Evaluating the potential of cybercartography in facilitating Indigenous self-determination: a First Nations case study on Vancouver Island

by

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BASc, Quest University Canada, 2017

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Abstract

Since the arrival of settlers in the 16th century, the Canadian Government has dispossessed First Nations people of their land and culture through a history of colonialism. This has led to over a century of contentious relationships between First Nations and the Canadian Government in which First Nations have often struggled with the revitalization and reclamation of their culture and land due to oppressive systemic structures. Cartography has been one approach, among many, adopted by First Nations to facilitate self-determination in recent decades. However, the role of cartography has been one focused on western technocratic approaches of drawing territorial boundaries as part of the land claims process. Such approaches may assist First Nations in documenting land use and negotiating territorial rights and as such move them towards self-determination. Conventional western cartography is inherently incapable of representing the rich spatial nature of First Nations' sense of cultural place. More recently, cybercartography has emerged due to technological advances in software and web-based publishing that has the potential to encapsulate First Nations' oral history and culture by providing digital multimedia elements (i.e. audio, imagery, and video) within a digital spatial context. The use of cybercartography in this manner is quickly increasing over time, but research is lacking in understanding how new representations of First Nations history and culture through cybercartographic frameworks explicitly facilitate, or prohibit, First Nations ability to attain self-determination. To address this gap, this study evaluates the ways in which contemporary cybercartographic technologies may facilitate the process of self-determination through an application development and interview process with a local First Nation on Vancouver island, BC. The research process throughout the project are evaluated using the Indigenous principles of Ownership, Control, Access, and Possession (OCAP) and uses this as a framework to understand

how the experiences of the Nation relate to the broader narrative of self-determination. The results of this study suggest that using a community-engaged approach to cybercartography facilitates community-specific requirements of self-determination, mainly because community engagement can lead to the development of tools that match community objectives and needs. Furthermore, this study demonstrated that the OCAP principles have the potential to be used in future studies for evaluating the efficacy of technologies that are intended to facilitate self-determination in First Nation communities.

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Dedication

This thesis is dedicated to a father whose unconditional love is present in my relationships and accomplishments. Although he did lack mentorship when it came to hard work.

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It is difficult to express my appreciation for the time Dr. Chris Bone dedicated to the improvement of my writing and formulation of written arguments. He truly went above and beyond as a mentor throughout my graduate studies and I thank him for this. I also wish to thank Dr. Crystal Tremblay for her guidance and perspectives on community-based research. And of course, this thesis would not have been possible without the unwavering support of my partner, Kelsey Mech who dedicated many hours of her life to simplifying mine. I would also like to acknowledge the support, openness and guidance the Hupačasath First Nation provided me throughout this project. When I initially started my graduate studies, I had no clear path towards a community relationship, and the Hupačasath were kind enough to open themselves up and share their personal knowledge with me. The introduction to the Hupačasath community would not have been possible without Dr. Craig Candler who opened doors and guided my field work. Finally, I would like to thank family members for standing by me and supporting me.

Chapter 1: Introduction

The history of colonization has led to a state of complex and oftentimes divisive relationships between Indigenous peoples and settler governments. In what is now called Canada, Indigenous people are not immune to the dispossession of land and culture experienced around the world. In the Canadian context, this dispossession started with the arrival of settlers in the 16th century, though ongoing acts of colonization continue to impact Indigenous peoples' right to self-determination towards the present day (Battiste 2011; MacDonald and Steenbeek 2015). Self-determination – the right to self-government of peoples with common cultural and political beliefs (Tamir 1991) – is globally acknowledged by international declarations such as the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP, 2007). Although Canada supports UNDRIP and has made a recent push towards reconciliation with Indigenous peoples (Abu-Laban 2019; Lightfoot 2018) there remain substantial barriers for Indigenous communities to realize their objectives for self-determination (Boutilier 2017; Exner-Pirot 2018; Jung 2018).

To understand how Indigenous communities engage in realizing their objectives for self-determination, this thesis approaches self-determination from three perspectives: the socio-political self-determination predicated on historical relationships between the Canadian government and Indigenous people, self-determination in terms of (cyber)cartographic representation and mapping processes, and self-determination in research where Indigenous people engage and are partners in the research process. These perspectives are central to understanding why Indigenous communities use maps and mapmaking in their self-determination process and will be explored in more detail throughout this thesis.

Historically, the Canadian Government has used policy to limit Indigenous communities' sovereignty. This policy most notably includes the Indian Act of 1867 that maintains that First Nations (excluding other Indigenous peoples such as Métis and Inuit) are wards of the Canadian Government (Bartlett 1977). The Canadian Government, through this Act, has stripped away the sovereignty of First Nations over time by implementing systems such as the chief and band council. Such systems limited Nations in decision making power, and required Chief and Council to report directly to the Ministry of Indian Affairs on matters of local governance thus inhibiting First Nations' ability to self-govern and were instead accountable to the Canadian Government (Bartlett 1977; Roe 2010). More recently, the 1969 Statement of the Government of Canada on Indian Policy, also known as the White Paper, attempted to further assimilate Indigenous communities in an attempt to eliminate Indigenous identity by removing the federal government's responsibility for Indigenous people, and undermining treaty rights (Nickel 2019). This 1969 policy was ultimately rejected and in 1971 was retracted as it did not adequately consult Indigenous people in the process, nor listen to Indigenous voices (Nickel, 2019). Fundamentally, this document showed the lack of understanding the federal government has when it comes to Indigenous perspectives on self-determination. The White Paper and the Indian Act are ultimately both concerned with limiting Indigenous people's self-determination whether intentional or not and highlight the unwillingness for the Canadian government to meaningfully engage in reconciliation with Indigenous communities.

More recently, the Canadian Government has been willing to acknowledge their history of colonization in attempts to reconcile their past, which has led to the creation of the Truth and Reconciliation Commission of Canada (TRCC) and 92 Calls to Action. One of the main objectives of the TRCC is to document human rights violations, such as the Indian Residential

School system, that were intended to erase Indigenous autonomy and cultural histories (Stanton 2011). Another example of a movement towards reconciliation is British Columbia's provincial government's effort to recognize language and education as human rights for Indigenous peoples through legislation of the Declaration on the Rights of Indigenous Peoples Act (Fraser 2019). While these examples demonstrate a new willingness for the government to acknowledge and address the impacts of their colonial policies, it is argued that the Canadian Government's movements towards reconciliation with Indigenous peoples have been insufficient to fully support Indigenous self-determination to the extent that is deemed necessary by most Indigenous communities (Corntassel 2008). One reason for this is because the recognition of historical violence towards Indigenous people is only one component of the colonial history that the TRCC addressed in their calls to action (The Truth and Reconciliation Commission of Canada 2015). In addition, there are calls to action regarding spatial reconciliation interested in the rejection of concepts such as *terra nullius*, where European settlers deemed land to be uninhabited (Becker 2018). The doctrine of *terra nullius* provides European settlers with a framework to assert sovereignty and in doing so erase Indigenous lands by mapping and renaming these lands with settler names. By remapping land, it becomes "empty space", capable of then being named using European names (Watson 2014).

In an effort to counteract the imposed policies of the Canadian government, Indigenous communities have engaged in the use of maps and mapmaking through counter mapping efforts with the Canadian Government who has a history of addressing self-determination claims to territory and rights to land-use practices within the Canadian legal system (Wilson and Selle 2019). While Indigenous peoples across Canada engage in this rights-based treaty approach, it does not always meet community concerns regarding the cultural aspects of self-determination,

including considerations of the environment, community health, natural resources, sustainability, and passing knowledge to future generations (Corntassel 2008). In some cases, treaties meet many of the requirements communities have for self-determination such as the Maa-nulth Treaty involving five Nuu-chah-nulth Nations on western Vancouver Island (Sloan 2014). The Maa-nulth Treaty is an example of First Nation communities exercising self-determination through the Canadian legal system and procuring rights to resources, negotiation, and decision-making power (Sloan 2012). The Maa-nulth treaty exemplifies the progress that can be made towards self-determination over previous policy such as the Indian Act. Therefore it is not that engaging with the Canadian Government is unbeneficial, it is that their legal system is not designed to understand Indigenous knowledge, and communities must conform to settler protocols for expressing their knowledge.

Attempts to settle the wide disparity in beliefs and values regarding these elements of self-determination have brought forth a broad range of policy tools and methodologies that serve as mechanisms of communication between First Nations and governments. The process of mapping, as well as maps themselves, have become central in the self-determination dialogue to engage with the Canadian government. Cartography, more formally, is the art and science of how we make maps, and is a production of western epistemologies of space and spatial representation where maps are used to pursue dominant narratives of groups in power (Eades 2015). Maps are used as systems of control by showing what is owned and by whom. Quite often this is done by omitting information to create a historical narrative. The Canadian government has contributed to the omission of historical knowledge through the creation of boundaries, provinces, and space that exclude Indigenous knowledge and places (Eades 2015).

The use of cartography and its principles are problematic for Indigenous communities who cannot simply adopt discrete boundaries and Cartesian grids to describe their rich and complex relationships with land and each other, both of which transition through different spaces over time (Thom 2009). Indigenous maps tend to be less concerned with control and more with relational aspects of space that do not place so much emphasis on precise locations but rather focus on the community's relationship to space (Eades 2015). However, Western maps have been used by Indigenous communities to evidence place-based narratives and communities have been drawn into using cartography as a tool to documenting their traditional relationships to their land in a form that "permits" them access to dialogue on self-determination with the Canadian government (Eades 2015; Olson, Hackett, and DeRoy 2016). This type of mapping emerged in Canada through the Inuit Land Use and Occupancy Project (ILUOP) of the 1970s and has become known as the occupancy study or traditional use study (TUS) (Bryan and Wood 2015). What differentiated ILUOP from previous projects is that it was documenting the extent of territory and practices based on Indigenous voices instead of the observations of outsiders (Bryan and Wood 2015). The ILUOP was instrumental in negotiating aboriginal title to the area known as Nunavut (Bryan and Wood 2015). Indigenous communities then engaging in maps and mapmaking have demonstrated influence over legal proceedings and to balance power relationships with the Canadian government. And even with the incorporation of Indigenous voices into mapping territory, Indigenous people are still working within the bounds of Western cartography to demonstrate their knowledge (Tobias 2000).

The acknowledgement that conventional cartography is unlike Indigenous peoples' traditional ways of displaying relationships leaves communities at a disadvantage when advocating for their rights to land and self-determination within the rights-based framework and

also in displaying their cultural knowledge. Two reasons for this are that using cartography represents simplified representations of Indigenous knowledge interwoven with colonial representations of property (Anker 2018). And secondly because settlers struggle with a "capacity problem" where settler society has limited capacity to conceptualize Indigenous territoriality and relationships with land in the same way Indigenous communities perceive these relationships. Traditionally Indigenous relationships to land were displayed through oral history communicated from respected elders and knowledge holders within the community (i.e. through stories) and through artistic forms (i.e. as tapestry, dance, petroglyphs). These practices exist the world over, with two notable examples including New Zealand's Māori who use haka (traditional dance) to develop relationships between their people and the land (Clément 2016), and in Canada where the Nuu-chah-nulth people communicate knowledge through Huulthin (shawls) which reference family and oral history in their embroidery (Green 2013). By requiring Indigenous people to transform their methods of representing history, western cartography does not fully capture the extent of cultural knowledge inherent to Indigenous communities and in doing so impedes Indigenous self-determination.

To address the complex disparity between knowledge representation and technology adoption (the latter of which could be considered involuntary), there have been developments over the last several decades in digital multimedia methods of mapping in more recent years referred to as "cybercartography", have been developed that align themselves more closely with Indigenous representations of place (Taylor 2013). Perhaps most widely known in Canada's scholarly community is an application developed by Fraser Taylor (who coined the term cybercartography in the context of Indigenous mapping) called the Nunaliit atlas (Taylor and Pyne 2010). This technology is open-source (i.e. anyone can contribute to the development of the

tool) and capable of displaying complex relationships between communities, knowledge, and land through a customizable interface. Yet, widespread adoption of the Nunaliit technology can be hindered when communities do not prioritize the technical knowledge, such as web-based programming skillsets, to undertake customization (Caquard et al. 2009). Challenges with application customization have led to the adoption of other technologies that enable cybercartographic development, such as free web-based mapping platforms like Google Earth (Google 2020) and proprietary story mapping applications like ArcGIS Online (Esri 2020a) which lack the customizability of Nunaliit, but require less technical skills to implement.

Challenges emerge when deciding which technology is best-suited for use by a given Indigenous community. By choosing an inappropriate technology, projects may struggle with engaging the community and fulfilling requirements of self-determination, such as accessibility to traditional knowledge. In the past, researchers have tended to prescribe technologies to Indigenous projects rather than working with communities to understand their objectives for these technologies or their desire to use them (Tobias 2013). This is because funding bodies for research, institutions, or agencies have predetermined ideas about research protocols (Tobias 2009:165). And more often than not, using the predetermined set of protocols, which could include a technology the institution has approved, may be detrimental to the successful completion of the project because it could contain a lack of necessary resources (Tobias 2009: 165). In cybercartography, following institutional protocols about the technology could have harmful effects on the project by not aligning with the technical knowledge of a community's GIS team.

In a form of "parachute research", the tendency has been to collect information from a community to further outsider knowledge of a specific technology, rather than working with a

community to find or develop a technology that best suits their needs (Tobias, Richmond, and Luginaah 2013). Examples of this often come from a Canadian context of developing cybercartographic applications using complex technologies that fail to support ongoing self-determination for the community due to their inaccessible nature. Relationships should be developed between community and researcher in an attempt to understand the research requirements of individual Indigenous communities and engage the community in the research process (Wilson 2008). These relationships should guide researchers in creating a reciprocal research product (i.e. one that benefits and engages the community) (Tobias et al. 2013).

Examples of Indigenous scholars developing methodologies for creating reciprocal relationships between researchers and Indigenous communities include the Indigenous research paradigm developed by Shawn Wilson (2008), who places research accountability as central to developing results that are useful to the community. Additionally, Joshua Tobias' (2013) work has identified the problematic nature of typical research in that it introduces a pre-established agenda upon arriving in a community that impedes the development of reciprocal relationships and community engagement. Tobias proposes a model of community-based participatory research (CBPR), which recognizes the importance of developing relationships to meet community needs at all stages of a project.

In addition to prioritizing relationship building, Indigenous methodologies developed by Tuhiwai Smith (2012) were used in a contemporary review of cybercartographic applications and how they are used as tools for decolonization (McGurk and Caquard 2020). In this review, using a set of 21 Indigenous criteria, cybercartographic applications were able to be assessed for the inclusion of Indigenous women's voices, how cybercartography is still largely under the technical direction of non-indigenous partners, and their differences when compared to

traditional GIS applications for claims research. In the example from McGurk and Caquard (2020), it is evident that cybercartography is moving in the direction of meeting the criteria as an Indigenous methodology however involving community more closely in the technology is important to meet this objective. And when all three of the above examples are considered together, it becomes clear that cybercartographic applications can be developed as technologies capable of integrating knowledge that is both useful politically and socially with a focus on improving relationships between the researcher and community in the process.

Indigenous communities engage with developing maps, and more specifically cybercartographic maps for various, community-specific reasons. Oftentimes it is to increase the potential for sharing learning material within the community, and cybercartography offers this potential through its multi-media interactivity and online availability. By engaging with cybercartography, communities are also engaging with political elements of self-determination because it is not possible to delineate cybercartography from the political, as mapmaking for Indigenous communities is intertwined with a history of working within settler epistemologies to produce forms of knowledge that will be accepted by the Canadian legal system. Settler societies are limited in the knowledge they will accept as evidence, and because of this, Indigenous communities choose to engage with cartography. And because cybercartography can display complex relationships with territory, it therefore has the potential to blur the lines between social and political self-determination by offering complex visual representations of territoriality (Anker 2018).

The objective of this research is to engage with Indigenous methodologies and use Indigenous principles to examine cybercartography's role in facilitating the process of self-determination for First Nation communities. Specifically, I aim to answer the following question

through the development and evaluation of a cybercartographic application: What is the potential for cybercartography to facilitate Indigenous self-determination? In answering this question, I hope to contribute new knowledge on how cybercartography addresses the community-specific requirements of self-determination.

To examine the role of cybercartography and Indigenous methodologies in self-determination, my study took a reciprocal, community-based approach to developing a cybercartographic application that engaged a broad range of community voices and perspectives and provided technical training to the community to limit technical barriers and address the key methodologies to decolonize the research process. The study emerged through a partnership between myself as the author of this study, a consultant, and the Hupačasath First Nation. My work developed a cybercartographic technology for the Hupačasath community that documented Indigenous knowledge geographically and represented elements of oral history through connecting place with audio, photo, video, and descriptive text. The study engages with Indigenous methodologies especially in the form of ongoing consultation to understand how the research product aligns itself with community requirements for self-determination. This study evaluated the ways in which contemporary cybercartographic technologies may facilitate the process of self-determination by developing a cybercartographic application specific to the community and conducting interviews with community members regarding its usability. The interviews and observations throughout the project were evaluated using the Indigenous principles of Ownership, Control, Access, and Possession (OCAP) (The First Nations Information Governance Centre 2014) to understand how the experiences of the Nation relate to the broader narrative of self-determination. To ensure future applicability of this study, a user manual was developed for the community that can be applied more broadly as a guide for other

communities and researchers interested in using this technology. This user manual was developed following a similar format to the Firelight Group's Direct-to-Digital Google Earth guide (DeRoy 2016), however the user manual developed here offers a step-by-step process for creating a customizable application. Finally, the findings from this study have been utilized to develop a university-level curriculum module that brings together elements of cybercartography and Indigenous knowledge with a focus on the process of understanding Indigenous relationships to place.

The structure of this thesis document was created to present these three main components of my research. Chapter 2 presents a detailed description of the case study in the format of an academic paper that is intended to be submitted to a peer-review journal after the completion of my graduate program. Chapter 3 represents the user manual as would be provided to First Nations interested in the development of a cybercartographic application. Chapter 4 presents the curriculum module, including learning objectives and instructions, as well as a link to the digital version that can be used by a wide range of courses interested in the digital mapping of Indigenous topics. Finally, Chapter 5 provides concluding statements about the main findings from this research, describes some of the limitations faced in this project, and provides recommendations for future research in this area.

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Chapter 2: Evaluating the potential of cybercartography in facilitating Indigenous self-determination: A case study with the Hupačasath First Nation

1. Introduction

Canada's history, like many countries' around the world, is marked by a contentious relationship with Indigenous peoples. Since the 16th century when settlers arrived and began the process of colonization, Indigenous Peoples' self-determination has been adversely impacted through attempts to assimilate to colonial values and ways of life (Battiste 2011; MacDonald and Steenbeek 2015). Self-determination, in any culture, is described as "the right of people to govern themselves by their own laws and exercise jurisdiction over their territories" (Corntassel 2008:118), and is globally acknowledged by international declarations such as the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP, 2007). Despite Canada's full support of UNDRIP and a recent push towards reconciliation with Indigenous Peoples (Abu-Laban 2019; Lightfoot 2018), there remains substantial barriers with Indigenous communities fully realizing self-determination (Boutilier 2017; Exner-Pirot 2018; Jung 2018).

While the process of constraining Indigenous self-determination predates the Canadian confederation of 1867, the Canadian Government has implemented numerous policy instruments over time that imposed limits on Indigenous individuals and communities, restricting their ability to maintain sovereignty and continue their cultural traditions (Barker 2008; Fontaine 2017). The first of these instruments was the Indian Act of 1867, which gave the Canadian Government legal authority over First Nations (the Indian Act excludes Inuit and Metis (Leslie 2002)) and set forth a process by which the government assumed responsibility for First Nations and replaced traditional governance systems with the Chief and Band Council System (Roe 2010). By doing

this, First Nations were required to report to the Ministry of Indian Affairs, which resulted in weakening their decision-making ability and traditional governance systems. The Indian Act went so far as to explicitly prohibit traditional forms of knowledge sharing such as feasts (referred to as a potlatch) and dance which are central to traditional communication through oral history (Bartlett 1977).

The stripping away of Indigenous self-determination by the Canadian Government has continued since the legislation of the Indian Act, arguably to the current day, through further political and social attempts at cultural assimilation. However, social backlash to certain policies, such as the 1969 Statement of the Government of Canada on Indian Policy (known as the White Paper), signaled social awareness of the Canadian governments attempts to solidify their colonial history by eliminating legislated differences between Indigenous people and other Canadians, effectively removing Indigenous identity (Cairns 2011; Nickel 2019). More recently, the Canadian Government has exhibited a willingness to acknowledge their history of colonization with Indigenous Peoples, notably through The Truth and Reconciliation Commission (TRC) of Canada (2015). One mandate of the TRC is to investigate human rights violations present within the Indian Residential School (IRS) system developed by the Canadian Government to assimilate Indigenous children into Canadian society (Stanton 2011). The TRC has created a historical record of residential school abuse and has made recommendations for reparations to IRS survivors (The Truth and Reconciliation Commission of Canada 2015). Such efforts have transcended to lower levels of governments, as the provincial government of British Columbia recognized language and education as human rights for Indigenous people through its Declaration on the Rights of Indigenous Peoples Act of 2019, from which it aims to facilitate language and cultural revitalization efforts for First Nation communities (Fraser 2019). However,

it has been argued that, for several reasons, the process of reconciliation faces inherent challenges with facilitating self-determination, with a main barrier being the difference in how the Canadian government and First Nations have envisioned the self-determination process (Corntassel 2008).

Canada's new comprehensive claims policy emerged in the 1970s and has continued to shaped Canada's approach to reconciliation, leading to Canada's vision of a rights-based framework of self-determination with a strict focus on territory and land settlement strategies (Wilson and Selle 2019; Bryan and Wood 2015). From this claims policy, the aforementioned ILUOP increased Indigenous voices in the mapping process by focusing on Indigenous participants and their knowledge (Eades 2015). This type of mapping, considered counter mapping, was engaged in by Indigenous communities to balance power relations between the Canadian government and Indigenous communities (Olson et al. 2016). Indigenous communities typically engage in maps and mapmaking for Indigenous communities is to address the limited capacity the Canadian government has to understand Indigenous methods of conveying knowledge (Bryan and Wood 2015) . The Canadian government sees it as in their best interest to employ land settlement strategies because they extinguish Indigenous title to territory where First Nation's accept monetary compensation and increased self-governance in return for agreements stating the return of land to the Canadian Government (Corntassel 2016). This is detrimental to First Nations as in some cases they relinquish rights to the majority of their homeland (Rynard 2000). Canada's primary focus on territorial delineation was largely responsible for the initial reluctance in endorsing UNDRIP in 2007, as they had concerns with provisions on land, territory, and resources (Pyne and Taylor 2012). Specifically, the declaration would have meant that the Canadian Government would be responsible for upholding the articles within UNDRIP

concerned with Indigenous rights to land. The perceived limitation of the declaration was presented as "irreconcilable with its constitutional foundation" by then Canadian Minister of Indian and Northern Affairs (Belanger 2011:133). These words are evidenced through legal disputes between Indigenous communities and the Canadian government, and these disputes are particularly relevant to cartography because they have created a framework for "proof" that has shaped the way Indigenous mapping initiatives represent knowledge (Anker 2018). One important case in framing proof as containing alternative forms of evidence is the Delgamuukw ruling (Delgamuukw v. British Columbia 1997) that opened avenues for distinctive forms of representation through maps which include place-based knowledge and testimonies from community members (Anker 2018). This place-based knowledge can take the form of site-specific information such as hunting or trapping locations or as place names and this knowledge is central to disputes around the infringement on territories as the Canadian legal system requires site-specific evidence that Indigenous communities are being impacted by government action (Anker 2018).

The Canadian legal system is also concerned with combining place-based knowledge with territorial boundaries where First Nations are asked to delineate their boundaries to define their territories as another form of representing their knowledge (Anker, 2018). Boundary delineation as part of a rights-based self-determination is therefore a political necessity for First Nation communities to communicate sovereignty to the Canadian government but it goes against the fundamental Indigenous discourse on territory where communities share spaces with a developed network of kinship ties (Thom 2009). Within this rights framework, it is common that communities might adopt western cartographic approaches (i.e. ways of mapping) to demonstrate their traditional knowledge and land use practices (Hunt and Stevenson 2017). This

is done because settler societies find difficulty in understanding land-based knowledge and how settlers are impacting Indigenous land rights (Tobias 2000). To communicate these rights requires Indigenous communities depart from their traditional ways of mapping and adhere to the rules of western cartography by mapping their knowledge on satellite representations of the landscape (Huggan 1989; Louis 2004; Louis, Johnson, and Pramono 2012; Pulsifer et al. 2010). In doing so, the cartographic approach to mapping Indigenous knowledge documents the traditional and contemporary use and occupancy of First Nations' land titled traditional land use and occupancy studies (TLUS) which develop visual relationships between land and First Nations (Tobias 2000).

Arguably, imposing western cartographic methods has facilitated First Nations in claiming rights to their territories as it enables Indigenous communities to catalogue their traditional knowledge and counter further dispossession of their territories (Louis et al., 2012; Peluso, 1995), thus pushing the Canadian Government to recognize Indigenous knowledge as evidence (Ridington 2014). As an example, the state required First Nations to submit boundary lines as part of British Columbia's Treaty Commission process (Turner and Fondahl 2015). These boundary lines were titled Statement of Intent (SOI) boundaries and were loosely based on watershed locations and followed mountain ranges that encompassed fishing, hunting, trapping, and other culturally important sites in what is now recognized as First Nation traditional territory (Barham 2001; Thom 2009). These boundaries have since been used as evidence of occupancy in a rights-based approach to self-determination (Olson et al. 2016).

However, western cartography, as an element of a rights-based framework, is in direct conflict with what Corntassel (2008) describes as "sustainable self-determination" that is built upon considerations of the environment, community health, natural resources, sustainability, and

the transference of knowledge to future generations (Corntassel 2008). It is a holistic version of self-determination that considers interlocking relationships between First Nations and land. Sustainable self-determination has been entrenched in First Nation ways of life, and until colonization, has not relied on cartographic mapping practices (Simpson 2004). Before colonization, the sharing of place-based knowledge by Indigenous peoples represented knowledge through oral history, song, and art (Caquard et al. 2009; Green 2013). For example, Nuu-chah-nulth communities of Vancouver Island store history, spiritual beliefs, and knowledge regarding social relationships and trade networks within Huulthin (shawls that hold spirits worn close to the body when conducting important business) (Green 2013). Practices for sharing place-based knowledge were constrained and thwarted by Canadian Government during colonization and led to the aforementioned dispossession of that knowledge (Bartlett 1977).

So, while rights-based self-determination relies on the distilling of Indigenous knowledge down to points, lines, and polygons on two-dimensional maps (Becker 2018), Indigenous territoriality is based on complex ontologies that are not confined to the reductionist scope of the traditional use study (TUS) used in the Canadian legal system. Though it is important for First Nation communities to engage in the rights-based approach to self-determination, it is missing the interrelatedness of places in First Nation territories (Becker 2018). I argue here that in order for meaningful reconciliation regarding Indigenous territory to take place, mapping Indigenous histories, knowledge and territory requires a merging of rights-based and sustainable self-determination through novel cartographic approaches that are concerned with strengthening the relationship between First Nations and their land.

