

Managing Scholarly Outputs in a Proprietary Platform: Exploring the Implications of Esri Story Maps for Spatial Digital Humanities Preservation

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Managing Scholarly Outputs in a Proprietary Platform: Exploring the Implications of Esri Story Maps for Spatial Digital Humanities Preservation

Spatial digital humanities projects often struggle with sustainability and preservation. Interactive, engaging websites require consistent maintenance to function well. As a result, projects rise and fall with grant cycles while technical staff face an ever-increasing portfolio of projects to maintain. For the past decade, Esri's StoryMaps platform has offered a way to combine maps, text, images, and other multimedia with relatively little technical overhead for the end user. This has had substantial influence on spatial digital humanities, expanding opportunities for a wide range of scholars and organizations to share archival research publicly. The challenge of preserving this work looms large, however, as the retirement date for the "classic" version of the platform approaches. Based on an effort at the University of Minnesota to contact authors for hundreds of public-facing story maps, this paper reflects on the difficulty of managing scholarly outputs in a system not primarily designed for that purpose and of representing web-based work within the library record. More broadly it asks, what does it mean for spatial digital humanities that so much scholarship is hosted and organized within one proprietary platform?

Keywords: spatial digital humanities; story maps; preservation

Introduction

Spatial digital humanities projects often struggle with sustainability and preservation. The computational environments in which digital projects are designed -- the servers, application frameworks, programming languages, and dependencies -- are constantly evolving to improve security and functionality. Given this shifting technological landscape, projects require consistent maintenance to continue functioning. Labs and

units that support digital humanities face an ever-growing portfolio as new ideas are funded but existing projects continue to hold scholarly value. For example, Smithies et al. (2019) describes the experience of the King's Digital Lab inheriting a hundred idiosyncratic projects from the 1990s and 2000s. They ultimately concluded that it was not feasible to keep them all running.

When spatial digital humanities projects must be decommissioned, there are two major sustainability issues to address. First, there is a preservation problem: how do you meaningfully capture the interactivity and ingenuity of the original display of materials in a format that can be sustained for the long-term? Second, and tied to a larger scholarly problem of ephemeral content on the web, there is the problem of reference rot¹: How do you ensure that scholars who have cited the projects can find preserved content in whatever new form it might take?

This article reviews some existing approaches to the preservation problems facing spatial digital humanities, then reflects on their relevance for the popular storytelling platform Esri's ArcGIS story maps.² It considers long-term content management challenges that arise using proprietary software that is not primarily designed for academic contexts. Motivated by the impending retirement of the "classic" story map templates, the article describes an effort at the University of Minnesota (U of MN) to contact authors for hundreds of vulnerable story maps to help preserve scholarship. The retirement offers an opportunity to reflect on the considerable impact of story maps on spatial digital humanities, to reckon with the difficulty of messaging transient scholars, and to consider what strategies we can implement to prepare for the next major transition.

Addressing preservation challenges in the spatial digital humanities

There is a growing set of initiatives and tools which seek to address web preservation

and to create pockets of stability within the constantly changing web. These approaches, however, sometimes fall short for spatial digital humanities projects.

Using persistent identifiers to create stable links

Persistent identifiers help direct people to the correct location for a digital object as it changes over time. Instead of pointing directly to a web location (i.e. a URL), persistent identifiers point to an intermediate resolution service. The service matches the identifier with a registered URL and returns it as an HTTP redirect.

While there are many types of persistent identifiers (including PURLs, ARKs, and Handles), Digital Object Identifiers (DOIs) are perhaps the most recognized in academia. In order to maintain high-quality links, only members of a registered agency can create or manage a DOI. These member organizations are only allowed to assign DOIs to content for which they are responsible as active stewards, not to third-party products. By minting a DOI, they make a promise that the link will resolve to a publicly available landing page. If the resource becomes unavailable, a “tombstone page” must remain with a statement detailing the reason for the resource’s removal. (DataCite Support n.d.)

DOIs and other persistent identifiers work well for static publications or research data that are being stored in a long-term repository. In these cases, the distributing entity is responsible for both maintaining the files and keeping persistent links up to date. The approach does not translate as well, however, to interactive digital projects (Hennessey and Ge 2013). Scholarly websites are often hosted on third-party platforms and continuously evolving alongside research projects. It would take extensive effort for registered agencies to track and ensure continuity of these websites, making them unsuitable targets for persistent identifiers.

