APPLYING AND INTEGRATING GIS FOR TRIBAL USE: A PROJECT THAT INCORPORATED GIS IN CULTURAL RESOURCE MANAGEMENT FOR NORTHERN CALIFORNIA TRIBES

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A Project

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by

Cole Morales

Spring 2022

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DEDICATION

This project is dedicated to the Tribes and tribal organizations protecting their cultural resources and overcoming obstacles that you all face every day.

Stay resilient and know that your work is appreciated by your community and our people who came before us.

ACKNOWLEDGMENTS

To our ancestors, for their resiliency and sacrifices that allowed Native people to be here today.

To my grandparents, for shaping and teaching me the importance of this work and that everything happens for a reason. Your teachings have made me into the person I am today.

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ABSTRACT

APPLYING AND INTEGRATING GIS FOR TRIBAL USE: A PROJECT THAT INCORPORATED GIS IN CULTURAL RESOURCE MANAGEMENT FOR NORTHERN CALIFORNIA TRIBES

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Since first contact, Native American Tribes in the United States have been in an ongoing battle to maintain their heritage and ways of life. Actions taken to assimilate Native American people in the United States have resulted in loss of land, human rights, culture, and natural resources. This project seeks to understand GIS as both a tool to manage cultural and natural resources, while at the same time, acknowledging that limitation to this work is present. Additionally, the literature on confidentiality is included to lay out which policies and acts are in place to better protect tribal resources, while also identifying legislation that diminishes protection.

CHAPTER I

INTRODUCTION

Background

Since first contact, Native American Tribes in the United States have been in an ongoing battle to maintain their heritage and ways of life. Actions taken to assimilate Native American people in the United States have resulted in loss of land, human rights, culture, and natural resources. These assimilation efforts and acts to erase Native people and their culture has been an ongoing process. Action performed by the Federal Government was justified through policies, federal law, and views towards Native American people. Foundational structures that have allowed the seizure of Native American lands and resources stem from rulings decided by the Supreme Court. These ruling inflicted undesired outcomes on Native people's culture, natural resources, and religious beliefs held by Native American peoples since time immemorial.

Supreme court case rulings such as *Johnson v. M'Intosh, Lonewolf v. Hitchock*, and the *Cherokee Nation v. Georgia* imposed detrimental outcomes for Native people and in Walter Echo-Hawks book *In the Courts of the Conqueror: The 10 Worst Indian Law Cases ever Decided*, Echo-Hawk claims that "Since that fateful decision in *Johnson v. M'Intosh* (1832), American law has often worked against Native Americans, legitimizing the appropriation for their property and the decline of their political, human, and cultural rights as indigenous peoples at the hand of the government" (Echo-Hawk, 2010, p. 3). The court cases in Echo-Hawks' (2010) work included *Lonewolf v. Hitchcock* and *Cherokee Nation v. Georgia* because they do not deal with what Echo-Hawk

describes as justice. The use of derogatory stereotypes towards Native people, alongside the antiquated legal doctrines wielded by colonial powers ensured forceful taking and subjugating of Native people and land (Echo-Hawk, 2010). These Supreme Court rulings allowed the unlawful purchase and seizure of Native American land to settlers, which paved the way for Manifest Destiny in America. The beginning of this paper examines the policies and Supreme Court cases permitted Native American land to be forcibly taken through justifiable infamous court case rulings.

The attack and loss of Native American title to the land added to the plethora of discrimination and obstacles that Native American people have had to endure since first contact. As Native people lost title to their traditional homelands, many tribal gathering, ceremonial, and religious sites were destroyed or privatized. It was not until the creation of the Antiquities Act of 1906 to protect and stop vandalism of Native American artifacts and landscapes in the American Southwest (Marincic, 2018). Following the Antiquities Act, the National Historical Preservation Act (NHPA) and its additional amendments was introduced to allow Tribes to register their sacred sites and religious sites to increase a Tribes power to protect their sites, while also facilitating consultation between public land agencies and Tribes being impacted by project administered by public land agencies (Marincic, 2018). NHPA does provide a level of protection for Tribes; however, limitations, cultural insensitivity, assimilation efforts by the United States, and a lack of understanding of Native American ideology do not allow for Tribes to obtain complete protection for their sites (Marincic, 2018). Lack of awareness to Native American ideologies and religious customs put barriers on Tribes, especially since the United States federally recognizes 574 sovereign tribal entities that

possess distinct and diverse culture, landscapes, climate, and religion (Bean, 1992). While the NHPA cannot provide Tribes with complete protection for their sacred and religious sites, there also lies the issue of Tribes not providing sensitive data to a government entity, which is the result of historical mistrust and trauma between Native American Tribes and the federal government. The limited protection found in the NHPA is concerning, but other avenues are available for Tribes to both better protect their cultural and religious sites by also preserving Native American heritage by implementing Geographical Information Systems (GIS) to manage cultural resources.

The history of GIS is quite impressive in terms of the vast users that apply the GIS platforms to solve problems and identify trends or patterns in our complex world. Walford (2020) describes one of the first applications of GIS in September 1854 in Soho London. John Snow, an epidemiologist and physician applied one of the first known applications of GIS to identify the spread of cholera (Walford, 2020). The GIS applications conducted by Snow showcased the potential that GIS can have when analyzing trends and patterns associated with pandemics and epidemics.

Throughout the years and with the aid of advancing technology, GIS is now more accessible to users through educating users through trainings and awarding certificates obtained in higher education. Fields that are utilizing GIS in the present day include medical professionals studying the spread of viruses and disease. Wildland managers seeking to mitigate wildfires, specialists studying climate change impacts, and water sanitation to name a few. The purpose of this project is to provide background of why GIS would be a good tool to implement in cultural resource management for Tribes; however, this project will delve into the limitation of integrating indigenous knowledge

to a GIS platform. Lastly, due to confidentially concerns Tribes will also need to account for sensitive data being released due to policies and acts in place (Plaut, 2009).

The literature on projects integrating GIS in indigenous communities was first introduced by the First Nations people of Canada, but the practice of mapping of indigenous land is quite limited (Chapin et al., 2005). As stated previously, users seeking to enter the GIS field can gain experience and education from universities and community colleges, but for indigenous users, the Environmental Systems Research Institute (ESRI) is providing conferences and resources for indigenous users. Indigenous GIS projects mapped the location of Mountain Maidu allotment locations in Plumas County, California, which identified Maidu people who owned these allotments (Middleton, 2010). The outcome of this project influenced and enhanced the stewardship of the Mountain Maidu homelands by the Maidu people in portions of Plumas County, while also facilitating community engagement (Middleton, 2010). Another indigenous project worked with the Inuit people of Igloolik. Elders and community members included place names in the Inuit peoples of Igloolik language that were used by the local community for hunting and fishing. Applying GIS to indigenous project also provides Native American in the United States with additional protection when working with public entities in traditional homelands.

The Freedom of Information Act (FOIA) is one act that raises concerns for Tribes when protecting sacred sites. The focus of the FOIA is for transparency for public agencies and the American people (Plaut, 2009). Transparency in this situation has good intentions, but for Native American Tribes the FOIA creates an obstacle for Tribes striving to protect sacred sites (Plaut, 2009). Where GIS applies in these situations is

through FOIA and its nine exemptions. The exemptions are put into place to mitigate the release of information that falls within these nine exemptions. For GIS to trigger an exemption, a sacred site or location must be recorded and filed through a GIS process to allow for a halt for sensitive information to occur (Plaut, 2009). The GIS process and implementation for Native American cultural protection showcases many benefits for Tribes, but there are limitations that arise when integrating GIS into cultural resources management.

Native American communities that plan to implement GIS into their cultural resource management operations should keep in mind that integrating indigenous knowledge to a western concept, such as GIS, can have its drawbacks and limitations. For instance, features such as mountains, trees, and streams would be considered as a nonliving object, while indigenous knowledge and connection to the land would categorize these features as living beings (Reid & Siever, 2019). Furthermore, GIS users must acknowledge the cultural sensitivity when working in Native American communities. Knowledge and information obtained from these projects come from the community members, which can result in unintentional harm. These potential harms include reducing indigenous knowledge, not considering the ways knowledge is passed down by generations, decreased access to land, and created conflict within communities. As we look at the mapping of indigenous territories, we see that indigenous knowledge does not hold the same definition of boundaries as the western concept. This project seeks to understand GIS as a tool to manage cultural and natural resources, while at the same time, acknowledging that limitation to this work is present. Additionally, the literature on confidentiality is included to layout policies and acts that are in place to

better protect tribal resources, while also identifying legislation that diminishes protection.

Statement of Problem

As stated in the early section and will be covered later in this paper, Protection of cultural artifacts and sacred sites is an ongoing obstacle for Tribes. Furthermore, while Tribes continue to keep locations and sensitive information confidential while working with public agencies in the event of development; providing information on options to increase tribal confidentiality is a priority in this project. The literature shows in Chapter II that applying GIS to indigenous and Native American communities is a new concept. Lastly, GIS platforms, such as ESRI's ArcGIS pro provides their users with tools and function to include attachments to data points. This project focused on ESRI's ArcGIS pro platform. For Tribes that hold federal recognition, a free license of ArcGIS Pro is available (United States Department of the Bureau of Indian Affairs, n.d.). Tribes that are not federally recognized do not qualify for a free license and must either pay for this service through ESRI or use an alternative GIS platform (United States Department of the Interior Bureau of Indian Affairs, n.d.).

Features included in ArcGIS Pro, such as the add attachment tool, allows a user to include pictures and MP3 files to the data. The inclusion of adding MP3 files can further enhance the power of GIS for tribal use by adding recordings of the history associated to traditional homelands identified by elders who pass down knowledge to the future generations. Through storytelling and oral tradition, Native people's knowledge is passed down through these means from one generation to the next (Real Bird, 2017).

The goals of this project are to showcase acts and policies that both aid and harm sensitive information held by Tribes, and to provide a guide to new or beginner users of GIS for tribal use. Taken together, these two scholarly pursuits provide an essential context for tribal consideration of any GIS project. Lastly, the design for this project uncovered additional functions that can aid in cultural preservation and the passing of knowledge to future generations.

Questions Answered by the Project

GIS technology is progressing, and its history shows that GIS will continue to grow and improve how managers find solutions to the problems that arise in our complex world. Unfortunately for Tribes, the complex problems in cultural preservation and protections have stemmed from the United States through its efforts to assimilate and erase Native people (Pearce & Louis, 2008). The acts and polices in place historically worked to harm Native people, but as time passed these acts are moving towards producing elevated protections for Tribes which was historically not present (Marincic, 2018). Although these acts such as the NHPA are in place to grant a level of protection for Tribes, there are still flaws, amendments, policies, and a cultural understanding that must be incorporated to gain Tribe's trust and unobstructed protection for cultural resources and sacred sites (Plaut, 2009).

The questions that this project seeks to answer is if the GIS platform can be utilized for tribal operations in cultural resource management? If this platform can be utilized, does it also provide additional protection for Tribes under FOIA's exemption for information dissemination? Does the vast array of tools provided by the GIS platform

may also facilitate a system that can enhance tribal cultural preservation and passing down of history to future generations?

Finally, understanding that the template and guide (covered in Chapter III) will be designed to expose new tribal GIS users with a project tailored for a two California Tribes so they can use this project to setup and structure a GIS database based on their cultural artifacts and sacred sites. It must be noted that this project acknowledges that Tribes cultural resources, natural resources, and beliefs are diverse and that what might work for one Tribe will not work for another.

Significance of the Project

The goal for this project is to evaluate GIS as a tool for tribal users to; one, increase protection of cultural artifacts and sacred sites based on the exemptions provided by FOIA, two, strengthen cultural preservation for tribes, while also utilizing GIS technology to preserve tribal history and culture, and three, acknowledge and describe that GIS possesses many tools and features that may be helpful for Tribes. It is also important to remember that GIS can diminish tribal cultures through assimilating Native knowledge to fit western ideology (Reid & Sieber, 2019).

The focus of this GIS project is to expose tribal GIS users to options that can be used to manage cultural resources. Chapter II explains that the use of GIS is still a new concept within indigenous and Native American communities. The template created for this project worked off a previous template created by a Tribal Historical Preservation Officer (THPO) from a Northern California Tribe. The work stemmed from emergency work that had been conducted after a wildfire that took place in Northern California.

The purpose of creating this GIS project was to record and document cultural resources that reside in the footprint of this fire to ensure that resources be protected from the cleanup work. Although this work is tailored for the response of a wildfire, the GIS project and documentation can be geared and useful for the daily operations that THPOs or cultural resource managers face in daily operations. Within the United States, there are over 574 federally recognized Tribes that hold sovereignty to govern themselves. This number does not include the state recognized Tribes or tribal organizations. Tribes that reside in the United States live in a vast and diverse landscape and climate (Bean, 1992). Additionally, each Tribe possesses a distinct culture and religious beliefs. Although this project is geared for emergency work for a Northern California Tribe, the significance of this paper is to expose tribal GIS users to the structure and thought process on why this project was vital in hopes of encouraging and providing a guide on how Tribes can incorporate GIS in their operations, which is tailored for their specific resources.

Limitations

This project evaluates the implementation of GIS into tribal cultural resource management. The GIS platform used for this project is ESRI's ArcGIS Pro. Limitations to consider are that numerous GIS platforms are available for users. Each platform varies which may suit one user better than another. These varieties include the price of the software, specialized tools for analysis, and software designed for specific needs to name a few. For instance, the Arches Project provides an open-source GIS software which focus is managing cultural heritage data (Arches Project Cultural Heritage Inventory and Management Software, 2022). A major limitation that presents itself for tribal use of GIS

is the integration of Native American knowledge and epistemologies into a western concept, such as GIS. In addition, the framework that is applied in this project might be useful for one Tribe, but due to cultural diversity, this framework might need to be modified or adjusted to accommodate another Tribe's needs.

Definition of Terms

Artifacts

"An object (tool or ornament) Showing human workmanship or modification" (State of California Native American Heritage Commission, 2022).

Cultural Resources

"Relates only to remains and sites associated with human activity or activities or elements or areas of natural landscapes which traditional cultural significance" (State of California Native American Heritage Commission, 2022)

Doctrine of Discovery

Under this doctrine, European explorers "discovered" and claimed title to Native land in the name of the monarch who sponsored their journey (Echo-Hawk, 2010).

Federal Indian Law

Body of law pertaining to American Indians and Alaska Natives that defines their bundle of political and legal rights as indigenous peoples (Echo-Hawk, 2010)

Geographical Information Systems

> A geographic information system (GIS) is a system that creates, manages, analyzes, and maps all types of data. GIS connects data to a map, integrating location data (where things are) with all types of descriptive information (what things are like there). This provides a foundation for mapping and analysis that is used in science and almost every industry. GIS helps users understand patterns, relationships, and

> geographic context. The benefits include improved communication and efficacy as well as better management and decision-making. (ESRI, n.d.)

Indigenous

Of or relating to the earliest known inhabitants of a place and especially of a place that was colonized by a now-dominant group (Nesterova & Jackson, 2018).

Native American/American Indian

> An American Indian or Alaskan person is someone who has blood degree from and is recognized as such by a federally recognized tribe or village (as an enrolled tribal member) and/or the United States. Of course, blood quantum (the degree of American Indian or Alaska Native blood from a federally recognized tribe or village that a person possesses) is not the only means by which a person is considered to be an American Indian or Alaska Native. Other factors, such as a person's knowledge of his or her tribe's culture, history, language, religion, familial kinships, and how strongly a person identifies himself or herself as American Indian or Alaska Native, are also important. In fact, there is no single federal or tribal criterion or standard that establishes a person's identity as American Indian or Alaska Native. (United States Department of the Interior Bureau of Indian Affairs, n.d.)

Open-Source

In the case of Free and Open-Source Software, the source code is typically published under a free software license with end-user rights to run the program for any purpose, to study how the program works, to adapt it, and to redistribute copes including modifications (Neteler et al., 2012).

Public Lands

> Land that is owned by the United States government. Public land refers to the public domain, unappropriated land belonging to the federal government that is subject to sale or other disposal under general laws and is not reserved for any particular governmental or public purpose.
>
> Much of this land was acquired early in the history of the United States as a result of purchases, war, or treaties made with foreign countries. The federal government used this land to encourage growth, settlement, and economic development. Land that was not developed, homesteaded, or sold remaining in federal ownership as public land. Today, the federal government employs principles

> of land use planning and environmental protection to preserve the natural resources and scenic beauty found on public land (The Free Dictionary, n.d.).

Sacred Sites/Religious Sites

> Specific, discrete, narrowly delineated locations on federal land that are identified by an Indian tribe, or authoritative representative of an Indian religion, as sacred by virtue of their established religious significance to, or ceremonial use by, an Indian religion. (United States Department of the Interior Bureau of Land Management, n.d., p. 3).

Tribe(s)

"Any aggregate of people united by ties of descent from a common ancestor, a community of customs and traditions, adherence to the same leader, etc."

(Dictionary.com, n.d.)

CHAPTER II

LITERATURE REVIEW

Native American Title to Land and Cultural Resource Protection

Relationships between Native American Tribes and the Federal Government throughout history are riddled in conflict and mistrust. This relationship stems from conflict between Native people and colonists. The use of federal Indian law has permitted and justified the taking of Native American land and resources. The result of this legislation through the federal court cases diminished tribal access to traditional homelands. Tribal access and ownership of these lands caused the destruction and desecration of sacred sites, culturally important natural resources, cultural artifacts, and religious sites held extremely important by Native American people. This section will describe the legislative powers and law cases that justified the taking of Native American lands. Additionally, this section will discuss how these decisions are impacting Native American Tribes today when it comes to protection of sacred sites, cultural important natural resources, cultural artifacts, and religious sites.

The use and exploitation of Legislation in federal Indian Law is the foundation that Settlers used to take and justify Native American title to the land. By justifying the seizure of Native American land, this legitimizes the action of requiring land. In Walter Echo-Hawks, *In the Courts of the Conqueror: The 10 Worst Indian Law Cases Ever Decided,* three court rulings studies in this book outline major problems that occurred in federal Indian law that shaped how Native American Tribes work to protect

and access resources today. This section will start by looking at three court cases which justified the taking of Native American land. These cases are *Johnson v. M'Intosh, Lonewolf v. Hitchcock,* and the *Cherokee Nation v. Georgia.*

Delving into the first case in the *Johnson v. M'Intosh*, this court decision allowed for the unlawful purchasing and coercion of Native American lands in the Midwest. Before the Revolutionary War, lands beyond the Allegheny Mountains were to be set aside for Native Tribes as decreed by the King of Brittan through the Royal Proclamation of 1763 (Echo-Hawk, 2010). Echo-Hawk (2010) further describes that the Royal Proclamation of 1763 stated that no squatters or purchase of this land be conducted unless land be purchased by the Crown. A fake document was created which illegally allowed the purchase of lands held by Native people. This fake document was approved by an unknowing British soldier, which resulted in approximately 66,000 acres to be illegally purchased (Echo-Hawk, 2010). This unlawful purchase of land was taken to court and to ensure that this land be taken legally through the court system; a specifically chosen judge, plaintiff, and defendants were used to sway the outcome in favor of taking Native land. Attorney Robert Goodloe Harper was chosen to represent the illegal land taking. Harper was chosen due to his success in previous court trials that were related to the unlawful taking of Native Land. As stated earlier, specific defendants, plaintiffs and judges were chosen due to their willingness to work in favor of taking this land and the benefits associated with both parties acquiring this land, which was the result of Harper being chosen as the attorney (Echo-Hawk, 2010). An example of the level of tampering shown by Harper is described by Echo-Hawk (2010):

> The pretend defendant was William M'Intosh, who owned land within the Wabash purchase but derived his title from the United States rather than the Indians. M'Intosh was picked because of his willingness to collude and play ball with the law. (p. 66)

This tampering is not the only instance of influencing the trial's outcome. Echo-Hawk (2010) also explains that Harper also "shopped" for judges that would be rule in favor of taking this land from Native peoples. In addition, Harper also handpicked all the players in this lawsuit, Harper paid and picked player and told them what to say (Echo-Hawk, 2010). This influence also included attorneys he would be set against to stack the deck in his favor (Echo-Hawk, 2010). One important factor of this trial is that the ruling of this case included the transfer of thousands of acres of Native land, which impacted their tribal sovereignty; however, Native representation was not considered in this trial. No Native American person was present throughout this court case (Echo-Hawk, 2010). Harper and the attorney representing M'Intosh referred to Native people and Tribes as "savage Tribes" and "an inferior race of people" (Echo-Hawk, 2010). This detail is crucial because these attorney and parties are representing Native people's land and sovereignty. Although the attorney Harper had influenced the court in his favor, the outcome of this court case resulted in negative outcomes for Native people.

