IIIF:
Activating Digital Assets for Accessibility and Creativity

Agnes Etherington Art Centre

December 15, 2023

DESIGN DE Plume INC.

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Foreword

The information, findings, and conclusions contained within this report reflect the current landscape of research related to accessibility and Indigenous language support within the International Image Interoperability Framework. We recognize that conversations related to discrimination, unconscious bias, barriers, and related issues, however unintentional, can be difficult. This document is intended to create awareness and to inform future actions that will help move the needle forward toward greater inclusion and accessibility.

All readers are asked to pledge to enter this conversation with empathy, respect, and a commitment to learning. You may find yourself wanting to question what you are learning; however, we ask that you lean into those feelings and ask yourself why you are having that reaction. Hold space for the experiences of others and understand that systems of oppression are deep-rooted. They can take a lot of work to dismantle, including from within ourselves.

If you would like to learn more, some suggested resources to consult include the following:

- IIIF Consortium
- Why Accessibility Is Important
- Office of the Commissioner of Indigenous Languages

Land Acknowledgement

The authors of this report acknowledge and recognize the land upon which we reside and work, those lands from which this report is being accessed and read, and the deep-rooted and long-lasting wounds caused by white imperialism and settler colonialism. The harmful effects of these actions continue to hurt Indigenous communities across the world. We recognize the responsibility we have as scholars and advocates to amplify Indigenous voices and to carry forward the stories of those who can no longer speak for themselves. We also acknowledge that while we pursue this goal, western cultural and heritage institutions, such as museums, have often been at the forefront of colonial domination and must therefore reckon with their own injustices. We appreciate that Indigenous political, trade, and kinship relationships extend beyond the geographic boundaries that we commonly assign to distinct communities and nations, and we would like to particularly acknowledge the Indigenous Peoples upon whose ancestral lands this report has been researched, written, and produced as follows:

- The Atikameksheng Anishnawbek
- Wahnapitae First Nation
- The Métis Nation of Ontario
- The Anishinaabek People
- The Haudenosaunee
- The Huron-Wendat

Additionally, the authors of this report acknowledge and recognize that this report may be accessed from various locations around the world. Many of these locations include lands that are the ancestral, unceded, and treaty territories of Indigenous Peoples from Turtle Island, Abya Yala, and the Americas in their entirety, to the home territories of Indigenous Peoples in the global arctic, Australia, Polynesia, Africa, Asia, and across the globe. We acknowledge that these lands have been stewarded by these Indigenous communities and nations since time immemorial, and we offer our gratitude to these Peoples. We, moreover, recognize, that five hundred years later, settler colonial nations continue to benefit from the brutal realities of physical and cultural genocide and forced removal that enabled the original settler

colonizers and conquistadores to not only seize and inhabit these lands, but to write the narratives of history that have silenced Indigenous and minoritized voices and stripped these Peoples of their stories, their possessions, and their identities along with their lands. In acknowledging their existence and expressing both our respect and gratitude for their stewardship, we hope to, in some small way, restore some of their dignity.

Acknowledgements

Partners and Contributors

This project is the result of a collaboration between the following partners and contributors:

Agnes Etherington Art Centre

- Gabriel Bevilacqua, Collections and Care Manager
- Alicia Boutilier, Chief Curator/Curator of Canadian Art
- Emelie Chhangur, Director and Curator
- Leah Cox, Exhibitions and Commissions Manager
- Sebastian De Line, Associate Curator, Care and Relations
- Charlotte Gagnier, Programs Coordinator
- Qanita Lilla, Associate Curator, Arts of Africa
- Danuta Sierhuis, Digital Development Coordinator
- Kate Yüksel, Communications Coordinator

Design de Plume, Inc.

- Lisa Baer-Tsarfati, Project Manager and DEI Consultant
- Davide Dorigo, Graphic Designer
- Lindsay Levesque, Graphic Designer
- Mary Medaglia, Digital Project Manager (formerly)
- Erik McManus, Senior Web Developer
- Meggan Van Harten, Partner and Strategic Leader

Prime Access Consulting, Inc.

- Sina Bahram, President
- Luke Leiby, Junior Software Developer
- James Scholes, Director of Digital Accessibility
- Sam Shaw, Director of Operations

Funding

Agnes Etherington Art Centre acknowledges the support of the Canada Council for the Arts.

Executive Summary

The International Image Operability Framework—more commonly known as IIIF—is a promising, open-source suite of technical standards concerned with the interoperability of digital assets across servers and web environments. In this context, interoperability refers to the ability of these assets to work together seamlessly with one another. IIIF enables a range of applications for digitally integrated museums or museums that have fully embraced digital technology, to enhance various aspects of their operations, exhibitions, and visitor experiences to enhance their online offering. Its applications include sharing and reunifying collections cross-institutionally, providing deep zooms into images, and creating annotations, but they can only be considered truly useful if IIIF's infrastructures and applications are re-tooled through an accessibility and inclusivity lens.

Over the past year, Agnes Etherington Art Centre, Design de Plume, Inc., and Prime Access Consulting, Inc. undertook a study to identify several core issues with the existing IIIF specifications and its related applications to analyze opportunities for museums through an intentional technical case study. This report charts pathways toward an accessible and inclusive future use for IIIF, outlines IIIF's role in transforming museum values, and identifies key next steps in achieving a more integrated application of IIIF within the museum sector.

To frame our study, we tested IIIF's viability against its future potential in seven key areas. This established a set of actions for *baseline* improvement.

- **Inclusive Engagement and Accessibility:** Improve IIIF infrastructure to incorporate accessibility features for individuals with disabilities (e.g., providing screen reader support with alt text and visual descriptions for images).
- **Technological Access and Connectivity:** Address the "digital divide", or the unequal access to and use of digital technologies such as the internet and computers among different groups of people or communities, by optimizing IIIF for enhanced remote community access (e.g., reducing bandwidth requirements for loading digital assets in areas with low-bandwidth internet).

- **Indigenous Worldviews and Digital Sovereignty:** Respect Indigenous Sovereignty by embedding Indigenous protocols into a digital sharing framework for culturally sensitive digital access (e.g., creating systems that enable private, tiered, or restricted access as determined by Indigenous communities).
- **Language Revitalization:** Enhance technical support for Indigenous languages to support language revitalization (e.g., re-tool IIIF interfaces and annotations).
- **Ethical Considerations and Cultural Protocols:** Align IIIF with ethical considerations regarding the digital representation of cultural heritage, respecting cultural protocols around what can be shared publicly and what should remain restricted according to Indigenous traditions.
- **Interoperability and International Collaboration:** Enable Canadian museums to engage with international communities and vice-versa (e.g., utilizing IIIF tools of interactivity, interoperability, and findability for global public engagement and research in/across collections).
- **Curatorial and Artistic Innovation:** Create new curatorial and artistic methodologies through IIIF technology (e.g., rethinking by digital display, publishing, and storytelling).

Our findings reveal that to create a more equitable, accessible, and culturally respectful digital museum experience that aligns with contemporary values of inclusion, diversity, and ethical responsibility in the digital space, we need to begin with structural changes in our software development.

Scope of Investigation

A case study from Agnes Etherington Art Centre at Queen's University informs the technical research conducted as part of this project.

Agnes Etherington Art Centre: A Case Study

Situated within territories of the Anishinaabe, Haudenosaunee and Huron-Wendat, Agnes Etherington Art Centre (Agnes) is a curatorially driven and research-intensive professional art centre that proudly serves a dual mandate as a leading and internationally recognized public art gallery as well as an active pedagogical resource at Queen's University in Kingston, Ontario. By commissioning, researching, collecting, and stewarding works of art, and by exhibiting and interpreting visual culture through an intersectional lens, Agnes creates opportunities for participation and exchange across communities, cultures, histories, and geographies.

Its collections—numbering over 17,000 works—include cutting-edge contemporary art and fine examples of Canadian historical art, Indigenous art and historicized Ancestors, and material culture including the Collection of Canadian Dress and the Lang Collection of African Art. The Bader Collection, comprising over 500 works with a focus on seventeenth-century Dutch and Flemish painting, includes one portrait and three exquisite character studies by Rembrandt.

Agnes is committed to anti-racism. The Agnes staff work to eradicate institutional biases and develop accountable programs that support and centre the artistic expression and lived experiences of Black and Indigenous Peoples, as well as all People of Colour. Agnes promotes 2SLGBTQIA+ positive spaces. Admission is free and everyone is welcome.

Project Context

In conjunction with the transformational change occurring as part of Agnes Reimagined, Agnes is planning for digital architectures to support paradigmatic shifts in museological practices. Agnes has emerged as a leader in digital-born programming since 2020 with the

launch of Digital Agnes, a space dedicated to collaborative exchange and experimentation in digital arts and media. Digital Agnes is home to digital arts programming, including commissions, exhibitions, publications, podcasts, children's programs, and more. This research project prototypes an expanded vision and stature for Digital Agnes by innovating how art is presented online in more accessible ways and engages artists and Indigenous and remote communities to imagine new futures for IIIF.

While Digital Agnes was developed with accessibility in mind, recommendations from the museum's digital strategy and audience feedback underscored the importance of enhancing our approach to cultural sensitivity, particularly in providing digital access to Indigenous cultural heritage. This is in keeping with the directives set out by Agnes's Indigenous Advisory Council, and governed by the principles of ownership, control, access, and possession (better known as OCAP), developed by the First Nations Information Governance Centre that assert that Indigenous peoples have control over data collection processes, and that they own and control how this information can be used. As a result, Agnes aims to offer high-resolution images and enriched multimedia content with digital-born experiences, or content and experiences that originate and are designed specifically for digital platforms or online environments, to support the research and interpretation of art collections online. IIIF allows us to engage artists, artworks, and communities in new and innovative ways, expanding what it means to curate in digital space.