It has taken many years to develop strategies for documenting Indigenous peoples' knowledge where initial projects used paper maps during the Inuit Land Use and Occupancy

Studies in the 1970s (Freeman 1976) that acted as evidence for territorial claim (Freeman 2011). These maps offered a new perspective on Indigenous knowledge as the information included in these maps came from Indigenous participants. However, there were limits to the utility of paper maps as they were difficult to replicate and share. These paper maps were replaced with digital methods of capturing First Nations land use in geographic information systems (GIS) (i.e. a system for gathering, managing, and analyzing data) capable of displaying relationships between traditional knowledge and geographic location using a digital database (Duerden and Kuhn 2006). Developing digital GIS meant First Nation communities could share their knowledge more easily in land claim disputes with the Canadian Government (Chapin, Lamb, and Threlkeld 2005).

In the last two decades, cartographic technology has increased in its potential to demonstrate relationships between First Nations and land by facilitating the requirements of sustainable self-determination (Aporta et al. 2014; Eisner et al. 2012; Pulsifer et al. 2010; Stone 2019; Thom, Colombi, and Degai 2016). The technologies being developed are encompassed within the field of cybercartography introduced in 1997 as a digital, interactive, multimedia and multi-sensory format for cartography (Taylor and Pyne 2010). Using cybercartography as a tool to document Indigenous knowledge has the potential to map relationships to land that traditional cartography cannot by incorporating oral and visual history and potentially meeting the requirements of sustainable self-determination (Pearce and Louis 2008; Taylor and Pyne 2010).

Some of the first applications of cybercartography for Indigenous knowledge mapping come from Canada with the introduction of open-source technologies such as the Nunaliit Cybercartographic Atlas (GCRC 2018). Through this introduction, cybercartography encouraged Indigenous communities to use multimedia approaches for communicating their traditional

knowledge (Taylor and Pyne 2010). Though the multimedia integration was received well by Nations, open-source applications were limited in their ability to address sustainable self-determination because of their technical complication where unconventional operating systems (i.e. Ubuntu) and command-line interfaces (i.e. communication with the computer via text input) are utilized for application development (GCRC 2018). The level of technical expertise required to develop the applications made it difficult to implement in the long term (Caquard et al. 2009). One reason for this is because each community is different, and developing specific protocols and technologies that work for the requirements of each community is important to meeting their objectives for self-determination. For this paper, technical expertise will be discussed as one of many reasons Indigenous communities will require a broad spectrum of technical solutions. This is because communities might prioritize mapping to varying degrees and the reason communities may find it difficult to engage in application development requiring advanced technical skill is not because the community is not capable, but rather is likely due to a complex relationship between community priority, financial stability, and other factors that dictate the level of technical engagement.

To address these complex relationships requires a varied spectrum of technologies. Developed alongside Nunaliit, there have been ventures into cybercartography that require less technical expertise through solutions such as proprietary software (i.e. Google Earth and ArcGIS Online) developed with comprehensive user interfaces which can be accessed through conventional operating systems with web-browser support (i.e. Apple and Microsoft products) (Aporta et al. 2014; Thom et al. 2016). By corporations such as Google and Esri entering the field of Indigenous cybercartography, there is increased capacity to develop software capable of being scaled to meet the usability requirements of a broad spectrum of communities and projects

(Sood, Shipra, and Soni 2016). However, development of cybercartographic applications using proprietary methods is a burgeoning field which has the potential to lower operational barriers to mapping solutions for sharing First Nations' knowledge (Taylor 2013:4). In doing so, technologies such as these which use intuitive user-interfaces have the potential to support First Nations' objectives for self-determination by decreasing entry requirements and access.

The overall objective of this study is to examine the potential cybercartography has for facilitating indigenous self-determination. This objective is achieved through a multi-stage process involving the development of a cybercartographic application that is developed and evaluated through a series of focus groups and interviews. To accomplish this, I evaluate individual experiences with the application using the Indigenous research principles of Ownership, Control, Access, and Possession (OCAP). This framework is based on Indigenous notions of self-determination in research, where each principle is a step toward First Nations enacting sovereignty over their knowledge, personal information and how research is conducted (Schnarch 2004). The OCAP principles provide a useful framework to evaluate the digital application by drawing together themes identified during the interview process and framing them as elements of self-determination. The intention of this study is to engage community members in the evaluation of cybercartography as a tool for self-determination. In doing so, this study offers new perspectives on how cybercartography might meet community-specific requirements of self-determination through merging rights-based and sustainable self-determination practices.

2. Background to Cybercartographic Approaches

Cybercartography has emerged as a digital mapping platform approach that shares Indigenous traditional knowledge through location-based interactive text, photo, audio, and

video components (Hayes, Pulsifer, and Fiset 2014). The majority of research to date has utilized the Nunaliit Cybercartographic Atlas framework to both mobilize and evaluate the delivery of traditional knowledge (Taylor 2014). Nunaliit atlases are described as "an interactive data management platform for collecting, relating, presenting, and preserving information and its context, with a particular focus on using maps as a unifying framework" (Hayes et al. 2014:129). Nunaliit itself is a command-line interface for the Ubuntu operating system based around schemas designed to display similarly inputted database documents (i.e. a schema could be created to display location data). The interface is designed for iterative development where schemas can be updated as data evolves. For example, input documents can evolve to have additional multimedia attachments (i.e. images, video, and audio). Using a database, Nunaliit interacts with modern web clients (i.e. applications to integrate database documents) in concert with a computer's internet browser to create interactive online cybercartographic atlases (GCRC 2018).

The majority of cybercartographic projects that utilize the Nunaliit framework are concerned with language mapping (Aporta et al. 2014; Caquard et al. 2009; Hayes et al. 2014; Keith, Crockatt, and Hayes 2014; Pulsifer et al. 2010), and many of Nunaliit's projects have been focused on mapping communities in the Canadian North (Anonby, Murasugi, and Dominguez 2018). These atlases catalogue Indigenous knowledge and its relationship to land in a way a traditional cartographic map does not. For example, the Gwich'in atlas had the objective of recording audio, video, and photo information associated with place names in their territory in an interactive map (Aporta et al. 2014). More recent ventures into the Nunaliit framework for cybercartographic mapping have contained relationships between Indigenous knowledge, the land, and time (Anonby et al. 2018). However, researchers have expressed difficulty with the

implementation of Nunaliit in comparison to other proprietary solutions (Becker 2018; Caquard et al. 2009; Cope et al. 2018; Pulsifer et al. 2010; Thom et al. 2016). Nunaliit requires a comprehensive understanding of markup language and even research teams struggle with this limitation (Caquard et al. 2009). And for communities who do not prioritize technical knowledge of mapping systems, Nunaliit may not be the most advantageous technology to use for cybercartographic endeavors.

The use of the Nunaliit platform has grown over time, which has in part been facilitated by its open source structure (i.e. the code to develop atlases is freely available). However, the structure on which it is developed presents tradeoffs that can limit some communities with varying priorities. There are two options for creating a cybercartography in Nunaliit (Nunaliit Map Makers and Nunaliit Developers), both of which require customization of a digital atlas by way of modifying or creating computer code. The ability to fully customize an atlas means that a community can create a product that entirely meets their needs in terms of both design and functionality, but it does provide a barrier to access to those communities with limited human resources versed with computational proficiency. This challenge is similar to any application that requires customized coding in web-programming languages such as JavaScript or HTML, as customization comes at a cost of accessibility for a broad variety of projects. Conversely, there are those applications that are highly accessible by allowing users to "point and click" in order to add content and alter the appearance of different elements, but customization is limited as design is mostly hard-coded into the application. Examples of such software applications include Google Earth (Google 2020) and Esri's Story Map (Esri 2020a), both of which allow atlas developers to create web-based maps on-the-fly and package these maps into web pages with no

programming requirements. Both are free to access and use, although Esri's Story Maps do require paid subscription for applications over a data storage threshold.

Options for developing atlases exist somewhere in the middle of this spectrum, and as such include moderate issues of accessibility coupled with moderate levels of customization. These options typically include developing mapping content in a desktop geographic information system (GIS), and then publishing the layers to the web, which can then be embedded into a custom built website. GIS applications such as QGIS (QGIS Development Team 2020) and Esri's ArcPro (Esri 2020c) fall into this category, as users bring spatial data into these applications, alter their appearance and add associated content, and then publish everything as a map that is placed on a web page. The benefit of these applications is that First Nation communities are increasingly adopting and utilizing GIS software for managing and visualizing spatial data related to their territory, and as a result trained staff are able to develop the types of maps that can be used in cybercartographic applications. However, there is still a challenge in converting these maps to web content that can be shared on the Internet, yet the barriers are not as steep as those presented by Nunaliit and similar applications.

Beyond the selection of programming languages and platforms, developing and implementing cybercartographic applications in communities is also challenged by technical, logistical, and educational hurdles. There are technological limitations to some remote communities adopting cybercartography due to a lack of contemporary computer systems (Stone 2019), and many remote communities generally do not possess adequate Internet bandwidth (Thom et al. 2016). These technological limitations affect how applications are used for community self-determination in that they can either not function on the available computer systems, or cannot be shared throughout the community via the Internet (Eisner et al. 2012).

Logistically, many cybercartographic applications are developed and implemented by researchers outside the community who spearhead and implement the projects (Aporta et al. 2014; Caquard et al. 2009; Keith et al. 2014; Pulsifer et al. 2010). These researchers struggle through mechanisms such as funding and community distance to implement and maintain the relationships required for long-term utility (Aporta et al. 2014; Caquard et al. 2009), which can potentially lead to lower adoption rates and communities not engaging with and using cybercartography for community self-determination (Caquard et al. 2009). Educationally, there are difficulties in providing adequate training on the cybercartographic applications (Caquard et al. 2009) where many projects do not contain technical training due to funding availability or research priority (Aporta et al. 2014; Keith et al. 2014). This undermines the process of self-determination for communities involved in these projects, because they are not self-sufficient in managing the technology. It is clear that cybercartography has potential to provide pathways to community self-determination through cultural revitalization by allowing multimedia, however, it is still unclear exactly how these technologies meet community requirements. Despite these challenges, cybercartographic applications have shown much promise in several First Nation communities. However, these barriers are a reminder that several considerations need to be at the forefront when planning and implementing these applications if they are to be used by communities for years to come in ways that help facilitate self-determination.

3. Methods

3.1 Project Background and Study Area

3.1.1 Project Background

This study involved the development of a relationship with the Hupačasath First Nation community interested in creating a cybercartographic application with incorporated elements that relate to community self-determination. In November of 2018, the researcher met with a local consultant in an effort to develop a relationship with a local First Nation community interested in developing a cybercartographic application. The consultant acknowledged the importance this project could have for a First Nation community and agreed to introduce the researcher to the Hupačasath First Nation. The decision to work with the Hupačasath First Nation was not entirely that of the researcher, as it is difficult to develop relationships with First Nation communities without prior relationships having already been established. Because of this, when the consultant introduced the researcher to the Hupačasath First Nation it was part of the community's larger ethnohistoric project, and the Hupačasath First Nation was receptive, it was this opportunity that led to choosing this Nation. In February of 2019, the Hupačasath First Nation were contacted through this consultant and a meeting was arranged between the researcher, consultant, and Hupačasath First Nation to discuss the project. Upon this initial meeting, a member of the Hupačasath First Nation communicated they had an existing interest in a project that would revitalize traditional knowledge of their territorial place names and history that had been rendered inaccessible in an outdated digital format. The Hupačasath First Nation were receptive to partnering with the researcher to develop a cybercartographic application that would support multimedia and document their traditional knowledge of place names with an emphasis on

language, as members of the Hupačasath First Nation were concerned community members were aging and youth were disengaged from learning Hupačasath history. The Hupačasath First Nation community members also expressed the sentiment that community engagement had declined due to technological hurdles in their previous digital place name map.

Previous attempts at mobilizing their traditional knowledge in a digital format began in 1999 during the Hupačasath Place Names Project (Hupačasath First Nation 2002). The project moved place name information from the Hupačasath Nation's first Traditional Use Study (TUS) into a digital format that was accessible to community members (Hupačasath First Nation 2002). This project had the aim of allowing community members to access and interact with Hupačasath place names (Hupačasath First Nation 2002). The project documented place name pronunciation through audio, language, and static map images. At the time, the project proved beneficial because it allowed community members to learn about their history at home on their personal computers, and provided youth an interactive medium for learning. The user interface of the Place Names Project and compact-disc-based format worked well for distributing place name knowledge as many members had computer access. Over the years this format became obsolete as technology changed and computers lost their ability to read the files. With the loss of access to the original Place Names Project, the community was unable to distribute their place name information digitally and express the need for a contemporary approach to mapping.

3.1.2 Study Area

The Hupačasath people reside in their traditional territory located on Central Vancouver Island (see figure 1). They are part of the Nuu-chah-nulth language group. Their territory can be described as ranging from kał-ka-č'ałḥ (Mt. Arrowsmith) to ƛuš-ƛuš-k̓uk (Hannah Mountain) to ƛ̓ii-ḥuut (Mt. Hammerston). Within this territory, there are four distinct groups, the Muh-uulth-

aht, the Kleh-koot-aht, the Cuu-ma-as-aht, and the Nah-mint-aht. The Muh-uulth-aht reside in the area of ʕa-ʔuk-ḵuk mu̓u-ḥuł (Great Central Lake), the Kleh-koot-aht at ʕa-ʔuk-ḵuk ƛ̓i-kuut (Sproat Lake), the Cuu-ma-as-aht at ʕas-ẇin-ʔis near the mouth of the Alberni Inlet, and the Nah-mint-aht in the area of Nahmint (ʕaʔiƛ-na-mint). Project interviews and focus groups were conducted within this territory at the Hupačasath Hall of Gathering on the ʕas-ẇin-ʔis reserve near the town of Port Alberni. The Hupačasath First Nation gave place names to streams, rivers, bays, and mountains within this territory. Most place names were created hundreds of years ago, and the knowledge of them has been passed down through generations via oral history. Place names often describe the type of activity that occurred at that site.

Place names serve to indicate sovereignty over traditional territories by describing First Nation's history. It is not only that place names possess historical knowledge, place names preserve language, stories and culture. In the context of sharing place names in a cybercartographic application, place names remind settler society as well as Indigenous communities of the importance of Indigenous places in light of the erasure that takes place on settler maps. And so by integrating them into cartographic practices, place names are also used as evidence for rights and title to territory in the Canadian legal system. The dimensionality of place names goes beyond the phonetics, the language, the descriptions, or the imagery embedded in a map. For Indigenous people, places are viewed both with subjectivity (personal experiences), but also with overarching tones or themes to a place that are reflected as a shared perspective within a group (Basso 1988). In this sense, place names build a shared knowledge and relationship to land and are therefore important to self-determination. Most interestingly, place names can preserve modes of communication such as "speaking with names" where individuals interact relationally with a shared understanding of place (Basso 1988).

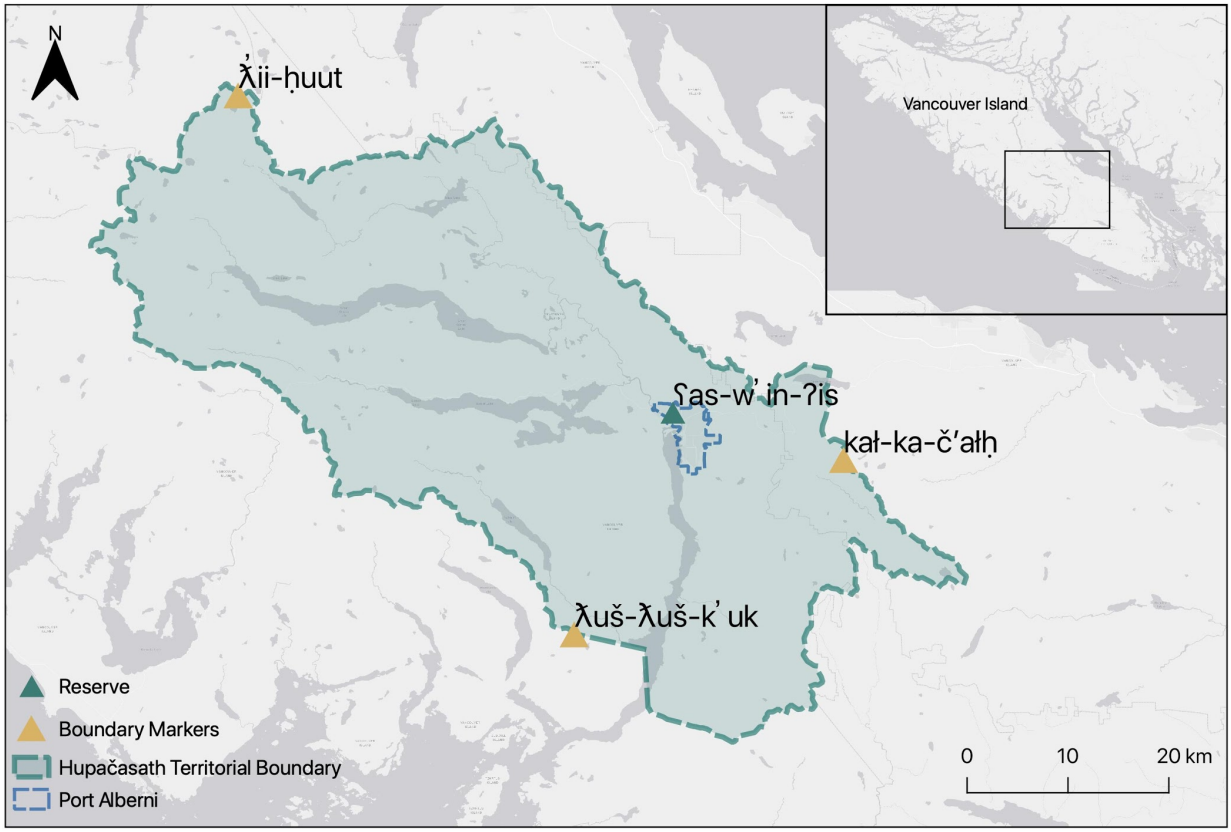

Figure 1. The project study area on Vancouver Island, British Columbia (QGIS Development Team 2020)

3.2 Methodological Approach

Throughout the research process it was the researcher's objective to adhere to respect, reciprocity, and responsibility to create healthy relationships with the community members involved in the project. It can best be described by Shawn Wilson as an Indigenous research paradigm (Wilson 2008). This is the reason our case study uses an iterative approach to the development of a cybercartographic application for the Hupačasath First Nation (Pyne and Taylor 2012). This iterative approach is a series of processes that involve consultation, implementation, and evaluation as described by Pyne & Taylor (2012). For the Hupačasath First Nation's cybercartographic application, this was participatory, with semi-structured community engagement through conversations, interviews, and focus groups where researchers worked with

community members to understand the Hupačasath First Nation's requirements in the development of a cybercartographic application and followed semi-structured methodology described by Partington (2001). The semi-structured approach allows for the interviewer to expand or contract on certain questions based on the flow of conversation (Partington 2001:33), and proved important in allowing participants to tell their stories. The iterative nature of this study took place through a process in which the researcher would consult the community, develop application components, and return for multiple rounds of consultation until the application was deemed to include the multimedia components the community required. Finally, the application would be evaluated in a focus group or through community member interviews to understand the degree to which it aligns with individuals' notions of self-determination. The intention of the iterative process is to promote community engagement by consulting key members of the community at every stage of the development process and to ensure the results connect with the research objective.

3.2.1 Community Consultation

Prior to community consultation, the researcher reviewed a spectrum of cybercartographic applications that could provide a multimedia experience for the community members of the Hupačasath First Nation (see figure 2). These technologies were placed on a spectrum of accessibility for the community who have no trained web developers and limited computational expertise. The spectrum defines customization as the ability of the application to match community specifications and accessibility is defined as the ease to which a novice computer user can use the software to build web applications. Programming languages for application development were ranked as least accessible, where computer expertise requirements were highest, and proprietary mapping tools most accessible, where computer expertise was

lowest. Developing an application using a programming language offered the highest level of customization, and the proprietary mapping tools offered the most accessible user interface with limited customization. An example of a programming language that allows for a high degree of customization is JavaScript, which is a programming language capable of compiling multimedia and geospatial datasets to create web maps. An example of a proprietary mapping tool with limited customization would be a Google Earth Mash-Up, which consists of Google Earth (Google 2020) combined with an array of Google's software. There are moderate, open-source options such as desktop Quantum GIS (QGIS) (QGIS Development Team 2020) combined with JavaScript libraries such as Leaflet (*Leaflet API Reference* 2020) that create basic interactive web maps that can be hosted online. There is also software such as Esri's ArcGIS platform, that combines desktop ArcGIS (Esri 2020b) and ArcGIS Online (Esri 2020a), a pay-per-use cloud service capable of creating interactive multimedia maps, that could be more suited to the requirements of a community with limited expertise. These moderate options have tradeoffs, where open-source software still requires programming knowledge to publish online, and Esri's platform requires licensing fees. There must be a compromise for the Hupačasath First Nation community that balances access and customization and acknowledges the community's level of current capacity.

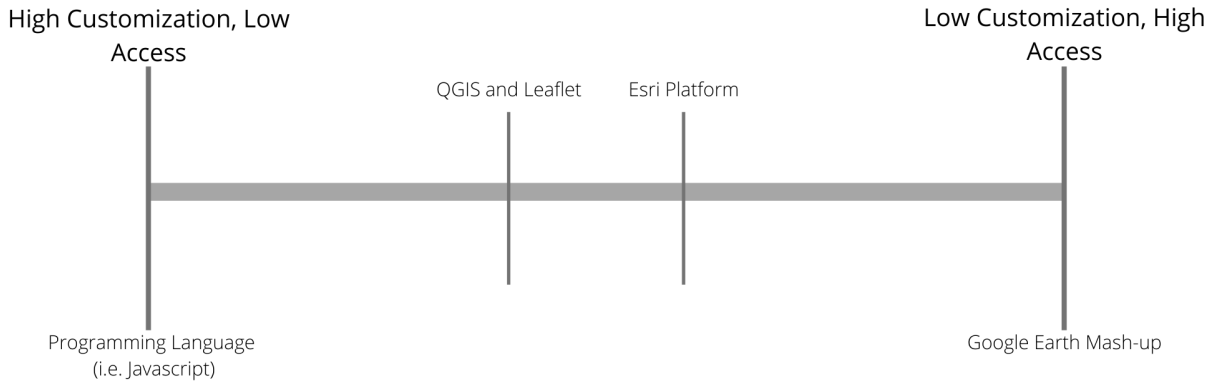

Figure 2. The spectrum of customizability and access

Esri's online software allows users to implement scrolling story functionality with detailed maps which allow the user to upload photos, embed videos from popular streaming sites such as YouTube and embed hosted audio files (Cope et al. 2018). All of this is done through a simple user interface. However, unlike the other web applications, there is a licensing cost associated with implementation. The University of Victoria volunteered to carry this cost, as they had expressed interest in working more closely with local First Nation communities. In addition, the consultant had explained the community's familiarity with Esri software. Therefore, with the combination of the community's familiarity with Esri's platform and the removal of licensing fees, it was decided that preliminary designs would be presented to the Hupačasath community using Esri's platform.

The first stage of community engagement is modelled after Taylor et al. (2014) and took place through consultation with the aim of developing an understanding of the requirements the members of the Hupačasath First Nation had for a cybercartographic application. This first stage and partnership began in February 2019. During this first stage, the researcher brought and presented application designs using Esri's software to the community. The initial designs were

provided as a means to demonstrate how the data from their previous Place Name Project could be digitized.

Following the initial February meeting, subsequent interviews were conducted in March of 2019 at the Hupačasath First Nation Hall of Gathering that lasted approximately thirty minutes and were completed with the previously elected chief and lead GIS technician in which the main objective was to identify the types of multimedia content, as well as how participants would like to see information portrayed. For example, one question looked at whether participants would like to see photo, video, and audio included. Participants were presented with an honorarium and hand-fired pottery as a gift at the beginning of each interview. A secondary objective of the March 2019 interviews was to understand which specific software they were comfortable with. Conversations with the community's GIS team acknowledged they wish to use file types they are familiar with from their training and experience on ArcGIS desktop software because the head GIS technician at Hupačasath First Nation has been working with Esri programs since the 1990s. They also wished to integrate the web application with their desktop software. Although the GIS team was familiar with components of the Google platform, such as Google Earth, they had reservations about the file structure, and compatibility. This in combination with the demonstrations of Esri's software led the community's GIS team to decide this would be the most easily adaptable application style. Therefore, the Hupačasath First Nation confirmed they wish to continue application development using this software.

3.2.2 Application Development

The application development stage consisted of the researcher creating an application that included the knowledge and multimedia requirements from the March 2019 interviews (see

figure 3). For example, during one of these interviews, the researcher posed a question about the types of media to be included in the application, and the participant answered that audio recordings of an elder who is now deceased were essential. The researcher then noted that these audio recordings were identified as a requirement within the application by community members. To maintain constant contact with the community during the development process, the researcher worked closely with a Hupačasath First Nation youth at the Hall of Gathering who could consult staff for the researcher during the development process. This youth was instrumental in creating an accessible phonetics guide based off of the elder audio recordings.

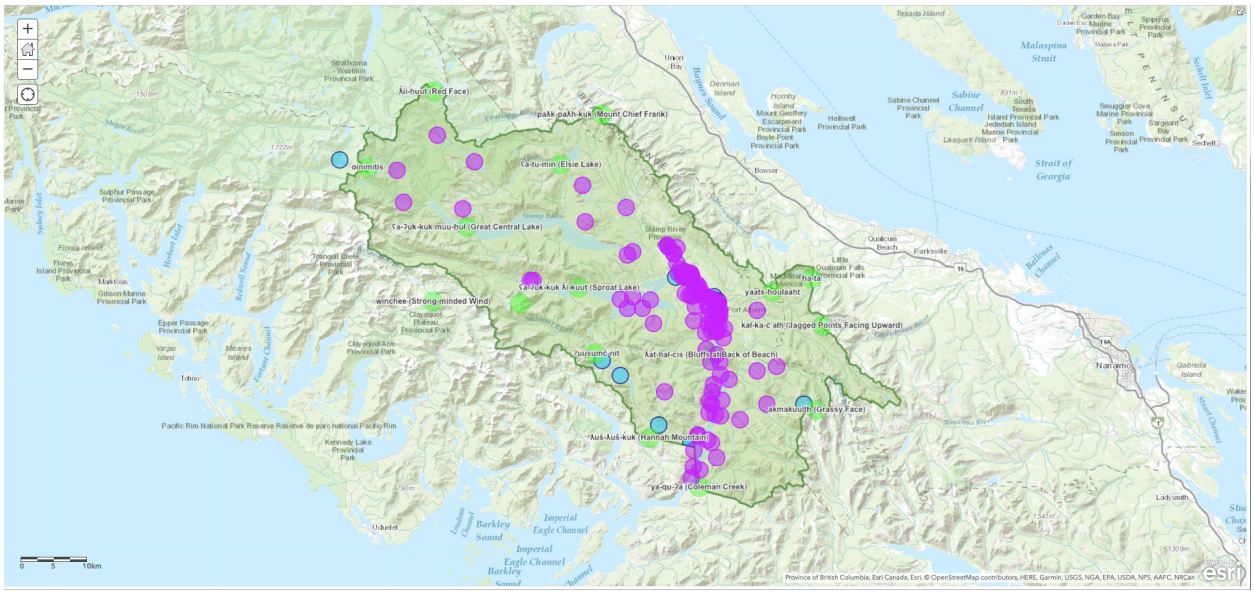

Figure 3. The Hupačasath place name and language application

Once participating community members from the Hupačasath First Nation were satisfied the application had been developed to the requirements agreed upon, the application was brought to the community and multimedia functionality was demonstrated during a focus group of four knowledge holders in June of 2019. Multimedia included audio recordings of elder speakers pronouncing each place name, a text description of the place, a photo of the place, a Nuu-chah-

nulth place name, and a phonetic spelling (see figure 4). This information was collected from focus groups, prior mapping projects, archival sources, and field research.

