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Advances in technology and the increasingly widespread use of the Internet have led archives to publish information for researchers and digital collections on their websites. While this increases the number of people who can access their materials, it does not mean that their online resources are accessible to those with hearing and visual impairments. Many studies have been conducted on the accessibility of library websites, but the archival field has been lagging in this area. This paper examines the extent to which the digital resources that archives publish online comply with Amended Section 508 of the Rehabilitation Act of 1973 and W3C's Web Content Accessibility Guidelines 2.1. An analysis of archives websites in the United States using the WAVE tool and survey responses from members of the Society of American Archivists convey that electronic resources provided by archives are only partially accessible for users with hearing and visual impairments.

Headings:

Accessible websites for people with disabilities

Archives

Assistive computer technology

Electronic information resources

ACCESSIBILITY OF ARCHIVES' DIGITAL RESOURCES FOR USERS WITH
HEARING AND VISUAL IMPAIRMENTS

by
Meredith H. Campbell

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Denise Anthony

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INTRODUCTION

The development of the World Wide Web and digital technologies has facilitated new opportunities for cultural heritage institutions and has expanded the scope of their collections. The Internet has been heralded as a tool for providing universal access to information. For libraries and archives, advancements in technology have led to the provision of electronic resources and the digitization of collections, which allows the public to access their materials without ever having to step into their physical buildings. Though the web was intended to be universally accessible, it is not always because websites are often designed without consideration of the diversity among people (Aizpurua, Harper, & Vigo, 2016). The praise of the possibilities of the Internet has often overlooked a subset of the population that is possibly disadvantaged by the prevalence of electronic resources. Websites and digital resources that are not created utilizing accessible design put those with hearing impairments and visual impairments at a disadvantage.

To browse the Internet, people with visual impairments primarily use assistive technology such as screen readers. These software tools process the page source sequentially, parse the HTML code, and read the content out in computer-synthesized speech (Sahib, Tombros, & Stockman, 2012). Websites that are not designed with an eye towards accessibility can cause problems for the sequential processing of pages. Though this paper will also consider the challenges faced by those with hearing impairments,

Internet users with visual impairments are more disadvantaged than both sighted users and users with other disabilities despite assistive technologies (Aizpurua et al., 2016).

The evolution of Web 2.0 has caused even greater problems. Whereas webpages used to remain static once published, they are now dynamic and interactive. In addition to screen readers needing to relate different sections of a page, they now need to understand whether updates have been made to the page (Brown, Jay, Chen, & Harper, 2012).

Internet users with hearing impairments also are disadvantaged when videos and other audio materials do not include closed captioning or transcriptions.

The World Wide Web Consortium's (W3C) Web Accessibility Initiative (WAI) works with participants from various industries, disability organizations, educational and research institutions, and government to develop strategies, guidelines, and resources to ensure that the Web is accessible to people with disabilities. W3C formulates common protocols such as HyperText Markup Language (HTML) and Cascading Style Sheets (CSS) that promote and ensure the interoperability of the World Wide Web ("Web Accessibility Initiative (WAI)," 2017). The WAI has created Web Content Accessibility Guidelines (WCAG) to assist web content developers, web authoring tool developers, and web accessibility tool developers in producing content that is accessible for users with a wide range of disabilities. These disabilities include blindness, low vision, deafness, hearing loss, learning disabilities, cognitive limitations, limited movement, speech disabilities, and photosensitivity. Now up to version 2.1., WCAG guidelines make web content more usable to everyone (Kirkpatrick et al., 2017).

While the accessible design of websites has been studied in other fields, the topic has received far less attention from archivists. Within the information science field, the

majority of studies have focused on libraries, especially academic libraries at public universities as they have to abide by federal laws. The Americans with Disabilities Act of 1990 requires that education programs and services are accessible to those with disabilities. Academic libraries that receive federal funding are obligated to make their websites accessible under the Amended Section 508 of the Rehabilitation Act of 1973. Researchers have examined the extent to which libraries and libraries' websites provide accessible electronic materials for patrons with hearing impairments and visual impairments. They have tested various aspects, including the compatibility of digital offerings with assistive technology, e.g., screen readers, and institutions' websites' compliance with the widely accepted WCAG guidelines. There is very little research that examines whether archives are making their electronic resources and collections accessible for users with hearing impairments and visual impairments. Just like libraries, archives seek to provide widespread access to information. Students, researchers, and the public regardless of disabilities should be able to access archival material. The Society of American Archivists (SAA), a professional association, holds "Access and Use" as one of its core values. In their official statement, SAA states that "archivists promote and provide the widest possible accessibility of materials, consistent with any mandatory access restrictions..." ("SAA Core Values Statement and Code of Ethics," 2011). There is no mention of making materials available to people of all abilities in this statement.

SAA organized a Joint Working Group on Accessibility in Archives and Records Management. In July 2008, this working group surveyed members of the SAA Archives & Archivists Discussion List about working with people with disabilities in archives. Based on the results of the survey, the working group composed "Best Practices for

Working with Archives Employees with Physical Disabilities” and “Best Practices for Working with Archives Researchers with Physical Disabilities” (SAA AMRT/RMRT Joint Working Group on Accessibility in Archives and Records Management, 2010a, 2010b). Unfortunately, the working group did not publish the survey widely. On SAA’s website, the provided link points to the November/December 2008 issue of *Archival Outlook*, which briefly discusses the survey (Ganz, 2008). To find the actual survey questions and results, one has to find the November 2008 issue of the discontinued *The Records Manager* newsletter of the SAA Records Management Roundtable. The accessibility of digital materials is only inquired about in one question that asks which types of accommodations are provided for researchers with disabilities. One of the choices was “assistive computer software.” The results for that question are not included in the newsletter (Kimok, 2008).

In the President’s Message in the January/February 2018 issue of *Archival Outlook*, Zanish-Belcher announced that the SAA Council approved the creation of a Task Force in November 2017 to Revise Best Practices on Accessibility. The purpose of this task force is to review and expand the best practices for employees and researchers mentioned above to cover neuro-disabilities, temporary physical disabilities, and any others determined to be within scope (Zanish-Belcher, 2018). (This task force published their draft document in October 2018, after the proposal and literature review for this paper were conducted.) However, this draft, unlike the proceeding 2009 Best Practices, does include guidelines for the accessibility of digital resources (SAA Task Force to Revise Best Practices on Accessibility, 2018). Furthermore, there has been little research about the extent to which archives are accommodating users with hearing impairments

and visual impairments. Prior research regarding libraries conveys that the digital materials they provide are not one hundred percent accessible yet despite federal laws and best practices within the field. Therefore, it is worthwhile to study how archives fare with accessibility in light of SAA's best practices.

The paper seeks to answer the following questions: Are archives actively making their electronic resources and collections available for patrons with hearing impairments and visual impairments? Do they (1) have formal accessibility policies published on their websites, (2) produce websites that comply with Section 508 and the Web Content Accessibility Guidelines 2.1, and (3) provide assistive technology, such as screen readers, in reading rooms?

LITERATURE REVIEW

Definitions

Before further discussion, a definition of web accessibility is needed. While accessibility can refer to technical access (e.g. hardware, software), the definition goes beyond that for this paper. Web accessibility includes the provision of add-on technologies (e.g. screen readers, screen magnification, voice input) and interfaces designed according to standards and presented in a manner in which it can be interpreted by as many users as possible and by assistive technology (Craven & Nietzio, 2007). Archivist Brenda Kepley has stated that for people with disabilities, accessibility means that “all things available to all other people should be available to those with disabilities” (Kepley, 1983).

The Assistive Technology Industry Association defines assistive technology as “any piece of equipment, software program, or product system that is used to increase, maintain, or improve the functional capabilities of persons with disabilities” (“What is AT?,” 2015).

According to the American Foundation for the Blind, visual impairments include contrast sensitivity, glare sensitivity, light sensitivity, and light/dark adaptation in addition to blindness and low vision (“Key Definitions of Statistical Terms,” 2018). For this paper, hearing impairments are defined as a partial or total inability to hear.

Web Accessibility Research

There have been substantial research initiatives to address web accessibility problems faced by users with visual impairments (Sahib, Tombros, & Stockman, 2012), e.g. the European Internet Accessibility Observatory's (EIAO) project endeavors to show how task-based approaches and statistical measures can be used to assess the accessibility of websites. Though others (Craven & Nietzio, 2007; Davis, 2012) have lamented the usefulness of WCAG to produce accessible websites, these guidelines are what the EIAO's accessibility measurement tool is based on (Craven & Nietzio, 2007). Aizpurua, Harper, and Vigo (2016) also challenged the effectiveness of WCAG guidelines when studying the relationship between web accessibility and user experience.

Andy Brown, Caroline Jay, Alex Q. Chen, and Simon Harper studied the challenges that Web 2.0 technologies pose for screen readers. One of the biggest challenges users with visual impairments face is not being notified of updates made to dynamic web pages. Updates can occur so frequently that they do not allow the content to be read by screen readers. While assistive technologies are constantly improving, the web is evolving at the same time. Unfortunately, visually impaired users do not benefit greatly from dynamic webpages because of the manner in which screen readers currently access, recognize, and understand information (Brown, Jay, Chen, & Harper, 2012).

Making web content accessible poses challenges for government institutions, too. For example, the Legislative Assembly of Ontario discovered that their database was essentially impossible for screen readers to interpret when new regulations forced an examination of their web indexes (Caballero & Guldner, 2017). Caballero and Guldner wrote that the 2005 Accessibility for Ontarians with Disabilities Act called for

information provided by the Assembly to be made accessible, including electronic content. Following WCAG guidelines, a database indexer made the necessary coding changes and then the information architecture coordinator tested the changes for compliance. A number of studies in the early 2000s evaluated the accessibility of federal e-government websites in the U.S. with automated testing software (Condit Fagan & Fagan, 2004; Ellison, 2004; Potter, 2002). While these studies found slightly better accessibility compliance than those discussed below which analyze library websites, 100% accessibility had not been achieved. Paul T. Jaeger, a leading researcher on the accessibility of e-government, argued that the methodologies used by these studies are insufficient because they do not provide insight into the reasons for low accessibility, e.g. cost or lack of understanding. As a result, Jaeger assessed e-government websites using policy analysis, user testing, automated testing, and webmaster questionnaires in 2006. The analysis of his data showed:

- compliance with Section 508 varied largely among websites,
- the level of importance given to website accessibility differed between agencies,
- agencies oriented towards disability issues are more likely to have accessible websites,
- no standardized approach to Section 508 among agencies exists,
- agencies do not possess accurate perceptions about the accessibility of their websites,
- greater compliance with Section 508 could be obtained with more funding and education for web developers,

- and fully accessible e-government websites have not yet been realized (Jaeger, 2006).

The accessibility of e-government continues to be of interest (Galvez & Youngblood, 2016; King & Youngblood, 2016; Lazar, Williams, Gunderson, & Foltz, 2017), which makes it even more surprising that the archival field, which serves government institutions, has scarcely addressed the accessibility of their websites and digital collections. With research from other fields producing similar results, it is possible that archivists do not feel the need to spend resources on similar studies. However, if this topic is not showing up in archival literature, then the awareness among practitioners and students of accessibility challenges is unclear.

Accessibility Research Conducted by Librarians

Despite the concerns over relying on standards to evaluate accessibility mentioned above and empirical research that reveals that WCAG 2.0 guidelines only address about half of the challenges blind web users face (Power, Freire, Petrie, & Swallow, 2012), many researchers studying library websites have used WCAG guidelines as criteria. While there has been a lack of research in the archival field, many studies have examined how well libraries are making their digital content accessible. Much of the literature written on the accessibility of electronic library resources has focused on the compatibility of assistive technologies, such as screen readers, with online materials. Researchers have tested various library materials including screencasts, online tutorials, and databases. Some of the more frequently cited papers will be discussed in this literature review.

