions in society are not left behind when a

person logs on to the Internet or volunteers a map annotation, but rather are reinforced in digital cyberspaces (Crutcher and Zook, 2009). The interrelations between society and technology challenge the idea of an Internet free of social divisions.

Open GIS and Spatial Data Infrastructure

Recent literature by Daniel Sui (2014) has focused on the idea of open GIS as a response to some of the issues of the digital divide and information justice in regards to geospatial technologies. He proposes eight dimensions of Open GIS (See Sui 2014 fig. 1): open hardware, standards, research, publication, funding, education, data, and software. He argues that GIS software has been the most prominent sector of GIS scholarship to embrace open movements (Sui, 2014). Standards are addressed in the spatial data infrastructure literature, especially in the contexts of metadata and interoperability. Open standards follow similar logic, but the standards themselves are open for scrutiny and crowd sourced revision. One primary source for open standards is the Open Geospatial Consortium. File formats are also worthy of consideration, the variety of geospatial data formats is overshadowed only by the dominance of a select few. One of the goals of the OGC is the facilitation of interoperability (Sui, 2014) and this leads to questions of the format(s) in which geospatial data are distributed. While all eight dimensions of open GIS are worthy of further study, open data is most relevant to this review.

Spatial data infrastructure (SDI) can be conceptualized as a technical and social network of geographic information sharing. They occur at many scales. Much discussed are national spatial data infrastructure (NSDI), regional SDI, and global SDI. In the NSDI in the US has been a framework by which the federal government has encouraged technical standards and data sharing practices. SDI development has led to an increased use of standards and a reduction in the technical barriers to data sharing (Harvey *et al*, 2012). Geographers are interested in this concept not because of the geographic nature of the information alone, but because of the interrelations of various actors in a social and technical network. Recently, geographers have been especially interested in response to the cloud, location services, and VGI and what this means for SDI (Harvey *et al*, 2012).

The literature on SDI is vast. *GIS Worlds: creating spatial data infrastructures* (Masser, 2005) features comparative studies of SDI across various international cultural contexts. The book, published by software giant ESRI, focuses on technical analysis of SDIs globally as well as the evolution and diffusion of SDI. The technical nature of SDI is beyond the scope of this review. However, Ian Masser has contributed to the GIS and society literature on SDI (Masser, 2011) using case studies of sub-national, national, and supra-national SDIs. He calls for further research on SDI in the contexts of e-governance and the information society. Literature on the social networks (or actor networks) of SDI informs work on critical GIS, geographies of the

digital divide, geospatial education, and information justice. Research in Western Europe has advanced the importance of, what Dessers calls the "architecture of the inter-organisational chain and its intra-organisational links" in the context of the spatial enablement of the public sector (Dessers, 2013 p. 217; *see also* e.g. Petrovic *et al*, 2013; Vandenbroucke *et al*, 2009; Crompvoets *et al*, 2008). Local government implementation of SDI in the United States is highly variable, data sharing is increasingly common but there is much work to do on issues of standards and timeliness.

Both technical and organization structures are necessary to facilitate local government geospatial data sharing (Hendriks *et al*, 2012). These structures are well represented in the literature as Spatial Data Infrastructure. There is a consensus in such literature that institutional issues have overtaken technical issues as the primary obstacle to spatial data infrastructure success (Harvey and Tulloch, 2006). Also popular in the SDI literature is the idea that spatial data infrastructure has graduated from the first generation of product based infrastructure to the second generation focusing on the user. The SDI Cookbook (Nerbert, 2004) outlines the route to a global SDI, or GSDI, and stresses the importance of a focus on geographic information discovery, evaluation, access, and exploitation (p 69). Hendriks *et al* (2012) attempt to break down some of the confusion that has emerged around defining SDIs by positing that SDIs are defined by objectives and components.

Objectives can be wide ranging and it is recognized that stakeholders will only participate if it is advantageous to them or their organization, and in cases where data providers are concerned about improper use or dissemination, stakeholders must not feel threatened by the infrastructure (McLeod, 2000). Objectives for all stakeholders will likely not be known during the early stages of an SDI implementation and may evolve throughout its lifespan. Components carry out the processes necessary to meet the SDI objectives and may represent human or technical actors in networks at various scales and levels of complexity (Harvey, 2001; Ghose, 2007). In the study of geospatial data sharing in Wisconsin, these actor networks are represented as land information agencies, planning organizations, private businesses, software providers, libraries, universities, users and so on—a web of components each with their own objectives, organizational structures, budgets, policy, and level of awareness of their involvement in an SDI. Upon examining local government data sharing in the context of SDI, Harvey and Tulloch found "data sharing is clearly subordinate to larger governmental mandates and functions. Data sharing purely for the sake of data sharing does not occur" (2006 p. 758). However, based on what I heard from land information professionals at the 2015 annual conference of the Wisconsin Land Information Association, more local governments are spending land information resources on geospatial data sharing implementations, facilitating

open access, and developing necessary sharing infrastructure to facilitate their objectives.

The Wisconsin Land Information Association and other state level coordination of land information efforts in Wisconsin are examples of the types of inter-organizational collaboration that provides important context to the geospatial data sharing practices in the state. There is also a geographic dependence on social practices surrounding an SDI. Harvey and Tulloch propose "counties with longstanding GIS programmes serve as the model for the surrounding area" (2006 p. 755). Survey results analyzed in Chapter 3 (as well as the comments of more than one interview participant) confirm that local influence in Wisconsin such as a disparity in data licensing procedure and policy in neighboring counties can lead to change in practices. Technological developments can cause disruption of sharing infrastructures, such as a recent move to new cadastral formats being adopted by some counties in Wisconsin. Land information officers discuss the pros and cons of the various new formats emerging on the Department of Administration WLIP e-mail list and at conferences such as the example above. This is currently playing out at the same time that the WLIP is developing a statewide parcel and address-mapping database that will require some standardization of data collected at the county and municipal levels.

I cannot help but wonder what role libraries, especially academic libraries, will play in the evolving network of geospatial data distribution. Many university libraries serve as geospatial data clearinghouses for students, researchers, and the public. Libraries are in a position to effectively distribute data as they have developed networks and infrastructure around digitized data. Students require high quality and timely geospatial data for effective research. Geoportals are becoming an increasingly popular way for universities to distribute geospatial data to the campus communities. These topics are discussed in Chapter 4.

Conclusions

Data producers are often creating data for their own use and sharing it as an afterthought. Sharing of data needs to be taken into consideration before the point that the data is actually written. The way in which data is collected, its creation, distribution, and restrictions should all be critiqued by academic literature and peer review. Taking it even further, feedback on the data should be taken seriously and encouraged. If some people report that the data is too difficult to use, it should be reworked and updated. Under the banner of *Open*, data should be available, usable, and *used*.

Projects to increase access to geospatial information should consider work done in GIS and society, PPGIS, the digital divide, internet geographies, spatial data

infrastructure, and open society. Critical research in these fields have exposed that injustices in geospatial knowledge are about more than just access to data, but mirror offline disparities of knowledge production and are dependent on context of political networks and power relations. Producers of data should not only consider interoperability and availability, but also usability so that data can be used in a meaningful way by everyone. Finally, these producers should critically evaluate the process of production to ensure that the data does not over-represent some and under-represent others. It appears that geospatial technologies are here to stay and geographers will play a critical role in ensuring that the discipline advances justice, equality, equity, and transparency. Geospatial technologies will continue to be powerful, but scholars must be critical of utopian ideas of information democracy in the digital age, especially in the case of geospatial information.

Chapter 3:

PUBLIC GEOSPATIAL DATA SHARING IN WISCONSIN

This chapter draws off my experience as a graduate student GIS assistant at the American Geographical Society Library at UW-Milwaukee as well as a survey and follow-up interviews that were designed and conducted for this research.

The AGS Library is working with other UW System actors to implement a UW System-wide open geoportal for academic access to geospatial data. Information from the data providers is crucial to help determine the course of action needed as well as some of the barriers that may prevent the implementation of such a system. This chapter seeks to uncover motivations behind sharing practices, explore restrictions and licenses applied to public geospatial data in Wisconsin, and discuss barriers that must be navigated before the implementation of a UW System geospatial data portal.

Harvey and Tulloch (2006) analyze data sharing by local government. They find that data sharing among local government agencies is essential to the proper coordination of governing functions. However, "data sharing is clearly subordinate to

larger governmental mandates and functions. Data sharing purely for the sake of data sharing does not occur (2006 p. 758)."

Local Wisconsin Geodata at the AGS Library

As the Geospatial Data Clearinghouse for UW-Milwaukee, the American Geographical Society Library helps students, faculty, staff, and the public to obtain geospatial data of all kinds. The vast majority of the data that is requested covers Southeast Wisconsin. Some of the data in the AGS collection could be obtained by downloading it online directly from the county or by following the data providers' request procedures. Some data can only be obtained through the library GIS services by making a request in lieu of purchasing the data. In these cases, the AGS Library has arranged with a data provider such as a county or regional planning commission to distribute the data to UW-Milwaukee faculty, students, and staff. The licensing and data sharing agreements on file at the AGS Library are varied in their date of implementation, currency, relevance, and language. Data acquisition documentation is not available for all datasets in the collection, but the acquisition process at the AGS Library is far from standardized and is rather highly dependent on the policies and procedures of the data producers.

On one end of the spectrum, if data is available for download (and relevant to the needs of patrons) the practice has been to download it, save it in the archive if

appropriate, ensure complete metadata is available, and distribute it without restriction. On the other end of the spectrum, some data sets have specific restrictions. A notable example in the AGS Library collection of such a restriction on data distribution is base map data from the web mapping application known as the Milwaukee County Automated Mapping and Land Information System (MCAMLIS.) This example is a very high-resolution vector dataset of Milwaukee County including a multitude of features. This data was restricted for distribution in a few ways. First, the data was available to UW-Milwaukee students for *classroom* use only. Per the licensing agreement and subsequent policy at the library, the AGS Library GIS data services collected the patron student ID number, department, the course the data was being used for, and the supervising instructor for the course or research.

Although all data requests were recorded on a paper form, the MCAMLIS data requests required the student to sign a special data agreement restricting redistribution, defined fair uses, and warned of academic consequences for failure to comply. Faculty could also request data and permission was granted for them to distribute the materials for classroom use to students under a slightly different sub-licensing agreement with the library. Because of legal issues surrounding an indemnification clause in the license agreement required by the Land Information Office (with which the university could not legally comply) an insurance policy covering liability was still in place until very recently.

The interesting story of MCAMLIS data does not stop here. It came as a shock to AGS Library GIS staff when Milwaukee County's response to the UW System Geospatial Data Survey included a statement that the MCAMLIS steering committee was considering offering the data for direct download on their website. At a MCAMLIS Steering Committee meeting in February 2015 a motion was made and passed to discontinue enforcement of the copyright for the data. Although this move is applauded by myself and my coworkers, it is interesting how a product that had been under such restrictions was now being offered for download by anyone for any use. These events, in fact, were an inspirational push to do this research and are an excellent example of a positive change for geospatial data in Milwaukee. A third generation of the mapping platform has been announced and ideally the capability to export the dataset in a useful spatial format is included in this new version.

State, County, and municipal level data are essential components of a geospatial data collection in the AGS Library. The scale and resolution of these datasets are unmatched by most data distributed at the federal level or available at no cost from private producers. While there are some state mandated requirements for county governments including the sharing of parcel information and a land records modernization plan, the counties are autonomous in deciding how their data is distributed (Day, 2012). Some choose to make it free online, some choose to make it available only to certain individuals or organizations. What has resulted, at the county

level specifically, are 72 different data sharing policies for 72 different counties. Although the AGS Library does not hold data from every county, there are occasional requests for data covering locations in the state that are outside of the commonly requested areas. At times, the AGS Library has purchased data from counties that charge fees for certain data in order to distribute this data to UW-Milwaukee patrons under a data sharing agreement. This seems to be a declining trend because even data producers that do not distribute their data openly tend to share data for educational use without charge or restrictions beyond redistribution.

Obtaining federal data is straightforward using information portals such as data.gov. It is not best practice at the AGS Library to archive the majority of the data obtained from federal sources. When a request for a federal dataset is received, the practice is to download, organize, and screen the data to quickly deliver it to the patron. Some state agency data, such as conservation and environmental data from the Wisconsin Department of Natural Resources (DNR) is as simple to obtain as connecting to a public-facing FTP server. Most DNR data includes metadata or is somehow documented for external use. One county GIS professional I interviewed remarked that it was difficult to determine what data is available from state agencies and how to obtain it. Other state agencies have shared data with the AGS Library, but may not make that data available for download on a website.