Areas of Investigation

In consultation with the teams at Design De Plume, Inc. and Prime Access Consulting, Agnes staff identified a staggered "simpler to more complex" roll-out for potential use cases of IIIF to expand digital infrastructures and build familiarity and digital capacity. This began by integrating IIIF into plans for a reimagined online collections portal and object records.

Informed by Agnes's digital strategy, observed online behaviors on object records—for example, employing user experience analytic tools, like Hotjar, Agnes has noted that users visiting object records on the online collections portal are clicking on images to enlarge them—staff input, and community feedback, the following four priorities surfaced as key areas of investigation for implementing IIIF in Agnes's digital offering for collections access:

Accessibility Enhancements

While IIIF presents promising opportunities for digital initiatives between museums, their visitors and other cultural institutions, the design, development, and technical specifications that underpin IIIF still leave much to be desired around digital accessibility and inclusive design. For example, IIIF currently has minimal to no support for appropriate accessibility metadata, like alternative text descriptions for images, and is incapable of surfacing this metadata in ways that are of use to users who require assistive technologies, such as screen readers (assuming that museums have alternative text and/or visual descriptions for their permanent collections available). This is left to the implementing museum or cultural institution to figure out how to surface this metadata, and accessibility does not seem to be well-integrated within the existing standards surrounding IIIF's APIs or viewers. Some of the IIIF viewers have accompanying Accessibility Statements, measuring their conformance against the WCAG baselines, but simply aiming to meet these standards falls short of what users need for an online experience to be fully accessible to them in usable ways.

Aim: To improve screen reader capabilities for collections images.

Approach: Evaluate IIIF alt text capabilities and evaluate known shortcomings of the Mirador viewer against WCAG criteria.

Optimization for Low Bandwidth

Improving the inclusivity of IIIF also extends to people who may have limited internet access or devices. With digital programming, museums can serve audiences beyond their physical locations, potentially reaching global audiences. However, low bandwidth may still limit how well users can access digital content. Within Canada, 90% of households have high-speed broadband connections, yet the availability of service is distributed unevenly, especially in rural areas and within Indigenous communities. In much of rural Canada, fibre optic and cable infrastructure is underdeveloped: service is often limited to lower-capacity satellite, wireless, and dial-up connections, and there are limited service providers to choose from, resulting in subscription costs that are higher than those for equivalent service in the urbanized regions of the country. For many Indigenous people, these circumstances are amplified. Currently, only 49.3% of Northern households and 43.3% of households on First

Nations reserves have broadband coverage; Nunavut is entirely without broadband infrastructure of any kind, instead relying on satellite connections that top out at speeds of 15 Mbps,31 well below the CRTC universal target speed of 50 Mbps down. Some individuals may only have access to shared community connections and/or devices, further constraining their speed and quality of internet service. The experiences of Indigenous Peoples in Canada reflects the experiences of over half of the global population. "53% of the world does not have access to high-speed broadband, leading to the risk of compounding negative effects in terms of economic, political, and social inclusion and equality." Addressing this digital divide by paying attention to reducing the network payloads and bandwidth requirements of loading IIIF-enabled digital assets will make museums' collections and digital programming more accessible for a wider audience, both at home and internationally.

Aim: To minimize the bandwidth required to load IIIF assets and viewers for improved access for users who have low-bandwidth Internet connections.

Approach: Test and optimize the data payloads required to load IIIF assets and viewers.

Indigenous Cultural Sensitivity

The inherent colonial legacies of museums and their collections also necessitates an examination of ethics, values and mindsets when sharing collections online and the digital tools through which this is accomplished. The ethos of IIIF supports an ecosystem of open access and re-use that has emerged across museums and cultural institutions over the past few decades. While this move towards openness is often for institutional transparency and public engagement, it is also grounded in Western-Euro-centric and Enlightenment values around universal knowledge generation and sharing, which is at odds with Indigenous and non-Western ways of knowing that include culturally specific protocols for what information can and cannot be shared. For Indigenous traditional knowledge, cultural belongings, and Ancestors in the digital space, some data, including images, cannot be publicly shared and any access to this knowledge—either online or offline—must be governed by Indigenous Peoples and source communities, much like visiting certain cultural belongings in-person. Default openness continues to "highlight the loss of control of intellectual property that many Indigenous communities experience… [and the] ongoing exclusion and erasure of Indigenous sovereignty and authority of their voices, representations, and narratives in

GLAMS [Galleries, Libraries, Archives, Museums]."In order to uphold and implement the calls to action in the Truth and Reconciliation Commission's 2015 report, museums must seriously examine their practices for knowledge production, access and authority around the sharing of images and create systems that "ask us to look differently or not look at all". While it is incumbent on museums to reflect on what is shared through their online platforms and seek out Indigenous leadership and guidance, having Indigenous-informed policies and digital infrastructures in place that could support private, tiered, and/or restricted access for communities is imperative should IIIF be chosen by Indigenous communities as a suitable tool for museums to use as part of the rep/matriation process.

Aim: To ensure that any digital access to images of Indigenous cultural belongings and heritage is only available to community members and approved by Agnes's Indigenous Advisory Circle (IAC).

Approach: Develop and test a secure mechanism for a tiered, restricted, private and/or controlled "request for access" model for Indigenous Ancestors or cultural belongings.

Support for Indigenous Languages

Through digital programming, there is an opportunity to contribute to language revitalization efforts by incorporating technical support for Indigenous languages—both oral and written—in IIIF's interfaces and features. While technology can help to facilitate language revitalization, the technology must reciprocally work to further Indigenous communities' aims for their languages, rather than solely benefitting the hosting museum or cultural organization.

Aim: To include Indigenous languages within the platform interface and in annotations.

Approach: Validate the extent to which IIIF viewers can support Indigenous languages.

Research Methods and Findings

Informed by Agnes's case study, Design de Plume, Inc. (DDP) and Prime Access Consulting, Inc. (PAC) tested IIIF's capabilities using the Mirador viewer in order to determine whether and how well IIIF could be considered accessible for deaf-blind and other low vision users, users with low-bandwidth internet, and Indigenous users who wished to access digital content in their native languages. The following sections discuss DDP's and PACs methods and findings.

Alternative Text

PAC conducted an analysis of the integration of alternative text (alt text) into non-moving IIIF images, particularly using IIIF Presentation API Versions 2 and 3 with the Mirador viewer. These APIs are standardized interfaces within the IIIF framework that provide a structured way to describe and interact with digital content. They were used in the analysis to evaluate how alt-text is incorporated into non-moving IIIF images when viewed through the Mirador viewer, which itself was selected because it is a widely used feature-rich and open-source image viewer with support for the functionalities desired by Agnes such as comparison view and annotations. According to Mirador's accessibility statement, Mirador 3 aims for WCAG conformance, and a recent investigation by Barrierfreie Informations- und Kommuikationsangebote des Freisaates Sachesen (BIKOSAX) revealed that it already largely achieved this. PAC's research revealed that built-in support for accessibility features like alt text is not present in the IIIF framework, nor is there explicit accessibility-related guidance included in its documentation. However, we found that using metadata at the root level of the Manifest is an effective workaround, especially with Presentation API V2 as such metadata is surfaced by Mirador as readable HTML. This is the only solution that reliably surfaced alt text. In contrast, Presentation API V3 presented challenges, including the lack of a reliable Manifest generator.

Methodology

PAC's research was conducted with two versions of the IIIF Presentation API as the target: V2 and V3. For each, we experimented with the placement of alt text at different levels in the

Manifest, such as root, annotation, image, canvas, and sequence. The term "levels" in this context refers to the layers within the semantic structure of a JSON (JavaScript Object Notation) file, known as a Manifest in IIIF. These levels are conceptual abstractions that organize data, for instance, dividing a digital book into sequences of "canvases" representing pages. As a Manifest is interpreted by a viewer application, it uses this multi-layered semantic structure to correctly display the content to the user. This hierarchical design, which might include levels for collections, Manifests, sequences, and canvases, is dictated by the IIIF Presentation API specification, ensuring standardized and coherent data representation. The effectiveness of these placements was then evaluated in the Mirador viewer.

For Manifest generation, validation, and image serving, we used the following tools:

- Manifest Generator: Digital Bodleian https://digital.bodleian.ox.ac.uk/manifest-editor/#/?_k=23pq79
- Manifest Validator: IIIF Presentation Validator https://presentation-validator.iiif.io/
- Image Server: Cantaloupe https://training.iiif.io/intro-to-iiif/INSTALLING_CANTALOUPE.html
- Viewer: Project Mirador https://projectmirador.org/

Metadata in a IIIF Manifest consists of JSON key-value pairs that offer additional semantic information not covered by the IIIF specification. An example metadata entry for alt text would be:

```
"metadata": [
 {
  "label": "alt text",
  "value": "A small, yellow labrador retriever puppy looks content with a tennis ball in its mouth."
 }
]
```

Results

The differences between IIIF's Presentation API version 2 and version 3 are extensive, encompassing breaking changes and non-breaking changes. Here are some headlining differences:

Breaking Changes:

- **Property Naming and Semantics Changes**: Renaming properties (@id to id, @type to type, viewingHint to behavior, attribution to requiredStatement, etc.) for consistency and to reflect intended semantics.
- **Property Value Changes:** Changes include allowing long texts in metadata, allowing non-images in thumbnails, and requiring arrays for multiple values.

Non-Breaking Changes:

- **Audio and Video Content:** Introduction of features like accompanyingCanvas, placeholderCanvas, duration on Canvas, and timeMode on Annotation.
- **Additional Features:** Introduction of new behaviors (auto-advance, no-auto-advance, thumbnail-nav, repeat, no-repeat, etc.), adding language on external resources, and adding the services property for Collections and Manifests.

