FINAL REPORT

GIS Story Maps: A Tool to Empower and Engage Stakeholders in Planning Sustainable Places

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16. Abstract

Public engagement continues to be transformed by the explosion of new digital technologies/tools, software platforms, social media networks, mobile devices, and mobile apps. Recent changes in geospatial technology offer new opportunities for use in participatory planning processes. Yet, civic tech as a movement, and public participation geographic information systems (PPGIS) as a discipline, have somewhat lagged behind the proliferation of new digital tools that can be leveraged for public engagement purposes. This project explores the evolving technology landscape and use of GIS Story Maps as a tool to empower and engage stakeholders in participatory planning processes. This research incorporated both a literature review and cases studies as research methods. The Nick J. Rahall, II Appalachian Transportation Institute (RTI) at Marshall University and Institute for Public Administration (IPA) at the University of Delaware research team's case-study approach demonstrates that GIS Story Maps can help to fulfill mandates for an open government and public involvement by incorporating the use of interactive digital engagement tools into participatory planning processes. Preliminary research suggests that online, interactive GIS Story Maps are ideal for fostering citizen engagement, providing meaningful context to complex topics and concepts, and empowering informed decision making. Additional research is suggested and needs to be informed by empirical evidence that either supports or refutes this premise.

17. Key Words GIS Story Maps, participatory planning processes, public participation geographic information systems (PPGIS) public engagement, public involvement, digital technologies, civic tech		**18. Distribution Statement** No restrictions. This document is available from the National Technical Information Service, Springfield, VA 22161		
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1. Executive Summary

Supported by the Mid-Atlantic Transportation Sustainability Center – Region 3 University Transportation Center (MATS UTC), this project explores the evolving technology landscape and use of GIS Story Maps as a tool to empower and engage stakeholders in participatory planning processes. This research builds on the Phase I MATS UTC study: *The Use of Smart Growth Scorecards/Assessment Tools to Advance Sustainable Land-Use Practices*, which was conducted by a research team from the Nick J. Rahall, II Appalachian Transportation Institute (RTI) at Marshall University (MU) and the Institute for Public Administration (IPA) and Delaware Center for Transportation (DCT) at the University of Delaware (UD). Phase I research indicates that a variety of contemporary tools have been developed to assess outcomes of smart growth policies and transportation improvements as well as performance on key indicators of sustainability. However, considerable technical expertise, staffing resources, and funding are needed for local governments to utilize newer, state-of-the-practice scenario planning, visualization tools, and travel-forecasting models. Moreover, transportation models are not specifically designed to engage stakeholders in technically complex decision-making processes.

The explosion of new "high-tech" or online digital tools that enable governments to broaden public engagement and involvement in decision making is transforming participatory planning processes. Recent advancements in digital geographic information systems (GIS) technology are providing new opportunities to engage the public in participatory planning processes. The concept of public participation geographic information systems (PPGIS) describes a new field that seeks to leverage the power of GIS to build the planning capacity of citizens, better engage stakeholders, and empower informed decision making.

GIS is evolving from an environment that is strictly proprietary to a more open system that allows a community of geospatial developers, GIS users, and the general public to access and use geographic/geospatial data. While GIS technology is widely available and routinely used for data access and mapping, local governments face obstacles in the greater use of GIS for planning purposes. Moreover, local governments may lack institutional support, training, and funding to acquire and use new GIS hardware, software, Internet-based technology, and public-engagement tools.

Map-based storytelling offers a dynamic platform with which to satisfy mandates for increased transparency, accountability, and public engagement in planning for sustainable places. Introduced in 2012, GIS Story Maps are part of ArcGIS Online, Esri's cloud-based mapping and GIS platform. GIS Story Maps combine geospatial data with photos, video, audio, and text to visualize a theme or sequential events. User friendly and designed for non-technical audiences, GIS Story Maps have quickly become acclaimed as a storytelling medium and a social media outreach tool to engage the public.

Continued advancements in the digital technology landscape—including web-based, interactive GIS—will propel the framework and trajectory of participatory planning processes. A case-study approach, used by the RTI and IPA research team, demonstrates the potential use of GIS Story Maps to fulfill mandates for an open government and public involvement by incorporating the use of interactive digital engagement tools into participatory planning processes. Online, interactive techniques and mapping applications are ideal for fostering citizen engagement, providing meaningful context to complex topics and concepts, and empowering informed decision making. In other words, there is strong evidence that GIS Story Maps can be effectively used to empower and engage stakeholders in participatory planning processes. They combine dynamic maps with images, narrative, and other media to visualize a theme or sequential events and can be easily shared via social media or embedded within a website.

To advance the use of story maps to engage stakeholders in planning sustainable places, communities of GIS users are encouraged to:
- Expand the community of GIS users.
- Foster "open" access to data, including geospatial data, GIS layers, and basemaps.
- Disseminate outcomes of storytelling with maps.
- Build the capacity of non-GIS users.

2. Introduction

2.1 Problem Statement

This study builds upon outcomes of the Phase I June 2016 report, *The Use of Smart Growth Scorecards/Assessment Tools to Advance Sustainable Land-Use Practices* (www.ipa.udel.edu/publications/smart-growth-scorecards-2016.pdf). Prepared for the Mid-Atlantic Transportation Sustainability University Transportation Center (MATS UTC), the study was conducted by researchers from the Nick J. Rahall, II Appalachian Transportation Institute (RTI) at Marshall University, and the Institute for Public Administration (IPA) and the Delaware Center for Transportation (DCT) at the University of Delaware (UD).

The purpose of the Phase I study was to gauge causal linkages between shifting smart growth agendas and the development of new tools to evaluate smart growth outcomes. Phase I outcomes reveal that both the concept of smart growth and the development and use of scorecards/assessment tools have co-evolved. Shifting state and federal legislation, leadership, political agendas, and funding have shaped the extent to which smart growth practices have been incentivized and implemented at the local government level. Yet, assessing the effects of smart growth remains challenging. If smart-growth programs are implemented, considerable resources are needed to develop performance measures, track progress, and quantify results. If key indicators of performance are identified, it may take years to achieve results. In addition, many facets of smart growth are qualitative and cannot be easily measured. Local governments—especially small municipalities with limited professional capacity or resources—may lack performance measurement systems and/or performance indicators to quantify outcomes of smart growth.

As described in Phase I, a variety of contemporary tools have been developed to assess outcomes of smart growth policies and transportation improvements and evaluate performance on key indicators of sustainability. Scenario-planning and activity-based transportation modeling tools continue to be refined, advanced, and utilized by experienced planning professionals. However, considerable technical expertise, staffing resources, and funding are needed for local governments to utilize newer, state-of-the-practice scenario planning, visualization tools, and travel-forecasting models.

According to the Phase I study, both the culture and nature of participatory planning is changing. New federal mandates and executive orders have heightened the need to create open, transparent, and participatory planning processes. Federal open government directives are intended to trickle down to state and local government levels to increase accountability, promote informed participation by the public, and improve effectiveness of policies and programs. The study also acknowledges that the digital revolution has created an explosion in the use of online digital

technologies (e.g., electronic tools, systems, devices and resources). "Web-based, interactive visualization tools show promise to integrate high-tech (technology) with 'high-touch' (in-person) participatory processes. Online digital formats offer a much-needed and dynamic platform with which to satisfy mandates for increased transparency, accountability, and public engagement" (Scott et al., 2016, p. 88). Phase I makes several recommendations that focus on optimizing use of contemporary assessment tools, including the need to "Support Development of Digital, Interactive, and Visually Appealing Tools" (Scott et al., 2016, p. 90). The University of Delaware and Marshall University research team recommended that:

- Planners and decision-makers should complement sophisticated assessment tools with qualitative evaluations (e.g., checklists, audits, surveys).
- More web-based, interactive instruments should be created and piloted to further democratize policy and decision making (e.g., Geographic Information System [GIS] Story Maps, monitoring techniques, dashboards, sustainability indicators, visualization tools).
- New tools should complement GIS-based and analytic tools by tracking the more subjective aspects of smart growth (e.g., public engagement and place-making).
- Geospatial analysis of land use should be combined with the more participatory dimensions of smart growth to provide a more balanced approach to achieving sustainable communities.
- Both visually appealing high-tech and high-touch public-engagement processes should be utilized to illustrate various scenarios at public workshop settings, virtual workshops, online platforms, and via social media.
- An open environment for information sharing, education, and transfer of knowledge should be promoted via access to advanced technology, a community of users, and open data.

2.2 Purpose and Need

GIS has moved from costly, proprietary, and stand-alone software to open-source, web-based technology. Additionally, GIS technology—once used by only by technically skilled practitioners—has become more visual, interactive, and accessible to non-skilled GIS users. A Governing Technology article states, "GIS applications have transformed into simpler, user-friendly tools with mass appeal and—most important—they live entirely on the web" (Vander Veen, 2008).

In the mid-1990s, professional planners, GIS practitioners, academicians, cartographers, leaders of both government and non-government organizations (NGOs), and others recognized the potential for the non-traditional application of GIS to influence public policy, democratize decision making, and support collaborative planning processes (Seiber, 2006). As a result, public

participation GIS (PPGIS) emerged as a field of interest and study. PPGIS research has focused on its social history, evolution, and frameworks to harness the use of the technology and open data to advance participatory planning processes. Governments that traditionally used geospatial mapping and GIS technology for institutional purposes are now using interactive GIS applications to provide public context for planning and other issues via the Internet, smartphones, tablets, and other mobile devices. Moreover, GIS is being used in participatory and open planning processes to improve the quality of public engagement and empower decision-makers. With the widespread availability of Internet access, the implications of web-based PPGIS (or WPPGIS) in transportation planning gained momentum in the mid-2000s (Tang & Waters, 2005). Yet, the breadth of PPGIS research lags behind the explosion of new digital technologies, geospatial tools, and interactive GIS applications that have "gone viral." Because web-based GIS tools show promise to augment participatory planning processes, while providing an interactive, networked environment for decision making, this topic merits further research.

To address this research gap, under the auspices of Mid-Atlantic Transportation Sustainability University Transportation Center (MATS UTC), researchers from the Institute for Public Administration (IPA) at the University of Delaware and the Nick J. Rahall, II Appalachian Transportation Institute (RTI) at Marshall University conducted this Phase II study to explore the potential for using interactive GIS Story Maps in participatory planning processes. Esri is an international supplier of GIS software, web GIS, and geodatabase management applications. In 2012, it publicly introduced GIS Story Maps as part of ArcGIS Online—its cloud-based mapping and GIS platform. GIS Story Maps combine the power of web-enabled maps, geospatial data, narrative text, and multimedia as an innovative way to engage non-technical audiences through map-based storytelling. Esri has devoted considerable resources to build GIS Story Map expertise and a community of users. Yet, the potential to use GIS Story Maps to engage and empower stakeholders in participatory processes to plan for sustainable places has not been fully explored. Moreover, an untested premise is that non-GIS professionals—with limited geospatial knowledge and experience—can create visually appealing and effective GIS Story Maps using available ArcGIS Online storytelling templates, trusted geospatial data, and/or basemaps published by Esri or other authoritative agencies.

2.3 Research Questions and Methodology

The purpose of this Phase II study is to address several basic research questions. First, how has the intersection of new "open government" policy frameworks, and the emergence of PPGIS, provided a foundation for public engagement? Second, how have advancements in digital technology—including web-based, interactive GIS—improved participatory public engagement? Third, can both a research team comprising skilled GIS professionals (RTI) and a team of public policy practitioners (IPA), with no prior knowledge of GIS, effectively use Esri's online resources (e.g., ArcGIS Story Map application templates, gallery examples, tutorials, intelligent

web maps) and geospatial data to craft GIS Story Maps? Finally, are the resulting GIS Story Map products designed effectively to engage stakeholders in participatory planning processes, provide context to complex planning topics and concepts, and support informed decision making? In other words, can GIS Story Maps be used as effective tools to empower and engage stakeholders in planning sustainable places?

Two primary tasks were undertaken to carry out this research. First, a review of the relevant literature was conducted. It explored public participation and engagement in transportation planning to determine how methods have been shaped by challenges of conventional techniques, federal policy frameworks, calls for open government, and the evolution of the use GIS technology from a planning instrument to a public-engagement tool. The reviewed literature includes scholarly literature, federal mandates, and online resources. It focuses on the:

- Distinction between public involvement and public engagement.
- Policy framework that supports public participation in transportation planning.
- Impact of shifting philosophical and policy frameworks on conventional public involvement methods.
- Participatory planning challenges and advancements.
- Growing imperative to optimize public engagement in transportation planning toward more dynamic, high-performance, and interactive public-engagement processes through the use technology and visualization techniques.
- Evolution of using GIS technology as a spatial database, mapping tool, and spatial analysis tool in the planning field to deployment as a system of engagement that empowers decision making within a digital culture.
- Emergence of a field called public participation GIS, or PPGIS.

Second, both the RTI and IPA research teams used a case-study approach to explore the practical application of GIS Story Maps in planning for sustainable places. The case-study method provides an overview of each research team's experience crafting GIS Story Maps, perceived effectiveness of using GIS Story Maps to convey sustainability issues, potential for using map-based storytelling to engage planning stakeholders, and lessons learned. While a case-study approach is ideal for a preliminary, exploratory stage of a research project, it has limitations. The case studies demonstrate the potential to use or integrate GIS Story Maps within participatory planning processes, but empirical evidence to support or oppose this notion is lacking. The research outcomes are intended to provide a foundation for a more structured, in-depth study. The design of future research should include the collection and analysis of data to provide empirical evidence as to whether GIS Story Maps are effective in empowering and engaging stakeholders in planning sustainable places.

3. Literature Review

3.1 Public Participation vs. Public Engagement

The terms public participation and public engagement are often used interchangeably. Yet, a review of literature implies that the concepts are different and the terms should be distinct. The body of research suggests that public participation doesn't necessarily equate to citizen engagement (Lukensmeyer & Torres, 2006, p. 9). Much has been written about the effectiveness of informing or gaining information through one-way channels of communication versus participatory methods that involve diverse stakeholders and facilitate two-way exchanges of information. Not all methods of public participation engender a high level of engagement that democratizes decision making, enhances creative problem solving, fosters trust, and builds consensus (Svara & Denhart, 2010, p. 5). A recent study makes the case for distinguishing the term *participation,* or public involvement in a planning process, from the concept of *engagement*, which "refers to both participatory activities and the dissemination of information to inform, educate, and empower the public" (Cassello, Towns, Belanger, & Kassiedass, 2015, p. 89).

The Spectrum of Participation, developed by the International Association for Public Participation (IAP2), identifies and describes five levels of participation. The spectrum describes "inform and consult" as more passive activities, while "involve, collaborate, and empower" generate higher levels of active stakeholder engagement. Figure 1—IAP2's Spectrum of Participation (as adapted by the City of Burlington, Ontario, CA)—shows how high levels of public participation can lead to increased public impact and informed decision making.

Figure 1: Graphic Depicting IAP2's Spectrum of Participation (City of Burlington, Ontario, CA, 2013)
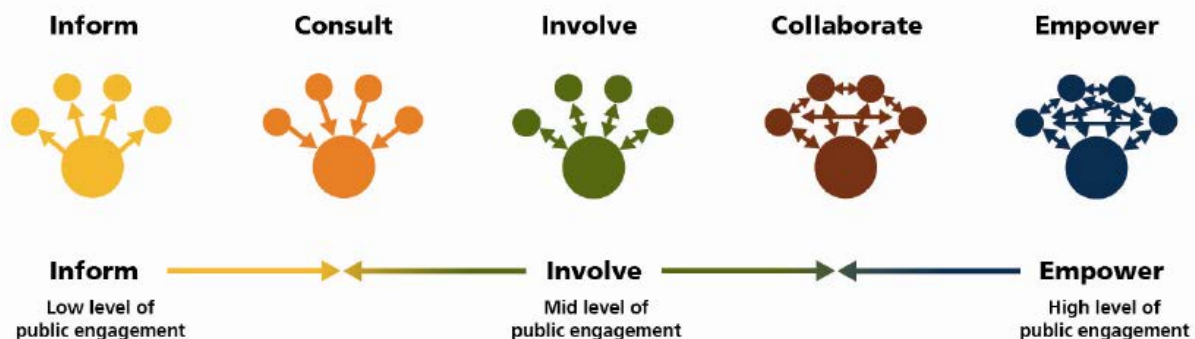
Thus, public engagement can be described as a deliberative process through which citizens and stakeholders come together to engage in thoughtful discussion, express their points of view, and discover common ground to influence government decision making (IPA, n.d.). The Transportation Research Board (TRB) Committee on Public Involvement in Transportation

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further defines public involvement in the context of transportation planning. It states that public involvement is "the process of two-way communication between citizens and government by which transportation agencies and other officials give notice and information to the public, and use public input as a factor in decision making" (O'Connor et al., 2000). Yee (2010) describes public participation as the practice of stakeholder engagement. He defines stakeholder engagement as "a framework of policies, principles, and techniques which ensure that citizens and communities, individuals, groups, and organizations have the opportunity to be engaged in a meaningful way in the process of decision making that will affect them, or in which they have an interest" (Yee, 2010, p. 3).