UW System Geospatial Data Survey

The UW System Geospatial Data Survey, a short six-question survey sent to the county land information officers (LIOs), regional planning commissions (RPCs) and to a select few municipalities was issued early in 2015 by e-mail. County Government participants were chosen from the list of Land Information Officers published online by the Wisconsin Land Information Officer Network (www.wlion.org). All of Wisconsin's 72 counties are required to appoint a Land Information Officer and all were invited to participate. Wisconsin has six regional planning commissions organized by regions of the state of Wisconsin: South Eastern, South Western, Mississippi River, East Central, Bay Lake, North Central, West Central, North West, and the Capital Area. Contact information for these organizations was found through their websites or through the website of the Association of Wisconsin Regional Planning Commissions (www.awrpc.org).

The research team for the survey included the Geospatial Information Specialist at the AGS Library, the Map and Geospatial Data Librarian at Robinson Map Library at the University of Wisconsin, the Senior Outreach Specialist at the Wisconsin State Cartographer's Office, the Geospatial Technology Facilitator in the Anthropology and Geography Department at UW-Eau Claire, and myself. These actors were all especially interested in a UW System geoportal.

Figure 1: UW System Geospatial Data Survey Questions

1. Does your agency currently require a handwritten signature (or digital equivalent) on a formal data-sharing agreement before an institution may access your geospatial data for educational use?

2. If your agency currently requires a signed data-sharing agreement for access to geospatial data for educational use, will you continue to do so in 2015?

3. If your agency currently does not require a signed license/data sharing agreement for access to geospatial data for educational use, do you intend to implement such an agreement in 2015?

4. Would you allow geospatial data from your agency currently archived at UW-Madison, or at any other institution of higher education in Wisconsin, to be redistributed across all UW System colleges and universities for educational use without additional signatures on a license/data sharing agreement?

5. Separate any data that may be archived at UW-Madison or any other institution of higher education in Wisconsin, does your county/agency provide direct download access to geospatial data files from the agency website? (We do not mean a web map, we are interested in online access to actual data files like shapefiles and geodatabases, etc.)

6. At present, the Robinson Map Library at UW-Madison maintains the most comprehensive geospatial data archive that is to be used solely for educational purposes. Theoretically, if at some time in the future a portion of the geospatial data archive at the Robinson Map Library were to be made publicly available, would you give permission for open access to your agency's data?

Finally, 24 municipalities with active GIS departments were invited to participate, with special interest in municipalities that have an online presence in regards to geospatial information. The survey was conducted using the Qualtrics survey engine and included a standard consent agreement laid out by the UW-Milwaukee Institutional Review Board for Human Subjects Research. Questions focused specifically on geospatial data sharing with the University of Wisconsin System and the public. The results of the survey and the follow up interviews are discussed below.

The questions asked were not only interesting topics for this research, but also important information that the AGS Library at UW-Milwaukee as well as the Robinson map library, the geospatial data clearinghouse for the University of Wisconsin-Madison, needed to help plan for better collaboration between UW System institutions. Robinson has worked with the Wisconsin State Cartographer's Office (SCO) closely to launch geodata@UW-Madison. In its current state of implementation, the geodata@UW-Madison geoportal serves the majority of Robinson's Wisconsin geospatial data to those with UW-Madison login credentials. Actors across the UW System including those of us at the AGS Library as well as the geography and anthropology department at UW-Eau Claire are interested in collaborating more closely in regards to the collection of county and municipal level geodata in Wisconsin with a goal to participate in the geoportal by contributing data and allowing students with any UW System login credentials to access the geoportal. A shared goal of these UW System actors is the streamlined access to public geodata for educational use by any student, faculty, or researcher in the UW System. Again, while UW System actors may think it is important for public access to be granted in this geoportal, the primary goal is to facilitate academic access and public access is being pursued as a secondary goal.

While these questions are insufficient to tell the full story of motivations behind data sharing, it was intentionally brief to elicit a maximum response rate. Although the survey was designed with this research in mind, its primary purpose was to explore possible barriers to the implementation of the UW System Geoportal. Since multiple UW System institutions have entered into data sharing agreements, formal or *ad hoc*, it is important to determine if these agreements could be extended to the whole UW System or if new data sharing agreements at individual institutions would need to be negotiated at the system level. The responses to questions 1-4 on the survey were designed to guide the process of such renegotiations and determine if license agreements would pose a significant barrier to the implementation of the geoportal.

Question 5 on the survey was aimed to determine if the data producers provided *raw* data, such as shapefiles and geodatabases, via some sort of web portal. The survey specifically excluded access via a web viewer because, as discussed in Chapter 4, web viewers often enable users to view data, but may not allow the user to download data for use in desktop GIS applications for further analysis. Typically, if raw data is available for download on a data producer's website, it can be assumed that redistribution of the data is not prohibited although this can depend on user agreements or legal language on the website.

Finally, question 6 was designed to determine if a county was open to the idea of public data sharing via that UW System Geoportal. It was assumed that some of the land information officers and other GIS professionals participating in the survey would need to obtain some type of approval in order to make this decision to share publicly, and it was therefore presented as a hypothetical situation to stress that the main purpose and goal of the geoportal is for academic rather than public access. Also, by stating that "some portion" of the data collection would be made available, it was clear that it would be up to the producer to decide if their data would be shared or not and that it would be up to them to decide which, if any, of their datasets would be made publicly available.

A seventh, more procedural question, was also included that asked if the participants were willing to participate in a follow-up interview. Some of those who responded that they were willing to be interviewed were contacted later in order to clarify their answers and explore motivations for sharing that were beyond the scope of this short survey. In total, 4 participants from county governments were interviewed and insights from these interviews are discussed below.

A comment box was included in the survey with a prompt asking if the participant if they had any additional comments or clarifications. While the majority of responses did not include comments, those that did comment provided useful information and provided interesting insights into some of the answers received. Some of

the more insightful responses are included below in discussion and all the comments in full text are printed in Appendix B.

Table 1: UW System Geospatial Data Survey Results

Answer:	Yes		No		Unsure		Not Applicable		Did not answer question	
Response from:	All	Counties Only	All	Counties	All	Counties Only	All	Counties	All	Counties Only
Q1	24 (31.2%)	23 (34.3%)	52 (67.5%)	43 (64.2%)	-	-	-	-	1 (1.3%)	1 (1.5%)
Q2	25 (32.5%)	23 (34.3%)	1 (1.3%)	0 (0%)	6 (7.8%)	6 (9.0%)	43 (55.8%)	37 (55.2%)	2 (2.6%)	1 (1.5%)
Q3	1 (1.3%)	1 (1.5%)	39 (50.6%)	33 (49.3%)	8 (10.4%)	7 (10.4%)	24 (31.2%)	21 (31.3%)	5 (6.5%)	5 (7.5%)
Q4	66 (85.7%)	57 (85.1%)	9 (11.7%)	8 (12.0%)	-	-	-	-	2 (2.6%)	2 (3.0%)
Q5	20 (26.0%)	16 (23.9%)	54 (70.1%)	50 (74.6%)	-	-	-	-	1 (1.3%)	1 (1.5%)
Q6	47 (61.0%)	40 (59.7%)	25 (32.5%)	22 (32.8%)	-	-	-	-	5 (6.5%)	5 (7.5%)

Notes: Counties N=67, All N=77. There were two respondents from Dodge county with identical answers and the answers were counted only once. Douglas County and City of Superior as well as Dane County and Capital Area RPC were answered by a single respondent (respectively) but are counted as four separate responses.

Survey Results

The research team was pleased with the response rates from counties with all but five of 72 Wisconsin counties responding with 77 responses in total. There

were responses from four of the nine RPCs and six municipalities of 24 contacted. The results of the survey question answers are displayed in Table 1.

Responses were received from 67 of 72 counties, with no response from Dunn, Juneau, Washburn, Waushara, and Winnebago counties. There were three responses from Regional Planning Commissions (as well as a response from Dane County for Capital Area RPC.) Six municipalities have responded: City of Oshkosh, City of Appleton, City of West Bend, City of Marshfield, Village of Bellevue, and the City of Superior (City of Superior and Douglas County are represented by the same respondent.)

More than a third of respondents said that they do require a data-sharing agreement. All of these respondents also intend to continue the use of a data-sharing agreement in 2015. Only one county intends to implement a data-sharing agreement in 2015. This county participated in both the survey as well as a follow up interview so this unique response is discussed below.

One of the most critical questions was: "Would you allow geospatial data from your agency currently archived at UW-Madison, or at any other institution of higher education in Wisconsin, to be redistributed across all UW System colleges and universities for education use without additional signatures on a li-

cense/data sharing agreement?" More than 85% of respondents, 85% of counties, responded "yes" indicating to the research team that they were open to the concept of a UW System geoportal

Of organizations open to the idea of expanding UW System access to all UW institutions via a geoportal, 42 are open to the idea of the geoportal allowing public access. Interestingly, 3 of the organizations who answered no to the question of expanding UW System access are open to public sharing (including the response mentioned above), which seems contradictory. The wording of survey questions may have led to unexpected answers, as public sharing was proposed as a hypothetical situation in the future. Of the 18 respondents open to a UW System geoportal and who share data on a website, all but one are interested in public access on the geoportal.

Nearly 60% of respondents and just over 60% of counties responded "yes" to the question of future public data sharing on the UW System geoportal. Of the 54 participants that responded that they do not have data available on their websites, 40 of them are interested in a public UW System geoportal. Only 15 counties answered that they currently share data on their websites for direct download. Some users may believe that agencies who do not share data on the internet are not open to public data sharing, but it may be the case that they lack the financial or human