The results of *Johnson v. M'Intosh* reinforced that Native American land can only be purchased by the Federal Government and not by private people (Echo-Hawk, 2010). This ruling is reinforced by the doctrine of discovery (Echo-Hawk, 2010). Echo-Hawk, (2010) provides a simple and straightforward description of the Doctrine of Discovery and the weight it holds in court, which states that under this doctrine, European explorers may claim title to Native land "discovered in the name of the

Monarch who sponsored their journey—a title recognized by all of Europe" (Echo-Hawk, 2010, p. 18). The use of the Doctrine of Discovery from then Chief Justice John Marshall used this doctrine to justify the taking of Native land by stating "this title was variously described by the court as the "fee," "absolute title," or the "absolute ultimate title," and the Indian right was described as a "right of occupancy" or "right of possession," which could by extinguished by the government through purchase or conquest" (Echo-Hawk, 2010, p. 73). The use of the Doctrine of Discovery is one major tool that the United States and court systems have used to take Native land and justify the action.

As we look at court cases that impacted and influenced Native people in the United States regarding land, the *Lone Wolf v. Hitchcock* case is crucial to explaining the relationship between Native American people and the United States Government. One major result that came from the ruling of *Lone Wolf v. Hitchcock* was that Congress no longer needed Native consent to sell reservation land to homesteaders (Echo-Hawk, 2010). The outcome of this ruling came after many coercion efforts surfaced to justify the taking of Native land to sell to homesteaders coming into the region. This attack on Native people's rights to their land started on October 21, 1867, when seven diplomats calling themselves the Indian Peace Commission came to treat with the Cheyenne, Comanche, Kiowa, Arapaho, and Apache nations to discussion treaties that would outline the land that would be promised to them by the United States (Echo-Hawk, 2010). The seven Indian Peace Commissioners would consist of Senators, Military Generals, and the Commissioner of Indian Affairs (Echo-Hawk, 2010). Echo-Hawk (2010) provides a description of the outlines and reasoning behind the Medicine Lodge Treaty that was signed on this day by the United States and Tribes present:

> Senator Henderson Persisted, urging that the reservation would be for the Indians' own good, and he offered the Tribes buffalo-hunting rights in the ceded area so they could continue the chase and ways of their fathers while the great herd lasted. He proposed to make their home on the Red River around the Wichita mountains of their ancestral homeland, which would provide a spot to bury their dead and to farm for those who wished to do so. Based on these promises, the chiefs related at land and reluctantly touched the pen to the treat on Sunday, October 21, with the addition of an off reservation hunting clause, ceding sixty thousand square miles of tribal land to the United States in exchange for the reservation homeland, hunting rights and the other amenities promised by the United States. (p. 173)

Although this treaty was signed and agreed to by all parties, this promise would not last long. Native people adapting to reservation life would prove to be difficult and resulted in hardships. These hardships in conjunction with the Buffalo War of 1874-1875, which led to the disarming and relocation of tribal leaders resulting from conflicts and assimilations efforts to ban all ceremonial practices performed by Native people (Echo-Hawk, 2010).

Legal action continued. In 1889, the Jerome Commission allowed for the settlement of white settlers in Indian Territory, which sparked concern for Lone Wolf who was chief at this time (Echo-Hawk, 2010). The Jerome Commission was created to negotiate with Native American Tribes to gain land for the United States (Echo-Hawk, 2010). Negotiations between the Jerome Commission and Tribes resulted in nine Tribes agreeing to ceded from land prior to the *Lone Wolf v. Hitchcock* case (Echo-Hawk, 2010). The Jerome Commission negotiations might have been successful, but this success was acquired using coercion, intimidation, and bribery (Echo-Hawk, 2010). The previous negotiation practices performed by the Jerome Commission would be the same in this case. For the Jerome Commission to acquire this land, 3/4th of the adult male population had to agree and sign their signature for land to be relinquished to the commission (Echo-

Hawk, 2010). The Jerome Commission found opposition from tribal members who were against ceding their land. To ensure that the Jerome Commission obtained the signatures required, Native people were lied to and told that they would receive more money in exchange for their signature (Echo-Hawk, 2010). Additionally, Native people were ordered to sign these documents and interpreters for the Jerome Commission would sign for those who refused (Echo-Hawk, 2010). It was also reported that the names were added to the list of signatures required to meet that 3/4th of the adult male population mark; however, despite the efforts made by the Jerome Commission, they would not achieve the number of signatures required to obtain this land (Echo-Hawk, 2010). Native people opposed this bill strongly with Lone Wolf and tribal delegates traveling to Washington D.C. to lobby against the bill; however, this did not stop Congress from passing this bill in 1900 (Echo-Hawk, 2010). To halt this bill from becoming law, Lone Wolf and Native people turned to the courts and relied upon the Treaty of Medicine Lodge to stop this law from be enacted. Native people hired William M. Springer to represent them in Court (Echo-Hawk, 2010). Springer's interesting background included the creation of the Jerome Committee and time in Congress, which he used to work towards taking land from Native people (Echo-Hawk, 2010).

Going into this court case, Lone Wolf and his followers and supporters were optimistic that the case would be in their favor due to the power of the Medicine Lodge Treaty. Ultimately, this was not the case. The courts concluded that Congress had plenary authority over Tribes, which allowed for Congress to make decision for Tribes (Echo-Hawk, 2010). Echo-Hawk (2010) provides an overview of the decision by stating "The Lone Wolf Court held that Congress has '[p]lenary authority over the tribal relations in

the United States' and that political power 'is not subject to be controlled by the judicial department'" (Echo-Hawk, 2010, p. 176). Furthermore, Congress would exercise this plenary power in "good faith," which concluded that Congress can lawfully handle Native land as it sees fit (Echo-Hawk, 2010). Echo-Hawk (2010, p. 177) gives a great overview of the issue of working with Tribes in "good faith" by stating:

> The decision thus placed American Indians outside of the rule of law in their relations with the federal government, leaving them protected only by a thin hope that the government would act in "perfect good faith" (Echo-Hawk, 2010, p. 177). Echo-Hawk continues to explain the outcome of this case by stating "We must presume that Congress acted in perfect faith in the dealing with the Indians [and] that the legislative branch made its best judgement in the premises. In any event, as Congress possessed full power in the matter, the judiciary cannot question or inquire into the motives which promoted the enactment of this legislation. Without judicial review, no meaningful remedy could be hoped for by the Indians.

Echo-Hawks explanation and summary of this infamous court case can be summed up perfectly by stating, "Justice White allowed the fox to guard the henhouse – if Indians are injured by Congress, they must ask that same body for relief" (Echo-Hawk, 2010, p. 177).

The journey through *Lone Wolf v. Hitchcock* portrays how federal Indian law has viewed Native sovereignty and the consequences to Native people in the United States. The outcome of this court case shows how government officials used the legal system to take Native land, and how the court systems justified the seizure of Native land. Precedent is the foundation of all law, including federal Indian Law. By authorizing Congress to use its plenary power to define "good faith" Congress to do whatever they want with the land.

The final case reviewed here, *Cherokee Nation v. Georgia,* is notable for federal Indian law because of the actions taken by the state of Georgia to remove the

Cherokee people. Echo-Hawk in providing background to this court case stated “as you will see, this case involves an especially egregious set of facts: ethnic cleaning in the antebellum south via the machinery of the south (Echo-Hawk, 2010, p. 88). With court rulings such as *Johnson v. M’Intosh* which was discussed earlier, the taking of Native land was viewed as justified by settlers claiming that Native people do not utilize the land property by practicing agriculture (Echo-Hawk, 2010). The ruling of *Johnson v. M’Intosh* and Morton’s research were primary contributors of removal of the Cherokee people. Between the years 1820-1851, Dr. Samuel G. Morton began studying the skulls size and races in the United States to determine if the white race was superior to other races (Echo-Hawk, 2010). What Dr. Morton concluded is a hierarchy of races, with the white race being on the top, and Native people being placed extremely low on the hierarchy, and African Americans not making it on the scale (Echo-Hawk, 2010). This study was used to justify that Native people were inferior and justified that Georgia needed to rid the state of Native people and that the land be given to settlers (Echo-Hawk, 2010). Additionally, the state of Georgia actively broke treaties signed by the state and the Cherokee people. The Treaty of Hopewell was first signed by the Cherokee people and the United States back in 1785 with the goal “to make peace with the Cherokee Nation and to reserve land for it in the Northern Georgia forever” (Echo-Hawk, 2010, p. 92). This treaty was broken by the compact of 1802, which aimed to “extinguish all Indian land title in Georgia in exchange for the cession of land in Western Georgia, as soon as Cherokee title could be peaceably obtained, and on reasonable terms” (Echo-Hawk, 2010, p. 93). Although the Cherokee Nation refused to cede any land to Georgia, federal

authorities claimed that the ruling of *Johnson v. M'Intosh* already make Cherokee Nation land the state of Georgia's through this ruling (Echo-Hawk, 2010).

Attacks on the Cherokee Nation to take away tribal sovereignty and land did not stop here. The 1820s saw a barrage of polices to minimize the rights of the Cherokee Nation. Attacks to obtain Cherokee land included extinguishing land titles by stating that Native land is permissive and temporary under American law and that the state of Georgia had the power to exercise their sovereignty to take Cherokee lands (Echo-Hawk, 2010), Additionally, the state of Georgia prevented Native people from access the American court systems by decreeing that " no Indian and no descendant of an Indian, not understanding the English language, shall be deemed an competent witness in any court of justice created by the constitution or law of this State" (Echo-Hawk, 2010, p. 95). This law also included that all Cherokee laws void by the state (Echo-Hawk, 2010).

President Andrew Jackson's Indian Removal Act of 1830 had detrimental outcomes for the Cherokee and Native people. The Indian Removal Act's purpose in this instance was to ensure that Native people vacated their land and if not, federal protection and abandonment to state jurisdiction (Echo-Hawk, 2010). Georgia leaders went to great lengths to eliminate tribal sovereignty, land titles, and the gathering of Native people. Georgia issued a law that made any gathering of tribal official's illegal. If a gathering of tribal leaders or warriors took place this would result in "imprisonment at hard labor for four years" (Echo-Hawk, 2010, p. 97). What followed the Indian Removal Act was a lottery system set up by the state to grant white settlers Cherokee land (Echo-Hawk, 2010). In addition to the lottery system for Cherokee land, the state of Georgia also confiscated all Cherokee gold and silver mines by military force if needed (Echo-Hawk,

2010). Prior to the *Cherokee v. Georgia* court case, the *Georgia v. Tassel* was the foundation case that challenged the state by arguing that the actions being done by the state violated the Treaty of Hopewell, which attacked Cherokee sovereignty (Echo-Hawk, 2010). Although treaties were regarded at supreme law of the land by the United States, this did not stop Georgia in denying that the Cherokee people did not hold any political or property rights (Echo-Hawk, 2010). Georgia in this case stated that "Indian Tribes are inferior, dependent, and in a state of pupilage to the whites" And second, that the treaty is void because the general government had no right to treat with Indians within the Limits of the States" (Echo-Hawk, 2010, p. 99). This case used the previously covered Case, *Johnson v. M'Intosh*, to state that Native Tribes right and lands were void due to the doctrine of discovery (Echo-Hawk, 2010). Although the ruling of *Georgia v. Tassel* did not favor the Cherokee people, this case did allow Chief Justice Marshall to appeal the case and allow the *Cherokee v. Georgia* case to enter the Supreme Court.

The beginning of the *Cherokee v. Georgia* case began with the Cherokee asserting that Georgia did not have the authority or power to seize their land. The Cherokee nation also challenged the Doctrine of Discovery and the claim that this Doctrine gives Georgia the power to take their land. The Cherokee nation added that treaties were the supreme law of the land and that the laws Georgia was imposing interfered with these treaties (Echo-Hawk, 2010). The lawsuit declared that the United States failed to protect the Cherokee nation from the unconstitutional acts that the State of Georgia imposed over the Cherokee Nation. Furthermore, the lawsuit aimed to declare the laws made by Georgia nullified and void to halt the seizure of Cherokee land and mines (Echo-Hawk, 2010). The conclusion of this case favored Georgia and was

dismissed due to the court system not acknowledging the Cherokee nations sovereignty and jurisdiction to sue the state of Georgia. The courts in this case concluded that "an Indian Tribe or nation within the United States is not a foreign state in the sense of the constitution and cannot maintain an action in the courts of the United States" (Echo-Hawk, 2010, p. 105). By allowing this case to be dismissed, this paved the way and allowed Georgia to take and remove the Cherokee people from their traditional land. The creation of policies, science, and unlawful justification were the driving factors on how the Cherokee people lost the title of their land and mines. Boarding southern states such as Alabama followed the actions of Georgia and began removal and relocation of Native people from the South (Echo-Hawk, 2010).

Although the ruling of this case favored Georgia in justifying the seizure of Native land, the ruling of a similar court case, *Worcester v. Georgia*, caught the eye of Chief Justice Marshall. Chief Justice Marshall during this time took a different approach from his previous stance of attacking Native American Sovereignty like he did in the *Johnson v. M'Intosh* case prior. Chief Justice Marshall began striking down the cruel Indian laws that Georgia imposed on the Cherokee and all Native people (Echo-Hawk, 2010). While striking down these laws, Chief Justice Marshall ruled that,

> Georgia had no right to tread on the sovereignty of the Cherokee Nation or take its land. Abandoning derogatory racial stereotypes, the majority simply described American Indians as "A distinct people, divided into separate nations, independent of each other and of the rest of the world, having institutions of their own, and governing themselves by their own laws." (Echo-Hawk, 2010, p. 108)

This ruling came too late, and the removal of the Cherokee people was in effect and the ruling was ignored by the state of Georgia (Echo-Hawk, 2010). President Andrew Jackson also weighed in on the ruling of Chief Justice Marshal by stating, "John

Marshall has made his decision, now let him enforce it" (Echo-Hawk, 2010, p. 110). In the end, the Cherokee people and Native people in the south were removed and relocated in the thousands hundred miles away to different states. The removal of Native people at this time is known to many as the Trail of Tears.

The ruling of these three court cases summarizes successful efforts to take and justify the seizure of Native American land in the United States. The justification through the federal court system legitimizes the United States ownership of Native American land. Through the removal of Native title through the federal court system, Native American Tribes today have faced challenges in protecting cultural artifacts and cultural natural resources in traditional homelands.

Cultural artifacts for Tribes in the United States are quite diverse due to the geographical regions, climates, and landscapes found in the United States. Furthermore, 574 Tribes reside in the United States; this number also includes Alaska Tribes that are federally recognized by the federal government as sovereign nations. Due to the large number of Tribes and diverse landscapes cultural artifacts and culturally important natural resources vary widely depending on location. For instance, in California, Bean (1992) explains that California Native people are diverse culturally and in landscape. Bean (1992) continues by stating that California contained over one hundred different cultures of Native people with different traditions, history, religions, and knowledge about specific landscapes. Due to the cultural diversity, cultural artifacts for each Tribe will vary depending on each Tribe.

For instance, cultural artifacts used by the Mountain Maidu people of northeastern California include tools such as bedrock mortars and portable mortars to

grind acorns and other objects. Kurtz (1963) through speaking with Mountain Maidu elders convey those large bedrocks were used next to villages to grind nuts and seeds. Furthermore, Kurtz (1963) also discusses that two pumice stones were used as tools to straighten arrows. For culturally important natural resources, Kurtz (1963) goes on and further discuss plant materials use for both basket-making and ceremonial purpose such as maple and willow. This example given for the northeastern Mountain Maidu showcases the types of tools and artifacts that are found within a landscape. Artifacts and natural resources provide a Tribe with history and the continuation of customs, traditions, and ceremonies.

For Tribes, the inclusion of protecting sacred sites and gravesites is in the forefront in ensuring that tribal history and identity is preserved and intact for future generations. Additionally, the preservation and protecting of land is crucial for tribal cultures that are rooted in the natural world (Suagee, 1998). By delving deeper into the reason why protecting sacred sites is so crucial for Tribes, Brody (2017) explains that once a sacred site has been changed either by alterations or destruction the site loses it religious or cultural significance. This protection is enforced by the National Historic Preservation Act (NHPA). This act allows Native American Tribes to register their sacred sites under the NHPA to provide protection from destruction and harm, which is one of the few options that Tribes currently possess to protect sacred sites (Marincic, 2018). The history of protection for Native American cultural sites began with the creation of the Antiquities Act of 1906; however, the one goal of this act was to protect and stop the vandalism of Native American artifacts in the American Southwest (Marincic, 2018). Additionally, this Act's primary purpose was to designate monuments in the America,

such as Devil's Tower in Wyoming and Mount Olympus in Washington (Marincic, 2018). The NHPA does provide Tribes a tool to increase the protection power of sacred sites; however, the NHPA does have its drawback and in instances does not provide the protection Tribes seek. The criteria that Tribes must meet to register their sacred sites through the NHPA includes

> Lands that must be associated with significant events, people, or architecture, or the land must have the potential to yield information relating to prehistoric or history. This includes property that is of traditional religious and cultural importance to Native Nations. (Marincic, 2018)

Looking back to 2016, the Standing Rock Sioux Tribe engaged in a legal battle with the Energy Transfer Partners over the creation of the Dakota Access Pipeline (DAPL). The Standing Rock Sioux Tribe contested that the pipeline would destroy ancient burial sites and potentially poison the only source of drinking water (Marincic, 2018). After a long battle with permitting issues for the pipeline and presidential memorandum, the pipeline was ruled in 2017 by a federal district judge that the Environmental Impact Study was inadequate (Marincic, 2018). In this instance the Environmental Impact Study held more power in halting the pipeline progress than the NHPA, which was "useless in protecting its cultural sites from significant damage" (Marincic, 2018, p. 1780). As seen with the Standing Rock example, the NHPA does have drawbacks when it comes to the level of protections for Tribes. Unfortunately, the concerns that Tribes have with the NHPA continues.

As stated in the beginning of this section, mistrust and conflict between Native American Tribes and the United States is an ongoing conflict between each other. For Tribes to obtain full protection from the NHPA, Tribes must disclose the location of

sacred sites, which puts Tribes in a vulnerable situation by disclosing sensitive information to a third party or the public (Marincic, 2018). Furthermore, by requiring that Tribes disclose the areas of sacred sites within traditional homelands this allows the United States the knowledge of these areas that are cultural important to Tribes cultural and religion (Marincic, 2018). A cultural and religion that the United States aimed to erase through efforts of assimilation, such as Indian boarding schools, the outlawing of Native American practices, and ceremonies (Marincic, 2018). Mistrust for the United States is a feeling that will not be forgiven or forgot by Tribes. While reading deeper into the NHPA, there are amendments that are in place to bring Tribes into consultation when projects occur in areas of traditional homelands.

In 1992 the NHPA was amended by Congress to enhance the protection of the NHPA, which included that federal agency consult with Tribes regarding land that is culturally significant or religiously significant (Marincic, 2018). This consolation is better known as Section 106 within the NHPA. It requires federal agencies to consider impacts created by the implementation of a new project on federal lands (Marincic, 2018); for agencies beginning the process of tribal consultation, the point of contact for Tribes starts with the Tribal Historical Preservation Office (Marincic 2018).

