ABSTRACT

Title: USING GEOSPATIAL INFORMATION SYSTEMS TO PREDICT THE FORM OF “ROADBEDS AND ROAD SEGMENTS” CLASSIFICATIONS FOR THE CHEROKEE TRAIL OF TEARS IN MISSOURI, 1837-1839

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This thesis aims to answer the questions, “How can we efficiently use the processes of categorization and Geospatial Information System (GIS) methods and analyses to help identify the ‘form’ that various segments on the Trail of Tears, specifically the listed National Historic Trail (NHT) of the “Cherokee Trail of Tears in Missouri, 1837-1839”? Can a predictive model be developed by looking at the spatial relationships between modern roads and the suspected paths taken by the Cherokee in 1837- 1839? If so, what other information can be gained from this approach?”

The classifications are derived from the National Register of Historic Properties (NRHP) Multiple Property Documentation Form (MPDF) and discuss the classifications and criteria that segments of the Trail of Tears must meet to be considered contributing characteristics. The NRHP documentation form defines these different classes of the Trail of Tears into ‘three basic forms:1) Modern Roads, 2) Limited-Use, Passable Roads, and 3) Abandoned Roads. This thesis is limited to the segments of the Trail of Tears that

fall within the Mark Twain National Forest (MTNF) boundaries. Though much of the Trail has been modified into modern roads, traces are still evident in many locations along these modern routes that hold integrity from the significant period of the late 1830s. Because the Trail of Tears passes through multiple states and traverses over 6,000 miles, managing the protection of its physical traces can be a logistical challenge for cultural resource managers.

For this thesis, I developed a carefully constructed GIS model that is able to predict these classifications of various Trail of Tears segments using a sequence of geoprocessing methods, logical operators, and Boolean algebraic expressions. Using GIS, I determine the spatial relationship between the National Park Service's Trail of Tears linear data and the extant roads that have been documented to date. I then use statistical analysis to assess the model itself and its findings.

The results identified seventeen segments of the Trail that are likely to hold integrity in the roadbed and road segment form three: abandoned. This is important because this form is the most sensitive to any undertakings and includes the segments that hold the greatest amount of integrity. The results also confirmed that the Trail of Tears does have a spatial relationship with many modern and limited-use roads that are still used today. Basic statistical analysis confirmed that the sample segments used to develop the draft model are representative of the model's outcomes when applied to a forest-wide scale and that a total of 68.94 miles of the Trail crosses through the Mark Twain National Forest.

This thesis also emphasizes collaboration and consultation methods with the Cherokee Nation throughout the chapters as the way forward before this model is considered

finished. The intent of this thesis is to provide a management tool for cultural resource managers to predict which segments of the Trail of Tears fall into the three classifications by using a specific set of geoprocessing methods. This tool can be helpful in identifying areas of the Trail that may hold more physical integrity than others and implementing specific protection measures from any undertakings. It also adds to our understanding of the Trail of Tears within the MTNF.

This model can also contribute to our understanding of the Trail of Tears and the hardships the Cherokee faced during that time. It will also provide research and public education opportunities so we can adequately convey the significance that the Trail of Tears has in our history. This model is built to be flexible for adding additional parameters that may be added through future research or consultation. The methodology used to produce this model would stay the same if used in other areas where the Trail crosses. The input parameters are likely to differ, but the methodology would stand.

USING GEOSPATIAL INFORMATION SYSTEMS TO PREDICT THE FORM OF "ROADBEDS AND ROAD SEGMENTS" CLASSIFICATIONS FOR THE CHEROKEE TRAIL OF TEARS IN MISSOURI, 1837-1839

by

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Thesis submitted to the Faculty of the Graduate School of the University of Maryland, College Park, in partial fulfillment of the requirements for the degree of Master of Professional Studies in Cultural and Heritage Resource Management

2024

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Forward: **Termination**

An end to the life we have known,
Just like before.
How long will it be before you try
Again to end our existence?
Once we asked only to share
What you eventually took and what we had.
What had we done then
To make you act the way you did?
You didn't listen then
And you're not listening now.
You only tell us what we should do.
You say you want what's best for us.
We had that once and you took it.
How do you know what is best for us
When you don't know what is best for you?
No, we can't change the past
But you're not trying to make
The future any better for us.
You're only trying to push us
As far away from you as possible.

- D. Chiltoskie

Acknowledgments

I want to express my deepest appreciation to my husband and best friend, Clay, for his unwavering support throughout the past few years. You have been my rock; I love you.

I would also like to thank my sweet pup, Khaleesi, for ~~demanding~~ ensuring that I took plenty of breaks to let her outside, prompting me to stretch and get fresh air.

I am also eternally grateful for my six cats, Simba, Peaches, Tux, Niffler, Floki, and Mr. Jon Snow Kitten Floofy Tail for keeping my lap warm and my desk crowded.

I would lastly like to thank myself for persevering despite multiple setbacks and challenges. My determination and resilience have been pivotal in reaching this milestone, and I am proud of this achievement.

*"*What a shame she went mad*"* – *Taylor Swift*

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(I) Introduction

In an attempt to answer, how can we efficiently use the processes of categorization and Geospatial Information System (GIS) methods and analyses to help identify the 'form' that various segments on the Trail of Tears, specifically the listed National Historic Trail (NHT) of the "Cherokee Trail of Tears in Missouri, 1837-1839" that crosses the Mark Twain National Forest? Can a predictive model be developed by looking at the spatial relationships between modern roads and the suspected paths taken by the Cherokee in 1837- 1839? If so, what other information can be gained from this approach? This thesis aims to create a reliable GIS model that can predict the "Three Basic Forms" classification status of other Trail of Tears segments that have been identified within Mark Twain National Forest jurisdiction. These Forms are defined in the National Register of Historic Places (NRHP), Multiple Property Documentation Form (MPDF) for the "Cherokee Trail of Tears in Missouri, 1837-1839," National Historic Trail. The Trail of Tears encompasses over 5,000 miles and crosses through several states. The ability to predict the NRHP classifications for 'Property Type One: Roadbeds and Road Segments' could save many of the limited resources archaeologists and researchers retain when attempting to apply this criterion to other Trail of Tears segments. The ability to predict the form of a segment of the Trail of Tears can also identify segments where more resources are needed for protection and research.

To do this, in Chapter One, I will first discuss the theoretical concepts of Foucault's governmentality and the need to implement a more holistic way of thinking through consultation with descendant communities to administrate cultural resource management practices adequately. I will discuss how we use the National Register of

Historic Places (NRHP) as a guide for determining what archaeological resources are considered ‘significant’ and why consultation with descendant communities should be a greater focus in this determination. I will lay out the framework that the National Register of Historic Places Multiple Property Documentation Form for the “Cherokee Trail of Tears in Missouri, 1837-1839” defines as the criteria for Property subtype one: Roadbeds and Road Segments,” as these definitions, as they are, are essential to the research presented here. These definitions were derived from previous research on the Trail of Tears and a condition survey of extant roadbeds and road segments (Patterson 2013: F3). It is also with the understanding that these definitions may change through forthcoming consultation, or more variables will be incorporated.

I will then explore the history of the Trail of Tears and the events leading up to it in Chapter Two. While this research relies heavily on many technical aspects of the physical remains of the Trail of Tears, it would be an injustice not to discuss the setting in which this tragic event occurred. This history is the reason we apply significance to historic roadbed swales and ruts from the routes taken during these events and why a modern highway while lacking in its historic environment, is still considered important.

In Chapter Three, I will briefly discuss what GIS is and the many processes and functions that can take place in the software that allow us to understand the spatial context of the natural and constructed environment and archaeological data. I will also identify the data I used to build the model. Equally essential details of the methods used to create the model will follow. With a number of geoprocesses, logical operators, and the use of Boolean algebra, a meticulously designed model was developed and

depicted predictions of the roadbed forms that various Trail of Tears segments possess within the Mark Twain National Forest. The results of this are discussed in Chapter Four.

In Chapter Four, I will present my results and observations after applying the predictive model to any intersecting segments of the Trail of Tears within the boundaries of the Mark Twain National Forest. Problems that were encountered and the proceeding solutions will be addressed, along with the final outcome of the model pertaining to the roadbed and road segment forms. Additionally, the results from the various geoprocessing methods used to classify any roads will be presented as those were essential to the overall success of the model.

In Chapter Five, I analyze the results presented in Chapter Four. From the results, I examine what the application of the model can inform us about the Trail of Tears in Missouri. I interpret the outcomes of the predictability model along the various segments of the Cherokee Trail of Tears in Missouri that intersects with Mark Twain National Forest managed land. A basic statistical analysis will also be conducted to understand more about the data gained from these processes.

In conclusion, I will wrap things up with a discussion about the future research opportunities and the ramifications this could have on those who are involved in the management of the Trail of Tears, including the MTNF's consulting parties. I will also address the various implications of applying this model to other National Forest managed Trail of Tears segments, or other lengthy linear cultural resources.

(II) Governmentality, Significance, and the NRHP:

In order to answer the questions of how can we efficiently use the processes of categorization and Geospatial Information System (GIS) methods and analyses to help identify the 'form' that various segments on the Trail of Tears, specifically the listed National Historic Trail (NHT) of the "Cherokee Trail of Tears in Missouri, 1837-1839"? Can a predictive model be developed by looking at the spatial relationships between modern roads and the suspected paths taken by the Cherokee in 1837- 1839? If so, what other information can be gained from this approach? We must first understand why approaching such investigations through a blending of governance and collaboration with Descendant communities is the right approach. This chapter is structured in a way that first discusses why humans rely on categorization, followed by a discussion on governmentality and the importance of categorization to governance. The following critique of relying on only these methods to evaluate cultural resources and how we can attempt to mitigate this way of thinking is presented. After these discussions, I will examine the relationship between the US Forest Service and the Cherokee Nation, along with the widely accepted use of GIS as a tool to help govern cultural resources. Then, finally, a discussion of the laws and criteria for the National Register of Historic Places as it pertains to the Cherokee Trail of Tears in Missouri and the need to conduct consultation before the determination of such categories. 36 CFR § 800.16(f) defines consultation as "the process of seeking, discussing, and considering the views of other participants, and, where feasible, seeking agreement with them regarding matters arising from the Section 106 process."

Humans have had to rely on our ability to categorize for millennia, and this ability is even considered to be a characteristic of “sophisticated thought” (Seger and Miller 2013, Walther et al. 2009). This ability of the human brain to efficiently categorize situations, events, and the natural world has been foundational to societal evolutions. It is how our brains work and process the world around us. “We have evolved the ability to detect the higher-level structure of experiences, the commonalities across them that allow us to group experiences into meaningful categories and concepts. We instantly recognize and respond appropriately to objects, situations, expressions, etc., even though we have never encountered those exact examples before. Without this ability, experiences would be fragmented and unrelated” (Seger and Miller 2013:1). These connections and interrelations are everything when trying to understand natural and man-made environments. This is an important concept to keep in mind going forward.

For example, words such as trees, rivers, animals, and bugs tend to lead one to think about nature. However, these words start to mean very different things from one another if you are looking for something to eat. You would not hunt a tree or a river as you would many animals (or even bugs if you’re desperate). Instead, you would start to separate those words into edible and non-edible classifications. These are very basic categorizations, but they are still incredibly important to survival.

We do this with almost every action we carry out; some classifications are as basic as non-edible vs. edible, but many are more complex, such as if we start to separate animals by species, environments, and population numbers for the management of a continued food source for a small town. This is also where the concept of governance comes into play. To make sure that this food source remains a viable option for the

future, a limit on the number of animals one can hunt may be imposed, or measures may be taken to protect a certain environment so that this animal's population remains sufficient enough that there is a reliable food source for the future. However, one cannot govern a resource if one does not understand all the variables that contribute to the success of that resource; this is where the concept of interconnection between these variables is stressed. Some societies have a better understanding of how all variables are connected, such as the Native Americans, and some societies rely too heavily on advanced classification and categorization to recognize the interconnectedness of the natural and man-built environments.

Foucault's Governmentality

"Governmentality" by Michel Foucault, 1991, discusses the idea of governance and its evolution over the centuries in Western societies. The idea that governance is poised as a 'problem' in a theoretical sense as questions of "how to govern oneself, how to be governed, how to govern others, by whom the people will accept being governed, and how to become the best possible governor" (Foucault 1991: 87), arise in sixteenth-century Europe. These questions still influence societies worldwide, but different societies and cultures have approached their idea of governance very differently. The idea stands, though, that governance is a conceptual issue that ranges from international, national, state, familial, and personal levels. In our personal lives, we determine how and by whom we allow to be governed. It can be the state, your employer, or even religious and moral governance, on the condition that we maintain some sort of rationale as to why we allow this type of governance over us.

Foucault further goes on to iterate the importance of the ‘art of government’ on subsequent forms of emergent European governments from the late sixteenth century to the early seventeenth century. Essential to this construct is the formation of a “set of analyses and form of knowledge… which were essentially to do with knowledge of the state, in all its different elements, dimensions and factors of power, questions which were termed precisely ‘statistics’, meaning the science of the state” (Foucault 1991: 96). The ‘reason of the state’ was understood in a “full and positive sense; the state is governed according to rational principles which are intrinsic to it and which cannot be derived solely from natural or divine laws or the principles of wisdom and prudence; the state, like nature, has its own proper form of rationality… and must find the principles of its rationality in which constitutes the specific reality of the state” (Foucault 1991: 97). The science of government made it possible to “identify problems specific to the population” and “through its shifts, customs, activities, etc.”, population has its own specific phenomena in which can be quantified through statistics (Foucault 1991: 99).