3.2 Policy Framework for Public Participation

Direct citizen participation in government stems from traditions of American democracy and rights of access to government, as afforded under the U.S. Constitution. Federal legislation provides a strong policy framework for public involvement in planning processes. Public engagement in the planning process didn't develop as a practice until well into the twentieth century. The 1926 Supreme Court case *Village of Euclid, Ohio v. Ambler Realty Co.* set the framework for local zoning and planning in America and, by extension, the public's role in the process. In this landmark case, the U.S. Supreme Court held that a zoning regulation does not violate the "due process" clause of the Fourteenth Amendment to the U.S. Constitution if it is reasonable and represents the public interest (U.S. Supreme Court, 1926). It upheld the notion that due process is achieved when procedural requirements exist for public participation in the planning process. When the practices of public notices and public hearings are instituted, they provide safeguards against arbitrary legislative action, and therefore decisions are made in the interests and needs of the public (Sinaiko, 1975).

During the 1920s, the federal government passed a pair of laws that provided a foundation for planning and zoning in the United States and firmly routed planning as a profession (APA, n.d.). First, the Standard State Zoning Enabling Act (SZEA) was developed and revised by the U.S. Department of Commerce between 1921 and 1926. It encouraged city zoning to make proper use of land. SZEA outlined guidelines for creating a board of adjustment to act not only as an authority, but also to engage the public. The act also called for public notice of meetings, zoning changes, as well as a period for public comment by anyone, not just property owners (U.S. Department of Commerce, 1926).

Next, the Department published A Standard City Planning Enabling Act (SCPEA) that called for establishing a planning commission to prepare and adopt "master plans," as well as guidelines for establishing a regional planning commission and regional plans. The act specified that "sooner or later every State will need legislation cover all of these subjects… each of these subjects is a necessary part of effective planning legislation, and the text of this act supplies a

model from which to frame and develop the planning legislation" (U.S. Department of Commerce, 1928). The act called for at least one regular public meeting to be held each month. Furthermore, "before the adoption of any plan or any amendment, extension, or addition the commission shall hold at least one public hearing, notice of the time and place shall be given by one publication in a newspaper of general circulation in the municipality and in the official gazette" (U.S. Department of Commerce, 1928). The acts were also followed by a number of studies and models for land use and zoning codes, the prescription for public involvement continued to be public notices and hearings (Goodspeed, 2008).

Public participation programs were initiated in the 1950s based on assumptions that a more actively involved citizenry would lead to more effective and democratic governance (Day, 1997). The civil rights, anti-poverty, and other social justice movements during the mid-1960s heightened the need to expand the public's role in federal policy making. With the passage of environmental protection legislation in the late 1960s, public participation became institutionalized in the federal policy-making process. The National Environmental Policy Act (NEPA) of 1969 required the federal government to inform and obtain stakeholder input on decisions regarding environmental issues, assessments, and environmental impact statements (EIS) (Prevost, 2006). Because many infrastructure projects require EIS, public participation became an integral part of the transportation planning process (Weiner, 2013).

In 1967, the federal Freedom of Information Act (FOIA) was enacted to ensure an informed citizenry, which is vital to the functioning of a democratic society. It encourages federal agency accountability through transparency by providing access to public records and decision-making processes. For example, federal transportation laws and regulations provide general guidelines for locally developed public involvement processes and procedures.

In the late 1960s and early 1970s, citizen participation requirements transcended other federal policy arenas such as housing, economic development, education, coastal zone management, and transportation planning. During this era, federal citizen participation requirements filtered down to state and local governments. In order to qualify for federal grants-in-aid and revenue sharing programs, state and local governments were mandated to provide opportunities for citizen participation (ACIR, 1979). While the type of required public involvement was not specified, traditional forms of public participation were "high-touch" and involved face-to-face interaction at public meetings and workshops. Examples of high-touch methods include (ACIR, 1979, p. 4 and Beierle, 1998, p. 4):

- Organizational – In-person methods such as forming citizen boards, task forces, committees, and/or special interest groups.
- Individual – Voting, participation as a program client, and testimonies and/or comments at public hearings.

- Information dissemination – Reports, displays/exhibits, correspondence, newspaper articles, press releases, phone hotlines, advertisements for public hearings, public notices of funding applications, and/or other hard-copy publications.
- Information collection – Surveys, opinion polls, or input gathered at public hearings, workshops, and meetings.

3.3 Shifting Philosophical and Policy Frameworks

The philosophical framework for public participation began to change in the late 1970s as citizens expressed increasing distrust of all levels of government in the United States. Growing concerns with government accountability, transparency, and a perceived disregard for "the public good" fueled general dissatisfaction with conventional public participation methods. Several concurrent movements advanced a growing imperative to increase government transparency and enhance the public's role in government policy and decision making. The rise of the New Public Management focused on government performance and supported the fundamental ideal that governments should be publicly accountable to the people they serve. The Reinventing Government movement emphasized treating citizens as customers or "stakeholders" in the business of government (Svara & Denhart, 2010). While the 1966 federal Freedom of Information Act (FOIA) paved the way for open public meetings and documents, the open government movement in the 1970s and 1980s responded to calls for increased transparency and accountability.

In addition to federal statutes, regulations, and authorizing legislation, several presidential executive orders were issued to advance inclusive public participation in federal government affairs. Two executive orders were signed by President Clinton in 1994 and 2000, respectively, to (1) address environmental justice in minority and low-income populations and (2) direct federal agencies to provide meaningful access to programs, services, and activities to individuals with limited English proficiency populations (US DOT, n.d.-a). During President Obama's administration, a Memorandum on Transparency and Open Government was issued to institute the three principles of transparency, participation, and collaboration as cornerstones of an open government (The White House, 2009). Obama's 2009 Open Government Directive requires federal agencies to take immediate, specific steps to achieve key milestones of those key principles (The White House, 2009). With respect to participatory government, it states:

Government should be participatory. Public engagement enhances the Government's effectiveness and improves the quality of its decisions. Knowledge is widely dispersed in society, and public officials benefit from having access to that dispersed knowledge. Executive departments and agencies should offer Americans increased opportunities to participate in policymaking and to provide their Government with the benefits of their collective expertise and information. Executive departments and agencies should also solicit public input on how we can increase and improve opportunities for public participation in Government (The White House, 2009).

Open data is defined as data that can be freely used, reused, and redistributed by anyone (Open Knowledge International, 2010). In 2012, President Obama issued a directive titled "Building a 21st Century Digital Government" to provide citizen developers with tools to unlock government data. President Obama then launched an Open Data Policy and Executive Order in 2013 to ensure that data released by the federal government is publicly accessible via the Internet and useable (Park & VanRoekel, 2013). More state and local governments have followed suit to adopt open data policies as both a way to better inform citizens, inform data-based decisions, and promote economic growth.

3.4 Public Involvement in Transportation Planning

Because many transportation infrastructure projects have environmental consequences and require EIS, mandated public involvement in transportation planning is rooted in NEPA of 1969. Beginning in the early 1990s, transportation planning and policy underwent major changes during several waves of federal surface transportation legislation under U.S. Code Title 23. Federal regulations require state departments of transportation (DOTs) and metropolitan planning organizations (MPOs) to develop long-term plans and short-term investment programs for projects using federal funds.

Public involvement in transportation became codified under the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 (Peckett & Lyons, 2012, p. 43). ISTEA assigned MPOs with the responsibility to develop long-range regional transportation plans and short-range regional transportation improvement programs in cooperation with state DOTs, regional transit agencies, and local governments. It emphasized the need to broaden participation in transportation planning and provide meaningful engagement of diverse stakeholders. It set forth broad expectations for a "continuing, cooperative, and comprehensive (3-C) planning process" by MPOs and their partners in all metropolitan areas with populations of more than 50,000 people (US DOT, 2000). In addition, it emphasized the need to target outreach to underserved and underrepresented populations.

ISTEA's emphasis of early, proactive, and sustained citizen input continued under successive waves of federal surface transportation authorization bills. The Transportation Equity Act for the

21st Century (TEA-21) of 1998 reinforced the overarching philosophies and goals of public participation in transportation planning. Yet, there was a lack of federal guidance on the form, content, and performance metrics requirements for public participation processes devised by state DOTs and MPOs (O'Connor et al., 2000).

The Safe Accountable Flexible Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) of 2005 broadened opportunities for public involvement in the transportation planning process. The act required that MPOs develop and utilize a participation plan to enhance the public participation process. Transportation agencies were advised to conduct convenient and accessible public meetings, make information available in electronically accessible formats, and "employ visualization techniques to describe plans" to the public (US GPO, 2005). The act prescribed advancing the use of technology in land-use and transportation planning (e.g., GIS mapping, scenario planning, and visualization techniques), developing meaningful performance measures, and communicating performance measure outcomes by transportation professionals (Polzin et al., 2008).

Public involvement in transportation continued under the Moving Ahead for Progress in the 21st Century Act (MAP-21) of 2012. It further reformed state DOT and MPO transportation planning processes by incorporating performance goals, measures, and targets into the project prioritization and selection processes. One rationale for performance measurement was to better gauge the extent to which planning processes were inclusive and engage all sectors and users of the transportation network (US DOT, 2012). Signed into law on December 4, 2015, the Fixing America's Surface Transportation Act (FAST Act) continues MAP-21 provisions that support and enhance state DOT and MPO performance management reforms. In addition, it specifically requires public involvement in planning processes to improve the resilience and reliability of the transportation system, mitigate stormwater, and enhance travel and tourism (US DOT, 2016).

With the passage of ISTEA in 1991, and focus on improving participatory and collaborative transportation planning practices, research increasingly focused on bridging the theory and practice of public engagement. Numerous studies were sponsored and/or conducted by the Transportation Research Board (TRB), National Cooperative Highway Research Program (NCHRP), agencies such as the U.S. DOT and state DOTs, private consulting firms, regional transportation authorities, academic institutions, and others. The TRB Committee on Public Involvement in Transportation was formed to "enhance understanding, acceptance, and practice of public involvement as an art and science in transportation policy implementation and all phases of the transportation process" (TRB ADA60, 2013). The committee's current work focuses on exploring the use of new communications technology, tools, and techniques to advance public engagement to enable transportation agencies to better respond to evolving and dynamic federal transportation policy and planning frameworks (TRB ADA60, 2013).

Public engagement and equity in transportation planning is among the focus areas within U.S. DOT's Transportation Planning Capacity Building (TPCB) website (US DOT, n.d.-c). The literature spotlights best practices for public involvement, design of effective processes, elements of public involvement plans, evaluation metrics, and new innovative approaches. The Federal Highway Administration (FHWA) states that, "Early and continuous public involvement ensures that decisions reflect public needs and interests, consider diverse viewpoints and values, and are made in collaboration and consensus with all stakeholders. This process builds mutual understanding and trust between government entities and the people they serve" (US DOT FHWA, 2015).

3.5 Participatory Planning Challenges and Advancements

Despite the passage of legislation to enhance citizen participation, shortcomings of conventional participatory planning methods are well documented. Traditionally, governments have used "high-touch" (in-person) methods (e.g., public hearings, workshops, forums, task forces, and committees) to provide opportunities for public involvement. Face-to-face interaction at public meetings or workshops is the most time-tested way for governments to involve citizens in the planning process. While high-touch planning processes provide a two-way dialogue, they are time consuming and often require long-term commitments from participants. Traditionally, public participation methods have been formulaic, regimented, and typically limited to specific points in government hearings or administrative processes. Gordon, Schirra, and Hollander (2011) observed that even traditional public participation processes augmented with verbal descriptions or images failed to promote an understanding of "spatial and urban concepts" by decision makers.

Standard public information and outreach practices were also panned for failing to target underrepresented or underserved populations, including marginalized people living in communities most impacted by government decisions. Routine in-person, or high-touch methods, have been criticized for paying "lip service" to mandated requirements. An evaluation of citizen participation at the federal level, conducted in 1976 by the Interagency Council on Citizen Participation, revealed that federal authority and responsibility was fragmented, agency resources were insufficient, and leadership and commitment was uneven. The council stated that "the planning, execution, and evaluation of citizen participation processes are unresponsive to the real needs and priorities of a large segment of the public" (ACIR, 1979 11).

Transportation planning public-engagement processes and related practices continue to be shaped by convergence of factors. Changing federal policy landscape, best practice research, increasingly complex issues, growing diversity of stakeholders, and new communications technology provide both challenges and opportunities, which are summarized in the next sections.

3.5.1 Design and Quality of Processes

A key problem has been the design of public participation processes. While the need for public engagement is well established, the ideal forms and designs of public participation processes are less clear. Researchers cite the need to go beyond conventional public participation processes that are prescriptive and provide one-way exchanges of information. "Simply inviting the public to participate is insufficient for fostering legitimate and sustainable public engagement" (Gordon, Schirra, & Hollander, 2011, p. 506). Public meetings too often are planned as "one-and-done" events. They fail to effectively proactively engage stakeholders throughout a public planning process (O'Connor et al., 2000, p. 4).

The quality of public participation processes is also challenging. Bailey et al. (2015, p. 45) notes that "the quality of public involvement processes in transportation deserves more attention, and it is fruitful to consider the literature from cognate public goods management fields." Research (Connelly, 2006) suggests that ineffective public involvement stems from the management of a process rather than a "failure to engage" participants. Designing, controlling, and framing public involvement is critical to the quality of a process.

3.5.2 Lack of Clarity

Conducting engagement without a clear public engagement plan, goals, and objectives has also proved difficult (Casello et al., 2015, p. 90). Standard forms of public engagement have been criticized for simply going through the motions to meet required checklist activities (O'Connor et al., 2000, p. 5). Once a planning process was underway, "tell *then* ask" characterized the norm for traditional public involvement with stakeholders. Planning processes typically failed to proactively cultivate meaningful discourse, continuous input, and ongoing engagement of stakeholders. Instead of providing meaningful opportunities for public engagement, activities were conducted to serve as a postscript to fulfill legislative mandates.

To address these concerns, federal regulations for MPOs (23 CFR 450.316) and Federal Highway Administration (FHWA) guidelines now require MPOs, state DOTs, and transportation agencies to develop public engagement plans. These plans must outline a process to provide stakeholders with robust opportunities for participation at all planning stages, collaborative input, access to open meetings, and involvement in decision-making processes. Yet, plans and resulting processes may not be effective unless they are tailored to local conditions, specific audiences, and/or target groups. For plans to win local acceptance and move forward, public outreach and engagement processes must provide continuous and authentic engagement opportunities (Casello et al., 2015).

While there is not a one-size-fits-all approach to public engagement, several best practices are recognized. Wagner (2013) condenses public engagement best practices into three principles. First, events should be accessible to facilitate involvement of diverse stakeholders. Second, a variety of tools, techniques, and strategies should be utilized to promote two-way communication and interactions. Third, outcome-oriented processes should facilitate continuous involvement, encourage meaningful input, and achieve intended outcomes (Wagner, 2013, p. 39–41).

Casello et al. (2015, p. 90) suggests a three-pronged framework for effective public engagement that includes customizing outreach messaging, stimulating public interest, and targeting community groups. Engagement should include both "push" techniques—to spread information through various outreach approaches—and "pull" methods—to obtain stakeholder input through conventional high-touch (in-person) and high-tech (technology) methods (Casello et al., 2015).

3.5.3 High-Performance Public Involvement

Another issue related to the improved design and quality of public participation processes is the lack of high-performance public involvement. The divide between the actual and the desired levels of public involvement in transportation planning is described as the "Arnstein Gap" (Bailey et al., 2015 46). To address this gap, participation processes need to incorporate broader citizen values, include "credible" stakeholder representatives, link to policy decision-making outcomes, and build consensus of participants (Bailey et al., 2015). These recommendations to address the Arnstein Gap are consistent with outcomes of a 2008 National Research Council report that evaluated public participation in environmental decision making. This report noted that while there is not a one-size-fits-all prescription public participation, there are principles and "best processes" that can augment the effectiveness of participation methods (Dietz & Stern, 2008).

To attain high-performance public involvement, a framework is needed that (1) fosters analytic, evidence-driven discussion among stakeholders about process quality metrics, (2) includes multi-dimensional evaluation frameworks for public involvement design and outcomes, and (3) develops strategies for increasing performance of public involvement processes (Bailey et al., 2015). In addition, to create a climate for high-performance public involvement, the public participation process needs to build a shared vision and articulate planning objectives (Bailey et al., 2015).

Structured public involvement (SPI) is one tactic to realize high-performance public involvement. Incorporating high-tech strategies (e.g., electronic polling and visualization tools) within large-group processes can promote understanding of data and complex issues, stimulate stakeholder responses, and establish a framework within which planners and decision-makers can set priorities on defined scenarios (Bailey et al., 2012).

3.5.4 Accountable Public Outreach

The purpose of public involvement is to obtain local knowledge and perspectives, share information, and develop a plan that achieves support for implementation. Yet, problems with transparency, accountability, and inclusiveness continue to plague public involvement in transportation planning. Traditional public participation processes tend to be reactive and lack solution-based approaches that incorporate citizen input. Organizations that have established trust with key stakeholders are often uninvolved or under involved in public processes (Alter et al., 2008).

Diversity, equity, and inclusion remain public participation barriers in transportation planning. Communication and language barriers often prevent minority- and low-income individuals from attending meetings and engaging in transportation planning processes. Moreover, logistical, technical, and educational issues are cited as barriers to participation in traditional processes (Bailey et al., 2012). To establish accountability, public outreach processes must be inclusive and "involve engaging a broader spectrum of the public" (Alter et al., 2008 p. 46). In addition to improving the design and quality of public participation processes, focusing a lens toward accountable public outreach may foster early, continuous, and meaningful opportunities for inclusion and input from diverse stakeholders.