Digital preservation techniques for websites

Another common approach to addressing ephemeral web content is web archiving. Web archiving captures the content of a website at a specific moment in time - allowing scholars to link to what the website looked like when they accessed it, even if the content has since been taken down or changed. The Internet Archive's Wayback Machine is the largest manifestation of this approach, with approximately 850 billion websites saved at the time of writing. The Wayback Machine allows any scholar or member of the public to create a snapshot of a website, as I have done for some of the citations in this article. Other examples of web archiving in action include Perma.cc, Archive.it, and utilities promoted by the International Internet Preservation Consortium (IIPC n.d., Zittrain, Albert, and Lessig 2014). Many web crawlers, however, only capture information that is visible from the client. When confronted with web pages built using JavaScript, JSON, databases, or dynamic logic, they struggle to capture content. (Davis 2014; Hennessey and Ge 2013; Pennock 2013). For most spatial digital humanities portals and publications, this approach cannot adequately represent the complexity of the material.

In response to the challenge of dynamic content, tools have been developed that are better able to represent embedded media, intricate navigation, and other interactive features. These tools support collection of resources based on the requests and responses sent during interaction with a web site. When accessing an archived website, the tool directs the browser to resources in the collection instead of the live web, providing a more robust experience after the source content becomes unavailable. Examples of archiving tools that take this approach include Rhizome's Conifer, Archive-It's Brozzler crawler, and Archiveweb.page. While these archiving tools offer vast improvement in representing interactive elements, they are far from perfect, especially

when capturing web maps. Stapelfeldt et al. (2022) tested archiving tools on both Leaflet maps and StoryMaps, finding that they struggled to access the content of map pop-ups and sometimes missed embedded video content. In addition to these limitations, many web crawling tools require substantial technical expertise to use. It can be difficult to understand what content has been captured and what elements are still loading from the live web, making the tools tricky to use for those not trained in digital preservation.

Without the ability to easily replicate interactive websites, preservation of digital humanities projects has been an active area of scholarship and advocacy. In the context of custom-built interfaces, Smithies et al. (2019) calls for heterogeneity in archiving approaches to match the heterogeneity of the projects themselves. Options include building functionally limited but usable static websites, preserving projects using virtual machines, and depositing project components in institutional repositories (i.e. content, code, and description of process and user experience) (Edmond and Morselli 2020; Rockwell et al. 2014).

Elegant endings

Several interest groups and organizations have taken up the challenge of how to “elegantly end” digital humanities projects (Smithies et. al 2019). These groups offer resources for prioritizing preservation actions when approaching complex digital objects, as well as technical guidance for building more robust digital infrastructure.

The Digital Documentation Process (DDP) advocates cataloguing digital humanities projects to make them more findable, citable, and durable (Fostano and Morreale 2019). They recommend every project have a persistent landing page with a DOI and documentation (i.e. an “Archiving Dossier Narrative”) describing the rationale, outcomes, and methods for the project. The Socio-Technical Sustainability Roadmap

and Guidelines for Preserving New Forms of Scholarship offer checklists and recommendations for digital project teams to work through while planning for the sustainability of their projects (Greenberg and Hanson 2021; Visual Media Workshop 2023). The Endings Project meanwhile advises how to build longevity into the very design of an interface (Holmes and Takeda 2023). For example, they recommend that websites have no dependence on fashionable technologies, server-side software, or external services (Carlin et al. 2016).

Some common themes emerging from these communities include the importance of 1) early conversations between scholars and support staff around the logistics of long-term project management and of 2) assessing technology options with respect to project preservation priorities. These excellent recommendations can be difficult for staff to implement, however, if they have limited interaction with scholars at the beginning of their work. For many teams, developing custom websites in alignment with Endings Principles may be out of scope, leaving scholars grappling with the limited preservation features of third-party software-as-a-service.