Presentation API V2

Alt text located at the root level of the Manifest displays correctly in the Mirador viewer's Resource section, which allows users to access and interact with various types of resources associated with a digital object or collection being viewed in the Mirador viewer, upon pressing the "toggle sidebar" button. Although the alt text was rendered, it's crucial to understand that this metadata entry applies to the entire Manifest. This method is effective for single-image Manifests but becomes problematic when multiple images or canvases exist. This is because in multi-image Manifests, there is no way to distinguish the alt text or metadata in a meaningful way for each image within the Manifest. It is also important to note that no direct link was created between the image content and its text alternative, requiring users to know where to go looking for it, which makes the framework less accessible for users requiring screen readers.

Meanwhile, placing alt text at the canvas level (representing the individual pages within the Manifest) resulted in a "TypeError: Failed to fetch" error when the Mirador viewer attempted to load the Manifest. The error message did not provide any indication of its cause or possible resolution, but this is not currently a viable strategy because of it.

Finally, inserting alt text at the sequence level (representing the logical order of canvases or images within the Manifest) resulted in the Manifest being successfully loaded, but the alt text was not displayed or surfaced to users in any way. The image was visible, but there was no accompanying alt text metadata in the semantic information rendered by the Mirador viewer. Therefore, this is also not an effective strategy to surface alt text within IIIF.

Presentation API V3

V3 testing was complicated by the lack of a reliable V3 Manifest generator. We modified a Manifest sourced from IIIF's sample recipes, specifically selecting one that suited our focus on a single, non-moving image.

Unfortunately, manually incorporating metadata at the root, annotation, and image levels (annotations and images are both located in the canvas level) resulted in no metadata being rendered in the Mirador viewer, despite successfully loading a Manifest. At present, we are not aware of any means of successfully providing text alternatives for graphical content when Presentation API V3 is in use.

Colour Contrast

DDP conducted an analysis of the accessibility of the Mirador viewer in response to its review of the existing literature related to IIIF accessibility. The BIKOSAX report flagged the following areas for accessibility issues, which DDP reviewed with automated tools and by manually inspecting the viewer and code to determine which, if any, had been resolved since the report was published.

The following issues have been resolved:

- Previously missing or incorrect ARIA labels have been corrected for a number of regions, including the clickable logo linking to the Project Mirador site, the workspace navigation section, and the “Start Here" button.
- Low-level sidebar labels have been appropriately retagged as h4 headings.
- All buttons now provide adequate contrast with their text labels on hover.
- The interface is now mostly responsive and all interface text remains viewable at 200% with browser dimensions of 1280 by 720 px.
- Search autocomplete options, which were not previously navigable by keyboard, now support keyboard navigation.
- The workspace navigation section has been moved outside the main element for immediate access.

However, issues persist around the following:

- As PAC's research reveals, there is no provision yet in the IIIF Manifest for alt text descriptions.
- Colour contrast remains inadequate in several areas, including the Add Resource field label and annotation and search result indicators.
- Tooltips can hide controls or content but are not dismissible without shifting the cursor or focus.
- The page titles of Manifests are simply "Mirador" and do not change to reflect the content being viewed.
- Text in menus does not wrap at smaller display sizes, resulting in labels being cut off.
- Focus states are not adequately visible in sidebar fields.
- The language attribute of the Manifest does not change when the interface language is changed.

Methodology

DDP conducted a thorough review of colour contrast to ensure visual accessibility. For this purpose, we utilized the tool Contraste, which is designed to assess the colour contrast of text, images, and graphical objects against their backgrounds. Our evaluation was guided by the WCAG 1.4.3: Contrast (Minimum) criterion, a key criterion for accessible web content that ensures sufficient contrast between text and its background for users with colour blindness

and vision disabilities. This manual testing involved comparing colour combinations used in the digital resources against the WCAG threshold to ascertain conformance and identify areas needing improvement.

The WCAG 1.4.3: Contrast (Minimum) criterion specifies that text and images of text must have a contrast ratio of at least 4.5:1, except for large text, which has a lower minimum requirement of 3:1. Large text is defined as text that is 18 point (or 14 point if bolded) and larger, recognizing that larger text can be easier to read at lower contrast levels. For smaller text, the higher contrast ratio requirement of 4.5:1 applies.

Results

As with alt text, the contrast ratio between content and its background is a fundamental component of accessible digital design. This pertains primarily to the contrast of text, as well as interactive navigation and control elements like buttons and menus. According to a 2020 report on the accessibility of the Mirador viewer, Mirador's default colour scheme does not meet Web Content Accessibility Guidelines (WCAG) contrast requirements in certain areas. As several years had passed since it was published, we examined the latest iteration of the software to assess the continuing accuracy of this claim. We discovered that certain instances of insufficient contrast had been resolved, such as the Add Resource button, while others remain, including the Resource location field label in the Add Resource pane and the annotation highlights on images. We also noted inadequate contrast with the navigation controls for multi-image resources like manuscripts, with the buttons fading to indicate they are disabled at the beginning or end of a series of images, failing contrast checks in particular.

Mirador currently allows developers to use a dark theme that users can change directly through the interface. Throughout our testing, we have found that even more links become inaccessible when the user switches to dark mode. Some buttons in light mode have an insufficient contrast ratio of 3.1:1, where the contrast ratio needs to be at least 4.5:1 in order to meet AA Level WCAG conformance. In dark mode, the ratio is slightly higher at 4.19:1, but it applies to all text links and most interface components. By changing the button colour to be slightly lighter in dark mode, Mirador's colour contrast could be WCAG conformant.

Speed and Bandwidth Requirements

One of the main purposes of the IIIF framework is to allow users to access and view extremely large image files irrespective of the technical limitations of their devices. It achieves this by using the Image API to convey user requests to an image server, a kind of software that processes and delivers an image or part of one to a user; this offloads the processing off the user's device completely and ensures that images load quickly and at a minimum bandwidth cost, regardless of their device's capabilities. That said, differences in load times will nonetheless occur as a consequence of varying access to network infrastructure. Decades of user interaction research reveals an inverse relationship between load times and user attention span. A 2020 Nielsen Norman retrospective asserts that a load time of even 1 second is enough to interrupt a user's thought process, and that the longer users have to wait for resources to load, the likelier they are to leave altogether. Because of this, DDP deemed it important to investigate potential load times for real-world users of Mirador in-browser.

Methodology

To evaluate the performance of digital resources in various network conditions, we employed Chrome's built-in DevTools's network throttling tool for speed tests. This tool allowed us to simulate different internet speeds, mimicking the conditions that users in low-bandwidth environments might experience. By adjusting the speed settings using this tool, we could effectively gauge the responsiveness and loading times of digital content under constrained internet access. Specifically, DDP tested the demo implementation on the Project Mirador website with the two default Manifests, a self-portrait by Vincent van Gogh, and a collection of eighty-four Indian manuscript paintings in the Mirador comparison view.

Results

One advantage of viewing ultra-high-resolution images using IIIF is its ability to segment them into tiles on the server side, delivering only the pixels necessary to fit the viewport size and zoom level of the viewer. As a result, it is highly performant even with extremely large files, with the limiting factor on response times being the user's device and connection speed. We undertook internal testing, loading several configurations of multi-image IIIF

Manifests in Mirador at a number of speeds, as well as the Wikipedia.org landing page for a baseline of comparison. In the case of both a single Manifest and two Manifests displayed simultaneously in the comparison view, we recorded approximately 1 second response times on initial load at the 50 Mbps download speeds currently available to over 90% of Canadian households. At the 15 Mbps available to satellite internet subscribers in Iqaluit, a single Manifest achieved a 1.27 second load time. Lower speeds resulted in progressively longer load times, though at minimum broadband speeds we recorded load times no higher than 6.98 seconds, and while load times extended to several minutes at dial-up internet speeds, we have no reason to believe this could be materially improved upon by other methods of image delivery. That said, further optimization of load times might be possible through image compression. This was a recommended addition to the 2.0 version of the Image API, specifically to address the needs of users on low-bandwidth connections; it was deferred at that time and does not appear to have come up again in later versions of the specification.

Mirador Time Testing

We tested load times at the following speeds:

- 50 Mbps
- 15 Mbps
- 1.5 Mbps
- 256 Kbps
- 56 Kbps

These are, respectively, the CRTC targeted minimum speed available to all households in Canada by 2031, the current maximum speeds available on satellite in Nunavut, the minimum speeds for broadband and high-speed internet as defined by the CRTC, and the maximum speed for dial-up access.

Test 1

Description of test: Mirador viewer embedded onto a web page with a multi-page Manifest (12 pages). https://iiif.harvard.edu/mirador-viewer/

Details: 39 requests, 3.4 MB of resources

- 50 Mbps
    - Load: 975 ms / Finish: 5.81 s
- 15 Mbps
    - Load: 1.27 s / Finish: 6.14 s
- 1.5 Mbps
    - Load: 6.98 s / Finish: 9.58 s
- 256 Kbps

Controlled Manifest Access

Agnes recognizes the importance of ensuring respectful and responsible access to Ancestors. Indeed, this requirement also extends to digital representations of these items, as on the Agnes website where catalogue listings of Indigenous belongings deliberately do not include photos. In line with its commitment to cultural sensitivity and Indigenous consultation, access to these objects is granted on a case-by-case basis, under the guidance of Agnes's Indigenous advisors. To facilitate this controlled and thoughtful access, Agnes wishes to implement access control measures to its IIIF Manifest. These measures would allow it to manage and grant access to Ancestors in a manner that respects the diverse perspectives, protocols, and considerations shared by its Indigenous partners. This approach reflects its dedication to fostering collaboration, cultural understanding, and the responsible sharing of invaluable cultural heritage objects.