3.5.6 Performance Metrics and Outcome Measures

While federal agencies like FHWA have issued public involvement guidelines and principles, the form, content, objectives, and metrics for public involvement in the transportation sector remain nebulous (Bailey et al., 2013). Wagner (2013) cites several benefits of measuring the performance of public engagement in transportation planning. These include establishing accountability with the public, improving performance, increasing transparency, and building trust (Wagner, 2013).

The absence of evaluation frameworks and performance metrics to measure the performance of public engagement in transportation planning is problematic (Wagner, 2013 and Bailey et al., 2015). Ramasubramanian (2008) notes that metrics for public participation is often gauged by meeting attendance—or "bums on seats"—instead of an evaluation of outcomes.
To achieve high-performance public involvement, objective data (process quality data), and clear process quality indicators are required (Bailey et al., 2015). Lessons learned from measuring the quality of public processes in environmental justice and other fields can be applied to the urban planning and transportation sectors. Drawing upon research from public administration, environmental management, and process quality fields, Bailey et al. (2013) suggests that quality, inclusion, clarity, and efficiency be used as overarching topics to assess the qualities of public-engagement processes.

3.5.7 Changing Digital Technology and Public Engagement Landscape

With the dawn of the digital age, the public engagement landscape is evolving with the development and use of high-tech and interactive visualization tools. "High-tech" approaches use digital tools to provide online public engagement opportunities through websites, electronic networks, social media, open source computing and data, and mobile applications. While high-tech public engagement lacks personal interaction, it minimizes barriers to public participation as it is available to anyone with Internet access. The most effective strategies integrate high-touch (in-person) and high-tech approaches to sustain long-term engagement involve diverse stakeholders and incorporate a wide range of activities and techniques. While digital public-engagement tools are not a panacea, they are strategies being used by governments to build trust, engage stakeholders, and visually show planning outcomes. As the Center for Digital Government explains, "governments need to balance information dissemination and citizen interaction" through new tools while incorporating advanced content technology into established websites. "This allows governments to deliver the improved information access and online services that naturally lead to increased citizen satisfaction and participation" (Center for Digital Government, 2013).

The potential to integrate high-touch methods with high-tech approaches, as a means to provide enhanced opportunities for public involvement, began to be realized in the early 2000s. Scott and Herzer (2002) pointed to the potential of "accessible" communications technology (e.g., email, websites, and multimedia formats) to enhance interaction, present information, and garner public input. Jenkins, Purushotma, Weigel, Clinton, and Robinson (2009) viewed technology as requisite to building a participatory culture, media literacy, and inclusive citizen processes. For citizens to better respond and interact with evolving dimensions of new media technology, a participatory culture needs to be fostered. Moreover, they recognized the need to build the capacity for media-literate citizens to "gather and analyze information, develop informed opinions, and share these perspectives with others" (1616).

Despite the availability and use of digital technology, efforts to ensure outreach to engage diverse stakeholders have become considerably more complex. Citizens are not only more connected, but also rely on technology to communicate and expect "real-time" and instantaneous information. It's become considerably more difficult to attract public interest to attend in old-school meetings or processes that lack interactive technology and visualization tools. O'Connor (et al. 2000, p. 5) noted that "in an age of sound bites and limited attention spans, public involvement practitioners must develop ways to capture and maintain public attention and convey complex information, as well as receive complex feedback."

Leveraging the power of technology requires designing public-engagement processes with digital tools that best "foster the elicitation and capture of stakeholder valuations from the largest

number possible of participants in an efficient, equitable, and transparent manner…" (Bailey 2015, p. 51). Scenario-planning and activity-based transportation modeling tools have been effectively used for public engagement purposes by MPOs, DOTs, and larger local governments. Yet, these tools are complex and resource intensive for smaller local jurisdictions. Concurrently, local governments are increasingly using data analytics, civic engagement technology, and online digital tools/platforms to both inform decision making and convey performance metrics. As a result, web-based interactive visualization tools and digital strategies are helping local governments become more transparent, efficient, collaborative, and productive (Goldsmith & McClellan, 2013).

Research by Griffith and Young (2013, p. 13) indicates that engaging stakeholders through both in-person and online forums can generate "local knowledge, collective intelligence, and creativity." Improved engagement in transportation planning and policy development has been demonstrated through the use of participatory GIS software, public crowdsourcing and design competitions, decision-support software, and electronic polling. In addition, "immersive planning" is described as an innovative approach that uses technology to engage and communicate with the public about complex topics, such as transportation (Gordon, Schirra, & Hollander, 2011, p. 209). Examples of immersive planning practices include participatory GIS technologies, visualization tools, and digital-based games.

Public engagement continues to be transformed by the explosion of new digital technologies/tools, software platforms, social media networks, mobile devices, and mobile applications or so-called apps (Mihailidis & Thevenin, 2013). Sui (2015, p. 10 citing Bennett & Segerberg, 2011) observed that "digital media…and location-based social media…are contributing to the more personalized collective action process that maintains high levels of engagement, agenda focus, and network strength."

Although high-tech modes of communication have the potential to reach more stakeholders in virtual settings, planning professionals must consider transportation justice issues. Underrepresented, underserved, and marginalized populations that lack access to the Internet, technological savvy, or mobile devices may inadvertently be excluded from public-engagement processes that focus on high-tech approaches. To ensure broad-based representation and input from all stakeholders and gauge the effectiveness of participatory programs, performance measurement is needed. Wagner (2013) suggests that three best-practice principles—event accessibility, interactive engagement, and outcome-oriented processes—be used as metrics of a successful digital public engagement process that supplements participation in traditional settings.

3.6 Evolution in the Use of GIS Technology to Optimize Participatory Planning

The effectiveness of maps as a tool for analyzing data and conveying information to the public during the planning process is not new. Traditionally, GIS focused on cartography and were used as a spatial database, mapping tool, and geospatial analysis tool (Sui & Goodchild, 2001). Professional planners used a variety of GIS and technical tools to map, visualize, and analyze land-use and transportation connections at multiple scales. In the early 2000s, GIS were regarded as the "new media." GIS were envisioned as both a tool to communicate geospatial information to the general public and as a digital technology to facilitate public dialogue (Sui & Goodchild, 2001). Drummond and French (2008) foresaw future uses for GIS in planning in the areas of analysis, design, and process. With respect to process, it was anticipated that GIS could "significantly enhance… public participation and improve the quality of civic dialog during the planning process" (Drummond & French, 2008, p. 172).

3.6.1 Emergence of the Field of Public Participation Geographic Information Systems (PPGIS)

The potential for using GIS as a tool for capacity building and social change was recognized in the mid-1990s. Obermeyer (1998) notes that the evolution in the use GIS to influence public policy and is firmly rooted in the planning profession. Planners originally used GIS for institutional purposes, not as a public involvement mechanism. GIS software was limited for use as a computer-based tool to analyze land use, development, and other planning issues from a geospatial perspective.

In the mid-1990s, planning practitioners, leaders of community-based organizations, and social advocates began to realize that GIS could be used in a variety of contexts to support and facilitate public participation. The term "public participation GIS" or PPGIS were coined by planning professionals, yet definitions of PPGIS vary (Obermeyer, 1998). Shroeder (1996) described PPGIS as "a variety of approaches to make GIS and other spatial decision-making tools available and accessible to all those with a stake in decisions." According to Krygier (1998), PPGIS were regarded "broadly as an integrative and inclusive process-based set of methods and technologies amenable to public participation, multiple viewpoints, and diverse forms of information." Sieber (2006) explained that PPGIS "pertains to the use of GIS to broaden public involvement in policymaking as well as to the value of GIS to promote the goals of nongovernmental organizations, grassroots groups, and community-based organizations. Seiber (2006) also noted a multi-disciplinary interest in using GIS activities (e.g., information dissemination, visualizations, and graphical user interfaces) to empower and involve underrepresented and/or marginalized individuals in collaborative planning processes. Yet, her definition decidedly focused on the application of GIS to address societal issues rather than to engage stakeholders in participatory planning processes that transcend multiple disciplines— including land-use and transportation planning.

Perhaps the best definition comes from Ramasubramian (2008, p. 26) who states that PPGIS "describes the range of participatory planning activities that are supported or enhanced by the use of digital tools such as GIS maps." Ramasubramian (2008) urges planning practitioners to leverage the power of digital tools—such as GIS—to build capacity of planning participants, fully engage participants, and empower informed decision making. She offers a set of PPGIS guidelines that focus on participatory planning as a people-oriented process rather than a technology-centered practice.

Tang and Waters (2005) explored the potential of PPGIS (or WPPGIS) to transform transportation planning. The study's goal was to determine strategies to incorporate WPPGIS into transportation planning, research, and development projects. It was envisioned that "incorporating pictures, text, interactive maps and other forms of related data with a user-friendly, graphic interface and analytical tools on the Internet undoubtedly could help the public access and understand [transportation planning] information" (Tang & Waters, 2005, p. 10).

3.6.2 Advances in PPGIS

Recent changes in digital geospatial technology offer new opportunities for use in planning and public engagement and have made WPPGIS a reality. In the past two decades, advances in software, access to open data, and availability of online, accessible platforms have made GIS more powerful, user friendly, and accessible by non-GIS practitioners with minimal training (Sui & Goodchild, 2001, p. 387). Web-based systems are providing greater opportunities to create new geospatial applications that provide more ways to connect a broader community to data and GIS content. Because GIS technology has become more visual, interactive, and impactful, it is being used to improve the quality of public engagement in planning and decision making. As a result, GIS and other digital technologies are being used to advance more holistic, collaborative approaches to government problem solving.

In the past few decades, maps have been integrated with data analysis and supercharged with digital technologies, including geographic information systems, the Web, mobile communications, and the cloud. Thanks to these technologies, maps can be used and interacted with in a myriad of ways. Countless maps are generated and used every day—to help millions of people know where they are, to guide them to where they want to go, to locate services, to support decision making, and to serve a multitude of other functions (Esri, 2012).

As demand for open data grows, more data will becomes publicly available online. Maps may be the best way to convey complex information. In addition, new open-source GIS software is

allowing planners to download, assemble, and share geospatial applications via the Internet. Sui (2015) notes a shift from GIS being practiced in a proprietary manner to an open-source mode that integrates crowdsourced data, open access to software and GIS data, and social media campaigns. Emerging GIS practices have also shifted the application of GIS from strictly geospatial technologies to "address more pressing issues related to social equality/equity and environmental sustainability" (Sui, 2015, p. 10). In his research, Sui (2015) notes a convergence of quantitative and qualitative GIS. Map-based geospatial storytelling is enabled by GIS applications that provide data in a manner that can be easily visualized, explored, and interpreted by citizens.

3.7 GIS Story Maps as a Public-Engagement Tool

Esri is an international supplier of GIS software, web GIS, and geo-database management applications. Most local governments use Esri technology to create maps, compile geographic data, analyze mapped information, and share geographic information. Esri has led the movement to democratize digital mapping in the cloud-connected era. In 2012, Esri introduced map-based geospatial storytelling, or GIS Story Maps, as part of its cloud-based software platform—ArcGIS Online. ArcGIS Online provides an infrastructure for making maps and geographic information available throughout an organization, across a community, and openly on the web. Because map-based storytelling is a relatively new technology, there is not yet a large body of research available on integrating story maps into participatory planning processes. The bulk of information on storytelling with maps comes from Esri, an industry leader and advocate for the use of GIS Story Maps by non-GIS users. As such, there is a lack of peer-reviewed research on the use of GIS Story Maps with the PPGIS body of literature.

GIS Story Maps combine geospatial data with multimedia tools (i.e., photos, video, audio), text, and interactive functions to help people visualize a theme or sequential events. Story maps use geography as a means of organizing and presenting information. They combine interactive maps with, text, photos and other media to create a user experience that is intuitive to tell the story of a place, event, issue trend, or pattern (Esri, 2016). Story maps are designed for nontechnical audiences with access to the Internet; users do not need experience with GIS software to read or use the technology. Map-based storytelling is being used as a tool to improve communication, provide visual and interactive context for issues, and actively engage stakeholders in land-use and transportation planning. There are six story map elements, including:

- Story – Concept or message the author is trying to communicate.
- Text – Guide to help the user interpret your maps.
- Spatial data – Content that supports the author's story.
- Cartography – Attractive representation of spatial data.
- Supporting Content – Elements to enhance the story (graphs, pictures, charts, etc.).
- User Experience – Design and functionality (Esri, 2012).

According to Esri founder and president Jack Dangermond (2016), "GIS is increasingly deployed as a system of engagement that gives cities the power of deep analytics combined with an easy framework for communication and sharing." The storytelling context of GIS Story Maps can be more powerful than the data used to create them. Because GIS Story Maps can present information in a meaningful context to citizens and enhance data interpretation, governments and transportation agencies are using them to build understanding, collaboration, and a more holistic approach to problem solving. The power of data visualization, via GIS Story Maps, is advancing collaboration and innovation to tackle contemporary sustainability challenges, including issues planning transportation systems. Dangermond (2016) states, "Maps provide a way for citizens and taxpayers to better understand how spending or other decisions are being made as it relates to where they live and work." He adds, "Story Maps are becoming an increasingly important tool to share that understanding with larger audiences in a way that engages and inspires just as GIS is becoming an increasingly important tool [for governments and other entities] to understand and address the challenges of today and tomorrow."

GIS Story Maps present a great opportunity for public engagement. Data exploration (at one's own pace) within the app allows for meaningful, individualized interactions between the user and the information being presented. Story maps can be used for a number of purposes including:

- Locating something
- Providing directions
- Describing a place
- Explaining a geography-related topic
- Summarizing a status or situation
- Comparing two or more themes
- Comparing two or more places
- Showing change over time
- Forecasting the future
- Providing a narrative
- Presenting a briefing
- Enabling participation (Esri, 2012)

4. Case Studies

Most GIS professionals, planners, web programmers, and other specialists who build digital maps will have the necessary skills to create a GIS Story Map. While the actual creation of a story map requires some technical ability, Esri designed the interface for individuals who lack GIS skills. Esri provides free online tutorials, storytelling template applications (apps), and intelligent web maps via ArcGIS Online to facilitate GIS Story Map building by non-skilled users. Yet, there is a deficit of scholarly research on using of map-based storytelling to support participatory planning processes.

To address the void of scholarly research on using map-based storytelling to support participatory planning, the RTI and IPA research team each created GIS Story Map(s) to convey technically complex information and/or concepts to plan for sustainable places. The RTI and IPA research team used a case-study approach to explore the practical application of GIS Story Maps in planning for sustainable places. The RTI research team consisted of experienced GIS professionals (GISPs) that are certified and are endorsed by the GIS Certification Institute though a peer-reviewed evaluation as well as a graduate student. IPA's research team was composed of a public policy professional with expertise in land-use and transportation planning as well as a graduate research assistant with no prior knowledge or expertise in GIS. The goal was for each research team to independently test Esri's premise that both skilled- and non-skilled GIS practitioners can effectively create and use GIS Story Map(s) for public engagement purposes. Each team sought to craft effective GIS Story Maps using available Esri resources, templates, and GIS basemaps from available open or centralized data repositories. Each team explored the potential for using map-based storytelling to inform, engage, and potentially obtain meaningful input within a participatory planning process.

4.1 RTI, Marshall University: Creating a GIS Story Map to Communicate Economic Benefits of P3s for Financing Transportation Infrastructure Projects in West Virginia's Mingo County

4.1.1 Background

The Nick J. Rahall, II Appalachian Transportation Institute (RTI) at Marshall University is a leader in multimodal transportation and economic development in West Virginia (W.Va.) and the surrounding 13-state Appalachian Region. The U.S. Department of Transportation (DOT) has recognized RTI for its excellence in solving transportation challenges and addressing future needs through applied multimodal research, workforce development, and the application of sustainable transportation systems and infrastructure. Through a variety of programs, education, research, and technology transfer activities, RTI fosters the development and application of

sustainable transportation systems and infrastructure in rural areas and abroad. RTI places an emphasis on developing innovations and solutions that relate to nine program areas. RTI's Geospatial Sciences program area deploys GIS and related technologies and provides expertise to organizations in the various stages of geospatial sciences operations. Its team of skilled GIS professionals transforms geospatial information into custom, web-based maps and other applications to support critical functions for a variety of industries related to transportation and economic development.

In February 2012, RTI published a 166-page report, *Potential Economic Benefits of Public-Private Partnership (P3s) on Reclaimed Mine Sites in the Construction of the I-73/74 NHS Corridor* (RTI, 2012). This report explores the economic benefits available through the use of (P3s) for construction of the I-73/74 NHS Corridor. The study found that using P3s would provide significant construction cost and time savings for the I-73/74 NHS Corridor. Constructing the roadway without the use of P3s is estimated to cost $3.9 billion, while engaging in a P3 would save approximately $700 million. It determined that West Virginia's Mingo and Logan Counties would provide the greatest amount of potential development (in terms of planned communities as well as service, retail, and other commercial options) and are able to draw from their past post-mine land-use (PMLU) experiences.