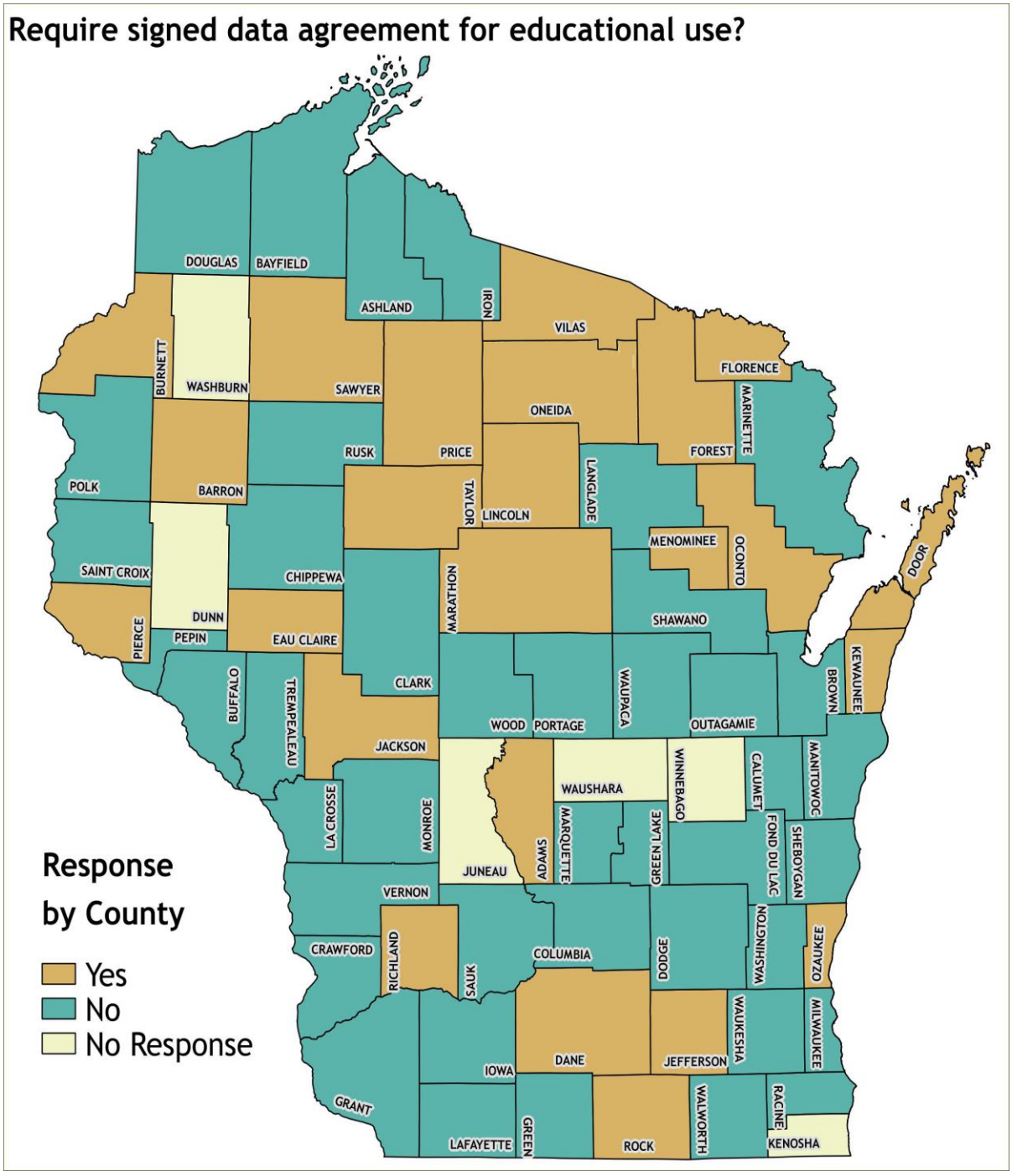

Figure 2 Map Showing County Response to Question 1

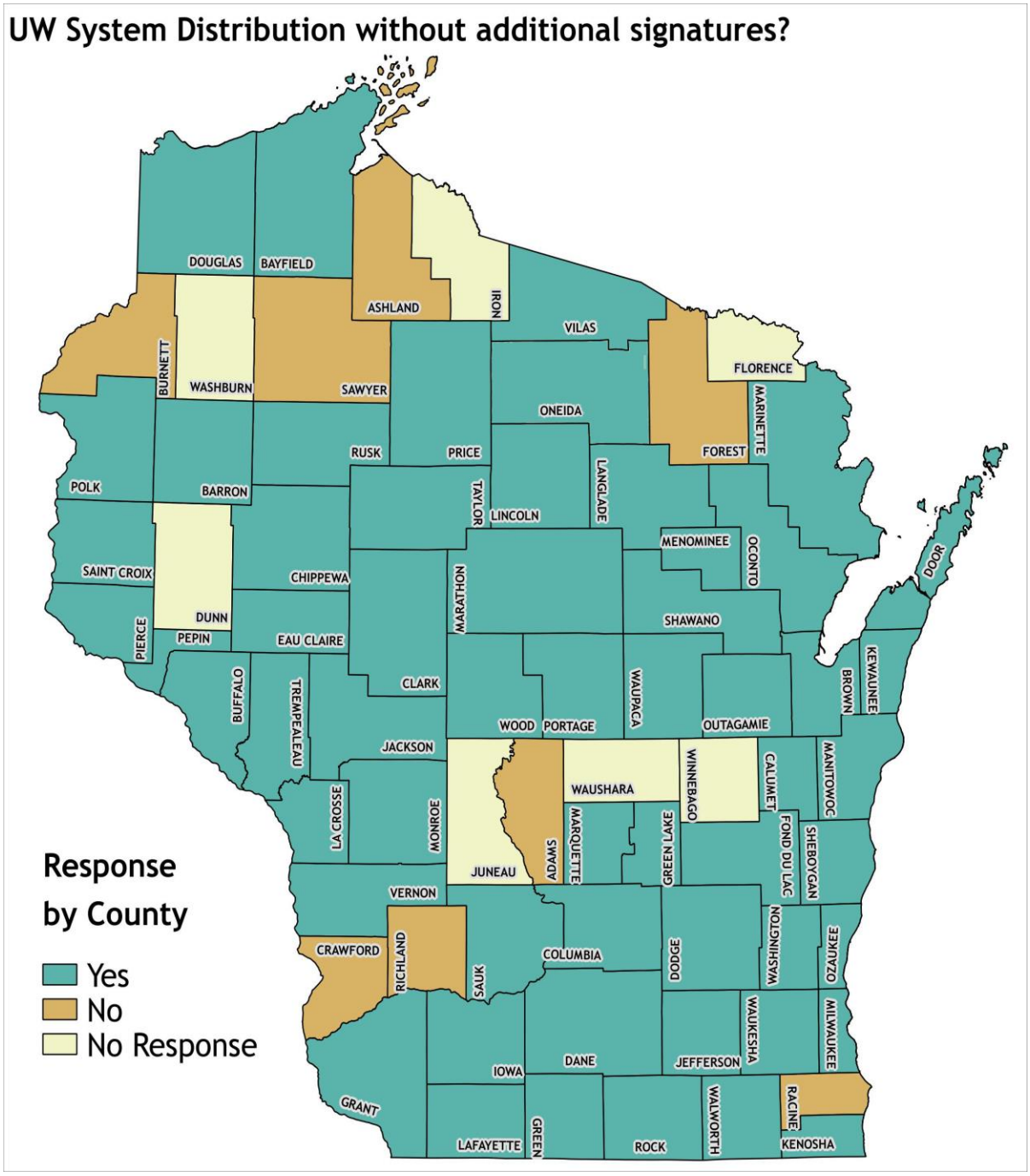

Figure 3 Map Showing County Response to Question 4

resources to implement an effective data portal. Perhaps these respondents are interested in the data portal as an alternative to implementing their own system.

Of the 24 organizations who require a signature on a formal data sharing agreement, none of them provide direct download for the public on their websites and only 6 of them are open to the idea of the UW System geoportal providing public access. There is a clear relationship between counties using data-sharing agreements and their willingness to provide data to the public via a UW System Geoportal. Of organizations that share their data online for direct download, none of them require a signature on a data agreement, although some do have a disclaimer or use restriction. It is unclear how often these policies are enforced.

Four counties commented that they are currently or are planning to review their data distribution policy. Five respondents indicated that they would need to confirm these issues with a county authority such as a land information council or county board. A couple of respondents indicated that some of their data is available while other data is not. Many of these organizations may have sensitive utility information that they do not share. One county commented and said that "[The County] has no policies set for sharing data…" Comments and corresponding survey answers are displayed in a table in Appendix B.

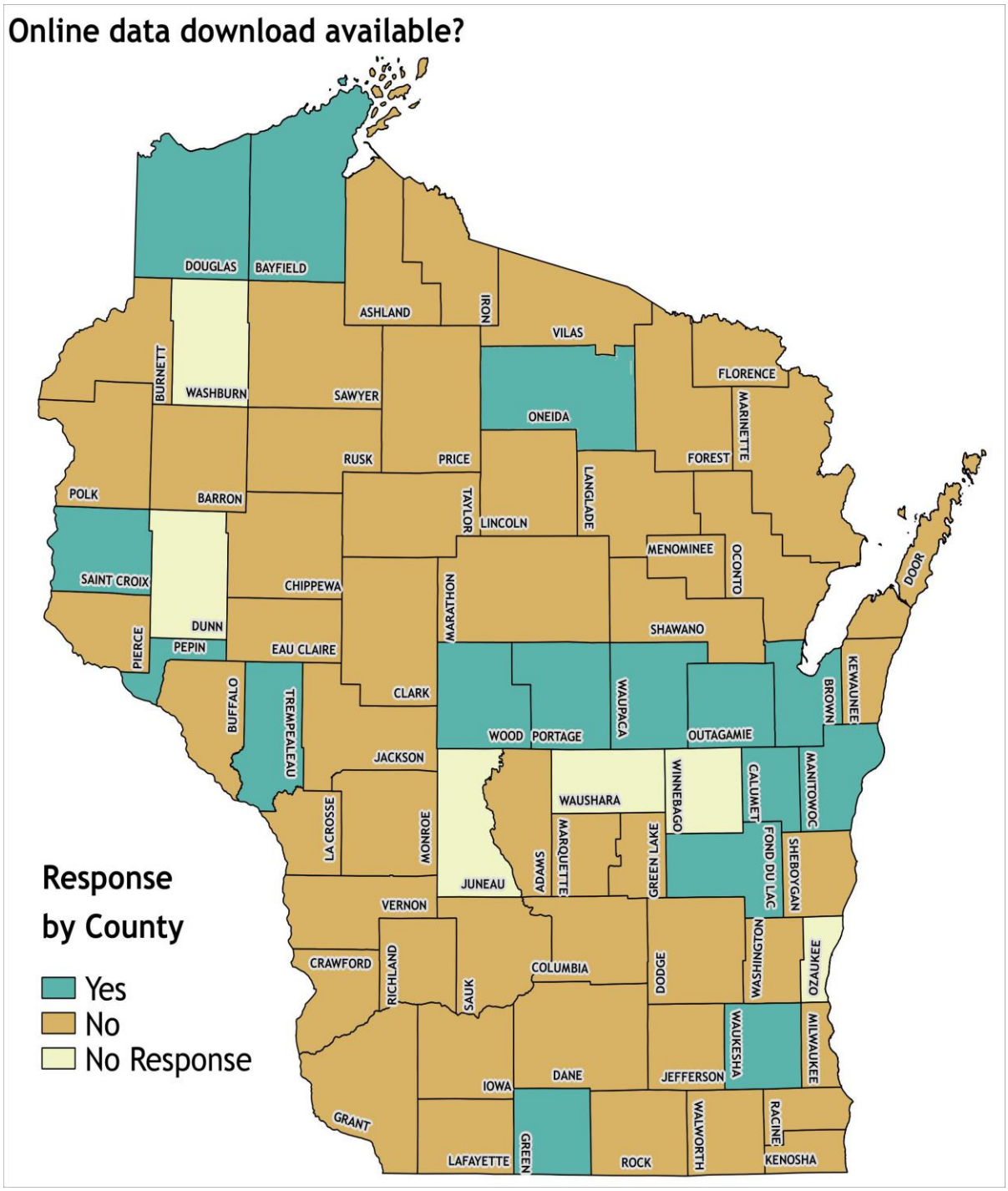

Figure 4 Map Showing County Response to Question 5

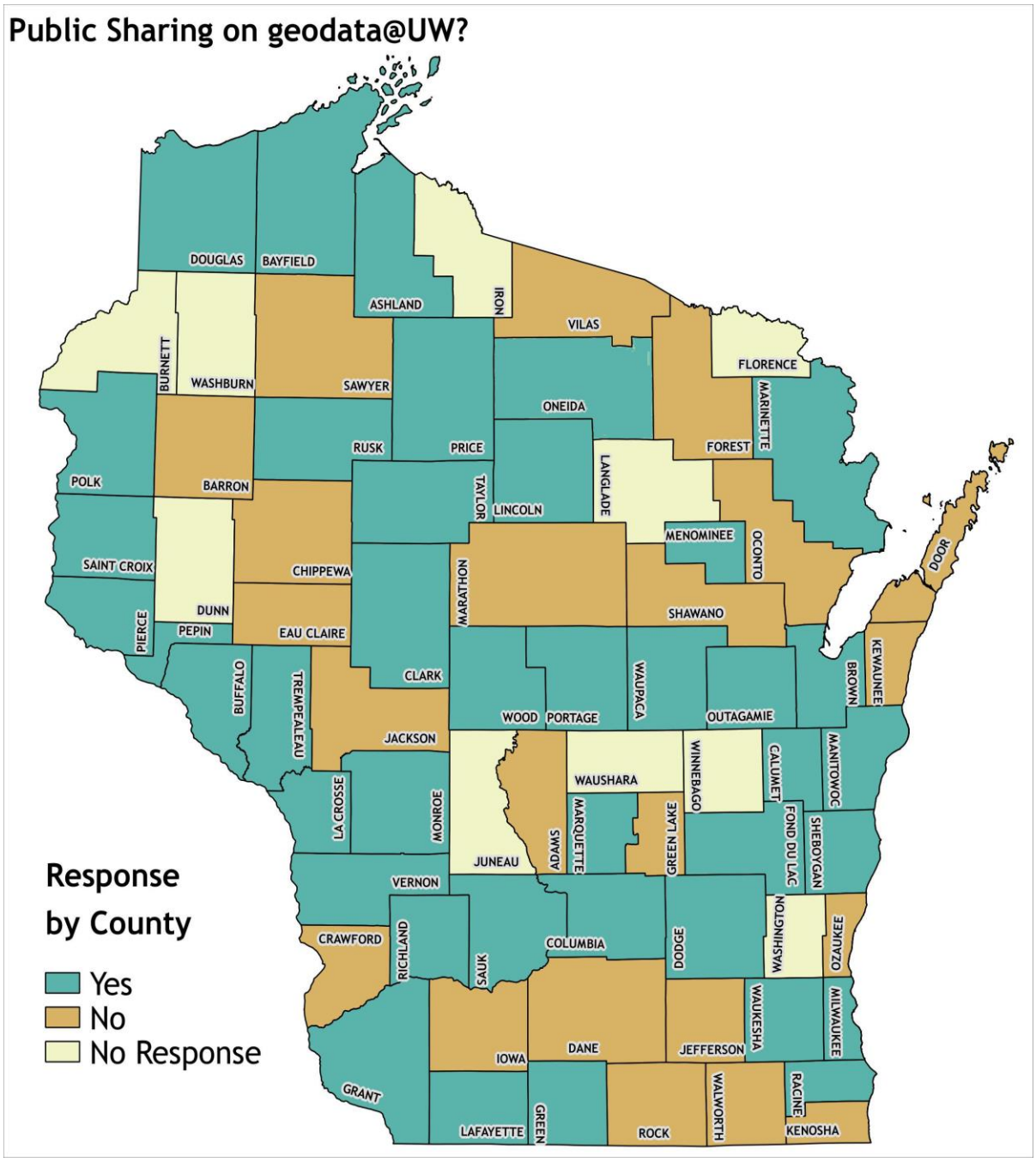

Figure 5 Map Showing County Response to Question 6

Survey Discussion

The barriers to the UW System geoportal project becoming a reality are hardly technical in nature. Opening up the geoportal to the rest of the UW System would be as simple as changing the login to accept any UW System credentials. The challenging barrier is the (re)negotiation of data sharing agreements between individual institutions in the UW System and the individual data producers. This leads to one of the most important questions on the UW System Geospatial Data Survey which asked if the agency would be willing to expand access to data they have previously shared with UW System institutions to a broader UW System agreement. What this essentially requires for counties that use some sort of data sharing agreement is that data sharing agreements with the UW System are approved at the system level. Previously, data sharing agreements would be signed by professional staff at the library or an administrator such as the director of libraries.