From this, ‘population’ shifts into the focal point of any governance and the purposes of the government, from one of sovereignty, becomes beholden to the population. “The welfare of the population, the improvement of its condition, the increase of its wealth, longevity, health, etc., and the means that the government uses to attain these ends are themselves all in some sense immanent to the population” (Foucault 1991:100). It is through these ‘means of government’ that cultural resources are managed today within a western, state central, context.

The Foucault understanding of governance is that in order to govern a resource for the population, obtain statistics and other ‘knowledges of the state’ regarding such a

resource, and manage the resource adequately based on such knowledge, we must first collect that knowledge and classify it into categories that are relevant to what it is we are aiming to understand.

Critique

It is easy to simply check if something fits nice and neatly in a tiny little box, but cultural resources are not simple, they are complex because humanity is complex, and they don't tend to fit perfectly into any tiny boxes.

Governance, as proposed by Foucault, relies on the various series of categorizations and order needed to understand the population and their relationship to resources that provide some benefit to that population to which the government is beholden.

In an Indigenous context, the idea of governance is different. Rather than a strictly state-centered model to define the concept of governance, the focus is more on interconnectedness and natural principles to govern (French and Hornbuckle 1981: 5). This was what Foucault's construct of governance omitted. As his construct of governance was developed in a European setting, Native Americans' application of governance is based on their beliefs, in which everything is connected, and the land provides the tools necessary for the survival of the people. The early Cherokee political organization represented "a kin-based, segmented, non-egalitarian, small-scale society" that is most equitable to a chiefdom (French and Hornbuckle 1981:5). "For the most part, the Cherokee exercised local autonomy with the various villages with the larger link of clan structure between the villages" (French and Hornbuckle 1981:5). Furthermore, all adults were allowed to engage in public discussions, with any decisions

made by consensus with the “red chief,” for wartime and external affairs, or the “white chief,” for domestic regulations (French and Hornbuckle 1981: 6). These organizational structures within Cherokee government are more community based, while Foucault’s government is centristically focused. The differences between the early Cherokee government and the European governments have been the cause of much woe throughout the decades. The differences in how Europeans see the world compared to Native Americans are evident through modern political structures. Not only have these views influenced the government structures we see today, but they also had a direct impact on our modern constructs surrounding cultural resource management and archaeology.

Contemporary Cherokee Governance and CRM

The modern political structure of the Cherokee Nations resembles the past Cherokee political structure and is similar to that of the US government. The most important thing to remember, though, is that the Cherokee Nation, along with all other federally recognized tribes, is sovereign and not beholden to the United States.

Idea of Sovereignty

The “Tribal Relations Strategic Framework for the Eastern Region, Northeastern Area, and Northern Research Station,” along with other U.S. Federal documents, defines a Federally Recognized Tribe as “An American Indian or Alaska Native tribal entity that is recognized as having a government-to-government relationship with the United States, with the responsibilities, powers, limitations, and obligations attached to that designation and is eligible for funding and services from the Bureau of Indian Affairs. Federally

recognized tribes are recognized as possessing certain inherent rights of self-government (i.e., tribal sovereignty) and are entitled to receive certain Federal benefits, services, and protections because of their special relationship with the United States. At present, there are 566 federally recognized American Indian and Alaska Native tribes and villages" (USDA Forest Service 2015).

Sovereignty between the U.S. and Federally Recognized Tribes is upheld through treaties and early U.S. Supreme Court decisions. *Cherokee Nation v. Georgia, 1831* determined that tribes remain "separate sovereigns, pre-existing the Constitution." This court also addressed the question of whether the Cherokee Nation was a "foreign state" and, therefore, could sue the State of Georgia in federal court. The court ruled that federal courts had no jurisdiction over such a case because Indian tribes were "domestic dependent nations" existing "in a state of pupilage. Their relation to the United States resembles that of a ward to his guardian" (*Cherokee Nation v. Georgia 1831*). This court also established the federal Indian Trust Doctrine that "continued to be built upon through Indian treaties, additional Supreme Court decisions, statutes, executive orders, and the historical relations between the United States and Indian tribes. In a broad sense, the trust responsibility relates to the United States' unique legal and political relationship with Indian tribes; tribes are political entities that predate the existence of both the European colonial powers and the United States of America, therefore possessing senior rights and interests…The federal Indian trust responsibility is a legally enforceable fiduciary obligation on the part of the United States to protect tribal lands, assets, resources, and reserved rights, as well as a duty to carry out the

mandates of federal law with respect to American Indian tribes" *(Cherokee Nation v. Georgia 1831).*

Modern Cherokee Nation

The modern political structure and legal authority of the Cherokee Nation is based on the Cherokee Nation Constitution, ratified in 2003, and is set up similarly to the US Government in that it has an executive, legislative, and judicial branch. According to the Constitution of the Cherokee Nation, drafted in 1999, the Legislative branch consists of an elected 'Council of the Cherokee Nation' with seventeen members led by the Speaker and Deputy Speaker and represent the districts within the Cherokee Nation. The Executive branch is led by the elected Principal Chief and Deputy Principal Chief. Every four years consists of an election cycle in which these appointees are voted in and are subsequently required to select Cabinet leaders, such as Secretary of State, Treasurer, etc. The Judicial branch of the Cherokee Nation is entrusted to a five-member Supreme Court with members appointed every two years with a ten-year term limit. This court oversees all lower courts within the Cherokee Nation. (Cherokee Nation 1999).

US Forest Service and Cherokee Relationship- CRM

The Executive branch of the Cherokee Nation, under the Secretary of Natural Resources Office, includes the Tribal Historic Preservation Office (THPO). The THPO's goal is to preserve and manage cultural heritages and protect sacred places that the Cherokee have a vested interest in (Cherokee Nation 2024). Their job is to consult through a government-to-government relationship with state and federal agencies to

ensure that their cultural resources are not negatively impacted by any undertaking on ancestral lands and other geographic lands of interest. They oversee all projects conducted on Tribal land in the same way, per 36 CFR § 800.2(c)(2)(B)(ii).

The Mark Twain National Forest (MTNF) is part of the USDA Forest Service agency and is therefore considered a U.S. Federal entity, and thus subject to consultation and collaboration with all THPOs who have ties to lands managed by the U.S. Forest Service per 36 CFR § 800. (Please see the section below for a discussion of cultural resource management laws and regulations for this process).

The Cherokee Nation THPO is considered a consulting party, as a sovereign nation, to the Mark Twain National Forest, as it pertains specifically to the Trail of Tears that crosses throughout the forest. The Trail of Tears and its many routes were declared a Sacred Site by the Tribe in 2016, per Executive Order 13007.

Throughout multiple communications between the Cherokee Nation and the Mark Twain National Forest, the Cherokee have expressed that their main geographical interest in Missouri is the Trail of Tears, as the area is not part of their ancestral homeland. Regular Section 106 consultation and collaboration communications are conducted between the MTNF and the Cherokee, which has resulted in a productive and mutually beneficial relationship between the two entities and embodies government-to-government relations.

CRM and the United States

For an inclusive definition of what ‘cultural resources’ are, Thomas King states that these resources “include those nonmaterial human social institutions that help make up

the environment in our heads- our social institutions, our beliefs, our accustomed practices, and our perceptions of what make the environment culturally comfortable," and should be "understood as those aspects of the environment – both physical and intangible, both natural and built—that have a cultural value to a group of people" (King 2013: 3). The term 'cultural resources' though, from a purely legal standpoint, is not defined. The term 'historic properties,' however, is defined in the National Historic Preservation Act (NHPA) to mean "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places (NRHP), and includes artifacts, records, and remains that are related to and located within such properties" 36 CFR § 800.16(L)(1). For all intents and purposes of this thesis, I will use the term 'historic properties' as a synonym for cultural resources (National Park Service and Advisory Council on Historic Preservation 1995: 2). The definition of historic place is especially important in a legal sense, as it pertains to cultural resource management in the United States.

The field of cultural resource management (CRM) came about through several federal legal frameworks over the decades in an effort to impose governance of these resources in the Westernized context. The Antiquities Act of 1906 and the Historic Sites Act of 1935 cumulated through the growing awareness that 'significant' 'historic properties' needed to be protected and preserved. The National Historic Preservation Act in 1966 framed the *why, what*, and *how* historic properties are to be managed and protected, which had been lacking in the previous regulations. The NHPA was further amended in 1976 with Executive Order 11593, "Protection and Enhancement of the Cultural Environment," which required federal agencies to consider the effects of their

actions (or undertakings) on properties listed on or eligible for listing on the National Register under their jurisdiction. This Executive Order further solidified the commitment that federal agencies must inventory and evaluate their historic properties against the criteria of the National Register of Historic Places.

Section 106 of the NHPA, codified as 54 USC § 300320 and 36 CFR § 800, identifies the role of a federal agency in the historic preservation process. Federal agency historic preservation responsibilities, outlined in title 54 U.S.C. § 306102(b)(5)(B) state that for an agency to comply with this title, they must “provide a process for the identification and evaluation of historic place for listing on the National Register and the development and implementation of agreements, in consultation with State Historic Preservation Officers, local governments, Indian tribes, Native Hawaiian organizations, and the interested public, as appropriate, regarding the means by which adverse effects on historic place will be considered.”

It has historically only been this Section 106 legal obligation to consult with Tribes who have an ancestral claim that the voice of the Tribe has ever been considered in the identification and management of their own ancestral heritage. Also, historically, consultation has been little more than a formal letter from the federal entity to the Tribal Historic Preservation Office (THPO) on the determinations that the archaeologists have already assigned. We, as archaeologists, must do better as this is not sufficient to adequately identify, interpret, and decide on the best management practices of the cultural resource. We cannot know the significance of a cultural resource without first *talking* with the descendant communities of whose heritage it originated. We cannot understand how to properly manage it without the insight of these communities and

developing a partnership in the stewardship of these properties. Chip Colwell (2016) states that “Descendant communities have helped to fundamentally transform archaeology into a science that is driven by an ethical engagement with key publics invested in the interpretation and management of the material past” (Colwell 2016: 113).

NRHP and Significance

The National Register of Historic Places, as outlined in 36 CFR § 60, aims to narrow down and define, legally, which historic properties are subject to further preservation and determine which defining characteristics of an archaeological resource or historic place convey a site’s significance.

The National Register of Historic Places defines the ‘significance’ and ‘integrity’ of a historic place and makes an effort to establish a consistent legal standard under which cultural resource managers are to operate. After a historic place is classified as either a district, site, building, structure, or object, one must then determine the historical context a property has within a relevant geographic area (National Register Bulletin 15 1995: 3). These contexts can represent American history, architecture, archaeology, engineering, or culture (National Register Bulletin 15 1995: 3). Then it is time to consider significance. The idea of significance, according to the NRHP, can be summarized below.

> The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feelings, and association (National Register Bulletin 15 1995: 2).

The NRHP defines significance based on four criteria. For a site to be considered significant, it must either be "**a)** associated with events that have made a significant contribution to the broad patterns of our history, **b)** associated with the lives of persons significant in our past, **c)** embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction or **d)** that have yielded, or may be likely to yield, information important in prehistory or history" (36 CFR § 60.4).

The idea of significance can be ambiguous and varied. The NRHP defines significance in a systematic and categorical method, in an attempt for cultural resource managers to logistically govern over such resources. William Butler asserts that "compliance with the cultural resource laws demands that of Historic Places (NRHP) significance for archaeological properties be well understood; significance is the vehicle for melding archaeological knowledge with cultural [knowledge] and thereby making contributions to preserve and protect elements of our heritage" (Butler 1987: 821).

Butler also goes on to say that "although we can identify many sites that may merit formal nomination for long-term protection, many sites cannot be saved," and if "a site is not considered eligible for the Register, i.e., it fails to meet one of the criteria for significance, then no avoidance is necessary or warranted because the *archaeologist* has stated that the site will not yield any information important to prehistory or history, and it need not be given any further consideration" (Butler 1987: 822). I agree that not all sites can, or should, be saved, but I disagree with Butler in that just because an archaeologist says so, a site should be deemed insignificant. In this determination of

significance, as it is, the Native voices who should have the loudest authority over these decisions are all but silenced. The NRHP gives no room for Native voices to have a say so over what is significant or not pertaining to their own cultural heritage. The only legal avenue for Native voices to have influence over their own heritage comes from Section 106, through consultation. Historically, efforts for consultation have been weak. This process needs to improve greatly, and real relationships between federal agencies and tribal governments must be cultivated. Without these relationships, cultural resource managers cannot, in good faith, claim to understand the significance of a historic place outside of their culture and, therefore, cannot make the best management decisions regarding said historic place. It is through a collaborative effort that government-to-government administration works best. It is through collaboration that results in the most advantageous method of understanding and protecting a historic place. “Collaboration is not motivated primarily by the benefits it bestows on archaeology. Rather it advocates a partnership approach that is motivated by the rights communities have to be active participants in the creation of knowledge” (Atalay 2012: 45).

We cannot possibly save and protect every flake, every farmstead remain, every 1970s bottle scatter, every lithic scatter, and so forth. It is an impossible task. Our legal duty as archaeologists is to record and document everything we can about a site or property we locate and then evaluate, from a Westernized approach, whether it meets any of the significance criteria of the NRHP through a series of applied categorizations. This, again, does not count the input from Native voices. The NRHP implies that if a resource does not meet these criteria, its preservation should not be needed because, in theory, you would have documented everything you could, and further efforts to excavate or

record the site would be redundant and/or would not add anything new to the archaeological record. This does not incorporate any reference to tribal sovereignty and the right to have a say in their own heritage.