Recommendations within the report focused on several guiding actions—particularly focusing on public engagement and a transparent planning process—that should be considered when a transportation agency (i.e., the West Virginia Department of Transportation [WVDOT]) is considering P3s and/or financing for future highway transportation needs. RTI's Geospatial Services team determined that report outcomes, and the potential to engage planning stakeholders in future P3 participatory planning processes, could be ideally conveyed in a GIS Story Map. While the RTI research team consisted of seasoned and skilled GIS practitioners, they previously had no prior experiencing developing a GIS Story Map. To develop the story map, the RTI team reviewed Esri's "The Five Principles of Effective Storytelling" (Esri, n.d.) to understand the perfect recipe to create a story map with a dynamic user experience. In addition, the team used Esri's online resources, available Story Map application (app) templates, and the app's tutorial page to guide the authoring process.

4.1.2 Sustainable Land-Use Planning Framework

Mingo County is located in the Appalachian Mountains, an area historically isolated from economic growth due to limited access, rough terrain, and little incentive for outside investment. In the mid-1800s, the vast coal resources located throughout the area that would become West Virginia began to be mined. The outbreak of Civil War halted coal production in southern West Virginia, while mines in the North remained active providing coal for the Union. In the period

following the Civil War, the coal industry began an era of development and growth (WVGES, 2004).

By 1890, electric coal cutting, loading, and hauling machines came into use. After 1936, mechanization proceeded very rapidly, with shuttle cars, long trains, conveyor belts, and all kinds of large mining machinery coming into common use. Large-scale surface mining did not start until 1914 but, with the development of huge shovels and draglines, the overburden could be more easily removed and in recent years this method has become a major method of mining coal in West Virginia (WVGES, 2004). Advances in extraction techniques have opened up millions of acres of land for natural gas mining. More than 1,000 streams have been filled and over 300,000 acres of mountains have been surface mined in West Virginia alone (Appalachian Voices, 2013).

Williamson, the county seat of Mingo County, W.Va., was once a bustling center of commerce and the hub of regional coal and banking industries. Like many Appalachian communities, Williamson's fortunes have been tied to the coal industry. The population grew from 27 in 1893 to 10,000 in 1925. This growth was fueled by the expanding railroad system that provided vast timber and coal reserves for extraction and transportation to manufacturing cities in the region (Sustainable Communities in Appalachia, 2013).

Williamson's decline began following two major floods in 1977 and 1984. As the coal mining industry declined, many communities suffered. Today, the Appalachian Regional Commission (ARC) ranks Mingo County as one of the most economically distressed counties in Appalachia based on three economic indicators: average unemployment rates, per capita market income, and poverty rates. Problems in the community include high rates of poverty (21%) and serious issues of public health. The U.S. Department of Agriculture (USDA) estimates that 12.5% of adults in Williamson have diabetes and 35.3% are obese—both are above the national average. Many of these issues are exacerbated by a lack of resources. It is difficult for many citizens to purchase necessities to maintain or promote health, such as healthy food and medicine (Sustainable Communities in Appalachia, 2013).

A growing movement recognizes that patterns of land use and development have long-term environmental, social, and economic consequences. Sustainable land-use planning, or Smart Growth, can shape vibrant communities, build strong economies, and foster a healthy environment (Scott et. al, 2016). Both Mingo County (Mingo County Redevelopment Authority, 2015) and the City of Williamson (City of Williamson, 2015) advocate for smart, sustainable land-use planning. An integrated approach to community development empowers local entrepreneurs to create good paying jobs and retain wealth in the community. The creation of a diversified economy is required to move away from the region's reliance on coal as the primary economic engine.

4.1.3 Mine Reclamation – The Beginning of Remediation for Mining Sites

Mountaintop removal is the process of surface coal mining that destroys a mountaintop or ridgeline. Before mining can begin, the topsoil and vegetation must be removed. Once cleared, explosives are used to access the coal seams that lie deep beneath the surface. Huge earth-moving machines known as draglines are used to remove coal and debris hundreds of tons at a time. The massive volume of material draglines can move reduces the number of miners needed to do the same job (Appalachian Voices, 2013).

The Surface Mining Control and Reclamation Act of 1977 (SMCRA) is the primary federal law that regulates the environmental effects of coal mining in the United States. The SMCRA states that coal operators must restore the land they have mined to its approximate original contour (AOC) and the condition of the land after the mining process must be equal to or better than the pre-mining conditions (Office of Surface Mining Reclamation and Enforcement, 2015). The Clean Air and Water Act was amended in 1977 and used along with the SMCRA to ensure adequate protection for the environment during surface mining. The act stated that only clean "fill" could be dumped into nearby streams, not "waste." However, after a 1988 provision, made by a former coal lobbyist Stephen Griles, all waste generated by strip-mining companies was reclassified as benign "fill material." The provision still stands today (Appalachian Voices, 2013).

The reclaimed land was often seeded with non-native, fast-growing grasses and trees selected to quickly provide ground cover. The long-term plan was to allow these areas to return to a natural state. In 2001, the West Virginia Legislature passed Senate Bill 603, which empowers county governments to plan for the reclamation of surface mines and their post-mining land uses. The bill requires all surface mining permits to have a reclamation plan and makes county commissions responsible for preparing land use master plans. In June 2009, the West Virginia Senate approved legislation requiring surface mine reclamation plans to conform with approved land-use plans. The legislation also authorizes surface mine reclamation plans to contain alternative post-mining land uses (Chi, Matthews, Weddington, & Hamilton, 2012).

4.1.4 Land Use Master Planning

The Land Use Master Plan (LUMP) will save the county and state construction costs by setting standards for reclamation and development of surface mine sites by the mining companies and determining the land-use and infrastructure needs within counties. Through P3s, the surface mining-process will provide the developable flat land required to help diversify the local coal-dependent economy. When LUMP is implemented through partnerships with coal companies, jobs and economic activity are maximized and focused around infrastructure projects (Mingo County Redevelopment Authority, 2015).

Mingo County has projects developed on PMLU using LUMP, including an Air Transportation Park, the Twisted Gun Golf Course, and Mingo Central High School. The Mingo County Air Transportation Park is located on land a short distance from a roadway that provides for air transportation needs and future economic development. The air transportation park was constructed on post-mine land, and was made possible by entering into a P3 with Alpha Natural Resources. The 900-acre site was donated to the Mingo County Redevelopment Authority at no cost to the taxpayers. The new airport boasts a state of the art 7,000-foot runway, lighting and instrumentation, and an additional 800 acres of developable property. The park increases the attractiveness of the area for future businesses and further commercial development. The park will serve private, corporate and industrial aircraft customers in the region (Chi, Matthews, Weddington, & Hamilton, 2012).

Twisted Gun is an 18-Hole, Professional Golf Association (PGA) golf course constructed as a post-mine land-use project. The course opened in fall 2001, at a cost of $2.3 million (100% private sector investment). The 90-acre site of the new Mingo Central High School was constructed to rough grade on a prior mining site by Alpha Natural Resource, and then donated to the Mingo County Board of Education. Alpha Natural Resources also committed a $400,000 contribution toward the construction of utilities to the school and athletic field sites (Mingo County Redevelopment Authority, 2015).

4.1.5 Public-Private Partnerships (P3s)

Public-private partnerships (P3s) are fairly new to the United States. With issues such as insufficient highway funds and needs for improved financial practices becoming more urgent, however, their usage for funding transportation infrastructure is becoming more widespread. P3 activities include financing, planning, design, construction, operation, and maintenance of projects. The Mingo County Redevelopment Authority is a leading force promoting public-private partnerships for infrastructure and economic development. Mingo County's economic success can benefit significantly from post-mine land use (PMLU) projects through continued diversification (Mingo County Redevelopment Authority, 2015).

In 1991, Congress identified the need for a north-south corridor extending from Michigan to Myrtle Beach, South Carolina. This roadway is designated I-73/74 North-South Corridor. Construction of the I-73/74 Corridor uses reclaimed surface-mine sites for part of the roadbed. In this P3, coal is extracted through surface mining as usual, but instead of reclaiming the land to AOC the mining company agrees to construct a portion of rough roadbed. Constructing the roadway is estimated to cost $3.9 billion, entering into P3s would save approximately $700 million (Chi, Matthews, Weddington, & Hamilton, 2012).

The Hatfield-McCoy Trails System (HMTS) winds through many of the counties directly affected by the construction of the I-73/74 and provides over 500 miles of off-highway vehicle trails to many off-highway vehicle enthusiasts. The HMTS hopes to expand the trails to 1,000 miles in the short term and an eventual 2,000 miles while adding multiple connecters to the trails already in place. Considering much of the HMTS is located in several of the I-73/74 counties, the possibility of using surrounding land for trail upgrades should be studied. The addition of several trailheads to the areas surrounding I-73/74 would bring more traffic to these locations and provide a boost to the local economies. Since the opening of the trails in 2000 there have been 44 new establishments for lodging, two ATV dealerships, numerous restaurants, gift shops, and other small businesses. The HMTS has seen visitors from 50 states and ten foreign countries and has over 300,000 user days per year (Chi, Matthews, Weddington, & Hamilton, 2012).

The economic impact, measured by jobs created, of these PMLU projects is estimated to be 359 direct jobs (Mingo County Redevelopment Authority, 2015). This number represents 4.1% of the total labor force of Mingo County. The estimated number of indirect jobs created by PMLU projects is 720, or 8.2% of the total labor force. The combined total of jobs created by PMLU projects is estimated to be 1,080, or 12.3% of the total labor force.

4.1.6 Marshall University RTI's GIS Story Map:
### Moving Toward Sustainability in Extraction Economies of Appalachia

The Marshall University RTI's GIS Story Map illustrates the challenges and successes of land use master planning in Mingo County, West Virginia. The GIS Story Map, Moving Toward Sustainability in Extraction Economies of Appalachia, can be found at http://goo.gl/BI0cpR.

The structure for the GIS Story Map is a modified Story Map Journal℠. This app template is ideal for multimedia stories that combine text, maps, images, and video. Additional story map apps were embedded into the main structure to support the narrative. The GIS apps that are integrated within RTI's Story Map Journal℠ include the:

- Choropleth Map
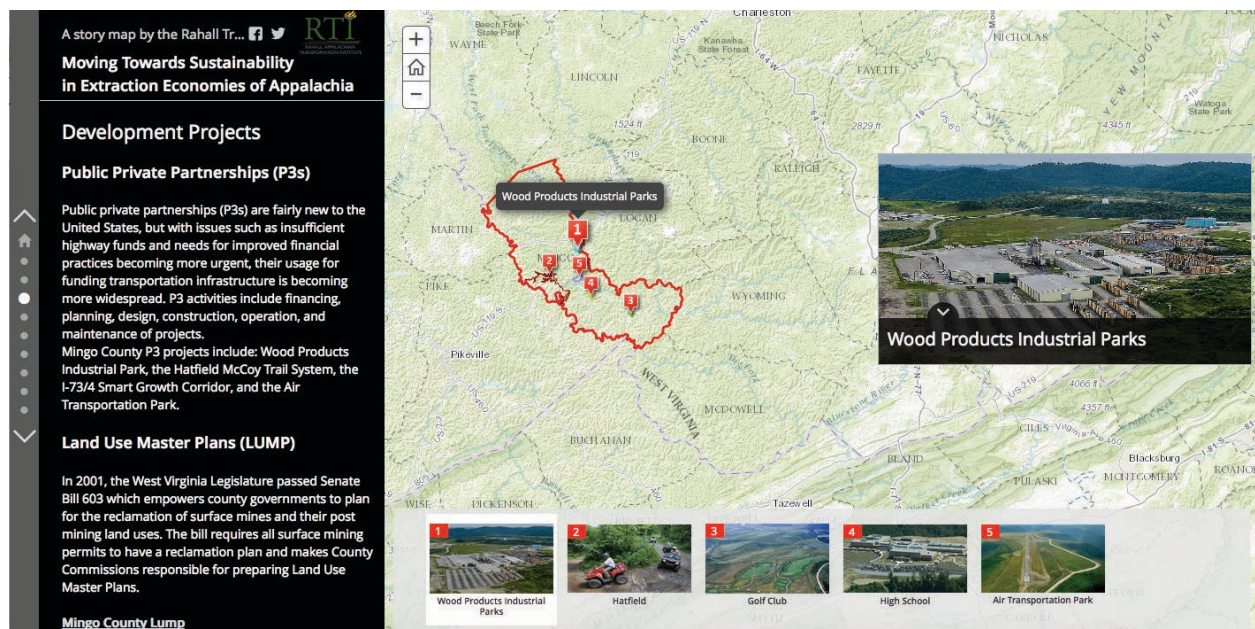- Story Map Tour℠
- Story Map Swipe℠

A choropleth map is a type of thematic map in which areas are distinctly colored or shaded to represent classed values of a particular phenomenon. This type of data visualization is appropriate for displaying normalized data such as rates (Esri, 2016). In this story, a choropleth map (Figure 2) is used to help viewers envision the rates of poverty, diabetes prevalence, and adult obesity in Mingo County. It also allows for comparison of these rates among the other counties in West Virginia.

Figure 2: RTI's GIS Story Map Choropleth
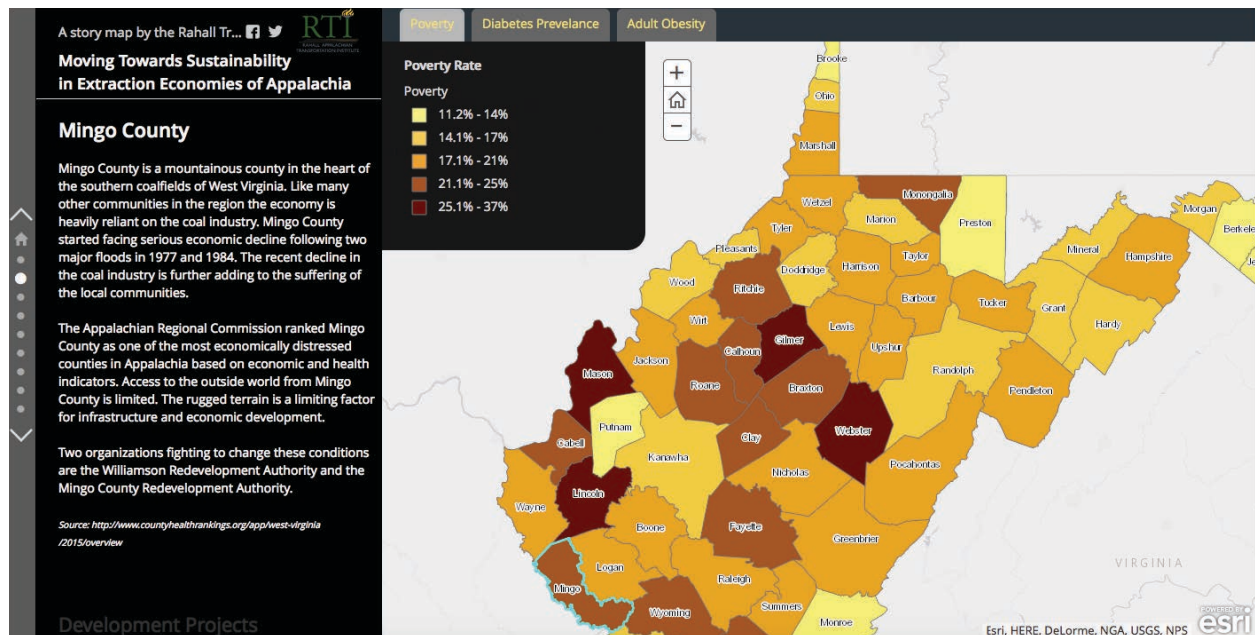
A Story Map Tour℠ presents a series of geotagged photos linked to an interactive map. This style of map is ideal for showing the location of the various development projects in relation to each other and the county. RTI's Story Map Tour℠ (Figure 3) shows the location of various development projects in Mingo County, West Virginia.

Figure 3: RTI's GIS Story Map Tour℠

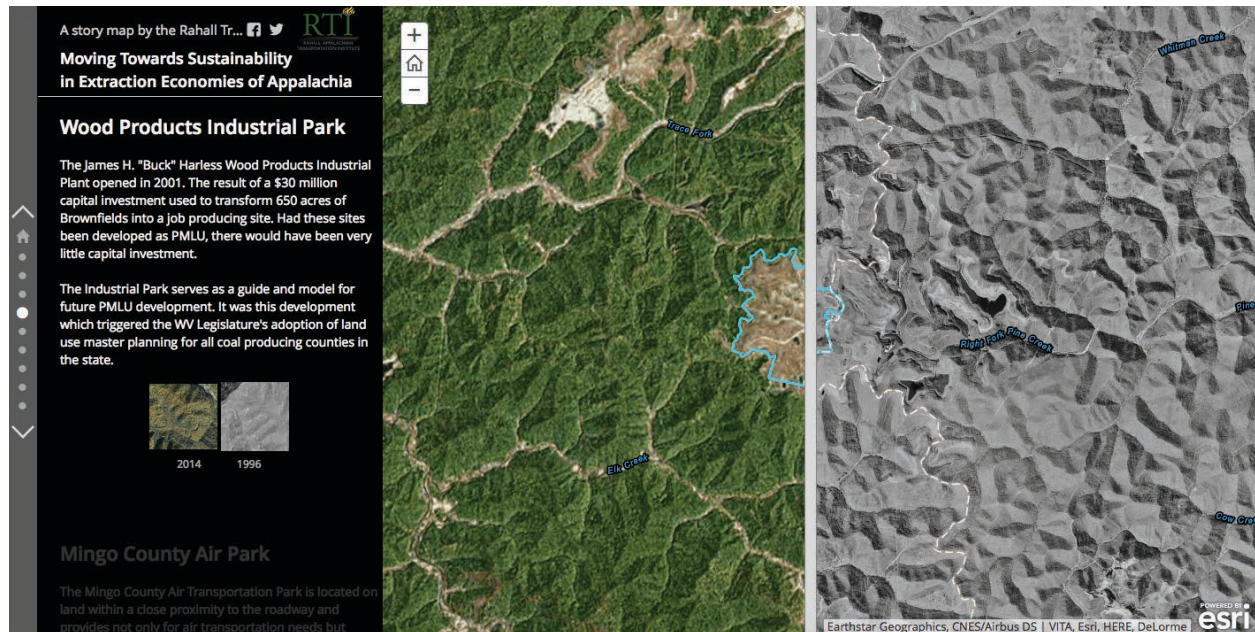The Story Map Swipe℠ app displays two separate layers in the same window. Users can slide the swipe tool back and forth to compare one map to the other. RTI's story uses satellite imagery

from two years, 1996 and 2014, to illustrate changes in land cover/land use at the Wood Products Industrial Park during that time period (Figure 4).