The goal for the Tribal Historical Preservation Office is to preserve the Tribes historical properties and the cultural traditions of the Tribe. The creation of the NHPA has come a long way in terms of protecting sacred sites for Native American Tribes. Initially the acts that protected the historical sites did not include Native American's people, but their sacred sites through the Preservation Act (Marincic, 2018). It was until way later in the 1990s until Congress began taking into consideration Native American

sites for protection (Marincic, 2018). The National Park Service (NPS) began to research on how to better work with Tribes in protection their cultural sites; the outcome of this research was Bulletin 38 (Marincic, 2018). The purpose of Bulletin 38 was to guide Congress with guidance on preservation methods for Native American sites (Marincic, 2018). The guidance of Bulletin 38 was incorporated into the NHPA in 1992 and has required federal agencies to mitigate harm from projects through tribal consultation (Marincic, 2018). The NHPA on paper strives to protect Native American sacred and cultural sites through Section 106's tribal consultation; however, as mentioned earlier through the example from the Dakota Access Pipeline, the NHPA does not fully protect Native American Sacred Sites. Furthermore, Section 106 is in place for Tribes to enter consultation with the agencies performing work on federal lands, but the level of consultation can vary and in instances agencies will underutilize, minimize, and eliminate consultation with Tribes (Marincic, 2018). For agencies acting and performing work, the head of the agencies must also review the federal register to inquire if any sites are listed in the project area for Tribes to be contacted for consultation (Marincic, 2018). Agencies begin communications to consult with Tribes that fall under section 106, but Tribes only have 30 days to response and if a Tribe does not respond to the agencies within 30 days, an agency may proceed with the project (Marincic, 2018). If Tribes do respond to the agency's communication for tribal consolation after the 30-day deadline the Tribes can still work with the agencies, but it comes at the cost: agencies are not required to reconsider findings after they have been made by the agencies (Marincic, 2018).

While the NHPA allows some level of protection and the mitigation of possible destruction of a site through tribal consultation, the outcome of a project still

falls in the hand of the federal agencies. Through Section 106, Tribes now can participate in tribal Consultation, but this does not grant full control over a project because ultimately the decision will be made by the federal agency (Marincic, 2018). Marincic (2018) describes two concerning passages used in the NHPA, the first being, "If no traditional and culturally significant properties are found, Tribes lose their right to demand agency action over the project" (Marincic, 2018 p. 149). The second passage that is concerning is reminiscent of the court case covered earlier in this paper is,

> Under the Preservation Act, federal agencies must make "a reasonable and good faith effort to identify historical properties." The Preservation Act provides that a reasonable and good faith effort could include research, consultation, historical interviews, and a field survey. (Marincic, 2018 p. 148)

These passages are concerning in that federal Indian law has been used to justify Congressional determination of "good faith," which had diverging outcomes for different stakeholder groups. Also, Congress and the United States did not understand Native American cultures. This is apparent through assimilation attempts on Native American heritage by stating, "If no traditional and cultural significant properties are found, Tribes lose their right to demand agency action over the project" (Marincic, 2018, p. 149). This continues to attack Native people and their right to project their sacred sites and religious sites because it does not consider the culturally sensitivity that Tribes require.

Instances of cultural insensitivity occurred between the Forest Service and the Havasupai over their traditional homelands consisting of the Grand Canyon region. In 1984, the Forest Service considered approving a uranium mine near the Havasu Canyon, which would run through sites and areas sacred to the Havasupai (Plaut, 2009). For the Havasupai people, speaking of their religion to anyone uninvited by the Havasupai

people would be sacrilegious and would cause calamity to the Tribe if outside people knew or visited these areas (Plaut 2009). The proposed area of this mine would run through and destroy an area that would, “destroy the continuum of life which is dispensable and central to the Havasupai religion” (Plaut, 2009 p. 138). Due to the conflict of the Havasupai’s religion of speaking of these places to non-Tribal people, the Havasupai’s response to this mine was delayed and the mine was approved by the Forest Services (Plaut, 2009). Action was taken from the Havasupai people and a federal court case was opened (Plaut, 2009). The outcome of this case unfortunately concluded that the Tribes were not forthcoming with the information when contacted, which resulted in the mine destroying cultural and religious sites for the Havasupai (Plaut, 2009).

The information and history covered in this section is the foundation in showing how Native American people lost title and right to their traditional homelands through federal law. The outcomes of these court cases are crucial in justifying that the taking of Native people land was right and needed to happen to ensure that Manifest Destiny would continue through the United States. Skipping forward into the 20th century and the present, Native people can protect their cultural and religious sites at a greater level than the previous generation. For Native people in the United States, cultural artifacts, religious sites, and sacred sites vary due to the diverse languages, ceremonies, landscapes, artifacts and much more that are found and used by each Tribe. Although the NHPA and the implementation of Section 106 has allowed for Tribes better protection for their sites, there are still improvements and amendments that can further be implemented to protect Tribes resources and consider the cultural sensitivity that must be acknowledged to move forward for both Tribes and federal agencies.

Tribal Background and GIS Implementation

Throughout the 50 states, you can find 574 federally recognized Tribes. In California, this state houses the most federally recognized Tribes at one hundred and ten. This number does not account for Tribes that possess state recognition or petitioning for federal recognition. One might ask, what does federal recognition have to do with Tribes? The importance of being a federally recognized Tribe is that this status confers sovereignty. Tribal sovereignty allows a Tribe to govern itself, which permits Tribes to work on a government-to-government relationship with government entities, such as the Department of Fish and Wildlife, the United States Forest Services, and other Land Management agencies. Additionally, tribal sovereignty allows for Tribes to better protect cultural sites, artifacts, and resources.

An article done by Liddell et al. (2021) looked at the historical and contemporary environmental injustice that has been done to Tribes in the United States. Liddell et al. (2021) stated that the lack of sovereignty for Tribes that did not possess federal recognition lacked the ability to exercise sovereignty of their traditional land. Lack of sovereignty for Tribes also hindered the ability for Tribes to participate and apply restoration, protection, and preservation over their traditional homelands (Liddell et al., 2021). Sovereignty is crucial for Tribes to protect cultural resources, cultural artifacts, and sacred sites.

Throughout the history of the United States, sacred sites have been destroyed or desecrated. These desecrations come in the form of development, exploitation of resources, or intentional acts (Garrett, 2009). In addition to sacred sites, cultural artifacts

have also been destroyed either on purpose, accident and stolen or exploited by non-Native people (Marincic, 2018). Furthermore, pollution is another factor that taints the natural resources that Native people use for ceremony purposes, sustenance, and cultural practices, such as basket making.

Examples of these attacks on Native resources include the impacts that the Shasta Dam in Northern California is having on the Winnemem Wintu. Since the creation of Shasta Dam in 1938, the impacts to the Tribes cultural sites are significant. According to Garrett (2009), the Winnemem Wintu have lost much of their land due to the construction of Shasta Dam. Even in 2004 when this article was published, the Tribe had seventeen cultural sites being threatened by the raising water levels. This in addition to the Tribe not possessing federal recognition presents many challenges for the Winnemen Wintu (Garrett, 2009). The impacts to Native American resources and cultural sites do not stop at developments. Pesticides and pollutions are another means that impact natural resources that Native American people use for ceremonies and basketmaking. Specifically, to California Native people, an organization called the California Indian Basketweavers' Association was formed to help monitor, educate, and dissuade the use of pesticides to protect the health of basketweavers.

By protecting cultural artifacts, resources, and sacred sites, Tribes can maintain their cultural identity. Native American people are tied to their landscapes and in turn, these ties are what preserve Native American identities (Garrett, 2009). Currently, Tribes can protect and maintain cultural resources, artifacts, and sacred sites through their sovereignty, but are options such as GIS available to better protect these areas? Modern computer software has advanced significantly throughout the decades and platforms such

as GIS have been implemented to solve complex problems in fields such as medical, land management, fire, police, and more recently in tribal communities. GIS allows for users, such as, tribal communities to record and map sites of importance. The capabilities of GIS provide Tribes the opportunity to preserve cultural sites and artifacts by mapping sites of significance, but the use of GIS in tribal knowledge does have its limitations.

Additionally, language surrounding this field and literature use the word indigenous to cover a broad range of populations, including Native American Tribes of the United States. This begs the question, how does GIS technology best compliment efforts to protect Tribes' cultural artifacts, resources, sacred sites, and heritage? Raising the question if GIS could provide Tribes with a platform to better protect resources is crucial in protecting cultural heritage for future generations. Although GIS may provide Tribes with a useful platform, there is also a drawback in how tribal knowledge is able to integrate in a Western style of data management.

Geographical Information Systems: History

The concept of GIS has been applied to a variety of fields throughout the years and has provided experts and managers with solutions to become successful. Walford, (2020) describes one of the first applications of GIS occurred September 1854 in Soho London. John Snow, an epidemiologist and physician applied one of the first known applications of GIS to identify the spread of cholera. Snow investigated the locations of drinking water pumps and their relationships with individuals who contracted Cholera. It was believed that Cholera was contracted by inhaling "putrid air," but Snow believed the cause stemmed from drinking water. The GIS framework that Snow applied

encompassed a hand drawn a map of the area of interest, while also including the number of individuals who contracted cholera for each household (Walford, 2020). By studying the relationship between the locations of water pumps and individuals who contracted cholera, Snow was able to conclude that the water pumps were the cause of the spread of Cholera in London (Walford, 2020).

The GIS applications conducted by Snow showcased the potential that GIS can have when analyzing pandemics and epidemics. Although the methods that Snow used involved hand drawn methods and interviews, GIS technology and software has advanced significantly since Snow's study in London. Fast forward to the 1950s and 1960s, many of the components that encompass GIS are changing. Goodchild, (2018) provides a great overview of major changes and advancements in the field of GIS. In the years during and following the 1950s, the field of GIS began its journey as a discipline at this time. Computing capabilities during the 1950s and 1970s had come a long way over the years, but access to mass storage, network speed, advanced analysis to data and punch cards being the primary record to input GIS instructions to name a few. Goodchild, (2018) puts the advancement of computing technology into prospective by stating that the laptops and smartphones of today compared to the IBM 360 of the 1960s are much more powerful (Goodchild, 2018). As we move further down the GIS timeline to the 1990s, GIS advancements continue to grow. At this point in time and moving on into the future to the present day, GIS is becoming more accessible to a wide range of users. Additionally, free open sources of GIS software are becoming more available. Neteler et al. (2012) describes that during this time a market is forming for GIS applications in the fields of business, academia, and public administration. Looking at the present day,

modern software and technology has allowed GIS to perform complex analysis, create databases that can hold mass amounts of data, and provide users with a variety of paid and free GIS software to help business and individuals perform analysis to enhance decision making abilities. Platforms offered by Geospatial Software & Saas Company (ESRI), Quantum GIS (QGIS), Grass GIS, and Arches Project are just several GIS platforms that provide users with either an open-sourced GIS platform or a subscription-based GIS platform that offers additional training.

As stated previously in this paper, the GIS platform has been applied to enhance the work and decision-making capabilities for public administrators and managers. Looking back and comparing the methods used by John Snow in 1854, GIS has come a long way since then. The GIS capabilities of today can portray the real-world using lines, points, and polygons that can store additional data regarding these real-world representations in a readable attribute table. Data that use points, lines, and polygons are categorized as Vector layers. The Walford, (2020) study that focused on John Snows study in 1854 recreated the historical map made by Snow using a modern GIS software. In this recreation, Walford, (2020) created the same map that Snow used by using lines to represent the street, polygons to represent the building, red dots to show the number of deaths caused by cholera, and a specialized icon to represent the locations of the pumps that were used for drinking water (Walford, 2020). GIS also allows users to import data from outside sources. Census data, which included address during the time of the John Snow study, was imported for the study (Walford, 2020).

The use of line, polygons, and points is just one way that GIS platforms represent world features. Raster datasets are an additional way to represent data in grid

like systems, where each grid holds a set amount of data. Pixel size is another factor that influences the amount of data that represents the real-world attributes being represented in the GIS software. This overview of the characteristics of Raster datasets is reinforced by an article by Hassouna and Asal, which states:

> In its simplest form, a Raster consists of a matrix of square cells organized into rows and columns (or a grid), which each cell contains a value representing information. The cell size determines how coarse or fine the patterns or features in the raster will appear. Raster's may be digital photographs, imagery from satellites, digital pictures, or even scanned maps. Raster files are also well suited for representing surface data that changes continuously, as they provide a regularly spaced representation of such data. (2016, p. 152)

Application of GIS Raster's according to Hassouna and Asal (2016) include the amount of rainfall that covers a specific region, wind speed for a region, and atmospheric pollution. These applications are just some of the applications that can be formatted in a Raster dataset. GIS users that work with vector and Raster datasets can run a wide range of tools provided by the GIS platform to guide managers and public administrators in making decisions. Additionally, GIS users can manipulate data to reach a certain outcome. GIS is a complex system that has grown from a simple framework that we have observed through the work of John Snow, and it has and will continue to grow in the years to come. As the platform grows and new GIS users are introduced to the system, this allows for a wide range of diverse users who have taken the tools of GIS and incorporated the software to meet their needs.

Geographical Information Systems: Applications

As stated earlier in the paper, GIS is a field that is ever growing. Fields such as the medical field are continuously looking at how to combat pandemics with the tools

that GIS offers. Even today, GIS has been utilized to better understand the spread of SARS-CoV-2 Virus, more commonly known as COVID-19. The virus emerged towards the end of 2019. This virus has spread across the globe and has been categorized as a pandemic. Due to the severity of the COVID-19 pandemic, GIS has been utilized to identify causes and active spread of the virus. Data obtained by the John Hopkins University Center for System Science and Engineering (JHU CSSE) can visualize and analyze the spread of COVID-19. Additionally, details on the virus total number of cases, mortalities and recovery cases can be mapped and tracked over time (Mollalo et al., 2020). Additional data including census data, socioeconomic, and economic status of the populations can be imported to better understand if relationships are present (Mollalo et al., 2020). GIS is a tool that is versatile in many professional fields. The GIS software possess a mass number of tools that can perform analysis to better sold the problems of managers and public administrators. Land managers in addition to medical professionals apply the GIS platform to better manage the extensive land they oversee.

GIS in the field of land management and natural resource management is a powerful tool that ensures that valuable resources such as water for instance is conserved, clean, and available for all. GIS software provides users a plethora of tools that analyze data to provide users with the solutions to complex problems land managers face today. For instance, Shakak (2015) performed a suitability analysis to identify locations where well sites can be established that meet good water quality and availability of water. Reasons for concerns in this study include that a large portion of the water in Sudan is reserved for drinking water, while another portion is set aside for agricultural purposes (Shakak, 2015). According to Shakak (2015), main factors that contribute to ground

water pollution comes from disposal of human sewage in the study area and the concentration of high levels of chloride and fluoride. High levels of chloride and fluoride result in harm in both human consumption and the rejection of water in agriculture applications. Water conservation is one of the many fields that GIS users' study to better protect and conserve for human consumption and agricultural operations.

In addition to applying GIS to water conservation, climate change impacts, such as wildfires have applied GIS methods to help mitigate wildfire impacts. In recent years the topic of wildfires and the impacts they bring to both forests and the public is concerning. According to Gitas et al. (2014), GIS has become a common tool in wildfire mitigation and monitoring. Additionally, special groups such as the European Association of Remote Sensing Laboratories Special Interest Group on forest fires actively promote the integration of GIS to daily operations for wildfire mitigation (Gitas et al., 2014). This article by Gitas et al. (2014) includes wildfire focused workshops are being incorporated to address on the local, regional, national, and global applications of GIS to help mitigate the complex challenges of responding to wildfires. At the beginning of the literature review, GIS is and has been used in the medical field to assist and mitigate the spread of deadly virus. Land managers in both the realm of water conservation and wildfires response are using GIS to identify areas of critical attention, while also using this platform to solve the challenges that arise in land managers daily operations. As GIS continues to grow, the user base and higher educational opportunities exposes the population to GIS. One such group that has been utilizing the power of GIS are tribal entities in their efforts to preserve cultural artifacts, sacred sites, and culturally important natural resources.

Since the 1960s, mapping indigenous land though GIS is growing and has not been isolated to Tribes in the United States, but by indigenous people throughout the world. According to Chapin et al., (2005), mapping indigenous lands has been performed in both Canada and Alaska. Furthermore, Chapin et al., (2005) state in their article that the reasoning and purpose for mapping indigenous land is to provide protection for cultural sites, historical hunting and gathering sites, and justifying traditional homeland. Most of the work done in Canada and Alaska mapped locations of hunting, fishing, gathering, and trapping locations (Chapin et al., 2005). Another project by Aporta, (2003), mapped 3,225 hunting and fishing locations recorded by GIS professionals who were guided by community members. This project took the place names of the Inuit people of Igloolik, in the eastern Canadian Arctic and incorporated the names of hunting locations (Aporta, 2003). Names of these locations were obtained through interviewing elders in the community. The maps produced for this project considered seasonal changes. Maps were produced for younger hunters to use while hunting. The concluding remarks made in this project stress that projects such as these do not need complex analysis or visualizations, but that GIS projects that map indigenous landscapes can be simple in design and still offer great information (Aporta, 2003).

The current GIS platform offers users an expansive array of tools to perform complex and simple analysis and calculations in the span of several minutes to several hours. Because of this complexity, higher education institutions offer courses to teach users how to operate the GIS platform and the wide range of tools offered. Since the growth of indigenous mapping, conferences such as the International Forum on Local Cultural expression and communication, the international forum of Indigenous Mapping,

and the Intertribal GIS indigenous Mapping Conference are geared for users working these fields and projects (Aporta, 2003). Additional providers of GIS software such as ESRI provide resources and training for users looking to map indigenous lands (Aporta, 2003). The access to indigenous mapping conferences, training, and work in higher education is extremely important because it allows indigenous people to be exposed to a complex system like GIS to better serve their community, maintain cultural identities, and cultural preservation.

Although GIS consists of part of the major components of mapping indigenous landscapes, the acquiring and possession of indigenous knowledge is the other half of the project. Research into participatory GIS is quite extensive and has been exercised in many fields including indigenous mapping. Elders within tribal/indigenous communities are major sources for the mapping process. As mentioned earlier in the indigenous mapping of the Inuit people of Igloolik, Elders were interviewed for the place names for hunting locations in their homelands. Another study done in Lassen and Plumas County in California mapped Maidu allotments land to better protect Maidu cultural resources, while at the same time asserting the participation of Maidu environmental stewardship in their traditional homelands (Middleton, 2010). While mapping Maidu allotments in Lassen and Plumas County, the researcher obtained data from both community members within the Maidu community, while also accessing historical records of Maidu people who were awarded lands by the Dawes Act of 1887 (Middleton, 2010). These studies obtained traditional data through two means, the first being by interviewing elders knowledgeable in culture, the second came through historical records. The act of using GIS to map indigenous lands provides

tribal/indigenous people with the tools to protect cultural artifacts and significant cultural natural resources.

However, with any research or projects being conducted, there will be limitations that occur and must be mitigated. By delving into the history of GIS, a better understanding can be made on and how GIS was first implemented to solve problems found in the world. This history also shows how far GIS has come as a tool for managers to solve complex problems; however, for this project, understanding GIS's origins may shine light on how it can be applied to Native American cultural resources and sacred site management.

Integrating GIS with Tribal Knowledge

Technology throughout the years has altered our lives socially, economically, and the way we manage and map natural and cultural resources. Technology such GIS and Global Position System (GPS) are a few of the top software tools that are being utilized to manage both private and public organizations. The flexibility of GIS in analyzing and portraying spatial data to a wide audience has made this platform useful to many fields. GIS is currently being used in the fields of military operations, environmental protection, and conservation of nature (Harvey et al., 2005). The utility of GIS has also been useful for Native American Tribes in the United States and First Nations communities in Canada. The action of recording and mapping indigenous lands is a process that has recently taken hold since the 1960s in Canada and Alaska (Chapin et al., 2005). The goal behind mapping indigenous land, is to protect cultural sites, hunting and gathering locations, and to justify traditional homeland (Chapin et al., 2005).