It is also our legal and ethical duty to consult with our partners, as outlined in the NHPA 36 CFR § 800.2(a)(4), to concur or disagree with the findings. For example, a Tribe that a federal agency has a duty to consult with may disagree with the NRHP designation of “not eligible” for a historic place that is important for that Tribe. They can then request that the federal agency protect that site and change its status to eligible due to a cultural significance or variable your findings may not have considered.

The research presented in this thesis relies heavily on the different constructs that cultural resource managers have to abide by within the legal framework of the United States, but it is with the understanding that this research will need to be consulted on to move forward before any meaningful implementation occurs.

How the NRHP legally defines significance and integrity for CRM managers is the framework for how historic properties are currently evaluated. This isn’t necessarily how it should be, but how it is. Cultural resources, though, should be equally evaluated through the lens of the descendants’ understanding of their ancestors and cultural heritage.

This thesis, however, only focused on the legal aspects of the NHPA and NRHP as applied to the Cherokee Trail of Tears in Missouri, with the intention for the next steps, following the results and analysis of this research, to be consulted on to further refine the parameters and needs for management of the Trail of Tears within the National

Forest in a collaborative approach. It is only through consultation and tribal involvement that the proposed model can be used to benefit all invested parties effectively. For now, though, this thesis will function within the parameters of the NHPA and NRHP.

NRHP Integrity Discussion

After the legal definition of significance if applied, integrity of the historic place must be assessed. The National Register of Historic Places defines seven aspects of integrity: location, design, setting, materials, workmanship, feeling, and association. Each of these aspects indicates a property's ability to convey its significance. Each of these criteria are defined below by the 1995 National Register Bulletin (NRB) 15, VIII.

> Location is the place where the historic place was constructed or the place where the historic event occurred.
>
> Design is the combination of elements that create the form, plan, space, structure, and style of a property that results from conscious decisions made during the original conception and planning of a property.
>
> Setting is the physical environment of a historic place. It refers to the character of the place in which the property played its historical role and its relationship to the surrounding features. Complemented with Location, this can be especially important in recapturing the sense of historic events and persons.
>
> Materials are the physical elements that were combined or deposited during a particular period of time and in a particular pattern or configuration to form a historic place and often indicate the availability of particular types of materials and technologies.

> Workmanship is the physical evidence of the crafts of a particular culture or people during any given period in history or prehistory. This is the evidence of artisans' labor and skill in constructing or altering a building, structure, object, or site.
>
> Feeling is a property's expression of the aesthetic or historic sense of a particular period of time and results from the presence of physical features that, taken together, convey the property's historic character.
>
> Association is the direct link between an important historic event or person and a historic place and requires the presence of physical features that convey a property's historic character (National Register Bulletin 15 1995: 44-45).

Most, if not all, of these aspects must be present for a historic place to retain its integrity. Knowing "why, where, and when a property is significant" will help determine which of these aspects are most important for a property to convey its significance (National Register Bulletin 15 1995: 44).

It can seem reductive to assess cultural resources in this approach, with strict categorization and classifications to determine their significance and integrity, especially without the voices of descendant communities. However, it can allow us to efficiently observe various correlations of a historic place's relationship to the surrounding environment and, through such correlations and relationships, present the systematic ability to convey importance or significance. But it is also the effort to include Native voices in the determination of these things that will more accurately assess which

resources show characteristics that would be able to convey their significance and integrity.

In the proceeding text, I aim to show the importance and potential adaptability of the NRHP in cultural resource management practice.

NRHP Significance of the Cherokee Trail of Tears

The Cherokee Trail of Tears is listed on the NRHP as a National Historic Trail that is of great importance to national history. It is also one of the largest linear historic properties that is managed in the United States. Its status as a Listed historic place on a national scale as “Historic and Historical Archaeological Resources of the Cherokee Trail of Tears” and at the local level, “Cherokee Trail of Tears in Missouri, 1837-1839”, represents a tumultuous time in American history and had lasting impacts on the economic, emotional, and spiritual health of thousands of Native Americans (Thomason and Parker 2002: E4). These impacts can still be seen today through the descendants of the survivors of this event. Given that this is such a large resource that covers thousands of miles, we can use processes of categorization to help identify and protect a given integrity factor for any segment that is of particular interest with more efficiency.

It should be understood, first and foremost, that the Cherokee Trail of Tears is a Listed National Historic Trail and declared a Sacred Site by the Cherokee, and it is subject to the same protections as any eligible or listed historic property. What is more, it is protected from any “adverse effects” from state or federal projects that can diminish its significance and integrity as a historic property. According to Section 106, any federal

undertaking must take this into account when determining the effects any such undertaking is likely to have on the Trail.

Because the Cherokee Trail of Tears is a historic property that covers some 5,043 miles with multiple routes, detachments, and dates, I will focus solely on the Cherokee Trail of Tears in Missouri, a Multiple Property Listing on the National Register of Historic Properties. The Cherokee Trail of Tears in Missouri is made up of the Benge Route, 1838, and the Northern Route, 1837 to 1839. These routes, combined with their variations through Missouri, are equal to some 600 miles, which is more miles of Trail than any other state (Patterson 2013: E2). While the Trail of Tears affected the Creek, Choctaw, Chickasaw, and Seminole Tribes, it was only the Cherokee who were forcefully escorted through routes in Missouri.

The Cherokee Trail of Tears in Missouri Multiple Property Documentation Form (MPDF), completed in 2013 by Tiffany Patterson with the Missouri Division of State Parks, lists, as the name suggests, multiple property types associated with this cultural resource. Property type I consists of Transportation Sites, with subtype A: Roadbeds and Road Segments and subtype B: Fords and Ferry Crossings/Landings. Property type II includes Buildings, Structures, and Building Sites. Property type III consists of Campsites, and property type IV represents Trail Graves. (Patterson 2013: F1-12).

Again, for the purposes of this thesis, I will further narrow my scope to focus on Property Type I, Subtype a: Roadbeds and Road Segments. “Roadbeds provide a physical link and sense of time and place of the actual Cherokee experience on the actual routes taken by the detachments on their journey west. They provide an understanding of the

difficulties inherent in overland travel in the 1830s and the challenges faced by the Cherokee on a daily basis" (Thomason and Parker 2002: E4).

These roadbeds and road segments will be "primarily significant under Criterion A: Ethnic Heritage/Native America for their historic use by the Cherokee on the Trail of Tears, and Criterion D: Yields, or potential to yield, information important to the historic use of the trail" (Patterson 2013: F4). "To be eligible for listing in the National Register under this cover document, a roadbed or road segment…

- For Criterion A: Must have clear and demonstrable association with the Cherokee Trail of Tears routes through Missouri. Found primarily through the historic record, via journals and letters, local removal period diaries and accounts of the removal or credible oral history accounts, etc.

OR

- For Criterion D: The potential for archaeological data and evidence can convey this significance criterion. Historical accounts of the Cherokee along the trail describe the loss and abandonment of personal possessions, breakdowns of wagons, stops for meal breaks and camping, and hunting for game to supplement rations. Remnants of these events and activities would have littered the roadway" (Patterson 2013: F4).

The MPDF states that "by definition, all Trail of Tears-related Road segments must retain integrity of location. However, many of the identified or identifiable segments will not retain integrity of design, materials, or workmanship and must rely heavily on aspects of feeling, setting, and association using the following guidelines:

1) Route: It must be possible to demonstrate that the roadbed or segment closely conforms to the route at the time of the Trail of Tears (this depends largely on

correlating diaries or reports from Cherokee delegations to known roadways… or connecting known entrance and exit points in the state by way of contemporary roadways (Patterson 2013: F1).

2) Physical appearance: The roadbed or segment should be unpaved, and segments must be relatively clear and passable. Completely abandoned road segments should be evidenced by ruts or swales.
3) Sense of function or destination: The roadbed or segment should be long enough to evoke a sense of destination.
4) Setting: The property should be in a setting characteristic of the original road. Generally, in a secluded, rural area with no modern intrusions such as recent roads or buildings, with the exception of extant 1830s resources" (Patterson 2013: F4-5).

Furthermore, the 2013 MPDF notes that based on "research of the roads used during the Trail of Tears and survey of existing conditions, roadbeds and road segments will take three different forms: modern public roads, limited-use, passable roadways, and abandoned, impassable roadways."

1) Modern public roads are defined as "road segments still in current use, but substantially altered. These segments are portions of the original Trail of Tears that have been widened, graded, and resurfaced to conform to modern road standards."
2) Limited use, passable roadways are defined if the "road segment is still used on a limited basis- usually as a footpath, farm access road, or forestry roads- and receives little to no maintenance. Swales, cuts, and fill slopes are major features

that are often still evident. Some may have improvements such as widening, gravel surfaces, low-water crossings, and limited drainage features.

3) Abandoned, impassable roadways are fragments that are no longer used or maintained. These are the original routes used by the Cherokee that have since been abandoned for new roads that conform to modern road or highway standards. They are evidenced by swales created by repeated use and/or erosion, road cuts, berms, and fill slopes" (Patterson 2013: F3).

The foundation of my thesis relies on these legally defined terms and processes. These are the aspects of the NHPA, NRHP, and MPDF that federal agencies must legally use to manage their historic properties, like the Trail of Tears in Missouri, 1837- 1839, a Listed property. Through these definitions, a starting point can be identified where Tribal input can be molded into the model for a comprehensive understanding of various characteristics that make up different roadbed and road segments on the Trail of Tears.

Using these definitions and processes, I will attempt to use various Geographic Information System (GIS) methods and analysis to develop a predictive model that will assist in identifying the different categories and criteria of extant roads and roadbeds of the Trail of Tears in Missouri within a modern context.

Consultation with Cherokee

This model aims only to be the draft process that will predict the categorized definitions outlined in the NRHP, which is, admittedly, regarded as a westernized form of governance. To move past this strictly westernized way of assessing our cultural resources, Native voices and point of views need to be added through collaboration and consultation.

Because the finished model, after consultation, is meant to be used as an internal tool for the Mark Twain National Forest and will not be subject to any programmatic or policy implementation, consultation will take place on a much smaller and informal scale. As there are no “findings or determinations” to discuss, formal consultation that requires an agency signature will not be pursued at this time. This management tool will be consulted on between the Cherokee Nation and the Mark Twain National Forest. This kind of consultation will look more like a discussion similar to the Mark Twain National Forest’s Cave Management Plan (in progress) and Wild and Scenic Riverways Management Plan (Mark Twain National Forest 2023; 2024). Tribal input was essential to the creation of these plans, but no signatories or ‘formal’ consultation took place. These are co-developed plans with input from all stakeholders involved, including Indigenous knowledge. (Mark Twain National Forest 2024: 61-67; Daniel Cain, personal communication 2024).

Before this project began, initial conversations with the Cherokee Nation THPO were conducted pertaining to this thesis. The Cherokee Nation will be our main consulting party as this model only pertains to the Sacred Cherokee Trail of Tears in Missouri. During those early conversations, it was decided for the Forest Service to create a draft model in which to work off of and visualize the concept to present to the Cherokee THPO (Daniel Cain, personal communication 2024). Now that the draft model is ready, the MTNF will invite the Cherokee Nation THPO to a call, during which I will walk through and present the processes and theory of the draft model, emphasizing transparency. Assuming the THPO will want to participate, we will encourage any

immediate comments or questions that may lead to a discussion (or discussions) for listening and consideration.

The draft model only incorporates significant variables and inputs that identify the physical integrity of the roadbeds and road segments. The question is, how else can we define significance from this draft model onto the Trail of Tears' segments in an adapted version of the model? Is there something else that can be added to this model that is of significance to preservation or research? In collaboration with the Cherokee THPO, we hope to finalize this as a useful management tool that identifies significant and integral parts of the Trail of Tears using all perspectives. This draft model will not be considered complete and ready for implementation until the consultation process has found agreement on all sides for future use.

This draft model is meant to be adaptable and altered to fit any needs brought up during consultations. This is a draft model and methodology for predicting specified categories and is open-ended. Again, this draft model is not considered finalized until consultation is complete.

Collaborative/ Participatory GIS

GIS, when used as a communication and collaboration tool, can allow for easier and more efficient input from the Cherokee Nation. As GIS becomes more a part of how cultural resource managers govern archaeological and cultural resources, the need for transparency and participation from those invested in a geographic area has also risen. As we emphasize collaboration from descendant communities in how we protect and manage our cultural resources, GIS should also include ways to collaborate.

Public Participatory Geographic Information Systems (PPGIS) refers to “the use of GIS to broaden public involvement in policymaking as well as to the value of GIS to promote the goals of nongovernmental organizations, grassroots groups, and community-based organizations” (Sieber 2006: 491). PPGIS came about, in part, as a response to the critique that “GIS represents yet another instrument of capital control and government surveillance… and frames GIS as a return to positivism in which its users quantify passionately help positions and reduce complex societal processes to points, lines, area, and attributes” (Sieber 2006; Pickles 1995; Curry 1998; Aitken 2002).

In contrast, “collaborative GIS systems may possess a set of basic tools that permit: (1) shared view, control and object selection of geographical information; (2) annotation and mark-up of geographic features with multimedia data in the form of text, graphics, photos, and audio/video; (3) interactive exploration of geographical data for spatial problems; and (4) awareness of other collaborators and their outcomes” (Sun and Li 2015). Collaborative GIS Systems, or PPGIS, shift the lens to include participants in co-developing GIS projects, putting the control back in the hands of all stakeholders involved. Though the exact definition of participants in PPGIS varies, typical contributors include “stakeholders who are affected by, bring knowledge or information to, and possess the power to influence a decision or program” (Seiber 2006: 495).

For a project focusing on the Cherokee Trail of Tears in Missouri, specifically segments that cross through federally owned lands through the Mark Twain National Forest, the collaborators in this case will be the Mark Twain National Forest staff and the Cherokee THPO. The various forms and examples of PPGIS will be discussed in Chapter VIII.