Figure 4: RTI's GIS Story Map Swipe℠

These maps are generally inserted into longer, textual reports as supporting figures or appendices. The GIS Story Map offers a more interactive and user-friendly method to view data. This technique brings a more artistic element to the analysis and visualization of data that is intuitive to a viewer. An effective narrative map requires an iterative process to identify the plotline, the data, and the visual components of the story (Lapum et al., 2015). The story map application combined RTI's maps, pictures, and text holistically to tell an engaging story about one county's economic challenges and achievements. The ability to link to outside websites and reports gives the user the option to easily explore the topic at greater length and potentially engage stakeholders in subsequent P3 participatory planning processes in West Virginia.

4.1.7 Outcomes

Both the 166-page report, *Potential Economic Benefits of Public-Private Partnership (P3s) on Reclaimed Mine Sites in the Construction of the I-73/74 NHS Corridor* and the resulting GIS Story Map effectively conveyed the economic benefits of using P3s for the construction of the I-73/74 NHS Corridor in West Virginia. The study provided strong empirical evidence of the economic importance of using P3s for facilitation and construction of future sections of the I-73/74 NHS Corridor. The results showed that the corridor can be vital for the economic development in the study region and more P3 options should be considered for transportation infrastructure investment in West Virginia and abroad. In addition, the GIS Story Map provides a highly visual and interactive digital tool that effectively summarizes the study for non-technical

audiences. The GIS Story Map could be effectively used by WVDOT or other transportation agencies and planning entities to engage stakeholders in future participatory planning processes when considering P3s to finance transportation infrastructure projects.

Because the resulting GIS Story Map was so compelling and impactful, the Marshall University RTI research team submitted it to ESRI's 2016 International Storytelling with Maps contest. Marshall University won third place in the "Best Infrastructure, Planning, and Government Story Map" category (www.Esri.com/landing-pages/story-maps/2016-contest-winners).

4.2 IPA, University of Delaware: Using GIS Story Maps to Empower Local Governments to Plan for Complete Communities in Delaware
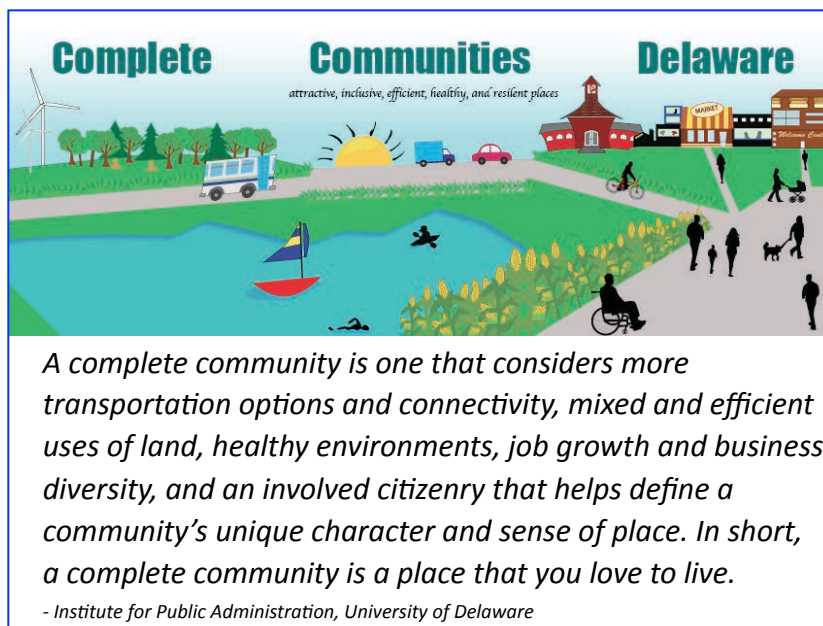
4.2.1 Background

Established in 1973, the Institute for Public Administration (IPA) at the University of Delaware is a research and public service center within the School of Public Policy & Administration (SPPA). Transportation policy and land-use planning are among IPA's research and public service activities. IPA works in cooperation with the Delaware Office of State Planning Coordination (OSPC) to provide technical assistance and training to assist Delaware local government officials prepare for future growth and development. Delaware local governments are required by state law to undertake a comprehensive planning process to provide a blueprint for land use and future growth and as a guide in decision-making about the built and natural environment. The outcome of comprehensive planning is the comprehensive plan, which dictates public policy in terms of land use, transportation, environmental and natural resource preservation, recreation, and housing.

In addition, IPA conducts applied research on critical transportation policy and planning issues in partnership with the Delaware Department of Transportation (DelDOT) and the Delaware Center for Transportation (DCT). Research has focused on the resiliency of transportation systems, impacts of climate change, integrating land-use planning with transportation, enhancing multi-modal transportation systems, advancing mobility management and specialized transportation options, and planning for complete and healthy communities.

In the last half-century, unsustainable patterns of development have limited transportation choices, opportunities for active recreation, healthy lifestyles, and access to healthy foods. Inactivity and sedentary lifestyles have contributed to skyrocketing healthcare costs, chronic obesity, and related diseases. To address the need for local governments to plan more prosperous and livable communities, IPA began working collaboratively in 2012 with OSPC and DelDOT on an integrated approach to transportation planning, land-use planning, and community

design—called Complete Communities. The project explored how to build planning capacity of Delaware local governments to advance the state's fiscal health, economic competitiveness, and efficient service delivery. The scope of work included the development of a comprehensive outreach strategy, a focused literature review of Delaware planning initiatives and national best practices, identification of characteristic elements of Complete Communities, a series of facilitated workshops, and a statewide forum. Based on an assessment and synthesis of this information, IPA developed an approach in partnership with DelDOT and OSPC, which was detailed in a 2012 report titled, *Formulating a Framework to Plan for Complete Communities in Delaware* (Scott et al., 2012).

Figure 5: IPA's Definition of a Complete Community

A complete community is one that considers more transportation options and connectivity, mixed and efficient uses of land, healthy environments, job growth and business diversity, and an involved citizenry that helps define a community's unique character and sense of place. In short, a complete community is a place that you love to live.
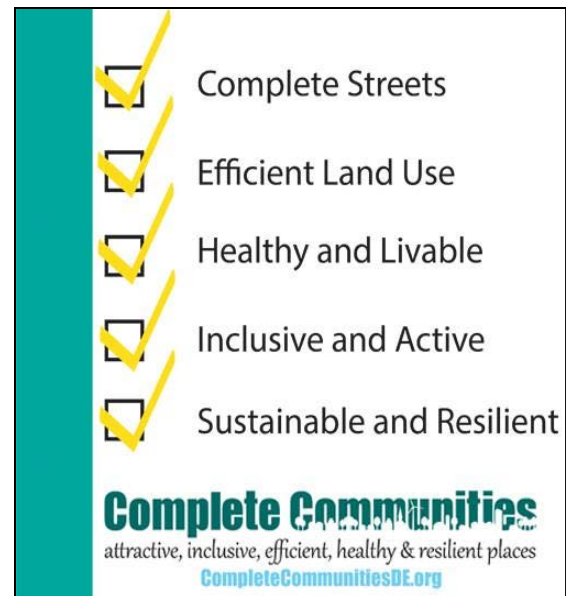- *Institute for Public Administration, University of Delaware*

In collaboration with planning stakeholders, IPA crafted a definition and identified five elements of a complete community: (1) Complete Streets, (2) Efficient Land Use, (3) Healthy and Livable, (4) Inclusive and Active, and (5) Sustainable and Resilient. In 2014, IPA launched an online *Delaware Complete Communities Planning Toolbox* (www.completecommunitiesde.org) as a resource for community leaders and local government officials to utilize:

- Complete-communities planning approaches, categorized by the five identified elements
- Community-design tools to create places that are dynamic and reflect community changes, oriented toward people not cars, reflective of a town's architectural and cultural heritage, visually attractive and enjoyable, accessible and inclusive, and economically vibrant.

- Public-engagement strategies to actively engage citizens and strengthen their involvement in community visioning and planning, creating durable social networks, and preserving the culture of a community. Early and continuous public involvement ensures that decisions reflect public needs and interests, consider diverse viewpoints and values, and are made in collaboration and consensus with all stakeholders.

The website is designed to be visually appealing to build local government capacity to develop complete communities planning approaches, implementation tools, and community engagement strategies. The online toolbox is designed to

Figure 6: Five Elements of a Complete Community

advance a complete communities-policy framework to help communities plan for and manage growth, consider benefits of better community design, spur reinvestment in older communities, protect natural and environmental resources, understand the connection between land use and transportation planning, promote placemaking as an economic development strategy, combat sprawl, and make more efficient use of limited funds for growth-related needs.

4.2.2 GIS Story Maps: Visual Tools to Communicate Elements of Complete Communities

In FY 2015, IPA initiated a project to strategically promote and disseminate the toolbox. Work tasks focused on enhancing web presence, tracking web performance, advancing Toolbox promotion techniques via community engagement and a robust social media campaign and enhancing content presentation by improving visual tools to further explain/promote Toolbox concepts. The development of a series of GIS Story Maps was planned to provide interactive visual tools that showcase best practices of complete-communities implementation strategies in Delaware (Pragg, 2015).

An IPA professional staff member, certified as a GIS Professional (GISP), had previously developed three GIS Story Maps to convey "Sustainable and Resilient" concepts within the Planning Tools section of the Toolbox (www.completecommunitiesde.org/planning/gis-story-maps/). However, as part of the MATS UTC project, IPA's research team tested Esri's claim that "ArcGIS Online facilitates data sharing without requiring a high level of technical expertise" (Esri, fall 2015). An IPA graduate research assistant with no prior formal GIS training or experience was assigned to produce a series of GIS Story Maps from a non-user perspective. To gain the necessary skills, the graduate research assistant enrolled in Esri's Virtual Campus

courses, explored story map tutorials, visited Esri's blog posts, and attended a Delaware FirstMap Map Seminar. Delaware FirstMap is an online portal to Delaware's publicly available spatial data, which provided the source for GIS basemaps used within each GIS Story Map. The research assistant also established a free ArcGIS Online Public Account before downloading GIS software. While anyone can make a free public account, Esri explains, "an ArcGIS public account is a personal account with limited usage and capabilities and is meant for non-commercial use only" (Esri, n.d.).

4.2.3 Creating a Series of GIS Story Maps to Illustrate Implementation of Complete Communities-Planning Tools Best Practices

ArcGIS Online offers multiple configurable apps to enhance a viewer's experience with interactive maps. As Esri further explains, "choosing a few options, you offer your users a focused experience for interacting with your map." IPA's research team identified a clear purpose (topic) that aligned with each of the five elements of a Complete Community that organize the Planning Tools section of the Toolbox. The intended audience for both the Toolbox and GIS Story Maps is local government officials, community leaders, and "citizen planners" (e.g., volunteer planning commission members). As suggested by Esri, the design of each proposed story map considered the need for functionality (i.e., ease of use), aesthetics (i.e., visual appeal), and visual elements (e.g., pop-ups or feature layers) that would enhance the story by displaying additional multimedia features. As a result, five GIS Story Maps were created to illustrate the implementation of "best practice" concepts for each of the five elements of a complete community. IPA's research team utilized multiple template formats to explore and compare advantages and disadvantages of each GIS template that was available as of fall 2015 to spring 2016.

*Complete Communities Element 1: Complete Streets*

Complete Streets are [transportation] systems that are designed, built, and maintained to safely accommodate travelers of all ages and abilities—motorists, pedestrians, bicyclists, and public-transit users—including children, non-drivers, older adults, and persons with disabilities (AARP, 2008). One strategy for developing complete streets is utilizing context-sensitive solutions. Context-Sensitive Solutions (CSS) is a *"*collaborative, interdisciplinary approach that involves all stakeholders in providing a transportation facility that fits its setting. It is an approach that leads to preserving and enhancing scenic, aesthetic, historic, community, and environmental resources, while improving or maintaining safety, mobility, and infrastructure conditions" (Center for Transportation and the Environment, 2007). This concept discounts a "one-size-fits-all" design of roads and streets. CSS strives to achieve flexible and creative transportation plans, designs, and programs.

The structure for the Context-Sensitive Solutions GIS Story Map, which may be accessed at http://arcg.is/1OBT9Ix, is the tabbed Story Map Series℠ app. This template is well suited for combining multiple maps to support the narrative. While the same basemap was used throughout the story map, each separate tab describes four "best practice" CSS projects in Delaware. Each example considers both the existing and future context of transportation and land use as well as the CSS designed to be in harmony with an area's history, environmental resources, and aesthetics. For example, the Brandywine Valley National Scenic Byway (BVNSB) leads travelers along state routes (SR) 100 and 52 through picturesque northern New Castle County, from Rodney Square in Wilmington to the Delaware-Pennsylvania state line. Its "historic sites, magnificent estates, glorious gardens, and mesmerizing museums" emphasize the byway's national significance attributed to three centuries of American industrial history, including water-powered mills and the Port of Wilmington" (DelDOT, n.d.).

The BVNSB GIS Story Map explains how CSS was achieved to emphasize a historically significant area while maintaining aesthetics and travelers' safety. It explains CSS measures were taken to preserve roadside vegetation and mature trees by moving utility poles farther from the road to moderate traffic speeds and enhance roadway safety. The story map tab provides a pushpin that provides location of the byway, a narrative that explains the CSS concept, and photographs of historic sites.

Figure 7: IPA's Context-Sensitive Solutions GIS Story Map uses the tabbed Story Map Series℠ series – Tabbed Layout app.
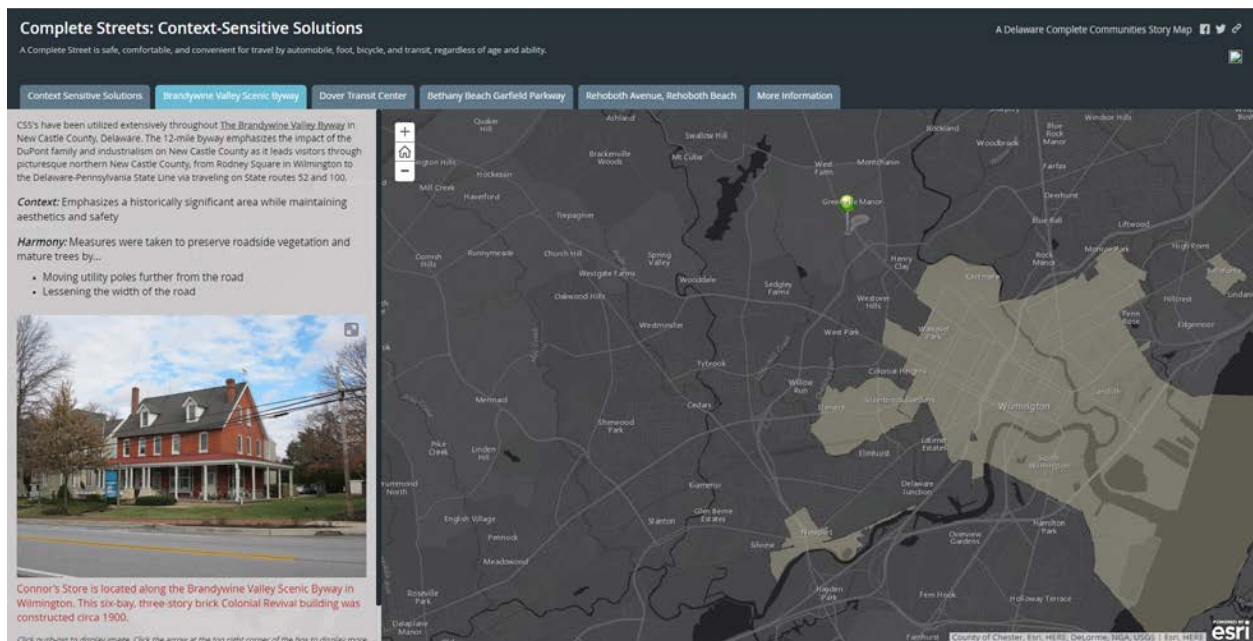
The Story Map Series℠–Tabbed Layout app was used to present a series of maps by advancing through a set of tabs on a top menu bar. The "main stage," or primary area of content, features a

map with pushpin to denote the location of a CSS project in Delaware. A description panel, to the left of the main stage map, provides space for a narrative description, images, and other content associated with each map. One drawback to this layout, however, is that the description panel does not provide sufficient space for large images or charts. While hyperlinks can be inserted to allow viewers to obtain more information about the context, clicking on a hyperlink will take the viewer away from the GIS Story Map, which is not ideal. Therefore, a larger or expandable description panel would be better.