Kristina Southwell and Jacquelyn Slater have studied the extent to which screen readers are compatible with electronic library materials. The researchers explored whether screen readers were able to properly access digitized materials from special collections libraries (Southwell & Slater, 2012). In their study, Southwell and Slater tested textual materials from digitized special collections of 69 U.S. academic library websites from the Association of Research Libraries (ARL). They found that the majority (58%) of sampled digital collection items were not screen-readable. Southwell and Slater also sampled from ARL universities in their 2013 study on screen reader compatibility with special collections finding aids (Southwell & Slater, 2013). They evaluated one finding aid from 68 schools using WAVE 5.0, an automated web-accessibility checker, to evaluate compliance with Section 508 and WCAG 2.0 guidelines. The researchers' data suggests that the special collections' finding aids comply with baseline guidelines, but the interpretation of them by screen readers is occasionally hindered because of faulty coding, inadequate use of headings or links for keyboard navigation. Most of the finding aids (89.23%) possessed at least one accessibility error, but the screen readers were able to process the main content of every finding aid. These errors included missing language identification, no alternative text for graphic images, missing labels, empty buttons, and missing headings at all levels of the documents. The navigation errors found in Southwell and Slater's 2013 study are similar to the navigation problems posed by websites for screen readers, which will be discussed below. Similar navigation errors were also found in a recent study of the Library of Congress' American Memory Digital Collection, which was conducted to examine the challenges that digital libraries pose for blind users (Babu & Xie, 2017). Data from pre- and post-interviews and think-aloud activities with

fifteen blind participants revealed design problems in the five following categories as stated by Babu and Xie (2017): “(1) Lack of meaningful text descriptions for multimedia content and format, (2) Lack of meaningful labels or instructions for digital library features, (3) Lack of meaningful labels for hyperlinks, (4) Lack of descriptive section headers in organizing content, (5) Lack of an explanation mechanism for jargon, e.g. ‘ephemera’.”

Some studies brought in the help of users to create and ensure accessible content, which is moving closer towards the usability studies and holistic approaches advocated by Aizpura et al. (2016), Craven and Nietzo (2007), and Davis (2012). One such study was conducted in 2015 and recruited students with learning disabilities to complete a usability test on a biology tutorial in a LibGuide format created by librarians (Webb & Hoover, 2015). Their study shows that user testing is very important because many changes were made based on the comments of the student participants. Webb and Hoover concluded that librarians should use a Universal Design for Learning mapping technique to ensure that their online tutorials are accessible to everyone.

In addition to testing content created in-house by librarians, researchers have examined how accessible vendor-created databases and tutorials are. Cheryl Riley, Suzanne L. Byerly, and Mary Beth Chambers analyzed popular databases in their studies. To evaluate ProQuest’s *Periodical Abstracts* and Gale Group’s *Expanded Academic Index ASAP*, Byerly and Chambers used JAWS for Window 3.7 and WindowEyes screen-reading programs (Byerley & Chambers, 2002). In a separate study, Riley evaluated *EBSCOhost*, *InfoTrack Web Business & Company Profile ASAP*, and *FirstSearch Electronic Collections Online* with a manual assessment based on the Web

Access Initiative (WAI) design guidelines and using the following screen-reading technology: JAWS for Windows 3.7, ZoomText 7.0, OpenBook 5.0, L&H Kurzweil 1000, and L&H Kurzweil 3000 (Riley, 2004). Both studies found accessibility errors that prevented all of the databases from being compatible with assistive technology. Additionally, Jane Oud (2016) evaluated 460 tutorials created by twenty-five different vendors. She found that tutorials produced in a webinar format were completely inaccessible based on WCAG 2.0. Findings for the rest of the tutorials were mixed, leading Oud to conclude that librarians cannot assume or trust that vendor-created content will be accessible for their patrons and therefore they are not a viable alternative for creating instructional material in-house.

The need for improvement of the accessibility of vendor-created content was also found by Wendy Walker and Teressa Keenan (2015) when evaluating content management systems. They studied Berkley Electronic Press's Digital Commons and OCLC's CONTENTdm. The methodology only involved one visually impaired participant and the results are therefore based on subjective feedback from one person. However, the findings are similar to other research on vendor products despite being based on feedback from one person. The participant faced problems resulting from "inconsistent or repetitive use of headings, poorly described links, and inadequately marked page elements." The participant found CONTENTdm to be less accessible than Digital Commons. This result has strong implications for archives, which frequently use CONTENTdm or other vendor-produced content management systems.

A significant portion of the literature has examined library website accessibility with validators such as Bobby and WAVE. Bobby provided similar web evaluation

functions as WAVE, but the tool is no longer available. Overall, it has been found that the compatibility of library websites with assistive technologies could be improved. Instead of solely testing accessibility, Erica Lilly and Connie Van Fleet also looked for a relationship between the accessibility of the library homepages and indicators of institutions' resources as conveyed by Yahoo!'s ranking of computer resources, ARL's ranking of libraries resources, and Carnegie Classification's range and extent of academic and research resources (Lilly & Fleet, 2000). The researchers, using Bobby, found that forty from Yahoo!'s list of the "100 Most Wired Colleges" in 2000 were accessible and that no relationship between accessibility and institutional resources existed.

Succeeding studies produced similar results. In 2006, Julia Huprich and Ravonne Green (2006) found that only 14% (three websites) of the Council on Public Liberal Arts Colleges (COPLAC) libraries' websites had no accessibility errors based on an assessment using the WebXACT validator. However, 86% of the websites had an average of 1.24 errors signifying that COPLAC institutions may be generally aware of accessibility standards and are working towards them. Two years later, Schmetzke and Comeaux discovered comparable results when researching website accessibility of academic libraries in North America. Going further, they also evaluated the websites of library and information science (LIS) schools (Schmetzke & Comeaux, 2009). The latter earned a Bobby approval rating of 47%, while academic libraries had a 60% approval rating. The low inaccessibility of LIS websites greatly concerned Schmetzke and Comeaux for two reasons. One is that people with visual and hearing impairments may not successfully complete LIS programs, thus affecting the future representation of this population in the profession. Second, LIS schools are failing to lead by example, which

also made the authors question the extent to which these schools are addressing accessibility design in their curriculum. Little coverage of the topic will not produce graduates who initiate or improve upon policies to create barrier-free electronic resources at their institutions. While Mary Cassner, Charlene Maxey-Harris, and Tonya Anaya (2011) also studied academic libraries in the U.S., they focused more on the elements of websites rather than their technical structure. In their sample of 99 ARL members' websites, the researchers found that 64% had a mission statement specific to patrons with disabilities, 88% had a dedicated webpage for people with disabilities, and 87% of those listed the assistive software and hardware provided by the libraries.

Academic library websites have received a large amount of attention from researchers, but there have been studies concerning public community libraries. Most recently, a study used the WAVE tool to check the websites of the members of the Urban Libraries Council for compliance with Section 508 and, like other studies, found that the majority of homepages on library websites have coding errors that prevent full accessibility (Liu, Bielefield, & McKay, 2017). The websites of the members of the Urban Libraries Council had been previously tested in 2014 by S.L. Matta Smith. The researcher concluded that it is important for libraries not just to develop websites for individuals with disabilities, "but to design library websites that bridge the gaps in function and use for all members of the community" (Maatta Smith, 2014). Other researchers have conducted investigations by state rather than evaluating libraries across the country. The websites of public libraries in Florida (Brobst, 2009), Georgia (Ingle, Green, & Huprich, 2009), and Indiana (Thorpe & Lukes, 2015) all could be improved to reduce accessibility errors.

Lastly, some researchers have begun exploring how metadata associated with digital collections can be used to increase accessibility rather than just discoverability (Beyene, 2017; Beyene & Godwin, 2018; Cheetham et al., 2014; Keenan & Walker, 2018). Research is starting to move beyond solely evaluating the homepages of websites. The studies conducted by librarians have demonstrated that adhering to accessibility guidelines will improve electronic content and websites for all users, not only those with disabilities.

Accessibility Research Conducted by Archivists

Despite the survey conducted in 2008 (Ganz, 2008) to investigate how archivists work with patrons with disabilities, there has been little further research on this topic. In a journal run of the *American Archivist*, only three articles were found on the topic of people with disabilities. The first article was published in 1983, decades before Ganz' survey. Brenda Kepley (1983) argued that archivists were not recognizing the needs of researchers with disabilities and that it was imperative for them to do so. As literature still shows it to be the case, Kepley asserted that the archival profession lags behind library science and museum administration when it comes to making their collections accessible. Due to its time of publication, the article does not address digital collections or websites. Kepley offered suggestions as to how archives can improve access for deaf, blind, and physically disabled users, while also questioning how much time and resources archivists should expend to assist users with their research. Kepley affirmed that archives are limited in their ability to make accommodations "because of staff, money, the needs of other researchers, or because the needs of a disabled researcher conflict with our primary responsibility to the documents themselves."

Twenty-nine years later, Lora Davis (2012) expressed a similar sentiment to Kepley: archivists still have a lot to learn about making their resources accessible to those with disabilities. Davis had trouble finding literature on archival website accessibility and had to rely on research from other fields for her 2012 article about the accessibility of websites created by the Philadelphia Area Consortium of Special Collection Libraries. The lack of discussion regarding this topic in the archival profession did not despair Davis because of the increasing focus on usability studies, user-centered design, and archival metrics tools created to collect user-based evaluation data. However, unlike many of the researchers in the library field, Davis does not consider automated tools that review website accessibility to be effective and labor efficient. It is for this reason that Davis believes that projects still in development will benefit more from the latest advancements in accessibility guidelines and usability testing. Her concluding comments suggest that she does not foresee content previously published on websites being transformed into accessible content (Davis, 2012). Others outside the field have echoed Davis' sentiments that website accessibility should be tested in a more holistic manner and with usability studies rather than with automated tools (Aizpurua, Harper, & Vigo, 2016; Craven & Nietzio, 2007).

While there appears to be little formal research and literature in the archival field, there is some evidence of practitioners beginning to focus on the accessibility of their online collections. For example, Courtney Tkacz gave a presentation at the Mid-Atlantic Regional Archives Conference 2017 Fall Meeting titled, "Beyond Alt Text: Accessibility in Digital Collections." Tkacz, Archivist at the Virginia Museum of Fine Arts, proposed that the field needs to move beyond traditional web accessibility initiatives and commit to

providing wider access to digital collections. In the presentation published on the Digital Repository of the University of Maryland's website, she asserts that digitization does not mean that "we are addressing the needs of the 253 million visually impaired and 360 million hearing impaired people worldwide" and points out that federal funding sources, e.g. the National Endowment for the Humanities (NEH), do not require accessibility measures for digitization projects. Tkacz was assured that developers were going to follow WCAG guidelines for their NEH funded project to digitize the Lillian Thomas Pratt archives. However, when testing the digital collection with the WAVE tool that checks for accessibility errors and features, she learned the developers did not do so. One of the biggest problems was the lack of alternative text for digitized documents. To increase the accessibility of digital collections, Tkacz suggested manual transcription (either in-house or outsourced), full text indexing (OCR), and summaries/verbal descriptions. As there are trade-offs between staff-time, cost, and level of accessibility for these strategies, Tkacz believes archivists need to take a hybrid approach just like they do for processing and digitizing collections (Tkacz, 2017).