There are a few motivations behind a switch to a system like this. The first, and something that has been discussed as a benefit to the data producers, is the reduction in the amount of times that data producers are contacted in regards to obtaining updated data for the collection. As more and more UW System campuses add GIS coursework, and thus increase demand for real geodata, the producers would likely see an increase in the staff time required for dealing with requests. A centralized UW geoportal would require just one point of contact between the data

producer and the entire UW System. This is also a reduction of the duplication of efforts of the various campuses. If one campus obtains geodata under a system level agreement, the data would be easily shared by patrons on multiple campuses. Contributing institutions could, in a sense, divvy up the counties and other data producers to split the work load among the various UW System staff.

One benefit to academic users is that this type of system will be able to accommodate an archive of local geodata. Some counties and other agencies may not be interested in maintaining archived versions of datasets, as they may not be useful once outdated. However, researchers are often interested in looking at change over time and this could be accomplished with updated data collected at frequent and regular intervals. This system would allow for scheduled data sharing, so that when a county updates a data set, they could simply send it to the UW System geoportal and know that any researchers interested in using this data would have the most recent and authoritative version. This has been voiced as a concern both in the comments of the survey as well as in the interview that followed. Data producers are concerned that if there data is available for download from another source, that users will not be using the most current authoritative version. However, this leads to another discussion that has been happening at the AGS Library: that academic users use public geospatial data differently than business or public users.

The comment box provided some useful quotations to understand of some of the ideas about data openness in Wisconsin amongst public land information professionals. One regional planning commission responded “WI's publicly available GIS data sources lag far behind our neighboring states. I feel WI should look into instituting something similar to MI's Geographic framework to avoid the fragmentation and lack of availability of our current state GIS data sources.” A county LIO responded “We have made our Geospatial data available as a free download for at least 4 years now. We do track the location (IP address to Lat/Long) of who is downloading the data solely for the purpose of justifying the need to make it freely available. It's very powerful to show a graphic of all the different users from all over the Country/World that have downloaded our data!” Another county answered “Our Data Downloads page includes a disclaimer and "Data Useage [sic] Agreement" but it's just "click through" to get free access to the data files.”

Some organizations seemed to have more restrictive thoughts on the idea of data sharing. One county responded “I have no problem providing data to anyone or any organization, as long as there is a [sic] understanding of "data integrity" and "data quality" between parties, and without some formal agreement I believe you leave alot [sic] to assumption.” Others expressed concern about private business making profit from their public data, indicating they were willing to share “…provided it did not go to a private enterprise for there [sic] use to charge the public.”

Other respondents seemed on the fence: “Some data will be public some will not”, “We will be looking at our data sharing policy as part of our Land Records Modernization Plan update. We would need to change our data sharing policy to allow open distribution of GIS data. We may look at that to create efficiences [sic] and reduce staff time filling data requests”, “In regards to last question we want users to aquire [sic] the data from us to insure [sic] they have the most accurate / recent version.”

It is in not my intention to demonize or criticize the agencies that do not share data with the public or for educational use or have restrictions on their data. Through the survey, the interviews, and what I learned while listening at the Wisconsin Land Information Association annual conference, the issues of data sharing are more complicated than simply a willingness (or lack thereof) to share data. Sometimes, such a decision is left to a county council or similar authority. In some cases, the data that the agencies use are subject to data agreements they have made with partners such as gas and electric utilities. There are a plethora of factors that could influence how the process of data sharing works at a specific agency.

One GIS professional I spoke with in a follow-up interview was the only survey respondent that replied stating that the county was planning to implement a signed data sharing agreement in 2015. This made me curious about their motivations, and it turns out that the county simply wanted to make their request process

more in line with the surrounding counties processes, and they were using signed data sharing agreements.

Interviews

Interviews were performed with representatives from four counties chosen primarily based on interesting or novel responses to survey questions or comments that needed more explanation. There were three interview participants and one who chose to respond to prepared questions. All of the participants were the appointed Land Information Officer for their respective counties and had indicated that they were willing to be interviewed for this research. The three interviews were conducted on the phone and questions were open ended, unscripted, and casual. Because I am most interested in their various motivations behind sharing policies, I did not want to confine the conversation to predefined topics. All the interview participants were asked about the organizational structure of their agencies including the number of users and departments using GIS.

The interviews served two purposes for this research. One purpose is to expand on survey results and clear up any questions about the answers. The interview responses put some of the answers to survey questions into a clearer context. The second purpose is to try to understand some of the reasons for answers to survey questions. The motivations behind sharing data or choosing to restrict data, charge

fees, or not share at all are not well understood. Stakeholders vary from county to county. In larger counties with large land information offices, there may be more than a dozen primary GIS users on staff and in smaller counties the GIS staff may be only one person or the primary GIS user may not consider themselves to be "GIS staff" at all. Interview questions focused on legal restrictions, disclaimers, indemnification, and other legal language and if such features were originating in the land information office or if there was influence from elected officials, counsel, or other local government agencies. While the scope of this project is not acute enough to provide data on the effect of these different influences or make definitive statements on why data-sharing is how it is in Wisconsin, I have learned enough to be able to make recommendations for further research on the topic as well as start to inform my investigation of public geospatial data sharing in Wisconsin.

The first interview was with a GIS analyst in a county planning and development office. This county was of interest because it had a small population but also hosts a UW System university with a GIS programs. He has been in the position for over 9 years and although the county is currently seeking a GIS analyst, he has been the only dedicated GIS staff, although he says that the location of the GIS staff in the planning and development office is convenient because this department works most with the digital land information.

When he started working for the county, the county was using physical Mylar parcel maps and have since modernized their land records according to the direction of the Wisconsin Land Information Program. This individual had responded to the UW System Geospatial Data Survey indicating that the county uses a license agreement and plan to continue to use this system in 2015. According to the interview, for most requests a signed license agreement will allow the requestor to use and distribute the data as needed within the agency but limits their rights to redistribute the data to third parties. If private businesses wish to use the data, there is a fee associated with the request. It is the opinion of the interview participant that the data sharing agreement protects the user by ensuring they have the most updated version from the most authoritative source. As I will discuss below, this idea is not uncommon.

The county shares data with a few UW System institutions including the AGS Library and recognize the importance of GIS students using real local data. He claimed that he receives little feedback about county data from users with the exception of the State Cartographers Office who provides feedback on statute related issues with land records modernization.

This interview participant stated that the county possesses security sensitive infrastructure data that the land information office is not allowed to redistribute because of their own license agreements with the utilities. This county launched their

web-mapping viewer in 2006 with a focus on a "parcel kitchen sink" type viewer. This public access to property information was implemented because it was mandated by the state and was funded by fees retained (under statute) for register of deeds documents. However, he notes that there has not been strict enforcement of this mandate. In regards to a UW System open geoportal, he thinks that a system wide signature on a license agreement would be a positive thing because it would decrease the number of requests he processes for educational use. He believes that his peers in other counties would be most concerned that students would redistribute this data without "going through the proper channels" and he thinks these concerns are justified.

The second interview was with a GIS analyst in a county neighboring the previous county. This county also has a small population and is primarily rural although a UW System campus is nearby. This particular participant has been with the county for over 17 years and is one of two dedicated GIS staff. There is also heavy use of GIS by the county surveyor and one staff member at the Sheriff's Department. This county was the only county to respond to the survey indicating that although the do not currently require a license agreement to be signed before sharing data, they plan to implement such a procedure in 2015. When I inquired about the reasons behind this, he first stated that people requesting data have been asking if there was anything to sign, mostly local businesses and other local government agencies.

However, he indicated that the most influential factor was that other neighboring counties, including the county above, are using license agreements and the county wanted to be more aligned.

The county ask for e-mails so they can keep in touch with data users. Like other counties, the legal language included in the license agreement restricts the licensee on redistributing the data and that they will not sell the data for profit. There is also indication that the data is available in an "as is" condition. Switching to a license agreement also helps to regulate the request process. Where previously, requests were handled differently for different types of users, requests will now be handled with a standard agreement.

Like most counties, this county is open to academic use and sharing; they charge fees only for business doing work that is not contracted by the county. Their web-mapping application has been live for nearly 10 years. The participant stated that at first there were many requests for assistance using the system, but these have weaned off and there has been a significant reduction in staff time required to facilitate requests for land information. Like the previous county, the system was initially intended for parcel information but has expanded to include other datasets of interest. The system also makes the data available for use by staff in the field.

This participant noted that he has faced issues with obtaining data from utilities but seem satisfied with data sharing with local municipalities and neighboring counties. He is open to academic use but share concerns about redistribution of out of date data or data being obtained from sourced other than the most authoritative. This county is exploring open source solutions, but at the moment is a "mixed shop" of proprietary and open source products. Finally, this interview participant mentioned the idea of switching from "raw" data files like ESRI shapefiles and moving to web services where the most updated data can be hosted on a server and users can connect and analyze the data using their own software. This possible shift in how geospatial information is distributed is discussed in more detail in Chapter 4.

The third interview participant is a GIS analyst for a mostly rural and seasonal vacation destination county in Central Wisconsin with a medium to low population which varies seasonally. Vacation properties and second homes are common. He believes that this county was the first to implement a data download page to facilitate requests for geospatial data. There are only 16 counties who offer data for download on a website (as found in the survey results above.) Interestingly, keeping aligned with the trend of the previous two interviews, counties seem to be heavily influenced by the practices of neighboring counties because other counties surrounding this one have also switched to a system of providing direct download of data files on their website.

Since I was curious who was involved in such a decision, he explained that it was his idea but that it was an easy sell to county decision makers. Although the county had been charging up to $50 for a CD of data before implementing the direct download, he believes that it didn't sufficiently cover the costs involved with staff time and materials required to produce the data in this form. At first, the data download page required a login and was intended to provide easy access to other local agencies, but now the system requires only an e-mail login.

The county land information office uses IP logging in order to track the location of those who are requesting the data with the intention of defending the open data policy by showing that users all over the state, country, and globe have used the data. He also keeps a database of e-mails so that in the future he can survey the users about their needs and desires for the county data.

He is exploring using ESRI's geoportal software, but would lose the ability to track downloads and this is important to them. He found it difficult to obtain data from other agencies, particularly from the state. He struggles to discover datasets that the Wisconsin DNR and other state agencies maintain and distribute. He recounted a story of purchasing an expensive and highly restricted dataset from the Wisconsin Natural History Survey.

This interview participant was very in favor of a UW System geoportal. Public access on such a geoportal would enable counties like his to easily access data from other counties, municipalities, or state agencies—provided that local governments make the data available beyond academic use. He believes that such a proposal would face little opposition from county lawmakers and regulators and that they would be more or less unaware. He believes that providing the data for use in this fashion would lend more value and weight to the data and in order to give value to the data, people need access. This seems almost contradictory to the worries of some other counties that data may find its way into the wrong hands and devalue the data.

The next follow up was not completed in interview format at the request of the participant. I provided some questions similar to the questions I had asked other participants. Unlike the other interview participants, this respondent worked in a county with a significantly larger population and more land information activities at the county government level. This county has a large urban center as well as a rural periphery. Although they only have 1.25 full-time-equivalent dedicated GIS staff, there are about 8 "*power users*" in the county representing the real property lister and register of deeds offices, development services, planning, permits, engineering, and land conservation staff.

This county does not use a license agreement but also does not make any data available for open download; they facilitate data requests through e-mail or phone. Private citizens and businesses are charged a fee for the data while county contracts, municipalities, and the academic community are not charged (dependent on the description of their intended use.) The decision of how a particular data set is shared, or if it is shared at all, falls on the county Land Information Officer and it is claimed that there are not a lot of political or policy reasons influencing this decision. County elected representatives have "no role" in the sharing of geospatial data.

Although this county had responded to the survey that they would not be willing to expand their current UW sharing agreements to a system wide agreement, it appears this was a mistake as the respondent refutes this answer in the follow-up and seems more than willing to participate in any kind of academic data sharing agreements. The county's web-mapping application is hosted in a partnership with the regional planning commission and she believes that this application has saved significant staff time and has provided a good level of access to actors who demand this information. However, she cites changing technology as a reason that the county will soon be able to manage their own data without contracting the regional planning commission (and sharing the grant money afforded by the WLIP.)

Legal Considerations

Harlan Onsrud (2004) finds that intellectual property, freedom of information, and information privacy are some of the most influential areas of the law that effect geospatial information. Following his framework of these three ideas, I will discuss how these ideas relate to public geospatial data in Wisconsin.