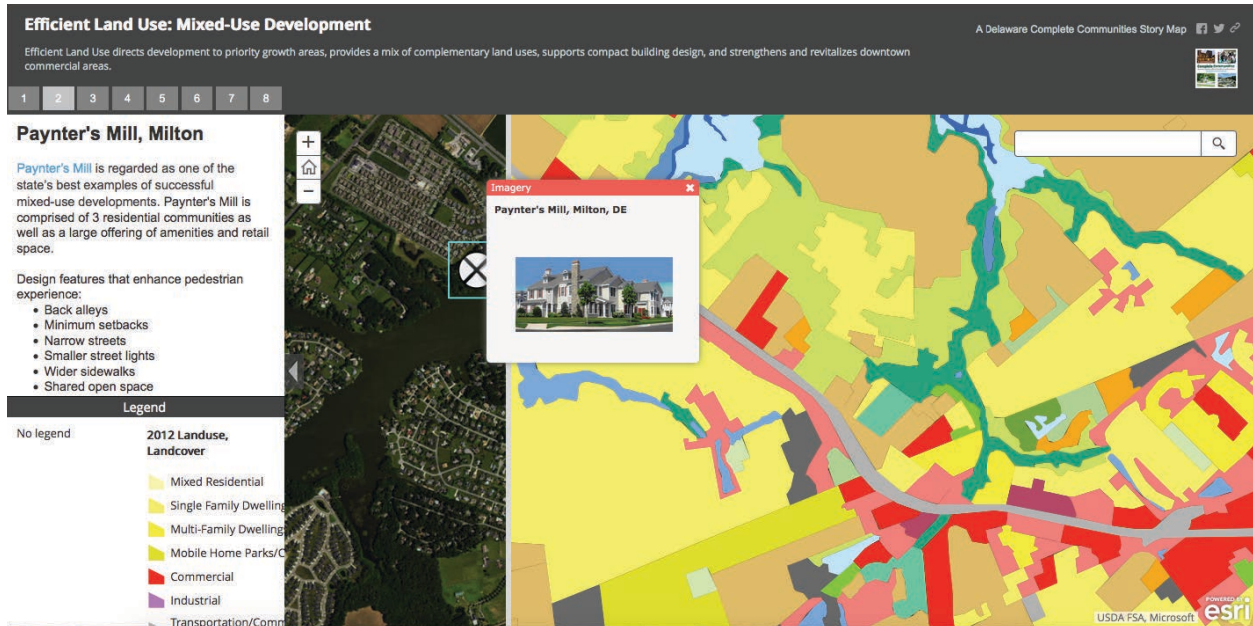### *Complete Communities Element 2: Efficient Land Use*

Efficient land use is a foundation of the *Delaware Strategies for State Policies and Spending,* which provides a policy framework for planning in Delaware. It is designed to guide and encourage efficient land-use patterns by coordinating local government land-use actions with state infrastructure and service delivery (OSPC, 2016). Efficient land use is the antithesis of sprawling land-use patterns. Local governments can achieve efficient land use by developing comprehensive plans and implementing "land-use policies that promote higher densities and mixed-use type development in appropriate areas such that complete communities can be developed—places where people could live, play, work, and shop" (OSPC, 2016, p. 19).

Mixed use is one of the ten principles of Smart Growth, a planning strategy that seeks to foster community design and development that serves the economy, community, public health, and the environment. Mixed-use development is characterized as pedestrian-friendly development that blends two or more residential, commercial, cultural, institutional, and/or industrial uses (MRSC of Washington, 2015). Adopting a regulatory framework that supports mixed-use development can help local governments better respond to a growing market demand for walkable, vibrant communities with convenient transit linkages, proximity to jobs, and access to nearby public services and spaces and activity-oriented destinations.

IPA developed a Mixed-Use Development GIS Story Map (Figure 8) to illustrate its use as a planning tool to achieve efficient land use. It can be accessed at http://arcg.is/1WWxGsY. IPA used Esri's Story Map Swipe℠ app, which enables viewers to compare two web maps, or two layers of a single map, by sliding a swipe tool back and forth. IPA's Mixed-use Development GIS Story Map enables a viewer to compare land use (right side of swipe tool) to aerial imagery (left side of tool) while learning about best-practice examples in Delaware. By clicking through each tab, a viewer can interact by zooming in on mixed-use development locations that are denoted by push-pins. The viewer can also see a larger image of the mixed-use development project, while swiping across to look at both aerial imagery and the designated land-use (or zoning) classification.

An advantage of this format is that it automatically builds a tool for analysis into the template. Since maps are the main focus of this template, one disadvantage is that it does not provide adequate space for a detailed narrative. IPA's research team was unable to include additional or larger pictures with captions to showcase mixed-use developments explained in the description panel. Although words can be hyperlinked to an outside website, picture, or video, the format does not enable pictures or charts to be displayed in the description panel.

*Figure 8: IPA's Mixed-Use Development GIS Story Map uses Esri's Story Map Swipe℠ app.*

Complete Communities Element 3: Healthy and Livable

Research suggests that the physical design of the built environment (e.g., homes, schools, workplaces, parks/recreation areas, business areas, and transportation infrastructure) can impact the health and livability of a community. A healthy and livable community is one that has affordable and appropriate housing, supportive community features and services, and adequate mobility options, which together facilitate personal independence and the engagement of residents in civic and social life. Planning for "aging-friendly" communities is one component of building a healthy and livable community. Aging-friendly communities are residential or mixed-use developments that provide affordable, accessible housing, multiple modes of transportation, access to community services, and community-engagement opportunities for older adults.

IPA's Planning for Aging-Friendly Environments GIS Story Map uses the Story Map Series℠ – Tabbed Layout app to illustrate where aging-friendly strategies and local regulations support aging in community in Delaware. The map can be accessed at http://arcg.is/1QfAOld.

The GIS Story Map harnesses U.S. Census data to provide visual representation of areas with concentrations of older adults (median ages of 52 years or older) living within census tracts in Delaware. The map (Figure 9) depicts clusters of older adult populations in dark blue. The GIS Story Maps show two specific geographical areas with high concentrations of older adults where "village-model" communities have been organized. By exploring the GIS Story Map content, viewers can better understand benefits of aging-friendly environments, two examples of village-model" communities, and the use of accessory dwelling units as a regulation that allows for affordable and supportive housing options for older adults.

Figure 9: IPA's Planning for Aging-Friendly Communities GIS Story map uses the Story Map Series℠ series – Tabbed Layout app.
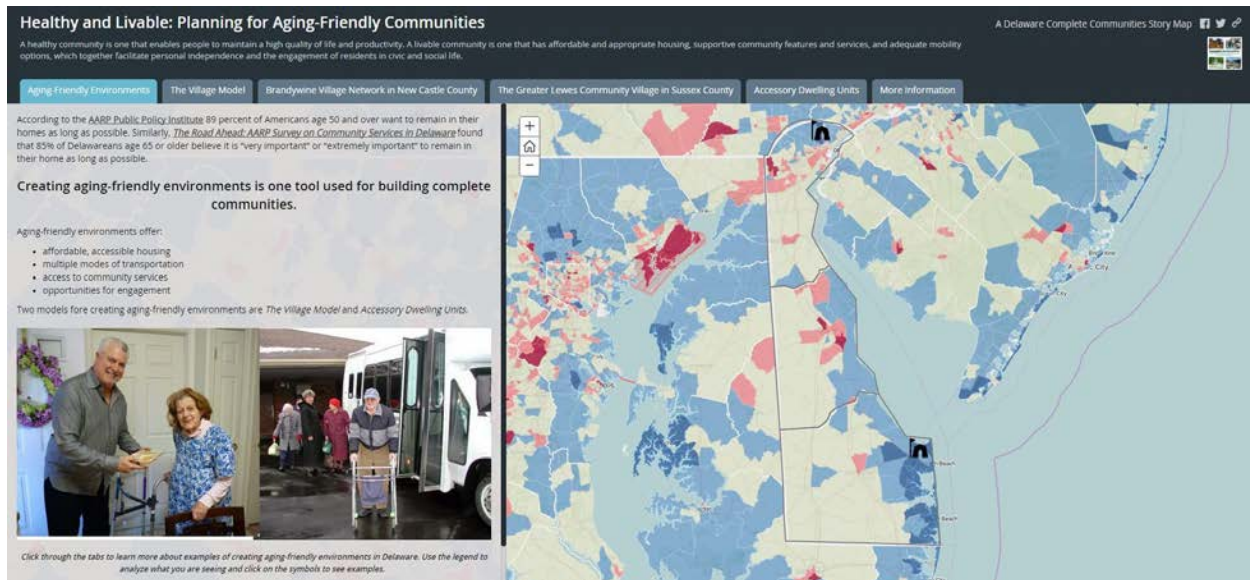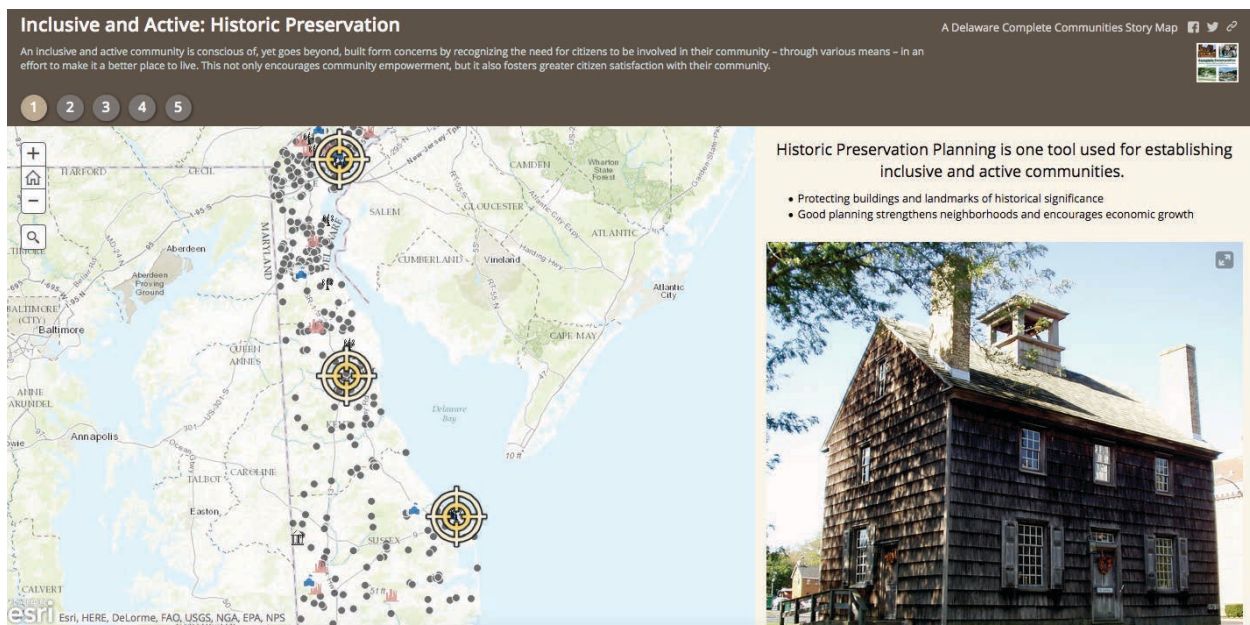

Complete Communities Element 4: Inclusive and Active

An inclusive and active community is conscious of, yet goes beyond, built-form concerns by recognizing the need for citizens to be involved in their community in an effort to make it a better place to live. This not only encourages community empowerment, but it also fosters greater citizen satisfaction with their community. Historic preservation planning is one tactic for encouraging an inclusive and active community. The National Trust for Historic Preservation describes historic preservation as the process of identifying, protecting, and enhancing buildings, places, and objects of historical and cultural significance. Historic preservation can build complete communities in Delaware by strengthening neighborhoods, fostering placed-based economic development, encouraging local economic growth, and conserving natural resources. Preservation-based economic development and heritage tourism are economic development strategies that are supported by the National Trust for Historic Preservation and advanced nationwide by Main Street communities.

IPA's Historic Preservation Planning GIS Story Map (Figure 10) uses the Story Map Series℠ – Bulleted Layout app to pinpoint locations of places designated by the National Register of Historic Places as cultural buildings, sites, structures, and districts in Delaware. Available at http://arcg.is/1LLSwVm, the GIS Story Map provides three Delaware best-practice examples of regulatory tools, historic renovation, and revitalization initiatives. The layout provides easy navigation to a series of maps, which are represented by numbered bullets on the top menu bar. However, the viewer needs to hover over each number to see the title of the map that will be viewed next. An optional description panel allows text and other multi-media content associated with each map to be presented. Although a map legend was provided, viewers need to scroll to the bottom of the description panel to see it.

Figure 10: IPA's Historic Preservation Planning GIS Story Map uses the bulleted Story Map Series℠ app.

Complete Communities Element 5: Sustainable and Resilient

While there are various definitions, a sustainable community is one that is economically, environmentally, and socially healthy and resilient (Institute for Sustainable Communities, 2016). Sustainable communities are communities planned, built, or modified to promote sustainable living. This may include sustainability aspects relating to conservation of natural resources, water, transportation, energy, waste, and materials. They tend to focus on environmental sustainability (development and agriculture) and economic sustainability. Healthy and vibrant downtowns are critical components of Delaware's economic well-being and quality of life. To help Delaware downtowns and neighborhoods become vibrant and healthy places,

Downtown Development Districts (DDDs) were authorized by the Delaware General Assembly authorized legislation in April 2014 to:

- Spur private capital investment in commercial business districts and other neighborhoods.
- Stimulate job growth and improve the commercial vitality of such districts and neighborhoods.
- Help build a stable community of long-term residents by improving housing opportunities.
- Assist municipalities in strengthening neighborhoods while harnessing the attraction that vibrant downtowns hold for talented people, innovative small businesses, and residents from all walks of life (OSPC, 2016).

Three jurisdictions (Wilmington, Dover, and Seaford) applied to become and were designated as DDDs in 2015. As a result of the initial funding round in 2015, $9.7 million in grant funding leveraged more than $160 million of private investment within the designated DDDs (State of Delaware, 2016).

IPA's research team was enlisted by Delaware's OSPC and the Delaware State Housing Authority (DSHA) to develop a GIS Story Map to highlight the success of the program's inaugural year. A modified Story Map Journal℠ app was used to produce IPA's Downtown Development District GIS Story Map (Figure 11), which can be viewed at http://arcg.is/208FjmV. The template provided the ideal format to explain how first-year program outcomes spurred private capital investment, stimulated job growth, improved commercial vitality, built stable communities, improved housing opportunities, and generated business attraction in each district.

The story map product combines narratives, photographs, maps, videos, graphs, and hyperlinks to direct sources of information to boost viewers' understanding of the DDD program and favorable economic impacts to each community and state of Delaware. Inspired by an Esri blog post, IPA embedded multiple Story Map Swipes within the Story Map Journal to amplify the amount of information displayed within each tab (Szukalski, 2016). For example, Figure 11 provides colored-coded stars to denote the location and type of residential, commercial, and mixed-use "large development project" grants that were awarded in Wilmington in 2015. Within this tab, viewers can also use the swipe tool to compare a street map view (left) to a satellite imagery view (right.) By clicking on the plotted colored stars, viewers can see an image of the development and learn the project's name, address, and type of development.