METHODS

The inspiration for this study came from previous research studies that have evaluated the accessibility of library websites. These studies, many of which are discussed in the literature review, have informed aspects of the methodology. This study seeks to provide results that can be compared to those of the library website studies. WAVE was one of the most popular accessibility checker tools used by researchers to examine library websites. Therefore, WAVE was chosen as the evaluation tool in this study. Many studies in the past have only tested the homepages on websites. The websites in this study were tested in greater depth as a random sample of all webpages that provided information about conducting archival research were tested. Some of these webpages contained digital collections, which Tkacz (2017) suggested should be studied. The presence of institutional accessibility policies on the sampled websites was documented, too. Lastly a survey was disseminated among archivists to collect data that cannot be collected by examining websites.

Evaluating Websites using WAVE

The most popular programs used in previous studies to evaluate the accessibility of library websites were WAVE and JAWS. Due to the limitations involved with writing a master's paper, websites were not evaluated with JAWS or Window-Eyes, which are both screen-reading software rather than website evaluation tools. WAVE is a free web-based service and provides data that can be compared to previous research. This web accessibility evaluation tool was developed by WebAIM and launched in 2001. The

official website for WAVE (<https://wave.webaim.org/>) reiterates that the tool cannot be used to determine “true accessibility” and that a report with no errors does not mean that a webpage is truly accessible. Only people can determine whether webpages are completely accessible and WAVE is more effective when used by those with knowledge about web accessibility. Despite these limitations, it is a useful tool to create awareness about and highlight accessibility problems with websites.

The sample of websites to be tested with WAVE was determined using the Society of American Archivists’ directory of institutional members in the U.S. While it is not a complete list of all of the archives in the country, it is a convenient source to obtain a representative sample. In February 2018, there were 600 institutions listed in the directory. Archives that were affiliated with academic libraries or public libraries were excluded from the sample. Generally, these archives’ websites are part of the larger academic libraries’ or public libraries’ websites. As a large quantity of research has previously been conducted regarding library websites, the researcher wanted to examine websites outside of that realm. Presidential libraries were the exception as the National Archives and Records Association administers them. Websites that only contained one webpage regarding archives and archival research were also excluded from the sample. For example, some corporations and non-profit organizations only had one page on their website dedicated to their archives. The application of this criteria and the inability of WAVE to test some websites, presumably because of their coding, dwindled the sample down to 92 websites.

The websites were tested from May-October 2018. For each website, the WAVE tool was run on every page that pertained to conducting archival research and digital materials. For example, the websites of government archives are frequently a collection of webpages on the main state government website. Therefore, only webpages that provided information about an archive's collections and facilities were sampled from. The researcher acknowledges that this could be subjective. The WAVE settings were selected to find elements that fall under Section 508 and WCAG 2.0 guidelines.

Only pages published by the institution were tested. Many archives host digital objects on websites powered by vendor-created content management systems, which were out of the scope of this research. Every website comprised of a different number of webpages. Some websites only had four relevant pages, while others had over fifty. There was no efficient way to determine how many pages a website contained before beginning the analysis. For testing, the researcher decided not to set a page minimum or maximum in order to capture data that fully represented each website. The number of pages tested for each website is disclosed in the results tables in the appendices. Another challenge was that the amount of digitized collections, finding aids, and resources provided varied greatly among websites. As well, some institutions had multiple websites for different digital collections. To create some order and equivalence, the researcher used the following guidelines:

- When there were lists of links to other pages, half were selected for testing using a random number generator. When there were links to 50 or more pages, one-quarter were randomly selected to test. For example, when

there were 50 linked pages, 25 of them were tested. When there were 80 linked pages, 20 of them were tested.

- When lists of links to other pages were alphabetized, the first item under each letter was tested.
- Archives occasionally linked to a search in their database that the archivists had already performed. In these situations, the search results page and the page that the first result linked to were tested.
- Collections that were featured on homepages were tested because the researcher assumed that featured collections would receive a relatively high amount of web traffic.
- Websites with different URLs, but clearly published by the institution under study were tested. The copyright at the bottom of webpages was used as the indicator.

For websites containing less than 10 pages, no random selection took place and all of the webpages were tested. This methodology was by no means perfect, but provided a way to randomly select pages from among hundreds; the final number of pages examined was 3,572. PDFs, a popular format for finding aids and policy documents among the websites studied, were unable to be tested by WAVE because the software lacks the function to do so.

The researcher navigated the websites page by page, clicking on all links to discover new pages. Pages were tested using the WAVE evaluation tool, which simply required entering the URL for each page on WAVE's website (<https://wave.webaim.org>). WAVE reports are divided into the following six categories: Errors, Alerts, Features,

Structural Elements, HTML5 and ARIA, and Contrast Errors. Errors are problems that need to be fixed, features indicate elements that aid accessibility, alerts are elements that could potentially hinder accessibility, and contrast errors signal problems for color blind users. ARIA elements are “hooks” that screen readers need to work with JavaScript (“WAI-ARIA,” 2015). The overall numbers of items in each of the six categories as well as a list of specific items and their frequency are provided in the findings and appendices. For example, there may be five errors on a webpage consisting of three missing alternative text and two empty headings. Measures of central tendency as well as range were calculated for each category for each website.

Evaluating Accessibility Policies

For each website, the presence of a published accessibility policy was recorded on a spreadsheet. Whether an archive had its own accessibility policy, provided a link to their parent organization’s policy, or if both were present was recorded. When an accessibility policy was present, a checklist was used to record its contents. The researcher documented whether the policy addressed accommodations for physical disabilities, accommodations for researchers with hearing impairments and visual impairments, or both.

Survey

A twenty-question survey about the accommodations provided by institutions for researchers with hearing and visual disabilities as well as archivists’ knowledge of web accessibility was created using Qualtrics. The voluntary survey was sent out to archivists who are members of the Society of American Archivists via the SAA Daily Digest listserv on September 6, 2018 and it closed on October 5, 2018. The identity of the 38

respondents was protected. No personal information was collected and Qualtrics anonymized responses. Respondents were asked the name of the institution at which they work in order to determine if their institutions' websites had been tested, which would provide context for the WAVE results of those websites. The informed consent letter and the survey questionnaire can be found in Appendix E.

.

RESULTS

WAVE Evaluation

Errors	
% of Pages	Number of Websites
Empty Link (42.36%)	Empty Link (69)
Missing Form Label (40.79%)	Linked Image Missing Alternative Text (63)
Document Language Missing (31.58)	Missing Form Label (57)
Linked Image Missing Alternative Text (29.25%)	Missing Alternative Text (46)
Empty Button (24.08%)	Empty Heading (45)
Missing Alternative Text (23.51%)	Empty Button (42)
Empty Heading (10.36%)	Document Language Missing (38)
Image Button Missing Alternative Text (5.12%)	Empty Table Header (14)
Broken ARIA Reference (3.42%)	Image Map Area Missing Alternative Text (10)
Empty Table Header (2.46%)	Image Map Missing Alt Attribute (10)
Broken Skip Link (2.21%)	Multiple Form Labels (8)
Image Map Area Missing Alternative Text (1.96%)	Spacer Image Missing Alternative Text (7)
Image Map Missing Alt Attribute (1.88%)	Broken ARIA Reference (7)
Spacer Image Missing Alternative Text (1.62%)	Image Button Missing Alternative Text (6)
Missing or Uninformative Page Title (0.76%)	Missing or Uninformative Page Title (5)
Multiple Form Labels (0.39%)	Broken Skip Link (5)
Invalid Longdesc (0.06%)	Invalid Longdesc (1)

Table 1: Frequency of errors across pages and frequency of errors across websites.

Errors

Overall, the majority of websites tested with the WAVE tool contained errors and alerts that would affect users navigating with screen readers and users with visual impairments. These errors convey that Section 508 and WCAG guidelines are not being implemented. Only eight of the ninety-two websites contained zero errors on all pages or an average of less than one error across pages. These institutions were: American Foundation for the Blind, Georgia Archives, Gerald R. Ford Presidential Library, Jimmy Carter Presidential Library, Nevada State Archives, Smithsonian Archives of American Gardens, Smithsonian Institution Archives, and Williamson County Archives. A total of 17 different types of errors were found across all the websites. However, only four

types of errors were found on more than 25% of the 3,572 pages that were tested. The top five errors across pages were: empty link (42.36%), missing form label (40.79%), document language missing (31.58%), linked image missing alternative text (29.25%), and empty button (24.08%). Calculating errors based on the number of websites they appeared on resulted in a slightly different top five: empty link (69), linked image missing alternative text (63), missing form label (57), missing alternative text (46), and empty heading (44). See Appendix A for the prevalence of errors for each website tested.

Errors				
Type of Institution	Number of Websites Tested	Mean	Median	Range
Government/Federal Agency	31	10.18	5.65	0.17-101.78
National Archives & Records Administration	8	7.02	4.725	3.93-23.33
Presidential Library	10	12.60	6.13	0-57.80
Corporate	1	63.67	63.67	N/A
Nonprofit	12	19.03	10.21	0.41-79.04
Historical Society	12	12.36	15.36	1.34-21.62
Research Center	10	10.34	8.82	3.83-21.35
Museum	5	42.63	8.24	0.02-193.98

Table 2: Frequency of errors based on institution type.

The archives-related webpages of corporations, governments of all levels/agencies, historical societies, museums, nonprofit organizations, and research centers were tested. The various websites of the National Archives and Records Administration (NARA) were designated into their own category as the government agency is a leader in the field. Presidential libraries, overseen by NARA, were also analyzed as their own category. The type of institution with the highest average of errors per website was Corporate with a mean of 63.67 errors. However, only one organization, Wells Fargo, fell under the Corporate category. The category with the second highest average of errors (42.63) was Museum. The two categories with the lowest average of errors was NARA (7.02) and Government/Federal Agency (10.18). Those in the middle were Nonprofit (19.03), Presidential Library (12.60), Historical Society (12.36), and

Research Center (10.34). Table 2 provides additional information on the number of websites per category and their medians and ranges.

Of the 3,572 pages tested, 71.12% had one or more contrast errors. This means that there is not enough contrast between the colors used on the webpages to facilitate easy readability by those with color blindness or other visual impairments. Only ten websites possessed no contrast errors or had an average of less than one contrast error. These ten were: California State Archives, Clinton Digital Library, Getty Research Institute, Jimmy Carter Presidential Library, Lesbian Herstory Archives, NARA Chicago, NARA Philadelphia, NARA Riverside, NARA St. Louis, and Williamson County Archives. Contrast error data for each website tested can be found in Appendix A.

Alerts

Alerts were more prevalent than errors. Only one institution, Williamson County Archives, had a website that contained zero alerts. The rest of the institutions' websites had an average of more than one alert. Thirty-two different types of errors were found across the tested websites compared to seventeen types of errors. The most frequent alerts among webpages were: redundant link (60.19%), redundant title text (36.00%), skipped heading level (33.99%), noscript element (31.30%), and unlabeled form element with title (26.76%). As with the errors, calculating alerts based on the number of websites they appeared on resulted in a slightly different top five: redundant link (76), link to PDF document (69), skipped heading level (66), redundant title text (60), and suspicious link text (56). See Table 3 for the prevalence of each type of alert found and Appendix B for the prevalence of alerts for each website tested.