Despite the use of GIS to protect cultural and natural resources, confidentiality and historical relations between the federal government and Tribes plays a large part in why Tribes do not disclose their data (Amberson, 2017). Federal laws such as the Freedom of Information Act is what creates hesitation for Tribes to share data with public land agencies (Amberson, 2017). Although the use of GIS allows for Tribes to protect cultural sites, it can also put Tribes at risk when working with other government agencies in land management decisions.

History and Current Work in Indigenous GIS

Although indigenous mapping had been introduced in the 1960s by First Nations people of Canada, data, and the practice of mapping indigenous land is quite limited (Chapin et al., 2005). Lack of knowledge and practice of mapping indigenous homeland and cultural sites is problematic because this hinders a Tribe's authority to preserve and protect cultural sites from development and policy change.

Although the number of data and case studies recording the practices of indigenous mapping is low, United States Tribes utilizing GIS in their operations is increasing (Chapin et al., 2005). As of the mid 1990s, 50 of the 550 recognized Native American Tribes within the United States have used GIS alongside the Bureau of Indian Affairs (BIA) created database (Chapin et al., 2005). As technology progressed through the 1990's, more support and access to GIS began to emerge from the professional field. As of 2008, a rise of specialized indigenous GIS conferences had been offered for indigenous GIS users. Additionally, Environmental Systems Research Institute (ESRI) has begun to work closely with tribal entities and provide free resources for indigenous

GIS users (Pearce & Louis, 2008). The increased support and participation within indigenous and tribal communities has helped these communities protect their cultural resources and justify to the federal government and other land management entities, that these resources exist and where they are located.

The GIS platform is an option for indigenous and tribal communities to record cultural sites and resources by using Global Positioning System (GPS). Although mapping culturally significant areas is beneficial for the Tribe's credibility to other government and non-government organizations, opposition within the Native Community can arise due to mapping culturally significant areas. A GIS project that mapped Mountain Maidu Allotments in California's Plumas County did have community members that expressed their opposition to the project (Middleton, 2010). Middleton (2010) explains how some Mountain Maidu community members saw the study and visualization of private property as dangerous or problematic. This example of community push back in recording and mapping culturally significant sites is just one aspect of the problems that can occur when mapping indigenous homelands.

Issues that can arise when mapping tribal/indigenous communities include:

1. Indigenous and tribal communities are not accurately represented
2. Indigenous and tribal data and concepts do not match that of western cartographic ideas
3. Confidentiality between tribes and federal governments and the mistrust between them due to historical interactions

As stated earlier, much of the data that revolves around tribal and indigenous mapping is quite limited. It must also be noted that the work that has been done in the

field of indigenous and tribal mapping is done by mostly non-indigenous GIS users and professionals (Chapin et al., 2005). One issue that arises by not having or involving indigenous peoples in the GIS process is that indigenous and tribal perspectives are not included, which results in the community not being accurately represented (Chapin et al., 2005).

Assimilation of Indigenous Knowledge

The second problem that can arise in indigenous mapping is that GIS and the idea of mapping is a western concept. Therefore, the integration of GIS within indigenous and tribal communities can be seen as another form of Assimilation (Pearce & Louis, 2008). Briggs et al. (2020) explains that, “Indigenous knowledge has been characterized as qualitative, holistic, experimental, and oral in contrast to Eurocentric knowledge as quantitative, reductionist, and objective, and written” (p. 3). The issues with GIS and integrating indigenous knowledge into a western concept is that indigenous knowledge does not follow the same concepts. For instances, features such as mountains, trees, and streams would be considered as a nonliving object, while indigenous knowledge and connection to the land would categorize these features as living beings (Reid et al., 2019). A more specific example of this difference in data would be through the beliefs held by Australian aboriginal communities. The aboriginal communities of Australia view seasonal pools of water as possessing spiritual beings. These spiritual beings held within these pools determine how much water may be taken by the indigenous communities (Reid et al, 2019). This spiritual process in this example could be completely disregarded in other agencies studying these pools. The process of the spiritual influence on the

seasonal changes in this pool may not be considered, which results in indigenous knowledge and belief being undermined. Another instance where indigenous knowledge falls outside of the idea of western mapping is that categorization of data. Indigenous knowledge identifies a single element falling within multiple categories. The Eastern Cree for instance views a river as a transportation network and a body of water. The Eastern Cree identify banks in proximity to large rapids part of the body of water even though the bank possesses bare land. This occurs because of the impassable rapids causing the Cree to carry their canoe instead of facing the rapids, which could result in injury (Reid et al, 2019). This example shows how a river can be classified as a body of water and a land feature when interpreting this data in a western idea of mapping (Reid et al, 2019).

As indigenous knowledge is transformed and integrated into GIS data, areas of concern that arise is the simplification and generalization of data. Briggs et al. (2020) explains the problems of picking and choosing certain data that may be deemed “useful” for a project, while leaving out a plethora of culturally rich data. Briggs et al. (2020) continues to describe how “validation” can undermine indigenous knowledge. Validation can hurt indigenous knowledge by comparing how indigenous communities classify their resources to the western styles of comparing resources. The western idea of classifying underpins the indigenous style by stating that the western style is more credible (Briggs et al. 2020). Reid et al. (2019) also states that mapping technologies can potentially provide harm to the communities. These potential harms include reducing indigenous knowledge by not considering ways knowledge is passed down by generations, decreased access to land, and creates conflict within communities. Delving deeper into mapping of

indigenous territories, we see that indigenous knowledge does not hold the same definition and boundaries as western concept. Indigenous boundaries are not so clear cut as western boundaries and this is also the same for data categorization of entities such as, rivers, streams, and mountains (Reid et al. 2019). Additionally, Olson et al., also recognizes the challenges in incorporating indigenous knowledge is geospatial technologies; however, new methodologies that can be taken into consideration when working with these communities are to: extend cultural sensitivity, maintain process sensitivity when collecting data, establish and confirm sampling process with the community when gathering data, be aware of linguistic and epistemological barriers, and understand that indigenous knowledge exists in varying degrees. Acknowledging GIS and the limitations associated with integrating tribal knowledge is critical. Understanding limitations related to integrating knowledge is the first step to ensure that epistemologies and cultural knowledge are not harmed throughout the GIS process (Olson et al., 2016).

Confidentiality and Representation

The power of GIS lets users create maps using spatial data gathered from one's environment. While this gathering and presenting of data is useful, Native American Tribes can be hesitant to disclose data or information that is culturally sensitive due to the lack of confidentiality between Tribes and public land agencies. The two biggest obstacles that Native American Tribes face when it comes to confidentiality for sacred sites is the Freedom of Information Act (FOIA), which was passed in 1966 (Plaut, 2009). The second obstacle that can arise when working with Tribes and confidentiality is that some Tribes might be prohibited from speaking about sacred sites due to religious

restrictions and beliefs within the culture (Plaut, 2009). The second obstacle is important because of the process involved between federal agencies and Native American Tribes in land management decisions. For instance, The Havasupai people of Arizona faced this obstacle when an energy company intended on building a uranium mine near Havasu Canyon (Plaut, 2009). The Havasupai people believe that if uninitiated people visit these sites, the repercussions to the community will bring disaster to the Tribe (Plaut, 2009). This is exactly what happened with the energy company and the Havasupai people in 1984. The belief among the Havasupai people restricted them from notifying the Forest Service and the result was the green lighting of the mine (Plaut, 2009). When the Tribe brought the issue to the federal district court, the ruling was that it was the Tribes responsibility to notify the Forest Service and, by not doing so, it was the Tribes fault (Plaut, 2009). Situations such as this one does not consider the cultural beliefs and sensitivity that are associated with cultural sites and sharing of information. As we see the cultural barriers between the sharing of sensitive information, another barrier that dissuades Tribes in sharing sensitive information to land management agencies is the Freedom of Information Act (FOIA). The Freedom of Information Act allows the releasing of sensitive information obtained by public land agencies, such as the United States Forest Service. The purpose of this act is to keep government agencies transparent and accountable for the work they conduct (Plaut, 2009). Plaut (2009) describes the purpose of this act as to:

> Create a broad and judicially enforceable public right to obtain agency records. If a member of the public reasonably describes records and files to procedurally proper request, FOIA requires the agency to release the records unless the agency can prove that requested information fits into one of the FOIA's nine narrowly constructed exemptions. (p. 146)

Although the nine exemptions are in place to help protect sacred sites, this does not guarantee that Tribes sacred sites are protected. These nine exemptions are Office of Information Policy (United States Department of Justice, n.d.):

1. Information that is classified to protect national security.
2. Information related solely to the internal personnel rules and practices of an agency.
3. Information that is prohibited from disclose by another federal law.
4. Trade secrets or commercial or financial information that is confidential or privileged.
5. Privileged communication within or between agencies, include those protected by the:
    a. Deliberated process privilege (provided the records were created less than 25 years before the date on which they were requested.
    b. Attorney-work product privilege.
    c. Attorney-client product privilege.
6. Information that, if disclosed would invade another individual personal privacy.
7. information compiled for law enforcement purposes.
8. information that concerns the supervision of financial institutions.
9. Geographical information on wells.

In addition to the effects of the FOIA, Native American Tribes are hesitant to share sensitive information due to the historical events and relationship between Tribes and the federal government. The forced assimilation and forbidding of Native culture such as the forced practicing to “Christianize” Native people in the Pueblos is but one example of the attack on religion and culture exercised by European colonists (Plaut, 2009). The FOIA is a large factor in why Native American Tribes hesitate in sharing their sacred sites with public land agencies (Plaut, 2009). The FOIA is the deciding factor in what information can be published to the public based on the nine exceptions (Plaut, 2009). In 2016, the FOIA was amended to make the access to agency information more accessible to the public (Amberson, 2017). This was done by incorporating the “the rule of three,” which stated “an agency is now required to make available for public

inspection in electronic format records that have been requested three or more times" (Amberson, 2017, p.958). This new amendment makes the guarantee of confidentiality to Native American Tribes extremely difficult. One work around the FOIA for Native American Tribes is utilizing other acts that can better guarantee confidentiality with sensitive information, but these work arounds do have limitations. Take into consideration the Archaeological Resource Protection Act (APRA). This act allows those archaeological resources not to be made available to the public under the FOIA, unless a federal land manager makes certain affirmative findings (Plaut, 2009, p. 150). This act continues by stating

> the governor of the state where "archaeological resources" are found formally requests that information, federal agencies must provide the information if the governor promises that she/he will "adequately protect the confidentiality of such information to protect the resource from commercial exploitation." (Plaut, 2009, p. 150)

Although the use of this act is promising, it does come with limitations. The first limitation is that archaeological resources are defined as "material remains of the past human life or activities, which are of archaeological interest" and that the archaeological resource be at least one hundred years old (Plaut, 2009, p. 150). The last limitation to this act is that sites that house spiritually deities do not fall under the protection of this act (Plaut, 2009). ARPA does provide participating Tribes with a better guarantee for confidentiality, but it does have its limitations. Tribes that hope to work with federal agencies would benefit from obtaining literature that would best fit a Tribe's need.

The detail that can be incorporated in the dataset can present the public land agency with high quality information. If the FOIA approves the dissemination of tribal information all resources held highly in the Tribe will now be public. As stated

previously, the goal of incorporating GIS within tribal operations is to identify culturally significant resources and landmarks within a Tribe's territory to protect these resources from being destroyed (Chapin et al., 2005). Although the sensitive information provided by Tribes will allow for a seat at the table when it comes to environmental decision making, it also comes with the risk of disclosing sensitive information to the federal government and the greater public if required by the FOIA (Amberson, 2017).

Work done by Plaut (2009) does shed light on how GIS may improve confidentiality for Tribes. In this paper, the nature of exemption six deals with information and files that regard personal and medical information. Because sacred sites are used by individuals and a GIS conveys exact locations of these sites, the disclosure of private personal information is compromised. The use of GIS and this exemption is better explained in Plaut's (2009) work by stating

> This argument gains support from a recent Tenth Circuit decision holding that electronic Geographic Information Systems (GIS) files are similar files. The court reasoned that the files reveal specific geographic point location of certain structures, which coupled with property records, would allow people to identify names of the structure owners. Thus, the court determined a "similar file" can consist of indirect reference to personal information. As with GIS files, sacred-site information reveals specific geographic point locations, information about what occurs there and who uses the site. If someone learned this information, they would be able to identify the people who use the site and the nature of their particular religious beliefs. This information is intimately personal. Thus, it is like that sacred site information is a similar file. (Plaut, 2009, p. 158)

Although GIS may provide increased protection in confidentiality, this action is not fully explored and further work into this GIS and exemption six is needed (Plaut 2009). Additionally, this specific example has not been presented into the court systems, so it's difficult to predict if the use of GIS in sacred sites would allow for increased confidentiality in the matter (Plaut, 2009).

Conclusion

Understanding history is the first step in acknowledging and creating a foundation to better understand the needs of people. Native American people have endured and overcame many obstacles imposed by the United States and are still overcoming obstacles. Laws and policies are backbone of why Native people don't have access and title to their traditional lands. This seizure of land is the foundation on why Tribes have difficulties trying to protect cultural and religious sites and resources. Laws that help protect Native people's resources have come a long way since their creation that only focused on the land and not the people; however, these laws and policies still need improving to ensure that Native people are heard, and that cultural sensitivity is acknowledged. Although GIS users vary depending on the field of study, the potential that GIS has for tribal users may be beneficial for protecting cultural resources and heritage, but the drawbacks and limitations of utilizing GIS should not be overlooked.

As we look at how mapping indigenous lands has progressed through the years, some countries have taken an initiative to better understand and work with Native communities, such as First Nations people in Canada (Chapin et al., 2005). The Canadian government has created a manual for GIS users to better understand political and ethical aspects of mapping these lands, methods of collecting data, but one drawback is present in that GIS functions or information is not included (Chapin et al., 2005). These manuals are a good first step in working with indigenous communities, but the issue confidentiality remains an issue when mapping indigenous lands (Chapin et al., 2005). For Tribes within the United States the biggest threat to confidentiality is the Freedom of

Information Act. Although this act will take more resources to allow for a more guaranteed policy, future studies can focus on how to incorporate sensitive information.

While indigenous mapping continues, it is important for GIS users to understand the complexity when working with indigenous knowledge. The idea of mapping and GIS stems from a western concept, which does not parallel Native knowledge or data. As more support continues to be integrated into indigenous communities, the hope is that GIS can be more inclusive to indigenous knowledge (Pearce & Louis, 2008).

The purpose of mapping indigenous land is to provide evidence and justify the natural and cultural resources so that Tribes and indigenous communities may protect these areas (Chapin et al., 2005). Although the mapping of these areas might help the local community, it is important that GIS users take into consideration the possible harm it may do to a community. These considerations include cultural sensitivity in the process of gathering information within a community, establishing and confirming that the method of gathering data within the community is appropriate, awareness of linguistic and epistemological barriers, and understanding the political dynamics of a community so that tensions are not created between neighboring communities (Olson et al., 2016; Chapin et al., 2005). Lastly, through the work of both Plaut (2009) and Amberson (2017), the FOIA act is one barrier that creates hesitation in working with federal agencies. Ways that Tribes may benefit from this research is understanding the various acts that deal with cultural resources such as the ARPA. Acts such as the ARPA may provide Tribes with a better guarantee that their data and information be protected, but the downside is that these acts have their limitations on what they consider cultural resources.

CHAPTER III

PROJECT DESIGN

This project has used a mixed methods approach of implementing qualitative and quantitative, such as, journal articles, similar Geographical Information Systems (GIS) projects in indigenous communities, and working closely under a Tribal Historic Preservation Officer (THPO) to gain insight and knowledge on applying GIS processes to a Native American focused project. First, this project included journals of the western use of GIS as a foundation to then be used to build upon the use of GIS from a Native perspective and lens. As stated in Chapter II by Chapin et al. (2005), the goal of mapping indigenous land, is to protect cultural sites, hunting and gathering locations, and to justify traditional homelands. The urgency for this project stemmed from a disastrous wildfire that occurred in Northern California that tribal entities in northern California responded to the emergency work to ensure that cultural resources and sacred sites were protected.

Journals from both Chapin et al. (2005) and Middleton (2010) both express the importance and need to include tribal representatives in GIS projects. The first project was developed under the supervision and guidance of a THPO. The application of ArcGIS Pro was developed to record and document cultural resources to protect and preserve artifacts found in the field by tribal monitors. The second project would then follow similar steps to create a GIS project for an additional Tribe affected by a wildfire. The THPO possessed a background in GIS software in tandem with extensive cultural knowledge, the GIS project incorporated fields to satisfy the needs of tribal resources found in this region of northern California. Because Tribes in California and the greater

United States are so diverse, it's crucial that projects such as this to consult and work closely with tribal representatives. This mixed method approach to this project allowed for a template and guide that incorporated GIS from a Native American lens, which facilitates the use of GIS for tribal use in cultural resource management, along with questions on how Tribes can modify this project to fit their needs based on cultural artifacts and sacred sites.

It must be noted that for this project, ArcGIS Pro was used, which was possible through a free license through the Bureau of Indian Affairs. This detail is crucial for the fact that federally recognized Tribes may apply for a license through the Bureau of Indian Affairs. Since there are Tribes in California and the United States that do not posses' federal recognition, open-source options are available for Tribes who may be state recognized, applying for federal recognition, or may be structed as a 501 (c) (3). The steps and knowledge applied in this GIS project were applied to a separate wildfire that occurred in northern California. Two projects following these justification and processes were created. The first project was designed by the GIS and cultural knowledge from the THPO and is the foundation that guided the second project. Since the study area for the second project took place in a different location in California, and the impacts of this fire affect another Tribe, the project was modified to accommodate the resources used and found for this specific Tribe.

The first steps for this project to be implemented was data collection from the field, which was conducted by tribal monitors. Tribal monitors were deployed to private and public parcels to mitigate and protect cultural artifacts and resources discovered in emergency cleanup operations. Tribal Monitors worked closely with the THPO who

guided and educated tribal Monitors on cultural resources found in the field. Although this project was geared for emergency work, this same field work is possible for tribal representative not engaged in emergency work.

Data collection for this project required GPS coordinates of the cultural artifacts, site photos of the artifacts, parcel address and Assessor parcel number (APN) of where the artifacts were located. The GPS coordinates were crucial for this project due to their accuracy in projecting the location of artifacts in the field in difficulties arise on APN and address confusions. Additionally, the literature in Chapter II that covered the importance of using GIS coordinates to aid in confidentiality regarding FOIA. All data gathered on artifacts found in the field were recorded by monitors' smart phones through apps such as Avenza Maps and a workforce app named Crew. The goal of the Avenza map app is to ensure that GPS coordinates of the artifact be collected.

The THPO and GIS specialist both trained tribal monitors on features and steps to record cultural artifacts found in field. Additionally, for federally recognized Tribes they can utilize Avenza Maps for Free under the Bureau of Indian Affairs, free licensing in the same fashion as ESRI'S ArcGIS pro (United States Department of the Interior Indian Affairs, n.d.). As for the Workforce App, Crew, this application was used to create group threads with tribal monitors and GIS specialist to convey cultural artifacts found in the field to then allow for GIS specialist to input artifact descriptions and locations into the GIS database. For monitors relaying description of cultural artifacts found in the field, crew allowed tribal monitors to convey pictures of the cultural artifacts, GPS coordinates for the artifact, and the address and APN of the artifact

location. Although the Crew app was used for this process, tribal representatives using this template may utilize alternative options available.

Once the data collection process phase was completed, the GIS specialists with guidance from the THPO began the process of inputting and categorizing data into the GIS database. The first step taken to complete this GIS project was creating a Feature Class to house the artifact description and geographical point to be plotted in the project. Appendix A provides step-by-step instruction on how this project created a feature class, but GIS users residing in various locations should consider the geographical differences that are associated with your region and purpose (Geographical Coordinate Systems and Projected Coordinate Systems). One key component of this project is that the instruction include in the appendixes were tailored for GIS users new to the software. It should be noted that this project primary worked with points and not lines, or polygons. If needed, tribal users in their own project may want to use lines or polygons to convey cultural resources accurately. The fields for this project were justified as follows:

- ❑ Address: To associate the cultural resources to a physical address being the emergency took place on both public and private property.
    - Assessor Parcel Number (APN): Each property has a nine-digit (e.g., 854-512-547) sting of numbers associated with each property. The inclusion of an APN is crucial if the property does not provide a detailed physical address (e.g., 0 Mill Creek Rd).
    - Description (DESC): A description of the artifact is included in the layer to describe the artifact found. Descriptions were provided by tribal monitors, but

ultimately the THPO provided a final description of the artifact is clarification was needed.