Copyright protection under the Copyright Act is not available for works of the federal government. Onsrud discusses how a purpose of copyright protection is to encourage expression (Onsrud, 2004). In the context of geospatial information, the argument would follow that by being able to copyright the creative expression of the database (an arrangement of *facts*) would encourage actors to compile geographic facts and that these facts would then be available for review, analysis, and critique.

He argues, however, that even without copyright protection, most of the government work in question would be performed anyway and therefore the incentive created by copyright protection is not applicable in this context. For state and local governments with whom copyright protection for geospatial data is sought after, restrictive publishing practices are challenged by free speech ideas and the right of citizens to access and disseminate government records (Onsrud, 2004). Although the survey didn't specifically address copyright protection, it did emerge as a topic of conversation at a meeting of the Milwaukee County Automated Mapping and Land

Information System (MCAMLIS) Steering Committee. Milwaukee County had partnered with local utilities during the start of the project and all partners have seen a return on investment. The MCAMLIS Steering Committee seems truly interested in providing open access to the datasets used in their mapping system and have chosen to discontinue enforcement of the copyright. However, the effects of copyright on local public geospatial data in Wisconsin remain somewhat ambiguous. Even works under copyright protection usually have some sort of *fair use* associated with them and because of this copyright protection may not be the best avenue for data producers not interested in distributing their data.

Freedom of information laws in the context of government records are related to the issue of intellectual property discussed above. The idea that citizens should be free to access and criticize government work is fundamental to the idea of transparent and fair governance. Onsrud discusses a balance between these ideas and the reasonable need to "maintain confidentiality of some government records (2004; np)." Freedom of Information Act requests have been a common way for the public to obtain access to government records, but the process is cumbersome and at the federal level agencies are encouraged to provide public access in more streamlined ways (Onsrud, 2004) like geospatial information technologies such as data portals or web-mapping applications.

Typically freedom of information requests are processed at the cost of reproduction, but through interviews and surveys of county data websites, some counties are charging upwards of $75 for a single CD of geospatial data. Research by Patrice Day "shows that those that license and charge in excess of cost of reproduction do so in violation of [Wisconsin's] open records law and the laws governing the [Wisconsin Land Information Program](Day, 2012 p. 169)." The interviews with counties providing relatively uninhibited access to their data online seems to contradict a point made in Day's research. Where she argues for the importance of political power in decisions surrounding geospatial data distribution, the interview participants felt that even county level elected officials had little to no influence on these practices.

One participant stated that she alone, as the county Land Information Officer, made the decision whether a dataset would or would not be shared. Day's research was focused, however, at the state level Wisconsin Land Information Program. The coordinating efforts of this agency were mentioned in interviews and survey comments. Based on my experience at the Wisconsin Land Information Association 2015 Annual Meeting, themed *Data Forward*, there seemed to be a consensus that sharing data with each other and the public was a positive idea.

Finally, Onsrud considers privacy law and geospatial information. The ability for GIS technologies to track and store information has led to uses in surveillance

and exposes issues of geospatial information and personal privacy (Onsrud, 2004). The public may not be aware of the extent that personal information about them, property ownership data for example, is collected and used. Without knowledge of the information being collected, it is challenging for an individual to guard against unwanted privacy intrusions (Armstrong and Ruggles, 2005). This geographic information is also subject to what Goodspeed calls the mosaic effect. Data with personal information either removed or masked can be cross-referenced with another dataset to reveal personal details (Goodspeed, 2012).

Privacy laws at the federal level require that citizens be made aware of information that is being maintained and used by federal agencies, but citizens may struggle in understanding the way their personal information is used in geospatial datasets. Interestingly, Onsrud argues that making this type of data as open and as transparent as possible will best allow citizens to know what type of data is being collected and allow them to speak out against injustices or privacy violations that may otherwise go unnoticed (Onsrud, 2004). An example of such privacy protections in Wisconsin is the redaction of Social Security numbers from government documents that has represented a significant portion of land information budgets at the county level in recent years.

Social-Cultural Considerations

Sui (2011) discusses many ethical issues of GIS and warns that geospatial technologies are a central component of *surveillance infrastructure.* Governments have shifted to statistical analysis and a politics of biopower rather than discipline for only the individuals who commit crimes (Crampton, 2003; 2007). Those who are categorized outside of cultural norms are perceived as dangerous in an increasingly risk-based society. Social demographic groups and individuals residing in particular areas are assigned a degree of dangerousness based upon the characteristics of those around them (Crampton, 2007). After the attacks on the world trade center on September 11th, 2001 surveillance has taken on new meaning in the United States and around the world. The public seems complacent towards this panoptic government because of the unique threat of terrorism. Legislation such as the USA PATRIOT ACT gives the government unprecedented authorization for surveillance (a critical component of this act is geoprofiling.) Geographic technologies have aided this societal classification and normalization through media such as crime maps (Crampton, 2003).

Political context and the social networks surrounding GIS construction are influential in project outcomes and success (Harvey and Chrisman, 2004; Sieber, 2000). The Actor-Network Theory framework is useful in identifying the institutional and

organizational factors that influence data sharing activities. GIS and Society literature tends to stress the importance of analyzing GIS from both technology and society perspectives. A fundamental assertion of Actor-Network Theory is that knowledge is socially constructed and that society and science is interrelated; therefore GIS specialists' activities are social as well as technical (Harvey, 2000; Martin, 2000). The framework is particularly useful in analysis of institutional factors that represent impairments to development of GIS (Harvey, 2000). GIS diffusion has spread vertically and horizontally, necessitating networks of collaborations with similar extents that intersect public, private, and educational sectors (Lin and Ghose, 2010; Harvey, 2000).

It is argued in chapter 2 that no matter how open the access to data, if marginalized populations are underrepresented in the data production, injustices can remain embedded in the data (Johnson, 2013). Non-governmental organizations, as well as marginalized individuals, may struggle to keep pace with GIS planning activities by the state or other powerful actors (Ghose, 2011). Issues of the digital divide cannot be overstressed, internet access is not ubiquitous, and the ability for citizens to meaningfully access information is dependent on many social and cultural factors.

Technical Considerations

Format is an important consideration for academic geodata requests. The majority of patrons at the AGS Library looking for Wisconsin geodata prefer shapefile or geodatabse format. Since most GIS courses at UWM use the ArcGIS suite of software, these ESRI proprietary formats are very popular. Students from urban planning and architecture disciplines are interested in AutoCAD and Microstation formats and most of the data requested by these patrons are saved in these formats in the archive as well. Occasionally, a request will be made for data normally distributed as shapefile or geodatabase to be converted to one of these other formats, and this can bring up unique challenges for our staff.

The common trend among the majority of patrons at the AGS Library is that they want "raw" data. Patrons are not as interested in connecting arc to an IMS or WMS server nor can most of the analysis they wish to complete be done on most interactive map viewers. Also, for many student projects and coursework, the authority of the data is not all that important. This does not apply in the same way to researchers using data on a project, where the currency and authority of the data may be crucial. Class projects, as required by many intermediate and advanced GIS courses, often tend to focus on methods and software rather than discovering any truth from authoritative data. Patrons may be less concerned about how recent the data is or if the data has been checked for accuracy and more concerned about just

being able to get the right type of data to test their ideas for analysis. While a county may have no use for 10 year old parcel data, a student may have an interest in comparing older data sets to a newer data set in order to do an analysis of change over time.

Conclusions

Considering the history of collaboration between GIS scholars and local governments in the Milwaukee metropolitan area there is no coincidence that detailed datasets are available from multiple agencies and allow students and researchers at UW-Milwaukee to do complex analysis to solve real problems in an urban area with more than its fair share. City of Milwaukee data, such as parcel and property data, are available in multiple formats, within a variety of web tools, and as raw data for analysis. They area also, like MCAMLIS, quite detailed with extremely good spatial resolution and accuracy. Milwaukee geospatial data are updated frequently and available for download. Even archived historical datasets are available for download on the city website. When MCAMLIS moves to direct download, this data will be available to anyone. It's worth noting that MCAMLIS is primarily an interactive mapping interface on the county web space and that it offers some analysis tools than simple map viewers.

The impact of other nearby agencies seems to be a major driver in the policies adopted regarding data-sharing. Two examples found in this research illustrate this point. The first is the single county that has decided to implement a data sharing agreement in order to keep themselves in line with neighboring counties and nearby municipalities. The second is the county claimed to be the first to offer data online for download. Other nearby counties have followed suit and there is a notable trend on the map showing where nearby counties have adopted this system (See fig. 4). Harvey and Tulloch propose "counties with longstanding GIS programmes serve as the model for the surrounding area" (2006 p. 755).

Local government participation in spatial data infrastructures, measured by participation in a national spatial data clearinghouse, is highly varied. The reasons for low level of participation from local governments in government data portals are unclear but pronounced (Maene, 2011). A National SDI (NSDI) effort was spurred by executive order 12906: *Coordinating Geographic Data Acquisition and Access: The National Spatial Data Infrastructure* which was signed by President Clinton in 1994 and placed the responsibility of the NSDI on the Federal Geographic Data Committee. Resistance of local governments to NSDI is characterized as fear of a loss of control and autonomy.

Low levels of data sharing was found to be an attractive way to ensure against data misuse and unlicensed distribution (Harvey and Tulloch, 2006). Objectives can be wide ranging and it is recognized that stakeholders will only participate if it is advantageous to them or their organization, and in cases where data providers are concerned about improper use or dissemination, stakeholders must not feel threatened by the infrastructure (McLeod, 2000). None of the county governments participate directly in the federal government's data portal, data.gov. Some metadata is available via the NSGIC GIS Data-Inventory, Ramona.

Data producers are creating data for their own use and sharing it as an afterthought. Sharing of data needs to be taken into consideration before the point that the data is actually created. With Internet access now literally in the hands of the masses the (technical) ability of the lay citizen to participate has swelled (Seeger, 2008). Web 2.0 and neogeography (e.g. Turner, 2006; Warf and Sui, 2010) broadly describe a major shift from users simply using the internet to download content to the situation today where the average internet user is contributing information. This has led to calls for more participatory governance in regards to land records and geospatial information.

In regards to data-sharing, the most progressive participant I communicated with was collecting e-mail addresses for users downloading files, but they have not implemented an effective feedback mechanism where users can report issues, offer

suggestions, or share new ideas regarding the dataset. Web mapping is an excellent way to show information to the public, but Wisconsin local governments have yet to find a way to effectively solicit geographic knowledge from citizens via these avenues.

The international reach of GIS means that agents must be conscious of varying definitions of privacy, international laws, and ethical issues surrounding the use and storage of information. Open geodata is about more than just being able to download data from a website. Whereas previous generations may have viewed privacy as the right to be left alone, individuals are now concerned about the storage and dissemination of our personal information. Information is being collected on a massive scale including personal details and geographic locations. Open data policy should be seen not as a violation of privacy, but as an opportunity for the public to access the information being collected about them and speak with their representatives about concerns. Beyond privacy, citizens have a right to evaluate any information that is used in decision making by a democratic government. These decisions, no matter how trivial, should be open to public scrutiny in order to expose inefficiencies, corruption, or actions that are not in the citizens' best interest.

Recent literature by Daniel Sui (2014) has focused on the idea of open GIS as a response to some of the issues of the digital divide and information justice in regards to geospatial technologies. He proposes eight dimensions of Open GIS (See

Sui 2014 fig. 1): open hardware, standards, research, publication, funding, education, data, and software. Open standards, software, and data are discussed elsewhere, but open research, publication, and education are also critically important for open government GIS activities, and the University plays a crucial role.

Even though GIS is a powerful tool, there is a steep learning curve involving not only advanced software, but also a degree of information literacy. Because it is unreasonable to assume that all citizens will be able to study geographic information science, it must be taken into consideration that open data is not really useful if a user doesn't know what to do with it. Web services should not be unusable to those without GIS training; proper documentation and the removal of complex technical jargon is critical. University GIS education, especially when taught in disciplines outside of geography, need to include spatial literacy and information literacy into the GIS curriculum.

Local government data producers should consider all users when datasets are created and ensure that uses other than the obvious are considered. A simple step that local government GIS professionals could take is the creation of standard metadata and the inclusion of this metadata whenever a dataset is distributed. Wisconsin's neighboring states of Minnesota and Michigan have effective open geospa-

tial data policy and a comparative study of these policies and those of Wisconsin local government would be a fruitful research direction for further research into this topic.

Chapter 4:

ENVISIONING OPEN GIS: THE ROLE OF THE UNIVERSITY AND THE LIBRARY

The final chapter of this thesis will address some of the issues in GIS education including university level instruction, access to required hardware, software, and data, and the changing roles of academic libraries in how they deal with geographic collections, GIS, and spatial literacy. While I have not explicitly studied the foundations of the current GIS curriculum, I am just over two years graduated from a GIS certificate program at UW-Milwaukee, which holds a reputation of being a leader in GIS activities. What started out as just computer software has infiltrated the natural sciences and beyond. Michael Goodchild (2006) argues that any students studying the surface of the earth have at least heard of GIS. UW-Milwaukee has a GIS minor, GIS specialties in urban planning graduate programs, as well as the graduate GIS certificate among others.