Wrap-Up

These GIS processes and tools outlined in the proceeding chapters aim to aid cultural resource managers in governing and making better management decisions regarding the Trail of Tears. While the management tools discussed in this thesis are based within the legal constraints of the NRHP criteria, it is my goal going forward that through continued consultation with the National Park Service, our State Historic Preservation Office, and Tribal Historic Preservation Offices, this model can be further adapted and more adequately customized to meet the needs relevant to the Mark Twain National Forest and Tribal stewardship of the Cherokee Trail of Tears in Missouri.

While I plan to look at the Trail of Tears from a modern standpoint and assess segments of its current condition, I will make an effort to convey “why” it is so significant in American history. The survival of tribes, despite the loss of their homes, family, and homeland is essential to comprehend its importance and need for preservation. In the following text, I will explore the history leading to the Trail of Tears and of the hardships that the Cherokee suffered on the Trail.

(III) Timeline Leading to the Trail of Tears:

Though native history begins tens of thousands of years ago and is rich and complex, the moment in time that set-in motion the events that led to the Indian Removal Act and the Trail of Tears begins as the first European ship sailed (by mistake) across the Atlantic Ocean only to realize there is a whole other half to the world with its own diverse, and already occupied, civilizations.

The civilizations between the Great Lakes region, Florida, and the Gulf of Mexico drew on the “inheritance of the rich, mound-building Mississippian culture” that thrived between approximately 600-1500 AD (Thomason 2002: E3; Nabokov and Snow 1992). Among these civilizations were the Cherokees, Creeks, Chickasaws, Choctaws, and Seminoles. Their societies derived from Mississippian dwelling patterns and traditions, and with the cultivation of maize, had evolved into “long-term, stationary settlements and sophisticated theocracies” (Thomason 2002: E3; Nabokov and Snow 1992).

European Infiltration

In the name of exploration, conquest, and wealth for the European countries who were thousands of miles away, Native Peoples of the Americas have long been suffering the consequences. The arrival of the Europeans was detrimental to the way of life for hundreds of thousands of people and cultures as they brought deadly foreign diseases and long-engaging conflicts upon disembarkment. “Spaniards looted villages, captured some of their hosts as slaves, murdered others, and left behind a legacy of disease and distrust that shaped future relations between Native Americans and Europeans” (Thomason 2002: E4; White 1983: 7). As the centuries passed and Europeans began to

lay claim and settle along the shorelines of the “New World,” tensions and conflicts with native societies increased. The lust for new lands, resources, and power became the center point of European agendas. As colonies were formed along the coast in the southeastern part of North America and shipping ports were established, more and more Europeans began to arrive, claiming more land and resources with them. These new settlers encroached upon the established borders of tribal nations that were steadily being forced to cede their land to these European governments and colonists. As the number of colonists multiplied, so did their need for land and resources, and so began a tumultuous cycle between the groups. “In combination, epidemic diseases, increased white populations, and warfare resulted in mass native depopulation, destruction of crops, and food scarcity; increased hunting of deer and other animals for profit-driven European markets also seriously depleted food sources, eventually forcing the acceptance of domesticated animals such as hogs, cattle, and chickens into the Southeastern tribal landscape” (Thomason 2002: E5; Goodwin 1977).

Before Removal- A Connection to the Land

Though very different in societal structures and traditions, all native nations had a deep and inseparable connection with their land. In 1932, Grant Foreman eloquently articulated this relationship:

> They loved their streams and valleys, their hills and forests, their fields and herds, their homes and firesides, families, and friends. They cherished a passionate attachment for the earth that held the bones of their ancestors and relatives. The trees that shaded their homes, the cooling spring that ministered to every family, friendly watercourses,

> familiar trails and prospects, bush grounds, and their property and their friends" (Foreman 1956).

As more Euro-American settlers arrived, there became frequent encounters between the two groups. Many interactions were hostile and taut, but there were plenty of civil interactions as well. Many of the native nations began assimilating into Euro-American culture and practices. "By the early nineteenth century, a number of Cherokee, Creek, and Choctaw families had turned from small farming to participating in a plantation lifestyle which mirrored that of their white neighbors, often surpassing them in wealth, market success, and number of black slaves they held. Many had converted to Christianity, attended school in New England, and married white men and women. At the same time, they maintained their ceremonial life, religion, culture, and tribal laws" (Thomason 2002: E11).

> Their lands and homes were beautiful and comfortable, the graves of their ancestors were close by, their orchards and fields were productive and profitable. Despite frequent confrontations with white settlers, they wanted nothing more than to be able to continue to raise their families, livestock, and crops in peace and harmony with their fellow countrymen and with their new neighbors (Thomason 2002: E11).

Though many families of these tribes assimilated to a more European way of life, many held strong to their traditions and practices and refused to adopt European culture. However, regardless of whether families chose to embrace the new white settlers' lifestyle or not, encounters of violence were still a common occurrence throughout the early 19th century between the groups.

A Litany of Broken Treaties

Termed as the “Five Civilized Tribes”, the Cherokee, Choctaw, Chickasaw, Creek, and Seminole Nations all treated lawfully with the European colonial powers and the newfangled American government as sovereign nations and entities. However, these treaties were consistently broken by the American government and always led to the ceding of more land by the tribes. Many of these treaties, though legally binding, were signed by unauthorized members of tribal nations or were deceptive in their intent.

The Proclamation of 1763 “‘forbade white migration across the Allegheny and Appalachian Mountains,’ but “explorers, hunters, and survey parties continued to move towards Kentucky” (Thomason 2002: E7).

The 1770 Treaty of Hard Labor “opened up more than 9,000 square miles between the Holston and Cumberland rivers” to settlers (Thomason 2002: E7). Land warrants given as incentives during the American Revolution further encouraged several white settlers to migrate onto lands that bordered the Cherokee Nation. Many of these settlers began to occupy lands within Cherokee territory and repudiated the notion of relocation (Thomason 2002: E7-8).

The 1775 Treaty of Sycamore Shoals was meant to provide safe passage for white settlers through tribal lands but was actually “a private sale of approximately half of the hunting grounds shared by Cherokees, Creeks, Chickasaws, and Shawnees to a group of speculators under the leadership of Richard Henderson, a North Carolina judge with a murky reputation, whom the Cherokee called “Carolina Dick” (Thomason 2002: E7).

Between 1776 and 1830, from the Great Lakes to Florida, nearly “all tribes east of the Mississippi River had signed treaties with the United States Government,” and by 1835, “The Cherokee had signed a total of 23 treaties that reduced their lands by 75 percent and pushed them almost one hundred miles south and west… All of these nations endured enormous suffering during the Removal era, but it was the Cherokee who experienced the greatest loss of life and the tribe with whom the Trail of Tears is most often associated. They called themselves *Ani 'Yun 'wiya*, or the Principal People” (Thomason 2002: E1, E3; Mooney 1900; Starr 1921).

While not a treaty, the passage of the Indian Removal Act of 1830 was an aggressive, offensive action taken by the American government to ensure the removal of Native Americans from their ancestral homeland to make way for the growing population of Americans. Signed by President Andrew Jackson, the Act was to ‘give’ any remaining tribes left in the East lands west of the Mississippi River.

The Treaty of New Echota, signed December 29, 1835, by “unsanctioned representatives of the Cherokee Nation… forfeited all remaining Cherokee lands east of the Mississippi River to the federal government. In return, the Cherokee were to be paid five million dollars” (Thomason 2002: E9); (McLoughlin 1986). With approximately only 100 out of the 17,000 Cherokee in attendance for the signing, “most Cherokee were united in opposition to removal under the leadership of Chief John Ross, who, despite being only one-eighth Cherokee, was trusted and beloved by his people” (Thomason 2002: E9; McLoughlin 1986).

Westward Cherokee Settlers

Before the passage of the Indian Removal Act in 1830, many Cherokee decided to move westward due to the "pressure of white encroachments and violence that came with them" (Thomason 2002: E9). These factions, totaling an estimated 6,000 Cherokee, relocated to the "St. Francis River in Arkansas and southeastern Missouri, within lands still controlled by Spain between 1782 and 1803. As Cherokee treaty rights were consistently being infringed upon in the east… another 1,000 Chickamauga Cherokee relocated to Arkansas in 1808," and in 1810 and 1819, under the leadership of Chief Tahlonteskee and John Jolly, even more Cherokee migrated to this area (Thomason 2002: E9-10). The three specified areas where the Cherokees were located can be seen in Figure III.I.

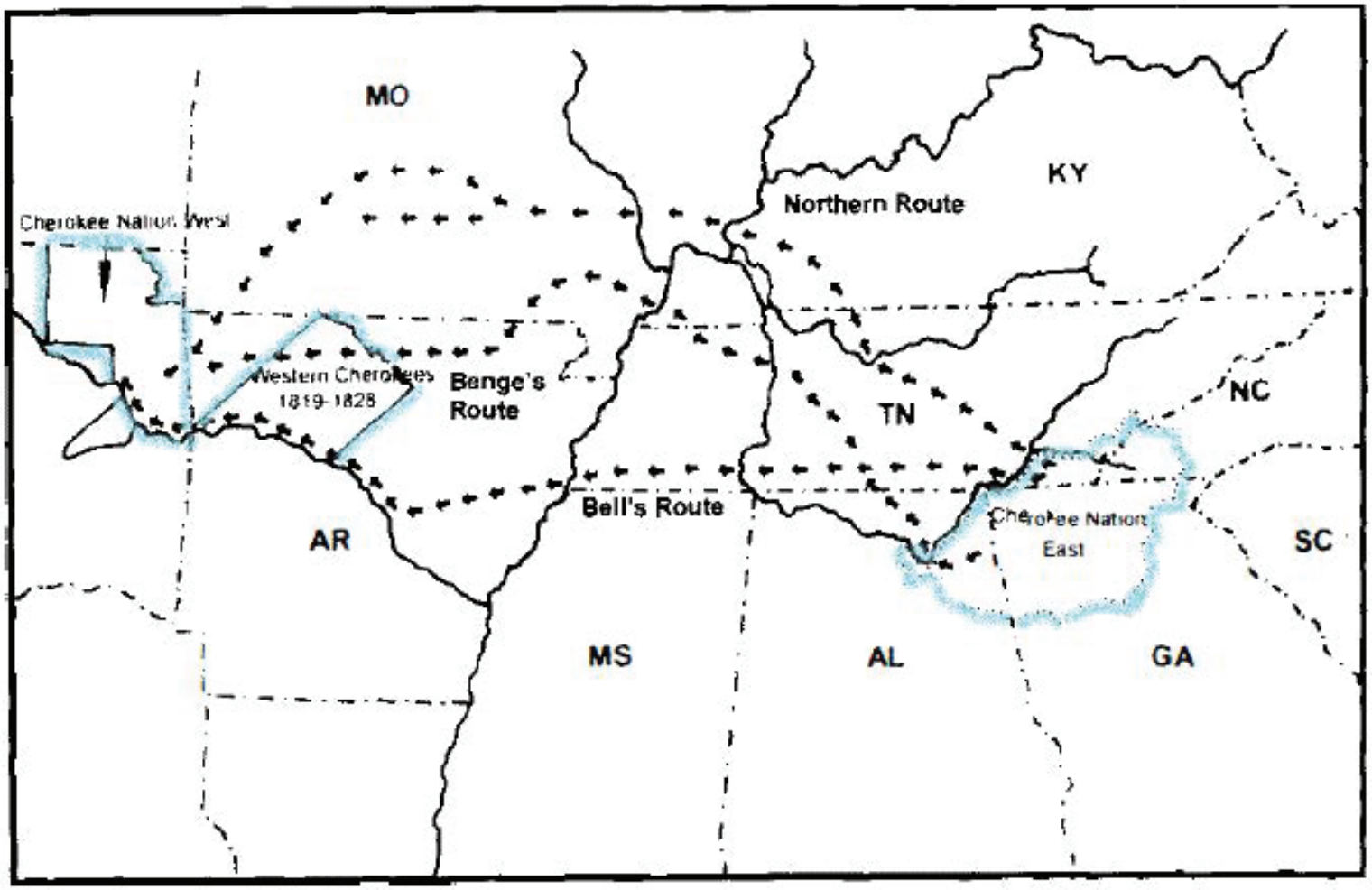
With the Treaty of Turkey Town in 1817, these Cherokee settlers were given titles to lands in northwestern Arkansas but were "forced to exchange these titles for lands in Oklahoma in 1828" (Thomason 2002: E10).

From portions of their homelands of Georgia, Alabama, Arkansas, Tennessee, North Carolina, South Carolina, Virginia, and Kentucky, these Cherokee emigrants "traveled along the trail that would become the main route [of the Trail of Tears] taken in 1838, crossing Tennessee and Kentucky into Illinois, Missouri, and Arkansas" (Thomason 2002: E2, E10; Brown 1938; Mcloughlin 1986: 233-234).

Political Atmosphere

Shortly after the Louisiana Purchase and due to an increase in competition for resources, the 1828 discovery of gold in Dahlonega, GA, located within the Cherokee's

Figure III.I : "Trail of Tears Route Map"



Map 1: Trail of Tears Route Map

Courtesy of Thomason 2002: E22, Multiple Property Documentation Form "Historic and Historical Archaeological Resources of the Cherokee Trail of Tears." On file with the National Park Service. (Thomason 2002: E22: Map 1).

eastern border, further emboldened President Jefferson's efforts to push out the remaining Cherokee. Though some had already migrated west, the majority of Cherokee, still in their ancestral homelands in the east, did not approve of the treaties and were unwilling to relocate from their homes.