Figure 11: IPA's Downtown Development District GIS Story Map uses Esri's modified Story Map Journal℠ app.
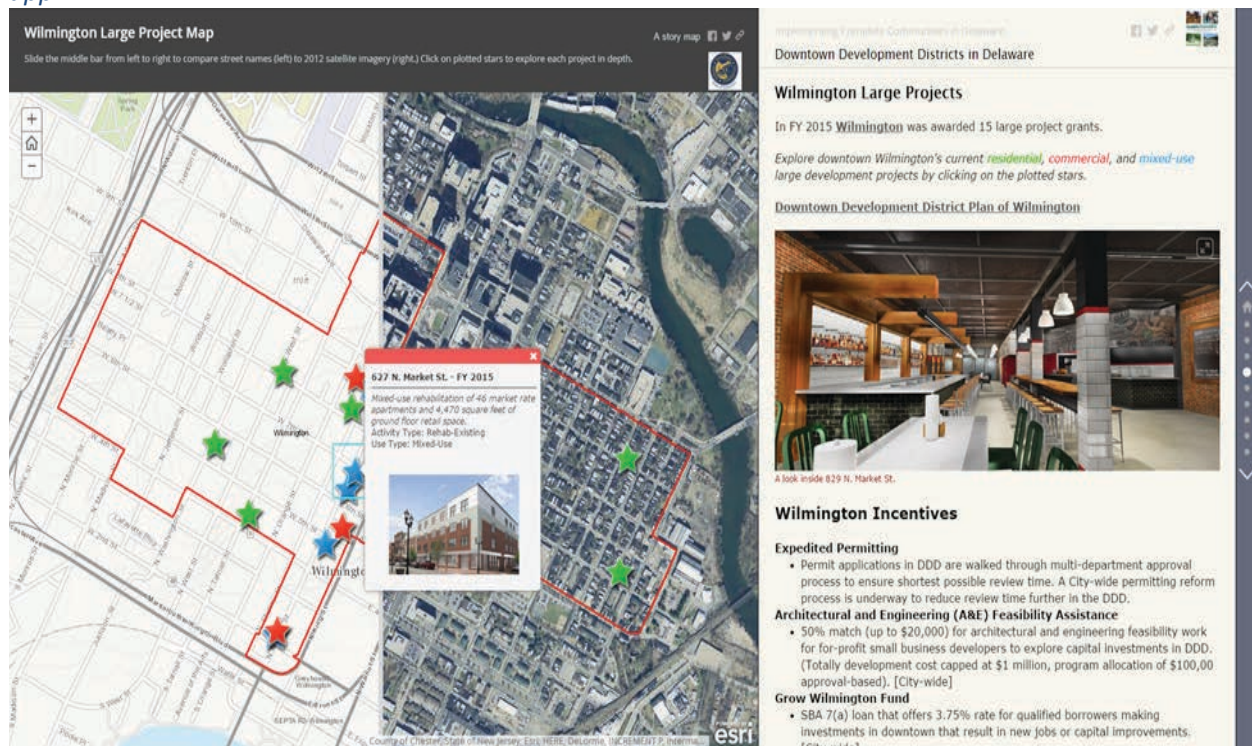
4.2.4 Outcomes

During the project period, five GIS Story Maps were successfully produced and disseminated within IPA's online Delaware Complete Communities Planning Toolbox. This is impressive especially given that the graduate research assistant assigned to the project lacked prior GIS skills prior to the project. It affirms that individuals with no GIS experience can master the technology and create visually appealing tools that are citizen-focused. As a testament to the quality of the map-based storytelling products, the research assistant was the only student selected to present at the 2016 Delmarva GIS "Going Viral" Conference in Dover, Delaware, on April 14, 2016. A GISP practitioner from Delaware OSPC, who attended the event and provided input on the DDD GIS Story Map, remarked that based on the quality of the work she would not have known that the student was a GIS novice.

In addition, each GIS Story Map effectively provided context to complex planning concepts, such as the application of Context-Sensitive Solutions in Delaware. Map-based storytelling on multifaceted topics such as aging-friendly communities, historic preservation, and mixed-use development provided concrete examples of regulatory practices being adopted by Delaware local governments. These examples can engage other local government "citizen planners" and support informed decision-making to advance sustainable land-use patterns and practices.

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In addition, the Delaware DDD GIS Story Map shows the potential for the technology to be integrated in social media and other public-engagement campaigns to support informed decision-making (i.e., as to whether a Delaware municipality should apply for DDD designation). The Delaware DDD GIS Story Map was featured in an August 2016 announcement by Delaware Governor Jack about the expansion of the program and designation of five new DDDs in Smyrna, Milford, Harrington, Laurel, and Georgetown. Delaware OSPC's web page on DDDs (www.stateplanning.delaware.gov/ddd/) provides a clickable tab that allows visitors to view the GIS Story Map to learn more about the program's success in driving investment into downtown areas, creating jobs, and building sustainable urban communities.

Figure 12: IPA's DDD Story Map is featured on the website of Delaware's Office of State Planning Coordination.

IPA is also moving forward with plans to organize and optimize viewing of its compendium of GIS Story Maps. IPA's project team created a "grid" application to display its GIS Story Maps in a gallery, tagged with key words, called "Implementing Complete Communities in Delaware" (see: goo.gl/FSl6fd). Each GIS Story Map within the gallery has a description and hyperlinked image that opens for viewing when clicked.

Figure 13: Gallery of IPA GIS Story Maps (goo.gl/FSl6fd)
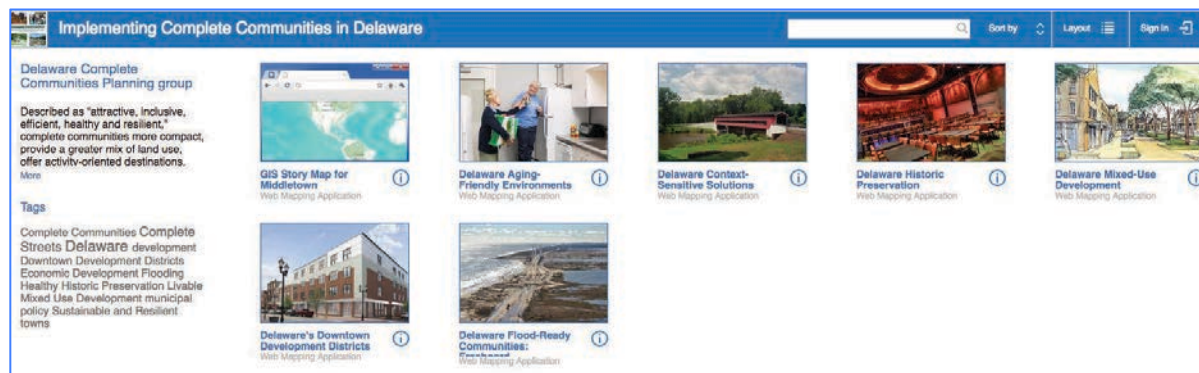
In addition, IPA's GIS Story Maps are featured on the gallery of FirstMap Delaware at goo.gl/XvgRlC. The gallery provides a collection of maps and applications relating to the functions of Delaware state government. The FirstMap Delaware website is part of Delaware's Open Data Portal (https://data.delaware.gov/), which provides location-based data, is mapped in GIS, and is available for export.

*Figure 14: IPA's Story Maps on the FirstMap Delaware Gallery*
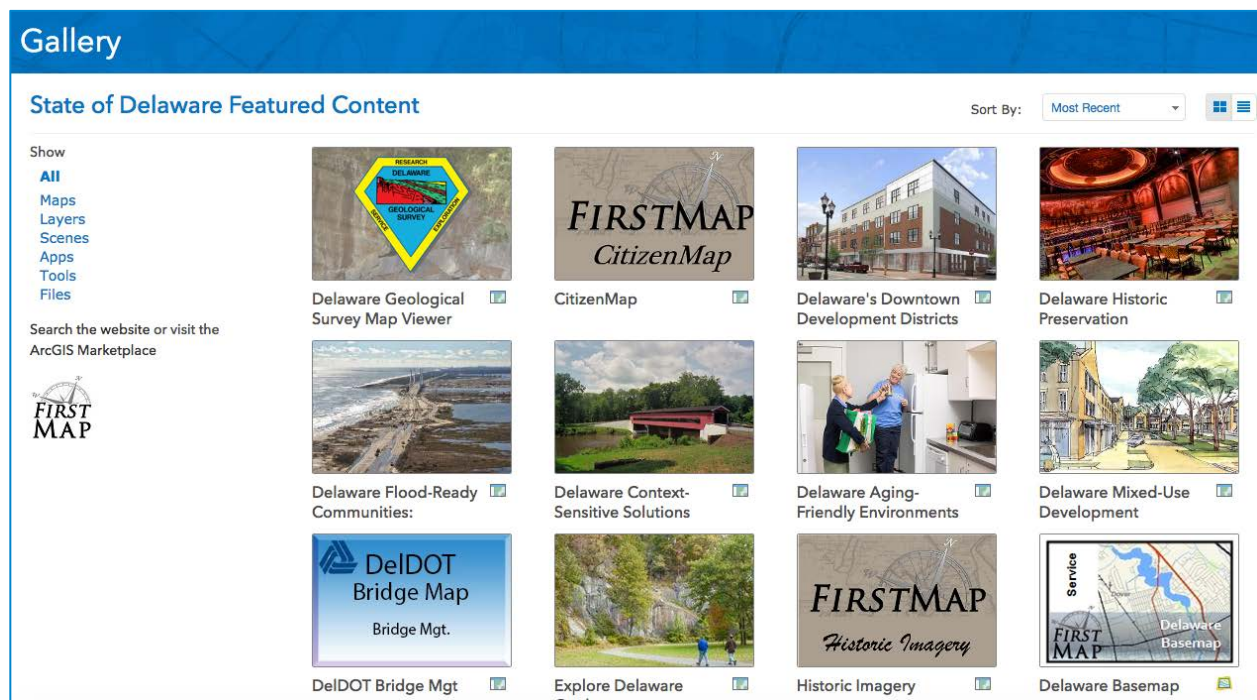
IPA's *Planning for Complete Communities in Delaware Toolbox* maintains a strong social media presence. To heighten awareness of the use of GIS Story Maps, a small image (thumbnail), link to map, and brief description are posted social media. When viewers share story maps using the

Twitter and Facebook buttons, their post will automatically use the title, summary, and thumbnail.

*Figure 15: Complete Communities Facebook Post*

Figure 16: Complete Communities Twitter Post
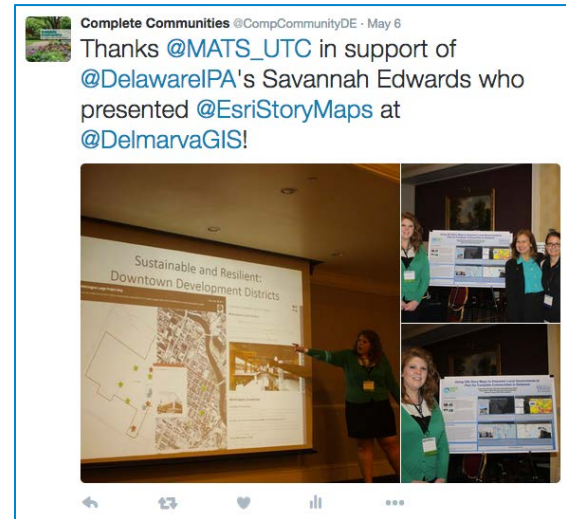
Moving forward, IPA will upload and disseminate all visual tools—including GIS Story Maps—within a new section of the Delaware Complete Communities Toolbox (www.completecommunitiesde.org).

Figure 17: Planned Visual Tools Section of the Delaware Complete Communities Planning Toolbox
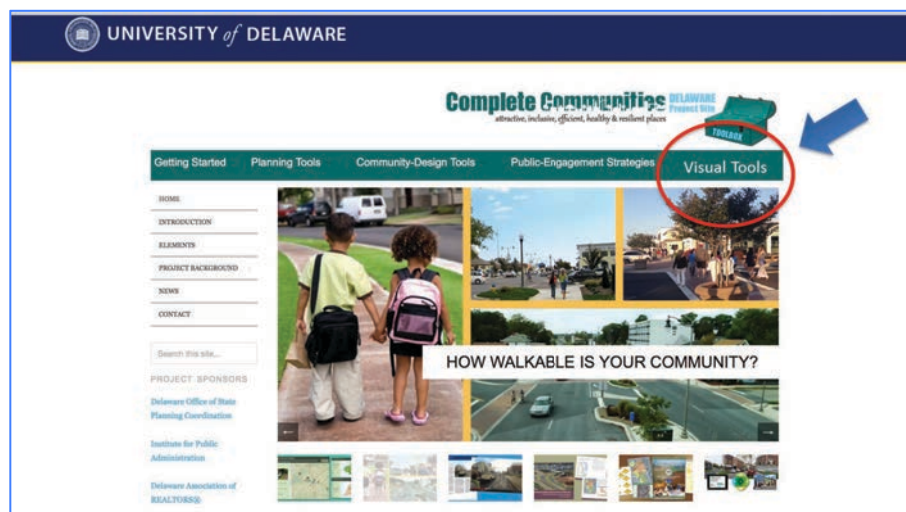
5. Summary and Conclusions

5.1 Lessons Learned

As the old adage says, "A picture is worth a thousand words." Maps are a time-tested way for government entities to convey public information and educate citizens. Map-based storytelling provides new opportunities to engage stakeholders in participatory planning processes. Because GIS Story Maps combine map-based data and tools with the new technologies, they deliver geospatial information in a simple, interactive, and user-friendly way. Enriched with multimedia content, amplified by digital platforms (e.g., the web, the cloud, and mobile devices), and powered by data visualization, GIS Story Maps provide an ideal framework for public interaction, communication, and meaningful engagement. The high-impact visual content that is generated via storytelling with maps can be used for "high-touch" and "high-tech" participatory processes, especially when advanced as part of a comprehensive public-engagement strategy. Because the technology has "gone viral," GIS Story Maps can be viewed anywhere and anytime on a mobile device that has Internet access. Government officials and stakeholders can analyze data, derive information, and interact with the technology to shape public policies, make informed decisions, and generate public discourse on critical planning issues impacting a community.

Moreover, Esri's online map-based storytelling apps and templates have made GIS Story Maps a low-cost, accessible digital engagement tool. The RTI and IPA research teams tested Esri's premise and proved that both highly skilled-GIS professionals and others with limited geospatial knowledge and experience can create visually appealing and effective GIS Story Maps. Seasoned GIS practitioners and GIS rookies with minimal training can harness the power of maps with multi-media content to engage stakeholders in planning for transportation and land-use sustainability. To become proficient, non-GIS users simply need to use a free, non-commercial ArcGIS public account or an ArcGIS subscription account. Once registered, Esri provides a Story Map Tour builder with step-by-step instructions to create a GIS Story Map. In addition, Esri's story-telling community provides inspiration to new users by uploading examples within an online Story Maps Gallery.

The major takeaway is that GIS Story Maps should be explored further and utilized by transportation and land-use planners as a tool to empower and engage stakeholders in transportation and sustainability planning. GIS is evolving from an environment that is strictly proprietary to a more open system that allows a community of geospatial developers and users to access and use geographic data. With greater access to open-source data, web-based GIS Story Maps have the potential to incorporate crowdsourced data, social media, and other methods of online public engagement. Planners, engineers, and academics need to strengthen alliances, build

databases of geographic data, and form communities of users to advance the use of GIS Story Maps in public-engagement processes.

5.1.1 Esri's GIS Story Map Nuances

Access to Esri's online resources and application templates was beneficial to both the GIS-proficient RTI research team and the non-GIS-skilled IPA research team. Esri has effectively created a large community of users that can connect via an online forum. Through this virtual venue, both experienced GIS users and neophytes can share their map-based storytelling experiences. Esri's online GIS Story Map Gallery provides inspiration and enables prospective users to search mapping products by either story map app or subject. In addition, Esri's Story Maps team provides technical support, training seminars, and blogs to ensure success and demonstrate how industry communities (e.g., local government, state government, transportation) are using the technology.

From fall 2015 to spring 2016, when each research team was developing GIS Story Maps, five GIS Story Map apps templates were made available by Esri. The research teams experienced some limitations using the app templates. For example, an app template may restrict the user from uploading and displaying unique branding images, logos, and links. Non-skilled GIS users may also lack access to open data. Needed spatial data (or basemaps) may not be publicly available. Moreover, although GIS Story Map app templates are free to non-commercial ArcGIS public account users, this classification prevents a user from accessing premium data, publishing data, performing analysis, setting up enterprise-wide use, or customizing app templates. The ability to create a highly interactive and visually appealing story maps may require additional coding. Codes can be downloaded and modified via GitHub if the author has any developing experience (GitHub, Inc., 2016). Modifying codes allows for more personalization and visually appealing layouts. Yet, this skill is beyond the technical capabilities of most non-skilled GIS practitioners, local government officials, citizen planners, and academicians—including undergraduate and graduate students.

Furthermore, most templates require the author to have an additional account with Flickr, an online visual-image management and sharing application. Existing templates require users to upload photographs by logging into a Flickr account then selecting image(s) from an individual album. This could potentially deter users who are not familiar or comfortable registering for a public photo-sharing interface. Esri's new template, Story Map Cascade℠[1] addresses this problem by allowing users to directly upload photos and image files from their desktop.

[1]Story Map Cascade℠ is one of Esri's new story map templates that was not used by the RTI-IPA research teams.

5.1.2 Esri's New GIS Story Map App Templates

Esri encourages app developers, advanced GIS users, its GIS Story Map team, and its large communities of users to create customized story maps, develop prototype designs, and share results. Updates and enhancements to ArcGIS Online have been generated from spin-offs of customized versions with favorable user experiences. For example, the Esri's new Story Map Shortlist℠ app template was previously only available as a source code download that required self-hosting. It is now hosted in ArcGIS and features an interactive builder for authoring.

In addition to the new Story Map Cascade℠ and Story Map Shortlist℠ apps, Esri released a third app beta template in summer 2016—the Story Map Crowdsource℠. Crowdsourcing describes a process of leveraging the skills, ideas, talents, and energy of a large group of people to innovate, create content, or solve problems. "Through crowdsourcing, organizations can solicit skills and ideas from a large group of people, such as the online community, to generate content, products, or financing" (Goodrich, 2013). Esri's new Story Map Crowdsource℠ app is ideal for engagement processes as it enables users to publish and manage a crowdsourced story where viewers can contribute photos with captions. In addition, contributors can specify, or "geo-locate," the location of a photograph by clicking the map to using a geotagged photo. With the introduction of its new GIS Story Map app templates, Esri has developed an online gallery (Figure 15) that simplifies the process of selecting an app and creating a story.