Accordingly, DDP undertook a review of IIIF API access and authentication practices to determine what is currently possible and to make recommendations for Agnes's implementation.

Methodology

DDP's research was conducted by reviewing the documentation for the IIIF Authentication API and its successor the Authorization Flow API, as well as the IIIF community standards and discussions related to controlled Manifest access located on the IIIF Slack server.

Results

Password protection of Manifests appears to have originally been supported under the IIIF Authentication API V1. Our investigation determined that this API has been deprecated and existing implementations of it may no longer work, as it required support for third-party cookies which has been discontinued by all major browsers. Aware of this change beforehand, the IIIF community actively pursued contingency plans, releasing a replacement called the Authorization Flow API in July 2023. Unlike its predecessor, Authorization Flow is not intended to provide authentication services directly; rather, it sits between the image viewer and a third-party authentication service to verify whether the user has permission to view a resource, and if not, seamlessly sends them through the third-party authentication flow and returns them to the viewer without seeing any broken image links. What this means is that the responsibility for controlling access to IIIF Manifests often falls on the systems and servers hosting the Manifests. Server administrators can configure their IIIF server to make certain Manifests private, meaning that they are only accessible to authorized users or applications. Access can be controlled through various means, such as requiring authentication tokens (either issued by OAuth providers or CAS servers) or specific HTTP headers. Many IIIF servers use access tokens or authentication cookies to validate users' permissions. When a user requests a Manifest, the server checks their credentials and permissions before providing access. This allows for fine-grained control over who can view the Manifest.

API V2 introduces a more structured approach to authentication and access control. It defines a dedicated "Authorization Flow API" that allows clients to authenticate and retrieve access tokens from an authentication server. In V2, access control information can be included directly within the Manifest itself. This means that the Manifest can specify who is allowed to view it and under what conditions. V2 introduces bearer tokens, which are included in the HTTP headers of requests to the IIIF server. These tokens are used to authenticate and authorize users to access the Manifest or specific resources within it. Authentication servers can provide token services, which generate and manage tokens for users based on their credentials and permissions. These tokens are then presented to the IIIF server to grant access. V2 allows for extensions that can provide additional access control

mechanisms beyond the core specifications. These extensions can be used to implement custom access policies.

The reason that access to IIIF Manifests primarily relies on external authentication is because IIIF is designed to be a flexible framework that can be integrated into various existing systems and platforms. It allows institutions to leverage their existing authentication and access control mechanisms, rather than mandating a specific approach. External authentication is favoured because:

- **Integration Flexibility:** IIIF is used by a wide range of institutions, including museums, libraries, universities, and cultural heritage organizations. These institutions often have their own authentication systems in place, which may be tightly integrated with their other digital infrastructure. Allowing external authentication means that IIIF can be seamlessly integrated into these existing systems.
- **Security and Compliance:** External authentication mechanisms are often designed to meet specific security and compliance requirements. Institutions may have policies and practices in place to ensure data security and user privacy. By allowing external authentication, IIIF can align with these security standards. This also ensures that questions about data sovereignty, digital protocols, and information processing that institutions will already have addressed in setting up the security of their websites more generally will also be applied to the security of access to their IIIF Manifests.
- **Customization:** Different institutions may have unique access control needs. External authentication allows them to implement custom access policies and user roles, tailoring access to their specific requirements.

In clear and practical terms, the current API specification proposes CAS (central authentication servers), OAuth (open authorization) providers, or tailored login systems as solutions for controlled Manifest access. OAuth is an open standard for authorization and authentication that allows users to grant third-party applications limited access to their resources without sharing their credentials, like usernames and passwords. CAS is a single sign-on (SSO) protocol and system used for authenticating users across multiple web applications or services. It ensures that users only need to log in once to access various applications securely. The flexibility provided by the current Authorization Flow API is highly

convenient for institutions, as it means IIIF clients can pass authentication requests to their existing access control systems if they have them. Although Agnes does not currently make use of a public-facing access control system, a web-based member portal would be a straightforward option that is familiar to users and simple for the centre to implement. This new approach gives Indigenous communities working with cultural institutions the flexibility to tailor their requirements and choose the authentication solution that best suits the needs of the protocols for digital access and visitation with their Ancestors and cultural belongings as part of rep/matriation efforts.

Indigenous Language Support

A 2018 conference paper on the state of technological support for Indigenous languages in Canada revealed that the adoption of Unicode and the expansion of character coverage in standard Windows and MacOS fonts like Times New Roman have greatly improved font support for Indigenous languages on desktop operating systems, and that while system-installed keyboard layouts do not always support syllabics or special Roman characters and diacritics, there is extensive coverage through custom keyboard layouts. Moreover, almost all Indigenous languages have been written in several different orthographies. Yet, little development has been made toward the development of Indigenous-language speech technology despite Indigenous communities expressing great desire for such technologies due to the traditionally oral nature of knowledge dissemination and distribution amongst these communities.

To support Agnes's efforts towards cultural respect and sensitivity in ensuring that text annotations in its Manifest could be offered in Indigenous languages while also working towards the possibility of the full internationalization of the Mirador viewer, DDP conducted an investigation of the integration of Indigenous languages into IIIF Manifests with the Mirador viewer. DDP's research revealed that while Indigenous language support is not a specific consideration in the design and development of the IIIF standards, incorporating Indigenous language text into IIIF experiences may find support using some existing text-to-speech (TTS) programs as discussed below. When analyzing the availability of Indigenous-language instances of the Mirador viewer, DDP was unable to locate any current instances of

the Mirador viewer that had been translated into any of the Indigenous languages currently spoken in Canada.

Methodology

For the assessment of language support, we specifically focused on Inuktitut texts because Inuktitut belongs to the same language family as Kalaallisut, for which a TTS system had already been developed by the government of Greenland. We therefore wished to perform comparative tests with this TTS system, as well as a system designed solely for romanized text to determine what kinds of support might reasonably exist for Indigenous languages. Consequently, these Inuktitut texts were tested using two different TTS systems: MacOS VoiceOver and the *Martha* TTS system, which was developed by the Language Secretariat of Greenland for the Kalaallisut Language. MacOS VoiceOver, a screen reading feature integrated into MacOS, was used to evaluate the intelligibility and clarity of the Inuktitut language in a more common TTS environment. Meanwhile, the Martha TTS system, known for its capability to recognize and pronounce Kalaallisut, a language related to Inuktitut, provided a comparative perspective on language support in specialized TTS technology.

Results

The Mirador user interface has been translated into a number of languages and supports internationalization via community-authored translations. To date, it has not been translated into any of the Indigenous languages spoken in Canada. One potential complication to providing translations is the optimization of text interfaces for European languages, which typically use multiple shorter words to express concepts. By contrast, many Indigenous languages are polysynthetic and agglutinating, with single long words that contain much of the grammatical and semantic content that, in European languages, are conveyed by separate words and phrases; this can result in words getting cut off or broken onto separate lines where interfaces provide insufficient space. Much of the Mirador interface, including the side pane for metadata, is responsive and can be adjusted by the user to resolve this issue, but certain components like menus are not fully responsive and could pose a problem for internationalization. That is, although there is no limit to the length of tooltips used to identify the menu icons in Mirador's sidebar (and therefore, no immediate reason why the

information in these tooltips could not be translated into Indigenous languages), the semantic menus that open when an icon is clicked on are not responsive or customizable in the current version of the Mirador viewer. If the viewport is large or wide enough to accommodate the full length of the words featured in the semantic menu, the menu will stretch to accommodate the length of these words; however, if the viewport is not wide enough to accommodate the length of these words, the menu box will cut the words off. Text will not wrap onto the next line but will instead be completely lost behind the margin of the menu box.

For users of screen readers and text-to-speech software, no speech synthesis technology is yet available that officially supports any of the Indigenous languages spoken in Canada. We investigated the possibility of using an English-language speech synthesis solution for Indigenous-language text, specifically testing both romanized and syllabic Inuktitut using the VoiceOver TTS system. While it can vocalize the romanized text, its pronunciation is clearly tailored to English and is barely intelligible, while it is entirely unable to read syllabic text, instead announcing the Unicode character name for each individual character. Surprisingly, a potential workaround for Canadian Inuit languages does exist in *Martha*. Our investigation revealed that Martha is capable of pronouncing romanized Inuktitut text with a considerable degree of accuracy; furthermore, it can recognize and pronounce syllabic text. Of course, while this has the potential to benefit Inuktitut-speaking users, speakers of other Indigenous languages will remain unserved until further development work is undertaken.

Manifest files allow users to add annotations in Indigenous languages. All that is necessary for these annotations to be readable to users is for their operating systems to support the necessary fonts. In the case of display on the user end, system default fonts should be sufficient in most if not all cases, but depending on the language, users may need to install custom keyboards and/or fonts that support their specific script. Therefore, Agnes would be able to create Manifest annotations in Indigenous languages, even if not machine-readable by TTS engines. This could potentially be enabled directly in the Mirador viewer interface through the use of Mirador Annotations, a viewer plugin giving end users the opportunity to do so independently of the institution serving the object. Institutions and community members could work with the Mirador community to provide translations for the Mirador interface into Indigenous languages. IIIF also supports audio file playback, and such

playback in Indigenous languages can be used by blind and low-vision users to offer spoken descriptions, narrations, and interpretations of visual content. That being said, audio as a substitute for text annotations may not be accessible as it is not transparent to screen readers, limiting its utility to users who can hear the content. Deafblind users interact with computers using braille displays and any non-text content is entirely unavailable to them.

Recommendations

Alternative Text

Immediate Recommendation

Continue using and implementing API V2

While Manifests in the Presentation API V2 continue to be supported, PAC would prefer to be able to recommend migration to the latest specifications, in order to take advantage of added functionalities like including content search within images, multi-language support, and compatibility with complex content beyond static images. Unfortunately, PAC's results indicate that alt text cannot be provided for any content within a V3 Manifest.