The "Anti-Indian" agenda posed by President Andrew Jackson's presidency focused on the "removal of native peoples from their homes to Indian reservations… as a perceived necessity for the economic success of the new republic" (Thomason 2002: E1) with little regard to the effects it would have on them. His agenda revealed a "troubling disregard for the reality of Southern tribes during the 1830s since his plans for removal specifically and most forcefully targeted the Cherokees, Choctaws, Creeks, Chickasaws and Seminoles" (Thomason 2002: E2).

With the American emphasis on ideas such as 'Manifest Destiny' and 'Westward Expansion,' occupied lands west of the Mississippi River, previously given to some of the eastern Tribal Nations, were also being increasingly inhabited by white settlers. This push began to affect the Indian nations of the Plains, the Northwest, Southwest, and California in the same way that Eastern Tribes had experienced. The 1814 map of the Missouri Territories gives a glimpse of how the West was perceived during this time, along with the continuous westward expansion into Native lands (Figure III.II). Removal was becoming the normative policy on Native Americans, and often, the removal "took place at the very doorsteps of their homes" (Thomason 2002: E1).

Figure III.II : "Missouri Territory formerly Louisiana" Authored by Mathew Carey. 1814.

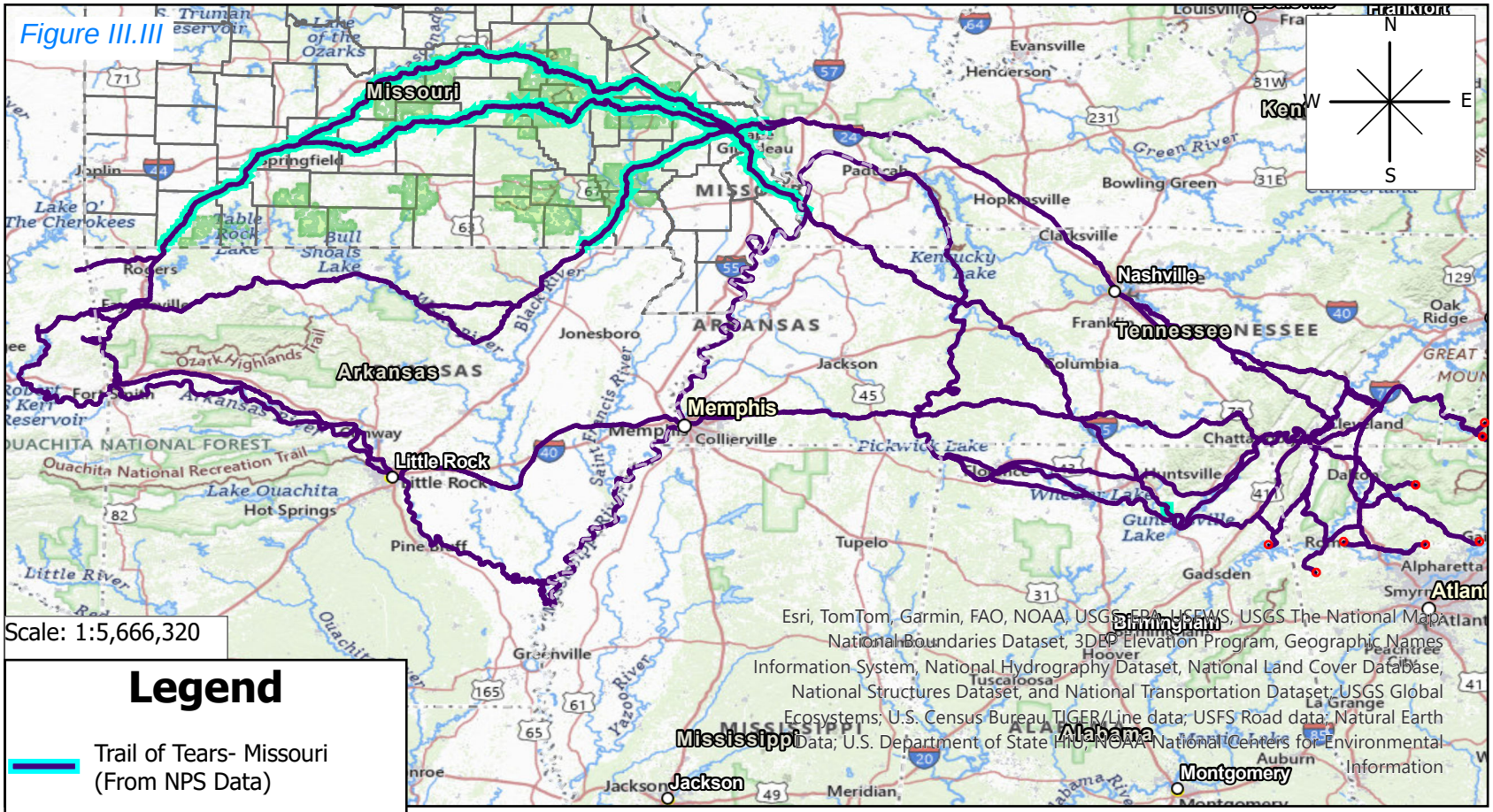
Courtesy of Library of Congress Geography and Map Division Washington, D.C. 20540 to 4650.
Digital ID: http://hdl.loc.gov/loc.gmd/g4050.ct000652

Legal framework

While many tribes fought to keep their land, the Cherokee used the legal system to fight. The Cherokee pled their case to the Supreme Court, led by Chief Justice John Marshall, who decided in their favor. In the cases of *Cherokee Nation v. Georgia (1831)* and *Worcester v. Georgia (1832)*, the Supreme Court confirmed that the Cherokee were the “undisputed possessors of the soil” and free from the jurisdiction of the State of Georgia. This decision of the court became the foundation of the legal fight for tribal sovereignty and is still contested in our judicial and political affairs today.

President Andrew Jackson stated that he knew of the court decision but added, “John Marshall has made his decision, now let him enforce it,” and enacted the Treaty of New Echota anyway on May 23, 1836 (Thomason 2002: E15). This blatant rejection of the Supreme Court’s decision was unmet with resistance and, therefore, was allowed to take place. “The State of Georgia not only ignored the Cherokees’ plea, but openly encouraged overt aggressive act directed against the Cherokees by Georgia residents” (French and Hornbuckle: 1981). The routes taken during this period of removal are provided by the National Park Service in Figure III.III and overlayed with a topographic base map with the segments crossing through Missouri highlighted in blue.

Figure III.III



Legend

- Trail of Tears- Missouri (From NPS Data)
- Trail of Tears - National Historic Trail
- Departure Points

User: AnsleyLester
Date Saved: 6/30/2024

Trail of Tears Routes - National Historic Trail
National Park Service (100k) Data 2024

The Trail of Tears

A group of about “600 wealthy, ‘pro-treaty’ Cherokee departed in January of 1837” and received compensation for their land and property. They represented a small number of Cherokee who received this kind of recompense. Other ‘pro-treaty’ Cherokee departed the Cherokee Nation in March 1837 under the supervision of General Nathaniel Smith. By October of 1837, John Ridge, Elias Boudinot, and their families departed with this group from Creek Path, Alabama, and traveled through Nashville. (Thomason 2002: E15).

Lieutenant B.B. Cannon’s detachment had departed from present-day Charleston, Tennessee, around the same time as the other two detachments and arrived in Indian Territory a month after Gen. Nathaniel Smith. They traveled “overland through Tennessee, Kentucky, Illinois, Missouri, and Arkansas. These emigrants encountered severe weather that delayed them, and a number of ill and elderly Cherokee died and were buried along the way. Cannon's route would later be followed by the majority of the emigrating detachments in 1838-39” (Thomason 2002: E15).

Removal and Hardships

As most Cherokee refused to recognize the legality of the New Echota Treaty, they proceeded to live and resist relocation. The forcible expulsion of the Cherokee began on June 6, 1838, under the command of General Winfield Scott.

> Without sufficient time to prepare for the journey west, forced to abandon their personal property, without tools, provisions, ammunition, or money, the Cherokee endured hardships beyond measure. The Indians who were

> forcibly removed under Jackson's policy lost all their personal property and were driven from their homes with little more than the clothes they were wearing when the soldiers arrived at their door (Thomason 2002: E15-16; Mooney 1900: 131).

Survivors interviewed by James Mooney recall:

> On turning for one last look as they crossed the ridge, [the captives] saw their homes in flames, fired by the lawless rabble that followed on the heels of the soldiers to loot and pillage…To prevent escape, the soldiers had been ordered to approach and surround each house . . . so as to come upon the occupants without warning (Thomason 2002:E16; Mooney 1900: 132).

After being forced from their homes, the Cherokee were taken to “temporary forts or concentration camps in Alabama, Georgia, Tennessee, and North Carolina. Intense summer heat, overcrowding, and lack of sanitation, food, clean water, and medicine left the Cherokee malnourished, weak, and sick. Between four and ten Cherokee died every day in the camps from heat, lack of food and water, and disease. After several weeks in these temporary camps, the Cherokee were marched to emigration depots to be assigned to various detachments for the journey west. Emigration depots were created at the Cherokee Agency at Charleston, Tennessee, near Ross's landing at present-day Chattanooga, and south of Fort Payne, Alabama” (Thomason 2002: E16-18).

It was at these emigration depots that in 1838-1839 a total of seventeen Cherokee detachments were gathered to be exiled to Indian Territory in Oklahoma. Four of these

detachments would travel by water, while the other thirteen detachments would travel by land through several different routes. (Thomason 2002: E17).

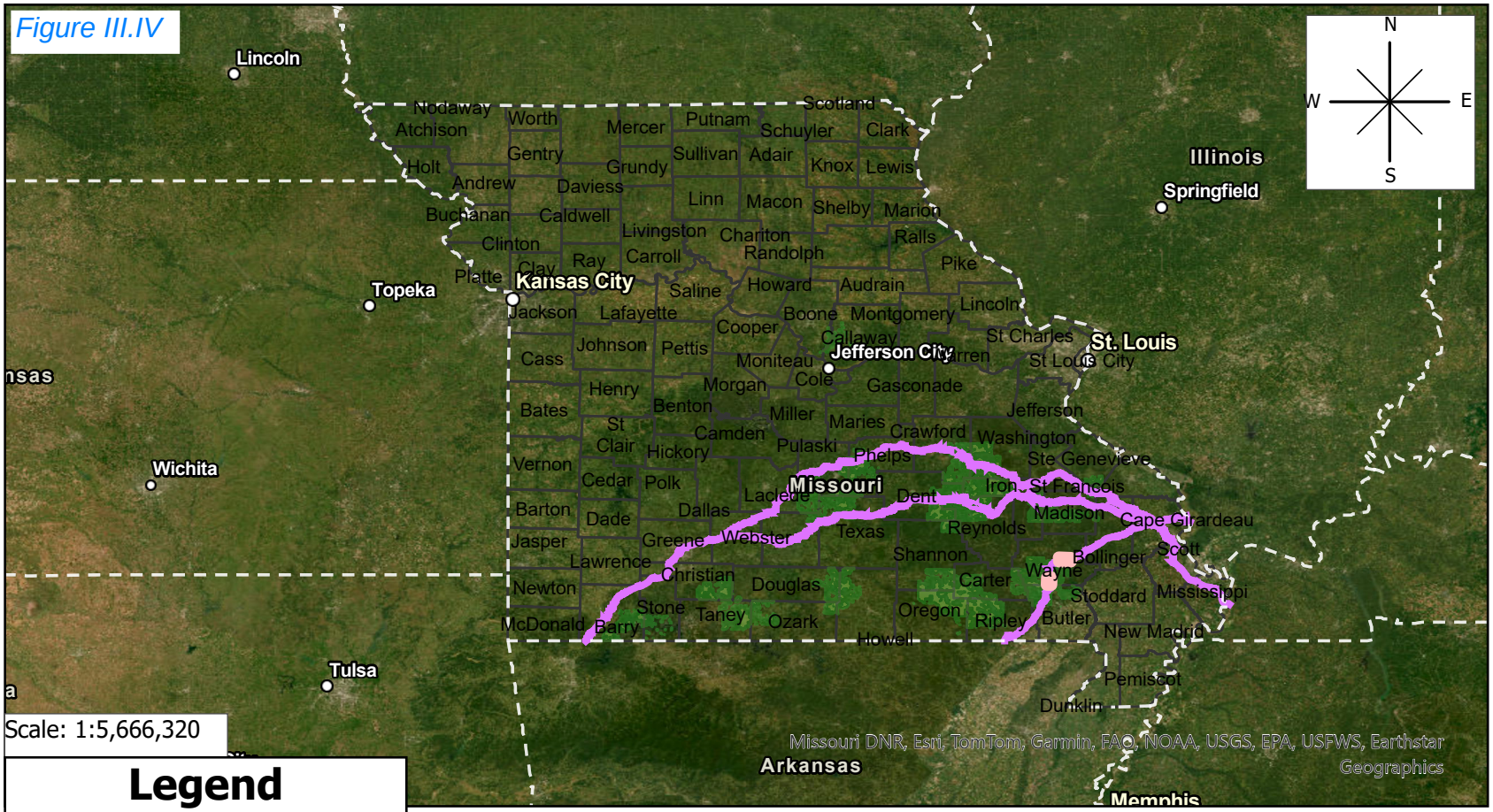
Estimations of deaths are between 500 to over 4,000, a significant loss for the Cherokee. “The Reverend Daniel S. Butrick, a missionary who accompanied the Cherokee, estimated that over 4,600 Cherokee lost their lives in the camps and along the trail from cholera, smallpox, influenza, pneumonia, starvation, exposure, and broken hearts” (Thomason 2002: E18).