In earlier chapters I argue that the Open GIS movement and related open source, open data, and other components of what has become known as *Open Society* can help guide key ethical and practical considerations of geographic knowledge

production and access to geospatial information. Sui's (see Sui 2014) eight dimensions of Open GIS are all relevant in today's university settings, and are particularly relevant at UW-Milwaukee.

The University's Role in GIS Development

While critical GIS scholars often discuss GIS roots in the military and government land management, many popular GIS tools emerged out of the academic sector and have advanced geographic information science research. The university plays a wider role in geographic information science than simply training students to work with GIS and use of GIS for research. Universities were important early drivers in the GIS software community. Low-cost software such as OSU Map and IDRISI (now known as TerrSet) emerged out of Ohio State University and Clark University respectively as accessible and yet robust geographic information systems. All the members of my thesis committee recall using these early GIS software in their studies. Free and open source spatial statistical software GeoDa, created by Luc Anselin at Arizona State University is a powerful yet simple example of meeting the demand for accessible software.

Before the dominance of ESRI and Arc in the GIS field, these tools were very popular with academic users and beyond. Although way finding applications such as Mapquest emerged before Google Maps, it was Google that thrust geospatial

technologies back into the mainstream and revitalized the conversation about these technologies. Since the release of Google Earth in 2005, there has been a surge of new interest in GIS by users outside environmental and geographic research. A new range of proprietary and open source technologies emerged on the market. Geospatial data deserves special consideration in this context. As discussed in previous chapters, data is moving off of physical media (CD-ROMS and hard disks) and moving to the cloud. Popular applications such as OpenGeoportal are meeting the demand for easily accessible free geospatial data. From its beginnings in university labs and custom built software to solve problems, to a huge market dominance by just a few major players, the Open GIS movement is bringing geospatial technologies full-circle and returning to a more grassroots environment. ESRI is catching on and has created its own open source geoportal, ESRI Geoportal Server. ESRI has also been very present in the creation of new online geospatial technologies encouraging novice users to make web maps and online applications for their businesses, research, or for fun such as the ArcGIS API for JavaScript, AppBuilder, and ArcGIS Online.

Today, open Application Programming Interfaces (APIs) are emerging as a sort of middle ground between open source and proprietary development as companies such as Google allow customization of their tools to fit a diverse range of needs. Sui (2014) notes that open source software development has "proved to be capable

of an accelerated development cycle to meet community needs faster [than proprietary software development] though vibrant online forums and interactions (p. 5)." This observation can be extended to the university where researchers are designing software for their research needs. Open science principles would encourage these software to be published under open source license and that research data be published in order to encourage scrutiny and replication.

Academic Libraries and GIS

GIS services in libraries are an important point of contact for novice users that need additional assistance with using the available datasets. Similar to traditional reference desk functions, users may need help articulating research goals and questions. GIS staff experienced with GIS projects can be an important resource for students and researchers to articulate goals and research more effectively.

The range of geospatial web services may be useful to researchers requiring up to date data. Hosted web mapping services, for example, can allow anyone to connect to the layer and perform analyses. If the data is updated, the researcher will still be working with the most recent version since the hosted service would be updating live. From a library collection perspective, this could mean a change in the way data is archived. At the AGS Library, multiple versions of datasets are organized by year. The year assigned to the dataset is usually the year of publication, but this can cause

complications when the year of publication isn't known, multiple versions are released each year, or the time of year the data was collected is an important factor. Archiving geospatial web services could be as straightforward as taking a *snapshot* of the data on some regular cycle as a way to ensure the data is available for temporal analyses.

One issue that I discuss in Chapter 2 is that web services are not a substitute for shapefiles, as an example, when it comes to the public's right to know—or more specifically the legality of such a system under open records law (Day, 2012). A related issue is preparing the next generation of GIS students for accessing data not (only) through a spatial data clearinghouse but via hosted web services. GIS courses, when appropriate, should introduce not only the topic of web services, but also include "connecting" rather than "downloading" directly into coursework.

Creating metadata or updating existing metadata to fit standards is also an increasingly important function in academic library GIS services (Wolf, 2011). Data lacking the proper metadata for facts such as the date of creation, the ground date of the data, the individual or office responsible for the data's creation, spatial reference, accuracy, distribution, or who to contact with questions, etc., can be frustrating not only from an archival perspective, but also in that its usefulness is hindered by a simple lack of documentation. The need for standardized metadata could not be more obvious to individuals responsible for organizing geospatial data.

These metadata are crucial for helping students and researchers that need data to be interoperable with other datasets used in their research. Metadata is used to help patrons find the correct spatial and temporal resolution. Patrons may need to know the coordinate system the data should be in if they mistakenly reproject or transform the dataset. Perhaps a patron simply wants to know who to contact to ask questions or request the data in an alternate format. All of these tasks are made possible for library staff by keeping effective metadata.

Producers of local public geodata who provide access to online services are becoming more common. Some producers allow users to download raw data directly from the web service or on another page of their website. However, web services can be used as an alternative to raw data download to give the public "access" to the information without being able to download files, and therefore edit and redistribute datasets. This can lead to frustrating situations where one is able to import and display data, but is not able to perform advanced geoprocessing or useful spatial queries because of the level of restriction on the service.

Metadata for web services may force data clearinghouses and library GIS services to review how they maintain and create metadata. In the case that the web service is indeed the only access method for the information, it is essential that patrons feel comfortable with not only what the information *is*, but how to use it, what capa-

bilities are available, and if they are able to obtain the raw dataset elsewhere. If a patron is using the dataset to symbolize and export a visualization a web service may be appropriate. Patrons needing to perform advanced analysis will need to know if the data can be copied or exported.

Metadata may be available within a web viewer or be accessed using metadata viewing tools bundled in desktop GIS applications. Better is when human readable documentation including task based explanations focusing on novice users who may not be familiar with metadata standards, technical jargon, and geographic concepts is available. Associating an individual as a point of contact within the producing organization is also useful. Patrons are provided with this information within metadata files. To borrow (and modify) a metaphor from the GIS scholar Nick Chrisman (2005), in early cartography, maps were signed by the cartographer. Technological advances in process and accuracy make the product increasingly anonymous. Metadata is becoming the equivalent of the cartographer's signature and is "bringing back individual identities (np 13)".

More research is needed on lifecycle management of geographic datasets (Wolf, 2011). While 10 year old parcel data may be useful for a temporal analysis, and thus worth saving and maintaining, other types of research may require more recent data. This legacy data may need continued curation such as metadata and format management to enable it to remain useful amongst more modern data.

More than Just Data

GIS services in academic libraries should be more than just IT or a computer lab, it should provide specialized GIS advice and complete datasets with documentation to enable researchers and students to achieve their goals. This requires specialized software, hardware, and storage systems as well as training and qualified academic and technical staff. One of the most crucial new frontiers for geospatial data collections in academic libraries are web services and geospatial information in the cloud.

When a library creates or links to web GIS services, it is important to consider the abilities of the users. Many users are not familiar with GIS functions; they expect web mapping interfaces to function like Google Maps. Although GIS practitioners use terms like *buffer*, *intersect*, *overlay*, and *clip* daily, a novice GIS user may not understand these terms. Web services that I have accessed in Southeastern Wisconsin advertise download of shapefiles, but this operation can only be done on query results with a limited number of records. The ability to perform queries on a database is an important part of information literacy in GIS, but novice users interacting with the front end may demand the same functionalities without the need to know query languages or have an understanding of relational database management systems. In brief, web

applications advertised to library users should feature advanced functionality without overwhelming the user with complex GIS and database management jargon (Kong and Stonebraker, 2014).

Students and researchers visit the library and make use of library services to get things done (Matthews, 2014). When they stop into or contact GIS services, they should accomplish something. Rather than encouraging patrons to fill out a data request and wait for an e-mail, staff should be discussing research and project goals with patrons and giving advice on datasets, tools, methods, and services that are relevant to the patron's goals. Matthews states, "we have to assume that as the media and publishing landscape further transforms, libraries will need to as well—not just in terms of how we provide access to information, but in how we provide value to users (Matthews, 2014 p.2)". Simply helping patrons know what is *out there* is a critical step in success.

Ridefelt (2011) found that awareness of spatial data infrastructures leads to easier access to data. Library GIS services can employ techniques such as an effective data catalog, links and guides on how to use popular data, services, and software, and maintain a social media presence to make patrons aware of updated services or new tools.

GIS at the American Geographical Society Library

In working as a GIS student assistant at the AGS Library, I have conducted research interviews with undergraduate and graduate students, faculty, staff, visiting and remote researchers, and the public. I have become interested in how academic libraries, specifically the geographic collections, deal with GI technologies, software, data, information literacy, etc. AGS Library GIS staff are spending less and less time on data requests and more time enabling patrons to get the information they need. As data becomes increasingly available online, libraries will spend more time helping patrons *use* the data. The AGS Library is serving patrons from an increasingly diverse range of disciplines. In addition to reaching out to potential GIS users, the library could be reaching out to departments such as computer science and information science in order to encourage the advancement of GIS application development, web development, and relationships between developers and users.

Many GIS users on campus have interacted with the digital spatial data staff at the AGS Library. In more than two years of experience at the AGS Library, I have had the opportunity to learn more about geospatial data from a user perspective as well as from the perspective of facilitating access to students and researchers. While there have been many changes in policy and activities since the time of writing, Day and

Maene (2006) recounts the authors' experiences as librarians at the AGS Library in the early stages of the geospatial data activities.

While reference statistics are maintained at the AGS Library, I have not analyzed these materials for this research. However, I can make some general comments about the patrons who request data from the AGS Library as well as the datasets they request. Local vector data such as cadastral, land use, and transportation layers are popular with students and researchers for a huge range of analyses. Aerial imagery is also requested frequently including data distributed by government as well as images that have been scanned from hard copy imagery.

Most of the data that is requested is by students for use in coursework or for projects. Data is distributed to public patrons who make requests as well as staff and researchers at the university. The vast majority of the data that is requested is for Southeast Wisconsin. State, County, and municipal data is a critical part of the data distributed by the AGS Library. The scale and resolution of these datasets are unmatched by most data distributed at the federal levels.

The primary goal of any library is to provide access to information to users. According to the Curator of the AGS Library, Marcy Bidney, a goal and vision of the AGS Library is to provide as many points of access to the collections as possible. As I argue in chapter one, access is about more than simply being able to obtain data.

Therefore it becomes important at the AGS Library to support users in their use of the geospatial data in the collection. In addition to being available, Sui (2014) argues that data should be usable and used in order to realize Open Data and Open GIS.

The UW System geoportal can help the AGS Library accomplish these goals and also help the wider UW System to increase access to public geospatial data. As discussed in chapter three, the UW System geoportal has a primary goal of providing access to the entire UW System for educational use, but a surprising response in support of public data sharing on the geoportal means that the geoportal has the potential of becoming a primary source for local public geospatial data across the state of Wisconsin.

Open Source and the Library

Open data has become a commonly used term among people who are interested in obtaining, curating, and distributing geospatial data. The impacts of other components of open source and Open GIS (See Sui, 2014) are also influencing Library GIS services. For example, open source tools could be used by library staff to manage geospatial data collections.

University of Ghent uses a PostGIS based SDI used for primary source data storage and a database where students, staff, and faculty have appropriate restrictions based on a managed permissions structure (Verfaille *et al*, 2011). Administration is

done using web access so administrators can manage the server implementation remotely. I do not wish to comment on the advantages or disadvantages in such a situation, although Verfaillie *et al* (2011) compare and contrast their system with a system very similar to that used at UW-Milwaukee and elsewhere: desktop and enterprise software are dominated by proprietary applications such as the ArcGIS suite. The GIS curriculum has been slow to respond to the influx of hosted geospatial services such as spatial data servers like ArcServer, PostGIS, and others.

At the AGS Library, open source tools are used for the creation of finding aids for aerial photo collections and for extensive paper map series in the map collection (which exceeds 700,000 items). These projects have made use of PostGreSQL (and the spatial extension PostGIS), Quantum GIS, the leaflet.js open source JavaScript library for web mapping, and others. Projects that required scripting or coding made use of code from GitHub and other open source repositories where other developers share what works for them and offer suggestions and bug fixes.

Currently the actual digital spatial data collection at the AGS Library is stored on traditional network storage servers and is accessed by navigating through organized folders with Windows Explorer. The UW System Geoportal, which makes use of OpenGeoportal software, is an example of how the principles of Open GIS could be used to better access the university's spatial data resources. Under this system, the library staff would no longer be the *gatekeeper* of data and would rather be focused on

facilitating access through the online tool. A patron would be able to access data from anywhere without the need for making a formal data request. Built in search tools would allow users to search effectively by keywords and/or by geography in order to find the best possible dataset for their project.