The role of Esri story maps within spatial digital humanities

For the past decade Esri story maps have offered a way to combine maps, text, images, and other multimedia to craft engaging narratives with little technical overhead for the end user. The earliest version of Esri story maps (i.e. “map stories”) were custom built projects exploring the possibilities of storytelling for specific datasets (Carroll 2019). Within a few years, the Esri Story Maps team began releasing builders designed so that those without programming or web development expertise could create map-driven narratives. With the hosted iteration of the platform (now referred to as “classic story maps”), users had the option to choose between seven templates to tell their stories (Basic, Shortlist, Spyglass/Swipe, Map Tour, Map Journal, Map Series, and Cascade).

In 2019, Esri introduced a unified builder (“ArcGIS StoryMaps”) combining the functionality of earlier templates, simplifying the code base, and improving user-experience. Hundreds of thousands of stories were built using the classic story maps templates and more than a million stories have already been created in ArcGIS StoryMaps (Evans 2022).

Esri story maps have had a strong impact on spatial digital humanities. Proprietary but with affordable licenses for academic institutions, Esri handles most of the complexities of web hosting such as storage, security, and maintenance of the code base. The platform’s substantial options for displaying data and intuitive user interface reduces the number of projects requiring a custom-built portal. It also encourages folks to engage in spatial digital scholarship who might otherwise have lacked funding or been intimidated by technical requirements. This has made it possible for small technology teams to support a much larger number of projects simultaneously. Rather than working with the project leads from a few dozen projects, teams may end up managing hundreds or thousands of accounts and have limited direct interaction with the projects being built.

An enormous number of projects have been built with the platform, from students completing course assignments to major exhibits at the Library of Congress (Mattke et al. 2016-2021; Library of Congress 2022). When talking with humanities faculty, the term "story map" has become almost synonymous with “digital mapping” and is used to evoke a wide range of products and functionality. Story maps are being used for academic assignments, whether to share collaboratively collected data in introductory history courses or for individual semester-long capstone projects (Mizuno and Saladin 2019; Botten 2019). Graduate students and faculty are using story maps to showcase research in conference presentations, in support of dissertation work, and as

part of their scholarly portfolios (Faulkner-Gentry 2018; Saladin 2018). Librarians are using story maps to create finding aids for researchers exploring archival collections and to expand the audience for library exhibits (Hankin-Redmon 2019; University of Minnesota Law Library 2021; Wangensteen Historical Library 2023) Story maps are also being used to convey humanities research beyond typical scholarly circles, presenting research outside journal paywalls in a format more accessible to the communities they seek to address (Malone 2022; Mills 2020).

While story maps have greatly expanded the number of digital humanities projects that staff can manage simultaneously, they face many of the same long-term sustainability challenges as custom-built portals. It is difficult to archive complex interactive story maps and to maintain references to the shifting location of these projects in the scholarly literature. The scale of their use and transience of the academic community increases the difficulty of communicating with creators about product changes. Given the number of story maps in existence, these challenges have a substantial impact on spatial digital humanities and the future of preserving this genre of project.

Long-term management of ArcGIS StoryMaps in an academic context

Thousands of universities (predominantly in the United States) use Esri products, but the company's primary clients are in government and industry.³ For these clients, web applications belong to the organization rather than the individual making them. For example, if the creator of a StoryMap about a city infrastructure project left their position, responsibility for maintaining the content would remain with their employer. This is not the case in academia, however, where projects are intellectual assets of the scholar rather than the institution supporting them. This presents substantial challenges in how to handle hosting and sustainability for projects created by

students, staff, and faculty who have moved to other places.

One option is to move StoryMaps so that the work follows researchers to their new context - whether to another university or to a personally managed account.⁴ Copying content ensures that researchers retain the ability to edit and control sharing access, but the tools available to support these kinds of transfers have limitation. The free third-party tool ArcGIS Online Assistant allows scholars to sign-in to two accounts simultaneously and copy items between them. The tool does not (currently) offer a way to “clone” a story map with all embedded web maps and associated data layers included. Associated items must be copied separately and references to the new item IDs updated manually in the story map. GeoJobe has a product that can clone story maps but both the originating and receiving organization must purchase it, creating financial and administrative hurdles. The University of Michigan has also developed a Python notebook capable of cloning a story map, but it requires substantial technical knowledge to use and is still under development (Knoop 2020). An update to the Esri platform in August 2023 has also made it possible to duplicate some StoryMaps without requiring tools outside of the ArcGIS Online platform. The major downside for all of these approaches is that the resulting story map is a copy and therefore does not retain the original URL. This will cause broken links and reference rot if the original project has been cited in scholarly literature or shared with others.