> In the Cherokee language of Tsalagi, their exodus into the Trans-Mississippi West is described as *nunahi-duna-dio-hilu-i,* "the trail where they cried" (Thomason 2002: E4).

Trail of Tears in Missouri

For the purposes of this thesis, I will discuss the three routes that crossed through Missouri from 1837 to 1839, which can be seen in Figure III.IV. Much of this information is presented by Tiffany Patterson on the “Cherokee Trail of Tears in Missouri, 1837-1839” National Register of Historic Properties Multiple Property Documentation Form from 2013. These routes of the Trail of Tears are specific to the Cherokee, as they were the only detachments that took land routes through Missouri (Patterson 2013: E2). I will mainly focus on the Benge Detachment, as my area of study is located on this route, but I will briefly touch on the Northern Route and Hildebrand Route. There was a total of thirteen detachments that crossed the Trail by land in Missouri.

Figure III.IV



Scale: 1:5,666,320

Legend

- Area of Study
- Trail of Tears- Missouri (From NPS Data)

0 95 190 380 570 760 Kilometers

User: AnsleyLester
Date Saved: 6/30/2024

Cherokee Trail of Tears Routes National Historic Trail In Missouri

The Benge Route

In October of 1838, comprising of approximately 1,100 Cherokee, including 144 enslaved African Americans, the Benge detachment left Wills Valley in northeastern Alabama.

Due to the lacking field notes, road surveys, and other materials from that period, the Benge route is considered the “most obscure” of the routes taken, and the exact route is still being debated. It is known that the Benge detachment did occasionally “veer from officially surveyed roads on the suggestions of locals” (Patterson 2013: E8). There is still much of the route that is well defined by historic roadbeds, with ruts and swales, that have since been abandoned for modern road reroutes. (Patterson 2013: E8). There is speculation that the reason that Benge did not follow the other detachment routes was because some of the Cherokee were slaveholders, and going through Illinois, a free state, might cause issues (Patterson 2013: E7).

With multiple routes being suggested based on historic maps and topography, the National Park Service’s route is the most credible of these predictions. (Patterson 2013: E6- E7).

Patterson states that “the route taken by the Benge Detachment through Missouri is completely different than those taken by the other twelve detachments. Benge entered Missouri in Mississippi County and traversed portions of seven southeastern Missouri counties before crossing the Ripley County border into Arkansas in December 1839” (Patterson 2013: E2).

Patterson goes on to state that the Benge route “covered approximately 160 miles and followed two established state roads, one from the landing across from Iron Banks, Kentucky to Jackson, and the second from Jackson, through Greenville, south to the Arkansas border. For the Cherokee and others traveling by foot, horse, and wagon in the late 1830s, this route crossed swamps, sparsely populated rugged terrain, and took an estimated 12 to 14 days. Accounts of the weather, roads, and descriptions of places along the route provide a better sense of conditions that the Cherokee faced during their winter journey through Missouri in late November and early December 1838” (Patterson 2013: E11).

We have some accounts from witnesses who can describe the conditions encountered and state of the detachment. A Mormon settler in west central Missouri named Albert Rockwood stated “we had a heavy [sic] fall of snow on the 17th and 18th of October and also on the 7th and 8th of November. Also several small flurries since. It has been very cold for a month past the ground is and has been frozen, several inches for a number of weeks” (Patterson 2003: E12).

The detachment supplier, Jonathan Colburn, wrote that “the weather was extremely cold and the roads in very bad condition from the weather, the want of work and the great number of wagons with the emigrants which in many places made the road almost impassible at least it was with great difficulty teams with reasonable loads could make but a moderate day’s journey” (Patterson 2013: E12). The 1901 Encyclopedia of the History of Missouri notes that during the early to mid-19th century, there were many resources allocated by the state’s General Assembly to survey roads but did not provide any resources for maintaining those roads. “State Roads authorized by the Legislature

were 60 feet wide and passed through more than one county… the citizens along the route then cut out and worked the road" (Conrad 1901: 367). Patterson cites these witnesses and recorders who describe very specific conditions and physical features of the road used during the time of the Trail of Tears, specifically on the Benge Route (Patterson 2013: E12). With thousands of wagons crossing a muddy or unkept path, the need for short alternatives was surely needed. With these conditions and the sheer amount of people traveling that road, scars would inevitably be etched into the earth, leaving traces behind still extant today (See Figure III.V and III.VI). These terrible travel conditions were constant throughout the journey, and the suffrage was great to the Cherokee people, who had already lost everything. The following figures represent modern day, extant examples of the traces left during the heavy travel during the Trail of Tears.

The Northern Route: Winter 1938-39

Lieutenant B.B. Cannon's route, first taken in late 1837 with approximately 365 Cherokee, became the most used route of the Trail of Tears, with eleven more detachments traversing it between 1838 and 1839. These detachments compiled from "several hundred people to nearly 2000 people for each detachment, along with wagons, horses, and other livestock" (Patterson 2013: E6). "His route, known commonly as the Northern Route, crossed the Mississippi River into present-day Cape Girardeau County, covered portions of fifteen counties, and exited into Arkansas from Barry County" (Patterson 2013: E2). It is on this route that the Cherokee crossed more miles

McMinn Farmstead, swales to right of gravel road. Photo by Tiffany Patterson, October 2011.

Figure III.V, *Courtesy of Patterson and Weisman, "Cherokee Trail of Tears in Missouri, 1837-1839." On file with the National Park Service. (Patterson 2013: Figure 14).*

Natchitoches Trace Swales on Corps of Engineer Property, Old Greenville vic., Wayne County. Photo by Russell Weisman, February 2012.

Figure III.VI, *Courtesy of Patterson and Weisman, "Cherokee Trail of Tears in Missouri, 1837-1839." On file with the National Park Service. (Patterson 2013: Figure 15).*

of the Trail than any other state. On Lieutenant Cannon's first trek, in January of 1838, an accompanying physician, Dr. G.S. Townsend, reported on the "deleterious effects" of the "Miasmatic exhalations of the immense swamps" near the Mississippi River crossing. He also reported that "the experiment just made of land transportation will not justify a repetition, either on account of economy, expedition, or comfort to the Emigrants." He suggested that a water route would be much more appropriate and efficient as opposed to land travel. This report was received and effectively ignored, instead becoming the most traveled route of the Trail of Tears (Patterson 2013: E22). The following table, Table III.I, represents the reported US Military information for each detachment.

Patterson explains that "the Northern Route can be best visualized by following present-day maps and roadways," though some segments are likely to have been abandoned with modern road relocations (Patterson 2013: 23). Because of the relationship with modern roads, much of the Northern Route may be "under or immediately adjacent to existing routes (Patterson 2013: 23).

Hildebrand Variation of Northern Route

Peter Hildebrand's detachment took a modified route that stemmed from the main Northern Route. According to the "Trail of Tears through Missouri," the Hildebrand detachment "departed the primary Northern Route a few miles northwest of Jackson" (Patterson 2013: 23). Accounts of "Cherokee traveling through Fredericktown and near Iron and Shepherds mountains" corroborate this theory (Patterson 2013: 23). It is suggested that he rejoined the main Northern Route in Webster County.

Table III.I Cherokee Detachments in Missouri

Detachment #	Departure Location	Conductor	Assistant	Enumeration upon leaving per US Military (Per Chief John Ross, in parenthesis)	Ennumeration upon Arrival	Deaths reported in US Military Reports	Days on Road
1 (Northern Route)	Cherokee Agency Area	Hair Conrad (replaced by Colston prior to departure)	Daniel Colston	710 (729)	654	54	143
2 (Northern Route)	Gunstocker Creek, Cherokee Agency Area	Elijah Hicks	White Path (died en route, replaced by William Arnold)	859 (858)	744	34	126
3 (Northern Route)	Chatata Creek, Cherokee Agency Area	Jesse Bushyhead	Roman Nose	846 (950)	898	38	178
4 (Benge's Route)	Eight miles south of Fort Payne, Alabama	John Benge	George Lowery	1079 (1200)	1132	33	106
5 (Northern Route)	Savannah Branch, Cherokee Agency Area	Situwakee	Evan Jones	1205 (1255)	1033	71	149
6 (Northern Route)	Candies Creek, Cherokee Agency Area	Old Field	Stephen Foreman	841 (983)	921	57	153
7 (Northern Route)	Cherokee Agency Area	Moses Daniel	George Still	1031 (1035)	924	48	164
8 (Northern Route)	Cherokee Agency Area	Choowalooka (replaced by Thomas N. Clark at Smith's Ferry)	J.D. Wofford	1120 (1150)	970	unknown	162
9 (Northern Route)	Ooltewah Creek, near Vann's Plantation	James Brown	unknown	745 (850)	717	34	177
10 (Northern Route)	Mouse Creek, Cherokee Agency Area	George Hicks	Collins McDonald	1031 (1118)	1039	unknown	189
11 (Northern Route)	Near Vann's Plantation	Richard Taylor	Red Watt Adair	897 (1029)	942	55	186
12 (Northern Route-Hildebrand Variation)	Cherokee Agency Area	Peter Hildebrand	James Hildebrand	1449 (1766)	1311	unknown	154
13 (Water Route)	Cherokee Agency Area	Capt. John Drew	John G. Ross	unknown (231)	219	unknown	104

Derived from information provided by (Patterson 2013: E21); (Thomason 2002: E20-21); (Starr 1921: 103).

Peter Hildebrand first departed southeastern Tennessee with a party of 1449 people (1766, per Cherokee leader John Ross) in October 1838 and traveled the same road with ten other overland detachments following the Northern Route to and across the Mississippi River. In Missouri, however, his party diverged from the primary route, forming the Hildebrand Variation Route through Missouri. Approximate 11,000 Cherokee traveled through Missouri along the Northern Route and its variations" (Patterson 2013: E2).

Arriving in Indian Territory

As the survivors from the Trail of Tears began to settle in the western territory, they were not free from conflict. The "Western Cherokee," part of the Old Settlers that came to this land before the Removal, had already set up their own form of government and constitution (Starr 1921:103-121). The survivors of the Trail of Tears from the East also had their own government and constitution, following the same laws that were established in the Eastern Cherokee Nation. Many supported the idea of a merged nation between the two divisions, while others protested the idea that Eastern Cherokees should have any say in the governing of the Western Cherokee. This splitting of views led to violence between the Old Settlers and the New Emigrants (Starr 1921:103-121).

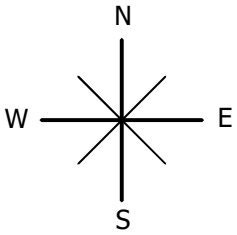
In part, due to this dissent and the concern over the welfare of their people, Eastern Cherokee Chiefs, George Lowry and John Ross, and the Western Cherokee Chiefs, John Brown, John Looney, and John Rogers, began correspondence with each other from June 1839 – August 1839 to discuss solutions and discontents (Starr 1921:103-121). Given that neither division desired a civil war, the *Act of Union Between the*

Eastern and Western Cherokee as signed on August 12, 1839, uniting both divisions into what we know as the Cherokee Nation today. The first *Constitution of the Cherokee Nation* was drafted shortly after this union and approved by the new Council on August 23, 1839 (Starr 1921:103-121).

Period of Significance

While the Cherokee Trail of Tears is considered a tangible historic trail, it is, in tandem, an event in time with the temporal periods of significance limited to the 1830s. In H. Tanner's 1836 "Map of Missouri: Roads and Distances," we can see the early understanding of the roads in the late 1830s when the period of significance took place. Though only dated a year from the events in 1837, it can be assumed that the roads and paths did not change dramatically. Tanner's map was georeferenced by me, and the NPS data was overlaid to show a comparison between any roads documented here and the Trail, see Figure III.VII. The sheer amount of people who traversed these routes would have left significant scars on the landscape, and some of these routes have become developed modern roads. Many pathways and roads that were heavily traveled throughout the centuries have evolved into the roads we use today. There is no sense in "forging your own trail" for such a long and dangerous journey. Thus, "The history of The Trail of Tears is one of the most painful and complex chapters in the American experience. It reveals national character and political policy at their worst, yet it also illuminates the strength of tribal people to survive against all odds, including the turbulence of Jacksonian democracy" (Thomason 2002: E1).