Alerts	
% of Pages	Number of Websites
Redundant Link (60.19%)	Redundant Link (76)
Redundant Title Text (36.00%)	Link to PDF Document (66)
Skipped Heading Level (33.99%)	Skipped Heading Level (66)
Noscript Element (31.30%)	Redundant Title Text (60)
Unlabeled Form Element with Title (26.76%)	Suspicious Link Text (56)
Link to PDF Document (22.32%)	Redundant Alternative Text (45)
Suspicious Link Text (21.89%)	Nearby Image Has Same Alternative Text (44)
Possible Heading (16.43%)	Noscript Element (39)
Justified Text (16.24%)	Suspicious Alternative Text (35)
Accesskey (15.75%)	Unlabeled Form Element with Title (34)
Nearby Image Has Same Alternative Text (14.14%)	Broken Same-Page Link (30)
Redundant Alternative Text (13.41%)	Missing First Level Heading (30)
Suspicious Alternative Text (12.40%)	Long Alternative Text (28)
Very Small Text (11.97%)	Very Small Text (26)
No Heading Structure (9.77%)	Device Dependent Event Handler (26)
Missing First Level Heading (9.46%)	Possible Heading (22)
Device Dependent Event Handler (8.68%)	Justified Text (21)
Missing Fieldset (7.59%)	No Heading Structure (20)
Broken Same-Page Link (5.57%)	Tabindex (19)
Orphaned Form Label (5.46%)	Orphaned Form Label (19)
Tabindex (4.68%)	Accesskey (15)
Long Alternative Text (4.54%)	Missing Fieldset (15)
JavaScript Jump Menu (3.47%)	Audio/Video (12)
Audio/Video (1.20%)	JavaScript Jump Menu (12)
Fieldset Missing Legend (1.15%)	Possible Table Caption (9)
Possible Table Caption (1.12%)	Link to Word Document (9)
Link to Excel Document (0.34%)	Link to Excel Document (5)
Link to Word Document (0.22%)	Fieldset Missing Legend (4)
Flash (0.09%)	Flash (4)
Underlined Text (0.08%)	Underlined Text (1)
Plugin (0.03%)	Plugin (10)

Table 3: Frequency of alerts across pages and frequency of alerts across websites.

The only corporate institution included in the study once again ranked the highest with an average of 89.80 alerts. The next two categories of institutions with the highest average of alerts across pages were Presidential Library (54.05) and Historical Society (42.26). The two with the lowest average were NARA (11.27) and Government/Federal Agency (18.86). Those in the middle were Research Center (27.11), Nonprofit (22.70), and Museum (21.60). Table 4 provides additional information on the number of websites per category and their medians and ranges.

Alerts				
Type of Institution	Number of Websites Tested	Mean	Median	Range
Government/Federal Agency	31	18.86	12.73	0.17-101.78
National Archives & Records Administration	8	11.27	10.91	7.46-18.70
Presidential Library	10	54.04	27.24	6.90-212.00
Corporate	1	89.80	89.90	N/A
Nonprofit	12	22.70	8.25	3.70-81.50
Historical Society	12	42.26	22.73	5.42-136.66
Research Center	10	27.11	19.67	4.00-65.84
Museum	5	21.60	24.80	6.95-34.72

Table 4: Frequency of alerts based on institution type.

There were only 12 websites that contained embedded audio and/or video files that received an Audio/Video alert. Three of those websites contained audio files without accompanying transcripts. One website had audio files with associated PDF transcripts, but those documents were not machine-readable. There was inconsistency among five websites; there were transcripts for some audio files and none for others. For embedded videos, two websites did not provide closed captioning or transcripts while one website provided both.

Features, Structural Elements, HTML5 and ARIA

Encouragingly, there were only two websites that contained no features to assist with readability or had an average of less than one feature. The two websites belonged to the Century Association Archives and the South Dakota State Archives. This high presence of features suggests that there were many instances when content was coded correctly to aid navigation. As well, every single website tested had at least one page that contained at least one structural element. Structural elements are especially important to help screen readers navigate tables. On the other hand, there were eleven websites that did not contain any or had an average of less than one HTML5 and ARIA elements to help screen readers navigate their webpages. ARIA, which stands for Accessible Rich Internet Applications, is code that supplements HTML to make web content accessible

for users with disabilities. However, the presence of HTML5 and ARIA elements does not always indicate a lack of accessibility problems. WAVE found HTML5 Video/Audio codes on some websites, indicating that their presence is made known to screen readers. However, no transcripts were provided for audio files in some of those cases. See Appendix B and Appendix C for further data on the features, structural elements, and HTML5 and ARIA elements found on each website.

Accessibility Statements

Thirty-five (38.04%) of the institutions had some form of an accessibility statement, whether on their pages pertaining to the archives or a link on the bottom of the pages to the larger organizations' accessibility statement (if they were a part of a larger organization), or both. For example, NARA College Park had an accessibility statement on its own webpage that only addressed physical disabilities, but its webpages linked to an accessibility statement on NARA's main website that applies to all of their museums, research facilities, and Presidential Libraries. The overarching policy states that sign language interpreters are available upon request and that all of the sites are regularly monitored to ensure that they meet the requirements of Section 508 and WCAG guidelines (National Archives and Records Administration, 2018). Both the Dwight E. Eisenhower and Franklin D. Roosevelt Presidential Libraries' websites also link to NARA's main statement, but have their own webpage dedicated to accessibility. According to that FDR Library, they "believe that [their] web sites are compliant with Section 508 and W3C" (FDR Presidential Library & Museum, n.d.). Yet, the WAVE tests show that the NARA websites do not entirely meet these standards. Both Presidential Libraries encourage users to contact them if they are having any difficulties.

Not all accessibility statements addressed hearing and visual impairments. The FAQ section on The Historic New Orleans Collection's website, mentions that the facility is wheelchair accessible and ADA compliant. There is no mention of the accessibility of their digital resources. As well, the Atlanta History Center and the NPS Olmstead Archives only mention physical accommodations on their websites. Only two archives specifically address hearing and visual impairments on their own webpages. The Austin History Center offers "Adaptive equipment: Kurzweil reader, Jaws and Magic" (Austin History Center, n.d.-b) while the Center for Jewish History offers "ASL interpreting, Adaptive Computer Technology, Assistive Listening Devices" (Center for Jewish History, n.d.). The New York State Archives addressed accessibility on their page dedicated to research room rules. Very generally they state that "a researcher may ask a supervisor about arranging for a reasonable accommodation for a special need" (New York State Archives, n.d.). Each of their webpages also provide a link to the New York State government's accessibility policy.

Twenty-five archives had links on the bottom of each webpage to their parent organizations' accessibility statements. Most of the accessibility statements by government archives mentioned that they make efforts to be compliant with Section 508. The statements of the California, Massachusetts, New Jersey, New York, North Carolina, South Dakota, Utah, and Vermont state archives claim that their websites are designed following WCAG. Seattle was the only local government archive tested that had an accessibility statement. However, it only discusses ADA accommodations. Utah's accessibility statement is the most in-depth. The statement explains the design standards that the website follows, which include straightforward design, images with alternative

text, relative font sizing, navigation, style sheets, layout, multimedia, hypertext links, scripts, and AJAX (Utah.gov, 2018).

Yet, out of all of the archives that had an accessibility statement in some form, only the websites of the Jimmy Carter Presidential Library and the Nevada State Archives had an average of zero and 0.29 errors, respectively. The rest had average errors of greater than one. Each of the archives with accessibility statements in some form had websites that contained at least one webpage with one or more alerts. Regarding contrast errors, six of the institutions with statements had websites with no contrast errors or with an average of less than one contrast errors. This conveys that having an accessibility policy does not ensure a website without accessibility challenges. Further, the Dwight D. Eisenhower Presidential Library and New Jersey State Archives contained websites that did not have any HTML5 and ARIA elements. Again, an accessibility policy does not necessarily guarantee that websites will have elements that assist screen reader navigation. Based on the WAVE results, a published accessibility policy on a website is not a strong indicator of its degree of usability for those with visual and hearing impairments. See Appendix D for a chart conveying the instances of accessibility statements and their coverage.

Survey Results

Thirty-eight respondents began the survey, twenty-four agreed to the consent letter that served as the first question, and twenty-three respondents fully completed the survey. Of the five respondents that stated their institution has a formal accessibility policy, only three of those are published online. Out of those five institutions, three institutions provide assistive technology for their patrons. Two institutions provide screen

readers, one adds closed captioning to any audiovisual materials, and another provides scanning and optical character recognition (OCR) services. See Table 6 for their exact responses. One of the respondents works in a special collections library that does not have assistive technology, but the main library has a designated station with adaptive technology. In total, seven respondents reported that their institution provides assistive technology, fifteen reported that theirs does not, and one was unsure.

	Respondents	Yes (%)	No (%)	Not Sure (%)
Provide Reference Services	24	87.50	12.50	-
Finding Aids Published on Website	23	82.61	17.39	0.00
Digital Collections Published on Website	23	86.96	13.04	0.00
Accessible Delivery of Electronic Materials & Accessible Website Design Discussed in Graduate Programs	23	17.39	82.61	0.00
Assisted Researcher with Hearing or Visual Impairments	23	47.83	43.48	8.70
Researchers with Hearing or Visual Impairments Needed to Use Digital Collections	20	45.00	35.00	20.00
Knows American Sign Language	23	13.04	86.96	-
Other Employees Know ASL	23	30.43	17.39	52.17
Institution has Formal Policy for Working with Researchers with Hearing and Visual Impairments	23	21.74	30.43	47.83
Policy is Published on Website	5	60.00	20.00	20.00
Institution Provides Assistive Technology	23	30.43	65.22	4.35
Archives Staff Develops its Own Website or Webpages	23	39.13	60.87	0.00
Institution's Website or Electronic Content Has Been Checked for Compatibility with Screen Readers	23	43.48	17.39	39.13
Compatibility Errors Were Found	10	40.00	20.00	40.00
Received Formal Education on HTML	23	34.78	65.22	0.00
Coworkers Received Formal Education on HTML	23	56.52	8.70	34.78

Table 5: Survey responses.

Only two of twenty respondents who provide reference services as part of their job responsibilities know some amount of American Sign Language (ASL) and only three respondents overall know any ASL. Seven of the respondents have coworkers who are familiar with ASL. Based on the responses, whether any of their reference archivists know ASL is unable to be determined. Finding aids are published online by 82.61% of the respondents' institutions and digital collections appear on 86.96% of the websites

belonging to the respondents' institutions. Of the twenty institutions that have digital collections online, ten have tested their electronic content. Nine out of the nineteen institutions with online finding aids have tested their electronic content. Of the ten respondents whose institutions tested electronic content, four of them found compatibility errors while four respondents were unsure of the testing results. Nine respondents confirmed that their archives staff is involved in the development of their webpages. Out of those nine respondents, four have received formal education on HTML and seven have coworkers who have received electronic content. Accessible delivery of electronic materials and/or accessible website design was discussed in only 17.39% of the respondents' graduate programs. None of the respondents were affiliated with any of the institutions whose websites were tested with WAVE.

Respondents Answers to Type of Assistive Technology Institutions Provide to Researchers
"Computer program"
"scanning and ocr services, document preparation, sound recording duplication"
"screen reader"
"We have screen readers. We also CC any audiovisual. We have a robust DSS department"
"I have a grad assistant that is legally blind and she uses features on Word to flip the black and white of documents and increase text size. The main library has a designated station with adaptive technology, but the special library I work in does not."

Table 6: Survey respondents' write-in answers to question about the assistive technology their institution provides.