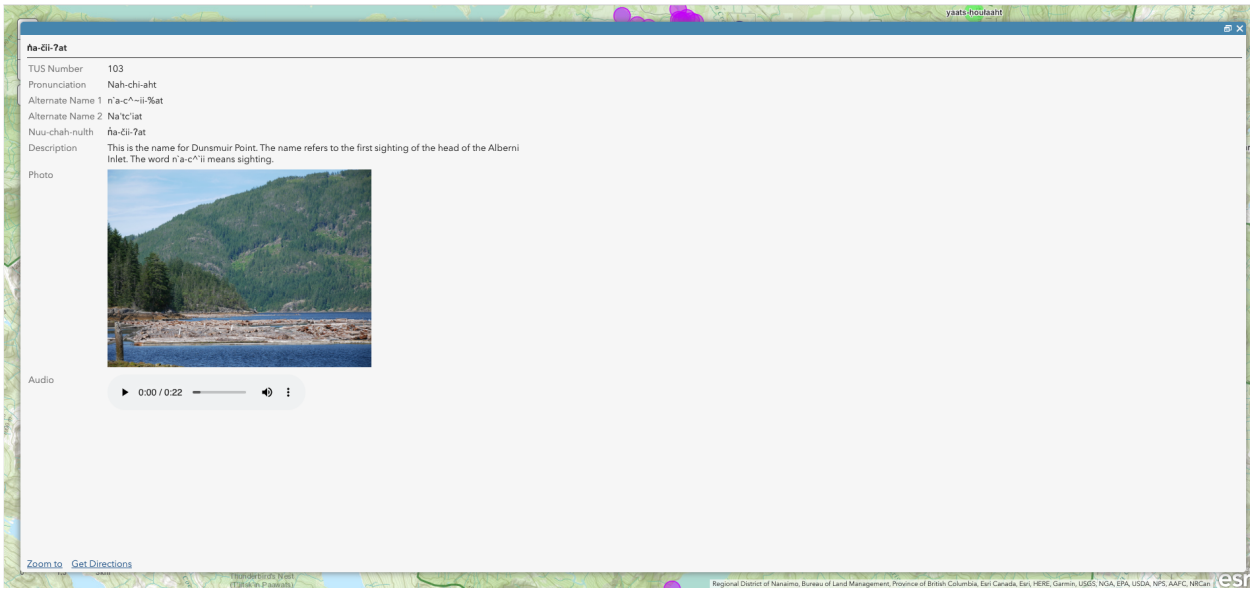

Figure 4. A place name pop-up window with embedded information.

Interviews were conducted in the form of multi-day community focus groups with elders and respected community members in order to determine the accuracy of the information included within the application. These members were chosen by council to best represent the community, and participants were asked to sign consent forms to begin the focus group. Selected community members were provided a Google Earth map of places that were included in the application, and asked to verify their accuracy, as well as provide additional places and stories about the Hupačasath First Nation. Google Earth was used for this part of the process only because of their three-dimensional visualizations that Esri's platform did not offer. The Google Earth software was projected on a wall-size whiteboard which the elders had access to using pointers or laser pointers as they so chose. The focus group consisted of three researchers and four knowledge holders, and provided a space for open discussion about each place in the

Hupačasath Nation's territory. To create a space where participants could speak freely, switching between Nuu-chah-nulth and English, one researcher was a youth community member who could write in Nuu-chah-nulth. Each researcher was tasked with one of the following: creating point locations on the Google Earth map, writing notes of important moments during the session, or posing interview questions. The process for verifying the information within the application was semi-structured where the researchers had a list of places with descriptions and the source of each spelling and description.

Once the application was created, a train-the-trainer approach was taken in which the community's GIS team learned the skills and methodologies to then operate the application and integrate it with their current desktop software. Researchers suggest this approach as it increases community capacity to use technology (Thom et al. 2016; Tobias 2009). The objective of this approach ensures the GIS team will possess the ability to train community members in how to undertake community-based mapping. This was done to ensure the community is capable of using the application without outside guidance.

The workshop, held in September of 2019, included the creation of locational information for place names in the form of points, lines, polygons and their associated attribute data for overlay on basemaps, and how to upload this information from their desktop software to ArcGIS Online. As an additional part of the training, participants were also guided in creating ArcGIS Online user accounts, using the online software, and integrating Nuu-chah-nulth keyboards on their computers for typing their language. Each GIS team member watched the researcher complete each part of the training, and then complete it themselves while being shadowed by the researcher in order to ensure the participants understood the process.

After consultation, development and training, the application was embedded in the Hupačasath First Nation website (see figure 5). The embed process involved the researcher, the lead GIS technician from Hupačasath First Nation, and the website consultant who was previously hired to manage the Hupačasath website. The application was embedded on the website because the Hupačasath Chief and Council thought this would be the best way of reaching community members. It is now publicly available for teaching and learning purposes.

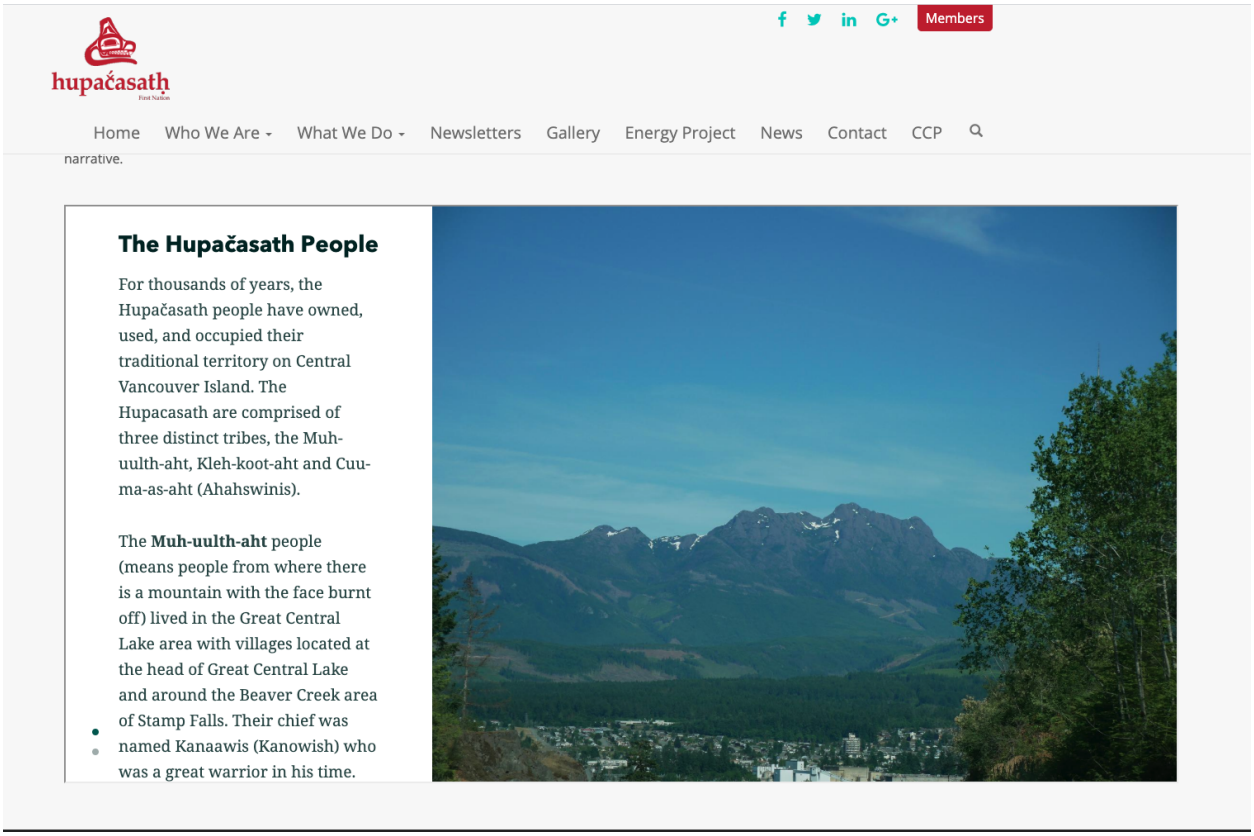

Figure 5. The Hupačasath website with the embedded application.

3.2.3 Application Evaluation

Follow-up interviews were conducted in September of 2019 with six community members to determine their community-specific requirements of self-determination, and how the

application addressed these requirements. These interviews lasted approximately forty-five minutes. Community members were selected by the Hupačasath GIS team to be representative of demographics within the community. The participants included a council member, a GIS technician, three community members, and a community elder. The interviews had five specific phases: (1) demonstration of application, (2) application component questions, (3) self-determination questions, (4) OCAP questions, and (5) application use questions. It must be mentioned that all interviews during this study were confidential, and therefore the names of interview participants have been omitted.

The first phase was the demonstration phase, where the researcher worked with the participant and demonstrated how to use the application. This involved an introduction from the researcher and thesis objective, describing the process of application creation, and then showing the user the multimedia within the map. The researcher would then explain the source of the material so participants knew who the knowledge came from.

The second phase was the application component which identifies information the participants would like added to, or removed from the application. What is included in this phase, are questions about the subsections of the application. For example, the researcher asked whether there are multimedia elements such as photos that could be included that have not been. The researcher used this information to understand how the developed application aligned with the specified requirements of a larger sample of the community outside the iterative consultation process described above.

The third interview phase was the self-determination phase of the interview and is intended to position the application within community self-determination. The self-determination section was semi-structured, with open-ended questions that gave the participants a space to

assert their definitions of self-determination. The section commenced with the researcher asking each participant generally about what self-determination means to the community? The researcher used the answers from these questions to develop themes and commonalities between participant answers to then draw conclusions about the utility of the application for this process.

The fourth phase of the interview process uses principles developed to express First Nations' self-determination in research (The First Nations Information Governance Centre 2014) to uncover how each participant sees this application fitting within Ownership, Control, Access, and Possession, where Ownership aims to ensure a community collectively owns their knowledge. Control then relates to how the community decides knowledge is used. Access is concerned with how First Nation communities can access their information independent of where it is stored. And Possession is more literal than ownership and is concerned with ensuring First Nations have the power to use their information within the community (Schnarch 2004). The use of OCAP is especially fitting as it ensures First Nations' interests are at the forefront of the research process contributing to a sustainable self-determination (Campbell 2013).

To further describe the importance of OCAP for First Nations self-determination, an in-practice example comes from the First Nations Regional Health Survey (RHS) which spearheaded the use of OCAP after the Assembly of First Nations Chiefs Committee on Health mandated there be a national survey of First Nations health every four years. This Regional Health Survey met the principles of OCAP by ensuring that community participation was present in every aspect of research including design, collection, and analysis meeting their objectives of self-determination in research. Moving beyond health research and applying OCAP to cybercartography facilitated researchers in its connection to self-determination (The First Nations Information Governance Centre 2014).

The fifth phase was the application use phase of the interview which asked participants to consider how the application would be used in the future. For example, the researcher posed questions on the ways the community will continue to update and use this tool in the years to come? This aided the researcher in understanding long-term use of the application.

3.3 Thematic Analysis

For this study, all the interview data was transcribed and contributed to the final analysis which includes the March 2019 and September 2019 interview transcripts. To increase the qualitative rigor of the study, it was decided that a top-down theoretical thematic analysis would be performed (Maguire and Delahunt 2017). This method of analysis was decided upon as it is meant for interview transcript data. The top-down thematic analysis is driven by the research question and researcher's focus (Braun and Clarke 2006). For this process, interview data is transcribed and the researcher familiarizes themselves with the content of each interview by reading over the interview transcripts carefully.

Next, the transcript data from each interview is categorized based on the OCAP principles. There are four categories of Ownership, Control, Access, and Possession used as key headings in the results and discussion to understand how OCAP applied to the research process. Themes are then identified within each of the OCAP principles where there were nine themes identified from the interview transcripts which included: Data Privacy, Verified Record of Cultural History, Community Involvement in Research, Technical Training, Education, Age Inclusivity, Community Scale Access, Cultural Knowledge Database, and Financial Barriers (see table 1). These themes were used as subheadings within the results and discussion section to address how the cybercartographic application met the requirements of OCAP.

5. Results and Discussion

5.1 Ownership

The OCAP principle of ownership is concerned with a community or individual's right to the possession of, and decision-making power over, the distribution of their personal information (Schnarch 2004). In this study, the importance of ownership emerged through the selection of a cybercartographic technology and the implications this technology would have on the distribution of intellectual property. Concerns regarding ownership surfaced through participants responses around information privacy and the importance of verifying cultural knowledge that was to be presented publicly.

5.1.1 Data Privacy

Cybercartographic atlases have the potential to communicate knowledge broadly and publicly. However, whether Indigenous knowledge should be public is at the discretion of the community. To enforce this, examples of OCAP in practice require agreements between Indigenous communities and the researcher where communities have the right to relinquish the use of information if it is misused (The First Nations Information Governance Centre 2014).

The participants from the Hupačasath First Nation view data privacy of cultural knowledge as unique from other forms of information, where ownership of cultural knowledge is meant to be shared more broadly with the community and other interested parties such as government or industry. For example, sharing place names reinforces their territorial occupancy (Tobias 2000); as for many Indigenous communities, place names act as mnemonic devices capable of capturing the stories and history of a people (Cogos, Roué, and Roturier 2017). For the participants, the privacy of this information is of lesser concern as they do not wish to

relinquish their rights to these areas, but demonstrate these rights at a regional level and beyond: “I don’t think it [decreases ownership], they’re our names, they’re our places, we’re just showing that yes, it is ours. This used to be done at Potlatches...you’d stand up and name your places, you’d name your people, it doesn't matter who is in the room. They could have recorded it and some people did and they are kept in museums. It’s meant to be shared, and the people are supposed to know it.” (community member, personal communication, 2019)

The above quote emphasizes the importance of sharing this knowledge to educate community members, as the participant’s response places education and cultural knowledge sharing as more important than information privacy concerning place names. This hierarchy is identified again by another participant who states: “We ran into this in our reconciliation, people want to hide our information and not share it, thinking that it’s giving them power, and all they are doing is losing it, and they’ll die with it...we need everybody to know our names" (community member, personal communication, 2019). While OCAP intends to keep information private by maintaining exclusive ownership over that information, the response from this participant expresses a greater need instead to share that information and knowledge for the sake of community education and self-determination.

The sovereignty of Indigenous knowledge is still a contentious subject, as there have been many examples of misused data in the past (Schnarch 2004). One regional example where researchers took advantage of the Nuu-chah-nulth people comes from a study in the 1980’s in which blood samples were taken under the pretense of an arthritis study, and used these blood samples to further the researcher’s academic career in areas of HIV and AIDS research which violated the agreements with the community (The First Nations Information Governance Centre 2014). This contributes to a mistrust of researchers and more reason for knowledge holders to

keep their information private. Mistrust such as this has led researchers to be cautious of maintaining data privacy when conducting any research (Eisner et al. 2012). Although regionally there have been exploitations by researchers of health data, the participants from Hupačasath First Nation indicate that these same concerns do not apply in the same way to cultural knowledge. As one participant responded: "The people are going to know [about their traditional knowledge] and I don't think that can be kept private. Personal information about somebody's health is different than a map [of cultural knowledge]" (community member, personal communication, 2019).

These findings put into perspective the importance the participating community members see in sharing their place name knowledge, regardless of past exploitations, and willingness to share it with researchers. This finding follows an emerging trend in which Indigenous communities are increasingly open to publicly sharing their cultural information such as the place names contained in this map (Keith et al. 2014), especially when the objective of these cybercartographic projects are to educate youth and future generations (Aporta et al. 2014). Future studies must address privacy concerns on a case-by-case basis where the data type and community stance on ownership be considered at the center of this process. This could be accomplished through preliminary meetings in which researchers are explicit with the community about how the research findings and distribution will influence the privacy of information.

5.1.2 Verified Record of Cultural Knowledge

Cybercartography has proven useful for verifying cultural knowledge by bringing knowledge holders together to authenticate information among a group of peers through solutions such as focus groups (Taylor et al. 2014). Verifying cultural knowledge is integral to

community ownership because this knowledge is often presented publicly to the state and industry to resolve land claim and traditional practice (i.e. hunting, harvesting) disputes. For the participating community members, this verification process contributed to self-determination by providing a consistent form of evidence: "I know how a lot of people are picky about information going out to the rest of the world...that when you put something onto a map, a paper, the internet, it's got to be right. It can't be somebody telling you that this is our property and it's not. So doing a background check and making sure...before you put it out there" (community member, personal communication, 2019). In this response, the participant is addressing the importance of knowledge accuracy as having implications when claiming land rights (Taylor, Anonby, and Murasugi 2019).

Verifying information is also crucial to the participating community members for localized decision-making processes as opposed to their regional land claims disputes. As one community member noted: "I could only see it increasing people's knowledge, even for people who work within the office quite often we need to find out some information and rather than having to go upstairs and try to find the appropriate box, to be able to go to a site like this and know that it's proper information that's been verified" (community member, personal communication, 2019). Since local scale decision-making is common in many First Nation communities, readily available cybercartographic information is important for determining responses to time-sensitive issues such as subsistence hunting and environmental changes (Eisner et al. 2012). For the Hupačasath First Nation, decision-making is kept to a local scale because the public information such as the place names within this study provide strong evidence for occupancy, however weaker evidence for current land use. The difference between these two is that occupancy does not necessarily have to be within the lifetime of the interview participant

(Tobias 2000), which aligns with the intent of cybercartography being an interactive multimedia experience for community learning (Taylor et al. 2014). However, even with cybercartographic projects focusing on occupancy knowledge, there is potential to incorporate current land use. Therefore, future studies should consider cybercartography to either have the potential for community level self-determination with a focus on building educational capacity and youth identity, or current use studies, which would require projects to identify their objective early in the research process.

5.2 Control

Within OCAP, control is concerned with the integration of Indigenous voices into all research processes to produce a project that aligns with the objectives of the community (Schnarch 2004). For cybercartography, this control can be asserted during the consultation, design, and implementation of the application. The emergence of control within this study came in the form of community research involvement and technical training.

5.2.1 Community Engagement in Research

The engagement of the community in the research process places the control of the content within the cybercartographic application within the community. Engaging the community in the research process is decolonizing and adheres to Indigenous research methods where researchers are focused on the value of knowledge and experience community members bring to the project (Dunbar and Scrimgeour 2006). Indigenous cybercartography describes this practice as being central to the development of any application (Taylor, 2014, p. 6).

For this project with the Hupačasath First Nation, this contemporary approach involved the consultation of a sample of community knowledge holders. However, there were limited

knowledge holders capable of contributing to the application content: “my problem is not many [community members] know the place names. I grabbed you who I could. That’s my biggest fear, I get more people dying and I lose the place names. I needed to get it recorded, I needed it mapped, I need photos, I need to listen phonetically, and get it out there quickly because the more people learn, it won’t die like other languages” (community member, personal communication, 2019). This response highlights that while researchers can follow Indigenous methods, there is often limited availability of community members who still hold traditional information. This is further evidenced by other studies with small samples of interview participants (Stone 2019). What this study with the Hupačasath First Nation does, is emphasize that this difficulty is potentially a symptom of the lack of knowledge holders left within the community available to contribute to the project.

Those participants who were included in the development of the cybercartographic application found the process to be adequate in terms of consultation: “I think you guys have talked to all the families and gotten all the history that you can out of our members, so I don’t think you could go wrong from that, but I’m sure others might dispute but I’m fine with it” (community member, personal communication, 2019). While this community member perceived the information acquired as adequate, it is naive for researchers to assume at any point that all the community’s knowledge is documented, especially with the depth of knowledge elders hold (Barnhardt and Kawagley 2005).

In line with this, participants not included in the development asserted the process would have benefited from additional outreach: “I really do think that you should do an open house to say hey this is what we’ve done, if there is anything else that you want to add to it, whether it’s a story, whether you know that there are indigenous plants there, is there a family history? Those

kind of things. If you don't get it, then you've done your part" (community member, personal communication, 2019). These responses reveal inability for community-led research such as this to exhaust all perspectives and sources of community knowledge. With this observation, it is also worth noting that it is common for community research to concern itself with immediate objectives, and consider much of this consultation as being outside the scope of the project (Eisner et al. 2012). For example, some studies see technical training to support ongoing research as being outside their scope (Caquard et al. 2009). However, the findings from this study emphasize the need for researchers to be looking for opportunities to build capacity internally for communities to continue research. To build this capacity, the literature suggests communities are more likely to use applications when they are involved in the consultation process, as this creates commitment to the project (Caquard et al. 2009). Indigenous authors corroborate these findings by acknowledging the importance of representative consultation, where a range of community members are consulted to increase engagement (Wilson 2008). Therefore, studies in this field should acknowledge the need for broad consultation and engagement during the research process to ensure applications incorporate a range of perspectives from different families and age groups, and therefore a greater level of commitment to the projects, to secure longevity.

5.2.2 Technical Training

It is vital that operational training be offered in order for Indigenous communities to exert control over a cybercartographic application. An appropriate method of accomplishing this is through the use of the train-the-trainer model, in which select community members are provided with the skills required to train other community members in the future (Tobias 2009). For the Hupačasath, this training was completed during a two-day intensive workshop with the two members of their GIS team. One participant, who possessed a background in GIS with many

years of experience, expressed confidence in their operational abilities after the training. However, another participant with less experience did not see the training as adequate, stating, " [the training should be] longer...when doing a project like this repeat a step many times instead of just learning how to use it, actually being a part of creating the map would help me learn" (community member, personal communication, 2019). This response suggests that participants should have been integrated into the application design process to further contextualize their learning.

The literature states that technical training is a requirement of a reciprocal relationship with Indigenous communities (Corbie-Smith, Moody-Ayers, and Thrasher 2004; The First Nations Information Governance Centre 2014). This is not always the case, where some research projects view training as outside the research scope (Caquard et al. 2009). Poor research design, lack of community consultation, or time and funding restrictions could be partly responsible for situations where researchers fail to properly train a community (Tobias 2000). This is an oversight in these cases since removing the training aspect of the research process also removes the ability for the community to fully exert control over the application.

This study adds evidence to the necessity of comprehensive technical training. It is important to note that the provision of training is not always equal, as members with more technical expertise may dominate the process and leave others with limited knowledge. Therefore, research that is to align with Indigenous research methods must incorporate inclusive training to ensure the community can use the application for its intended purpose, whether that be educational or otherwise. In future studies, there should be a budget and researcher time allotted for adequate training to ensure the community is involved in the technical side of the cybercartographic application.

5.3 Access

Access, as a principle of OCAP, addresses the ability for Indigenous communities to access their information regardless of where it is stored (Schnarch 2004). In the context of cybercartography, in order to meet this principle, stored data must also be comprehensible to community members. The cybercartographic approach used in this study furthered the comprehensibility of data by providing a platform capable of displaying cultural knowledge in a user-friendly manner. During this study's interview process, the following themes emerged on the topic of access: education, age inclusivity, community scale access, and cultural knowledge database.

5.3.1 Education

Using the cybercartographic application as an educational platform makes cultural knowledge accessible to individuals who were previously unable to access that information through the use of photographic and phonetic techniques. For example, the application increased access for elders by offering a means to engage with territorial place names: "Some of the elders can't read [maps]. They just don't, they can't. Show them pictures however, they'll remember" (community member, personal communication, 2019). Imagery has long been used as a tool for recognition and with the introduction of images into research, there are improvements in recollection of knowledge.

A similar study mapping Kitikmeot place names found photos were a good identifier for map users, especially for elders who were able to record more locations and places when images of these places were provided (Keith et al. 2014). However, within the study by Keith et al. (2014), photos were used to assist in knowledge collection throughout the research process, whereas the study with the Hupačasath First Nation used photos within the finished application

as navigational tools and place name identifiers, increasing access for community members. The use of photos in this study demonstrated the potential of cybercartographic multimedia for distilling memories and increasing the educational capacity of the application.

Cybercartographic atlases also offer the option of including phonetic elements in the form of audio and phonetic spelling for users to learn pronunciation. These elements were critical to the educational success of this application: “[the application can be used] with the youth especially, getting them familiar with the names, having the language in there so they can get used to the pronunciation of certain sounds and places, and it gives them that tie to their community, their land, and even their ancestors" (community member, personal communication, 2019). The study with the Hupačasath First Nation shows that incorporating audio and phonetic elements into the application increases the access youth have to their language by improving pronunciation.

The greater literature on phonetic spelling suggests it improves learning and in turn language revitalization (Bird and Miyashita 2018). Evidence of the application’s phonetic capability is demonstrated by the educational benefits for community teaching professionals: “the phonetics helped the teacher teach the kids, so she was able to sound them out, and then they got to hear [audio clips]” (community member, personal communication, 2019). Even with their expressed value, recent examples of place name applications do not include phonetics (Aporta et al. 2014; Becker 2014; Keith et al. 2014). It is possible phonetic spelling is not used because the learning process takes time and persistence (Gilakjani and Ahmadi 2011). This is something that concerned the Hupačasath community in that the International Phonetic Alphabet (IPA) is not an immediate means of pronouncing place names as it requires further education. To remedy the inaccessibility of the IPA, the phonetic spelling used in this study is simplified, relying on the

sounds of the English language where qu-ḵʷiḥ-ta becomes ko-kwetch-ta. This study demonstrates the viability of phonetic learning through its use by teaching professionals to benefit learning outcomes, as well as providing a guide for researchers involved in community engagement to properly pronounce and identify place names.

To improve language learning, audio provides dialects missing from the phonetic spelling. Audio of elder speakers is valued within the cybercartographic application as it contains the dialect of the speaker which ensures no further dialectical language transformations (Aporta et al. 2014). When educating community members, dialects offer language learners something to identify with, because many of them will have carried their dialect, even if they have lost the ability to speak the language (Corntassel 2003). This study highlights the importance of carrying dialect forward within cybercartography and indicates future applications should include these phonetic elements to increase the effectiveness of language learning.

5.3.2 Age Inclusivity

Cybercartography bridges the divide between the technically advanced and novice user. By increasing the inclusivity of these interfaces, it opens up a larger community of individuals capable of accessing the application. Findings from the Hupačasath case study show the application is intuitive for both elders and youth: “kids, no problem at all. Kids know more than we do when it comes to technology they are way more advanced than we give them credit for. The way I see it I think even for an elder to a certain extent that has basic computer skills would most likely be able to navigate through it without much problems” (community member, personal communication, 2019). The use of this application by elders was confirmed in another interview: “I already have elders using it, two of the language speakers are elders, they’re

already whipping through it, just so they can get the language down" (community member, personal communication, 2019).