Figure III.VII

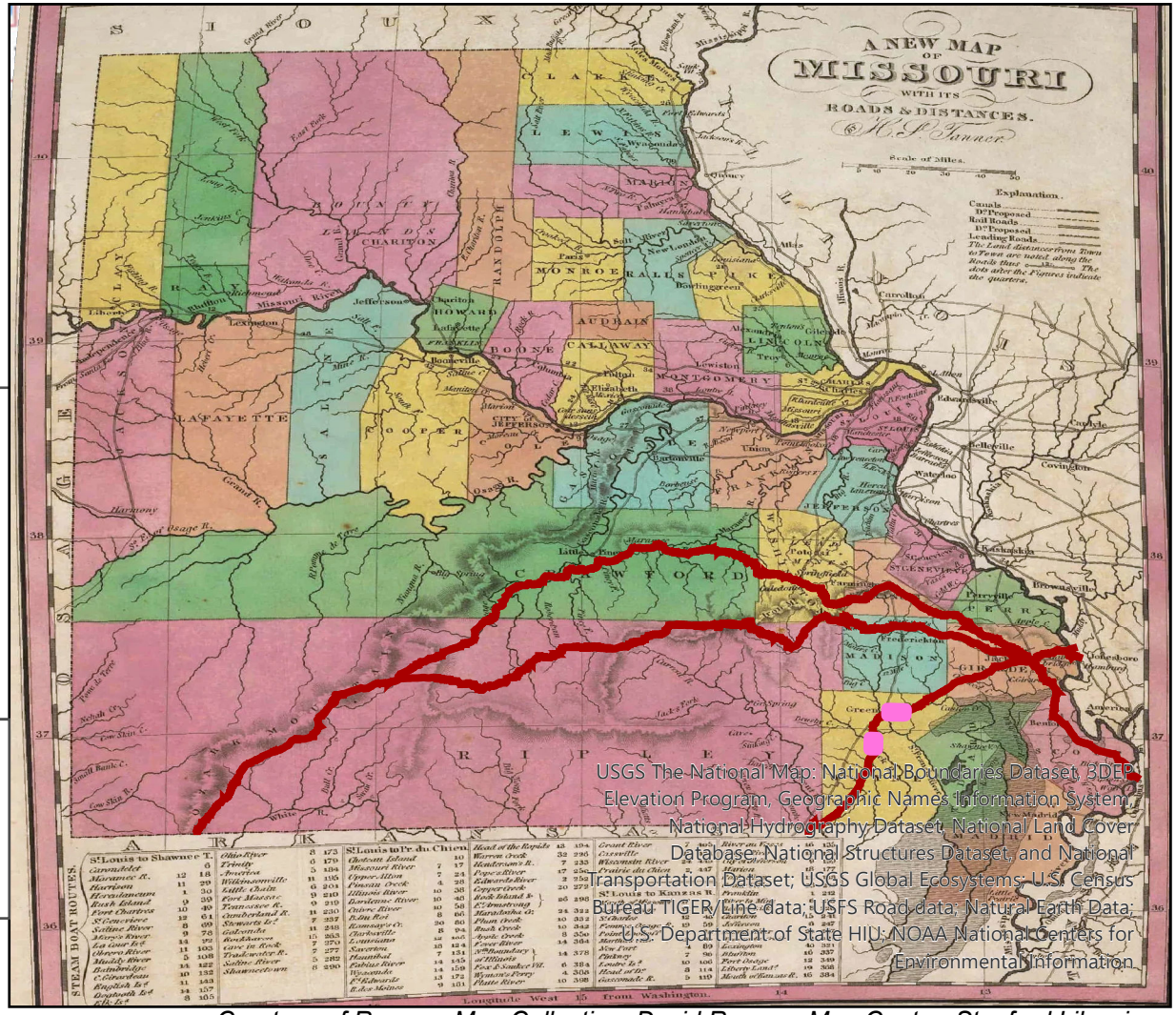


1836 Map of Missouri:
"Roads and Distances"
H. Tanner
Trail of Tears- Historic Map Review
Mark Twain National Forest

Legend

Trail of Tears- Missouri (NPS Data)

Area of Study



Courtesy of Rumsey Map Collection, David Rumsey Map Center, Stanford Libraries.

0 70 140 280 420 560 Kilometers

User: AnsleyLester Scale: 1:64,531 Date Saved: 6/29/2024

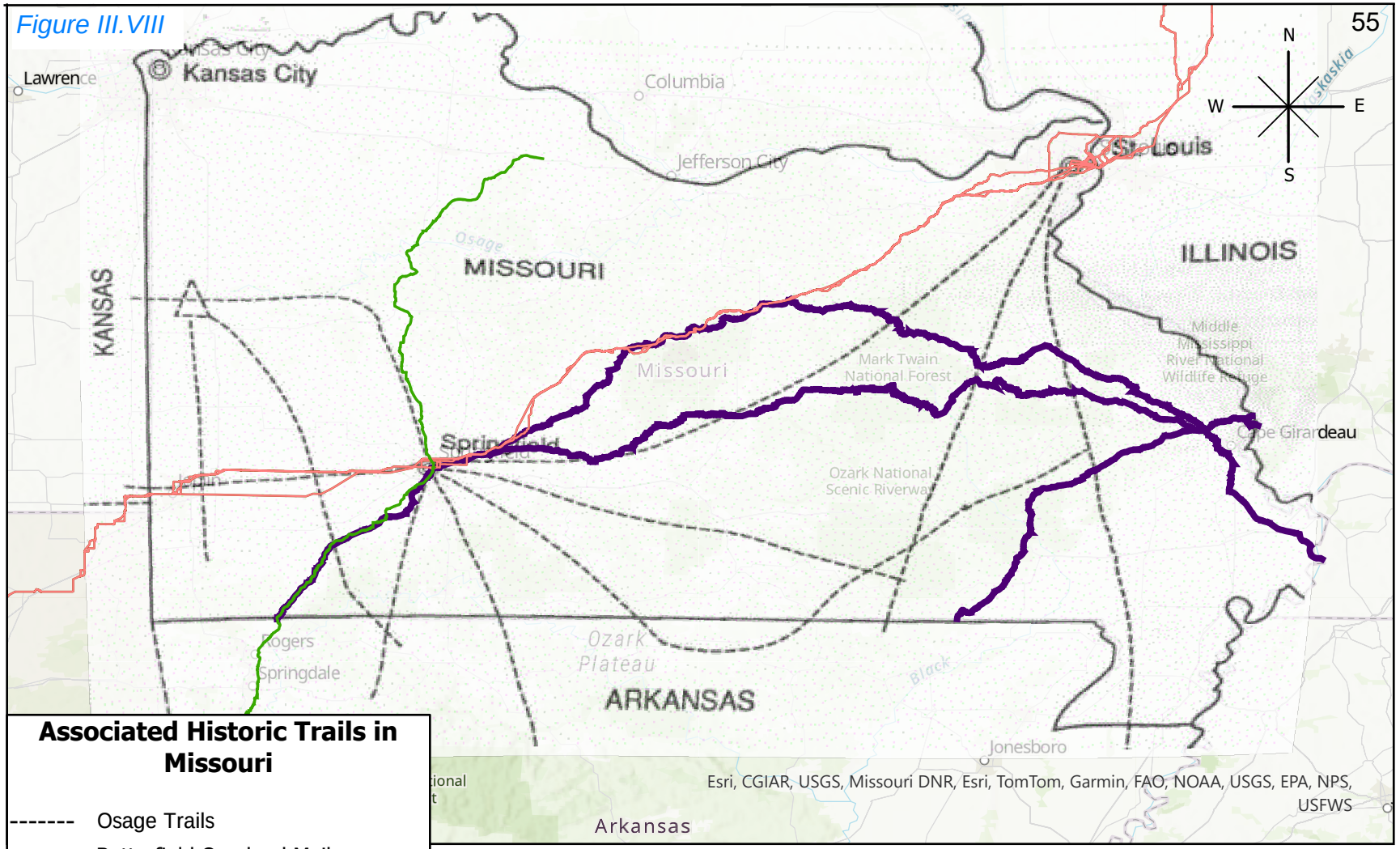
Other Historic Uses of the Trail

Though the focus of this thesis is the Cherokee Trail of Tears in Missouri, with a period of significance period pertaining to 1837-1839, these pathways and trails have a long history in Missouri transportation.

The Osage have an ancestral claim over the land in what is now present-day Missouri. They lived in the Ohio River Valley (up to present-day Pennsylvania) until about 1,800 years ago when their ancestors began to migrate west. They arrived in the St. Louis area about 1,500 years ago and continued their migration west about 700 years ago (Osage Nation Historic Preservation Office 2016). “By the time Europeans began exploring the area, about 350 years ago, many Osages were living along the Missouri and Osage rivers in Western Missouri. Between 1808 and 1872, through negotiations and treaties, the U.S. government reduced Osage lands to the current Osage Reservation in northern Oklahoma” (Osage Nation Preservation Office 2016). The Osage made regular and seasonal hunting and trading expeditions throughout their grounds, where “their migrations left clearly defined main trails in southern Missouri and central north Arkansas. Because they would rather travel a few miles farther to use a beaten path, they made fewer trails, but trails which marked the best terrain for travel” (Holiday 1994). Many of these trails would become pathways for the Trail of Tears and other historic routes in the next few hundred years, as shown in Figure III.VII.

In 1837, a state road was authorized from present-day St. Louis to Springfield that early settlers had called the “Osage Trail.” This route later became the famed Route 66 and is currently referred to as Interstate 44 (Holliday 1994).

Figure III.VIII



Associated Historic Trails in Missouri

- Osage Trails
- Butterfield Overland Mail Route (1857)
- Historic Route 66 Corridor (1926)
- Trail of Tears MO Routes (1837-39)

0 33 66 132 198 264 Miles

Scale: 1:3,192,509

User: AnsleyLester
Date Saved: 7/23/2024

Derived from (Holliday 1994)

One other historic trail, known as the Butterfield Overland Trail, was established in 1857 as an overland mail route between the eastern U.S. and populations in the far west (National Park Service 2024).

The adaptation of the original Osage Trails into several historic routes and modern uses is a testament to how important roadways can be to the migration and perseverance of humans.

Yesterday

Yesterday. . .

I always speak of yesterday

Only because. . .

We then had a chance.

We lived in peace,

As a nation

Who belonged. . .

Only to the Earth.

Now as yesterday. . .

We belong—as a Nation

Only now, it’s to Washington.

- Pam Taylor

(IV) Methods and Data Collection

In this chapter, I will provide a brief overview of what Geographic Information Systems (GIS) are and the geoprocessing tools that I will use for my methodological approach in answering my research questions: how can we efficiently use the processes of categorization and Geospatial Information System (GIS) methods and analyses to help identify the 'form' that various segments on the Trail of Tears, specifically for the listed National Historic Trail (NHT) of the "Cherokee Trail of Tears in Missouri, 1837-1839" that crosses the Mark Twain National Forest? Can a predictive model be developed by looking at the spatial relationships between modern roads and the suspected paths taken by the Cherokee in 1837- 1839? If so, what other information can be gained from this approach? I will define the data I will be using and where it came from. I will then define the objectives for each stage of the modeling process and the methods used to achieve the expected outcomes. After walking through the processes, I will discuss the statistical analysis that can be implemented to extract more information about the outcomes of the model.

To approach the first research question, how can we efficiently use the processes of categorization and Geospatial Information System (GIS) methods and analyses to help identify the 'form' that various segments on the Trail of Tears, specifically for the listed National Historic Trail (NHT) of the "Cherokee Trail of Tears in Missouri, 1837-1839" that crosses the Mark Twain National Forest, there is a need to understand what GIS approaches and techniques are available and how they can help infer certain attributes of a resource using only virtual methods and data.

To address the second research question: can a predictive model be developed by looking at the spatial relationships between modern roads and the suspected paths taken by the Cherokee in 1837- 1839, I will lay out the processes by observing the spatial relationships between modern roads and the Trail of Tears, in which a predictive model can be programmed to identify the 'forms' of roadbeds and road segments. I will first input several data sources, undergo various parameters and geoprocesses, and ultimately create a model that will predict what classification certain segments of the Trail of Tears fall into which of the "Three Basic Forms" of Roadbeds and Road Segments as defined in the Multiple Property Documentation Form, resulting in a draft predictability model.

To answer part three of my research question: if a predictability model can be developed, what other information can be gained from this approach, I will use basic statistical analysis and observations of the results.

Geographical Information Systems

Geographical Information Systems are regarded as a 'spatial toolbox' in which multiple software technologies exist (Wheatley and Gillings 2002: 9). Star and Estes (1990) stated that GIS is "an information system that is designed to work with data referenced by spatial or geographic coordinates. In other words, a GIS is both a database system with specific capabilities for spatially referenced data as well as a set of operations for working (analysis) with the data". Though GIS is used across multiple disciplines, archaeologists have found it to be a paramount resource for understanding the spatial components and relationships of archaeological data. It is not just a mapping tool to report spatial information. In fact, Marble (1990) suggested that there are four subsets

of GIS applications: Data Entry, Spatial Database, Manipulation and Analysis, and Visualization and Reporting. These subsets encapsulate the diverse potential that GIS can be used in a variety of fields.

GIS allows one to manage spatial data and gain knowledge from that information on various scales. It is arguable that GIS is used as an archaeological tool more often than a trowel. With the advances in datasets and GIS processing, it is possible to obtain vital information about an archaeological resource with only a laptop and GIS software. This can, however, turn into a slippery slope if said estimated or predicted information about a resource, driven solely from GIS, is regarded as 100% fact. Many developed models and processes that aid in predicting and identifying attributes only provide a percentage of accuracy, and there is always room for error or unseen variables. These models and geoprocessing techniques operate on numerous parameters, map algebra, and available data resources to produce outcomes intended to identify specific attributes of a geospatial dataset.

For the processes outlined in this thesis, I will be using the software, Environmental Systems Research Institute, Inc. (ESRI) ArcGIS Pro 3.2.2. Below are definitions of several GIS methods and processes that will be used to answer the research questions.

GIS methods

- Modeling: A set of rules and procedures for representing objects, processes, or events or predicting an outcome.
- Model: The series of rules and procedures that represent the prediction of geographic information. For this thesis, ‘model’ or ‘draft model’ (used

interchangeably) is used in reference to the specific, complete workflow used to make these predictions.

- ModelBuilder: A “visual programming language for building geoprocessing workflows. Geoprocessing models automate and document your spatial analysis and data management processes. You create and modify geoprocessing models in ModelBuilder, where a model is represented as a diagram that chains together sequences of processes and geoprocessing tools, using the output of one process as the input to another process” (ESRI 2024).
- Geoprocessing: “An analysis/ geoprocessing operation that is used to manipulate data from an input dataset and return the result as an output dataset” (ESRI 2024).