Given IIIF's current limitations in how accessibility features like alt text are not explicitly supported, custom metadata can serve as a practical alternative, but only for V2 Manifests and only at the root level.

Concerns about deprecation of the API V2 are valid, but PAC's research found that the most effective solution at the time of this exploration for providing alt text was to create a Presentation API V2 compliant Manifest using metadata at the root level that Mirador will serve. PAC advocates for moving to use V3, but could not identify a solution to surface alt text using a V3 Manifest with Mirador or any other viewer at the time of this research. PAC therefore contends that using V2 in tandem with Mirador is optimal for purposes of surfacing alt text.

Long-Term Recommendation

Advocate for greater accessibility integration in IIIF development

Because IIIF is an open-source software whose development is an ongoing collaborative effort, and its specifications and standards may therefore evolve, the following steps and considerations may help make API V3 or future API versions more accessible by supporting alt text:

- **Engage with the IIIF Community:**
    - Actively engage with the IIIF community, including developers, institutions, and accessibility experts, to discuss the specific accessibility challenges and needs related to alt text in API V3 or future API version.
    - Participate in IIIF working groups, discussions, and mailing lists focused on accessibility to share insights and seek input from others in the IIIF community.
- **Document Accessibility Requirements:**
    - Clearly document the accessibility requirements for alt text and other accessibility features in IIIF API V3 or future API version. Provide detailed use cases and scenarios to illustrate the need for alt text support.
- **Proposal and Specification Enhancement:**
    - Develop a proposal or enhancement request for the IIIF community that outlines the specific changes or additions needed to support alt text in API V3 or future API version.
    - Collaborate with IIIF developers and experts to refine and finalize the proposal, ensuring it aligns with IIIF's goals and principles.
- **Testing and Prototyping:**
    - Conduct testing and prototyping efforts to explore potential solutions for alt text support within the API V3 or future API version framework.
    - Identify any technical challenges and evaluate the feasibility of implementing alt text in V3 or future API version Manifests.
- **Engage with Viewer Developers:**
    - Collaborate with developers of IIIF-compatible viewers, such as Mirador, to explore how they can incorporate alt text support for API V3 or future API version Manifests.
    - Encourage viewer developers to join discussions and efforts related to accessibility enhancements.
- **Community Consensus and Adoption:**
    - Seek consensus within the IIIF community on the proposed changes or additions to API V3 or future API version to ensure widespread support and adoption.
- **Development and Testing:**

    - Work with developers to implement the proposed changes or additions to the API V3 or future API version specifications.
    - Thoroughly test the new features, including alt text support, to ensure they work effectively and do not introduce unintended issues.
- **Documentation and Education:**
    - Provide comprehensive documentation and educational resources for content creators, institutions, and developers on how to utilize alt text support in API V3 or future API version Manifests.
    - Offer training and resources on best practices for creating accessible digital resources within the IIIF framework.
- **Feedback and Iteration:**
    - Continuously gather feedback from users, institutions, and developers regarding the alt text support and accessibility features in API V3 or future API version.
    - Be open to making iterative improvements based on real-world usage and evolving accessibility standards.
- **Promote Adoption:**
    - Promote the adoption of API V3 or future API version with alt text support across institutions, museums, libraries, and other organizations to encourage the creation of accessible digital collections.

Colour Contrast

Immediate Recommendation

Create custom colour theme for the Mirador Viewer for Agnes Implementation

Creating a custom colour theme for the Mirador viewer involves modifying the CSS (Cascading Style Sheets) of Mirador to change the colours and visual styles to match Agnes's desired theme. The steps to implement this are outlined below:

- **Access the Mirador Source Code:**
    - You may download this directly from the Mirador GitHub repository: https://github.com/ProjectMirador/mirador

- **Identify the CSS Files:**
    - In the Mirador source code, locate the CSS files that control the visual styles of the viewer. Commonly, these files are named mirador-combined.css or similar. The CSS files are usually found in a folder like css or styles.
- **Create a Custom CSS File:**
    - Create a new CSS file in your project directory to store your custom styles. You can name it something like custom-theme.css.
- **Select Colors and Styles:**
    - Define the colors, fonts, and other visual styles you want to apply to your custom theme. You can use CSS rules to target specific elements and classes within Mirador. Ensure that the colours you select meet WCAG contrast criteria.
- **Override Default Styles:**
    - In your custom CSS file, use CSS selectors to override the default styles provided by Mirador. You can inspect the HTML structure of Mirador using web developer tools to identify the specific elements and classes you wish to target.
- **Link the Custom CSS:**
    - In the HTML file where you include Mirador, add a link to your custom CSS file after the link to Mirador's CSS files. This ensures that your custom styles override the default ones.
- **Test Your Custom Theme:**
    - Load your Mirador viewer in a web browser to test your custom theme. Make sure that the colours and styles are applied as expected.
- **Iterate and Refine:**
    - Fine-tune your custom theme as needed based on user feedback and further testing. You can adjust the CSS rules in your custom CSS file to achieve the desired visual appearance.
- **Documentation:**
    - Document your custom theme and any modifications you made to the Mirador viewer's CSS. This documentation will be helpful for maintenance and future reference.
- **Share and Deploy:**

- Once you are satisfied with your custom theme, deploy it on your website or platform where you use Mirador.

Long-Term Recommendation

Advocate for the default Mirador Viewer Theme to meet WCAG Contrast Criteria

Institutions should work with the Project Mirador community to ensure that Mirador's default theme fully complies with WCAG contrast criteria, and if necessary to ensure that elements are using uniform colours to simplify custom styling by host institutions and users, whether by browser/OS settings, custom stylesheets, or other supports. Although there are currently open-source options available for changing the theme colours available on GitHub, it would be beneficial to the larger community using IIIF and Mirador to adjust these contrast issues from the point of install. The following steps and considerations may help achieve this objective:

- **Engage with the Mirador Community:**
  - Become an active member of the Mirador community by participating in discussions, attending community meetings, and joining relevant mailing lists or forums. Engaging with the community would allow Agnes to build relationships and collaborate with developers and users who share Agnes's accessibility concerns.
- **Create Accessibility Use Cases:**
  - Develop use cases or scenarios that highlight the importance of accessibility improvements. Show how addressing accessibility issues benefits users, institutions, and organizations that use Mirador for digital collections.
- **Collaborate with Developers:**
  - Work closely with Mirador developers to explain the accessibility concerns and potential solutions. Provide clear and detailed explanations of the issues and how they impact users.
- **Propose Accessibility Enhancements:**

    - Create formal proposals for accessibility enhancements to the default Mirador theme. These proposals should include clear descriptions of the changes needed, the rationale behind them, and the expected benefits.
- **Offer Testing and Feedback:**
    - Volunteer to test accessibility enhancements and provide feedback during the development process. This collaborative approach helps ensure that the changes effectively address the identified accessibility issues.
- **Collaborate with Accessibility Organizations:**
    - Partner with accessibility organizations or experts who can provide guidance and expertise on making Mirador more accessible. Collaborative efforts can lead to more effective accessibility solutions.
- **Monitor Progress:**
    - Keep track of the progress of accessibility enhancements in Mirador. Follow up with developers and the community to ensure that proposed changes are being implemented and integrated into the default theme.
- **Advocate for Adoption:**
    - Encourage other institutions and organizations to adopt the accessible version of Mirador once improvements are implemented. Sharing the benefits and success stories can promote wider adoption.

Speed and Bandwidth Requirements

Immediate Recommendation

Adopt JPEG2000 and/or pyramidal TIFF as preferred image formats for Manifest use

Internet speed and bandwidth requirements are largely a factor of network infrastructure that are outside of Agnes's control; however, Agnes can ensure that it adopts file types for the images that will comprise its IIIF Manifests that will guarantee the greatest level of optimization and server-side compression and performance.

Controlled Manifest Access

Immediate Recommendation

Develop a tailored login system to control access to Indigenous Ancestors

**Note: DDP recommends using a WordPress installation and authentication for this process.*

Setting up a tailored login for controlling access to an IIIF Manifest through a WordPress website involves integrating authentication mechanisms and managing user access permissions. The high-level steps to achieve this are outlined below:

- **Plan and Requirements Gathering:**
  - Define the specific access control requirements, including who should have access to the IIIF Manifest and what types of users (e.g., administrators, authenticated users) will be granted access.
- **WordPress Installation:**
  - Set up a WordPress website if one does not already exist.
- **User Authentication:**
  - Choose an authentication method for user login. WordPress offers various authentication options, including username/password, social media login, or Single Sign-On (SSO) with third-party identity providers (e.g., Google, LDAP).
- **Install and Configure Plugins:**
  - Depending on the selected authentication method, install and configure WordPress plugins that facilitate user authentication. Popular plugins for SSO include "SimpleSAMLphp Authentication" or "Auth0."
- **User Registration and Management:**
  - Configure user registration settings to allow users to create accounts on the WordPress site if needed. Define user roles and permissions based on access control requirements.
- **IIIF Manifest Hosting:**
  - Ensure the IIIF Manifest is hosted and accessible through the WordPress site. Agnes may need to use a plugin or custom development to integrate IIIF with WordPress. Libraries like OpenSeadragon can help display IIIF content.