Figure 18: Esri's GIS Story Map App Template Gallery
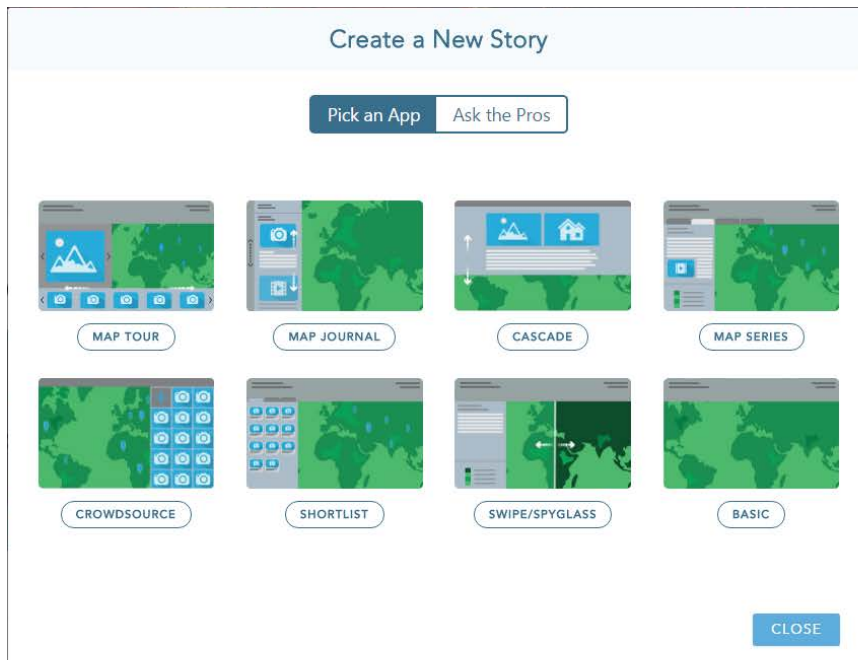
5.2 Conclusion

Public engagement continues to be transformed by the explosion of new digital technologies/tools, software platforms, social media networks, mobile devices, and mobile apps. Recent changes in geospatial technology offer new opportunities for use in participatory planning processes. Yet, civic tech as a movement and PPGIS as a discipline has somewhat lagged behind the proliferation of new digital tools that can be leveraged for public-engagement purposes. Further applied research is needed to explore the full potential of new digital tools and platforms in participatory planning processes "to leverage diverse sets of open data, big data, and geographic data to make comprehensive decisions" (Futrell, 2015).

5.2.1 Story Maps as Effective Public-Engagement Tools

Based on their positive experiences, the RTI and IPA research teams mutually conclude that GIS Story Maps can be an effective public-engagement tool. While neither team used the resulting GIS Story Maps as part of an active public participation process, both teams received favorable accolades from authoritative organizations and agencies. RTI's GIS Story Map received a 2016 International Storytelling with Maps contest award. IPA's series of Complete Communities GIS Story Maps were showcased at the 2016 Delmarva GIS Conference. The DDD GIS Story Map was used by the Governor's office and two state agencies to promote a state program. Moreover IPA's GIS Story Maps are showcased within its online *Delaware Complete Communities Planning Toolbox* (www.completecommunitiesde.org), which provides resources to build planning capacity of Delaware local governments, and promoted via its social media channels (e.g., Facebook and Twitter).

The RTI-IPA research team believes that public engagement needs to be reimagined to respond to the expectations and demands of an evolving digital culture. Continued advancements in the digital technology landscape—including web-based, interactive GIS—will propel the framework and trajectory of participatory planning processes. The RTI-IPA research team's case-study approach demonstrates that GIS Story Maps can help to fulfill a vision for an open government by incorporating the use of dynamic digital engagement tools into traditional planning processes. Online, interactive techniques and mapping applications are ideal for fostering citizen engagement, providing meaningful context to complex topics and concepts, and empowering informed decision-making. In other words, there is strong evidence that GIS Story Maps can be effectively used to empower and engage stakeholders in planning sustainable land use and transportation systems.

5.2.2 Research Limitations

This research incorporated both a literature review and case studies as research methods. The case studies offered preliminary, exploratory investigation of the use of GIS Story Maps as a tool for participatory planning processes. The value of these case studies is that they provide concrete, practical knowledge gained from applied research as opposed to knowledge from a theoretical context (Flyvbjerg, 2006). Yet, as previously discussed, case study research has limitations. Additional research needs to be informed by empirical evidence that supports or refutes the premise that map-based storytelling can empower and engage stakeholders in planning sustainable land use and transportation systems. Other studies have identified issues associated with using web-based public engagement strategies, which should be considered in future research. These include:

- The "digital divide" and access to technology.
- A pervasive lack of trust that public input will be used and valued.
- Reliability of public opinion gained through the Internet (Tang & Waters 2005, p. 56).

Moreover, future studies should assess the effectiveness of integrating GIS Story Maps into participatory and collaborative planning processes. As discussed previously, both the design and quality of participatory planning processes need to be addressed. In terms of design, while the use of technology is becoming requisite to build a participatory culture, conventional in-person techniques also effectively involve diverse stakeholders. Relying strictly on the use of either technology, or traditional public involvement methods, doesn't constitute public engagement. Strategies need to balance the need for both high-touch approaches and high-tech, "immersive" practices—including GIS Story Maps—that maintain high levels of engagement throughout a planning process. Moreover, the design of a participatory planning process should consider whether the use of GIS Story Maps as a public engagement strategy is (1) appropriate given the planning context, (2) sensitive to needs of diverse stakeholders, and (3) relevant to local governance conventions. To achieve high-performance public involvement, a structured framework should build a shared vision of an engagement process, establish goals, provide accountable public outreach, and measure outcomes. Paramount is the need for metrics to assess the extent to which GIS Story Maps can achieve meaningful stakeholder engagement by boosting inclusive decision making, promoting equity, enhancing local decision-making, and building social capital.

5.3 Recommendations

The case studies conducted by the RTI and IPA research team are compelling. They demonstrate a strong potential for GIS Story Maps to be incorporated within PPGIS and participatory planning processes to institute sustainable land use and transportation systems. Again, additional

research is needed to explore how new technologies—including GIS Story Maps—can foster citizen engagement in participatory planning, democratic, and decision-making processes. Several recommendations are outlined below.

5.3.1 Expand the Community of GIS Users

As an industry leader, Esri has grown a sizeable community of GIS users. Esri's website supports three broad communities of users. Industries and technical communities can find maps, applications, blog posts, forum threads, documentation, videos, and tweets on the website's "ArcGIS Resources" tab (http://resources.arcgis.com/en/communities/). App developers can connect via Esri's ArcGIS for Developer's website (https://developers.arcgis.com/). It enables developers to build web, mobile, and desktops apps by using Esri's cloud services, developer application programming interfaces (APIs), ready-to-use content, and self-hosted solutions. The website supports the #GeoDev community through forums, code sharing, and training. Esri also supports GitHub, which enables developers to view open source code, build, and share ArcGIS software.

Esri supports an annual GIS Day each November. The yearly event provides an international forum for GIS practitioners to connect and demonstrate real-world applications to non-GIS users, including elected officials, educators, and students. Both international and domestic GIS Day initiatives provide outreach to non-GIS users via social media and events that feature educational posters, multimedia demonstrations, and experiential (hands-on) learning opportunities.

In addition to Esri, other GIS software companies connect users via social media, training, webinars, events, conferences, demos, and tutorial videos. Two industry-neutral online forums—GIS Stack Exchange and Subreddit—provide question and answer sites for cartographers, geographers, GIS professionals, and the public. A Reddit online forum discussion on non-ArcGIS Story Maps indicates that several other software providers offer products and support for storytelling with maps. Examples include Leaflet storymap, Mapme Stories, Carto Odessey.js, Northwestern University Knight Lab StoryMapJS, and Tour Builder that is built on Google Earth maps.

Many states have developed GIS strategic plans that focus on sharing and coordinating resources among local and state governments. However, statewide strategic plans should address the need to leverage the vast GIS knowledge, data, products, and experience that comes from government entities, NGOs MPOs, regional councils (RCs), associations of governments (AGs), academia, non-profit organizations, and the private sector. Together, GIS providers can expand communities of GIS users by:

- Exploring and expanding partnership opportunities in geospatial data collection and application development.

- Framing GIS educational components and competencies for the next generation of GIS users.
- Developing cohesive and comprehensive statewide datasets that can be shared among other GIS users, non-GIS users, and stakeholders.
- Conducting outreach and hosting forums for GIS practitioners to connect and demonstrate real-world applications to non-GIS users.
- Establishing searchable, online geospatial data clearinghouses (i.e., portals, or centralized repositories for GIS data).
- Selecting, curating, and organizing geospatial datasets geared for public use (in addition to institutional purposes) within online data clearinghouses.
- Teaming with potential new communities of GIS users (e.g., K-12 schools, community centers, libraries, school- and university-based media centers, citizen planners) to provide training, workshops, or hands-on GIS Story Map learning labs.
- Creating collaborative environments where GIS training, education, and knowledge management can be developed across disciplines, organizations, and user communities.
- Inviting viewers to submit interactive mapping ideas.

5.3.2 Foster Open Access to Data

Since President Obama issued his Open Government Directive in 2009, initiatives have focused on using Web 2.0 technologies to (1) stimulate innovation and economic growth, (2) enable the public to gain information and collaborate online, and (3) provide a searchable, online database (i.e., data.gov) of data, tools, and resources. Many states and local governments have instituted policies, websites, and data.gov-style online catalogs to provide open data to citizens. According to data.gov, a website managed and hosted by the U.S. General Services Administration, there are 40 states and 48 local governments in the United States that have developed open data policies to foster transparency, participation, and accessibility to government affairs (data.gov, n.d.).

Data-sharing repositories make it easy for anyone to upload and access authoritative public data, including community basemaps. This, in turn, has fueled the creation of new digital tools and online mapping applications across the web, which provides a foundation to leverage geospatial assets and share data. Access to and discovery of geospatial data is critical for GIS stakeholders and individuals interested in developing GIS Story Maps. Non-GIS users, who lack the technical proficiency to create GIS public-private partnerships, critically need public access to current, accurate, and authenticated GIS layers and basemaps to create GIS Story Maps. Moreover, both seasoned software developers and enthusiastic hackers need access to data to craft innovative mapping solutions to public issues.

Across the United States there are many publicly available and searchable geospatial data clearinghouses (e.g., portals or repositories of GIS data). Esri hosts an ArcGIS Online Basemap Gallery that provides an authoritative source of basemaps that can be uploaded to a GIS Story

Map. GitHub (GitHub.com) is a web-based hosting service for software development projects where projects are made available for others to access and make contributions. Projects are maintained and managed in repositories. To enhance access to open GIS data access, it is suggested that communities of users establish online geospatial data clearinghouses (i.e., portals, or centralized repositories for GIS data) that:

- Offer a variety of GIS datasets that are user friendly and can be easily browsed, searched, previewed, and downloaded by both GIS users and non-GIS users.
- Provide website accessibility to the largest possible audience and be designed in compliance with the Americans With Disabilities Act of 1990 (ADA) and conformance to the latest World Wide Web Consortium (W3C) Web Content Accessibility Guidelines.
- Incorporate datasets provided by federal, state, local, and regional government agencies, NGOs, MPOs, RCs, AGs, non-profit organizations, academic institutions, and the private sector.
- Sustain the geospatial data infrastructure, continuity of data access, long-term storage, and archiving of data.
- Reflect geospatial data and technology standards as well as industry best practices.
- Streamline processes to make data sharing/access fast and easy.
- Provide website links to GIS-related user events, training opportunities, informational presentations, and galleries of mapping products—including GIS Story Maps.
- Provide one-stop download and web service access to GIS map data layers that are developed, aggregated, or acquired by consortiums of GIS users.
- Continuously update geospatial map layers to reflect needs of users—obtained via user surveys and collected from server metrics.
- Create opportunities to collaborate among user communities.

5.3.3 Disseminate Outcomes

Dissemination refers to a planned process of actively communicating and tailoring information to an intended audience. Although "dissemination" is a term often used in the context of research, a plan to disseminate map-based storytelling can support public knowledge transfer and heighten impact. Methods and strategies vary, but a dissemination plan should be part of the design of a participatory planning process. A GIS Story Map may be presented in a traditional (high-touch) public meeting or workshop setting. However, there is a growing demand for high-tech engagement via digital, interactive information sources that are viewable on any device (smartphones/tablets/laptops) or platform and shared via the web. Social media platforms (e.g., Facebook, Twitter, Instagram, YouTube) have revolutionized the way governments communicate with the public. GIS is now perceived as social media. It demonstrates the potential to open an interactive dialogue or gain real-time information from the public. More communities see the value of "citizens as sensors," that is soliciting citizen-generated data or crowdsourced

information to make communities smarter. In addition, social video marketing platforms (e.g., YouTube and Vimeo) can offer ways to extend training opportunities, promote products available to the public, showcase user tutorials, or explain how to interact with mapping products. Suggested dissemination strategies include:

- Presenting GIS Story Maps at public meetings, local workshops, community forums, professional conferences, research showcases, and academic seminars.
- Sponsoring map and GIS data competitions to promote geospatial work and showcase the potential of storytelling with maps.
- Embedding interactive maps in websites or blogs.
- Creating online GIS galleries with collections of "best practice" GIS Story Maps.
- Developing social media campaigns (e.g., Twitter, Facebook, Instagram, YouTube, Vimeo) with embedded story maps to target intended audiences and actively engage stakeholders.
- Identifying GIS Story Map "champions" and partners who will share GIS Story Maps with other enthusiasts.
- Publishing articles with active links (URLs) to GIS Story Maps/galleries in e-newsletters, listservs (electronic mailing list software), and online industry forums.
- Using blogs to create online forums, suggest ways to interact with GIS Story Maps, and share map-based storytelling expertise.
- Displaying GIS Story Maps on galleries of open-source user groups (e.g., FirstMap Delaware) and GIS industry leaders (e.g., Esri).
- Hosting interactive town hall events.
- Issuing media releases to explain the purpose of the mapping product and link to its URL.
- Researching how other agencies are integrating GIS Story Maps with social media platforms.
- Utilizing the "citizens as sensors" concept to gain public input/comments on GIS Story Map information.
- Integrating social media with GIS web pages to help promote web maps/apps and provide training (e.g., YouTube and Vimeo).

5.3.4 Build the Capacity of Non-GIS Users

Expectations for public involvement continue to rise. While GIS technology is widely available and routinely used for data access and mapping, local governments face obstacles in the greater use of GIS for planning purposes. Local governments may lack institutional support, training, and funding to acquire and use new GIS hardware, software, Internet-based technology, and public-engagement tools. Working collaboratively, state DOTs, MPOs, university transportation centers (UTCs), TRB Committee on Public Involvement, universities/academic institutions, local American Planning Association (APA) chapters, the International City/County Management Association (ICMA), GIS professionals (GISPs), and other GIS experts need to design and host

workshops, seminars, classes, and interactive learning labs to highlight the utility of GIS (and GIS Story Maps) for educational, public engagement, and visualization purposes.

Traditionally, university geospatial sciences coursework has been geared toward a particular major or students interested in gaining technical proficiency to master spatial analysis, cartography, spatial database management, and GIS app development. The higher-education GIS curriculum needs to be transformed from one that focuses strictly on the use of conventional geospatial technology to new uses—including storytelling for public engagement purposes. In addition, university geospatial science educators and library or multimedia design center specialists should introduce students, faculty, staff, and administrators to the power of storytelling with maps and using data to think spatially. For K-12 schools in the United States, Esri offers free ArcGIS Online accounts, online mapping tools, and instructional materials. GIS problem-based learning strategies and technologies, like GIS, can stimulate student intellectual development and critical thinking skills. Workshop and hands-on activities to introduce map-based storytelling concepts, explore galleries, and experience the basics of building a GIS Story Map would be beneficial to educators, administrators, students, and parents. GIS-user communities and professionals from the public sector, private sector, and academia need to leverage resources and collaborate to build capacity of non-GIS users. Suggested strategies for GIS communities of users and professionals include:

- Serving as a resource for educators by creating GIS in Education websites with lesson plan ideas and resources.
- Expanding the use of GIS and other geospatial technologies in K-12 schools by assisting with planning and carrying out classroom GIS Story Map activities/lessons.
- Recognizing/awarding educator(s) who have been instrumental in furthering the use of digital spatial data, Internet mapping services, and/or GIS Story Maps in academic settings.
- Hosting student contests to display GIS Story Mapping products at regional GIS or instructional technology conferences.
- Providing hands-on GIS Story Map "learning labs," training, or workshops for educators, students, "citizen planners," local government officials and the next generation of land-use planners, public policy professionals/administrators, transportation planners, and transportation engineers.
- Hosting events (e.g., hackathons) to inspire software developers, graphic designers, interface designers, project managers, planners, engineers, administrators, students, subject-matter-experts, and non-GIS users to collaborate on the creation of new GIS Story Map templates and applications.
- Sponsoring local GIS Day(s) to showcase real-world uses of GIS Story Maps to schools, businesses, the public, and other non-GIS users.
- Making public presentations to highlight the utility of GIS Story Maps for analytical, public engagement, decision making, and visualization purposes.

- Providing citizens with access to open, real-time data to better engage citizens, advance innovative solutions to issues, and improve services.

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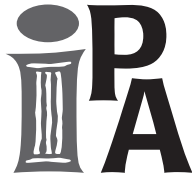
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