A second option is for institutions to continue to host StoryMaps created by their students, faculty, and staff after they graduate or leave. With this option, the accounts of alumni and former staff are deactivated so that account holders can no longer use products licensed by the university. The items can either be left within the now deactivated accounts or moved into an archival account. Leaving content within the organization where it was created improves the stability of links and avoids the

difficulty of moving items around within the ArcGIS Online universe. With this approach, however, the StoryMap author loses the ability to maintain and update their work. Researchers can no longer fix broken links, keep map data current, or even take down their project without intervention from administrators. This disconnect between the staff managing the items and the researchers whose scholarship is contained in those items is a major challenge, especially over the longer term.

A third option is to create an archival version of the story map. Universities that lack the staff, tools, storage capacity, or policies necessary to continue hosting the work of alumni may remove accounts and content soon after account holders leave the institution. With changing access to digital platforms and in acknowledgement of their ephemerality, some may choose to craft an alternative version of their scholarship. Like many other digital humanities products, the complex structure of story maps complicates preservation. The JSON format underpinning the platform prevents story maps from being archived using the Wayback Machine and complicates preservation with other web archiving tools. Preserving through emulation or containerization is also not an option because of entanglements with proprietary Esri servers.

The platform does support downloading static PDF versions of StoryMaps and some classic templates. This static copy can provide a general understanding of a project's layout for sighted audiences, but lacks accessibility features present in the digital product. For story maps that rely heavily on interactivity such as map actions or pop-ups, the PDF may not capture content well. To more fully represent content, scholars may choose to also save supporting assets (data, media, etc.) and a screencast recording demonstrating how interactive elements functioned. This kind of archival object can help keep a record of work, but its creation is hard to make a priority while the interactive version is still functioning and falls short of the back-up copy most

scholars desire.

It is important to note that not all story maps require a long shelf life. Many projects completed for a class or as part of a training do not need to be transferred, maintained, or archived. Even public-facing digital scholarship may have time-bound relevance. As Holmes, Jenstad, and Huculak (2023) articulate, ephemerality is fine as long as it is intentional. With little metadata required for items hosted by Esri, however, it can be difficult for ArcGIS administrators to systematically identify scholarship meriting more focused preservation effort.

Long-term management of story maps is a perpetual problem in academia, but the retirement of classic story maps brings these challenges especially into focus. Esri has announced that it will be retiring the classic story map templates starting in October 2025 (Evans 2022), a little over a decade after its release as a hosted application in ArcGIS Online.⁵ There are no built-in tools for converting classic story maps into the newer format, leaving authors to track down assets and manually copy over their content. For projects that were built using grant funding or whose authors have graduated, this can pose a substantial obstacle. Also, while rebuilding projects in StoryMaps provides a path forward for content, it will not prevent the wave of link rot coming with retirement of the original items. There are no redirects or persistent identifiers tying versions together, so scholars who encounter broken links to the original templates may not realize that the content is available elsewhere. Overriding all of this, with the high turnover of affiliates there may be difficulties messaging account holders about impending changes. The following case study details one university's attempt to inventory classic story maps and reach out to affected faculty, staff, students, alumni, and other former affiliates.

Case study

At the University of Minnesota at the time of writing, ArcGIS StoryMaps and other ArcGIS products are available to faculty, staff, and students at no cost and using single sign-on accounts (Manson et al. 2022). Former faculty, staff, and students retain their accounts and the content stored within them when they leave but lose the ability to sign-in or manage that content. Data, web maps, or story maps that have been shared publicly continue to be visible for use in portfolios, academic citations, and with the broader community. Due to the overall size of the institution, the low-barriers to access, and our approach to the content of former affiliates, the U of MN has one of the largest ArcGIS Organizations with over 19,000 accounts as of October 2023.