- **Access Control Logic:**
    - Develop custom logic or use plugins to control access to the IIIF Manifest based on user roles and permissions. This may involve writing custom code or using existing WordPress plugins for content protection.
- **Secure IIIF Manifest URL:**
    - Protect the URL of the IIIF Manifest to ensure unauthorized access is prevented. Use methods like authentication tokens, server-side access checks, or .htaccess rules to secure the Manifest's URL.
- **Custom Login Page:**
    - Create a tailored login page or integrate the login mechanism into your existing WordPress theme to provide users with a branded and seamless login experience.
- **User Interface Integration:**
    - Embed the IIIF viewer or viewer link on your WordPress pages or posts where access to the IIIF Manifest is granted. Customize the user interface to include login prompts or access instructions.
- **Testing and Quality Assurance:**
    - Thoroughly test the login and access control mechanisms to ensure they work as intended. Verify that users are only able to access the IIIF Manifest if they have the appropriate permissions.
- **Documentation and Training:**
    - Provide documentation and training to users and administrators on how to access and use the IIIF Manifest through the WordPress website, including the login process.
- **Monitoring and Maintenance:**
    - Implement monitoring and maintenance procedures to regularly review and update access controls, user roles, and security measures to ensure ongoing security and accessibility.
- **Compliance and Privacy:**
    - Ensure that access control mechanisms comply with privacy regulations and best practices, especially if you are collecting and storing user data.
- **Feedback and User Support:**

- Establish channels for users to provide feedback or seek support in case they encounter issues with access or the login process.

Indigenous Language Support

Immediate Recommendation

Provide Indigenous-language text and audio annotations within Agnes's IIIF Manifest

Although existing TTS engines do not provide seamless or even good support for the Indigenous languages currently spoken in Canada, DDP's conversations with members of the disability community have revealed that many deaf-blind, low-vision persons and persons with auditory disabilities whose first language is not English have, by necessity, learned to work around TTS technologies programmed with default English-accented voices. For this reason, our recommendation is to provide text and audio annotations, which can be surfaced using the Mirador viewer as described in the previous section of this report, as a stop-gap solution while working toward a more truly inclusive and accessible long-term solution as described below.

How Agnes chooses to create these annotations is best left to Agnes's staff to determine as they are best aware of their collections and the needs of the Indigenous communities with whom they are partnered and whom they serve.

Long-Term Recommendation

Advocate for the integration of Indigenous language support into the Mirador Viewer and TTS Technologies

Integrating Indigenous language support into both Mirador and TTS technologies will be a long process that will require the collaboration of many institutions and communities beyond just Agnes; however, Agnes can be an advocate in this space to effect change for a more inclusive, accessible, and equitable world by following the steps outlined below:

Mirador Viewer

- **Select the Indigenous Languages to Spearhead this Campaign:**

    - Determine which Indigenous languages should be the first to be supported within the Mirador viewer. Indigenous languages can vary significantly, so it's essential to focus on specific languages or language groups.
- **Create or Obtain Language Resources:**
    - Gather or create language resources for the selected Indigenous languages. This may include dictionaries, pronunciation guides, and text samples. Collaborate with speakers and language experts from the Indigenous communities to ensure accuracy and to ensure that Indigenous Peoples themselves are leading this work.
- **Select Appropriate Fonts:**
    - Ensure that the Mirador viewer can display the characters and glyphs required for the Indigenous languages. This may involve investigation of available fonts for their support of specific writing systems.
- **Integrate Indigenous Language Text:**
    - Modify the Mirador viewer's interface and user experience to accommodate Indigenous language text. This includes menus, labels, and annotations.
- **Add Translations and Descriptions:**
    - Provide translations and descriptions in English or other widely spoken languages for Indigenous language content to aid non-speakers in understanding the materials.
- **User Guidance and Instructions:**
    - Provide guidance and instructions within the Mirador viewer for users who may not be familiar with Indigenous languages. Offer tips on pronunciation, language navigation, and understanding the content.
- **Collaboration with Indigenous Communities:**
    - Collaborate closely with Indigenous communities, language revitalization programs, and language experts to ensure cultural sensitivity and accuracy in language representation.
- **Accessibility Considerations:**
    - Ensure that the integrated Indigenous language support is accessible to users with disabilities, including those who rely on screen readers or other assistive technologies.

- **Documentation and Training:**
    - Develop documentation and training materials for users and administrators on how to interact with Indigenous language content in the Mirador viewer.
- **Feedback Mechanisms:**
    - Establish channels for users to provide feedback on language support, allowing for ongoing improvements and refinements.
- **Ongoing Maintenance:**
    - Regularly update and maintain the Indigenous language resources and viewer interface to reflect changes in language usage and improve the user experience.
- **Cultural Sensitivity and Respect:**
    - Prioritize cultural sensitivity and respect when working with Indigenous languages and communities. Follow ethical guidelines and protocols for collaboration.

TTS

- **Identify the Need:**
    - Clearly articulate the need for Indigenous language support in TTS technologies. Highlight the significance of preserving and promoting Indigenous languages and the barriers created by the lack of TTS support.
- **Community Engagement:**
    - Engage with Indigenous communities, language speakers, and language revitalization programs to understand their specific TTS requirements and to ensure that any advocacy efforts align with their priorities.
- **Compile Language Resources:**
    - Gather language resources, including pronunciation guides, phonetic data, and recordings, for the Indigenous languages you want to support. Collaborate with Indigenous language experts and speakers to compile accurate resources.
- **Create a Comprehensive Proposal:**
    - Develop a comprehensive proposal that outlines the technical and cultural requirements for integrating Indigenous language support into TTS technologies. Include information on the linguistic characteristics and phonetics of the languages.

- **Collaborate with TTS Developers:**
    - Reach out to TTS technology developers, companies, and organizations. Share your proposal and advocate for their involvement in addressing Indigenous language support. Explore partnerships and collaborations.
- **Highlight the Benefits:**
    - Emphasize the benefits of supporting Indigenous languages, such as cultural preservation, language revitalization, and increased accessibility for Indigenous communities to digital content.
- **Promote Awareness:**
    - Raise awareness among stakeholders, policymakers, and the broader community about the importance of Indigenous language preservation and the role of TTS technologies in achieving this goal.
- **Advocate for Funding:**
    - Seek funding opportunities from government agencies, foundations, and organizations that support language revitalization and cultural preservation initiatives. Advocate for grants and resources to fund the development of Indigenous language TTS capabilities.
- **Build Alliances:**
    - Collaborate with organizations, institutions, and advocacy groups that share the goal of Indigenous language support. Form alliances and coalitions to amplify your advocacy efforts.
- **Demonstrate Demand:**
    - Show evidence of the demand for Indigenous language TTS capabilities through surveys, user testimonials, and endorsements from Indigenous language speakers and communities.
- **Leverage Technology Demonstrations:**
    - Create demonstrations or prototypes that showcase the feasibility and effectiveness of TTS support for Indigenous languages. Use these demonstrations to garner interest and support.
- **Engage with Legislators:**

    - Advocate for policies and legislation that promote the development and implementation of Indigenous language support in technology. Engage with legislators and government bodies to support your cause.
- **Educate and Train Developers:**
    - Offer training sessions and educational resources to TTS developers to help them understand the unique phonetics and pronunciation rules of Indigenous languages. Encourage developers to collaborate with Indigenous language experts.
- **Regularly Update Interested Parties:**
    - Maintain open communication with interested parties, including Indigenous communities, developers, funders, and policymakers. Provide updates on progress and developments in Indigenous language TTS support.
- **Advocate for Inclusivity:**
    - Stress the importance of inclusivity and cultural sensitivity in TTS technology development. Advocate for respectful and collaborative approaches that involve Indigenous communities in decision-making.

Next Steps

With the current research project concluded, Agnes Etherington Art Centre will be proactively seeking additional funds and partnerships to continue this work to implement the research and recommendations outlined in this report in a Phase 2 project beginning in 2024-2025 (pending funding). This will put in place the recommendations to implement IIIF in this report and the initiatives that arise from three artist-informed design workshops held by Agnes.

Immediate Implementations

Specific items from this report to be immediately implemented in order to successfully launch a IIIF Manifest at Agnes include:

- Implementing a WordPress Installation to house Agnes's IIIF Manifests and setting up a tailored login system to authenticate users requesting access to Indigenous Ancestors housed within Agnes's collections.
- Developing a customized colour theme for the Mirador Viewer that conforms to WCAG contrast criteria.
- Implementing the IIIF Manifest using API V2 in order to make the Manifest metadata accessible to disabled users reliant upon screen readers.
- Ensuring that all digital objects within the IIIF Manifest are JPEG2000 or pyramidal TIFF files to make them as accessible as possible to users with slow internet or low bandwidth.
- Including Indigenous-language text annotations within the Manifest that can be enabled in the Mirador viewer.

Long-Term Advocacy and Technical Research

While the research conducted by PAC and DDP revealed that it is possible to implement IIIF at Agnes currently with certain workarounds in place, IIIF, the Mirador Viewer, and TTS engines are all technologies that are not fully inclusive nor fully accessible. For this reason,

we have identified several long-term activities that should be undertaken to advocate for greater inclusion and accessibility with these technologies, as outlined below:

- Collaboration with relevant interested parties on revisions to IIIF specification to natively support alt text and other accessibility features. This change could obligate viewers to support alt text, enhancing accessibility across platforms.
- Investigation of a metadata model allowing alt text to be specified across Manifests that include multiple images, canvases, or even regions within images. Our existing research has focused solely on single, non-moving images, but it is common for Manifests to contain multiple entities. Further analysis is required to determine how specific accessibility affordances could be linked with the corresponding entity in such scenarios.
- Expansion into other areas of accessibility and inclusive design, such as audio description and captioning for videos delivered via IIIF Manifests. Alt text was the sole accessibility feature in scope for this round of research.
- Continued exploration of Indigenous-language support for the Mirador user interface.
- Continued exploration of how Indigenous-language support can be implemented in IIIF via dynamic media and automated.
- Collaboration with relevant interested parties on the development of a default theme that meets colour contrast guidelines.