Other applications that use similar technologies have found difficulties engaging a range of community members as elders find the interfaces difficult to use (Craig, Harris, and Weiner 2002; Eisner et al. 2012). Elders require interfaces with instructions, minimal jargon, and even find the QWERTY keyboard and mouse to be barriers to use (Dodd, Athauda, and Adam 2017). Applications that offer touch screen support, clear instructions, and minimal jargon significantly increase the ability of elders to access these technologies (Dodd et al., 2017). This cybercartographic application offers the touch screen support. Youth, typically, do not experience the same barriers with cybercartography (Cope et al. 2018; Strachan and Mitchell 2014), potentially because youth struggle less to complete computer-based tasks (Chun and Patterson 2012).

This study demonstrates the usefulness of incorporating these user interface elements to increase user access, especially elder access, to community knowledge. As populations continue to age, it is important to develop technologies capable of providing user interfaces elders can access. This aligns with the access principle of OCAP as it means knowledge is truly community accessible by all generations.

5.3.3 Community Scale Access

One role of Indigenous cybercartography is to grant community scale access to cultural knowledge (Taylor 2014). One such method of distribution is the internet, where similar projects found cybercartography enables the hosting of applications online as a method of communicating knowledge to a broad audience (Taylor and Pyne 2010). For the Hupačasath, It was the first time in many years this knowledge had been truly public: "that's just it, it's really the first time in

forever that this information is being opened up and shared, so I mean there's a lot exciting just about that, because it was all kept underground or held by certain people and you had to go through the proper training and rituals to share in that information" (community member, personal communication, 2019). This response suggests there have historically been barriers to the acquisition of cultural knowledge, particularly that which has been stored orally (Huntington 2000). Through the process of developing a cybercartographic application, this oral history is organized within a digital system, in part removing the aforementioned barrier. The same participant continues to elaborate on the importance of this principle of access for placing knowledge at the disposal of community members: "And now it is giving that ownership to people how much they want to be involved within their community, how much do you want to know about your traditions, your heritage, your land? And it leaves it completely up to them as a person how much you do or don't want to know…" (community member, personal communication, 2019). Cybercartography adds community-scale access through a dimension of interactivity not available in other forms of cartography (Taylor et al. 2014). By removing these barriers to access, cybercartographic applications have the potential to teach the importance of territory to community members who can then use this knowledge to protect it through a rights-based system of self-determination where knowledge of land use and occupancy are critical (Freeman 2011).

5.3.4 Cultural Knowledge Database

As the access principle of OCAP is concerned with Indigenous communities having total access to their knowledge (Schnarch 2004), the development of a knowledge database could be viewed as integral. Cybercartography has the potential to bring together information from many community members and catalogue it in a single cultural knowledge database. It is then

represented visually through a user interface hosted online and is the access point for the broader community and public. The access community members have is dependent on the availability of knowledge from their elders and knowledge holders, where willingness to share their knowledge is a barrier to access. The total available knowledge is decreasing with the aging and loss of knowledge holders (Simpson 2004). As is common, the Hupačasath saw value in counteracting the continued loss of language and knowledge within the community: "The problem is we're running out of speakers. So the [youth] that are learning to speak...can't hear an elder from Hupačasath speak to them...they would never hear that and never know without the place name map and being able to hear it..." (community member, personal communication, 2019). Therefore, the cybercartographic application acts as a database that secures Hupačasath history for the community in a public format where members can view, listen, and in turn empower the community with contributions of missing knowledge. This missing knowledge can then be used educationally to contribute to community self-determination projects or at a larger scale for producing strength of claim evidence and hold the state accountable (Corntassel 2008).

5.4 Possession

As a principle of OCAP, possession is concerned with the physical storage of information, for example, housing information on a hard drive in the offices of an Indigenous community (Schnarch 2004). However, cybercartography mobilizes this information, restructuring physical possession and moving it online. When cultural knowledge is in the possession of another party, there are associated risks of misuse (Schnarch 2004). Developing strong relationships between researchers and community decreases the risk by increasing the responsibility and trust between one another (Wilson 2008). Although possession was not a

major theme during the interview process, financial barriers emerged as a topic of discussion as it is concerned with the community's ability to possess the application.

5.4.1 Financial Barriers

In the case of the Hupačasath, their trust was placed institutionally with the University of Victoria who carried the financial cost of licensing the software. Because of this relationship, affordability of the cybercartographic application was not seen as a barrier to implementation by the Hupačasath community as funding support was provided by the university and funding needs were sufficiently met by the community. When asked about financial barriers to using the application, one participant responded: "Not in my department no. I can always find funding" (community member, personal communication, 2019). Another participant noted the ability for the community to apply for funding: "I think that the band would be able to figure out funding even if they had to apply for it" (community member, personal communication, 2019). However, the community requested that costs be kept to a minimum by doing as much as possible internally: "things that could be done to a great extent internally that's gonna keep costs down rather than hiring an outside consultant again or hoping and waiting on another funding opportunity to come down the line to continue it. It sounds like right now it's set up in a way that is sustainable and isn't going to cause any undue strain on our community budget" (community member, personal communication, 2019). This further emphasizes a previous point about the importance of training community members on use of the application in the future.

Other studies suggest (Eisner et al. 2012; Elwood 2006; Pulsifer et al. 2010) that Indigenous communities be presented with available solutions which are cost-effective to decrease the barriers to possession. The researchers in this study support the notion that financial barriers should be kept to a minimum when developing cybercartographic applications. It is

possible the use of the Esri Story Map platform is a solution for communities that is both user-friendly and has a low barrier to entry for cybercartographic projects when the community develops a relationship with an institution willing to support some the financial burden. In similar cybercartographic projects there were no software licensing fees due to the technology used (Keith et al. 2014). In other cases where purchasing or supporting mapping licenses is not feasible future studies should assess on a case-by-case basis the capacity of the community to use technology such as the one employed during this study.

6. Conclusion

State structures of colonialism have limited the ability of Indigenous communities to self-govern, which has caused a substantial loss of language, cultural history and practices. To counter these losses, Indigenous communities seek ways for preserving their cultural knowledge. One such technique can be found in contemporary cybercartography and its ability to document traditional knowledge through its multimedia framework. The overall objective of this study was to examine how cybercartography facilitates the process of self-determination for First Nation communities. This was accomplished through a multi-stage process of application development, focus groups, and interviews in which the individual experiences from the interviews were evaluated using the principles of OCAP to examine cybercartography's role in self-determination.

This study found that the requirements of a cybercartographic application are community-specific and these applications have the ability to facilitate self-determination when communities are engaged in the research process because community engagement helps determine the technology that is used. This should not come as a surprise, as Indigenous authors

say community engagement is crucial to successful research (Tuhiwai Smith 2012), where Shawn Wilson (2008) explains that research success is based on respect, reciprocity and trusting relationships which requires constant community consultation and engagement. However, there has historically been a trend in technology-oriented research with Indigenous communities where researchers have prescribed available technologies rather than engaged the community in deciding on which technology to use. Some research has the tendency to be overly-prescriptive and assert a pre-determined technology on a community, which in turn may not be compatible with the technologies they have used in the past, effectively lowering its ability to address community requirements of self-determination.

As researchers continue to work with Indigenous communities to implement technologies that facilitate self-determination, it is vital researchers do not prescribe technologies but instead develop research methods that explore technologies with communities. Research is trending towards more accessible technologies that may facilitate this process of researchers working more closely with communities. During this study, the cybercartographic application was integrated with technologies the community was comfortable with operating and this enabled the development of an application that incorporated many elements of self-determination.

It is especially rare that applications are evaluated for how they meet the community requirements of self-determination. This study's evaluation process using OCAP situated the interview findings within the greater principles of First Nations self-determination. OCAP proved to be a valuable set of principles for situating research in the context of self-determination as well as being applicable as a framework for evaluating research projects.

It is important to note that the findings from this research were borne from a limited number of survey participants. However, participants in this study were chosen by Chief and

Council and were considered knowledge holders and respected community decision-makers. Some challenges also existed with the duration of time that some participants were able to spend with the technology developed for this study. This limited the ability of participants to reflect on the questions that were posed during the interview because of the lack of time to organize their thoughts as well as interact with the application. Participants may have relied more heavily on the descriptions of the application presented by the interviewer rather than their own experiences, which may have influenced the answers provided. Also, the way this application facilitates community self-determination for the Hupačasath community cannot readily be expanded to include other First Nation communities, as each community has its own specific definition of self-determination. While certain findings may be relevant to other communities, care must be taken to avoid assumptions of a one community-fits-all approach. Furthermore, this study could be built upon by identifying important themes of self-determination for other First Nation communities and how similar applications address these themes. Finally, the Hupačasath community is not considered a remote community as it has access to updated technology in ways that other communities may not. This should be considered in the findings of this study because it created an environment in which the researcher and the community could communicate with little difficulty, but may further limit the applicability of these findings more broadly.

Indigenous self-determination is intended to be a central component of Canada's reconciliation process with First Nation communities. Cybercartography has a place in this process by improving the exchange of knowledge within and amongst communities. This study highlights that the development of cybercartographic applications for First Nations can foster a meaningful movement towards self-determination when developed *with* communities to ensure that specific perceptions and needs regarding self-determination are addressed.

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Chapter 3: User Manual

Applying Esri Technology in Mapping Indigenous Knowledge

A Step-by-step guide to communities developing their own web maps

by

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1. Introduction

First Nation communities possess vast historical and cultural knowledge that is at the center of vibrant communities who engage with traditional dance, art, song, and other practices which connect these communities to the land and each other. However, culture, language, and territorial dispossession are fundamental issues facing First Nations in Canada due to past and present measures of colonialism (Battiste 2011). To counteract these issues, many First Nation communities choose to employ cartographic tools that communicate their history to engage with the Canadian Government in an effort to protect and maintain these practices (Hunt and Stevenson 2017). Cartography, and more recently cybercartography, can be used as tools for community education and communicating First Nations occupancy and use of land (Tobias 2000).

1.1 Objective

The objective of this document is to detail the specific technical methods undertaken to develop a cybercartographic technology in partnership with the Hupačasath First Nation. The methods described in this manual are created to meet software requirements from focus groups, interviews, and conversations with the Hupačasath First Nation community. This manual was made possible because of the partnership between researcher and First Nation and this document is important as a reference for the Hupačasath First Nation as well as more broadly for consultants,

students, industry, and other stakeholders who engage with First Nations building similar technologies to ease the development process. It is important to note that this document is intended for communities or individuals who are already familiar with Esri's ArcMap software, and wish to move knowledge stored within this system online to be viewed and shared. By developing this user manual with the Hupačasath First Nation, it has offered opportunities for co-creation and relationship building for example with a community youth instrumental in the development of language tools integrated into the application. The following sections will provide readers with an overview of cybercartography, its implications for mapping Indigenous knowledge, and a step-by-step guide to developing this technology. Within the guide, special care will be taken to highlight the important work accomplished by a Hupačasath First Nation youth who developed a phonetic guide for place names within their traditional territory.

2. What is Cybercartography?

Cybercartography was first conceptualized in 1997 as a form of representing relationships to space using multimedia and being primarily interactive (Taylor and Pyne 2010). Early examples of cybercartography were developed to use CD-ROM to demonstrate landscape in 3 dimensions. This quickly faded and was replaced with a different vision for cybercartography that increasingly focused on supporting online multimedia maps (Taylor and Pyne 2010). As of 2003, the conceptual design of cybercartography possessed seven key elements (Taylor 2003):

- is multimedia using vision, hearing, touch, and eventually smell and taste;
- uses multimedia formats and new telecommunication technologies such as the World Wide Web;
- is highly interactive and engages the user in new ways;
- is applied to a wide range of topics of interest to society, not only to location finding and the physical environment;
- is not a stand-alone product like the traditional map but part of an information/analytical package;
- is compiled by teams of individuals from different disciplines; and
- involves new research partnerships and the private sector (Taylor 2003).

While not all cybercartographic endeavors possessed all these elements, they act as a framework to define a vision for cybercartography. Once the seven elements had been conceptualized, cybercartographic atlases began to be developed with a focus on visualization, imagery, and audio. As one of the key elements of cybercartography is to involve new research partnerships and work with multifaceted teams of individuals, it naturally ventured into Canadian politics around the revitalization of First Nations' language and culture.

3. Why is Cybercartography Important for First Nation Communities?

Canada's First Nation communities engage with cybercartography as a method of cartography that aligns more closely with Indigenous ways of communicating knowledge because of its ability to harness interactive, multimedia ways of displaying knowledge

. Cybercartography can be an effective teaching and documentation instrument for First Nations through its ability to combine and display knowledge online for the public to access (Caquard et al. 2009). It wasn't just the accessibility of cybercartography that proves useful for First Nations, but also the ability to incorporate traditional ways of knowing into western cartography. For example, oral history is how First Nations passed knowledge between generations (Ridington 2014), by developing methods of displaying audio, photo, and video, cybercartography has the potential to bring communities closer to retaining these oral methods.

4. Overview of Esri Software

4.1 ArcMap

What is ArcMap?

ArcMap (Esri 2020b) is used to explore, analyze, and visualize geospatial datasets. Its main function is to create maps for printing and publication, however an alternate function, and its main use in cybercartography would be for creating and then exporting files and using them in web-based formats. An Indigenous example of ArcMap in practice would be for the collection, exploration, and visualization of culturally modified trees (CMTs), or for representing place names and their history. The utility of mapping this information could be educational or for use with industry partners such as forestry companies who are harvesting on traditional territory.

Why use ArcMap?

In addition to being an important tool for mapping cultural knowledge, software such as ArcMap can be integrated with other software that supports the geospatial file types such as Quantum GIS (QGIS Development Team 2020) (an open source equivalent), and Google Earth (Google 2020) or online software such as ArcGIS Online. ArcMap has been heavily utilized in industry, government, and for community mapping over the last two decades and therefore it is likely communities are familiar and possess this software.

4.2 ArcGIS Online

What is ArcGIS Online?

ArcGIS Online (Esri 2020a) is a cloud-based software service that is free-to-use for small scale projects, but is a pay-per-use service for larger projects. ArcGIS Online is capable of hosting many file types as content, where its primary concern is being an online geographic information system (GIS) that allows users to view, analyze, and develop maps that can be embedded within websites and which are publicly shareable.

Why use ArcGIS Online?

For Indigenous knowledge, using ArcGIS Online is important for the communication of knowledge to the broader community, for educating community youth, and communicating a Nation's history. This is because it allows users to connect multimedia elements to geospatial data. It does this through pop-up windows integrated within the map window that for example could include an image, a description, an audio recording of that location's history, or a video. ArcGIS Online is therefore highly interactive and provides a space for creativity in how creators wish to map knowledge.

4.3 Esri Story Maps

What are Esri Story Maps?

Esri Story Maps (Esri 2020d) are web maps with added contextual information that produces a stand-alone resource capable of being shared online. They are integrated with ArcGIS Online where the Story Map provides information through text, imagery, and video and ArcGIS Online provides the map content.

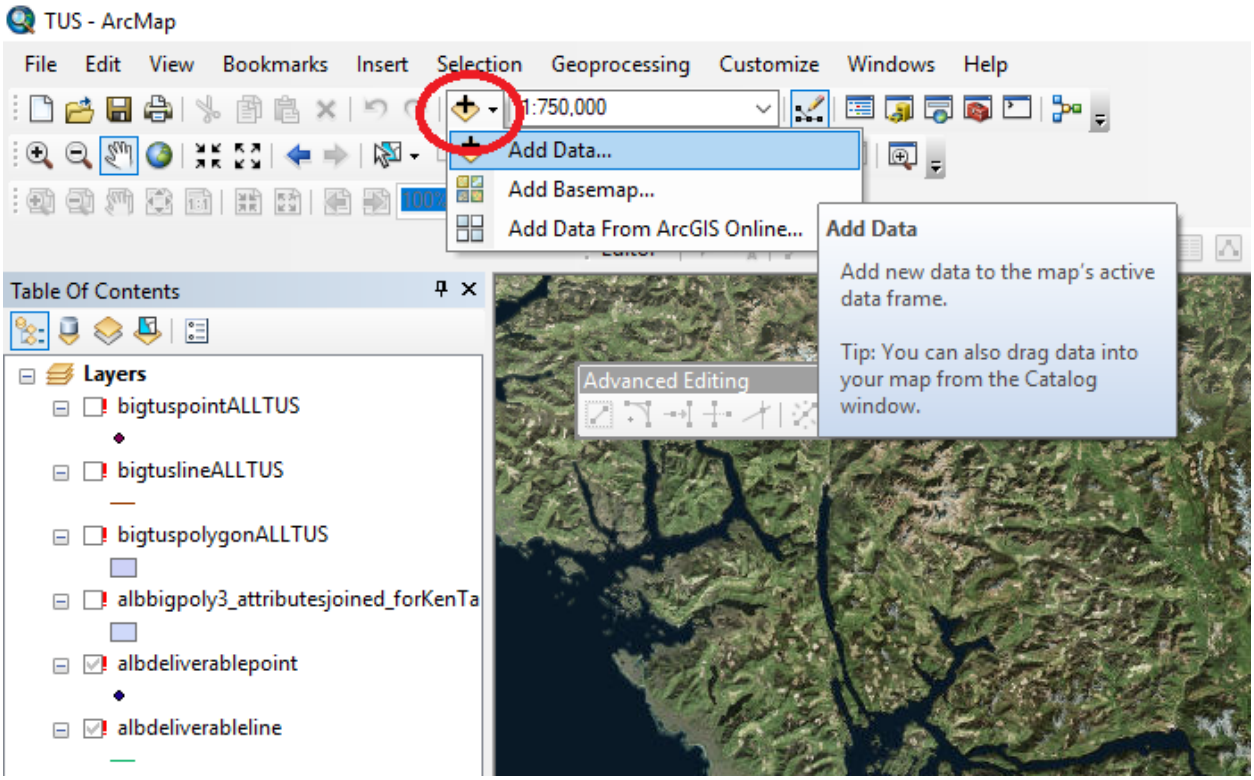
Why use Esri Story Maps?

For First Nation communities, Esri's Story Map platform has an accessible user-interface that with minimal coding experience, can be embedded within a website or shared with community members. Story Maps can share place-based knowledge, narratives, and many other forms of traditional knowledge. Because they are an Esri product, they are compatible with Esri's file formats from Esri's desktop software.

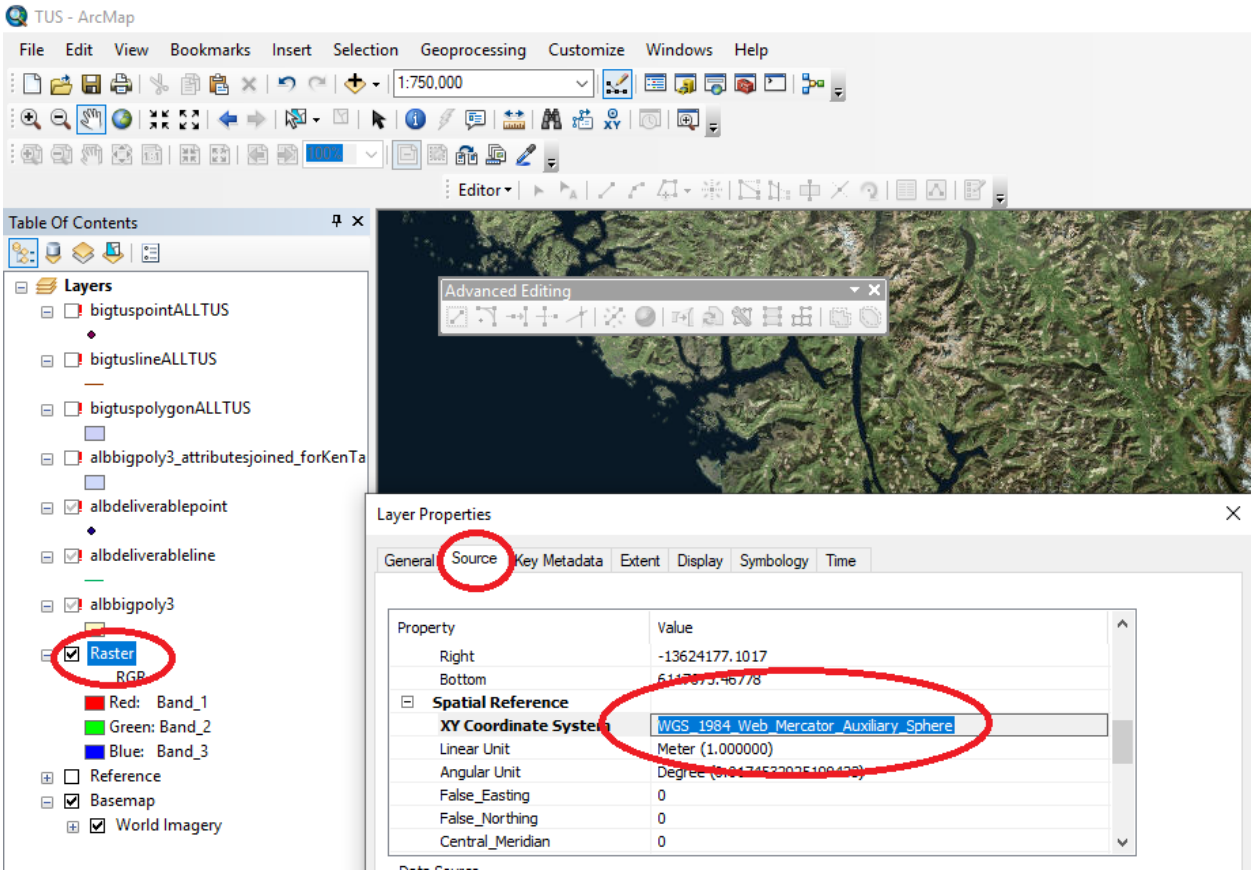
5. Creating Spatial Files in ArcMap 10.3

In the next section, you will learn how to trace features and create your own shapefiles. These shapefiles consist of lines (such as trails or hunting routes), points (places such as a mountain peak), and polygons (these are larger areas that could be a marine inlet or bay). Shapefiles are used to display the geospatial locations of traditional knowledge, and when combined with text information these locations become descriptive (i.e. they have text, and other multimedia elements embedded within them).

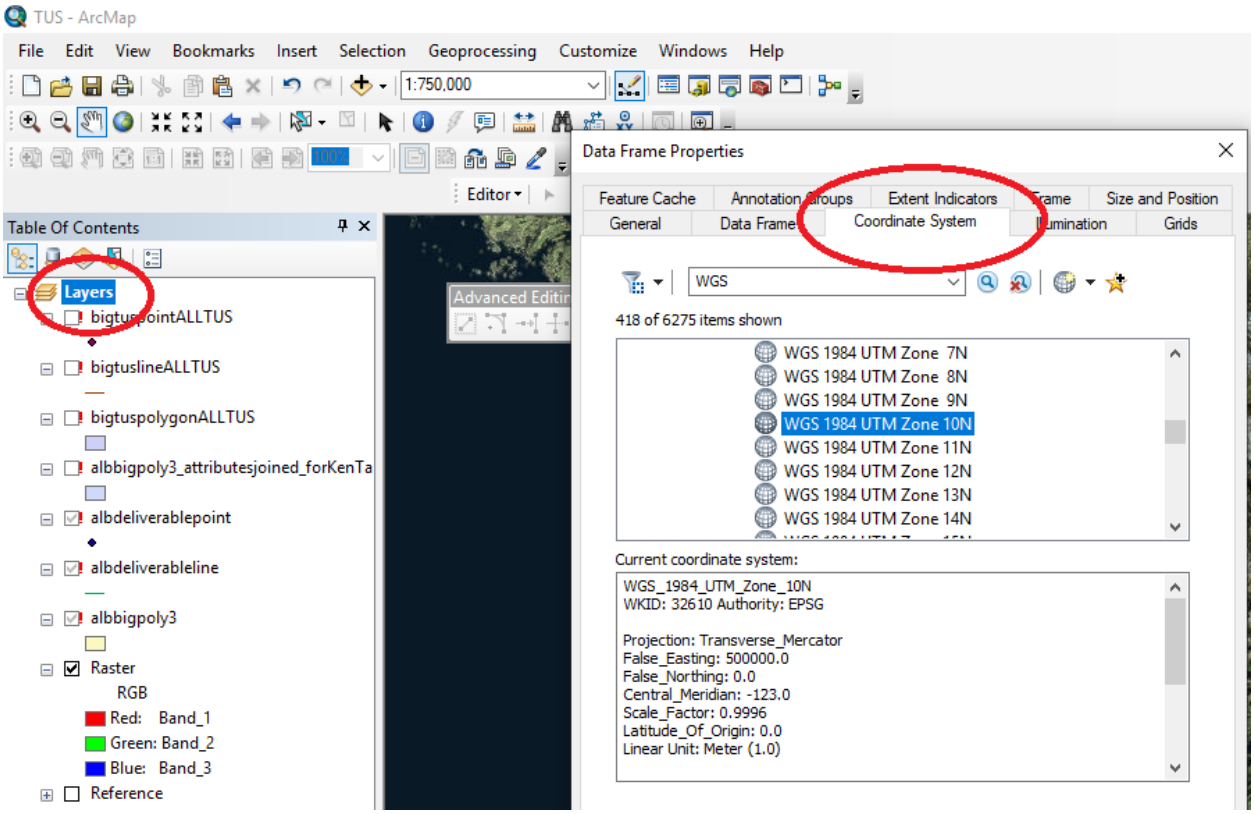
1. Open ArcMap 10.3 and start a new project
2. Load a raster image of your choosing (this can be an orthographic photo, base map, GeoTIFF etc.)
    a. In ArcMap, use the Add Data button to open your raster image for digitization.