When consulted, we encourage students and staff who have created a story map for a funded research project, ongoing exhibit, or partner organization to transfer ownership of the completed project to a departmental account. This ensures that the project remains in an account with editing privileges and an active contact person. Story maps have such a low barrier to entry, however, that our staff is not aware of every project that has been built in our organization. Unlike with custom-built applications where conversations about sustainability between scholar and support staff would likely take place early in the process, sometimes we do not know about significant projects until after its creator has graduated or left the university. We are constantly surprised (and delighted) by the story maps that have been created by individuals who never went through formal training with us, often as we are being asked about regaining access to edit them. Unfortunately, this increases the likelihood that robust scholarly work resides in deactivated accounts and that we might miss it in our attempt to message about technology changes.

We chose to start outreach efforts well in advance of the retirement of classic story maps for several reasons. We hope to have capacity to assist more students,

faculty, and staff transitioning to the new platform and archiving projects if requests are spread out over a longer timeframe. Some excellent story maps in our organization were created by digitally savvy graduate students on behalf of their advisors or instructors. In these cases, the students often have graduated and the project partner who is still actively affiliated with the university may not have the skills or dedicated time to migrate content. We hope to give account owners who are less comfortable with technology time to line up student assistance or seek training.

One of our strongest motivations for early outreach has been the anticipated difficulty of contacting affiliates who have left the university - a difficulty that affects more and more classic story map owners as time passes. Contact information for students, faculty, and staff often changes when they transition away from the university where they have created a story map. At the time of writing, U of MN alumni must sign-in to their university-issued email account once every 90 days to retain it. We anticipate that an imminent policy change, shortening the period of time alumni can keep their university email, will make it even harder to contact people who have left.⁶ At the present time, we do not have effective mechanisms for keeping contact information updated for deactivated accounts, adding urgency to our timeline for communication. Two years out from the classic story map retirement date only a third of the accounts containing a classic story map are still active in our organization (down 5% over a six-month period).

As of August 1st, 2023, the U of MN organization hosted 6506 classic story maps spread between 2472 accounts (see Table 1). Because of the educational context of our organization, many of these projects were created as part of a training exercise, to test out the technology, or for a low stakes course assignment. Only a portion contain significant research whose removal would impact the scholarly conversation. Part of the

challenge has been in how to identify the projects on which to focus outreach efforts. Overall, we have tried to take a conservative approach - assuming the possibility of content significant to the individual who created it - while being mindful of the limitations on our capacity to assist.

	Number of accounts with at least one classic story map	Number of classic story maps
Active account	674 (27%)	2034 (31%)
Deactivated account	1798 (73%)	4472 (69%)
Total	2472	6506

Table 1. Inventory of classic story maps held by active and deactivated accounts in the University of Minnesota ArcGIS Organization Aug 1st, 2023.

In our organization, over half of the classic story maps (58%) have been shared publicly, with another 15% shared internally either with others in the organization or with specific members of a group.

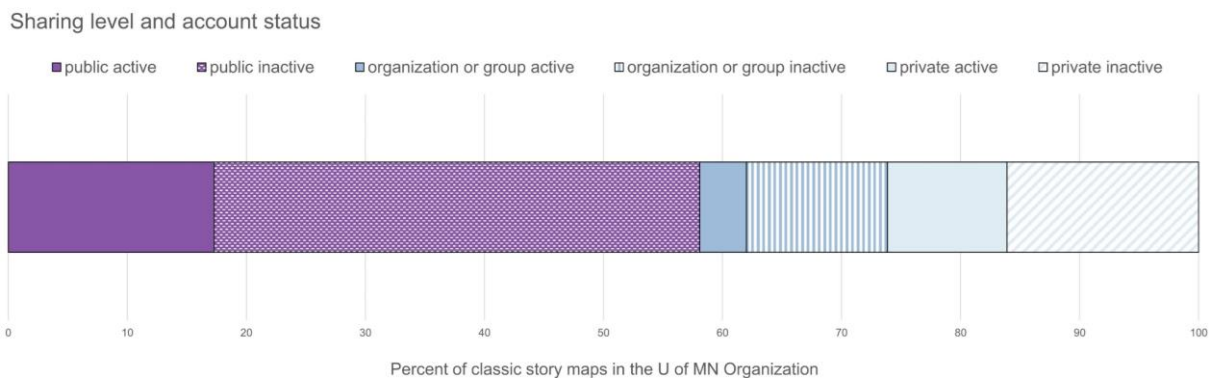


Figure 1. Sharing level and account status of classic story maps in the U of MN ArcGIS Organization Aug 1st, 2023

Outreach approach

We approached outreach about the retirement of classic story maps in three phases.