DISCUSSION

The survey results align with results of the WAVE testing. While archives' digital resources are not completely inaccessible, there is room for improvement. The errors found by WAVE across the 92 websites can impede usability and hinder the interpretation of digital objects that archives put online. Errors arise when a webpage's source code is flawed or essential code is absent. Whether looking at individual occurrences of errors across webpages or the frequency across websites, the most numerous error was empty link. This error means that a link contains no text to describe its functionality or target. Therefore, a screen reader will not be able to inform its users of the purpose of the link. Similarly, empty buttons on webpages prevent users from knowing the purpose of the button because there is no descriptive text for the screen reader to deliver.

Five of the seventeen types of errors found in this study are caused by missing alternative text from images, image buttons, image maps, or spacer images. Alternative text lets users know the purpose of digital objects. If an image is missing alternative text, then those using screen readers will not have any information about what the image is depicting. This is a very important consideration for archives because so many upload their photograph collections to their websites. As well, quite a few of the archives uploaded archival documents as image files, e.g. JPEG, without providing transcripts. It is practically impossible for screen reader users to gather any meaning about images without alternative text or transcripts.

Empty heading was another widespread error among the websites that affects the interpretation of pages. This error was reported when no content was found in a heading. Many screen reader users navigate webpages using heading elements and therefore, a lack of heading information would decrease their ability to efficiently do so. Ensuring that the language used to write the content of the webpages is identified is another way to help screen readers interpret webpages. Yet, the document language was missing from nearly a third of the webpages tested.

Missing form labels should be a concern for archives because they frequently have “Ask an Archivist” forms and search boxes on their websites. It is likely that the purpose of the form control, e.g. “enter your name” will not be conveyed to screen readers. All of these errors prevent screen readers from gathering essential context and navigation information to relay to their users.

The alerts found by WAVE do not make websites inaccessible, but it is still important to be aware of them and remedy them. Alerts signify elements that may cause difficulty interacting with websites or that have the potential to render content inaccessible. Redundant links are adjacent links that point to the same URL, which result in additional navigation and repetition for those utilizing screen readers. Other instances of duplicate information found involved redundant alternative text. An alert code for this was issued when the alternative text for an image was the same as nearby or adjacent text. When an image is not rendered, the alternative text will show. Either way, screen reader users will be presented twice with the same information. In these situations, an archivist is missing an opportunity to more clearly explain what is being portrayed in an image rather than repeating information presented elsewhere on the webpage. Likewise,

WAVE alerted to nearby images with the same alternative text. This is not helpful as it does not distinguish between images for those using screen readers and implies that the content of all the images is the same. However, WCAG guidelines suggest that alternative text should not be too long, which was a problem on 28 websites. Alternative text should be a concise description of the content and function of an image. Long alternative text might indicate extraneous content or that content unavailable to sighted users is being presented. For example, alternative text for a photograph on the Austin History Center's website that WAVE determined to be too long was, "William Sydney Porter, photo taken soon after his arrival in Austin. PICB 07214, Austin History Center, Austin Public Library" (Austin History Center, n.d.-a). None of that information is provided to sighted users in the text accompanying the image.

An alert that signifies a similar problem is suspicious alternative text. WAVE reported this alert when alternative text was insufficient or contained extraneous information. For example, screen readers inform their users when objects are images, which makes the use of alternative text like "image of..." unnecessary and redundant.

Link to PDF document, the second most frequently occurring alert, should be of great importance to archivists. Many access policies, fees and services policies, collection guides, and finding aids are uploaded as PDF documents. The accessibility of the PDF documents published on the websites in this study is uncertain as WAVE is unable to test the format. PDF documents will not be compatible with screen readers unless the creators take measures to make the documents accessible. One such measure is including an optical character recognition (OCR) process in the scanning of print documents to PDF documents. If possible, a screen reader should be used to test the OCR output. Archivists

should also adjust the color balance of the document to increase readability for those with low vision. Elements within the PDF document should be tagged, alternative text for charts, figures, graphs, and images should be added, and a read order should be manually assigned to aid screen readers. However, HTML is better suited for complex graphs and charts (Browder, 2018). Making PDF documents machine-readable adds time to scanning projects, but it is essential to ensuring the most widespread access to the documents. It appears that most archives included in this study are at least character encoding their PDF documents. Fifty-five websites contained PDF documents that featured text searching, while twelve websites contained some with that functionality and others without it; two did not contain any machine-readable PDF documents.

Many people need to be involved in ensuring widespread accessibility of digital resources because of the interconnectedness of the Internet. Some institutions, e.g. Ohio History, have multiple websites for their different digital collections. It is imperative that all of the websites are being reviewed for compliance and not only the main websites. A fair amount of archives included in the study use third-party systems to host their digital content. Frequent hosting platforms were CONTENTdm, ArchiveGrid, PastPerfect, Achron, the Internet Archive, Flickr, Online Archive of California (OAC), YouTube, and local universities. Archivists should advocate for vendors to develop their products following Section 508 and WCAG standards. This means having conversations with people in IT development. Similarly, archivists who are not responsible for the development of their own webpages should be proactive about checking their websites for accessibility problems and working with their web developers to create the most user-friendly website. This is important because over half of the survey respondents

acknowledged that their archives staff does not develop their own websites or webpages. When problems are discovered, archivists should not feel hesitant to make the website creators aware of them. Many of the accessibility statements on the tested websites had forms asking for feedback on usability and encouraging the reporting of issues.

Missing alternative text was one of the most prevalent errors found by WAVE in this study. This is a situation where archivists might be better at coding webpages than IT staff because they are more familiar with the material. Many of the errors and alerts found could be remedied with basic coding. However, archivists might not possess the knowledge to develop their own websites or assist in editing webpages because they have not received education on relevant topics. Of the 23 survey respondents, 82.61% do not recall the accessible delivery of electronic materials or accessible website design being discussed in their graduate programs. Further, 34.78% of respondents have not received any formal education on HTML and only 56.52% of their coworkers have. The positions their coworkers hold were not disclosed, however. It is unclear whether the coworkers accounted for work with technology services. Regardless, the survey results convey that archivists are not receiving formal education on website accessibility and website creation. Also unknown is what years the respondents attended graduate programs. Therefore, the results may not be an accurate representation of library science graduate programs within the past five years. Current graduate students need to be learning about this topic in order to help improve the accessibility of the digital resources of the institutions they become employed at and to further spread awareness of this important issue. The provision of assistive technology could be covered in reference classes, accessible finding aid formats covered in description classes, and classes covering digital

access could discuss how access involves making sure materials are usable in addition to ensuring material is available to the public.

The types of errors and alerts were fairly consistent across websites. This is most likely because pages within a website adhere to the same template. For this reason, the researcher does not believe that the variance in the number of pages tested across websites posed a significant problem. Even websites that are a part of a larger organization, such as NARA, use the same website template. To be proactive, compliance with Section 508 and WCAG should be evaluated when the template is in development. The colors used in templates should also be tested to ensure high contrast for users with visual impairments. However, many institutions already have websites. These websites need to be reviewed more than once as most websites are not static. The varying presence of audio file transcripts within websites is an example of inconsistency that may occur over time. Verification of compatibility for those using assistive technology should be checked each time a webpage is updated and new materials are published. This is another reason archivists should be involved in the coding of their webpages. The WAVE tool may not catch every error or potential problem, but it is very user-friendly and it is not time-consuming to create accessibility reports. It is a good gateway for archivists to start checking their digital resources. It is also better than not doing anything to check for compliance with Section 508 and WCAG.

The results of the WAVE testing was very similar to the results produced in studies on library websites using similar methodology. The most prevalent errors were the same across studies, which show that these are elements archivists need to pay attention to. Missing alternative text, missing form labels, linked image missing

alternative text, and document language were the most recurring errors found in this study and in the research conducted by Liu and McKay (2017), Matta Smith (2014), and Southwell and Slater (2013). As well, the testing conducted for this study found all of the errors that the aforementioned studies uncovered except for page refreshes or redirects. In Southwell and Slater's (2013) study of 68 finding aids from members of the Association of Research Libraries, only 10.29% produced WAVE reports with zero error codes. Out the 92 websites tested in this study, only two websites had webpages with zero error codes. However, 8.70% of the websites had an average of less than one error code across their websites. The results between the studies, though with different scopes, are comparable and show that library and archive websites need accessibility improvement. For previous studies that used the WebExact and Bobby compatibility checkers, results were also similar to this study. The most frequent errors concerned missing alternative text and missing form labels (Huprich & Green, 2006; Ingle et al., 2009; Spindler, 2002).

As with the error codes, the same types of alerts in this study were too the highest occurring in the studies of Southwell and Slater (2013) and Liu and McKay (2017). These most common alerts were missing first level headings, skipped heading level, and no heading structure. Southwell and Slater's (2013) research also showed the same pattern of alerts codes outnumbering error codes. Some of the conclusions drawn in studies of library websites can be applied to this study. Liu and McKay (2017) argued that the majority of website accessibility problems impact users with vision impairment. The errors and alerts found in this study align with that statement. There were only 12 websites that contained embedded audio and/or video files that received an Audio/Video alert. No transcripts were provided for audio files in many of those cases, which makes

them inaccessible for users with hearing impairments. Other archives hosted their videos on YouTube, which does provide the option for closed captioning. It is still worthwhile for archivists to create transcripts regardless of closed caption options because captions on YouTube videos frequently have errors (Tatman & Kasten, 2017). Despite the greater prevalence of accessibility issues concerning visually impaired users, archivists should remain vigilant about ensuring their audio and video content has accessible transcripts and closed captioning.

Southwell and Slater concluded, as of 2013, that ARIA landmarks, which aid screen readers, had not yet been incorporated into special collection libraries' finding aids. A greater prevalence of HTML5 and ARIA elements were found on archives websites. Only four websites contained pages with zero HTML5 and ARIA elements while the pages of only seven websites had an average of less than one element, meaning that some pages contained elements while others did not. Southwell and Slater (2013) believed the use of ARIA elements would increase over time as they become more widespread across the Internet in general. This study supports that proposition.

Libraries appear to be ahead of archives in providing assistive technology, such as screen readers, or at least stating their availability on their websites. Out of the 92 websites examined for this study, only ten (10.87%) had accessibility statements published online regarding their archives facilities and only two (2.17%) of those disclosed that they have adaptive equipment in their reading room. Fifteen of the twenty-three survey respondents in this study stated that their institutions do not provide assistive technology. Comparatively, Matta Smith (2014) found that 58 out of 127 urban public library websites provided information about accommodations for individuals with

disabilities. A 2011 study on academic library websites found an even higher amount of pages providing information for people with disabilities. Eighty-seven of the ninety-nine library websites tested had such pages and 87% of those pages listed assistive software and hardware (Cassner et al., 2011).

CONCLUSIONS

Archives websites are not in complete compliance with Section 508 and WCAG standards. Only federal agencies need to comply with Section 508, but it is best practice that everyone does. Federal agencies and local governments did have the lowest averages of errors and alerts compared to other institution types, but their websites are not meeting all of the requirements. The accessibility problems on websites can be remedied, albeit with knowledge, time, and resources. However, this is an investment archives should make to ensure that their materials can be utilized by the largest amount of people possible. Archives websites are not far away from reaching full compliance with Section 508 and WCAG. The majority of webpages and digital materials were coded with features, structural elements, and HTML5 and ARIA elements that improve accessibility. Some websites had instances where pages had both the “image with alternative text” feature and the “image missing alternative text” error. Webpage developers need to remain consistent, especially when new content is being added. It is not enough to have a compliant webpage when it is first created. Accessibility measures and verification need to be taken each time webpages are updated.

Archivists can work towards accessible electronic content by participating in the development of their institutions’ websites and advocating for accessible vendor-created products. Including accessible website design in the curriculum of library and information science programs would provide a foundation for archivists to do so.