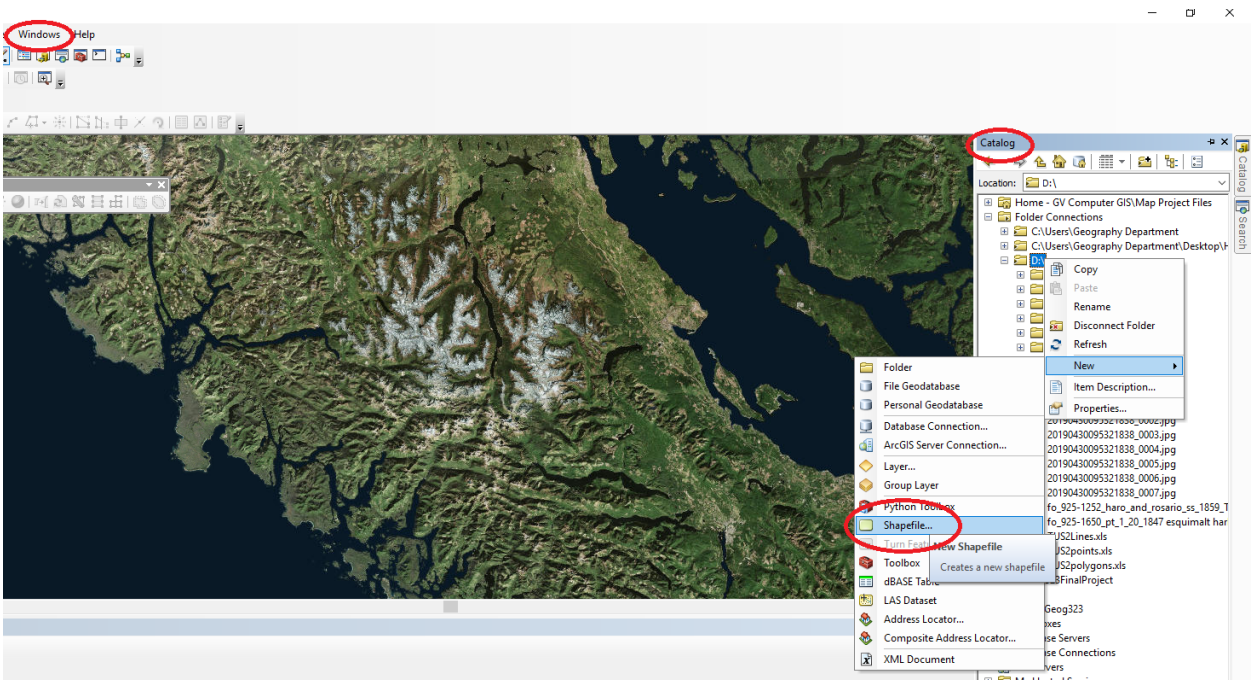
b. In the contents pane, uncheck all other visible layers so that only your newly added data is ready to be digitized.
c. Make sure your map projection is the same as your raster image
    1. Right click on your raster in the contents pane and select properties
    2. Open the source tab
    3. Note the projection (this will likely be indicated as NAD 1983 or BC Albers etc. if you're working in British Columbia)



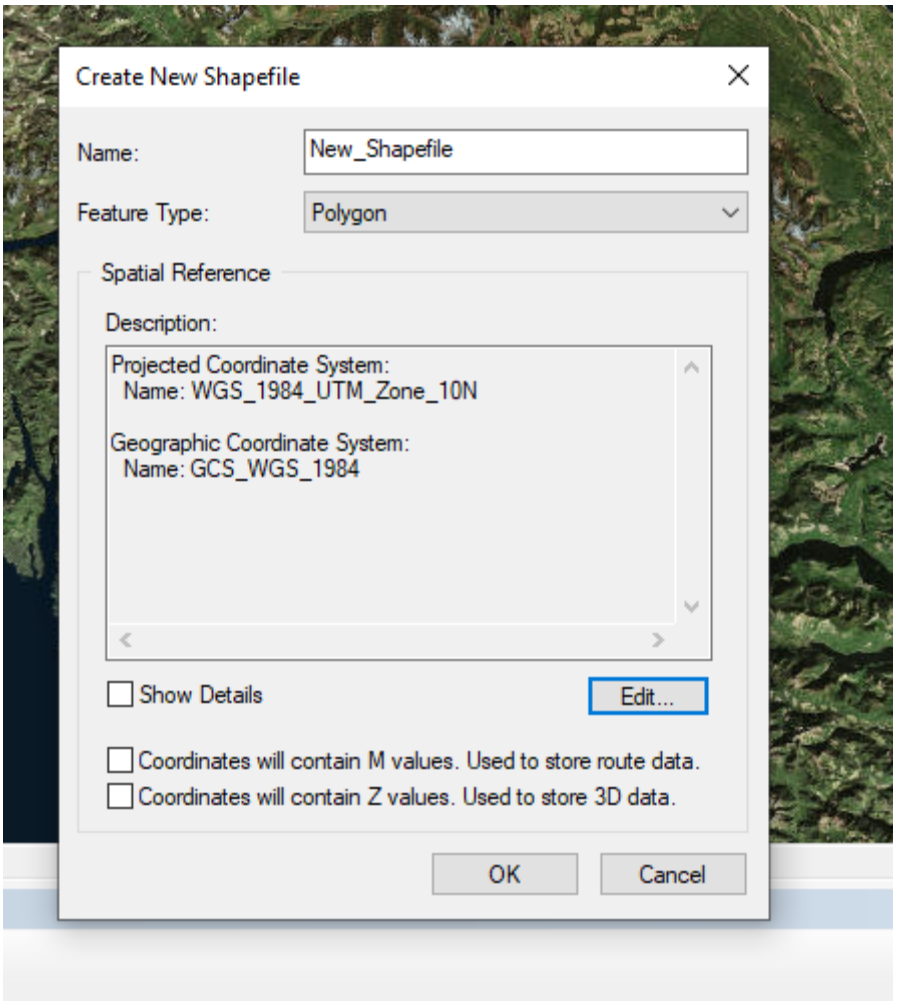
d. In the contents pane, now select Layers → right click → open the Properties
    1. From the properties window, select the Coordinate Systems tab
    2. Search for the desired projection from your raster image
    3. Select the projection and press OK



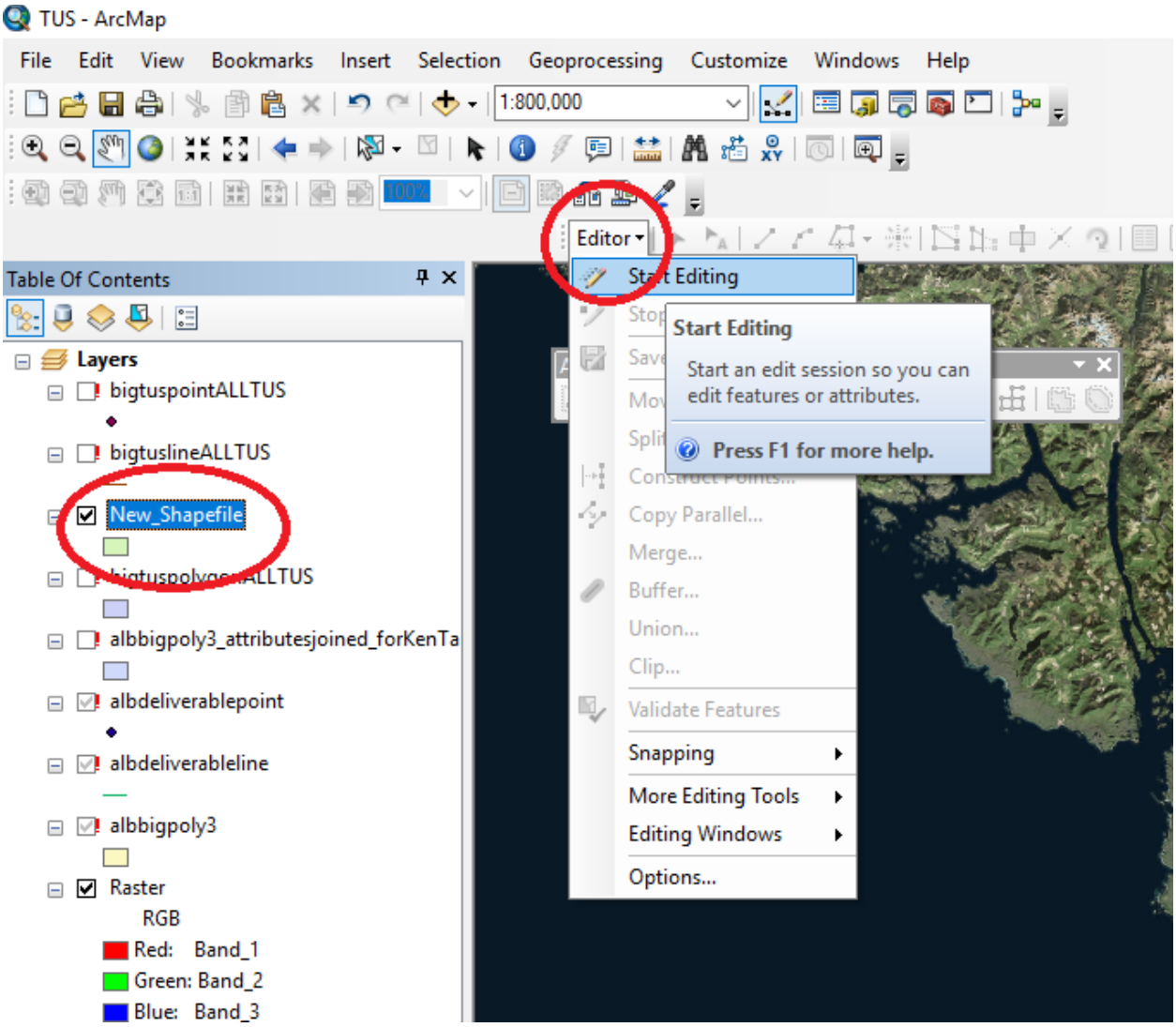
e. Zoom into the area of interest on your raster image using the Zoom tool
f. From the Windows Tab, open the Catalogue Pane
    1. Expand the Folder you wish to save your shapefiles within
    2. Right click on the folder and select → New → Shapefile
    3. Select Feature Type and name the shapefile



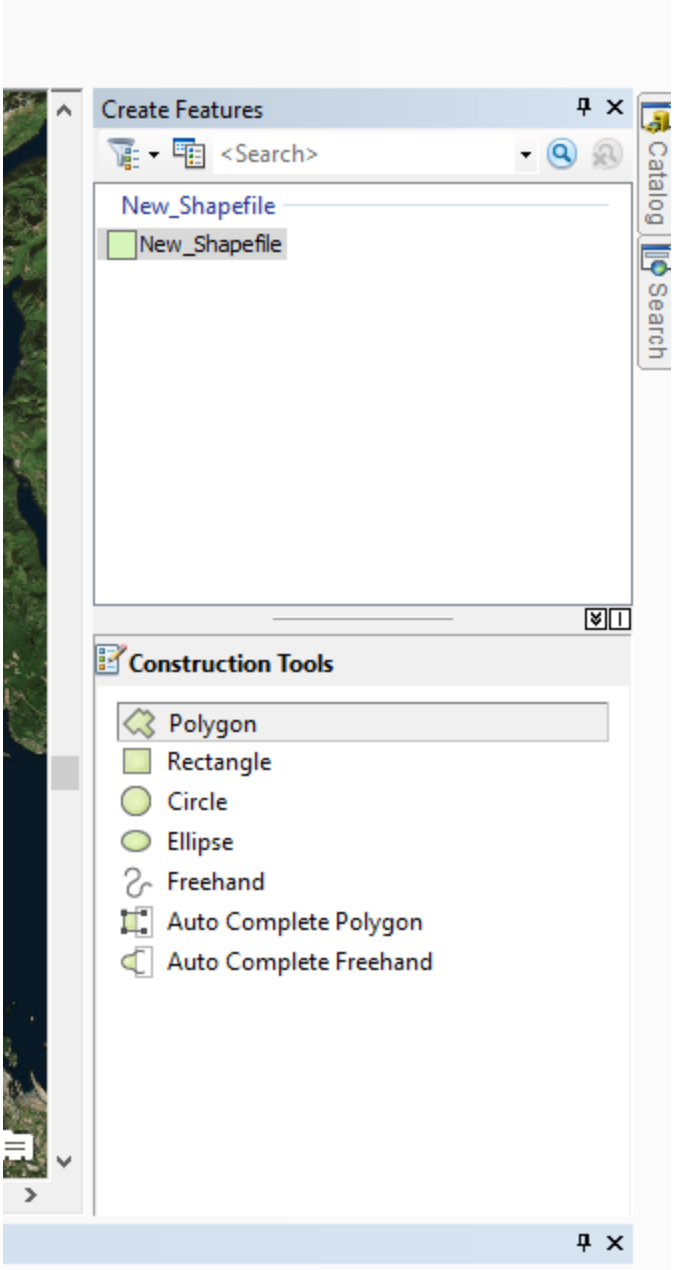
g. Under Description it will say “Unknown Coordinate System”, press Edit
    1. Select the coordinate system that was assigned for your raster and map
    2. Press OK



h. Your new shapefile will appear in the contents pane.
    1. Open the editor window from Customize → Toolbars → Editor
    2. Within this toolbar click on the Editor icon and scroll down to Start Editing



3. On the right hand side of the screen, a Create Features pane will appear.
4. Select the new shapefile, and underneath the pane in Construction Tools select (depending on whether your shapefile is a point, line or polygon) the Point, Line, or Polygon icon.



i. Trace the raster segment of your choosing. For a representation of how to navigate tracing features, please see this video: https://www.youtube.com/watch?v=fQ2CKy6U8zg

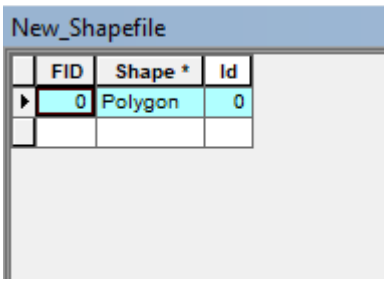
j. When finished tracing your shape, navigate to the editing toolbar and press Save Edits
    1. Select Stop Editing, to ensure we can save our shapefile.

6. Joining Attribute Data to Spatial Files in ArcMap 10.3

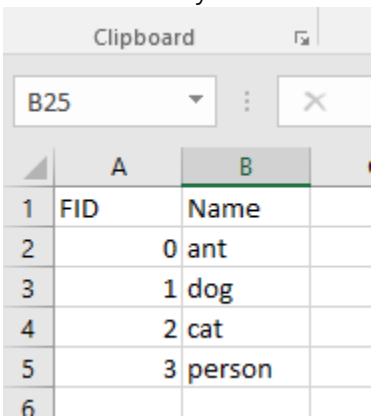
Spatial information can be linked to excel (.xlxs) and comma separated value (.csv) files (these are data tables). When organizing your spatial information, it's important to keep a spreadsheet with information associated with your shapes (points, lines, and polygons). This information can then be joined to a shapefile and used within a web-map to share information about a specific location.

To join a data table (attribute data) to a shapefile, the column names must match. For example, a shapefile that has an attribute table column marked "FID", should have a matching column in the excel spreadsheet labelled "FID". Within this column, the rows of information will be arranged with the matching information. This matching field will attach the rows of the FID column to the matching rows in the FID column on the spreadsheet.

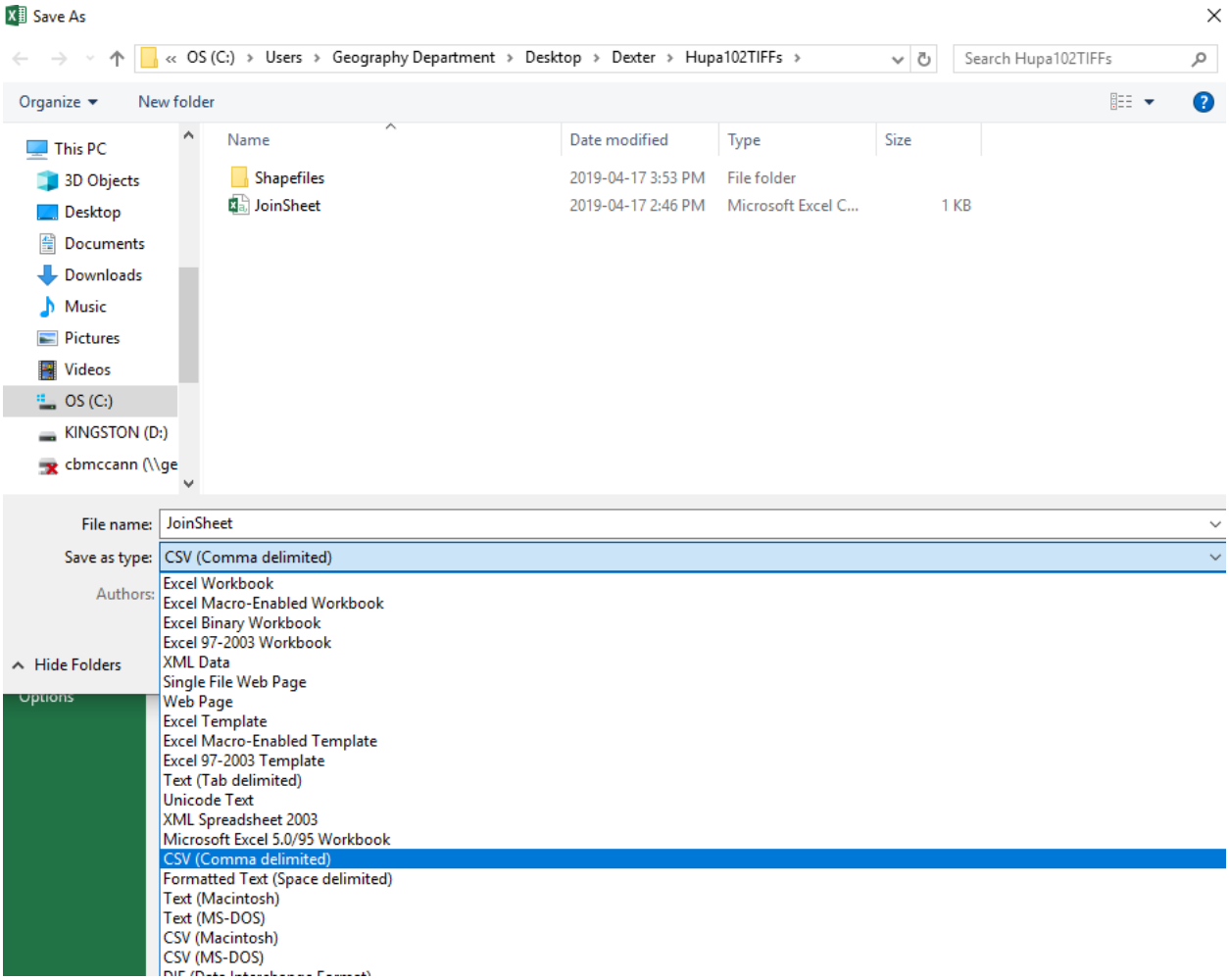
1. Setting up matching column IDs
    a. In ArcMap 10.3, use the Add Data button to open the shapefile you wish to join to your dataset.
        1. In the Contents pane, right click on the shapefile you created earlier → select the Attribute Table → and view the column names
        2. Note there will be a column name titled "FID". We will try matching this FID to a column in your dataset with the same name and matching numbering system.



b. Open a Microsoft Excel, and start a new project.
    1. Create columns titled “FID” and “Name”
    2. Match the numbering scheme from your attribute table with the FID column in your Excel spreadsheet. Enter a value for your Name column for every row with an FID (0-3)

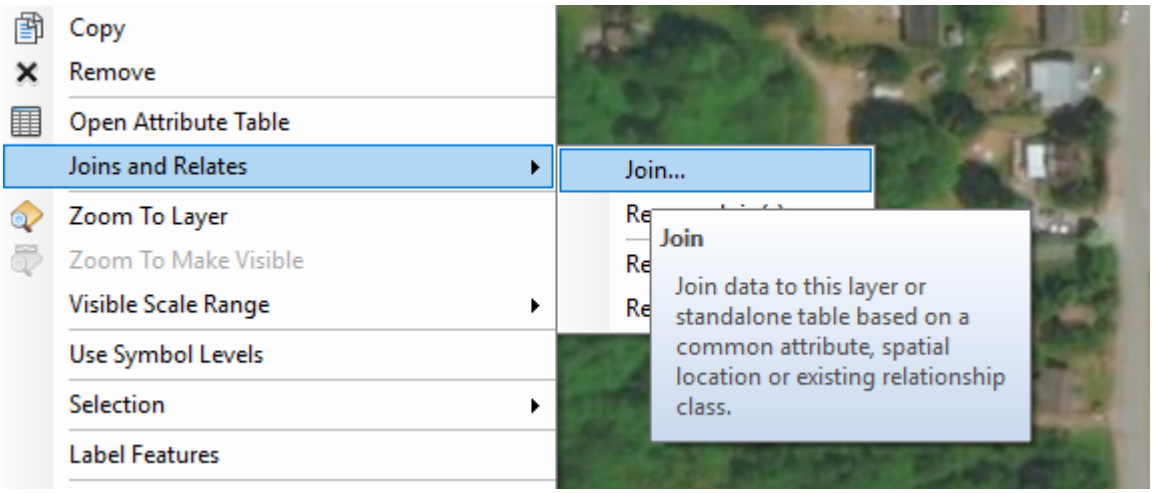


    3. Save this Excel document as a .csv file (Comma Delimited in the drop down menu)

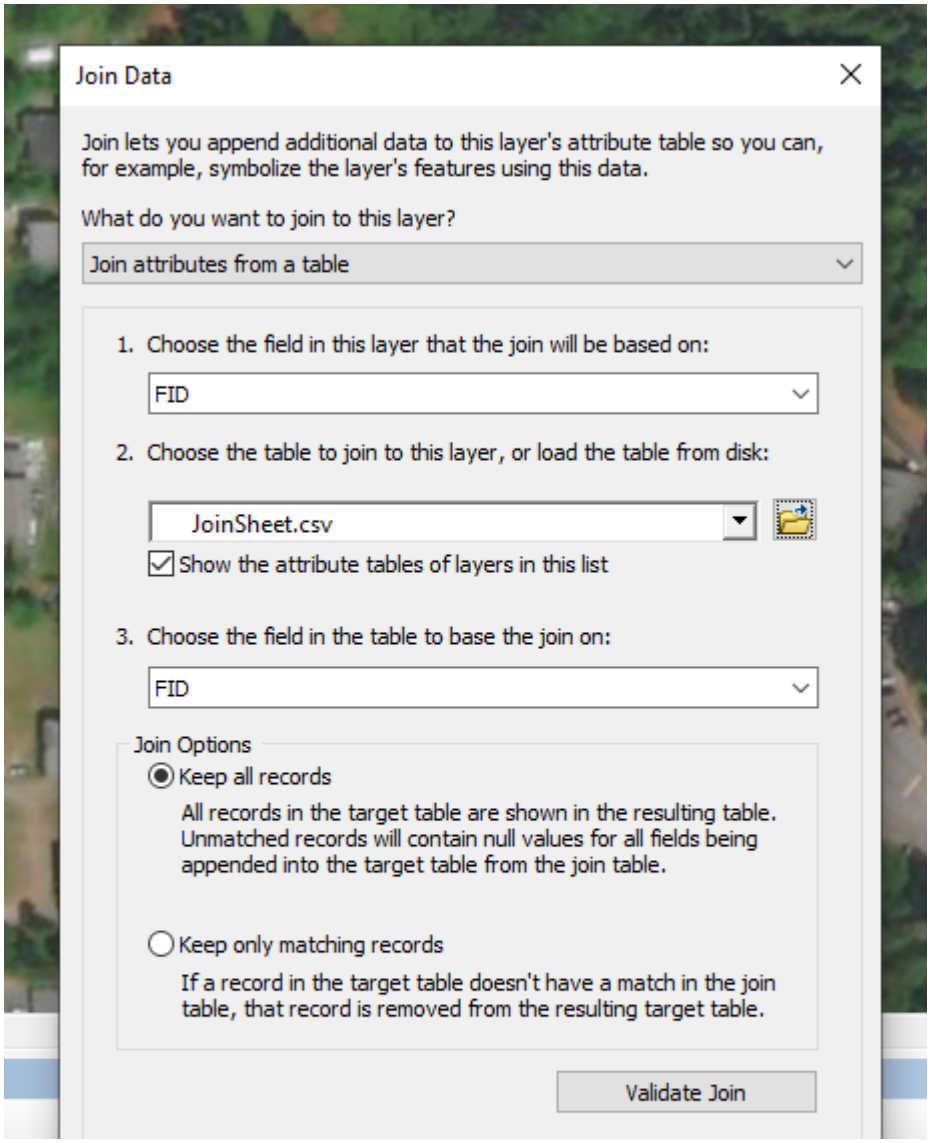


c. In Arc Map 10.3, use the Add Data button to add your .csv to the contents pane.
    1. Right click on the .csv in your Contents pane and click Open
    2. You can see that the FID and the Name fields are as you created them.

d. Right click on your newly created shapefile from last exercise
    1. Right click→ Joins and Relates → Join



2. A dialog box will appear, choose the FID from the dropdown menu for 1.
3. Choose your table from the dropdown for 2.

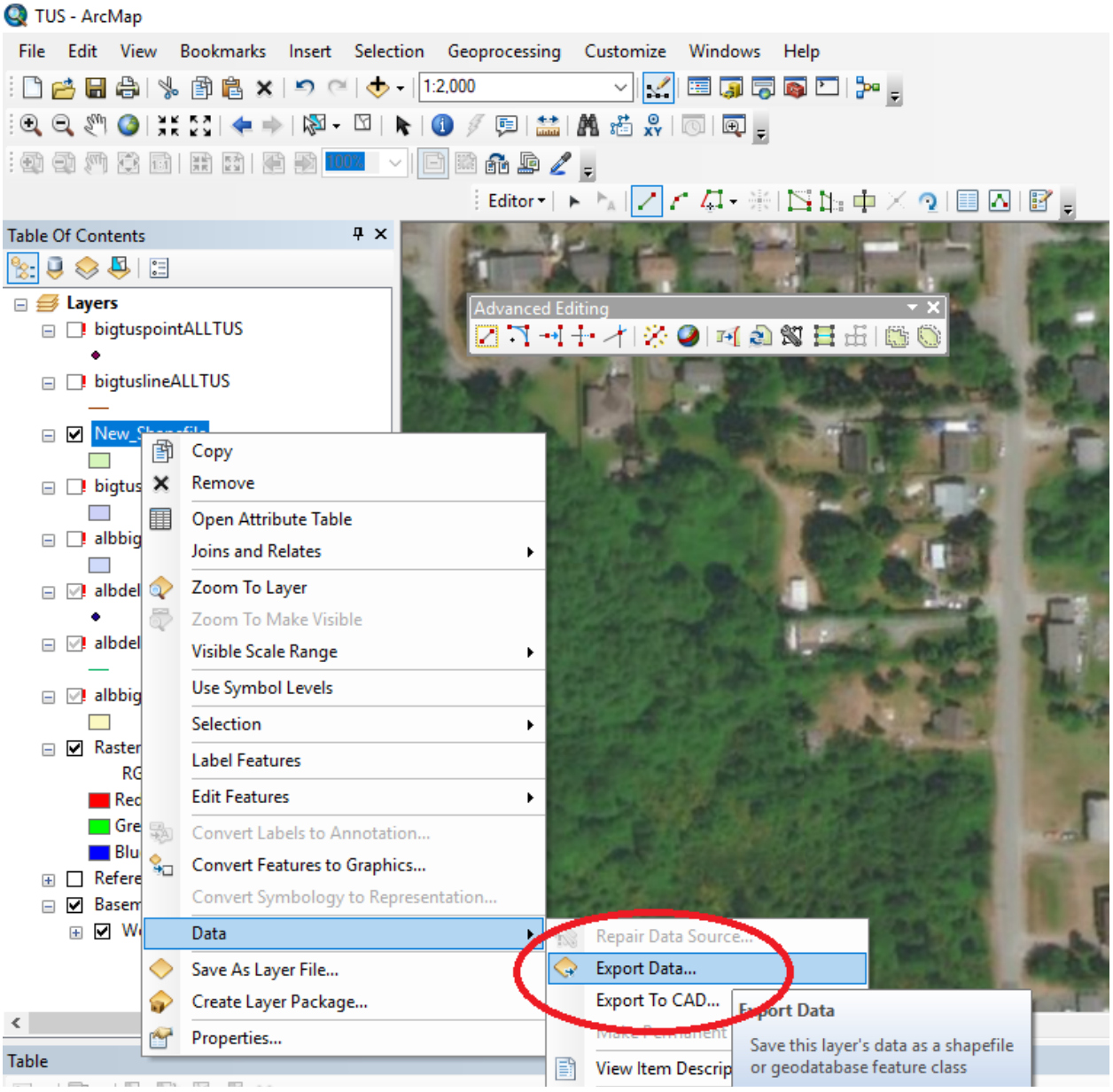


4. Choose FID for 3.
5. Select Keep All Records and press OK
6. Open the attribute table for your shapefile again and see the columns from your dataset have been added to your shapefile.