- Phase 1: Known projects, high view count story maps, and classic story map power users
- Phase 2: Active accounts with classic story maps at any sharing level
- Phase 3: Deactivated accounts with publicly shared classic story maps

In Phase 1 of outreach, we directly contacted a handful of account holders. These included: 1) projects that we have consulted with in the past seven years (e.g. exhibits affiliated with library collections); 2) creators of story maps with high view counts (i.e. more than ten thousand views); and 3) power user accounts that own many classic story maps (i.e. more than ten).

We received positive acknowledgement from most of the individuals and groups contacted during Phase 1. As a result of the outreach, several projects are in the process of being rebuilt using the newer version of StoryMaps. We generally expect the original authors (or their associated units) to rebuild the projects, while supporting training for new staff, students, and partners. In situations where we were directly involved in building the original story map (such as for some library affiliated exhibits), we have taken a more active role in transitioning content. The original versions of these projects will be hosted for as long as possible, with the newer version available to swap in when necessary. Other story maps have been assessed as too resource-intensive to rebuild and will be abandoned. Notably, it is not the relevance of the scholarship but limitations of technology and time that led to this choice.

During Phase 1, we also experimented with the Classic Story Conversion Helper tool v2.0 (2023). This Esri-authored python notebook aims to transform Map Series, Map Journal, and Cascade classic templates into StoryMaps. While we were able to successfully convert a few projects, promoting the tool to our users was not found to be

a scalable solution. The tool requires substantial familiarity with Python to use, making it out of reach for our average account holder. Additionally, if there are any errors in the original story map (e.g. broken image links), the tool will completely fail during conversion. At times it can be difficult to identify which element is causing the errors, complicating efforts to use the tool. Lacking the staff to attempt migration for large numbers of story maps, we chose to mention the tool to only a small handful of skilled GIS users.

During Phase 2 of outreach, we sent a batch email to active accounts with at least one classic story map at any level of sharing (private, group, organization, or public). While the students, faculty, and staff messaged during this phase have permission to sign-in and manage their accounts, we wanted to ensure that they would be able to easily identify the affected items and to pre-emptively reduce concerns about impacts to stories built with the newer version of the product. We used Salesforce to send personalized emails with a list of the classic story maps associated with each account (title, URL, and sharing setting). We also examined story map titles for phrases which either 1) aligned with examples used in training offered locally or through Esri or 2) signalled that the project had been made as practice.⁷ To do this, we used Python to flag titles, manually reviewed the results, and removed accounts from our outreach mailing list that only had story maps linked to a tutorial or test. In the end, our message during this phase went out to 412 accounts which collectively owned 914 story maps.

Phase 3 of outreach involved contacting a subset of deactivated accounts that had at least one publicly shared classic story map. Owners of these accounts are no longer able to log-in to manage their items and thus only able to view content that is shared with them as a direct link. They will not be able to create new StoryMaps within our organization, requiring them to set up an account through another university or a

personal account if they choose to rebuild. If their project has related web maps or data layers, it may be difficult for deactivated account owners to find links to these materials without the intervention of an administrator. Despite the limitations and challenges, ignoring these story maps could lead to the loss of substantial work. Out of the 50 most viewed classic story maps in our organization, 24% are owned by deactivated accounts.

Due to limited staff capacity, we had to be strategic in how we approached communication with deactivated account holders. Since former affiliates cannot log-in to view their private or internally shared content, we only reached out to those with publicly shared story maps. As with the active accounts, we used title keywords to remove accounts from our mailing list that only owned projects made for a tutorial or as a test. To focus on the classic story maps most likely to represent substantive research, we also further filtered out projects with less than 100 views. In Phase 3 of outreach, we attempted to contact 509 deactivated account holders who have collectively authored 667 publicly shared classic story maps (15% of all classic story maps held in deactivated accounts).