Archivists should be testing their digital resources with tools like WAVE, screen reading software, and human users. Providing assistive technology in reading rooms will allow researchers with hearing impairments and visual impairments to access digital collections. Archivists should be encouraged to learn American Sign Language in order to better assist hard of hearing researchers in using both analog and digital materials. Lastly, the majority of archives included in this study did not have their own accessibility policies, or do not have them published online. Establishing policies could create more awareness and responsibility.

Future research should evaluate the coverage of digital accessibility in library and information science programs. Students who receive awareness and tools to develop accessible digital information resources will take that education to their future jobs and share it among colleagues who may not have received such training.

LIMITATIONS

WAVE is not a perfect tool and it is not a complete substitute for testing websites with actual assistive technology and human users. However, WAVE was a suitable choice for the amount of time and resources available for this research. There were times when a WAVE report would indicate a certain number of linked PDF documents, but the same amount could not be manually found by the researcher. Reports could lead to false assumptions. For example, looking only at the average number of errors per page for the Century Association Archives could lead to the conclusion that each page had over twenty errors. However, nine of the eleven pages tested only had one error, linked image missing alternative text. The one hundred and seventeen instances of missing alternative text on one page and one hundred and thirty-two instances of empty table headers on another page skewed the data. Even on websites that used the same template for each page, the number of errors, alerts, features, structural elements, HTML5 and ARIA elements, may be different because of the varying amount of content on the pages. It was for these reasons that median, mode, and range data were also provided. Each website had a different amount of content tested. However, every website has varying amounts of pages and content.

It would have been very difficult to determine a preset number of pages to test beforehand. Ideally every relevant page and digital collection for each website would

have been tested. This was not possible due to time constraints. Therefore, websites with the least amount of pages had all of their pages and content that the researcher could find tested while larger websites only had a sample tested. However, because the same types of errors and alerts were common across the webpages of a website (most likely due to template use), the researcher does not believe this significantly compromised the results. A few archives had multiple websites each with different digital resources. Sometimes these websites were developed with other organizations. Only the websites under the sole ownership of the institution included in the sample was tested and the results were calculated as if all of the webpages were under one domain name.

Lastly, the number of survey respondents limits the generalizability of those results. However, the respondents were geographically diverse and were affiliated with diverse types of institutions. On the other hand, the respondents did not fully align with the scope of this study; some worked for archives affiliated with academic libraries. Despite these limitations, the survey is still valuable as it can provide some insight that the WAVE results cannot.

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APPENDIX A: ERRORS AND CONTRAST ERRORS BY INSTITUTION

Institution	Pages Tested	Errors				Contrast Errors			
		Mean	Median	Mode	Range	Mean	Median	Mode	Range
420 Archive	8	5.5	5	5	9-5	2.75	2.5	1	1-6
American Foundation for the Blind	22	0.41	0	0	0-1	5	5	5	5-5
Alabama Dept. of Archives & History	112	2.64	2	1	1-10	3.53	0	0	0-93
Arizona Historical Society	27	4.70	3	3	1-50	17.52	16	16	4-46
Arkansas State Archives	38	3.08	3	3	1-21	35.29	46	46	12-46
Atlanta History Center	8	9.62	10	10	7-12	40.88	8	7	2-274
Austin History Center	107	8.63	8	7	0-27	2.21	0	0	0-18
Brethren Historical Library & Archives	5	8	8	8	8-8	20.8	20	20	19-24
California State Archives	54	1.06	1	1	1-3	0	0	0	0-0
Center for Jewish History	32	8.75	5	5	3-43	9.56	1	1	1-112
Center for the History of Family Medicine	20	21.35	21	21	21-25	3	3	3	3-3
Century Association Archives	11	26.36	1	1	1-134	25.73	13	13	13-131
City of Portland Archives	12	6.18	6	6	6-7	12.64	13	13	11-15
Clinton Digital Library	59	57.80	1	1	0-1563	0.27	0	0	0-4
Delaware Public Archives	112	11.17	11	11	11-30	9.51	9	9	8-13
Densho Archives	67	5.41	4	4	2-29	75.01	32	18	17-986
Dwight D. Eisenhower Presidential Library	102	6.99	6	6	2-37	0.88	1	1	0-1

Franklin D. Roosevelt Presidential Library	20	21	21	21	20-23	127.7	119	119	119-169
Gerald R. Ford Presidential Library	47	0.57	0	0	0-12	19.07	16	16	0-58
George H.W. Bush Presidential Library	23	2.91	2	2	2-5	37.26	51	51	11-61
George W. Bush Presidential Library	70	4.2	3	3	3-29	47	41	42	38-193
Georgia Archives	33	0.27	0	0	0-5	1.45	0	0	0-24
Georgia Historical Society	10	17.9	19	19	7-23	31.6	30	16	16-70
The Getty Research Institute	59	20.25	35	4	4-110	0.90	1	1	0-8
Go For Broke National Education Center	33	11.87	12	12	0-20	4.54	5	5	0-9
History Nebraska	56	3.23	3	3	3-10	1	1	1	1-1
Indiana Historical Society	29	21.62	19	19	11-87	15.59	15	15	8-48
Institute of Child Nutrition	47	4.76	3	2	2-43	105	111	111	11-380
International Monetary Fund Archives	22	6.14	8	8	2-8	8.41	0	0	0-70
Jimmy Carter Presidential Library	41	0	0	0	0	0	0	0	0
John F. Kennedy Presidential Library	73	11.40	10	9	9-29	31.70	33	20	20-70
Leo Baeck Institute	48	9.52	6	4	4-42	29.31	11	7	4-157
Lesbian Herstory Archives	20	7.7	6	6	4-19	0.95	0	0	0-3
Litchfield Historical Society	6	3	2	2	1-7	25.33	25.5	25	11-35
Louisiana State Archives	18	3.83	3	3	3-15	6.67	7	7	6-7

LBJ Presidential Library	66	5.26	4	4	4-25	6.64	4	4	4-66
Maine Historical Society	13	1.34	1	1	1-3	1.23	0	0	0-15
Maryland State Archives	59	6.63	7	10	1-16	4.95	5	5	0-26
Massachusetts Archives	38	6.82	8	8	1-36	26.40	32	8	4-47
Moravian Archives	70	79.04	116	123	1-198	2.81	0	0	0-20
NARA Atlanta	42	3.93	4	4	2-10	6.38	0	0	0-79
NARA Boston	24	6.17	4	4	2-38	1.17	0	0	0-11
NARA Chicago	39	4.23	4	4	4-8	0.05	0	0	0-1
NARA College Park	9	4.78	4	4	4-8	1.33	1	1	1-3
NARA Kansas City	57	4.78	4	4	4-32	10.14	9	9	7-18
NARA Philadelphia	51	4.67	4	4	4-10	0.22	0	0	0-2
NARA Riverside	24	4.30	4	4	4-7	0.8	0	0	0-1
NARA St. Louis	15	23.33	4	4	4-288	0.20	0	0	0-3
National Guard Association of the US Archives	13	1.46	1	1	1-4	5.15	5	5	5-6
NPS Olmsted Archives	2	8.50	8.5	N/A	8-9	7	7	7	7-7
NPS Keweenaw Archives	7	8.43	8	8	8-9	7.14	7	7	7-8
Western Archeological and Conservation Center Archives	4	5	5	5	4-6	3.5	3	3	3-5
National Society Daughters of the American Revolution Archives	15	51.73	26	12	12-238	8.13	9	9	3-12
Naval History & Heritage Command Archives	101	15.97	14	14	13-30	3.55	1	1	0-68
Nevada State Archives	21	0.29	0	0	0-6	18	18	18	18-18
New Hampshire	18	14.89	7	2	2-68	2.44	1	1	1-11

Historical Society									
New Jersey State Archives	68	12.43	5	4	4-87	94.85	66.50	13	11-562
The New Orleans Jazz & Heritage Foundation Archive	107	8.54	5	5	3-18	11.10	9	9	0-43
NYC Records & Information Services	34	4.36	1	1	1-17	1.74	0	0	0-6
New York Historical Society	30	20.80	16.5	22	2-60	48.03	20.50	12	9-353
New York State Archives	101	6.31	0	0	0-56	2.21	1	1	0-7
State Archives of North Carolina	34	5.79	5	5	1-17	9.23	8	8	8-28
North Dakota State Archives	56	1.13	1	1	1-3	10	10	10	10-10
Oschner Archives	4	15.25	15	15	15-16	25.50	25.50	25	25-26
Ohio History Connection Archives	55	5.36	4	4	0-35	21.93	21	5	0-119
Pennsylvania State Archives	57	5.65	3	2	1-63	1	1	1	1-1
City of Philadelphia Archives	21	35.52	25	3	3-162	2.45	3	3	1-6
Political Communication Center Archives	9	7.78	7	7	7-14	5.78	1	1	1-42
Providence Archives	37	1.38	1	1	1-7	6.70	7	7	1-8
Rhode Island State Archives	40	3.55	3	2	1-22	3.35	2	2	2-15
Richard Nixon Presidential Library	46	15.80	15	15	15-45	2.02	2	2	2-3
Rockefeller Archive Center	83	8.90	1	1	1-29	16.24	14	14	9-73
Rutherford County Archives	14	2.79	3	3	0-5	1.50	0	0	0-8
Salt Lake County Archives	48	24.25	4	4	0-562	20.75	21.50	13	4-75
Seattle Municipal Archives	62	16.10	4.50	0	0-88	10.19	9	1	1-48
Smithsonian Institution Archives	51	0.02	0	0	0-1	1.37	0	0	0-32

Smithsonian Archives of American Gardens	20	0.25	0	0	0-2	27.50	25	19	18-69
Smithsonian Freer and Sackler Archives	20	10.65	7	7	4-32	17	6	6	3-210
Smithsonian Archives of American Art	86	193.98	3	2	2-6450	5.92	4	4	4-76
South Carolina Historical Society	9	18.67	14	12	12-63	4.67	5	0	0-10
South Dakota State Archives	32	7.66	7	7	7-11	4.53	0	0	0-38
Telecomm. History Group Archives	23	14.87	16	16	11-31	17.35	22	26	2-71
The Historic New Orleans Collections	33	8.24	6	6	2-20	2.73	0	0	0-32
Utah Division of Archives and Records Service	56	4.32	3	3	2-14	14.04	15	16	0-26
Vermont State Archives	42	1.12	1	1	1-3	33.24	20	20	9-283
Washington State Archives	37	4.35	6	6	2-9	34.20	6	3	3-266
Wells Fargo Corporate Archives	15	63.67	100	2	2-142	11.47	11	11	9-14
Western Reserve Historical Center	12	16.08	13	13	1-86	26.25	2	2	2-143
Williamson County Archives	12	0	0	0	0	0	0	0	0
Wisconsin Historical Society	56	10.73	9	9	5-40	20.98	14	14	8-108
Wyoming State Archives	23	19.09	18	15	15-58	19.43	19	17	12-34