7. Exporting Spatial Files for Use Online

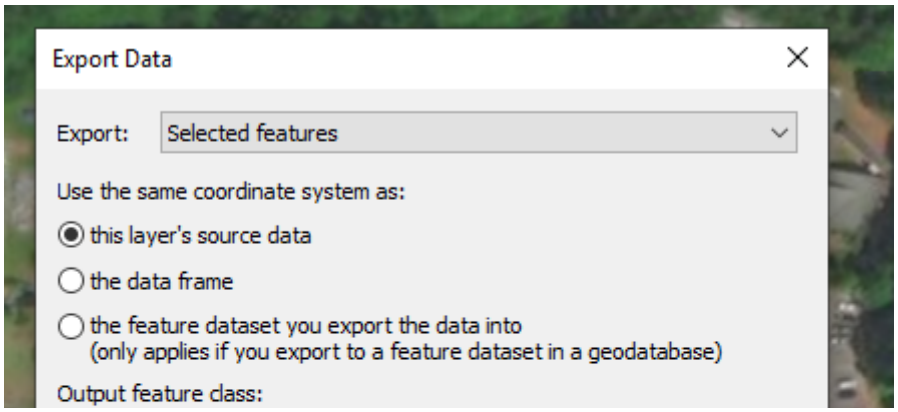
In this section, you will learn how to save your spatial files (shapefiles) in preparation for uploading to ArcGIS Online. ArcGIS Online supports other geospatial formats such as KML (Google's file type), however when communicating with ArcMap, the shapefile format offers the most backwards compatible format.

1. Right click on your shapefile, scroll down to Data → Export Data



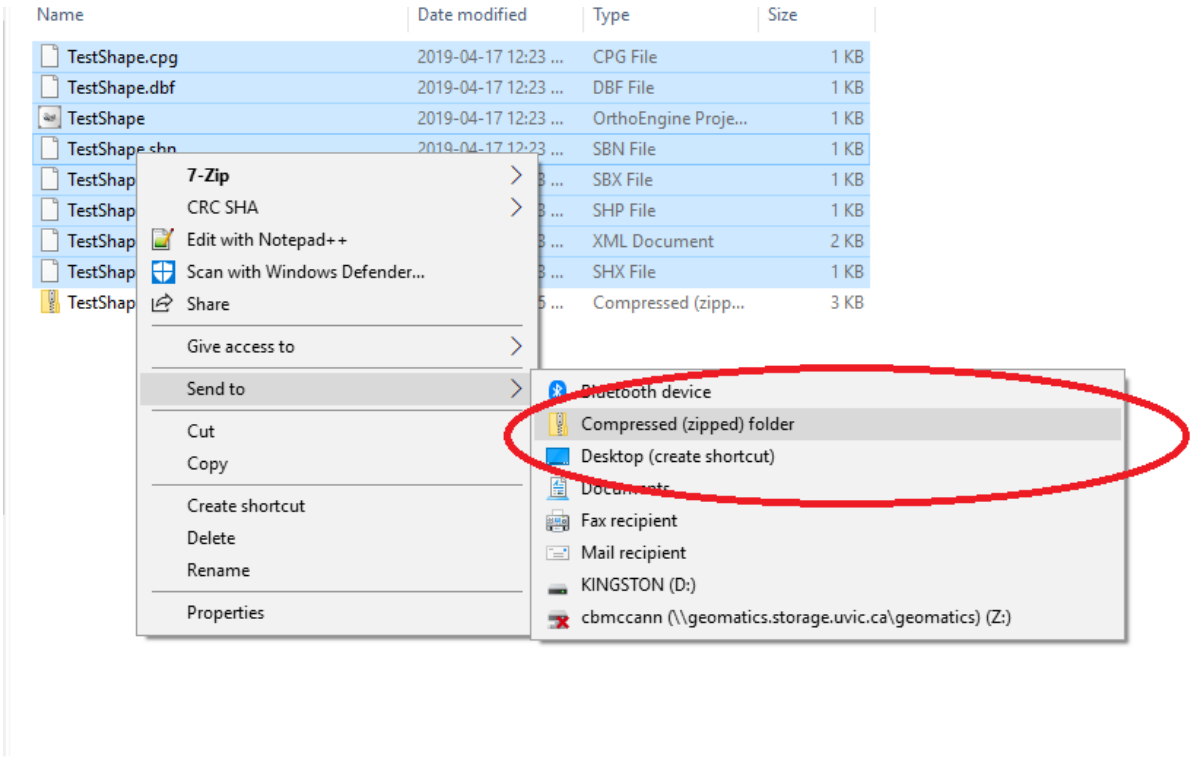
a. Select whether to export selected features within your shape, or the entirety of the shapefile with the drop down menu

1. Select “this layer’s source data” under the heading “Use the same coordinate system as:” This will export the data in the coordinate system you’ve chosen for your project.



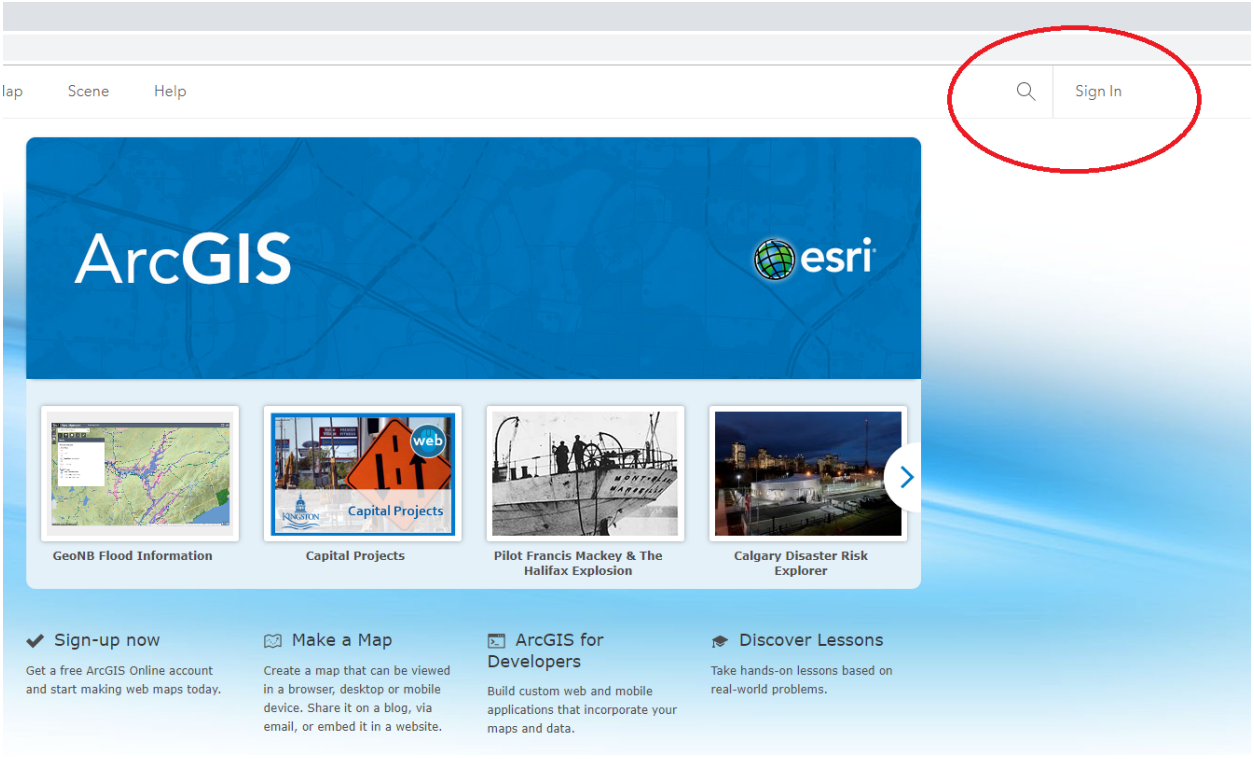
2. Press OK
3. Under “Output feature class:” select where you wish to save your shapefile.
4. In the next window, select to save as shapefile, and not a geodatabase.
5. Name your shapefile and press OK

b. Now we want to compress the saved shapefile to upload it to ArcGIS Online.
    1. Navigate to the folder in which you saved your shapefile.
    2. There will be 7 files labelled as your new shapefile name with different extensions, select all of these files.
    3. Select these files by using your mouse and holding shift on your keyboard.
    4. Right click, navigate to Send to → Compressed (zipped) folder
    5. Your shapefile will now be prepared to upload to ArcGIS Online. The following walkthrough will guide you through signing in and uploading this shape to an online map.

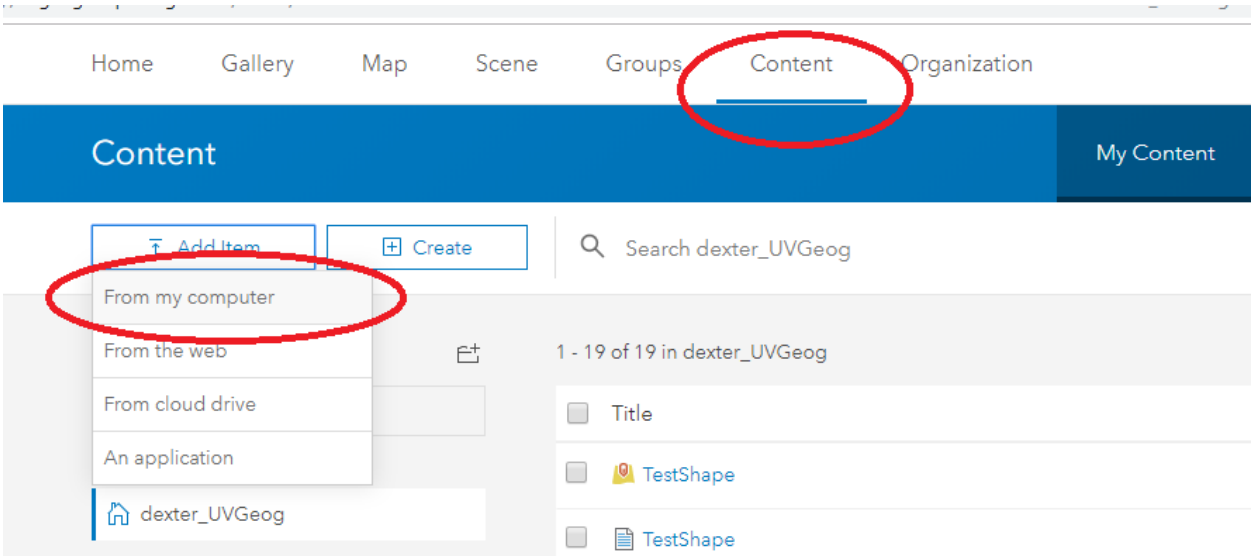

Name
Date modified
Type
Size
TestShape.cpg
2019-04-17 12:23 ...
CPG File
1 KB
TestShape.dbf
2019-04-17 12:23 ...
DBF File
1 KB
TestShape
2019-04-17 12:23 ...
OrthoEngine Proje...
1 KB
TestShape.sbn
2019-04-17 12:23 ...
SBN File
1 KB
TestShap
SBX File
1 KB
TestShap
SHP File
1 KB
TestShap
XML Document
2 KB
TestShap
SHX File
1 KB
TestShap
Compressed (zipp...
3 KB
7-Zip
CRC SHA
Edit with Notepad++
Scan with Windows Defender...
Share
Give access to
Send to
Cut
Copy
Create shortcut
Delete
Rename
Properties
Bluetooth device
Compressed (zipped) folder
Desktop (create shortcut)
Fax recipient
Mail recipient
KINGSTON (D:)
cbmccann (\\geomatics.storage.uvic.ca\geomatics) (Z:)

8. Uploading Spatial Files to ArcGIS Online

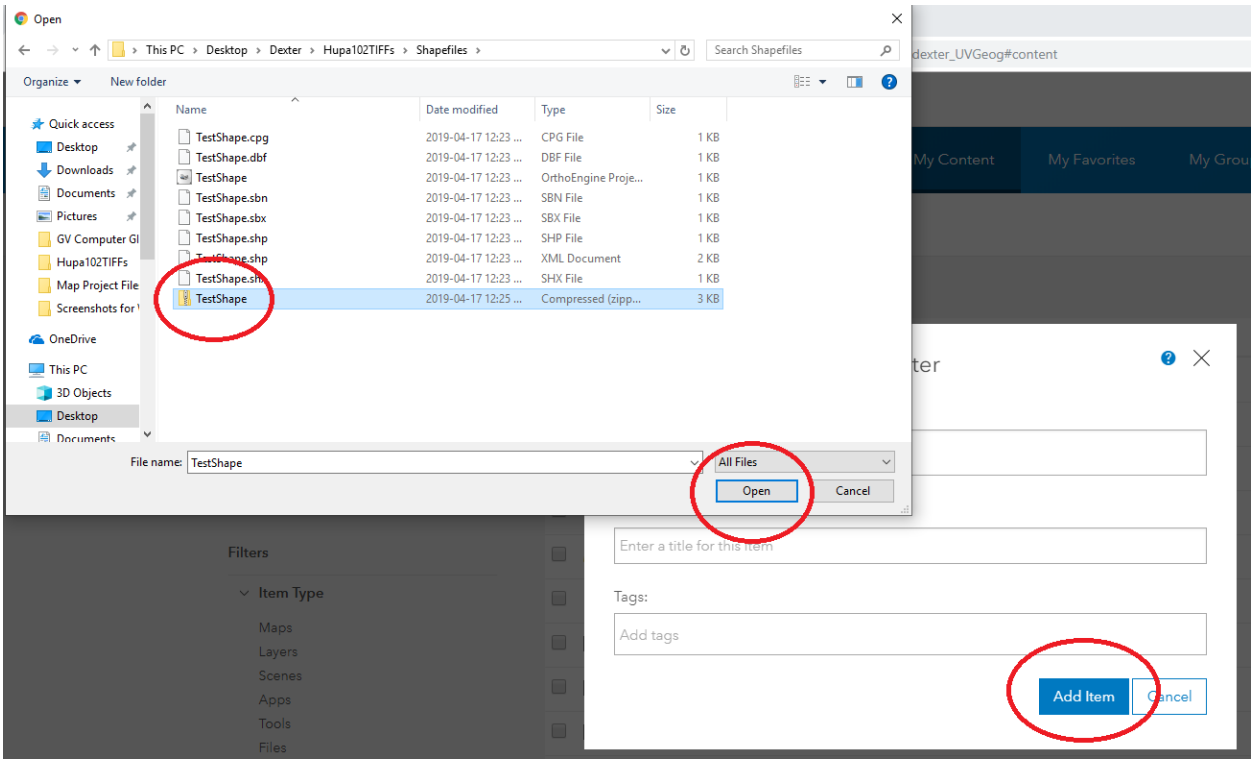
1. Navigate to ArcGIS Online and log in with your user account and password: https://www.arcgis.com/home/index.html



   a. After logging in, on the top menu bar navigate to Content → Add Item → From my computer

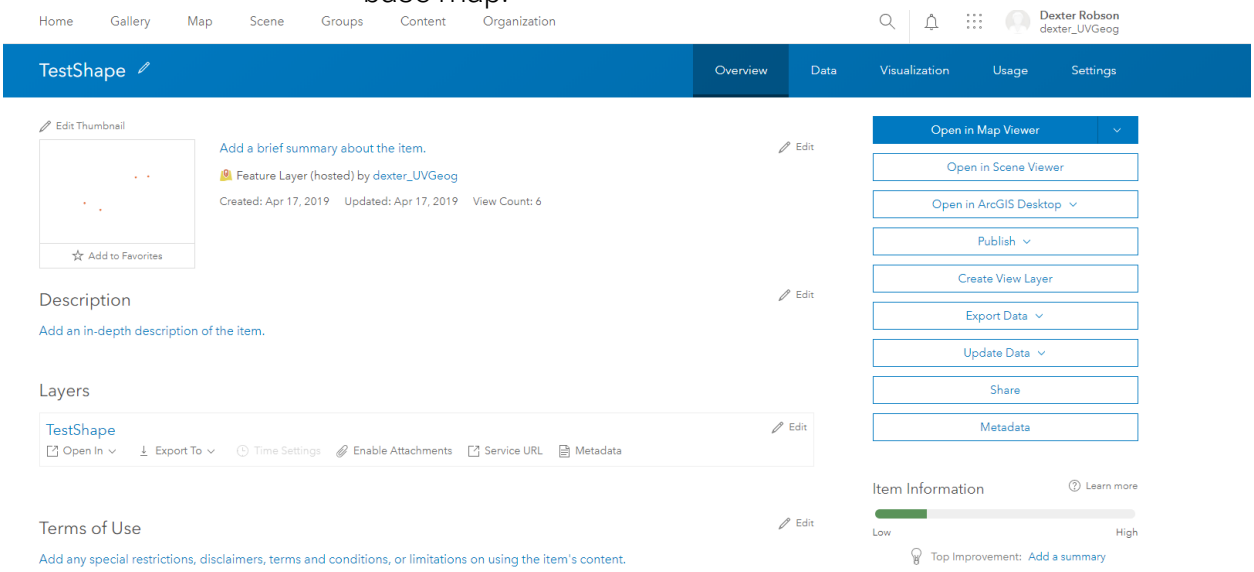


1. A pop-up box will appear, browse to your zipped shapefile
2. Select the shapefile and press OK
3. Enter a title for your item as well as some Tags (these can be specific or generic, however ArcGIS will not let you publish without tags)

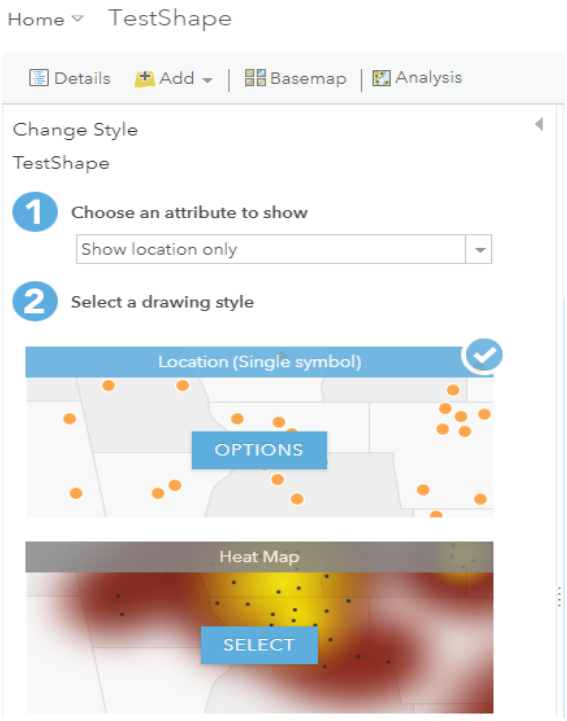


b. A new webpage will appear that asks for a Description of your shapefile

1. Fill this field in, and then navigate to Open in Map Viewer to make sure your shapefile has been projected properly on a base map.



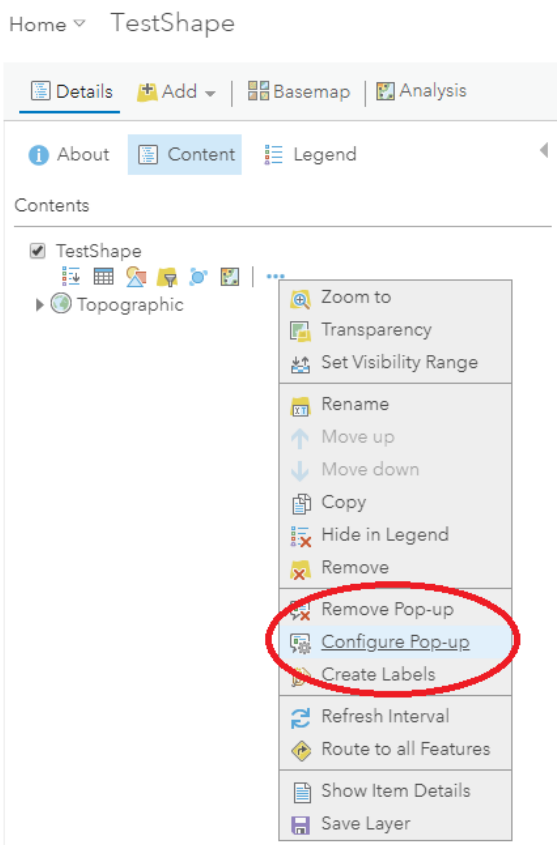
c. When the shapefile is opened in map viewer, there will be a prompt to Change Style
    1. In this screen, you can select the way in which the shapefile can be drawn on your map (the type of shape, size of point etc.)
    2. DO NOT represent your points in a heat map (the heat map will not be an accurate representation of your data).
    3. Once you're happy with the style of the shape, press Done



9. Adjusting Pop-up Windows in ArcGIS Online

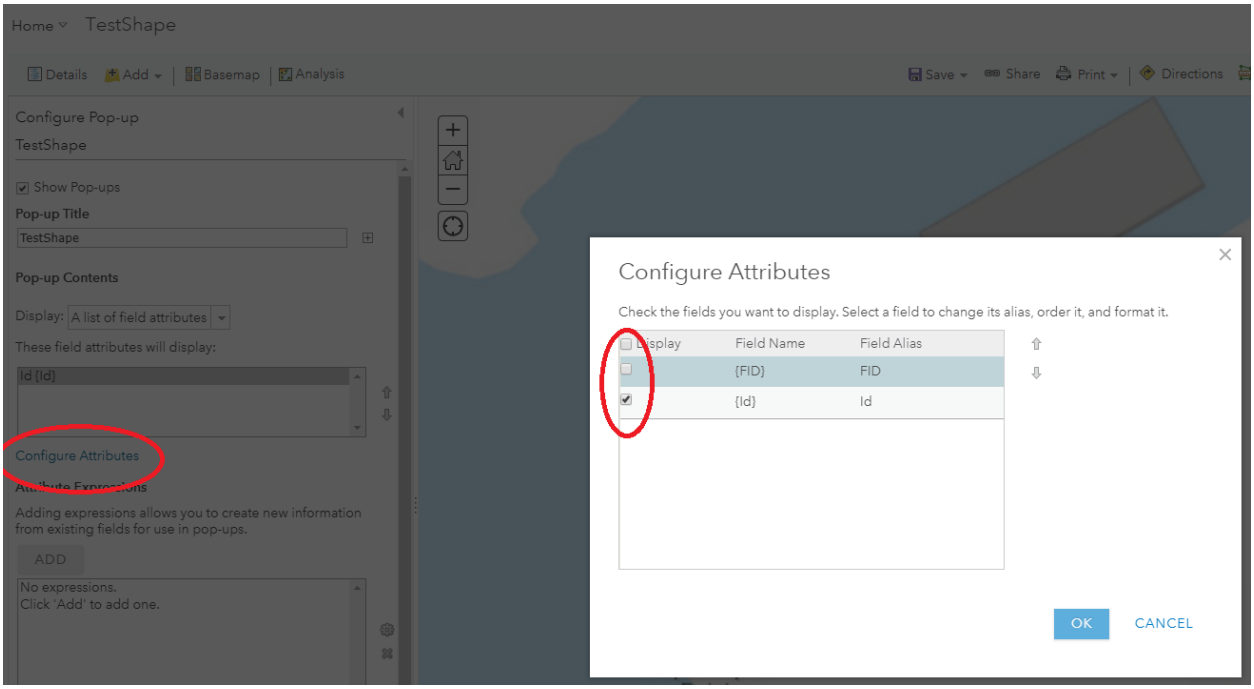
It's important when you're conveying spatial information, that the data is represented in the way that is stylistically appropriate for your project. Data from ArcMap will have attributes attached to it (from the attribute table or the joined excel file). This attribute data will all appear in a pop up when the shapefile is clicked on in the ArcGIS online map. Managing what the viewer sees can be done in a few simple steps.

1. In ArcGIS Online, navigate to Content → Your Shapefile → Open in Map Viewer
    a. In map viewer, in the Contents Pane, navigate to your Shapefile → More Options → Configure Pop-up



1. From this screen you can disable pop-ups entirely by unchecking “Show Pop-ups” or;
2. You can display specific attributes from different fields (column) names under the heading Pop-up Contents.
3. Under the Pop-up Contents heading, you can display “A list of field attributes”, meaning: Anything displayed in the dialog box under the pop-up contents heading from your attribute table will be displayed when the shapefile is clicked on in your map.
4. To configure which fields you wish to show, click Configure Attributes

5. Use the check boxes to select the fields you wish to display and press OK

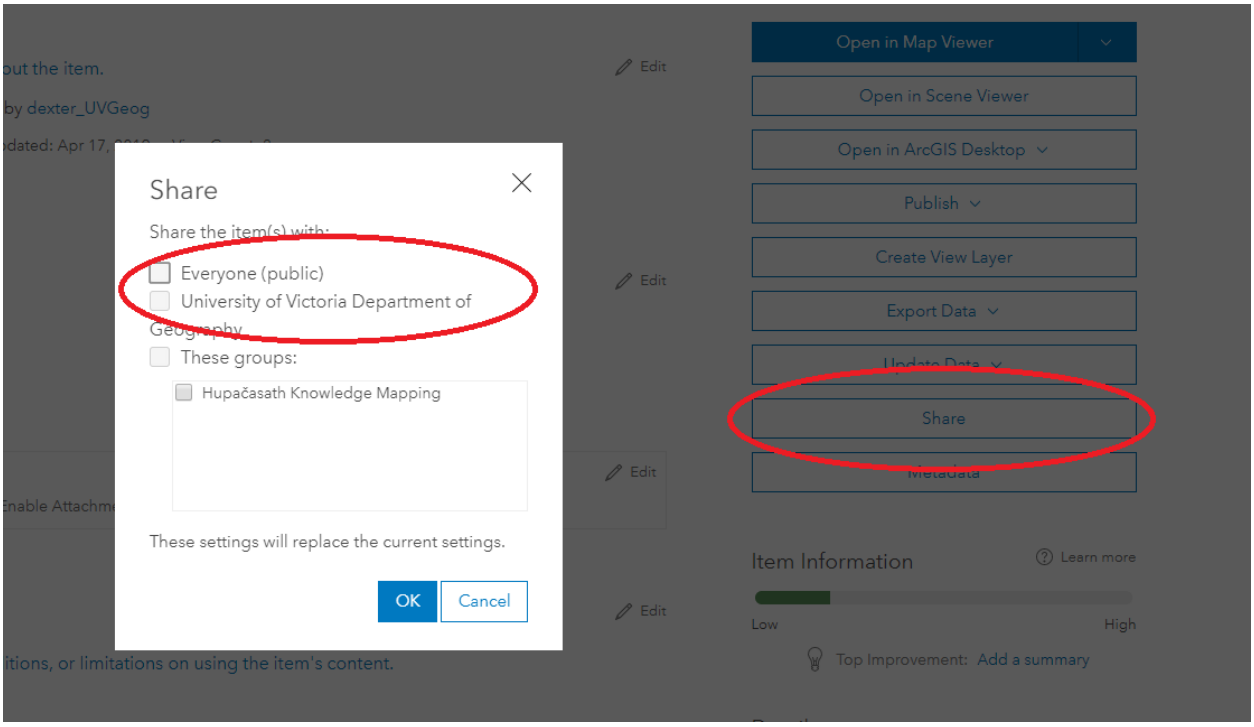


6. It is also possible to add images to your pop-ups using the Pop-up Media heading. But for now we will only focus on attribute data. To close the Configure Pop-up box press OK
7. Once the pop-up has been configured, navigate to the menu bar and select Save → Save, and enter a title for your map so you can integrate it into your Story Map down the line.