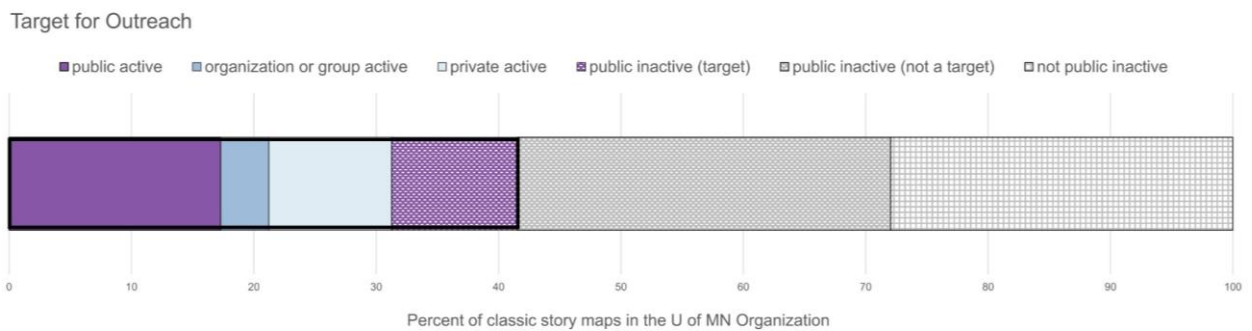


Figure 2. Classic story maps in the U of MN ArcGIS Organization that are a target for outreach grouped by sharing level and account status.

As anticipated, we had a high bounce rate for emails to deactivated account holders - only 56% of our emails were successfully delivered to these users. In addition

to expired university-issued email accounts, missing contact information also complicated outreach. 319 unique users opened the message sent during outreach phases 2 and 3. This included 54% of the active account holders who we attempted to reach and 20% of deactivated account holders.

These numbers help illustrate an important challenge staff face when navigating Esri technology transitions in an academic setting. Putting aside the difficulties of preserving interactive content, just communicating with scholars whose work will be affected can be a major obstacle. It is also important to note that the outreach effort described in this article took place at a large public university with more than a dozen staff employed in various types of GIS support. Smaller, less-resourced units may lack the capacity to maintain projects created by former affiliates or to do extensive outreach about deprecating technologies.

Discussion

While this article has primarily focused on the classic version of Esri's story maps, use of the platform has only increased since the introduction of the unified builder in 2019. Over 7500 of these newer style StoryMaps have been built in the U of MN organization alone at the time of writing, including award-winning spatial digital humanities projects, virtual library exhibits, and digital companions to published articles. Given the extensive presence of the Esri StoryMaps platform within the field of spatial digital humanities it is worth asking: How can we stay on top of representing StoryMaps in the archival record and how can our profession be preparing for the day when the current version is inevitably retired?

Advocate for effective ways to archive and move StoryMap content

Both the Endings Project (Carlin et. al 2016) and Smithies et al. (2019) argue

that to best preserve digital projects, archiving needs to be baked into the technology itself. Smithies et al. (2019) call to “embed archiving and maintenance deep into the culture of technical development, from requirements definition... through to infrastructure design, deployment, and maintenance.” The Endings Project meanwhile proposes tangible guidelines for future-proofing website design. While it is unreasonable to expect that Esri StoryMaps will be designed to operate free from server-side dependencies or to “gracefully fail,” it is possible to imagine more features supporting end-of-project needs (Carlin et al. 2016).

An example of a feature that would improve sustainability of spatial digital humanities projects is improved "print" versions of StoryMaps. While static representations will never live up to the compelling interactivity and functionality of the digital project, they preserve the core of the content. At present, PDFs generated from StoryMaps lack accessibility features present in the digital version of maps. Tab order of headers, tagging, and alternative text perform unpredictably in screen-readers due to issues converting the nested document structure of the interactive site. Additionally, more options could be offered for how to represent interactive elements in the static PDF. For example, in situations where a series of map actions filter the display of a single web map, there might be the option to include a series of static maps rather than having to choose only one map action view.