Artist-Informed Innovations

While not within the scope of the current report, Agnes plans to incorporate IIIF into its larger digital programming ecosystem via Digital Agnes, enhancing digital publishing and curatorial platforms.

Artist-informed design jams are being held in 2024 in association with the ongoing grant-funded research around how Agnes will implement IIIF in the future. These sessions are meant to engage artists in Agnes's digital infrastructures and to work with them to ideate new innovations in the digital display and publishing of 2D images and 3D models.

Through these design jams, Agnes investigates new artistic and curatorial methodologies using IIIF tools alongside artists. We investigate display and annotation tools to expand

realms for museological and curatorial practice. By collaborating with artists, the project not only builds awareness of IIIF but creates new, artist-informed exhibition technologies, which will instruct Agnes's implementation of the tools. We intend to innovate new curatorial digital platforms for contemporary art.

Appendix A: Definitions

Ancestor: A general term referring to ancestor that is a living being who by Western museological terms is referred to as human remains, modified remains, object, artifact, belongings, cultural ancestor, (in)tangible cultural heritage, or a work of art." Collison, Jisgang Nika, Sdaahl K'awaas Lucy Bell and Lou-ann Neel. 2019. *Indigenous Repatriation Handbook*. Royal British Columbia Museum. cited in De Line, Sebastian. "(DRAFT) *General Guidelines for Access, Care, Return and Engagement with Indigenous Collections*," Agnes Etherington Art Centre. Last updated 18 October 2022.

API: An API, or Application Programming Interface, is a set of rules and protocols that allows different software applications to communicate with each other. It defines the methods and data formats that applications can use to request and exchange information, enabling them to work together seamlessly. APIs are commonly used to enable the integration of different software systems, allowing them to share data and functionality, and they play a fundamental role in modern software development and the creation of interconnected applications.

Canvas: In the context of a IIIF Manifest, a "canvas" is a structural element used to define a region or surface onto which one or more images or content resources are intended to be displayed. Canvases play a crucial role in organizing and describing the structure of digital objects, such as books, manuscripts, maps, or any other complex visual or textual resources.

Custom Data Fields: Custom data fields refer to additional, user-defined data elements that can be included in a IIIF Manifest to convey specific information or attributes that may not be covered by standard metadata elements. These custom data fields are introduced by the creators of the Manifest or the organization managing the digital collection. They allow for flexibility in describing digital resources by accommodating specialized or unique information relevant to the digital objects or the institution's needs. Custom data fields can be used to provide context, provenance, or any other data that enhances the understanding and utility of the resources represented in the Manifest.

IIIF: The IIIF, or International Image Interoperability Framework, is a set of technical standards that defines how digital images, as well as other types of digital resources, should be structured, served, and accessed on the web to ensure interoperability and compatibility across different software systems and platforms.

- **Interoperability:** IIIF is designed to promote interoperability among cultural heritage institutions, libraries, museums, and digital image repositories. It provides a common framework for sharing and accessing digital resources.
- **Resource Types:** While IIIF initially focused on images, it has expanded to include other types of resources such as audio, video, and text. This allows institutions to present a wider range of digital content using the same framework.
- **APIs:** The IIIF standards include various APIs (Application Programming Interfaces) that define how resources should be accessed and presented. Examples include the IIIF Image API, Presentation API, and Search API.
- **URL-Based Approach:** IIIF relies on URL-based requests, where clients specify desired resource characteristics and parameters in the URL to retrieve content in the format and quality they require.
- **Community-Driven Development:** IIIF is developed collaboratively by the IIIF community, which includes cultural institutions, developers, and experts in digital preservation. This ensures that the specification evolves to meet the needs of the community.
- **Access Control:** IIIF also provides mechanisms for controlling access to resources, ensuring that institutions can manage permissions and restrict access to specific content as needed.

Overall, IIIF serves as a foundational framework for creating, sharing, and accessing digital resources in a standardized and interoperable manner, enabling institutions to make their cultural and historical collections more widely available to the public and researchers while ensuring long-term preservation and access.

IIIF Authorization Flow API: The IIIF Authorization Flow API is designed to address the need for authentication and authorization mechanisms when accessing restricted content within the International Image Interoperability Framework. While IIIF encourages open access to

digital resources, there are scenarios where access control is required due to factors such as internal policies, sensitive material, legal regulations, business models, and more. The Authorization Flow API provides a pattern for interacting with various third-party authentication and authorization protocols without requiring the client application to have detailed knowledge of these systems.

The IIIF Authorization Flow API is focused on security and privacy, emphasizing the protection of cookies and tokens in storage and during transport. It mandates the use of HTTPS for all communication and encourages IIIF clients to also run on HTTPS. This API enables secure and user-friendly access to restricted IIIF resources by providing a standardized pattern for client applications to interact with diverse authentication and authorization systems, ensuring a smooth and consistent user experience.

IIIF Image API: The IIIF Image API is one of the core APIs within the IIIF framework. It is specifically designed to facilitate the standardized retrieval and delivery of digital images over the web. The IIIF Image API defines a set of rules and conventions for requesting images with specific characteristics, such as size, quality, and format, to enable responsive image delivery for viewing and interacting within IIIF-compliant viewers and applications.

The IIIF Image API enables responsive image delivery, which means that clients can request images that best fit their display capabilities and user interactions. This ensures that digital images are presented to users in an optimal and efficient manner, enhancing the viewing experience within IIIF-compliant viewers and applications.

IIIF Presentation API: The IIIF Presentation API is a key component of the IIIF framework that is designed to facilitate the description and presentation of digital objects such as books, manuscripts, artworks, and other complex resources in a standardized and interoperable manner. The IIIF Presentation API defines a set of specifications and guidelines for structuring and describing the organization, layout, and content of digital collections, enabling consistent and rich user experiences across different IIIF-compliant applications.

The IIIF Presentation API is a foundational component of the IIIF framework, promoting interoperability, accessibility, and collaboration among cultural institutions, libraries, museums, and other organizations. It enables institutions to create structured and

standardized representations of their digital collections, making them easily discoverable, accessible, and shareable within the IIIF ecosystem.

Image: In the context of an IIIF Manifest, an "image" refers to a digital representation of a visual resource, such as a photograph, artwork, map, manuscript page, or any other visual content. IIIF Manifests are used to describe and structure digital objects, and images play a central role in this context.

Manifest: A IIIF Manifest is a structured, machine-readable document that serves as a comprehensive and standardized description of a digital object or collection of digital resources. It provides essential information about the content, structure, and presentation of these resources, making them easily accessible and shareable across different software systems and platforms.

Metadata: Metadata refers to structured information that describes and provides context for the digital resources represented in the Manifest. Metadata typically includes details about the digital object or collection, such as its title, creator, date of creation, description, copyright information, and any other relevant attributes. Metadata enriches the understanding of the digital content and helps users and applications interpret and discover resources. Metadata in IIIF Manifests adheres to standardized formats and vocabularies to ensure interoperability and consistent representation of information.

Appendix B: Understanding IIIF

The International Interoperability Framework (IIIF) is a set of standards for the online delivery of high-quality images and audio/visual files, as well as the global community that develops the standard. IIIF software solutions are commonly used by libraries, museums, archives, and galleries for displaying very high-resolution images on the web. Some notable institutions making use of IIIF include the Wellcome Collection, Harvard Art Museums, the Smithsonian Institution, and within Canada, the Art Gallery of Ontario among many others.

How It Works

The International Image Interoperability Framework (IIIF) works by providing a set of standardized protocols, specifications, and APIs (Application Programming Interfaces) that enable the interoperable sharing, presentation, and access of digital images and other resources, such as manuscripts, books, audio, and video, across different software systems and platforms. This involves the following:

- **Resource Digitization:** Cultural institutions, libraries, museums, and other organizations digitize their physical collections to create digital representations of items such as artworks, manuscripts, photographs, and historical documents. These digitized resources are typically stored in digital repositories.
- **IIIF Manifest Creation:** To make these digital resources accessible in a standardized manner, institutions create IIIF Manifests. A IIIF Manifest is a structured document that describes the digital object or collection, its content, structure, and metadata. It includes references to content resources (e.g., images, text), sequences (logical order), and canvases (surfaces for content).
- **Content Presentation:** Institutions use IIIF-compliant viewers or applications to present digital content to users. Viewers can be web-based or standalone applications. These viewers retrieve IIIF Manifests via URLs. For the purposes of the research conducted for this report, DDP and PAC used the Mirador viewer.
- **Manifest Retrieval:** When a user or application accesses a digital resource through a IIIF viewer, the viewer sends a request to retrieve the corresponding IIIF Manifest. The

IIIF Manifest contains critical information about the structure and presentation of the digital object.

- **Content Retrieval:** The IIIF viewer uses information in the Manifest, such as image dimensions, formats, and metadata, to request specific content resources, such as images or text, from the digital repository. These resources are delivered to the viewer, often in response to standardized IIIF Image API requests, ensuring optimal format and quality.
- **Display and Interaction:** The IIIF viewer displays the digital content to users, allowing them to zoom, pan, and interact with images, texts, and other media. Users can navigate through sequences, canvases, and content resources within the digital object.
- **Interoperability:** IIIF's standardized specifications and APIs ensure that IIIF-compliant viewers can seamlessly access and present content from different institutions, repositories, and collections. This interoperability promotes collaboration and sharing of digital resources.
- **Customization:** While adhering to IIIF standards, institutions and developers have the flexibility to customize and tailor their IIIF viewers and applications to meet their specific needs, design preferences, and user requirements.
- **Access Control:** IIIF includes mechanisms for controlling access to digital resources, allowing institutions to manage permissions, restrict access, and protect copyrighted content as needed.