- Weight: A weight field was incorporated by the THPO to portray a heat map of the artifacts found. The purpose of the heat map is to convey cultural artifacts that ranked higher on a weighted scale provided by the THPO to show high priority areas. Appendix B is provided to show the ranking system of cultural artifacts found in the field.
- Date: A date is included to times tape when the artifact was found. The date is useful to understand what events in the future or past may have impacted the artifact e.g., wildfires, floods, development, etc.
- Assessor: This final field is added to keep a reference of who discovered the artifact. Additionally, if future questions on the description or location of the artifact is needed then the property personnel can be contacted.
- Resource_Number: A resource number field is included to manage and track artifacts found in the field by tribal monitors. The resource number is in this project to reference the project and the number is identify each artifact uniquely. Appendix C provides an example of a resource number.

The justification of this project and the fields listed above was to protect cultural resources and, in this process, gain detailed information on the cultural artifacts found in the field to assist in mitigating future impacts to tribal resources.

Not only did this project include cultural artifacts, but culturally important natural resources were also included in this project. As covered by Kurtz (1963), Mountain Maidu people hold natural resources crucial for not solely sustenance purposes,

but for cultural and religious needs. Because of this, a GIS layer for culturally important natural resources was added to the project. Although this natural resource GIS layer is not as extensive as the previous cultural artifact layer, it offers GIS tribal users a space to convey cultural importance of these resources through descriptions in the GIS layer. The cultural artifacts layer covered previously share commonalities in including a date field and an assessor field. Where this layer differs from the previous is the notes field and the natural resource field, which are exampled by below:

- Natural Resources: The common name is used to describe what plant, tree, and cultural important resource is located at this point in the GIS layer.
- Notes: The notes field in this layer can be used to discuss a description of the resource such as the cultural importance, are multiple plants found in this area, or if it accessible by the public as a gathering location.

The natural resources component is relevant for reasons covered in Chapter II regarding the California Indian Basketweavers' Association in efforts to preserve and obtain access to gathering sites for basket making materials here in California.

As the project progressed and tribal monitors reported artifacts in the field, GIS specialist now began to add artifact data to the GIS layers. Additional steps in ensuring that the data gathered from the field was detailed and accurate were incorporated by creating site records. Sites records were included for each artifact found in the field, which included the geographical information, pictures, and descriptions. Upon further research of ArcGIS features provided by ESRI, two features were applied to the project to enhance the effectiveness of the project for monitors and the THPO in the field. These tools allowed attachments to be added to each data point created by the GIS

specialist. Attachments such as, site records and pictures of the artifacts now could be attacked to each point to grant easier access to artifact details for personnel in the field. For this project, Appendix D provides an example of a site record for cultural artifacts. The site record created in this project took elements from the site record provided by the Tribe and archeology records used by California State Parks Office of Historical Preservation. The feature that allowed attachments to be added to this project was the use of the enable attachment tools, which then was used to add attachments to each data point. The enable attachment tool allowed GIS layers to be modified to allow for attachments. This project only worked with attaching .JPG files and PDF files, while upon further inspection, the feature allowed the inclusion of Audio files that could be associated with each data point. The second step after applying the enable attachment tool was to add the attachment to each point with the site records and photos that were associated with its unique point. To attach file into this project, GIS users were able to browse .JPG or PDF files on their local computers or portable hard drive to then upload to the GIS project. Detailed instruction for steps on uploading attachment to the GIS data points are available to view in Appendix E. The essence of this project is designed for GIS users who are new to the GIS platform. This being said, the instructions and attachments are geared to be as detailed as possible to ensure that viewers can recreate and modify this project as needed.

When it came to adding coordinate points on the map, ArcGIS pro's locate tool was utilized to search and then add each coordinate point to any layer desired in the project. By performing this step, a new record (row) was now available to edit with the proper information on the artifact found. The fields that were populated were address,

APN, resource number, weight, date, assessor, as discussed and justified by the THPO earlier in this chapter. The steps and processes in this project aimed to gain as much data and details on the artifacts found in this project to ensure that mitigation efforts could be applied to prevent the destruction and loss of cultural resources in response to the emergency clean up post wildfire. One aspect of this project took into consideration that not all tribal cultural department incorporated that GIS and thus detailed instruction on how to perform GIS steps to maintain and update data layers were created. Additionally, guides were also produced ask keys to be later referenced if needed by THPOs or other tribal representatives. Appendix E is included and holds the steps on how to add points to the data layers, along with attaching files to each point for quick reference. Creating this project template and guide stemmed from work performed in emergency work after a wildfire. The literature in Chapter II conveyed that tribal representation is key when performing tribal work in GIS. The THPO's expertise guided and established the foundation that allowed for this project to be recreated for a different Tribe impacted by a wildfire. Although many of the aspects of data collection and population of data fields are similar, modifications to the project took place to accommodate the needs of the Tribe. The purpose of this project is to showcase the steps and process taken to build a GIS project for tribal resources and uses. For Tribes seeking to incorporate GIS in resource management operations, this template may be used and is not dependent on emergency work and may be tailored to fit the needs of Tribes that require modification. The outcome of this GIS project was to develop and create a GIS project for a Tribe. The final product was then sent to the Tribe and with the assistance of instructions developed by the GIS specialist the Tribe would be able to maintain and add data to the project for

future uses. The appendices used were the instructions and guides provided to Tribes, but with confidential information redacted.

CHAPTER IV

CONCLUSION AND RECOMMENDATIONS

Project Conclusion

This project touched on many aspects of Native American rights and how they have shifted from a place of racism and discrimination to a place that provides protection for Native American people and resources. At the same time, the protection and polices that are in place now are not guaranteed to protect Native American resources and ways of life. Currently, more amendments and policy change are necessary to ensure that Native people receive full protection for their cultural and natural resources to ensure that heritage and cultural preservation is unobstructed.

This project stated with the Echo-Hawk (2010), describing federal Indian law and how it has impacted, harmed, and taken away Native American title and rights in the United States. This discussion on federal Indian law is the backdrop on how federal protection resulted in the Antiquities Act to protect Native American resources, but simultaneously not provide protection to Native American people (Marincic, 2018). The creation of the NHPA did provide some level of protection for Tribes and their sacred sites, but as Marincic (2018) highlighted, the NHPA still requires additional amendments to fully support Tribes and their efforts. In addition to the NHPA, the United States and Government official's acknowledgement of cultural sensitivity is required to move forward in working with tribal entities. Plaut (2009) showcases the need of cultural sensitivity through the case study of the Havasupai people disclosing and protecting their resources to the United States Forest Service. Federal law has a history of hindering and

obstructing Native people and their culture (Echo-Hawk, 2010; Plaut, 2009). The FOIA is just one obstacle that Native American Tribes must overcome in their journey to protection their cultural heritage. Through this project and reviewing of journals on the FOIA and Native Americans, one tool that Tribes have at their disposal to add protection for their cultural resources and sacred sites is the use of GIS (Chapin et al., 2005). The use of GIS in many fields such as medical, land management, and water conservation is actively assisting mangers in solving the complex problems that are faced in their professions (Shakak, 2015). GIS in the realm of tribal use is no different and can add additional protection for Tribes under the exemptions of release of information under the FOIA. In the past several decades, GIS resources for Tribes have facilities the use of GIS in tribal operations.

The project design for this paper utilized the GIS resources, which provided GIS project that took into consideration tribal representation in creating the GIS database. Additionally, the project design's goal was to create a database, with instruction resources so that tribal users may maintain and add data to the when needed. Although this project was geared for emergency work following a wildfire, the same principles and justification can be applied and modified to a Tribes specific need. The purpose of this project is to expose and showcase the work that had been performed to provide a template and guide to how GIS can be incorporated into tribal use while also acknowledging that GIS does possess limitations that may harm or diminish tribal knowledge. As stated, multiple times in this project, Tribes are diverse and for a GIS project may require modification and alternation to satisfy the needs and cultural resources found in their traditional homelands.

Recommendations

Once in the process of creating a GIS project for tribal use several recommendations arose that may further enhance the GIS process. Additionally, future project may also take into consideration that additional GIS platforms are available to users. Future GIS projects may address these questions during and after development.

- Tribes in the process or not federally recognized by the United States do not have access to ArcGIS pro, such as in this project. Open-source GIS software may provide these Tribes with a comparable or enhanced option.
- Cultural preservation can be included in this project through the attachment features provided by ESRI's ArcGIS pro. This attachment feature provides users with the option to include audio files to data points. The literature in Chapter II discusses Native American Tribes passing down knowledge through oral traditions. Audio files may be included to enhance the delivery of cultural heritage.

These recommendation surface while the creation of the GIS project was undergone. The cultural preservation recommendation should be investigated close due to tribal trust to share cultural information. As Middleton (2010), found in their case study, some community participates may disagree and voice their concerns with using cultural information in projects such as this.

The software in this project used ArcGIS pro by ESRI, but for Tribes that do not possess access to this software, additional options are available. GIS software such as QGIS, GrassGIS, and the Arches Project all provide free open-source GIS software. GIS platforms such as the Arches Project provide a service that is tailored for the management of GIS data that involves cultural heritage.

GIS is being used by managers as a tool to better understand pattern, correlations, and additional tends that are found within our world. The tribal use of GIS is still relatively new, but it's capability in cultural resource protection may prove useful. That goes without saying that GIS does provide a level of harm for Tribes and their unique knowledge. As this paper explored the power of GIS alongside it harms to Native people, it is also providing a silver lining that Tribes may be able to utilize GIS to better protect their heritage and cultures that are diverse, unique, special, that has provided Native American people with the identity of a strong, resilient people who are carrying on their traditions today and will continue to for generations to come.

REFERENCES

REFERENCES

Amberson, S. E. (2017). Traditional ecological disclosure: How the Freedom of Information Act frustrates tribal natural resource consultation with federal agencies. *Washington Law Review, 92*(2), 937.

Aporta, C. (2003). New ways of mapping: Using GPS mapping software to plot place names and trails in Igloolik (Nunavut). *ARCTIC, 56*(4), 321-440. https://doi.org/10.14430/arctic629

Arches Project Cultural Heritage Inventory and Management Software. (2022). *Arches project*. Retrieved April 3, 2022, from https://www.archesproject.org/

Bean, L. J. (1992). Indians of California: Diverse and complex peoples. *California History (San Francisco), 71*(3), 302–323. https://doi.org/10.2307/25158646

Briggs, C., Burfurd, I., Duckham, M., Guntarik, O., Kerr, D., McMillan, M., & San Martin Saldias, D. (2020). "Bridging the Geospatial Gap: Data About Space and Indigenous Knowledge of Place." *Geography Compass* 14(11), e12542. https://doi.org/10.1111/gec3.12542.

Brody Hinds. (2017). Twenty-five years later: The amendments to the National Historic Preservation Act and tribal consultation. *American Indian Law Review, 42*(1), 141–171.

Chapin, M., Lamb, Z., & Threlkeld, B. (2005). Mapping indigenous lands. *Annual Review of Anthropology, 34*(1), 619-638. doi:10.1146/annurev.anthro.34.081804.120429

Dictionary.com. (n.d.). *Tribe*. Retrieved April 4, 2022, from https://www.dictionary.com/browse/tribe

Echo-Hawk, W. R. (2010). *In the courts of the conqueror: The 10 worst Indian law cases ever decided*. Fulcrum.

ESRI. (n.d.). *GIS mapping software, location intelligence & spatial analytics*. Retrieved April 3, 2022, from https://www.esri.com/en-us/home

ESRI. (n.d.). *What is GIS?* Retrieved April 3, 2022, https://www.esri.com/en-us/what-is-gis/overview#:~:text=A%20geographic%20information%20system%20(GIS,what%20things%20are%20like%20there)

Feir, D. L. (2016). The long-term effects of forcible assimilation policy: The case of Indian boarding schools. *Canadian Journal of Economics, 49*(2), 433-480.

Garrett, B. L. (2009). Drowned memories: The submerged places of the Winnemem Wintu. *Archaeologies, 6*(2), 346–371. https://doi.org/10.1007/s11759-009-9109-9

Gitas, I. Z., San-Miguel-Ayanz, J., Chuvieco, E., & Camia, A. (2014). Advances in remote sensing and GIS applications in support of forest fire management. *International Journal of Wildland Fire, 23*(5), 603–605. https://doi.org/10.1071/WF14117

Goodchild, M. F. (2018). Reimagining the history of GIS. *Annals of GIS*, *24*(1), 1–8. https://doi.org/10.1080/19475683.2018.1424737

Harvey, Francis, Kwan, Mei-Po, & Pavlovskaya, Marianna. (2005). Introduction: Critical GIS. *Cartographica, 40*(4), 1-4.

Hassouna, R. M., & Asal, F. F. (2016). Using GIS-based digital raster analysis for improving harmonic models-derived Geoidal Heights. *Applied Geomatics, 8*(3-4), 151–162. https://doi.org/10.1007/s12518-016-0173-8

Kurtz, P. L. (1963). *A history of Indian Valley, Plumas County, California, 1850-1920*. Chico State College.

Liddell, J. L., McKinley, C. E., & Lilly, J. M. (2021). Historic and contemporary environmental justice issues among Native Americans in the Gulf Coast region of the United States. *Studies in Social Justice, 15*(1), 1–24.

Marincic, A. M. (2018). The National Historic Preservation Act: An inadequate attempt to protect the cultural and religious sites of native nations. *Iowa Law Review, 103*(4), 1777–1809.

Middleton, E. R. (2010). Seeking spatial representation: Reflections on participatory ethnohistorical GIS mapping of Maidu allotment lands. *Ethnohistory*, *57*(3), 363–387. https://doi.org/10.1215/00141801-2010-002

Mollalo, A., Vahedi, B., & Rivera, K. M. (2020). GIS-based spatial modeling of COVID-19 incidence rate in the continental United States. *Science of The Total Environment, 728*, 138884. https://doi.org/10.1016/j.scitotenv.2020.138884

Nesterova, Y., & Jackson, L. (2018). Understanding the “local” in indigenous Taiwan. *International Education Journal: Comparative Perspectives*, *17*(3), 55.

Neteler, M., Bowman, M. H., Landa, M., & Metz, M. (2012). GRASS GIS: A multi-purpose open source GIS. *Environmental Modeling & Software: with Environment Data News, 31*, 124–130.

Olson, Rachel, Hackett, Jeffrey, & DeRoy, Stevens. (2016), Mapping the digital terrain: Towards indigenous geographic information and spatial data quality indicators for indigenous knowledge and traditional land-use data collection. *Cartographic Journal*, *52*(4), 346-355

Pearce, M., & Louis, R. (2008). Mapping indigenous depth of place. *American Indian Culture and Research Journal*, *32*(3), 107-126. doi:10.17953/aicr.32.3.n7g22w816486567j

Plaut, E. (2009). Tribal-agency confidentiality: A catch-22 for sacred site management? *Ecology Law Quarterly*, *36*(1), 137–166.

Real Bird, L. (2017). Reflections on revitalizing and reinforcing native languages and cultures. *Cogent Education*, *4*(1), 1371821. https://doi.org/10.1080/2331186X.2017.1371821

Reid, G., & Sieber, R. (2019). Do geospatial ontologies perpetuate indigenous assimilation? *Progress in Human Geography*, *44*(2), 216–234. https://doi.org/10.1177/0309132518824646

Shakak, N. (2015). Integration of remote sensing and geographic information system in ground water quality assessment and management. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, XL-7/W3*, 1483–1490. https://doi.org/10.5194/isprsarchives-xl-7-w3-1483-2015

State of California Native American Heritage Commission. (2022). *Archaeological terms glossary*. Retrieved April 4, 2022, from https://nahc.ca.gov/

Suagee, D. B. (1999). The cultural heritage of American Indian tribes and the preservation of biological diversity. *Arizona State Law Journal, 31*(2), 483.

The Free Dictionary. (n.d.). *Public lands*. West's Encyclopedia of American Law, edition 2, The Gale Group, 2008. Retrieved April 20 2022 from https://legal-dictionary.thefreedictionary.com/Public+Lands

United States Department of Justice. (n.d.) *Frequently asked questions.* FOIA. Retrieved 4/14/2022 from https://www.foia.gov/faq.html

United States Department of the Interior. (n.d) *Tribal Historical Preservation Office (THPO) grants.* National Parks Service. Retrieved April 1, 2022, from http://www.nps.gov/subjects/historicpreservationfund/thpo-grants.htm

United States Department of the Bureau of Indian Affairs. (n.d.). *Branch of geospatial support*. Retrieved April 17, 2022, from https://www.bia.gov/bia/ots/dpmc/bogs

United States Department of the Interior Bureau of Indian Affairs. (n.d.) *Frequently asked questions.* https://www.bia.gov/frequently-asked-questions

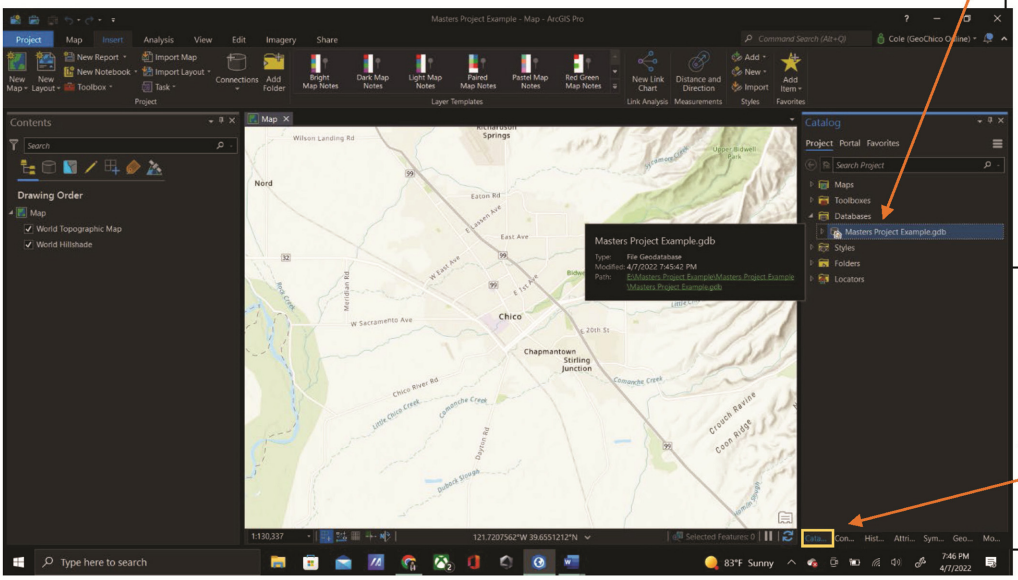
United States Department of the Interior Bureau of Land Management. (n.d.) *Traditional cultural places & Indian sacred sites.* https://www.ntc.blm.gov/krc/uploads/646/GuidetoTCPs&SacredSites.pdf

Walford, N. S. (2020). Demographic and social context of deaths during the 1854 cholera outbreak in Soho, London: A reappraisal of Dr. John Snow's investigation. *Health & Place, 65*, 102402. doi.org/10.1016/j.healthplace.2020.102402