The AGS Library also is active on campus in teaching data visualization and analysis using GIS to researchers and students. Workshops in cooperation with the new Digital Humanities Lab at UW-Milwaukee attracted attendees from various disciplines on campus. There has also been work done on the creation of library guides that help ArcGIS users transition to QGIS if, for example, they are losing their student license with ESRI upon graduation and would like to continue work without purchasing ArcGIS. Fortunately, ESRI proprietary software formats such as shapefiles are generally supported by open source tools but legacy formats such as coverage files and newer formats such as file geodatabases may not work as seamlessly. These instructional sessions could become more important as users access data in different ways. It is likely that library guides and instructional sessions for using the UW System Geoportal will be popular across the higher education system in Wisconsin.

Using open source applications and code libraries require a level of information literacy to navigate forums and lengthy technical documentation. Open source software may not always be the best option for specific applications. Linus Torvalds, the creator of the Linux operating system once said "Any program is only

as good as it is useful." While working on projects at the AGS Library, I found that library collections for topics such as .NET application design, database management, and web mapping were useful but not up to date enough to cover all the topics needed to code an application. It may not be enough to tell patrons that there are plentiful resources on the internet, instead links to these resources could be managed in online user services and referenced in metadata where appropriate. I think the most important consideration for collection development to be learned from advances in geospatial technologies is to maintain current software manuals and textbooks for desktop GIS applications which at the time are the most powerful way to interact with public spatial datasets.

Library GIS services can also provide access to open source software and resources for patrons. At the AGS Library, documentation has been provided to patrons on using QGIS but in the brief time using this software in the library, major changes have made parts of the guide obsolete despite being less than a year old. Tracking stable versions of popular tools could be one way to help patrons find the tools they need to work with data from our collection or elsewhere. For example, maintaining a folder of files that are needed for installation on popular systems to save users time troubleshooting lengthy installation processes. Guides with links to tutorials may have a more useful lifecycle if they are live documents hosted on a website that can be updated as changes occur.

Where GIS librarians of less than a decade ago were spending a lot of their time just gaining access to the necessary data, providing help in other parts of the process is becoming more important. Part of the day-to-day tasks of library GIS staff will become increasingly focused on watching for important updates to hosted datasets, open source and proprietary tools, and informational literature on the use of these resources.

Geographic Information Science at UW-Milwaukee

Teaching using only the most popular software, such as ArcGIS suite, for all spatial analysis needs could lead to a stifling of productive software development out of the academic sector. Open GIS as proposed by Sui (2014) should be embraced by universities, but this does not necessarily mean using only open source software and instead includes a range of dimensions that involve a change in the way research is published and funded, how issues such as special literacy are addressed, and even how the academic reward system is organized (See Sui, 2014). At UW-Milwaukee, progress is being made in ensuring that students are exposed to a range of software and are getting more than just a crash course in ESRI software.

I have completed GIS coursework at the undergraduate and graduate level at UW-Milwaukee and held a position as lead teaching assistant for an online introductory GIS laboratory in addition to my position as a GIS student assistant at the AGS

Library. I have also spent time attending meetings of the campus GIS Council, the interdisciplinary GIS planning committee at UW-Milwaukee.

As a teaching assistant in the department of Geography at UW-Milwaukee, I assisted in the migration of the online introductory GIS course to a new textbook. While many courses at UW-Milwaukee utilize textbooks from ESRI press, such as the Getting to Know Arc GIS series, my supervising professor adopted the book *Introduction to Geospatial Technologies* by Bradley Shellito (2013). The new curriculum exposes introductory students to software beyond the ArcGIS suite. Students begin using Google Maps and Google Earth, a platform that many students already have experience using in their personal lives for way finding, or perhaps even the creation of *map mashups*. The most intriguing part of this textbook is that two versions of labs using desktop GIS software are available, one for ArcGIS Desktop and the other for the popular open source desktop software QGIS. The textbook and the curriculum which we designed around it expose students to a range of geospatial technologies, not just desktop GIS.

Other, more advanced, Geographic Information Science courses at UW-Milwaukee are also exposing students to a greater variety of software. GIS courses in both the Geography and Urban Planning disciplines have exposed me to statistical software such as R Studio and SPSS, spatial statistical software GeoDa, the hydro-

logic modeling add-on to ArcGIS SWAT (Soil and Water Assessment Tool), and others. While only some of the examples I give fall into the bin of *geospatial technologies*, all are relevant to anyone wishing to do advanced spatial analysis in the academy, government, or industry. One professor in the department of Geography offers a Ph.D. level course in geographic information science and says that rather than teaching many of the software used in the course to completion, he instead tries to expose these advanced students to the range of software available.

ESRI products are very popular at UW-Milwaukee. Like many universities, UW-Milwaukee has an institutional site license that allows for non-commercial use in many contexts including student work, research activities, facility planning and management, and even for community partnerships. The official Web GIS infrastructure for campus is built on a Microsoft SQL Server and ArcGIS for Server platform. Despite this ubiquity, there is still a call from students, faculty, and staff for more open source tools to be taught in courses and to be available for various projects on campus.

When we were discussing moving to the new textbook for the introductory GIS course, we were concerned that the benefits of exposing students to a range of software, both proprietary and open source, may not adequately prepare them for more advanced courses in GIS using the ArcGIS suite. So far this has not become a problem especially considering that advanced courses are also starting to broaden

the range of software used in their courses beyond ESRI products. Still, using this range of software, especially in the context of an online course presents unique challenges. Some of these challenges stem from the fact that there is a wide range of computer literacy in undergraduate students. Concepts such as compressed files, hardware requirements, installation procedures, and data storage have all proven to be issues that require additional attention. These are in addition to the challenges of online courses which include fostering participation, providing technical support remotely, preventing academic misconduct, and encouraging communication with instructors.

On the other hand, offering a range of software solved some problems that were encountered when using only proprietary software and literature published by the same company. For example, ArcGIS suite is programmed for use on Microsoft Windows operating systems only, students using Apple OS X or Linux machines were often forced to use campus computer lab resources. Because QGIS is available on many operating system platforms, having this option in the course allowed students without Windows to use the software at home or remotely. Still, some software used in the course was only available for Windows and this required communication with the campus IT offices to install software in public labs and required me to frequently go to public labs on campus and ensure software was installed and working properly.

Generally, students have been quite receptive to the exposure to multiple software options and exposure to more than just desktop GIS applications. Google Earth is an excellent starting point because they realize immediately that they already have experience with geospatial technologies. ESRI products are becoming more and more popular with government agencies and private business where many GIS students are seeking employment after graduation. At the same time proprietary software may be too costly for students wishing to work for non-profit community organizations or those wishing to start their own businesses.

ArcGIS is ubiquitous in the GIS education at the university level but open source tools could be useful in introducing students to the range of alternatives and become comfortable with a variety of software. Muki Haklay has discussed this trend in GIS education in the UK arguing that GIS education needs to move beyond the *ARC/INFO Driving License* (Haklay, 2010). Beyond just open source, it is critical that students of GIS understand the fundamentals of the technology behind the front end systems, such as relational database management systems, application programming, and other practical skills of GIS professionals troubleshooting techniques like using technical documentation, finding and utilizing metadata, and choosing the correct tools and methods for particular tasks.

In introductory GIS courses, students use SQL via the ArcGIS Desktop platforms but may not even be aware that they are using *code*. With a single lab using SQL

in a database management system, students could learn to understand the simple operators that are used in graphical user interface tools in Desktop GIS platforms. Coding is a buzzword with students and young professionals. HTML, CSS, Python, JavaScript, (advanced) SQL or any of the popular programming, scripting, query, and markup (etc.) languages could be integrated into labs. These skills are in demand for GIS graduates seeking professional employment. Learning a language such as SQL can also be used as an effective way to teach principles of database management. Like GIS, computer programming can be useful in a plethora of disciplines and it would be an oversight if computer programing courses are only available for computer science majors.

In addition to a more acute focus on computer programming in coursework, academic libraries are also in need of this type of expertise among staff. Academic libraries struggle to attract talented staff with computer programming skills. In short, academic library budgets have been a barrier to attracting skilled programming staff when those individuals are likely to be offered significantly higher salaries in industry. This is all the more reason why computer programming should not only be included in the GIS curriculum but also in the Information Science curriculum so that librarians have the skills necessary to create and maintain technical applications at the library. Beyond applications used by staff in the library, as coding becomes a more important part of the broader university curriculum, the library (beyond GIS services)

will need to offer support by way of making available materials and information regarding computer science and computer programming that are useful and appealing to non-Computer Science majors and researchers.

Conclusions

Johnson draws a distinction between citizen open and enterprise open, arguing that corporations and other powerful actors have access to the tools necessary to deal with big data, while citizens lag behind. As big data becomes a prevalent term in the information sciences, it is important to be prepared to change GIS methods and services to accommodate new forms of data (Johnson, 2013). Developments in national spatial data clearinghouses, broadly defined, have been analyzed by Crompvoets *et al* (2004; 2007), finding that "the main factors [that] will have positive impacts on developments [are] the inclusion of web services, stability of funding, and creation of user friendly interfaces (Crompvoets *et al*, 2004 p. 665)". It is most important to be adaptable to change. It is impossible to predict what geospatial information will look like in the future. What is important is that academic libraries and the university prepare for new challenges in obtaining, using, and managing geospatial data.

It is important that universities be considered in spatial data infrastructures from their conception. For some agencies, particularly agencies that have the staff-

time and policy to handle geospatial data requests, contacting the agency directly is an effective way for users to obtain reliable data. Other times, institutional changes such as staff turnover, policy change, and budget cuts the request process can be full of red tape and may result in use of outdated or unreliable data obtained elsewhere, receiving poorly documented and therefore less useful data, or even require alterations to the project if a specific and unique dataset cannot be obtained at a reasonable cost.

The university also plays a critical role in the community beyond just the students enrolled. Within the discipline of GIS specifically, community partnerships have enabled grassroots and resource poor organizations to effectively use GIS for their activities. Literature discusses barriers faced on the implementation of GIS by organizations or individuals (Ghose; 2007; 2011; Ghose and Elwood, 2003; Ghose and Huxhold, 2001; Barndt, 1998; Harvey and Chrisman, 1998; Obermeyer, 1995). Many of these barriers are identified at the intersection between society and technology emerging out of concepts of the digital divide.

Rowena Cullen uses the phrase "digital divide" to describe disadvantage of people who, for one reason or another, lack access to information and communication technologies (Cullen, 2001). Blighted communities and marginalized populations could be empowered by GIS and visualization, but many face barriers to successful implementation of such technologies and struggle to compete against actors

with financial and political power. As an example, some community organizations are interested in geospatial technologies, but lack the financial and technical resources to effectively use them to influence decision making (Ghose and Huxhold, 2001).

Expanding GIS services in the library is one way that the university can position itself to offer assistance to the community in regards to GIS. At UW-Milwaukee, the library has been active in outreach to disciplines that could benefit from GIS but are not typically regular users of the technology. This could be expanded to include community organization partners in order to help spatially enable the decision making process at the community scale.

Hargittai (2002) has proposed a *second level* digital divide which addresses differences in internet and technology competency rather than simple access to hardware, software, and the internet. Information literacy is an important component of typical reference services in libraries, and GIS services are not exempt. Although the issues of marginalization and power are not as relevant, I see the gap in GIS training between *traditional* GIS disciplines such as Geography and Planning and the disciplines that are just adapting the tool into their curriculum as another type of digital divide. Since GIS was born from the military and positivist science, more qualitative disciplines may be left using a tool not well suited for their needs. This has implications for GIS developers who need to adapt to new uses for their

software as well as implications for students who will need to acquire the skills necessary to customize and adapt software to their needs. Users with a background in application development may find it easier to use GIS for quantitative purposes because they will be able to better understand the back end of the technology.

Finally, it is important to consider the role of geographic knowledge production. There has been much written in geography alone on the topic of volunteered geographic information (Flanagin and Metzger, 2008; Elwood, 2008; Elwood and Leszczynski, 2013; Elwood, Goodchild, and Sui 2012; 2013; Sui, Elwood, and Goodchild, 2013; Haklay, 2013). Warf and Sui (2010) argue that geospatial information is shifting from a *top down* to a *bottom up* system and this is causing a subsequent shift in the "standards of truth" (p. 197). When data is not available from a state agency, who can be trusted to provide authoritative data?

While there are some commercial data producers and distributers, these resources may be prohibitively costly for academic users, especially students. Anyone is now able to publish geospatial data online, by publishing a web map for example. This trend will force GIS professionals to learn to evaluate the trustworthiness and accuracy of datasets. For example, data on the location of cemeteries in Wisconsin is available but is prohibitively expensive for casual research. However, I found a website where an individual with an enthusiasm for cemeteries has collected data points representing cemeteries using his GPS and posted them online. While I

would not recommend this dataset to a student doing research on cemeteries because I may doubt its comprehensiveness, other users may be satisfied with this layer because it is more desirable than purchasing the data elsewhere.