APPENDIX B: ALERTS AND FEATURES BY INSTITUTION

Institution	Pages Tested	Alerts				Features			
		Mean	Median	Mode	Range	Mean	Median	Mode	Range
420 Archive	8	7.38	6	6	6-12	2.75	2.50	1	1-6
American Foundation for the Blind	22	5.77	6	6	1-6	6.60	6	6	6-15
Alabama Dept. of Archives & History	112	2.81	2	2	0-18	1.80	2	2	2-11
Arizona Historical Society	27	79.52	78	78	7-180	1.19	1	1	1-6
Arkansas State Archives	38	35.29	43	43	10-43	4.18	4	4	4-9
Atlanta History Center	8	18.88	15	15	13-48	4.75	5	5	4-5
Austin History Center	107	11.28	10	10	2-36	17.93	10	10	2-36
Brethren Historical Library & Archives	5	7.80	7	N/A	2-14	2.40	2	2	1-4
California State Archives	54	16.60	11	11	4-137	16.40	16	16	16-21
Center for Jewish History	32	34.94	18	12	2-237	19.13	4	4	2-183
Center for the History of Family Medicine	20	45.75	40	38	36-80	11.70	10	10	10-28
Century Association Archives	11	23.55	1	1	0-235	0	0	0	0-0
City of Portland Archives	12	18	17	17	14-23	15.64	15	15	13-21
Clinton Digital Library	59	212	3	3	1-1572	79.07	7	7	0-507
Delaware Public Archives	112	12.73	8	7	6-215	20.85	19	19	15-47
Densho Archives	67	34.07	13	52	2-653	26.94	5	5	1-325
Dwight D. Eisenhower Presidential Library	102	29.46	20	2	2-202	2.92	3	3	0-23
Franklin D. Roosevelt	20	6.90	7	6	3-11	3.80	3	2	2-8

Presidential Library									
Gerald R. Ford Presidential Library	47	159.47	10	2	1-1523	3.11	1	1	1-21
George H.W. Bush Presidential Library	23	9.17	4	3	3-58	9.48	4	4	4-37
George W. Bush Presidential Library	70	23.07	5	4	4-555	23.90	15	15	14-222
Georgia Archives	33	6.73	5	4	4-42	6.24	5	5	5-24
Georgia Historical Society	10	16.40	15	14	9-29	15	12	11	11-34
The Getty Research Institute	59	5.81	4	1	1-55	27.58	10	9	0-458
Go For Broke National Education Center	33	58.64	62	62	1-65	1.91	2	2	0-3
History Nebraska	56	26.29	8	8	8-274	15.64	6	6	6-145
Indiana Historical Society	29	136.66	100	97	88-375	23.52	22	22	18-28
Institute of Child Nutrition	47	54.19	19	105	4-283	3.57	1	1	1-37
International Monetary Fund Archives	22	17.36	7	7	4-130	7.18	6	6	3-17
Jimmy Carter Presidential Library	41	15.71	9	9	0-139	4.98	5	5	2-12
John F. Kennedy Presidential Library	73	27.22	19	13	2-197	8.59	5	5	4-54
Leo Baeck Institute	48	20.46	18	11	11-52	13.65	11	11	5-97
Lesbian Herstory Archives	20	9.95	9	9	6-21	5.70	5.50	5	5-7
Litchfield Historical Society	6	8.17	4.50	N/A	2-24	4.67	3.50	3	3-11
Louisiana State Archives	18	10.50	8.50	7	6-35	7.28	6	6	6-19
LBJ Presidential Library	66	27.26	27.50	18	10-234	5.74	2	1	1-46

Maine Historical Society	13	11.69	7	5	4-38	16.08	12	12	12-40
Maryland State Archives	59	8.95	9	10	0-36	4.29	2	2	0-56
Massachusetts Archives	38	28.29	4.50	4	3-87	2.21	2	2	1-21
Moravian Archives	70	81.50	86	86	1-175	74.19	94	0	0-135
NARA Atlanta	42	18.70	7.50	10	2-278	8.50	5	3	3-40
NARA Boston	24	11.29	8	1	1-41	5.71	5	5	0-24
NARA Chicago	39	9.36	8	6	6-18	3.72	3	3	3-18
NARA College Park	9	12.44	8	7	7-26	45.33	42	28	28-94
NARA Kansas City	57	10.53	8	8	7-30	3.47	3	3	3-24
NARA Philadelphia	51	8.82	7	7	6-21	3.96	3	3	3-13
NARA Riverside	24	7.46	7	6	6-15	3.92	3	3	
NARA St. Louis	15	11.53	9	7	6-25	4.20	3	3	3-12
National Guard Association of the US Archives	13	9.15	4	3	3-72	2.54	2	2	2-9
NPS Olmsted Archives	2	20.50	20.5	N/A	16-25	11	11	11	11-11
NPS Keweenaw Archives	7	12.57	12	9	9-18	13.43	14	15	11-15
Western Archeological and Conservation Center Archives	4	8.50	6	6	4-18	15.50	12.50	N/A	11-26
National Society Daughters of the American Revolution Archives	15	29.33	24	24	19-75	7	7	7	1-12
Naval History and Heritage Command Archives	101	21.57	14	8	7-138	3.45	2	2	2-23
Nevada State Archives	21	9.52	4	3	3-38	12.76	12	9	9-20
New Hampshire Historical Society	18	67.22	23	23	15-467	33	15	10	10-302
New Jersey State Archives	68	11.85	9	5	5-34	8.10	6	6	6-99

The New Orleans Jazz & Heritage Foundation Archive	107	5.17	1	1	0-40	4.03	3	3	0-14
NYC Records & Information Services	34	18.15	15	4	2-87	9.32	8	10	0-42
New York Historical Society	30	59.90	19	5	1-171	9.87	7	7	3-19
New York State Archives	101	20.33	20	20	1-370	16.63	17	17	3-371
State Archives of North Carolina	34	38.24	36	36	35-71	3.94	3	3	3-12
North Dakota State Archives	56	13.05	13	13	11-25	19.32	20	20	18-23
Oschner Archives	4	6.75	3.50	3	3-17	4	4	4	4-4
Ohio History Connection Archives	55	19.16	8	35	2-94	12.98	7	6	1-55
Pennsylvania State Archives	57	29.53	13	13	13-729	10.19	10	10	10-19
City of Philadelphia Archives	21	39.38	34	34	7-218	31.19	9	0	0-222
Political Communication Center Archives	9	4	3	3	3-9	5.89	4	4	4-14
Providence Archives	37	3.70	3	3	2-12	4.95	4	4	4-14
Rhode Island State Archives	40	8.13	7	6	6-26	3.78	3	3	3-11
Richard Nixon Presidential Library	46	30.11	9	8	8-439	8.17	6	6	6-78
Rockefeller Archive Center	83	65.84	7	4	4-1906	58.05	17	17	1-1898
Rutherford County Archives	14	6.71	7	7	1-23	2.86	4	4	0-4
Salt Lake County Archives	48	6.79	5.5	1	1-30	6.48	2	2	2-54
Seattle Municipal Archives	62	54.05	57	58	8-120	12.48	45	56	15-151
Smithsonian Institution Archives	51	24.80	25	25	9-49	9.53	5	4	4-60
Smithsonian Archives of American Gardens	20	6.95	6	6	5-14	5.75	4	3	3-16

Smithsonian Freer and Sackler Archives	20	14.05	5	2	1-74	34.25	9	4	2-470
Smithsonian Archives of American Art	86	24.80	26	27	12-54	25.67	21	21	8-154
South Carolina Historical Society	9	61.11	11	11	6-462	13.33	10	1	1-39
South Dakota State Archives	32	8.19	5.50	5	4-45	0.93	1	1	0-10
Telecommunications History Group Archives	23	8.70	6	2	1-58	14.18	8	0	0-48
The Historic New Orleans Collections	33	37.42	49	51	1-58	10.88	5	5	0-33
Utah Division of Archives and Records Service	56	14.48	14	14	1-52	5.61	5	5	0-18
Vermont State Archives	42	20.05	11.50	8	6-207	13.88	12	12	12-22
Washington State Archives	37	7.32	4	4	3-76	9.05	8	8	6-18
Wells Fargo Corporate Archives	15	89.80	117	131	20-159	13.133	9	9	9-24
Western Reserve Historical Society	12	5.42	5	5	2-15	9.42	10	10	2-20
Williamson County Archives	12	0.17	0	0	0-2	2.25	2	2	0-9
Wisconsin Historical Society	56	15.82	12	12	7-82	4.84	3	3	2-32
Wyoming State Archives	23	101.78	101	103	94-119	20.22	20	19	17-24

APPENDIX C: STRUCTURAL ELEMENTS AND HTML5 AND ARIA BY INSTITUTION

Institution	Pages Tested	Structural Elements				HTML5 and ARIA			
		Mean	Median	Mode	Range	Mean	Median	Mode	Range
420 Archive	8	10.25	8	9	4-29	3	3	3	3-3
American Foundation for the Blind	22	132.27	73	37	33-615	0	0	0	0
Alabama Dept. of Archives & History	112	3.31	1	1	0-29	0	0	0	0
Arizona Historical Society	27	20.92	20	20	12-31	0	0	0	0
Arkansas State Archives	38	29	28	28	19-86	101.95	112	112	78-112
Atlanta History Center	8	46.25	34	33	33-126	20	17	17	1-60
Austin History Center	107	22.11	20	18	13-77	16.98	25	25	0-40
Brethren Historical Library & Archives	5	24.80	23	23	20-34	2.40	2	2	2-4
California State Archives	54	22.64	18	16	15-139	16.77	15	15	15-56
Center for Jewish History	32	60.03	51.50	51	24-22	0.97	0	0	0-6
Center for the History of Family Medicine	20	39.20	37	37	34-58	23.95	22	22	22-46
Century Association Archives	11	9.82	4	4	3-46	15.55	4	4	121
City of Portland Archives	12	24.73	24	32	17-34	10.45	9	9	8-23
Clinton Digital Library	59	87.71	18	19	7-512	4.53	4	4	3-13
Delaware Public Archives	112	17.03	16	16	14-37	9.51	9	9	8-13
Densho Archives	67	15.06	12	12	4-40	75.09	32	18	17-986
Dwight D. Eisenhower Presidential Library	102	10.48	12	12	1-20	0	0	0	0
Franklin D. Roosevelt	20	127.70	119	119	119-169	41.45	24.50	21	17-201

Presidential Library									
Gerald R. Ford Presidential Library	47	29.43	11	6	5-160	19.06	16	16	0-58
George H.W. Bush Presidential Library	23	15.91	7	7	7-64	37.26	51	51	11-61
George W. Bush Presidential Library	70	36.80	34	33	18-87	7.39	7	7	5-9
Georgia Archives	33	22.72	21	16	16-46	4.94	5	5	3-5
Georgia Historical Society	10	33.90	36	N/A	21-45	5.90	6	6	5-6
The Getty Research Institute	59	25.51	23	23	7-71	0.08	0	0	0-3
Go For Broke National Education Center	33	29.85	31	31	0-39	41.09	44	44	0-45
History Nebraska	56	22.79	20	19	19-56	12.91	12	12	11-48
Indiana Historical Society	29	39.97	25	24	21-153	187.03	167	163	156-445
Institute of Child Nutrition	47	13.79	9	9	6-230	9.02	9	10	6-10
International Monetary Fund Archives	22	20.50	14	14	6-147	0.45	0	0	0-1
Jimmy Carter Presidential Library	41	24.93	16	15	3-182	90.10	98	98	1-109
John F. Kennedy Presidential Library	73	29.42	20	18	16-97	5.68	5	5	0-15
Leo Baeck Institute	48	22.88	23	25	16-31	6.62	9	9	0-30
Lesbian Herstory Archives	20	18	20	20	12-22	2	2	2	2-2
Litchfield Historical Society	6	20.50	23	N/A	4-27	39.5	43	43	20-44
Louisiana State Archives	18	39.06	37	36	26-65	290.28	294	294	195-364
LBJ Presidential Library	66	15.97	10	10	10-131	3.80	4	4	0-5