While moving content between accounts can break links, it also ensures scholars have control over their intellectual assets and gives them the best opportunity to receive communications about relevant technology changes. For this reason, geospatial and map librarians should also continue to advocate Esri develop features that will make it easy to transfer StoryMaps. Optimally, it would be possible to clone a StoryMap (i.e.

copy a StoryMap and all data, web maps, and assets on which it depends) without requiring the use of a third-party tool or extensive knowledge of Python.

There are several groups engaged in discussion with Esri developers about technological needs in higher education contexts. The ArcGIS Administration/Geospatial Support Community of Practice gathers regularly to discuss administrative challenges with supporting ArcGIS products. Likewise, the Higher-Ed ArcGIS StoryMaps Prioritization process, organized by Peter Knoop at the University of Michigan, offers an annual opportunity for the higher ed community to propose and prioritize desired improvements. The ideas that arise are brought to the Esri StoryMap team for discussion at the Esri Developer Summit. In these and other settings, it is on us to argue for the value of a preservation-friendly product.

Talk with academic audiences early and often about digital sustainability

There are no easy solutions when it comes to replicating the complexity of interactive projects or dealing with the pervasive spread of link rot. Appreciating the ephemerality that comes with publishing on the web and learning strategies for dealing with it are critical to digital literacy. While it can be hard to fit discussions about sustainability into classroom visits and technical workshops, it is an important mindset to promote.

It is also crucial for ArcGIS administrators to stay on top of communication with individuals who are leaving academia or changing university communities. Sending regular end-of-semester messages with options for long-term maintenance can help scholars act while they still have full access to their work. Finding ways to internally track StoryMaps connected to major spatial digital humanities projects could also be very valuable when messaging around future technology changes.

Final Thoughts

While writing this article I struggled with whether to include classic story map examples and how to cite them if I did. In the end, I chose to reference projects knowing that the links will be broken within a few years of this article's publication. There is not much that can be done to prevent this outcome. I cannot create snapshots in the Wayback Machine as I did for some other time-bound web resources. While I am confident that some of the projects will be archived or rebuilt as StoryMaps, I cannot provide a new link for them yet, nor is there a mechanism for redirecting in the future. This ephemerality is at the heart of spatial digital humanities - a central challenge to the continuity of scholarly discourse, an opportunity for innovation, and motivation for more intentional project endings.

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1. Reference rot occurs when the link for something that is cited no longer leads to the intended work either because it is no longer accessible at that location (i.e. link rot) or because the material available at the link has changed (i.e. content drift) (Hennessey and Ge 2013; Klein et al. 2014; Coble and Karlin 2023).
2. Changes in branding over the years complicates terminology on this topic. For this article I will be using "story map" when referring to projects built using the classic templates and as a broader term applying to all iterations of Esri map-based storytelling products. When referring to projects created with the unified builder released in 2019, I will use "StoryMaps."

3. According to Esri, at the time of writing more than 7000 universities use their products. Esri products are used at many scales of government including 20,000 municipalities, thousands of counties, in all fifty US states, and many areas of the US federal government. They are also used in industries ranging from construction to conservation and by 50% of the Fortune 500 companies (Esri Media and Analyst Relations 2023).
4. While some projects can be transferred into a free public account, StoryMaps that contain hosted web services or tile layers require a subscription licence to function. This cost can be a further barrier to transferring content for long-term management.
5. Starting in October 2025, Esri will review the use and functionality of each of the classic story map templates several times a year. Templates that “no longer work as expected” will be removed from ArcGIS Online and the stories that have been created with that template will no longer be available (Evans 2022).
6. The U of MN has long had an email-for-life policy allowing alumni to continue to use their university issued email address indefinitely (if they signed into it at least once every 90 days.) It will end this policy for incoming undergraduate students and will begin rolling back email for other alumni in 2024 (University of Minnesota Information Technology 2023).
7. Keywords used in the filter were: “test,” “delete,” “exercise,” “practice,” “tutorial,” “lab,” “north shore,” “state park,” “historic site,” “election,” “governor,” “congressional,” “senate,” “auditor,” “secretary of state,” “presidential,” “2018,” and “welcome to san diego.” The flagged story maps were inspected to reduce false positives.

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