Academic library GIS collections need to consider changing technologies, the range of GIS users in various disciplines, addressing issues of the digital divide and information literacy, and geographic knowledge production and standards of truth in order to remain effective in providing geospatial information services to patrons. The university in general must also consider these issues as an increasing number of students from various disciplines seek training in this growing field. GIS users, scholars, and developers would all benefit from an increased interdisciplinary dialog on the future of GIS and geospatial information, and the university plays an important role in facilitating these relationships.

In general, the era of geospatial data distributed on physical media such as CD-ROMS is coming to a close and GIS users need to be ready to adapt to web services. Further research on how this will impact metadata standards, geoportal, geospatial data clearinghouses, and GIS education is crucially needed. For GIS services in academic libraries, it will be necessary for staff to be informed on the most recent advances in geospatial information distribution and technologies in order to remain an effective component of the university GIS community. Universities have been a critical driving force in the development of GIS from the very beginning. Open GIS

can be an effective framework for ensuring that the university remains a cornerstone of research and development.

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APPENDIX A:

FULL TEXT OF UW SYSTEM GEOSPATIAL DATA SURVEY

[E-mail]

UW System Geospatial Data Survey

Please help us update educational access to WI geospatial data by taking this short 5-minute survey, consisting of 6 Yes/No questions. UW librarians plan to incorporate the results into a presentation at the annual meeting of the Wisconsin Land Information Association in February. We appreciate your response by Friday, January 16th 2015.

In addition to the primary purpose of the survey -- practical feedback for UW staff -- a UWM graduate student, Stephen Appel, will perform an analysis of the survey responses for his master's thesis research. In accordance with guidelines from UWM's Institutional Review Board for research with human subjects, survey respondents must provide consent in order for their responses to be used in research. You can give your permission by clicking the box below.

If for any reason you do **not** want your responses included in this thesis research, but are willing to answer the questions for use by UW staff, please respond to Eliza Bettinger: bettinge@uwm.edu.

Sincerely,

Jaime Stoltenberg, Robinson Map Library, UW-Madison

AJ Wortley, Wisconsin State Cartographers Office

Martin Goettl, Geography Department, UW-Eau Claire

Eliza Bettinger, American Geographical Society Library, UW-Milwaukee

[Qualtrics Survey Text]

University of Wisconsin – Milwaukee
Consent to Participate in Online Survey Research

Study Title: Information Justice and Geospatial Data in Wisconsin

Person Responsible for Research:
Student Primary Investigator: Stephen Appel, UW-Milwaukee; Masters Candidate, Department of Geography; GIS Student Assistant, American Geographical Society Library.

Primary Investigator: Professor Rina Ghose, Department of Geography, UW-Milwaukee.

Study Description: The purpose of this research study is to determine local government agency interest in participating in data sharing activities with the University of Wisconsin system for educational and public data sharing. There are two intended uses for survey responses. The first is for the evaluation of geospatial data sharing potential between local government agencies and planning commissions and the University of Wisconsin system. The second is for thesis research of the student primary investigator on the current climate of data sharing activities in Wisconsin. Approximately 80 subjects will participate in this study. If you agree to participate, you will be asked to complete an online survey that will take approximately 5 minutes to complete. The questions will ask about an agencies current data distribution policy, status of data sharing agreements with UW System institutions, availability of web based data distribution, and differences in policy regarding requests from the public and requests for educational use.

Risks / Benefits: Risks to participants are considered minimal. Collection of data and survey responses using the Internet involves the same risks that a person would encounter in everyday use of the Internet, such as breach of confidentiality. While the researchers have taken every reasonable step to protect your confidentiality, there is always the possibility of interception or hacking of the data by third parties that is not under the control of the research team. The results of this survey will be incorporated into a presentation at the annual meeting of the Wisconsin Land Information Association in February.

There will be no costs for participating. Benefits of participating include the potential for more effective data sharing for educational use with UW institutions.

Limits to Confidentiality

Identifying information such as your name, title, and agency of employment will be collected for research purposes as well as for the purposes of contact for follow up interviews. This information will also be used by the investigators listed above in order to negotiate future data sharing agreements with your agency. Data will be retained on the Qualtrics website server until the relevant information has been securely stored and will be deleted after this time. However, data may exist on backups or server logs beyond the time frame of this research project. Only the primary investigators and study staff listed above will have access to the data collected by this study initially, but this information may be used in the future to renegotiate data sharing agreements. The Institutional Review Board at UW-Milwaukee or appropriate federal agencies like the Office for Human Research Protections may review this study's records. The research team will remove your identifying information after analysis and negotiation of data sharing agreements and all study results will be reported without identifying information so that no one viewing the results will ever be able to match you with your responses.

Voluntary Participation: Your participation in this study is voluntary. You may choose to not answer any of the questions or withdraw from this study at any time without penalty. Your decision will not change any present or future relationship with the University of Wisconsin Milwaukee.

Who do I contact for questions about the study: For more information about the study or study procedures, contact Stephen Appel at srappel@uwm.edu.

Who do I contact for questions about my rights or complaints towards my treatment as a research subject? Contact the UWM IRB at 414-229-3173 or irbinfo@uwm.edu

Research Subject's Consent to Participate in Research:
By ticking "I Consent..." below, you are indicating that you have read the consent form above, you are age 18 or older and that you voluntarily agree to participate in this research study.

Thank you!

o I consent and wish to continue to survey

[Page 2]

Please complete the following:

Name: [Open Text Entry]

Title: [Open Text Entry]

Organization: [Open Text Entry]

Correspondence E-Mail: [Open Text Entry]

Would you be willing to be contacted for a short follow-up interview with the student researcher, regarding your agency's data-sharing activities and policies? Only a few survey respondents will be contacted for the student's research.

- *Yes*
- *No*

Does your agency currently require a handwritten signature (or digital equivalent) on a formal data-sharing agreement before an institution may access your geospatial data for educational use?

- Yes
- No

If your agency currently requires a signed data-sharing agreement for access to geospatial data for educational use, will you continue to do so in 2015?

- Yes
- No
- Unsure
- Not Applicable: We do not currently require a signed data-sharing agreement

If your agency currently does *not* require a signed license/data sharing agreement for access to geospatial data for educational use, do you intend to implement such an agreement in 2015?

- Yes
- No
- Unsure
- Not Applicable

Would you allow geospatial data from your agency currently archived at UW-Madison, or at any other institution of higher education in Wisconsin, to be redistributed across all UW System colleges and universities for educational use without additional signatures on a license/data sharing agreement?

- Yes
- No

Separate from any data that may be archived at UW-Madison or any other institution of higher education in Wisconsin, does your county/agency provide direct download access to geospatial data files from the agency website? (We do not mean a web map, we are interested in online access to actual data files like shapefiles and geodatabases, etc.)

- Yes
- No

At present, the Robinson Map Library at UW-Madison maintains the most comprehensive geospatial data archive in the state that is used solely for educational purposes. Theoretically, if at some time in the future a portion of the geospatial data archive at the Robinson Map Library were to be made publicly available to all users, would you give permission for open public access to your agency's data?

- Yes
- No

Do you have any additional Comments or Clarificaitons?:

[Open Text Entry]

[Page 3]

If you have any questions about this survey, please contact Eliza Bettinger at UW-Milwaukee, bettinge@uwm.edu, or Jaime Stoltenberg at UW-Madison, jstoltenberg@wisc.edu

APPENDEX B

DATA FROM UW GEOSPATIAL DATA SURVEY COMMENT BOX WITH CORRESPONDING QUESTION RESPONSES

Question Responses Y = Yes, N = No, U = Unsure, NA = Not Applicable, X = Did not answer question						**Comments (respondent and individual identities redacted.)**
Q1	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	
N	NA	N	Y	Y	Y	Our Data Downloads page includes a disclaimer and "Data Useage Agreement" but it's just "click through" to get free access to the data files.
N	NA	U	Y	N	Y	You should contact me. We are currently exploring these issues.
N	NA	N	Y	N	Y	Last question would be pending approval from committee at that time
N	NA	U	N	N	N	XXXXXXX County has no policies set for sharing data for educational and/or other purposes. Our maps are currenty not able to be shared at this time.
Y	U	X	Y	N	N	XXXXXXX County plans to review its data access policy in 2015
N	Y	NA	Y	Y	Y	All of our data is available for FREE at http://www.ci. XXXXXXX.wi.us/ XXXXXXX
Y	Y	NA	Y	N	N	Some data will be public some will not.
Y	U	X	X	N	X	I cannot answer 2 questions until I get consenus from our LIO Council
N	NA	N	Y	Y	Y	For the last two years we have provided our data on our website www.co. XXXXXXX.wi.gov under the departments land information tab. The information is provided in as is format to obtain anything specific or outside what is provided requires that a request for information form be completed and an hourly wage is charged at the rate of $80.00 per hour.
N	NA	N	Y	N	N	Because we collect a fee for the raw data files from any non-governmental/educational entity we would not allow the data to be made publicly available for download at this time. Our stance on that could change in the future if our policy changed.
Y	Y	NA	Y	N	N	We will be looking at our data sharing policy as part of our Land Records Modernization Plan update. We would need to change our data sharing policy to allow open distribution of GIS data. We may look at that to create efficiences and reduce staff time filling data requests
X	U	U	Y	N	N	XXXXXXX has supplied information to the UW-Madison Library System - Geography Division (specifically XXXXXXX XXXXXXX) at various intervals of time. The last delivery being October of 2014. The data provided consisted of specific data sets as requested by

						XXXXXXX. We stated that there would be a data sharing agreement that would need to be signed however indications are that this step was omitted. We want to make sure that data supplied was used by students and academia (non-profit). We also desired the option to incorporate any data sets created through use of XXXXXXX County information into our system. Informatiion was not to be transferred to any 3rd party or contractor. We would need to re-evaluate our policy on the redistribution of XXXXXXX County datasets to other educational entities. Providing open public access through the educational system is an interesting concept however there could be a duplication of effort between the Department of Administration, the State Cartographers Office and the UW-Library System on the acquistion and dissemination of information. Agencies desire many of the same datasets and access to information through a database portal.
N	NA	N	Y	N	Y	Provided it did not go to a private enterprise for there use to charge the public
N	NA	N	Y	N	X	I don't have authority to answer the last question. That has not been discussed.
N	NA	N	Y	N	Y	We plan to allow direct download capability.in 2015
N	NA	N	Y	N	Y	I would need to verify some of my answers with our corporation counsel but we do not have anyone sign a data sharing agreement. We do ask someone to sign a request that basically says we will not be held liable for any errors in the data or misuse of the data. I feel the data is an open record, but we do charge non-academic, non-governmental instituations for data acquisition.
N	NA	N	Y	Y	Y	Sounds great. Maybe you can host the State geospatial repository if we ever really get that going
Y	Y	NA	Y	N	N	In regards to last question we want users to aquire the data from us to insure they have the most accurate / recent version
N	NA	U	Y	N	Y	I have no problem providing data to anyone or any organization, as long as there is a understanding of "data integrity" and "data quality" between parties, and without some formal agreement I believe you leave alot to assumption
N	Y	N	Y	N	N	A couple of these questions I responded as "No" because that decision would would have to be discussed with my home committee.
N	NA	N	Y	N	Y	We currently use a login/password secure ftp site for geospatial data downloads on a request basis; we do not currently have an open site for downloading geospatial data
Y	Y	X	Y	N	N	In response to the last question on this page, the current data distribution policy for non-educational purposes would need to be changed for all other uses. Also, this seems like a duplication of efforts as the WI DOA is pursuing statewide data collections as well as providing a geo-portal for public consumption of the data.
N	NA	N	Y	Y	Y	We have made our Geospatial data available as a free download for at least 4 years now. We do track the location (IP address to Lat/Long) of who is downloading the data solely for the purpose of justifying the need to make it freely available. It's very powerful to show a graphic

						of all the different users from all over the Country/World that have downloaded our data!
N	N	N	Y	Y	Y	WI's publicly available GIS data sources lag far behind our neighboring states. I feel WI should look into instituting something similar to MI's Geographic framework to avoid the fragmentation and lack of availability of our current state GIS data sources.
N	NA	N	Y	N	Y	no
N	NA	U	Y	Y	Y	All these questions are to the best of my knowledge, I would have to consult our attorney for verification.
N	NA	N	Y	N	Y	May answers are based on what I feel our managers would approve. In some cases we would have an additional internal review before commuting to some types of data sharing. We also have some datasets which contain sensitive data and are not distributed outside of the organization.
N	NA	NA	Y	N	Y	There are some data sets that require a data release agreement, and the requests are given a greater deal of scrutiny; as they are sensitive infrastructure.
N	NA	N	Y	N	Y	Sensitive data pertaining to municipal utilities, etc. would not be shared. All other data can be requested. At this time there is no policy for sharing municipal data.