APPENDIX A

CREATING A FEATURE CLASS

- Open a new or existing ArcGIS project

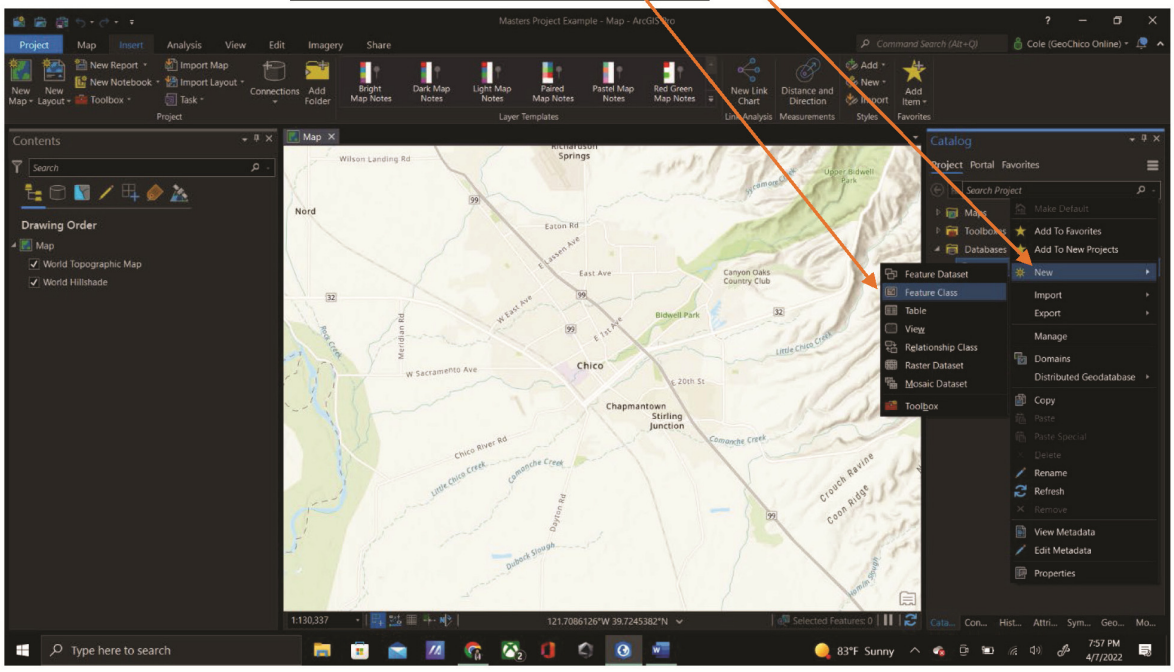


Step 2: Click the arrow next to "Databases" you will see the projects.gdb, once you see this option right click the project's name.gdb. in this example, the projects name is "Masters Project Example.gdb

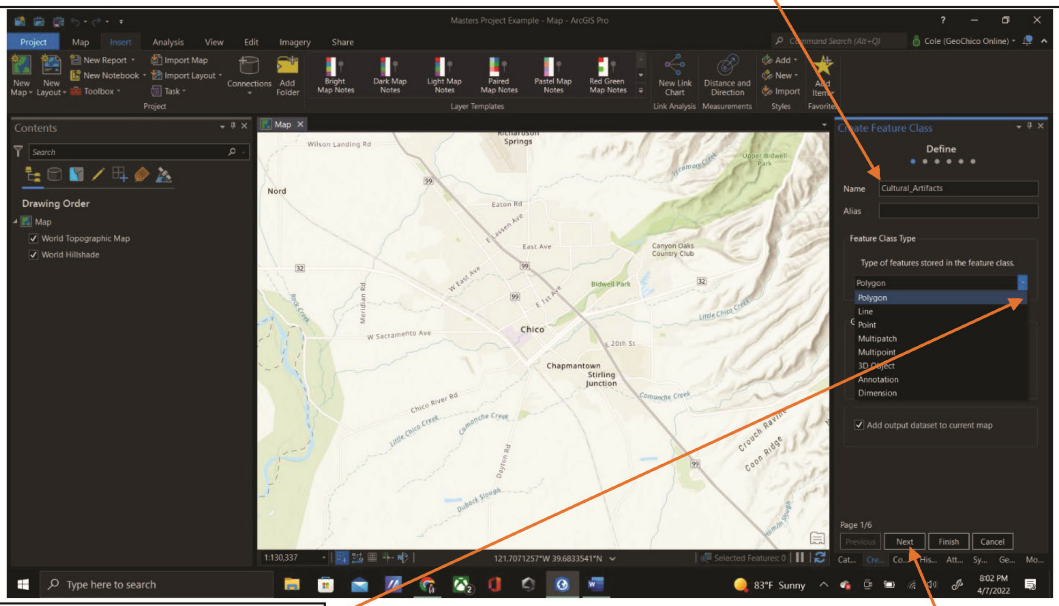
Step 1:

Click the Catalog tag at the bottom of the page.

Step 3: Once you have right clicked the projects.gdb, you will now click on the “new” option and select “Feature Class.” (.gdb stands for “geodatabase”)



Step 4: Now a new contents pane has opened to the right. This pane allows for you to add details about the layer you are about to make for cultural artifacts found in the field. The “name” field allows you to name the project.

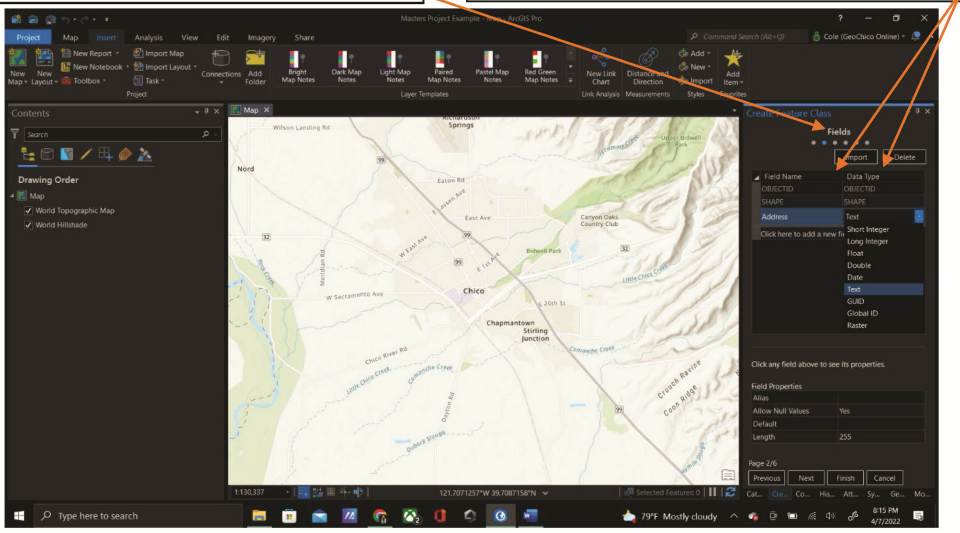


Step 5: Now that you have named your feature class, you now will select the type of features that will be stored in the feature class (e.g. lines, points, or polygons). For this project, points were only used, but another feature may be used. For example, line features could be used for trails. Polygons can be used for Bedrock Mortar to provide the user with detailed information on the size of the Bedrock Mortar. Consulting with a THPO or Tribal representative is needed to ensure the right feature type is used.

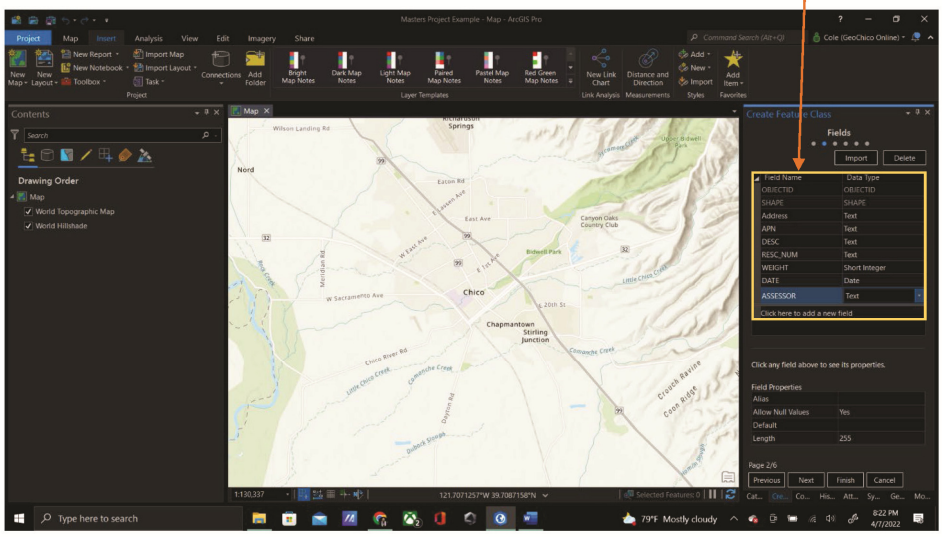
Step 6: After the desired feature type has been chose, click the “next” option to proceed.

Step 7: Once you have clicked on “next” a new pane named “fields” will appear. This pane allows you to start populating the fields that will be present in your Cultural_Artifacts layer.

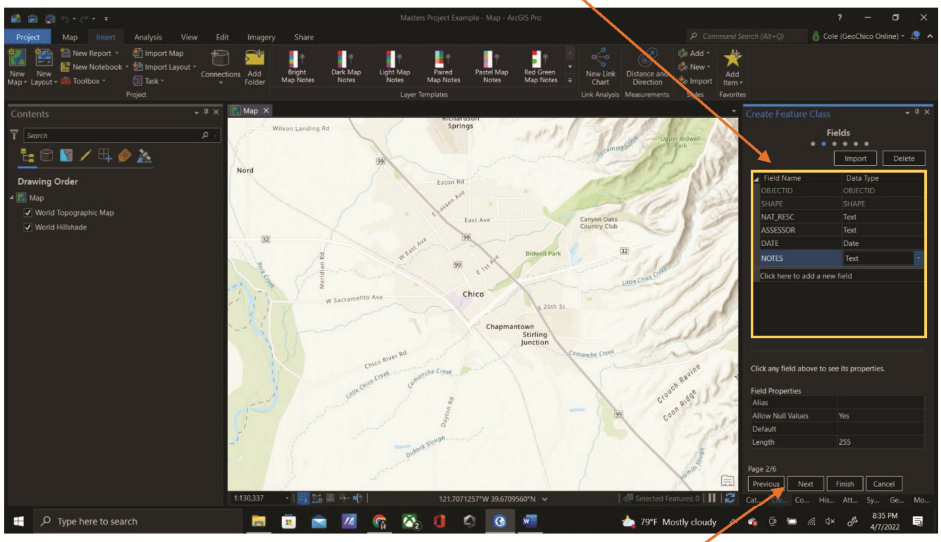
Step 8: The next step is to add the fields names and data types to be used in the layer. The “Field Name” is where you will name each column of data. The Data Type is where you will specify the type of data allowed in each column.



Step 9: The “Field Name” and “Data Type” for this project used the information below. The Text data type allowed for each GIS specialist to populate each field with the proper information and detail. When working with Field names and data types, it is important to shorten any field names that are long to abbreviations. For example, the “RESC_NUM” was used to represent Resource Numbers used in the project. Additionally, the Weight field used short integers because the numbers used for this project used 1, 2, and 3 to describe artifact priority. The short data field accommodates numbers that range between -32,768 to 32,767 (*ArcGIS field data types*).

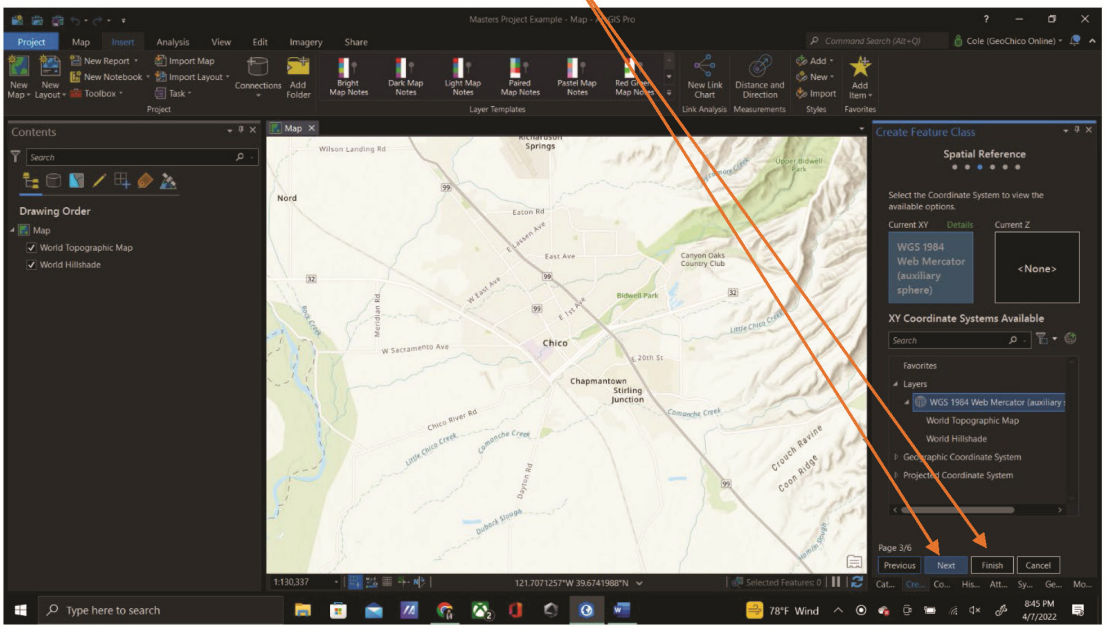


Step 9a: This project also used data gathered in the field by monitors that included cultural important natural resources. The fields used for this project are included below. The field NAT_RESC is for the common name describing the plant or tree information. The NOTES field was used to provide the GIS specialist with details on the abundancy of that resources. This field may be modified with information that satisfies a Tribes needs.

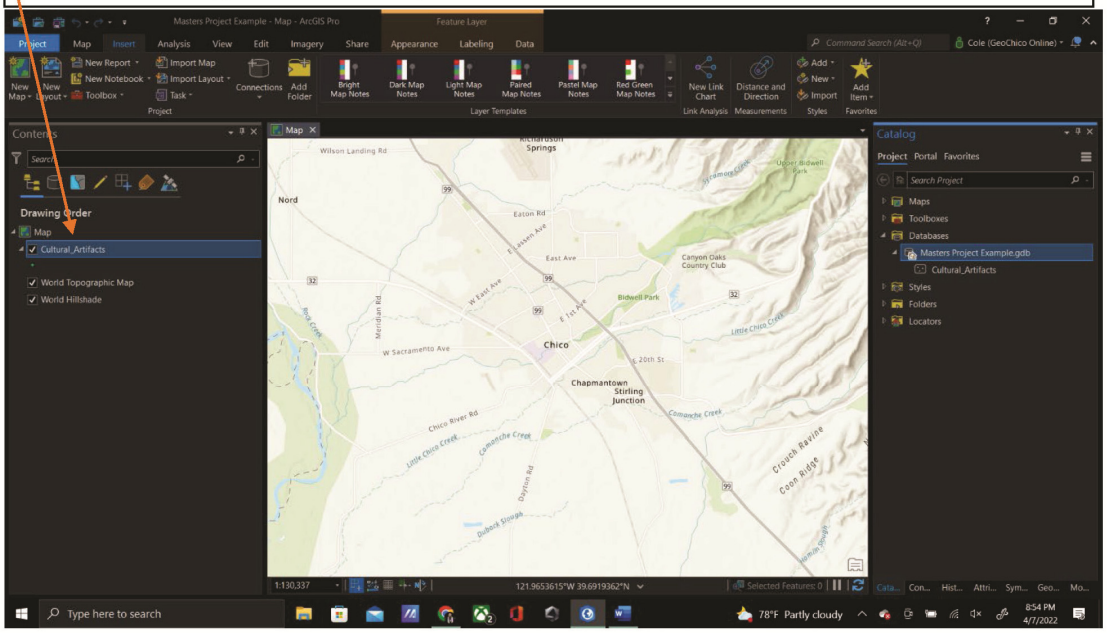


Step 10: Once you have added the desired Field Names and Data Types, now click the “Next” option.

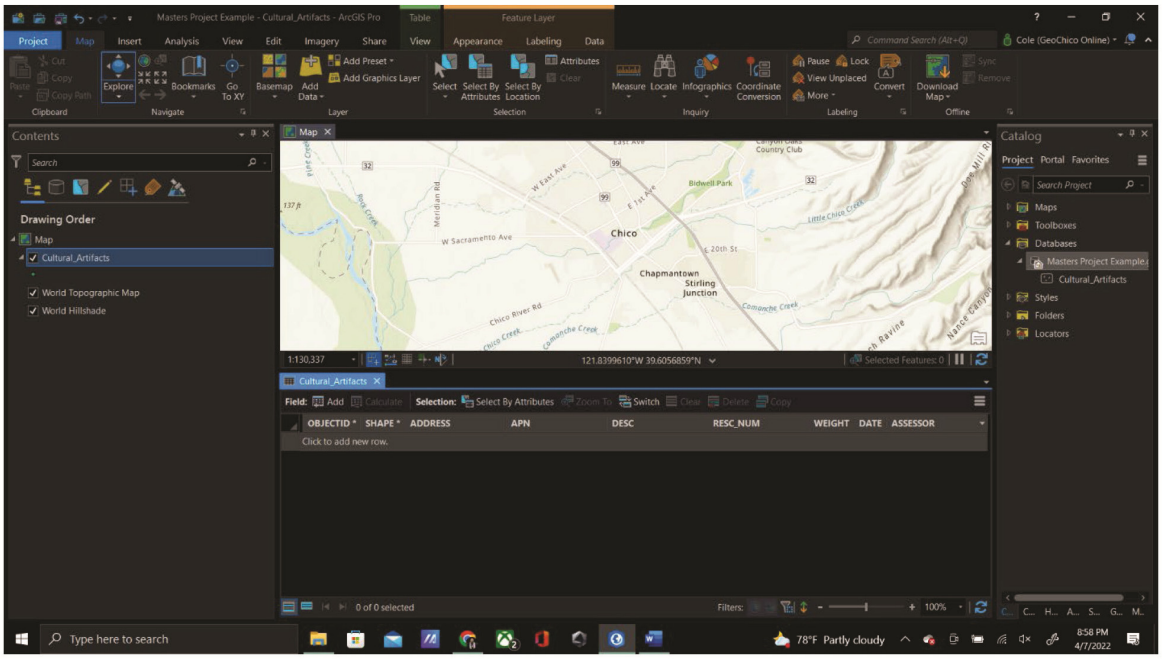
Step 11: The spatial Refence pane was left unchanged. The spatial reference may be changed, but for this project the next three pages were unaltered. For this step you many click next until you reach the 6th page, or you may press “FINISH” to finalize your new layer.



Step 12: Once you press “Finish” you will now see the layer you have created on the contents pane on the left. Now right click the new layer and select “Attribute Table”.



Final Step: Once you open the attribute table, you will see the data columns with the field names you created in the previous steps. Now you are ready to start populating the field with data. This process is shown in Appendix E.