Maine Historical Society	13	23.46	15	14	12-86	0.08	0	0	0-1
Maryland State Archives	59	13.80	10	10	2-71	0.48	0	0	0-18
Massachusetts Archives	38	47.21	15.50	10	10-127	10.84	10	10	9-31
Moravian Archives	70	1.06	0	0	0-48	2.81	0	0	0-20
NARA Atlanta	42	33.86	33.50	33	10-97	6.86	9	0	0-18
NARA Boston	24	40.08	38.50	0	0-159	8.25	9	9	0-18
NARA Chicago	39	37.97	34	30	27-93	10.74	9	9	7-17
NARA College Park	9	45.33	42	28	28-94	14.78	10	10	7-44
NARA Kansas City	57	43.54	43	36	36-80	10.14	9	9	7-18
NARA Philadelphia	51	40.41	35	34	32-214	9.45	9	9	7-17
NARA Riverside	24	53.17	45.50	42	28-120	9.33	9	9	7-17
NARA St. Louis	15	37.80	38	38	31-44	11.27	9	9	7-18
National Guard Association of the US Archives	13	23.15	17	17	16-79	1.54	1	1	1-8
NPS Olmsted Archives	2	74	74	74	74-74	80	80	80	80-80
NPS Keweenaw Archives	7	79.57	80	80	78-80	85	85	85	85-85
Western Archeological and Conservation Center Archives	4	30.50	26.50	25	25-44	31.50	31	31	31-33
National Society Daughters of the American Revolution Archives	15	169.80	129	115	115-341	16.87	17	17	5-19
Naval History and Heritage Command Archives	101	70.22	63	62	47-128	8	8	8	8
Nevada State Archives	21	22.79	20	19	19-56	12.91	12	12	11-48
New Hampshire Historical Society	18	34.52	32	26	26-55	68.14	66	39	23-126
New Jersey State Archives	68	24.66	19	19	14-90	0.01	0	0	0-1

The New Orleans Jazz & Heritage Foundation Archive	107	14.17	11	11	5-25	27.88	8	8	0-60
NYC Records & Information Services	34	5.15	4	4	3-10	7.29	7	7	6-9
New York Historical Society	30	43.47	18	18	7-255	8.73	11	11	1-12
New York State Archives	101	22.78	24	24	8-112	6.59	7	7	0-35
State Archives of North Carolina	34	50.12	41.50	39	33-107	143.56	135	133	130-170
North Dakota State Archives	56	19.57	17	17	17-67	4	4	4	4-4
Oschner Archives	4	51.75	51	N/A	48-57	10	8.50	8	8-15
Ohio History Connection Archives	55	15.40	15	8	1-44	19.09	14	1	0-271
Pennsylvania State Archives	57	110.53	47	38	29-752	86.11	86	86	86-92
City of Philadelphia Archives	21	17.90	0	0	0-71	2.48	3	3	1-6
Political Communication Center Archives	9	8.11	4	4	4-38	0.11	0	0	0-1
Providence Archives	37	30.38	26	26	23-85	22.32	19	19	18-80
Rhode Island State Archives	40	18.65	22	22	6-29	4.38	4	4	4-10
Richard Nixon Presidential Library	46	47.09	25.50	19	19-427	49.46	39	39	38-221
Rockefeller Archive Center	83	68.95	27	21	17-958	123.35	106	106	106-163
Rutherford County Archives	14	16.64	18.50	18	5-22	3	4	4	0-4
Salt Lake County Archives	48	15.22	11.50	6	5-56	4.88	5	5	2-5
Seattle Municipal Archives	62	47.26	45	56	15-151	39.39	61	61	3-182
Smithsonian Institution Archives	51	35.10	34	48	13-76	17.65	16	25	9-45
Smithsonian Archives of American Gardens	20	22	19	12	11-69	3.20	0	0	0-22

Smithsonian Freer and Sackler Archives	20	22.55	23	20	15-51	13.20	9	9	0-112
Smithsonian Archives of American Art	86	61.51	58	55	9-148	16.31	15	15	6-39
South Carolina Historical Society	9	20.11	18	18	9-52	5.67	3	1	1-18
South Dakota State Archives	32	18.16	14	10	9-50	18.41	5	3	3-120
Telecommunications History Group Archives	23	16.26	26	2	0-35	9.26	11	0	0-85
The Historic New Orleans Collections	33	19.91	21	17	2-33	2.18	0	0	0-9
Utah Division of Archives and Records Service	56	90.61	98	98	0-131	53.86	61	61	0-78
Vermont State Archives	42	95.36	91	90	86-220	357.62	351.50	350	343-498
Washington State Archives	37	13.59	10	9	7-38	31.95	47	3	3-256
Wells Fargo Corporate Archives	15	10.87	10	10	10-18	22.80	28	14	14-34
Western Reserve Historical Center	12	36.58	39.50	39	24-43	14.25	19	19	0-19
Williamson County Archives	12	14.08	14	15	9-22	39.42	49	52	0-55
Wisconsin Historical Society	56	51.11	43	43	29-180	11.54	15	15	0-15
Wyoming State Archives	23	91.74	69	64	53-329	60.04	61	61	59-61

APPENDIX D: ACCESSIBILITY STATEMENTS PRESENT ON WEBSITES AND THEIR COVERAGE

Institution	Own Policy	Link to Institution's Policy	Physical Accessibility	Section 508	WCAG Guidelines	ASL Interpreter	Assistive Technology
Atlanta History Center	X		X				
Austin History Center	X						X
California State Archives		X			X		
Center For Jewish History	X					X	X
Clinton Digital Library		X	X	X		X	
Dwight D. Eisenhower Presidential Library	X			X	X		
Franklin D. Roosevelt Presidential Library	X	X	X	X		X	
Historic New Orleans Collection	X		X				
Jimmy Carter Presidential Library		X	X	X		X	
John F. Kennedy Presidential Library		X	X	X		X	
NARA College Park	X	X	X	X		X	
NPS Olmstead Archives	X		X				
Louisiana State Archives		X			X		
MA Archives		X			X		
NARA Atlanta		X	X	X		X	

NARA Boston		X	X	X		X	
NARA Chicago		X	X	X		X	
NARA Kansas City		X	X	X		X	
NARA Philadelphia		X	X	X		X	
NARA Riverside		X	X	X		X	
Naval History and Heritage Command Archives		X		X			
New Jersey State Archives		X		X	X		
New York State Archives	X	X			X		
State Archives of North Carolina		X		X	X		
PA State Archives		X			X		
Richard Nixon Presidential Library		X	X	X		X	
Seattle Municipal Archives		X	X				
South Dakota State Archives		X			X	X	
Vermont State Archives		X			X	X	
Wisconsin Historical Society	X		X				X

APPENDIX E: SURVEY QUESTIONNAIRE

Q1 University of North Carolina at Chapel Hill Research Information Sheet, IRB Study #18-1127, Principal Investigator: Meredith Campbell

The purpose of this survey is to supplement the first part of the research study, which examines the degree to which the websites of randomly selected archives are compatible with screen readers and comply with the Americans with Disabilities Act of 1990. You are being asked to take part in this study because you are a professional in the archival field. You will be asked questions about the accommodations provided by your institution for researchers with hearing and visual disabilities.

Your participation in this study will take about 5-10 minutes. Your participation in this study is entirely voluntary. You can choose not to answer any question you do not wish to answer and you may exit the survey at any point. You must be at least 18 years old to participate. If you are younger than 18 years old, please stop now.

You will benefit from participating in this study by contributing to the archival field and, specifically, help to expand our knowledge on the extent of accommodations provided to researchers with hearing and visual disabilities. The risks from participating in this study are no more than those occurring in everyday life.

To protect your identity as a research subject, no personal identifying information will be collected. Your responses will be anonymized; therefore, your name cannot be connected with your responses and your data will remain completely anonymous.

If you have any questions about this research, please contact the Investigator named at the top of this form by emailing mhhc@live.unc.edu. If you have any questions or concerns about your rights as a research subject, you may contact the UNC Institutional Review Board at 919-966-3113 or by email to IRB_subjects@unc.edu.

I acknowledge that I have been informed of, and understand the true nature and purpose of this study, and I freely consent to participate. I acknowledge that I am at least 18 years old.

☐ Yes (1)

☐ No (2)

Q2 What is the name of the institution at which you are currently employed?

Q3 Is providing reference assistance to researchers a part of your job responsibilities?

☐ Yes (1)

☐ No (2)

Q4 Are any of your institution's finding aids published on its website?

☐ Yes (1)

☐ No (2)

☐ Not sure (3)

Q5 Does your institution publish any digital collections on its website?

☐ Yes (1)

☐ No (2)

☐ Not sure (3)

Q6 To the best of your memory, was ensuring accessible delivery of electronic archival materials and accessible website design discussed during your graduate school courses?

☐ Yes (1)

☐ No (2)

☐ Cannot remember (3)

Q7 Have you ever assisted a researcher at your institution that had any form of a hearing impairment or visual impairment?

☐ Yes (1)

☐ No (2)

☐ Cannot remember (3)

Q8 To your knowledge, have any researchers with hearing impairments or visual impairments needed to use or have used your digital collections?

- ☐ Yes (1)
- ☐ No (2)
- ☐ Cannot remember (3)
- ☐ Not applicable (4)

Q9 Do you know any amount of American Sign Language?

- ☐ Yes (1)
- ☐ No (2)

Q10 Does your reference archivist/s know any amount of American Sign Language?

- ☐ Yes (1)
- ☐ No (2)
- ☐ Not sure (3)
- ☐ I am the reference archivist (4)

Q11 Do any other employees at your institution know any amount of American Sign Language?

- ☐ Yes (1)
- ☐ No (2)
- ☐ Not sure (3)

Q12 Does your institution have a formal policy for working with researchers that have hearing impairments or visual impairments?

- ☐ Yes (1)
- ☐ No (2)
- ☐ Not sure (3)

Skip To: Q14 If Does your institution have a formal policy for working with researchers that have hearing impair...=No

Skip To: Q14 If Does your institution have a formal policy for working with researchers that have hearing impair...=No

Q13 Is the formal accessibility policy published on your institution's website?

- ☐ Yes (1)
- ☐ No (2)
- ☐ Not sure (3)

Q14 Does your institution provide assistive technology (e.g. screen readers) in the reading room for researchers to use?

- ☐ Yes (1)
- ☐ No (2)
- ☐ Not sure (3)

Skip To: Q16 If Does your institution provide assistive technology (e.g. screen readers) in the reading room for...=No

Skip To: Q16 If Does your institution provide assistive technology (e.g. screen readers) in the reading room for...=Not sure

Q15 Please provide the type of assistive technology your institution provides to researchers.

Q16 Did your institution's archives staff develop its website or webpages?

- ☐ Yes (1)
- ☐ No (2)
- ☐ Not sure (3)

Q17 To your knowledge, has your institution's website or electronic content published on its website ever been checked for compatibility with screen readers with an accessibility validator? E.g. WAVE

- ☐ Yes (1)
- ☐ No (2)
- ☐ Not sure (3)

Skip To: Q19 If To your knowledge, has your institution's website or electronic content published on its website... = No

Skip To: Q19 If To your knowledge, has your institution's website or electronic content published on its website... = Not sure

Q18 Were compatibility errors found?

- ☐ Yes (1)
- ☐ No (2)
- ☐ Not sure (3)

Q19 Have you received any formal education on HTML?

- ☐ Yes (1)
- ☐ No (2)
- ☐ Cannot remember (3)

Q20 Have any of your coworkers received any formal education on HTML?

- ☐ Yes (1)
- ☐ Not (2)
- ☐ Not sure (3)