10. Managing Your Content and Privacy In ArcGIS Online

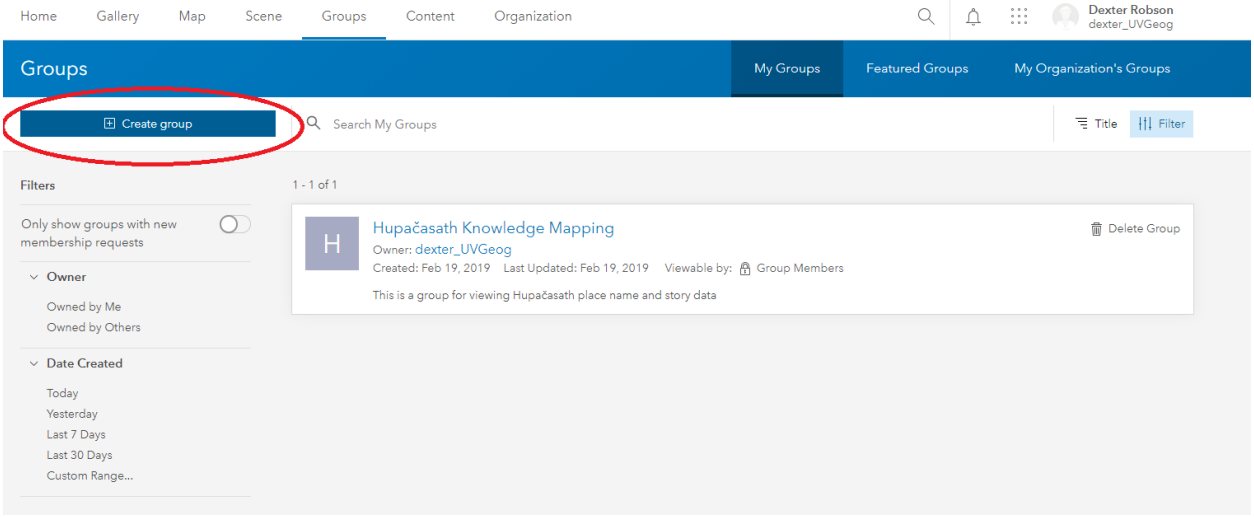
Once information is put online, managing the privacy of information is important. Especially when creating Story Maps, if files are private, they can't be viewed by the public in your Story.

1. Navigate to ArcGIS Online and log in with your user account and password: https://www.arcgis.com/home/index.html
    a. After logging in, on the top menu bar navigate to My Content
        1. Select the file you wish to adjust privacy settings on
        2. On the left hand side of the screen, there will be a Share button → click this button
        3. A pop-up will display with boxes for options of who you wish to share this item with. If all boxes are unchecked, only YOU can view this item. Adjusting this privacy is important, because web maps will not display in Story Maps properly if nobody has access.

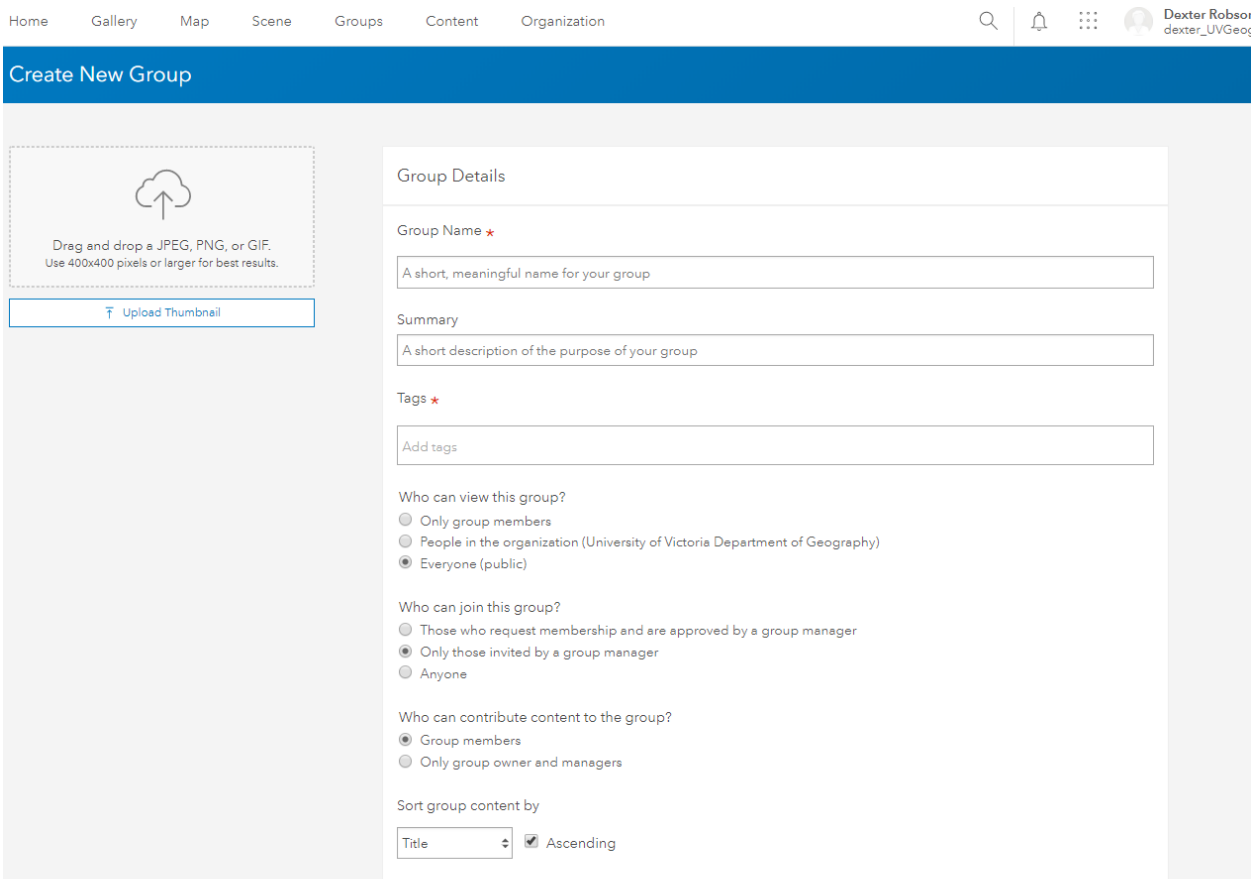


b. It's also possible to create groups to share information with. These groups can be invite only. This allows sensitive information to be shared with specific people.

1. To create a group, navigate to → My Groups → Create Group



2. Fill out the fields for Group Name and Tags and select who can view the group, join the group, and contribute to the group.
3. Now when you follow the steps in a. You will be able to select a specific group to share your information with.


Home
Gallery
Map
Scene
Groups
Content
Organization
Dexter Robso
dexter_UVGeo
Create New Group
Drag and drop a JPEG, PNG, or GIF.
Use 400x400 pixels or larger for best results.
Upload Thumbnail
Group Details
Group Name *
A short, meaningful name for your group
Summary
A short description of the purpose of your group
Tags *
Add tags
Who can view this group?
Only group members
People in the organization (University of Victoria Department of Geography)
Everyone (public)
Who can join this group?
Those who request membership and are approved by a group manager
Only those invited by a group manager
Anyone
Who can contribute content to the group?
Group members
Only group owner and managers
Sort group content by
Title
Ascending

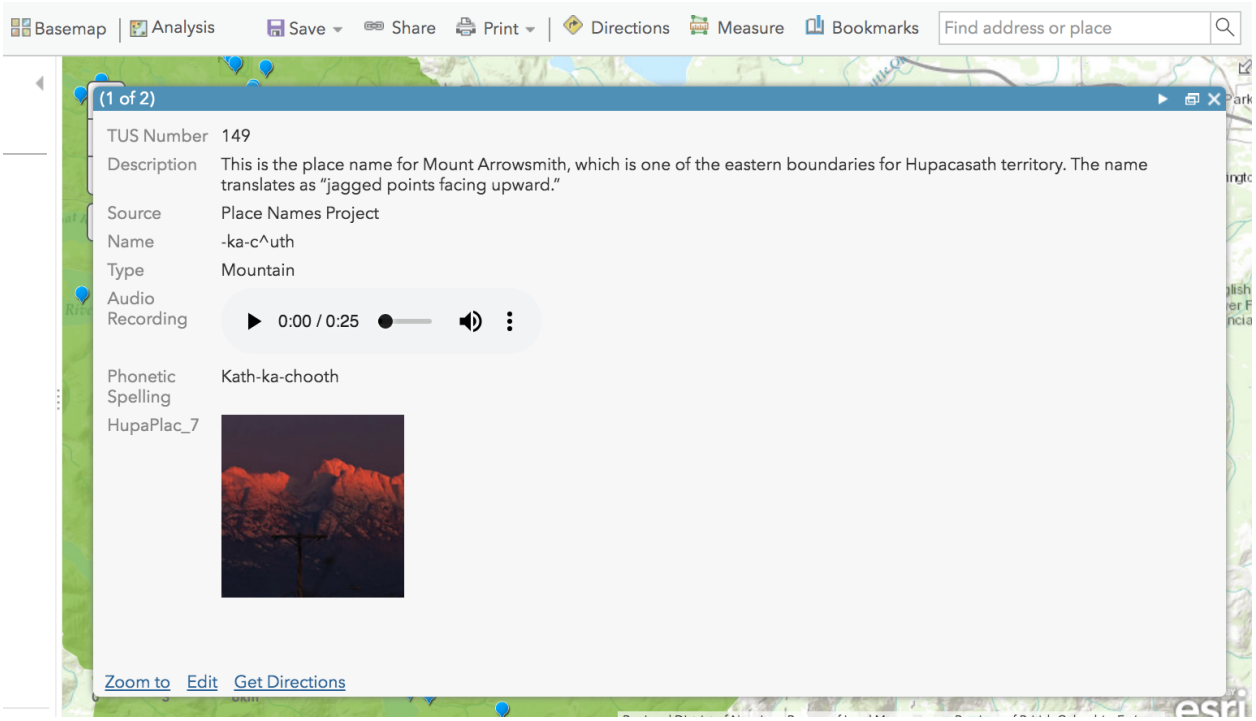
11. Embedding Audio and Photo in ArcGIS Pop-up Windows

Managing Excel spreadsheets so they are readable by ArcMap is very important so you can connect your dataset with your spatial points and display information in pop-up windows in your finished ArcGIS Online map.

1. In Excel, it's important to use a spreadsheet layout that is column-based. For example:

	id	TUS_number	text	Source	name	type	Land_Water	Audio	Photo	Pronunciation
2	1	16	This name for Drinkwater Creek means "creek running down hill".	Place Names Project	c'aa-@a-tus or c'aah=t'as	Creek	Water	<audio controls=""><source type="audio/mpeg" src="http://www.frontwheellove.com/wp-content/uploads/2019/03/TUS-16.mp3"type="audio/mpeg"></source>does not support?</audio>		Sa-ah-tuss
3	2	20	This name for Ash River means, "having wrinkles" and is derived from the word for wrinkle c'a-x=ak. tu-miis means ash, and c'a%ak means river.	Place Names Project	c'aax=>a	River	Water	<audio controls=""><source type="audio/mpeg" src="http://www.frontwheellove.com/wp-content/uploads/2019/03/TUS-20.mp3"type="audio/mpeg"></source>does not support?</audio>		N/A

    a. In the above example all of the data is organized and filtered by column. This is important because ArcMap will join data to an attribute table using unique identifiers (IDs). These identifiers will have to match between your shapefiles and the data in your spreadsheet. For example, the TUS_number column could be attached to a TUS_number column in ArcMap and the number 16 will have its data attached to the number 16 in ArcMap.
2. As you can see from the spreadsheet screenshot above, there are columns titled "Audio" and "Photo". These columns are where we embed HTML script that links this spreadsheet (when uploaded to ArcGIS online) to a URL. For example, the Audio column creates an audio control button in the pop up in ArcGIS online.
    a. As you can see in the screenshot below, the "Audio" tab is linked to the audio player button and the "Photo" column is linked to the image in the pop-up of Mt. Arrowsmith.



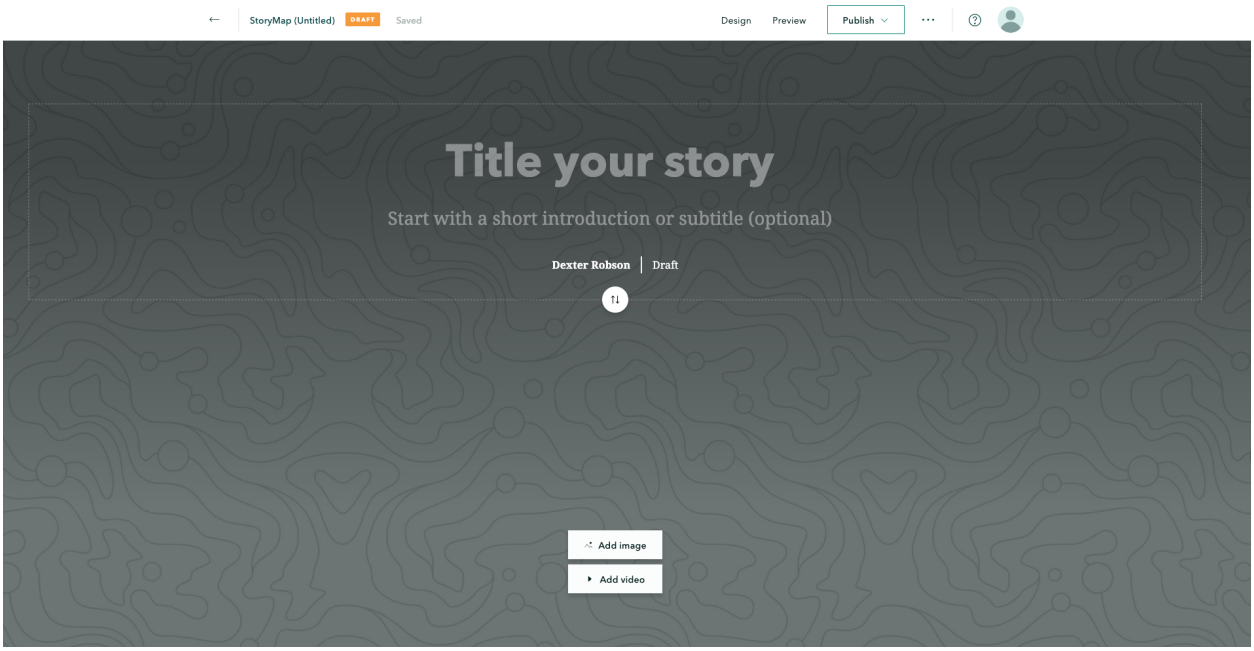
3. For showing images and audio in ArcGIS Online Pop-ups, using html embedding is the easiest way to automate the process. The following two lines of html should be used to embed either an audio URL or a photo URL of your choosing:
    a. Audio: <audio controls=""><source type="audio/mpeg" src="*insert your source here*"></source>does not support?</audio>
    b. Photo:
4. Note that these sources must be public and viewable. The best option would be to host the images and the audio on your own server and then link from there.
    a. For each row in your excel spreadsheet, you will need a new audio and photo embed link that is directed to the URL you wish to display in the pop up for that point.

12. Creating a Story Map and Adding Map Content

Once your data is uploaded to ArcGIS Online, and you have created your first map, now is the time to develop a story map that can then be either shared or embedded within your website.

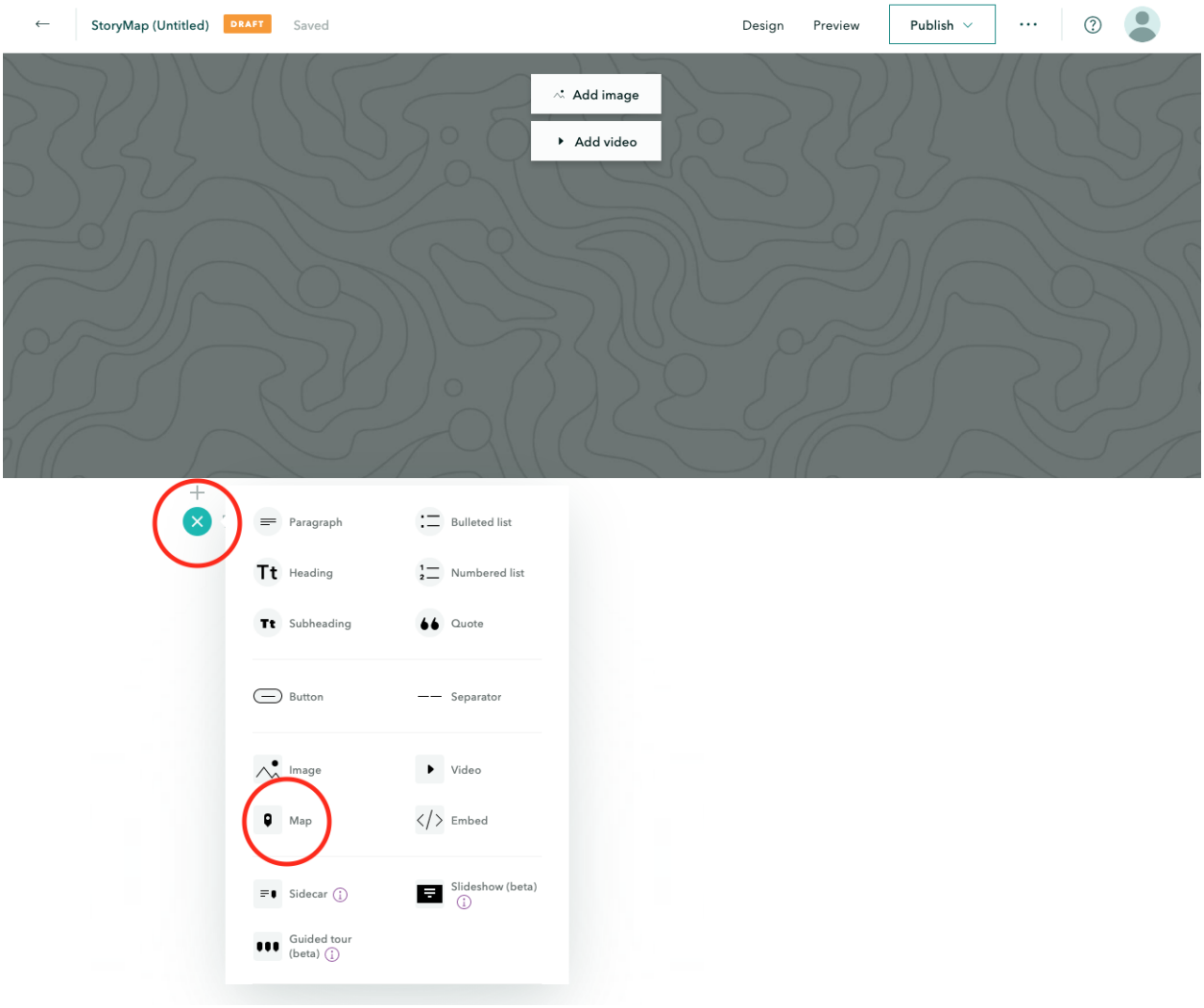
1. Navigate to https://storymaps.arcgis.com/en/ → Sign In
    a. Sign in with your username and password

b. You will be redirected to the main page, navigate to → My Stories
    1. select Create New Story
    2. Story Builder will launch

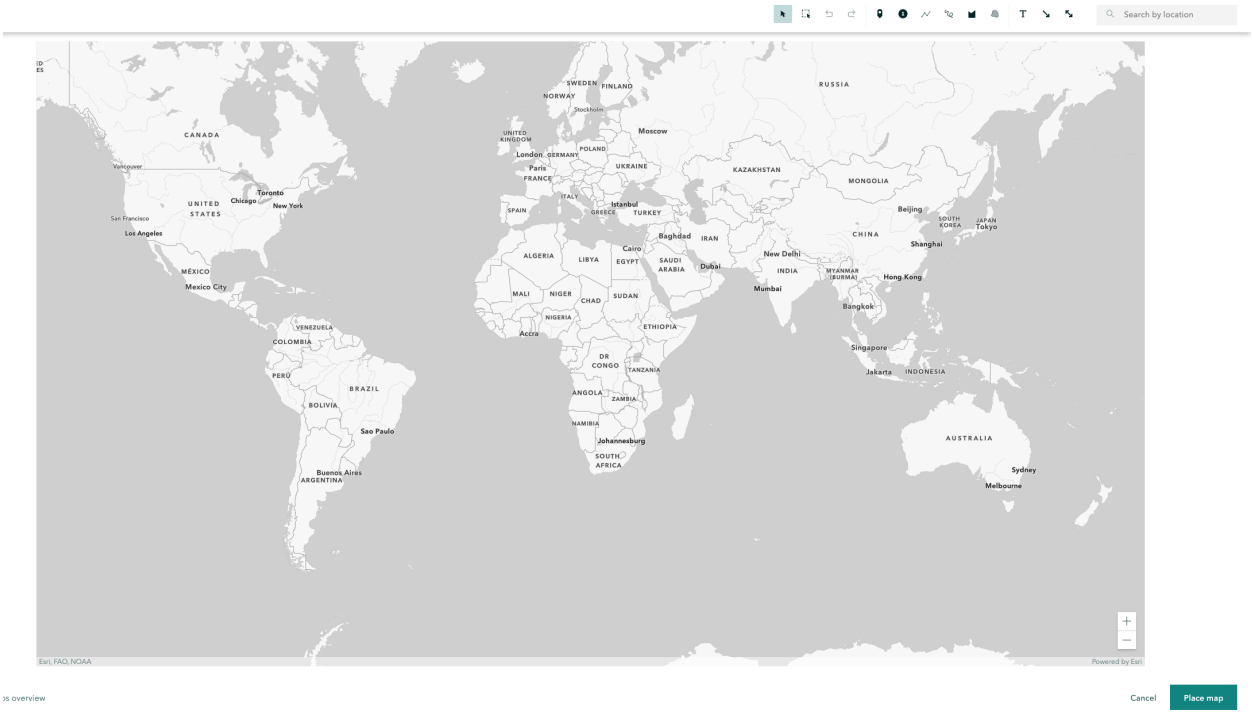


c. There are many navigational tools within the Story Map Builder interface you will be directed to after following step b.ii. Most of these tools are intuitive, however, there are areas in the Story Map creation process that can be confusing. I will touch on how to use the Content pop-up available upon scrolling down from your title page. Other content for managing Story Maps can be found here: https://storymaps.arcgis.com/en/resources/

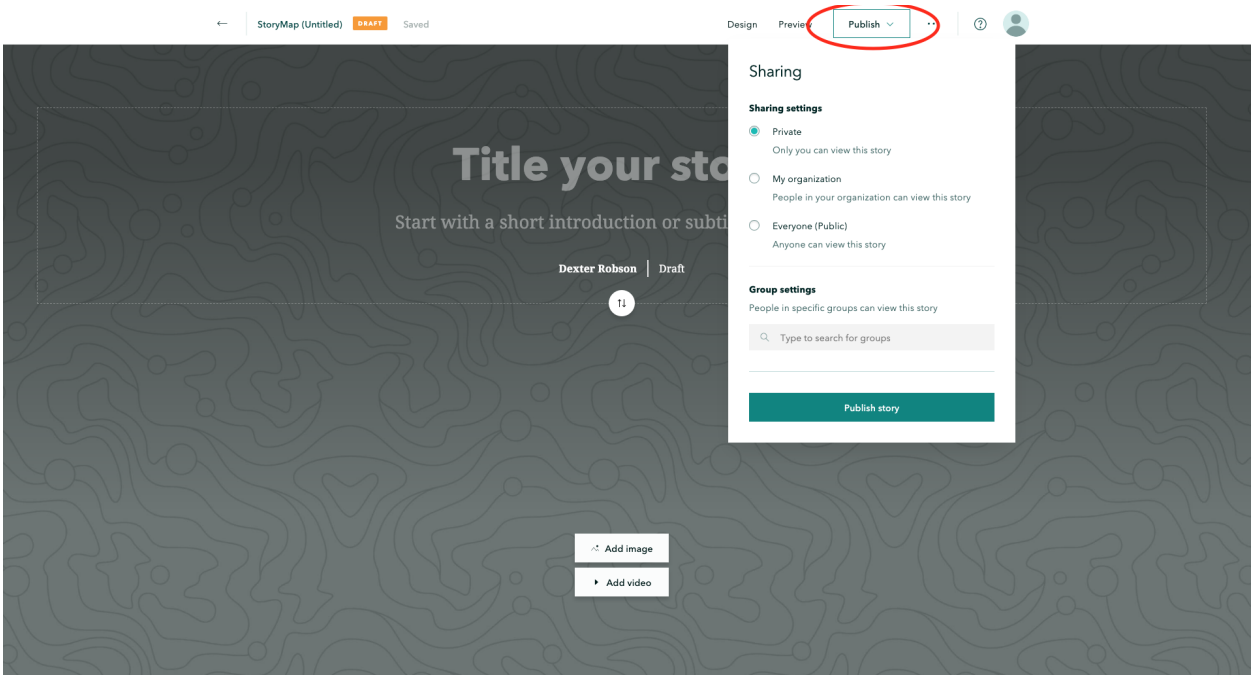
2. Navigating the Content pop-up
    a. The Content pop-up (green + sign on the left of the screen), is where you can add information to the story. To start to add content:
        1. Navigate to the green + icon at the left of the screen, left click
        2. This will give you a list of available content to add to your map. Here we will focus on embedding a map within your story.
        3. Select the “map” icon



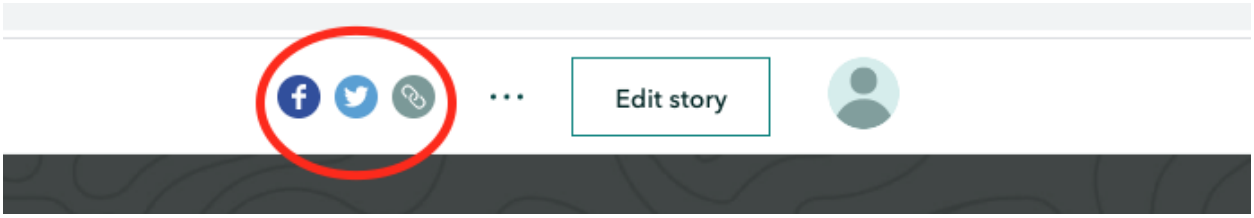
4. Once you have chosen from this selection, you can either choose to create an express map, which has limited functionality, or choose to add a map you have created in the previous steps.
5. The map that was uploaded in a previous exercise should be available there to embed in the map. Click this map and it will load on the screen.