APPENDIX B

WEIGHT SYSTEM

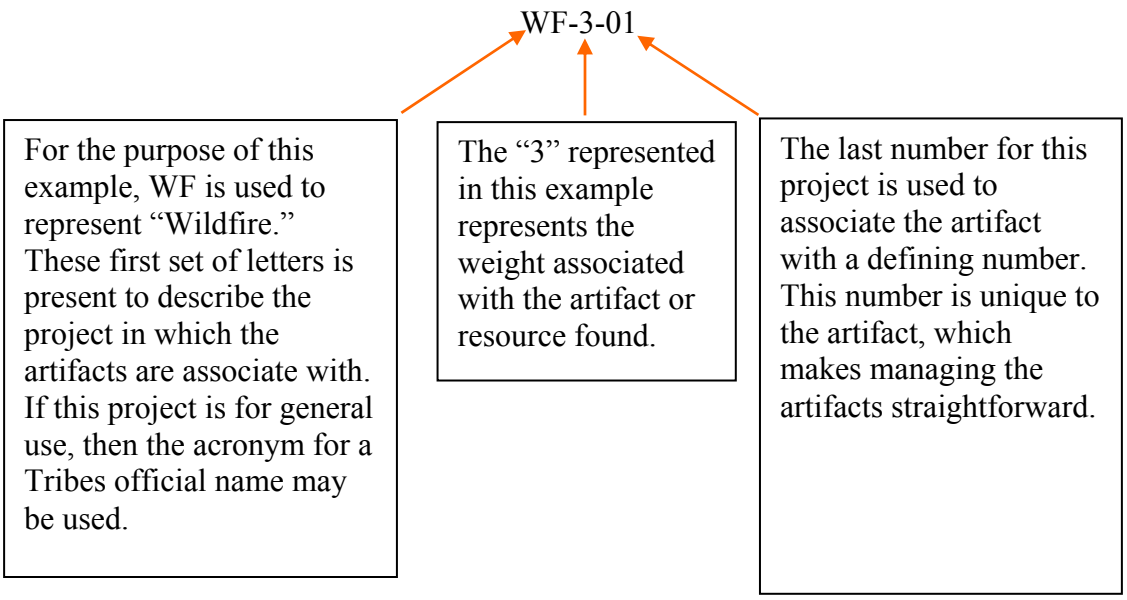
WEIGHT VALUE OF 1 = FLAKES OF OBSIDIAN

WEIGHT VALUE OF 2 = PORTABLE MORTAR (SINGULAR), PESTLES, WORKED OBSIDIAN

WEIGHT VALUE OF 3 = BED ROCK MORTARS, MULTIPLE PORTABLE MORTARS IN ONE SPORT (MORE THAN 2)

APPENDIX C

EXAMPLE OF A RESOURCE NUMBER



APPENDIX D

EXAMPLE OF A PRIMARY RECORD

Project Name/General Use: This box is used to describe the name of a specific project or if no project is associated then general use may be used.

Resource Number: This number is the string of letter and numbers that is covered in the project design.

Confidentiality Required: A yes or no answer is used to give the users background if this site or artifact requires special care due to confidentiality. A THPO should be consulted for further information.

Date Recorded: A date is crucial in ensuring that data is accurate and current

Assessor's Parcel Number (APN): provides details on the property in questions. Can provide property information is no address is associated.

County: The county the artifact is located in.

Owner And Address: Name of the owner of the property, which can be the name of the private landowner or the name of the public agency.

Decimal Degree: The type of format coordinate points that are sent from the field. Please refer to APPENDIX D.

Universal Transverse Mercator (UTM): coordinate system is used to provide better detail in the location of the site.

United States Geological Survey (USGS) 7.5 Quad: This information is used in archeological records to better pinpoint and describe the location of artifacts and sites.

Stash Location: If an artifact is moved in the field to mitigate the damage of resources, this field is used for the new coordinates of the artifact's relocation.

Associated Trinomial: If a site had been recorded and documented by archaeologies, this field is used to identify the Trinomial number that is associated with the previous work to be compared to the current work.

Artifact or Site Description: A detailed description of the artifact or if the site is associated with a village site, then a description is needed on what if found on the site.

Number of Photos Attached: Track and manage the number of photos associated with the cultural resource.

Remarks: If additional notes are needed to be included about the resources, this box is used to meet that need.

Photo/Sketch of Artifacts or Site: location where photos of the site or a hand drawn sketch may be attached to the site record.

Tribal Affiliations

PRIMARY RECORD SITE FORM

Project Name/General Use:		Resource Number:
Confidentiality Required:		Date Recorded:
APN:		County:
Owner and Address:		
Decimal Degree:	UTM:	USGS 7.5 Quad:
Stash Location:		Associated Trinomial:
Artifact or Site Description:		Number of Photos Attached:

Remarks:

Tribal Affiliations

PRIMARY RECORD SITE FORM

Photo/Sketch of Artifacts or Site:

APPENDIX E

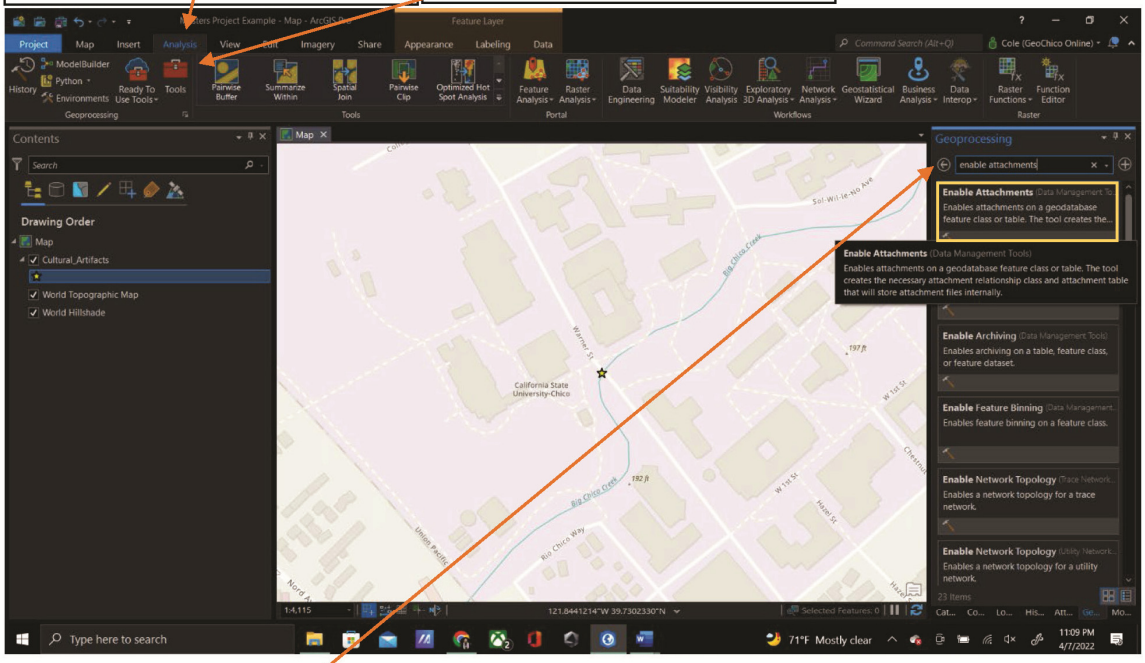
POPULATING AND UPDATING GIS DATABASE

*The information and locations in this example are hypothetical and used for demonstrational purpose only.

Now that you have created your Cultural Artifact layer in Appendix A, now you are able to start populating each column with data.

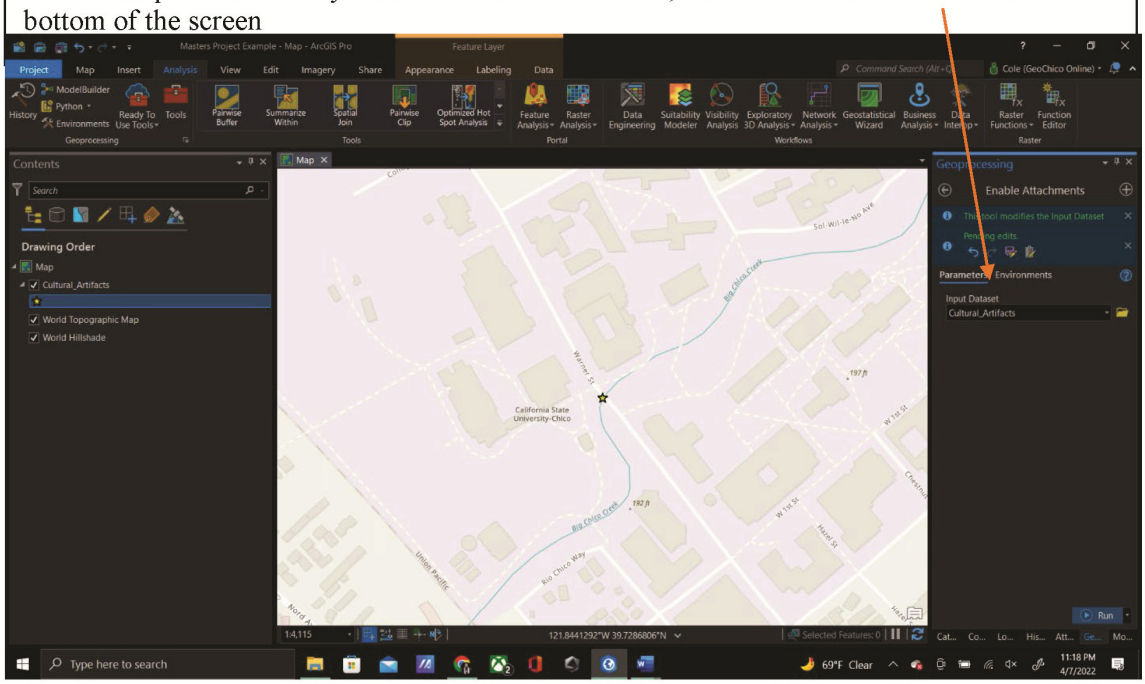
Step 1: At the top of the screen click on the Analysis Ribbon.

Step 2: Now click on the tool's icon.



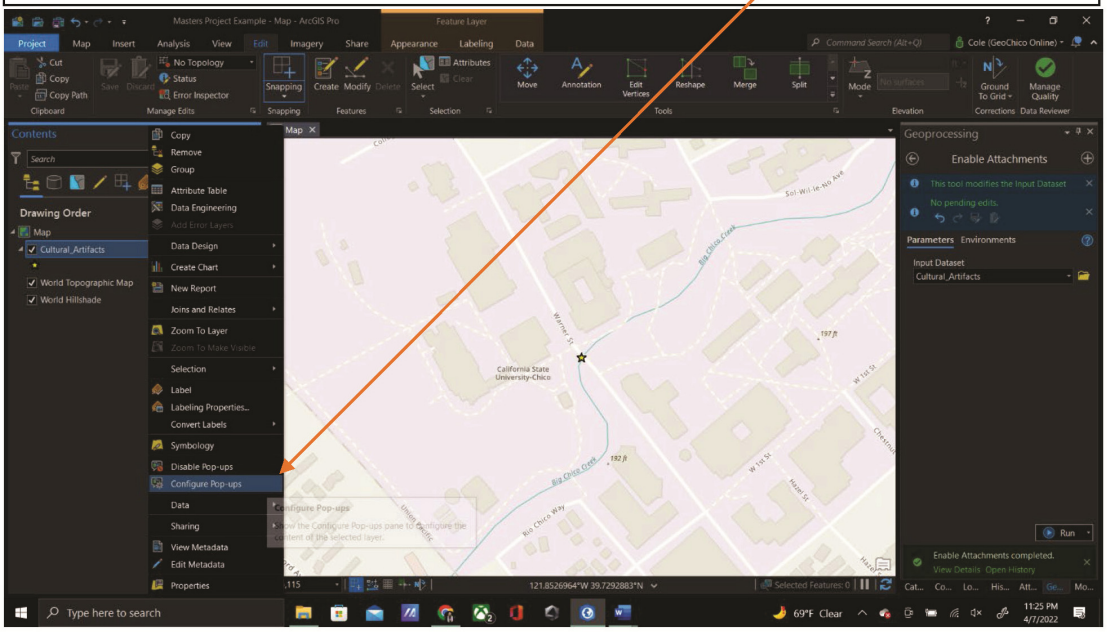
Step 3: After you click on the tools icon, on the right a geoprocessing pane will open with a search bar. In the search bar type in "Enable Attachments" this will search for the tool which will allow you to add pictures and PDF's to your data. Select the first option

Step 4: once you have selected the first option. You will see a drop-down menu that states "Input Dataset", select the arrow on the dropdown menu and select the layer you wish to add PDF's and pictures. Once you have selected the dataset, click on the "Run" button on the bottom of the screen

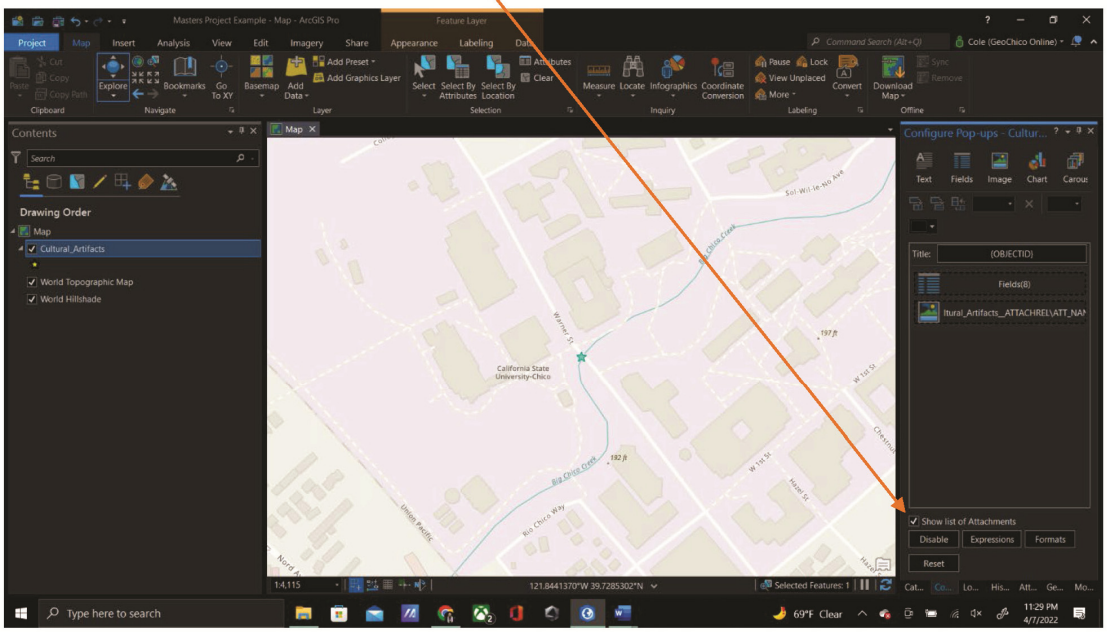


After pressing run. A green message and check mark showing "Enabled Attachments Complete" will be shown at the bottom right of the screen. Now that the tool has run, you can now add pictures and PDF attachments to your data.

Step 5: to ensure that your pictures show up in the pop-up windows. Right click on the data that you ran the "Enable Attachments" tool on and click on "configure pop-up".

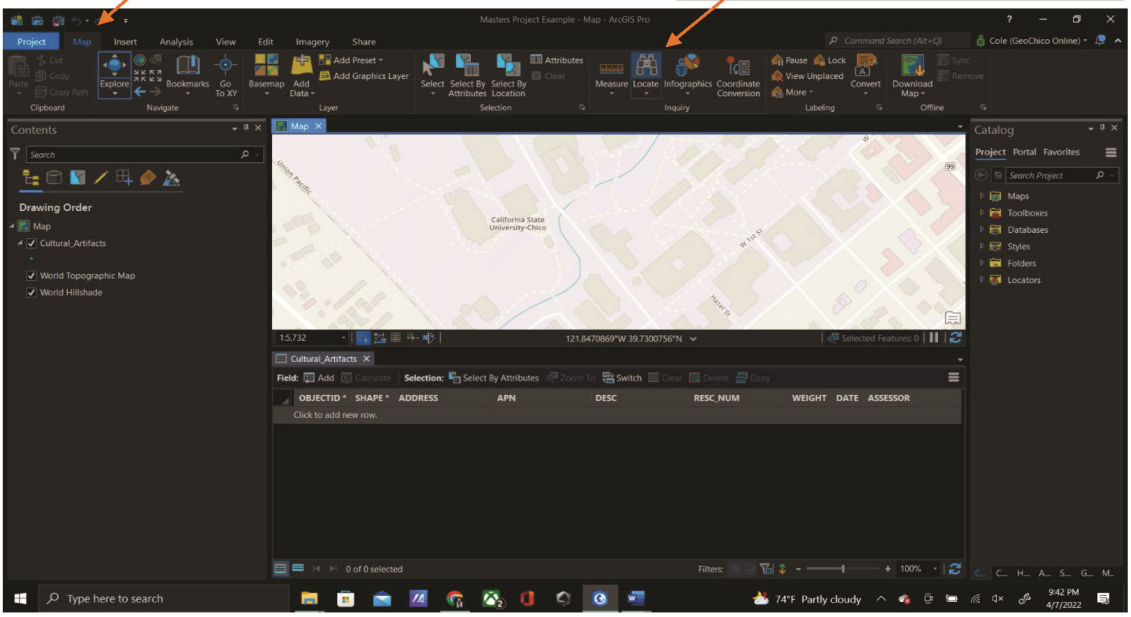


Step 6: A new contents pane will open on the right-hand side. Towards the bottom of the pane, you will see a box that says, "Show List of Attachments", make sure this box is checked.

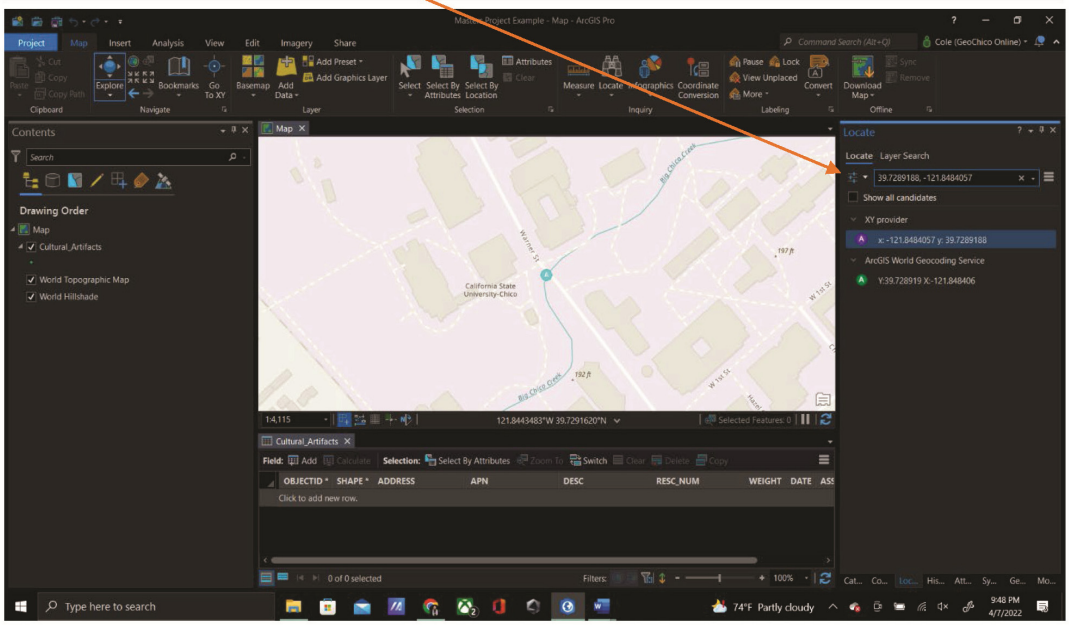


Step 7: let's start by selecting the map tap on the top ribbon.

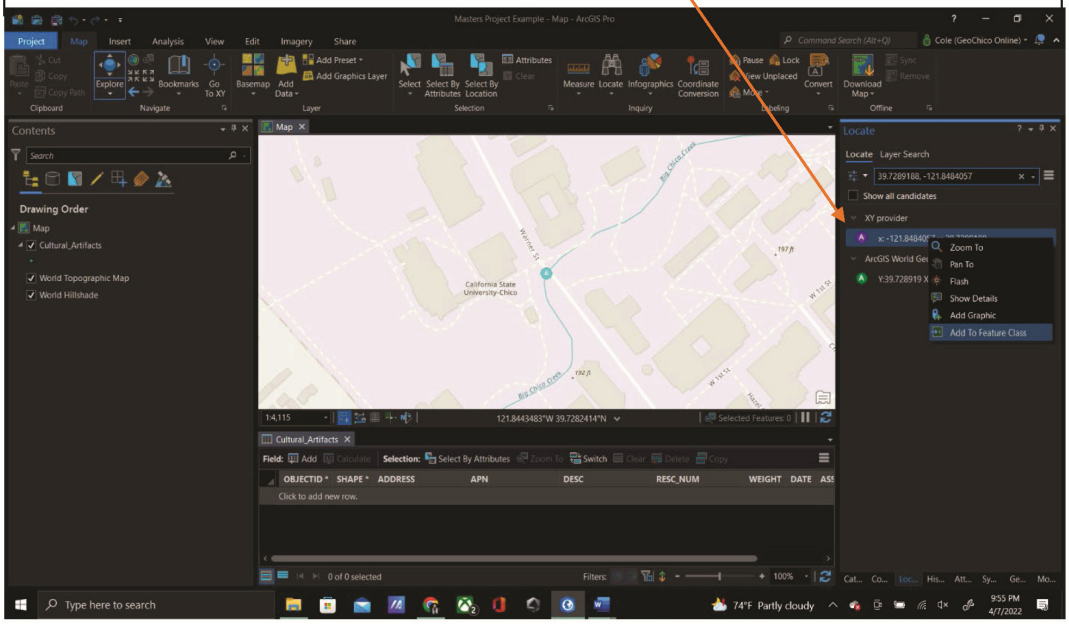
Step 8: now select the "locate" tool.