In summary, IIIF works by providing a standardized framework for describing, sharing, and presenting digital resources in a way that promotes interoperability and access across diverse software systems and platforms. IIIF-compliant Manifests, viewers, and APIs ensure that users are able to seamlessly explore and interact with digital collections, fostering collaboration among cultural institutions and enhancing the accessibility of cultural heritage materials.

How It Is Used

IIIF technology allows GLAM institutions (galleries, libraries, archives, and museums) to present, preserve, and share their digital collections. It enables viewers to examine the fine details of artworks through deep zooming features, crucial for digital exhibitions where

direct interaction with the artwork is not possible. While this technology was originally developed to reunite pieces of manuscripts held at multiple institutions around the world, it now supports the inter-institutional sharing of digital collections, fostering collaborative exhibitions and increasing the accessibility of each gallery's collections to a wider audience. Furthermore, IIIF's annotation capabilities enrich the viewer's engagement with artworks by providing detailed context, history, or interpretations.

Museums utilize IIIF to curate both digital and physical exhibitions, enhancing accessibility for those who are geographically distant or facing barriers due to disability or illness. The framework's deep zoom and annotation features serve as powerful tools for education, allowing detailed exploration of objects and artworks. Additionally, museums can share their digital collections with peers and educational entities, promoting a culture of shared knowledge and learning.

While IIIF does improve accessibility in some dimensions, it is important to note that the framework is not universally accessible as has been highlighted in the findings and recommendations of this report, and important advocacy must still be performed to work towards this universal accessibility in future versions of the IIIF API and the viewers used to access its Manifests.

Appendix C: Understanding Authorization Access Control

OAuth (Open Authorization)

OAuth is an open standard for authorization and authentication that allows users to grant third-party applications limited access to their resources without sharing their credentials, like usernames and passwords. OAuth works as follows:

- **User Requests Access:** When a user wants to access a service or application that requires authentication, they initiate the process by clicking a "Login with [OAuth Provider]" button or a similar action.
- **Authorization Request:** The service redirects the user to the OAuth provider (e.g., Google, Facebook, or Twitter) with an authorization request. This request includes details about the permissions the service is requesting (e.g., read-only access to the user's profile).
- **User Authenticates:** The user is presented with a login screen by the OAuth provider and enters their credentials. This step ensures that the user is who they claim to be.
- **User Grants Permission:** After successful authentication, the OAuth provider presents the user with a screen that outlines the permissions requested by the service. The user can grant or deny these permissions.
- **Access Token Issued:** If the user grants permission, the OAuth provider generates an access token and sends it back to the service's callback URL. This access token is a short-lived credential that authorizes the service to access the user's resources.
- **Resource Access:** The service can now use the access token to make authorized requests to the OAuth provider's API on behalf of the user. The provider validates the access token to ensure the service has permission to access the requested resources.
- **User Data Retrieval:** The service can retrieve the user's data (e.g., profile information or contacts) from the OAuth provider's API and use it as needed.

OAuth is commonly used for allowing third-party services to access user accounts, making it easier for users to sign in to different apps without sharing their login credentials. It

enhances security by limiting the permissions granted to these apps and allowing users to revoke access at any time.

CAS (Central Authentication Service)

CAS is a single sign-on (SSO) protocol and system used for authenticating users across multiple web applications or services. It ensures that users only need to log in once to access various applications securely. CAS works as follows:

- **User Accesses Application:** When a user attempts to access a CAS-protected application, they are redirected to the CAS server's login page.
- **User Authentication:** The user enters their credentials (username and password) on the CAS server's login page. This authentication step verifies the user's identity.
- **Ticket Granting Ticket (TGT):** If authentication is successful, the CAS server issues a Ticket Granting Ticket (TGT) to the user's browser. The TGT is a short-lived credential used to request access to other applications.
- **Service Ticket (ST) Request:** The user is redirected back to the original application with the TGT. The application requests a Service Ticket (ST) from the CAS server for the specific application being accessed.
- **ST Validation:** The CAS server validates the TGT and issues an ST to the application if the user is authenticated.
- **Access Granted:** With the ST, the application can access the CAS server's validation service to verify the ST's authenticity. If the ST is valid, the application grants the user access to its resources.

CAS ensures that users don't need to log in separately to each protected application, reducing the need to remember multiple usernames and passwords. It centralizes authentication and simplifies user management, making it a valuable tool for organizations with multiple web services.

Appendix D: Digital Accessibility

Accessibility and Its Importance

Recognizing the diversity of experiences and definitions within the realm of accessibility is paramount. The UN Department of Economic and Social Affairs identifies accessibility as the ease with which people with disabilities can use and access services and facilities, enabling their full and equal participation in society. This conception of accessibility underscores its vital role in empowering individuals with disabilities to exercise fundamental rights, such as access to information, education, and employment.

In Canada, as reported in 2017, 22% of individuals aged 15 and older identified as having a disability that affects their societal engagement. Notably, disability experiences are not homogenous; Indigenous communities, for example, have reported higher rates, with up to 32% of off-reserve First Nations individuals reporting disabilities.

The dialogue around disability is nuanced, often shaped by the confluence of medical and social discourses. The medical model of disability traditionally focuses on the individual's physical or mental disabilities as limitations requiring treatment or intervention. In contrast, the social model emphasizes environmental and societal barriers rather than the disability itself as the main obstructive force to participation and inclusion. It advocates for societal adjustments and accommodations to bridge the gap in accessibility.

In the context of Indigenous communities, where their history and experiences are deeply woven into the fabric of systemic discrimination and colonialism, both models can provide insight. Indigenous perspectives historically embraced inclusive views, recognizing individuals with disabilities as possessing unique strengths or spiritual gifts—valued differences rather than deficits. For example, the use of Plains Indian Sign Language (PISL) within Indigenous communities exemplifies a socially adaptive approach, promoting communication inclusivity.

The imposition of colonial western ideas of disability, which often emphasized pity or institutionalization, has, however, obscured these inclusive traditions. Today, Indigenous

persons with disabilities may confront a dual front of ableism and racism, with a compounded impact on access to services and opportunities.

The integration of both medical and social approaches to disability allows for a comprehensive understanding that honours individual needs for support and the dismantling of systemic barriers. It acknowledges the validity of personal experiences of disability and the imperative to transform social structures for inclusive participation.

Digital tools and standards, such as IIIF, play a critical role in bridging these approaches. By improving access to digital resources, IIIF facilitates not only the medical model through adaptive technologies but also the social model by removing barriers to information and cultural heritage. The implementation of IIIF can, thus, be seen as an embodiment of a dual-model approach to accessibility, providing both the means for individual empowerment and the platform for collective inclusivity.

In advancing our initiatives, we embrace a balanced perspective that recognizes the merits of both medical and social definitions of disability. This approach not only aligns with the principles of inclusivity and respect but also supports a nuanced understanding of accessibility as it relates to the full spectrum of human diversity.

Principles of Web Accessibility

IIIF is designed to deliver content over the web, and thus any evaluation of its accessibility compliance should be done in relation to web accessibility principles specifically. The World Wide Web Consortium (W3C), the chief standards body for the core web technologies, publishes the Web Content Accessibility Guidelines or WCAG, which serve as the de facto global standard for website accessibility. In a number of jurisdictions including Ontario, government and many private websites and other public-facing digital communications are required by law to comply with WCAG standards, and an increasing number of governments are in the process of or looking at implementing similar regulations.

WCAG and accessible digital design in general are guided by four core principles, abbreviated as POUR. Content must be:

- **perceivable**, meaning users must be able to identify it by way of their senses;

- **operable**, meaning users must be able to successfully activate interactive user interface and navigation elements;
- **understandable**, meaning users must be able to easily interpret content and interfaces and easily learn and remember how to interact with them; and,
- **robust**, meaning it should be interpreted equally well regardless of what technologies are used to access it, now and in the future.

Inclusion: Redefining Accessibility As "Access for All"

The general consensus among disability advocates is that accessibility has a narrower scope than inclusion: its specific focus is on accommodating people with disabilities. The language around disability and even how to define the term is constantly fluctuating, but in general, advocates who have adopted a social model of disability focus on how societal barriers, rather than individual characteristics, distinguish disability from other aspects of human diversity like age or language. In the design sphere, the closely related concept of inclusive or universal design aims to create one experience that works for the broadest possible range of people, accommodating for disability as well as age, culture, language, literacy, computer literacy, economic status, and more. An intersectional approach to accessibility in design is important for Indigenous audiences, whose experience of disability differs in meaningful ways from that of the broader public as noted above.

Key Principles of Indigenous Accessibility

Meeting Communities Where They Are

A core principle of Indigenous accessibility is to develop technology that meets the specific needs of each unique Indigenous community. This approach respects the cultural, linguistic, and historical contexts of each group.

Inclusive Design and Collaboration

Inclusivity is all about the active involvement of Indigenous communities in the development process. Institutions must engage in open dialogues and be receptive to community input, recognizing that inclusive technology design starts with the people it serves. Going into

engagement sessions with an open mind and ready to carry the weight of the information shared during these sessions is vital.

Respectful Symbolism and Imagery

Symbols and imagery must respect Indigenous cultures and avoid misrepresenting or appropriating cultural symbols.

Consultation and Compensation

Meaningful consultation with Indigenous communities is essential. Compensation should be provided for the time and expertise they contribute to the development process, acknowledging the value of their input. It is important to let their input guide the development process in order to develop products that actually meet the needs of Indigenous audiences.

Resources and Works Cited

N.B. References in this report were inserted as hyperlinks and internal document links to a final resources and works-cited page to ensure this document would be as accessible as possible for readers who might require assistive technologies like screen readers. As footnotes and endnotes interrupt the flow of reading for these users in a manner that can be jarring, and therefore, create an unpleasant user experience for such readers, the authors of this report opted instead to prioritize accessibility over academic conventions.

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