3. There are many options within the content pop-up to add dynamic map elements. It is at the discretion of the user to which elements they wish to add. After the map is created, it is now time to share the map, in which case you will need to Publish
    a. Navigate to the top right of your screen, where you will see a Publish drop-down menu, enter this menu and select how you wish to share your story (private, within a specified group or “organization”, or with the public. If you are embedding a map in a website, make sure the map is public.



4. The final step is how to share you map. Once the map is published, you can Share the map through the sharing settings at the top of the published map screen
    a. Navigate to the top right of your map screen and see the “Facebook”, “Twitter”, and “Link” icons. Choose the Link icon and it will copy the URL of your map to your clipboard.
    b. You can then send this URL to whoever is interested in viewing your map, this may be a teacher, a parent, a member of your council or any community member.



5. You can also Embed a Story Map in a website quite easily using an embed code or iframe
    a. Use this iframe box and replacing the “insert your story map URL here”: `<iframe width="800px" height="800px" src="insert your story map URL here"></iframe>`
    b. Use this code and paste it into any HTML editing software.

13. Integrating Indigenous Language Using Keyboards

The ESRI Story Map uses a Unicode font design that allows for Nuu-chah-nulth font to be typed directly into the map itself. Therefore, managing keyboards is the most important component to successfully using languages in the Story Map interface. For this example we will be downloading a Nuu-chah-nulth language keyboard, however many more keyboards are available on First Voices (https://www.firstvoices.com/) and Language Geek (http://www.languagegeek.com/) websites. There are instructions for the installation of language keyboards using Apple and Microsoft interfaces below:

Using an Apple interface, adding the Nuu-chah-nulth keyboard is as follows:

1. Navigate to http://www.languagegeek.com/nwc/nwc_keyboards.html
    a. Scroll down to the Wakashan Languages section of the web page
    b. Click on Mac Download (3.7)

Wakashan Languages

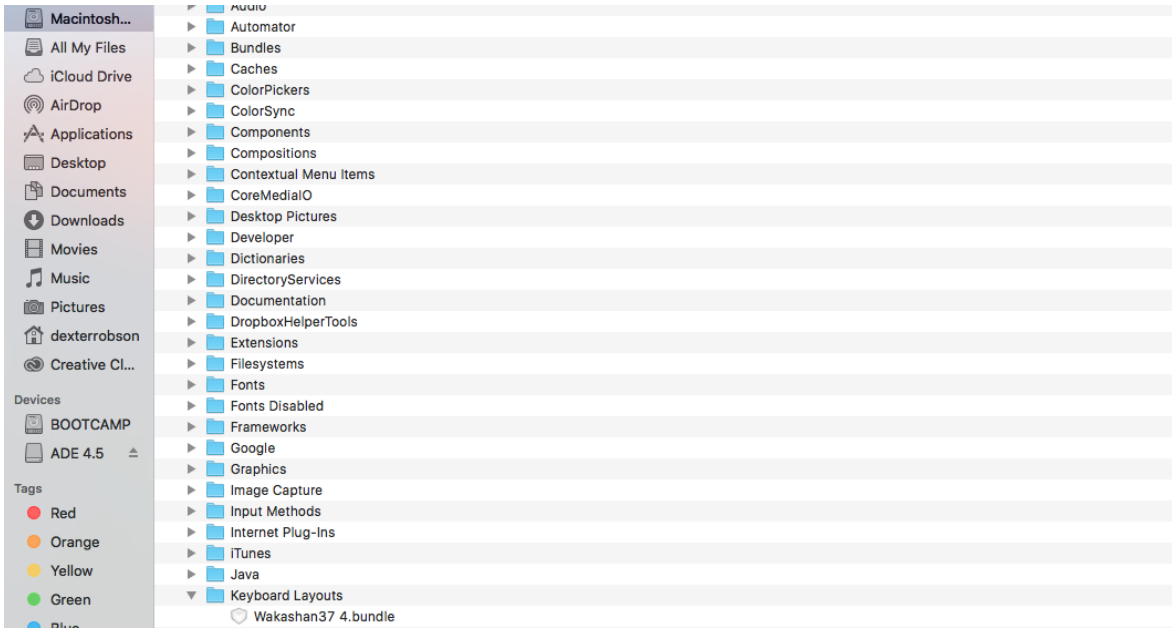
Mac Download (3.7) — Windows Download (3.5)

Mac Installation Instructions — Windows Installation Instructions

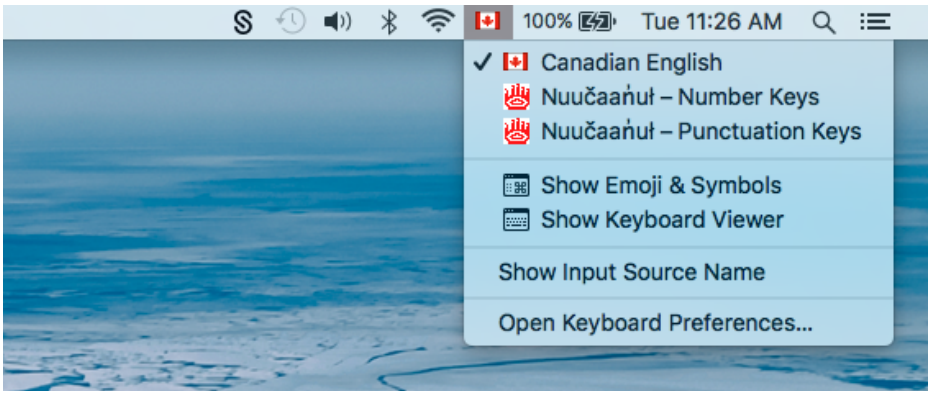
Diidiitidq	Nitinat	Keymap (pdf)
Haiłzaqvla	Heiltsuk	Keymap (pdf)
Kwak'wala / Kʷaḵʷala	Kwakiutl	Umista: Keymap (pdf) Americanist: Keymap (pdf)
Nuučaaʔuł	Nootka	Keymap (pdf)
Qʷi·qʷi·diččaq	Makah	Keymap (pdf)
'Uwiḵala	Oweekeno	Keymap (pdf)
X̌a'islaḵala	Haisla	Keymap (pdf)

Click to go back, hold to see history

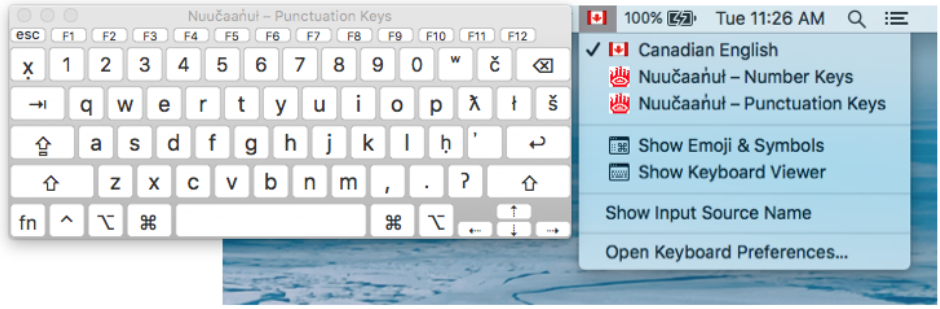
2. Unzip by keyboard layout by either simply double clicking the zipped file.
3. The keyboard will either have the extension .keylayout or .bundle. If it's a bundle, the icon will look like a white Lego piece.
4. In the Finder, choose Go > Computer or type Shift-Command-C. This opens up your account folder.
5. Expand the Macintosh HD item, then the Library item, scroll down to find Keyboard layouts.



6. Drag the keyboard layout you saved earlier into the Keyboard layouts list.
7. Log off the computer or restart it.
8. If you have a Mac OS version earlier than 10.9.1 Mavericks
    a. Open System Preferences > International. Click the Input Menu tab.
    b. Scroll down until you find the name of the keyboard layout you just installed. Make sure the checkbox is selected. The layout is now ready to use.
9. If you have OS 10.9.1 Mavericks or later
    a. Open System Preferences >Language and Region. Click the Keyboard Preferences button at the bottom.
    b. Click the Input Sources tab at the top.
    c. Click the + (plus) sign at the bottom left to 'add a keyboard layout'.
    d. Select Others in the left-side pane, this should display a list of keyboard layouts which includes the one you are looking to activate. Select the keyboard you want and click add. Don't worry if the message says 'Keyboard layout not available', just ignore this.
    e. The layout is now ready to use.
10. To access the key layout, click on the flag at the top of your screen. Select the keyboard layout from the list.



11. The keyboard may be listed under either its Native, English, or French name. Please check through the list for alternate names and/or spellings.
12. A helpful tip for typing with the new keyboard is to select "show keyboard viewer" This is beneficial in that you can then view where each symbol is located on the keyboard, and also type by clicking on the key in the viewer.

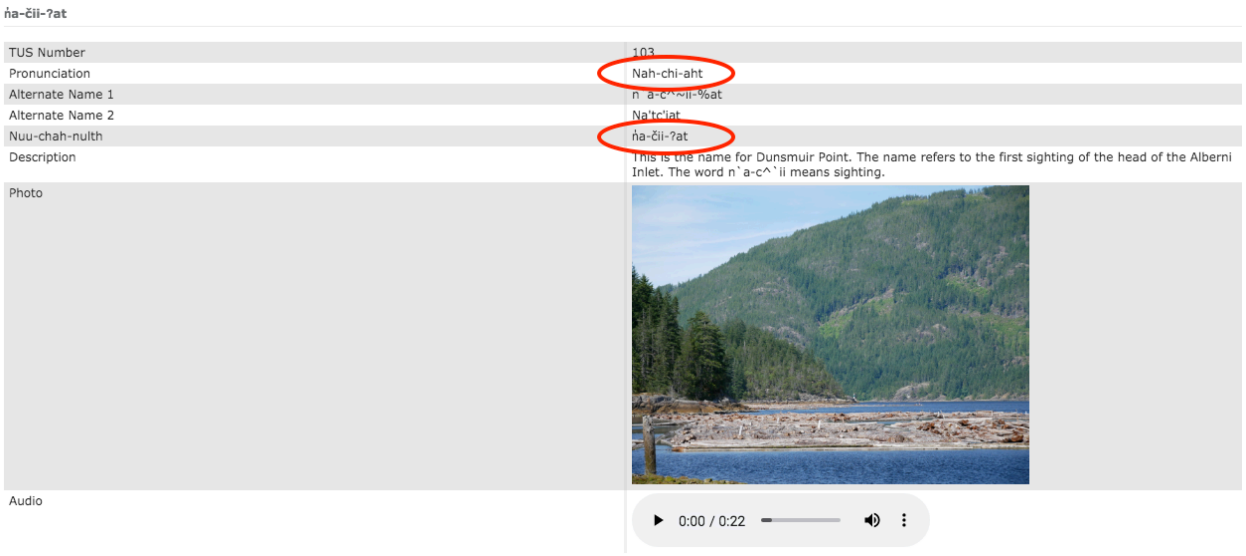


Using a Windows interface, adding the Nuu-chah-nulth keyboard is as follows:

1. Navigate to http://www.languagegeek.com/nwc/nwc_keyboards.html
    a. Scroll down to the Wakashan Languages section of the web page
    b. Click on Windows Download (3.5)
2. Save the file to a destination you will remember
    a. Unzip the folder using any unzip tool
    b. Within the folder there will be a list of language folders, navigate to your language folder
    c. Within your language folder, there will be a setup wizard. It will likely be labelled “setup”
3. The keyboard will be installed through an installation wizard. Depending on your version of Windows, you will need to restart your computer. This is recommended regardless.
4. You should now see a keyboard icon in your system tray (the start bar at the bottom of your screen). You can switch between keyboards by clicking on this and selecting your desired language.
5. A helpful tip when using the keyboard layout is to select “show language bar” so you can see the letters you wish to type and their location on the keyboard.

13. Developing a pronunciation guide for place name pop-ups

As an objective of application development with the Hupačasath First Nation, an accessible pronunciation guide was integrated into each place name pop-up. To develop this guide, researchers worked with a Hupačasath First Nation youth who took the lead in developing a simple phonetic spelling for each place name which through interviews, became instrumental in guiding community members through learning pronunciation. Interview responses indicated that the pronunciation guide was being used in the local school district to teach youth the place name in Hupačasath territory. The guide followed English phonetic elements, to create easy-to-access pronunciation building on a language the community is already familiar with. It was decided by the Hupačasath community that using the International Phonetics Alphabet required another step in language learning that was not necessary. Below is an example of the “Pronunciation” and “Nuu-chah-nulth” spelling of a place name.



14. Conclusion

This document introduced the reader to the fundamental steps in developing an Esri-based cybercartographic application capable of sharing community knowledge as envisioned by the Hupačasath First Nation. By working so closely with the Hupačasath on this project, the user manual acts as a research product presented back to the community as a means of accountability by showing what methods are taken to develop the cybercartographic application and how to replicate these methods. There are details omitted from this document, especially in developing the Story Map itself, as this process is largely creative and the text, imagery, video, audio and any other multimedia elements to be included are at the discretion of the communities who choose to follow these methods. Ultimately, how the narrative is shaped will be in line with the community's vision and the technology is only a possible framework for storytelling communities can engage with if they see fit.

By no means are Esri's products the best option for developing cybercartographic applications, as Esri is one of many options on a spectrum of available technologies. It is important to engage with community members to truly understand specific technology requirements to implement what best fits the resources the community is willing to allocate to the project. This could mean using free-to-use software such as Google Earth, or a customized application using a programming language (i.e. JavaScript). The right technology is the technology chosen by the community.

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Chapter 4: Curriculum Module

Introduction

The curriculum module is designed as a university assignment for a 100 level geography class at the University of Victoria. Drawing from chapters 2 and 3, the intention of this module is to introduce first year university students to the history of Indigenous land use and occupancy. The curriculum module is distributed to students via a publicly accessible hyperlink to an online narrative map which includes interactive examples for students to follow: https://storymaps.arcgis.com/stories/ad1577d4ede349c188184165767ad84c

Description

Many Indigenous communities use web mapping to document their knowledge in a format that is highly interactive and accessible that can be used as an educational tool for teaching community members (i.e. Indigenous youth) and others who are interested in learning about their language, culture, and history. For this project, you will choose a region (preferably in the vicinity of Victoria) and tell a story that communicates Indigenous relationships to land. Over the next few weeks, you are expected to collect a variety of Indigenous knowledge (i.e. place names, traditional plant knowledge, and stories) and then develop a Story Map that contains this information within a greater narrative about Indigenous knowledge.

Learning Outcomes

- After completing this assignment students will:

- Have a greater understanding of Indigenous relationships to land and the colonial history of British Columbia.
- The skill to develop a series of maps that tell a story of the relationship between Indigenous people and settler societies
- Familiarity with both collecting data in the field and online in ArcGIS Online
- Know how to embed photo and video within ArcGIS Online map pop-ups
- Experience with using Indigenous language keyboards to increase language capacity of online maps
- The ability to develop a Story Map that brings images, videos, and text together in a meaningful way to communicate Indigenous relationships with land.

Instructions

Planning

Using guidance from lectures and readings, develop a narrative about the relationship between Indigenous people and land that is geographic in nature.

At the very least, your story map must contain the following:

- Three separate maps
- One primary dataset
- One secondary dataset
- One point vector data layer (This could be a petroglyph i.e. petroglyph at East Sooke Park)

- One line vector data layer (this could be a travel route i.e. the route between the Chatham Islands and Oak Bay)
- One polygon vector data layer (this could be a village site i.e. Sitchanalth the Songhees village site at Willow's Beach or a parks layer)
- Two images
- Text to accompany images and maps

At the very least the pop-up windows in your maps should contain the following:

- One photo
- A name written using the First Voices language keyboard
- A description of the feature

Begin Developing

- As a part of the Story Map, you should select a location that acknowledges the Indigenous lands and perform research to locate information on the history of this territory.
- Choose a local area and identify features (place names, locations of traditional plant medicines, or where stories took place) and create web maps of this information as related to the geographic narrative that you wish to tell.
- Install the First Voices Language Keyboard in the language of their choosing (http://www.fpcc.ca/language/toolkit/LanguageKeyboards.aspx) to type the name of each location in the Indigenous language of the region (i.e. Lekwungen) within their pop-ups.
- Provide text that clearly describes your experience in creating this place name ma. In doing so, consider the following questions:

    - What did you learn about Indigenous relationships to land?
    - What were the main messages the students took away from the exercise?
    - How could the map be used in the future?
- Embed a photo, a description, and a name in the language of the region in each pop-up window **(please refer to the example map below)**.

Revise

- Once you are confident that your story meets the above criteria, dedicate at least 5 hours to refining your application, especially the narrative that ties your maps, images, and text together.
- You should evaluate your maps from the perspective of someone with minimal technological capabilities who is interested in your topic.

Chapter 5: Conclusion

Indigenous people and the Government of Canada have long-standing contentious relations (Corntassel 2012). Canada's reconciliation process relies on a rights-based approach to self-determination with a focus on using Western forms of two-dimensional cartography to grant Indigenous people territorial claim and rights to subsistence land-use practices (Corntassel 2008). However, this approach to reconciliation omits many aspects of self-determination concerned with cultural preservation and these two-dimensional representations of Indigenous relationships with land do not convey the full impact of the Canadian government's land use practices (Tsuji 1996). Efforts to increase the capacity cartography has for communicating Indigenous knowledge have included traditional use and occupancy studies that rely on the perspectives and contributions of Indigenous people. However these studies still rely on the two-dimensional western cartographic techniques for relating geographic location to descriptions of these locations (McIlwraith and Cormier 2015). Because western cartography does not incorporate cultural elements such as oral history, visual learning through spiritual practices (i.e. song, dance, and art), and the development of strong relationships with the land, much of Canada's Indigenous people's history is not communicated in the use of these approaches (Hunt and Stevenson 2017).

The emerging field of cybercartography has the potential to address many of the inadequacies of western cartography by providing a space to implement audio (i.e. oral descriptions and history of place), video (visual), and text-based techniques for preserving traditional knowledge and maintaining cultural practices and importantly communicating the impacts on Indigenous territories (Taylor 2013). However, past research using cybercartographic approaches has not clearly delineated how cybercartography, with its interactive and multimedia

approach to mapping meets the requirements of self-determination for First Nation communities. Therefore, the overall objective of this thesis was to examine the potential for cybercartography to facilitate the process of self-determination for First Nation communities and to then explore ways of mobilizing these findings. Here I provide a list of three takeaway points from this thesis that are broader perspectives than what was provided in the case study presented in Chapter 2. These points are intended to guide future research in this area.

1. Community consultation with a direct focus on technology adoption facilitates opportunities for Indigenous self-determination

Since the objective of much cybercartographic research with Indigenous communities is to develop an application with the maintenance of traditional knowledge and education in mind (Engler, Scassa, and Taylor 2013), research projects that rely on the input of community members to decide which cybercartographic technology to use are likely better-equipped to address community requirements for self-determination. This can be accomplished through one-on-one interviews, focus groups of respected community members, and meetings with the chief and council where the research team identifies the community's key requirements of self-determination for an application. For the Hupačasath, cybercartography's role related to the social aspects of self-determination displays cultural knowledge in an educational format to improve the spread of knowledge throughout the community and reclaim elements of the map by introducing stories, elder voices, imagery, and language. The cybercartographic application can also meet requirements of self-determination related to the political, where during this project the Hupačasath First Nation developed a clear boundary and provided evidence for their occupancy within this boundary through place name recognition. Furthermore, to strengthen the political,

rights-based elements of this project, the community connected these places to traditional use information as part of their ongoing ethnohistoric study. Ultimately listening to the voices of the Hupačasath First Nation guided cybercartography's role in their community which highlighted specific developmental goals for self-determination.

2. Aligning project objectives with the greater objectives of self-determination produces a reciprocal research product

Due to the long-standing history of colonization, and ongoing colonialism by the Canadian Government, research involving Indigenous communities will likely always relate in some way to self-determination and especially research which is concerned with cartography, as the history of maps in Canada is inherently political (Anker 2018). For First Nation communities who engage in mapmaking, maps are colonial tools which Nations use to engage in reconciliation efforts with the Canadian Government. Therefore, researchers who work with First Nation communities should look towards aligning project objectives with self-determination to develop a reciprocal product. Researchers should understand the community's objectives for using the cybercartographic application to facilitate self-determination at the beginning of the research process and then design the product to meet these objectives. For the Hupačasath community, these objectives pointed to the shortcomings of their previous experiences with cartography and research and how they were unable to demonstrate cultural aspects related to territorial places. By introducing the cybercartographic application, the Hupačasath were able to improve social aspects of self-determination by demonstrating their complex relationships with their territory. This was aided by the close consultation process with the community that continuously shaped

the application throughout the research process through iterative and detailed interviews, focus groups, and conversations.

3. The OCAP principles can effectively evaluate cybercartography through the lens of self-determination

By using the Indigenous principles of OCAP to frame interview responses, this study was able to situate its findings within the context of self-determination and evaluate how the cybercartographic technology addressed elements of self-determination. Because cartography's history in Canada is largely exploitative where the Canadian Government used maps to erase the Indigenous history of land use (Eades 2015), OCAP positions research in cartography to consider communities first by framing project objectives within Indigenous principles of self-determination with the potential to decolonize aspects of the research process by pushing research to adhere to Indigenous perspectives. For the Hupačasath First Nation, OCAP offered an interview framework that considered the principles of Indigenous people at the center of the interview questions and for myself as a researcher, it positioned my discussion around self-determination and the community-specific objectives for the Hupačasath First Nation. Furthermore, OCAP is important for Indigenous cybercartography because it allows the findings to be applied more broadly. For example, instead of simply highlighting a community's desire for phonetic elements in their cybercartographic application, using Indigenous principles such as OCAP further situates the response within an understanding of how community access to traditional knowledge contributes to self-determination.

By integrating OCAP into this project, I was able to address findings from McGurk and Caquard (2020) who use 21 Indigenous research criteria developed by Linda Tuhiwai Smith

(2012) to evaluate how cybercartographic projects address Indigenous self-determination. Their findings indicate cybercartography better aligns itself with Indigenous perspectives on self-determination over other methods of cartography, but technology still remains under the direction of outside research partners. By implementing OCAP in this project, I was able to increase the role the Hupačasath First Nation had in directing technology development by focusing on how their community members could control and access the application. Also, by following the principles of OCAP this project focused on training community members to use the technology to become less reliant on non-indigenous partners. Therefore, the OCAP principles offer a unique and much-needed perspective for researchers who wish to decrease the exploitative nature of Indigenous research.

Limitations

The most obvious limitation for this research was the number of participants that were able to be involved in the research process and provide feedback on the development and use of the cybercartographic application. However, it is important to acknowledge that, while few in number, these participants were selected for their position as key knowledge holders in the community. Participants were also challenged by the limited time available to interact with the technology developed for this study, which may have affected participant's ability to reflect on interview questions. Furthermore, the transferability of the findings from this study may face challenges when applied to a community that does not have Internet connectivity similar to The Hupačasath First Nation. Having a location close to an urban center provided the community with sufficient broadband services for being able to seamlessly interact with the technology over

the Internet, but those communities in more remote locations may have more limited resources and hence experiences.

It is also important to note the user manual and curriculum module were developed in such a way as to assume the user will have prior experience working with ArcMap and a Windows operating system. The accessibility of the user manual and curriculum module is therefore limited to communities that already possess these skills or have access to computers set up for this type of mapping. In addition, the curriculum module and user manual do not use open-source software, further restricting the usability of these technologies to communities who possess the resources to operate them. Both of these elements may limit more broad applicability of these materials, especially to Indigenous communities outside of Canada.

Further limitations to this thesis include the lack of community involvement in the thesis writing process and absence of consultation in the final thesis findings. The thesis is also embedded in a single First Nations approach to self-determination through cybercartography, and this must be remembered when applying any of the findings to other projects and communities. This thesis was also relatively unique in that the First Nation possessed a wealth of archival knowledge that had already been collected through stringent research processes during previous traditional use and occupancy studies. This does not discredit the findings, however it sped up the process of collecting and developing the application. Finally, due to a longstanding history of non-reciprocal relationships between outside researchers and First Nations communities, the process of developing trusting relationships with said communities is often an understandably long one. This project had the advantage of relying on strong pre-existing relationships between the community and a research consultant to facilitate the efficiency of this study.

Researcher Reflection

I must acknowledge I am a settler, researcher and academic and my perspectives throughout this project are shaped by my own experiences, and influenced by the many colonial systems within which I have resided. Through the community engagement process of this project, I learned a great deal about the interconnected relationships Indigenous people have with the land and with one another. Through interviews, focus groups, and conversations with Hupačasath community members, I learned that place names do not only offer descriptions of place, but also relate the emotional and cultural attachment to place. When community knowledge holders come together to discuss these places, they are reminiscing as friends about the places that have in some ways shaped their identity. I have learned that Western representations of space using cartographic techniques limit the ways First Nation communities can demonstrate their connection to land and this influences the Nation's ability to convey the impact settler societies are having on their territories.

These learnings have extended into research design, where I have developed an understanding regarding the necessity of building relationships with community members and honoring those relationships. Furthermore, I have come to recognize that every community has their own requirements of research and researchers must honor these through a thorough consultation process. For instance, I have learned that to respect traditional knowledge research design must allow for space to be created for tangential elements of stories, and for conversations between community members so participants are not limited by the protocols of the researcher. By working with the Hupačasath, I was able to remove myself from the academic sphere and learn situationally about their culture, and I believe this has strengthened my ability to work with First Nation communities in participatory research. Engaging in this research process has

fostered a strong foundation for me to continue questioning the impacts of colonial systems, the roles I play in them, and decolonizing my work in the future.

Summary

This study demonstrates that cybercartographic applications have the ability to facilitate self-determination, so long as the unique requirements of the community are prioritized and the community is engaged in the development process. The historical trend in technology-oriented research with Indigenous communities demonstrates a tendency to be overly prescriptive and assert a predetermined technology on a community, rather than engaging the community in decisions around technology adoption. This in turn may result in the use of a technology that is not compatible with the technologies used in the past or the resources available, thereby lowering its ability to address community requirements of self-determination.

This overall thesis mobilizes the findings from the study in the form of a user manual and curriculum module with the intent of educating Indigenous and non-Indigenous students. The user manual offers a model for how a community-engaged research process can produce reciprocally beneficial material that can be applied within the community for managing their cybercartographic application, and outside the community for other projects that wish to mobilize cultural knowledge. By using a community-engaged approach, which prioritized listening to and incorporating community voices, the user manual and technical training were added as project elements at the request of the community, though typically these may have been viewed as outside the scope of research.

Additionally, the curriculum module demonstrates the applicability of cybercartography to educational use through the creation of an assignment for a university course based on the

methods used in this study. The range of applicability of this technology for education is further demonstrated through the implementation of the cybercartographic tool by a local school district to teach indigenous and non-indigenous elementary students about First Nations history and the Nuu-chah-nulth language.

In Canada, First Nations face challenges with the communication of their knowledge and culture with the Canadian government and within their communities. Cybercartography offers a highly interactive method of displaying that knowledge that has the potential to engage and educate people about the history and culture of First Nations. Throughout this thesis, I have attempted to evaluate the benefits and challenges cybercartography in self-determination, and conclude by stating that the promise of any technology hinges on the degree to which community engagement is at the center of developing and evaluating technologies *with* and *for* First Nations.

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