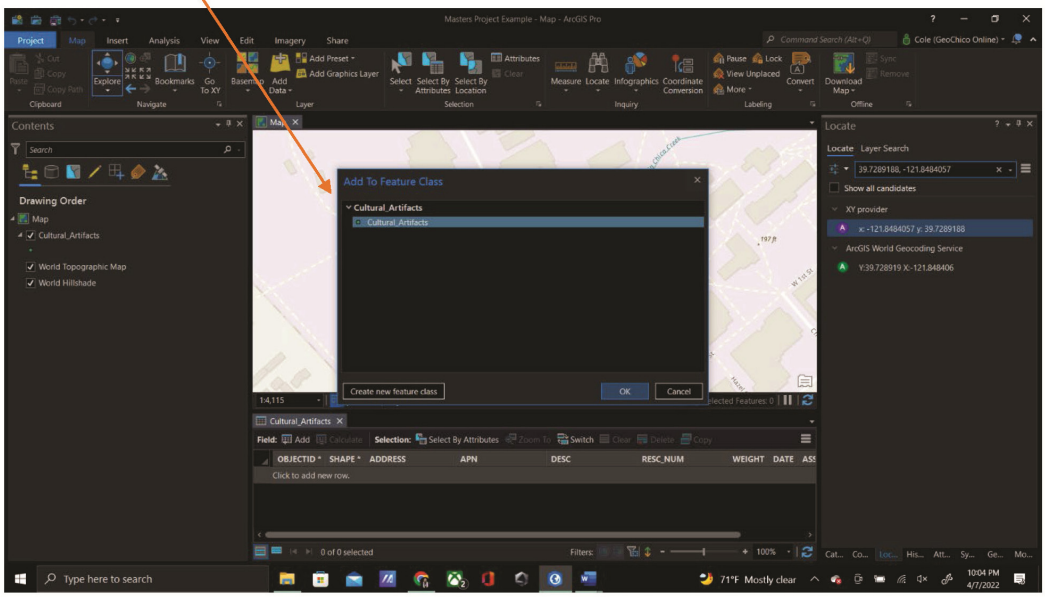
Step 9: The pane to the right will open with a search bar where you can search the latitude and longitude coordinates sent in by a monitor or taken in the field. For this project, the decimal degrees formats were used by monitors to send in the coordinates. Make sure to add a negative to -121.8484057.

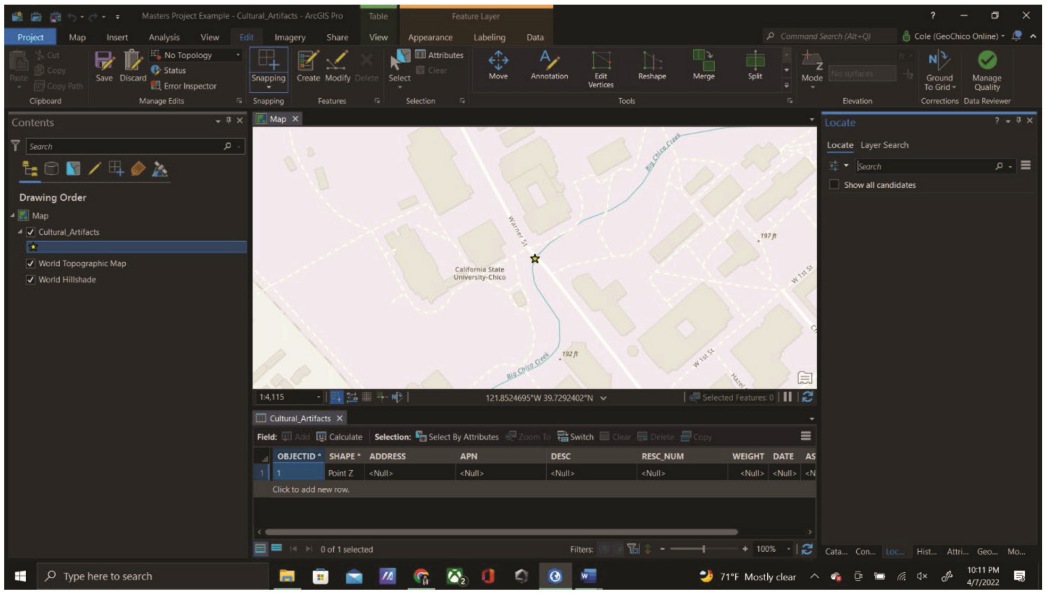


Step 10: Once you search the latitude and longitude, you will see two options. The first option will give you the latitude and longitude coordinates by the "XY Provider" and the second will be from the ArcGIS world geocoding service. Right click on the "XY Provider" option and click "Add to Feature Class".



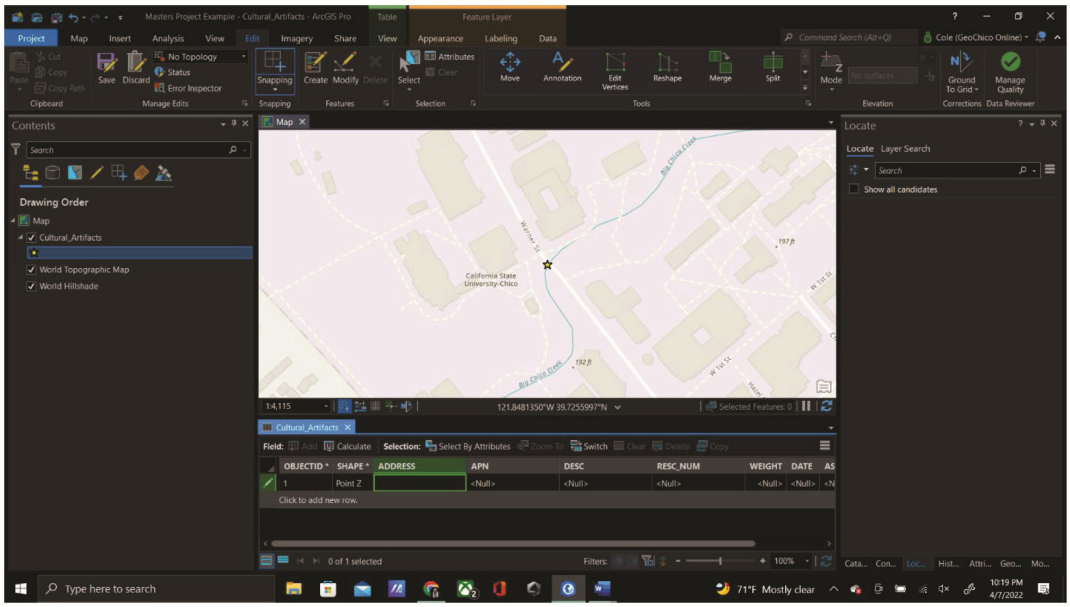
Step 11: By selecting the "Add to Feature Class" option, a new window will open, which you can then add the coordinates into the proper data layer, which in this case would be the Cultural_Artifacts Layer. Select the layer as shown below and press "OK".



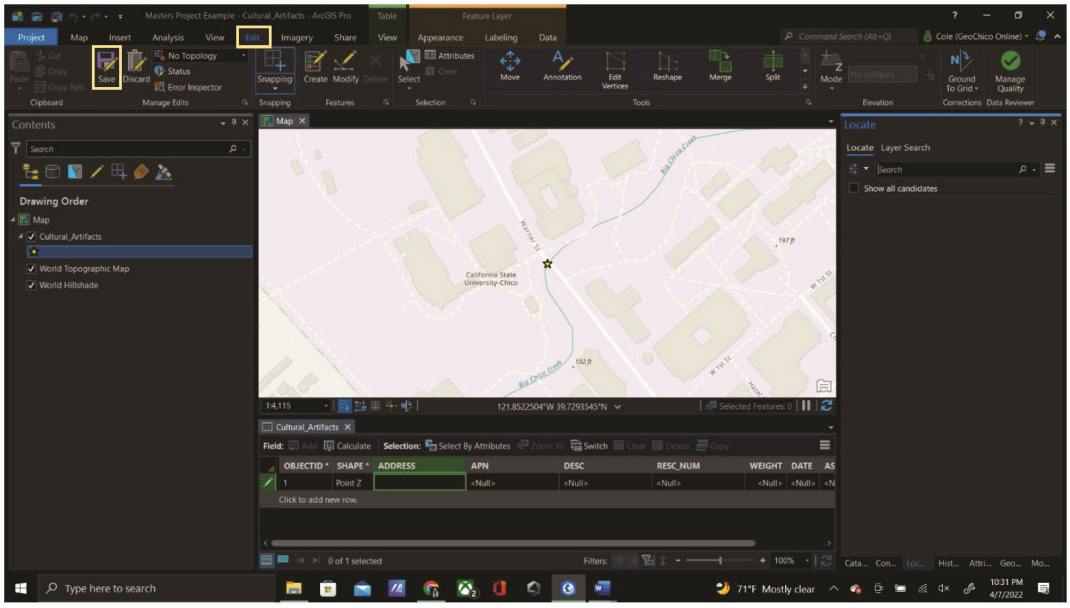


Step 12: After selecting the desired layer, open that layer's attribute table and scroll until you see the new row, which will have values that say "null". Additionally, you will also see the data point inputted from the previous step on the map.

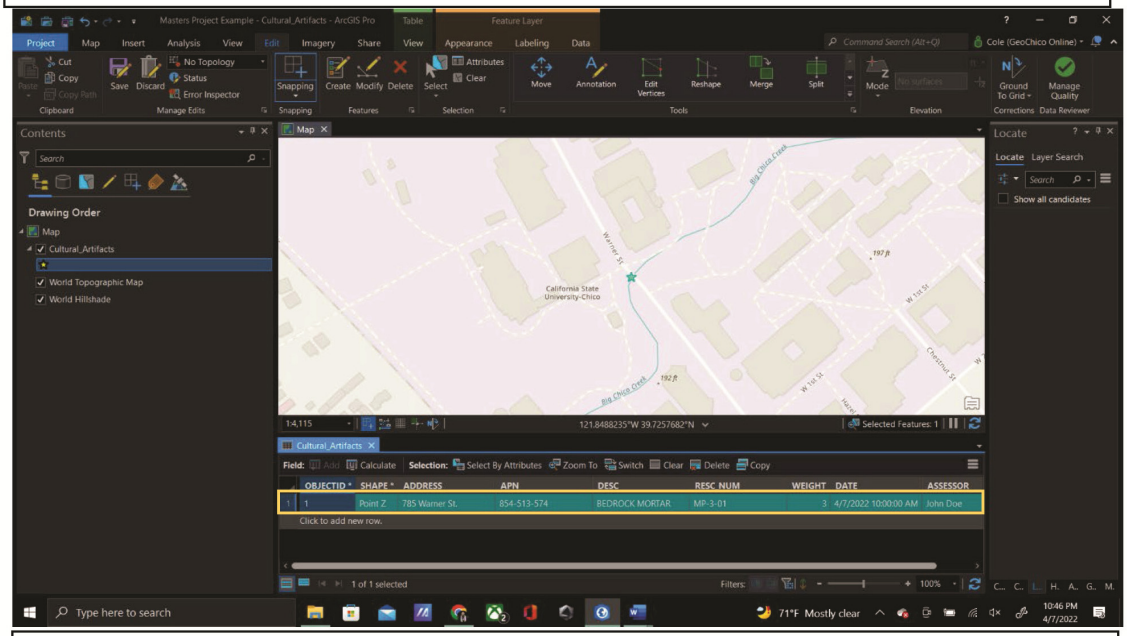
Step 13: double click on the “null” values. This allows you to edit each field with the proper information. You can edit these fields at any time by double clicking each field. Once you double click on the field to edit, you will see a green pencil in the attribute table and that indicates that the table is ready to edit.



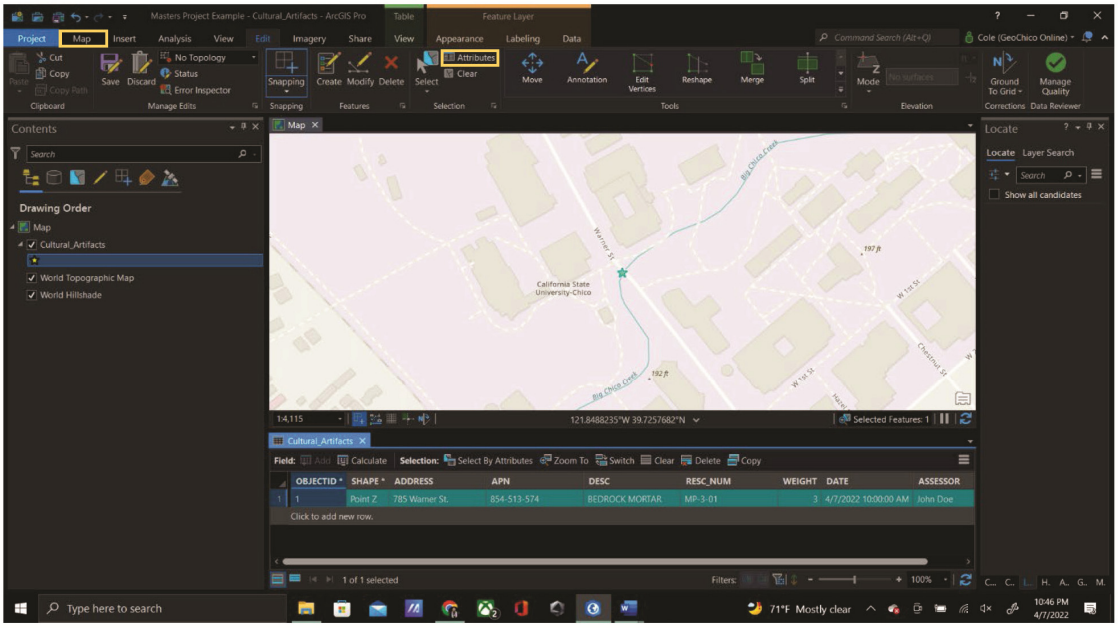
Step 14: Always make sure to save your edits once you input them. The “save edits” option found under the edits ribbon and is shown with the pencil and floppy disk icon. By selecting the save option, all the information you inputted about the resource is added to the project.



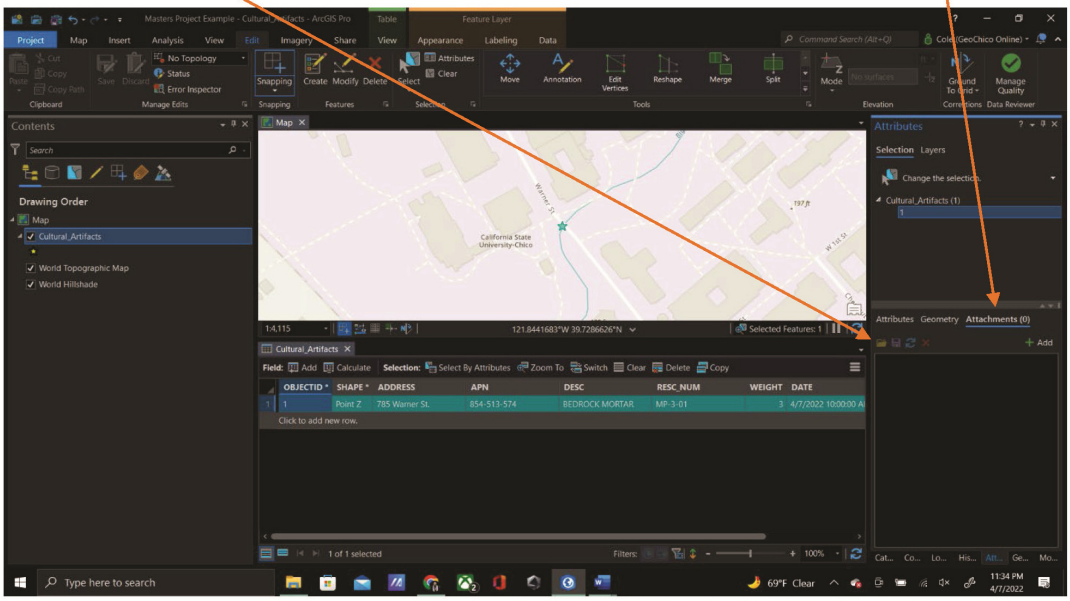
Step 15: Once your edits are saved, highlight the row you just created. This can be done by selecting the number on the far-left side of the attribute table. This then highlights the row with a bluish green color. After this step, we now move to attaching sites records and photos to the data points.



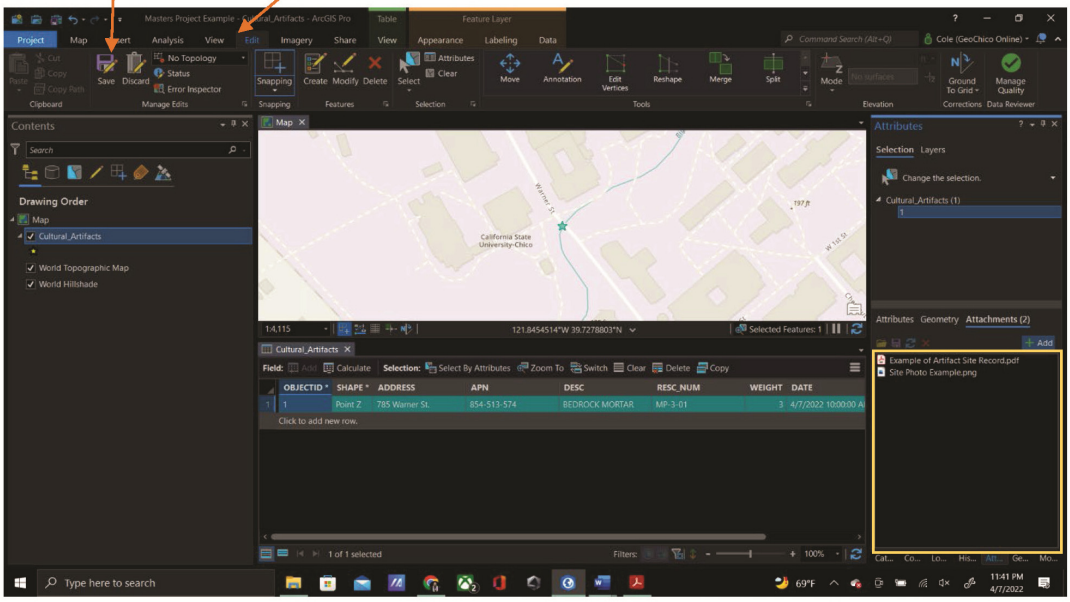
Step 16: now navigate to the map ribbon first and then click on the “attributes” option.



Step 17: A new contents pane will open on the right side of the screen. Then click on the "Attachment" option. This will allow you to either drag or drop files or if you click on the green plus icon with the word "add", you may browse your computer for the folders that hold the artifact records and artifact picture.



Step 18: After completing the last step you will now see your files in the "Attachment" box. Once you see your files, click on the "Edit" tab at the top of the screen and select the "Save" option denoted with the floppy disk icon to save your attachments and work.



Step 19 (Final): Once you have saved your edits. This will allow you to click on each point feature on the map, which will result in the pop-up window displaying the data you inputted in the earlier steps, along with the artifact's pictures and site record. This feature made it easy for this project to view artifact data and pictures in the field.