Other Useful Definitions

- Logic Operators: A mathematical operator used to compare logical expressions that returns a result of true or false: “less than, greater than, equal to, not equal to.”
- Boolean Operators: A logical operator in which a combination of conditions can be specified, resulting in an expression that results in a true or false (logical) condition. Common Boolean operators include AND, OR, and NOT.
- General Roads: Roads that are identified from the Missouri Department of Transportation (MoDOT) database and the United States Forest Service (USFS) Road data.
- Roadbed/Road Segment Form: Referring to segments of the Trail of Tears that meet one of the criteria for Property Type One: Roadbeds and Road Segments of

the NRHP Multiple Property Documentation Form. A segment is defined as a section of the Trail of Tears that represents a roadbed form and is considered one segment until that form changes.

- “Three Basic Forms”: the classifications of different segments of the Trail of Tears. 1) Modern Roads, 2) Limited Use Roads, 3) Abandoned Roads.
- Area of Study: Small area in which the model will be trained and programed.

Source Data

A model is only as accurate as the source data that is used for the inputs. The need to have reliable data for all inputs that are going into a model is essential to obtaining an accurate and precise model output. Inaccurate or incomplete data can not only be misleading, but it can give false predictions and outputs that can have real-world consequences if decisions are made based on the outputted information. Below is a list of the datasets with descriptions that are used for inputs and processes related to the Trail of Tears NRHP Roadbeds/ Road Segments and the Draft model. Maps solely used for historical background purposes are not listed in this section.

NPS Trail of Tears Data (100k): This is a vector line dataset that shows the “approximate designated route of the Trail of Tears National Historic Trail. The coordinates for this dataset were generally ‘heads-up’ digitized at a scale of 1:100,000 (or larger) of a series of planning maps using a variety of GIS software. The National Historic Trail alignment was identified before ground-verification could occur and consequently the designated Trail does not always coincide with the historic trail trace” (National Park Service 2022).

MoDOT: This dataset was developed by the Missouri Department of Transportation and stores descriptive data about roads in Missouri and “is the base linework for Missouri Roads Routes” (Missouri Department of Transportation 2024). There are no attributes that represent surface materials (paved vs. non-paved), so this data will need to be sorted through other methods of deduction.

USFS Roads: This dataset is a map service provided by the Enterprise Data Warehouse (EDW) depicting the existing National Forest System Roads (NFSR) that are “under the jurisdiction of the U.S. Forest Service. Each feature represents a segment of a road, along which all of the attributes are the same” (Enterprise Data Warehouse 2024). This database is updated daily.

USGS Local Roads Layer: This dataset is provided by the USGS Transportation service from The National Map (TNM) and is based on TIGER/Line data provided through the U.S. Census Bureau. This data includes the name or route designator, classification, and location. This dataset was acquired after it was clear there were some data gaps between the USFS Roads Layer and the MoDOT data. After researching and applying various other credible road data sources, this is the layer that best fits the needs of my research in combination with the other two main layers.

USFS Drainage Layer: This layer is part of the FS Topo cartographic database that is updated as needed between the National Forest/Grasslands units and the USFS Geospatial Service and Technology Center. It portrays features “associated with water lines such as Rivers, Streams, Shorelines, Canals, etc., as points, lines, or polygons.”

(Layer Properties Metadata- USDA Forest Service, Geospatial Service and Technology Center).

ESRI Basemap Reference Layer (not selectable): No apparent metadata or description. Works as a non-selectable layover layer to identify roads and municipalities. Available on the ESRI Basemap database.

World Imagery- ESRI Basemap database: This World Imagery provides “one meter or better satellite and aerial imagery in many parts of the world. This is provided by ESRI, Maxar, Earthstar Geographics, and the GIS User Community” (World Imagery metadata, accessible through the ESRI Basemap database).

Stages of Development

Stage One: To begin the development of the Draft model, I will first need to identify any segments of the Trail of Tears that intersect within lands managed by the Mark Twain National Forest. Stage Two: Next will be to classify the general documented roads under the classifications for the “Three Basic Forms” outlined in the NRHP Multiple Property Documentation Form. Stage Three: I will then aim to use several geoprocessing methods and analysis to identify spatial relationships between the Trail of Tears and general roads surrounding the Trail. The aim and Stage Four is to create an output of a reliable GIS model that can predict the “Three Basic Forms” classification status of other Trail of Tears segments that have been identified. This research will be divided into Part I and Part II. Part I will consist of training/ programming and an accuracy check of the model in a specified, controlled area. Part II will consist of the training and accuracy check for the model when applied to the whole of the Mark Twain.

ModelBuilder will be used to link all of these geoprocesses and steps in a “cause and effect” exhibition, so the process can be repeated. Because the entire length of the Trail of Tears covers over 5,000 miles, being able to predict the NRHP classifications for ‘Property Type One: Roadbeds and Road Segments’ can save an extensive amount of groundwork for archaeologists and researchers attempting to apply this criterion to other Trail of Tears’ segments in similar environmental circumstances.

Geoprocesses and Map Algebra

I will use both deductive and inductive reasoning methods to obtain my results for Part I. I will start with deductive reasoning by using known variables and then applying a series of Boolean expressions, conditional statements (IF, THEN), and other logic operators (rules) with a sequence of geoprocessing functions to produce this model. To ensure overall accuracy, I will train the model by checking the prognostics of each Trail of Tears’ Roadbed form with Satellite Imagery, USFS Roads, USGS Local Roads, and MoDOT Roads data within my Area of Study. If there are any discrepancies in what I expect to see based on either of these datasets, then I will modify my selected parameters and logic operations until I get an agreeable output that reflects what I see with the continuous datasets, specifically the satellite imagery and road attributes. This is how I will “train” the model so it can be applied at a larger scale with the same datasets and functions.

Once all segments of the Trail of Tears are being predicted accurately by the model in the Area of Study, I will expand the parameters of my study area to the whole of the Mark Twain National Forest and apply inductive reasoning to implement the model at this large scale for Part II. I will use the same accuracy measures as in the Area of

Study but will use the “Create Accuracy Assessment Points: random selection” function in ArcPro to select a sample of segments that will be cross-referenced with the same satellite imagery. This process will continue until all random segments are projecting the expected form of roadbed/ road segment of the Trail of Tears. When the accuracy of this model is operating at 100% for all randomly selected segments, the draft model will have met the requirements for this research and can be expected to correctly project (or predict) the “form” of any segment of the Trail of Tears located on the Mark Twain National Forest.

At this point, I will utilize simple statistical analysis to gain more insight into the results of the draft model. Most Common, Percentages, Lengths, finding Differences, Sum, and Least Common will be calculated, with a comparison between the sample dataset and the forest-scale dataset.

Area of Study Selection

For the purposes of programming (or training) this model, I will need to identify a controlled environment. This area is ‘controlled’ in that every segment of the Trail of Tears crossing the Mark Twain National Forest in this area will be used to program this model. Every output from the series of geoprocessing and map algebra methods that make up the model (i.e., the roadbeds/ road segments “form”) will be checked for accuracy using satellite imagery. Until the outputs from the model are projecting the “form” correctly for each segment of the Trail of Tears within the Area of Study, this cycle will continue.

From background research, it seems that the Benge Route of the Trail of Tears is the most uncertain of the routes taken. In response to this, I choose to focus my initial efforts on suspected segments of this route on the Poplar Bluff Ranger District, located in southeast Missouri, and is part of the Mark Twain National Forest.

Narrowing my parameters to this district, I choose five segments that intersect the forest on the northeast and southwest corners of Wayne County. This is my area of study, and all initial processes will be limited to this environment until the model is applied to the whole of the Mark Twain National Forest. This will be the first stage of building the model (See Figure IV.I).

RESEARCH DESIGN – PART I

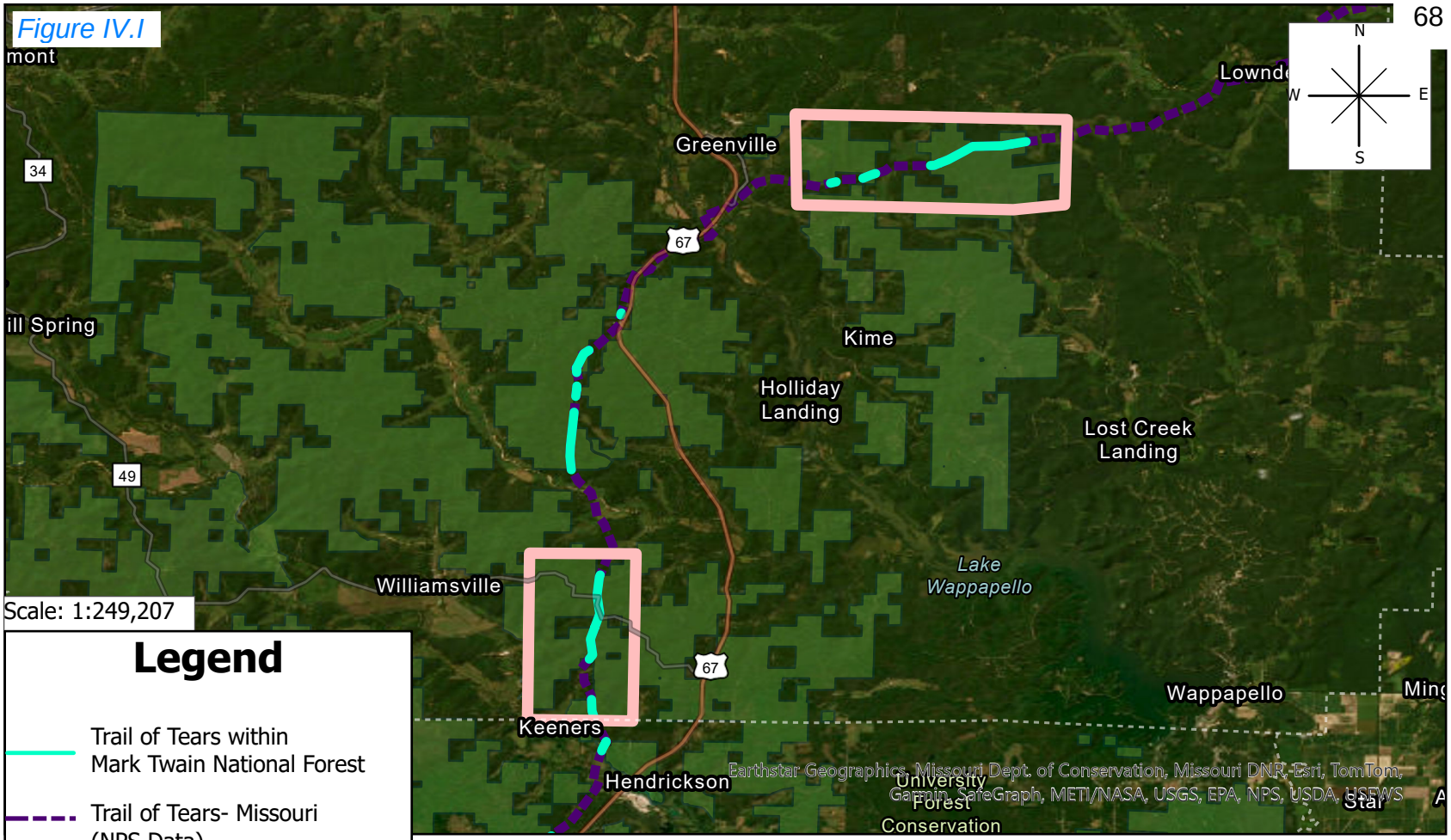
Stage One

The first action to complete was to identify Trail of Tears segments within Mark Twain National Forest lands.

This study is limited to only the Trail of Tears segments that intersect with Mark Twain National Forest lands. The FS Ownership layer, a vector polygon, was used to identify which lands are under MTNF jurisdiction. The National Park Service Trail of Tears data, as the most widely accepted dataset for the Trail of Tears, was used to identify the Trail's location in the form of a vector polyline.

To determine which segments of the Trail of Tears meet this criterion, these two layers underwent the Intersect geoprocessing method that took the segments intersecting with Mark Twain lands and created a new polyline of the data meeting those criteria. A 60-meter buffer is placed on either side of the new polyline to highlight how much of a

Figure IV.I



Legend

- Trail of Tears within Mark Twain National Forest
- Trail of Tears- Missouri (NPS Data)
- Area of Study
- USDA FOREST SERVICE

0 4.08 8.15 16.3 24.45 32.6 Kilometers

Trail of Tears Managed by Mark Twain National Forest
Poplar Bluff Ranger District, Wayne County

User: AnsleyLester
Date Saved: 6/30/2024

distance will be appropriate to determine spatial correlation with other intersecting features.

The 60-meter buffer was determined because it is a widely used distance in which sites are delineated (the typical distance of two 30-meter interval shovel tests from a given resource) and is used regularly in field methods as the distance after which, if negative, will not result in a correlation between another resource (Council of South Carolina Professional Archaeologists 2013: 18; Virgina Department of Historic Resources 2009: 1; Mississippi Department of Archives and History 2019: 12.5.2). This can change depending on different environmental variables a site may contain, but for the purposes of this thesis this was used as the general distance in which two things may be spatially correlated. This new polyline is used at a later stage.

Stage Two

Next, I classify general documented roads with the National Register of Historic Properties Multiple Property Documentation Form's criteria for Property Type One: Roadbeds and Road Segments' "Three Basic Forms" as defined in Chapter II.

Because much of the Trail of Tears closely follows many contemporary roads that have been modified to accommodate vehicles as the primary choice of travel mode (Patterson 2013), it can be reasonably assumed that IF the NPS Trail of Tears polyline falls within 60 meters of a documented road, THEN it is with greater certainty that a relationship between the two features will exist. So, the second stage was to classify all the roads within my area of study to correspond with the criterion of the "Three Basic Forms" of the NRHP MPDF Property Type One: Roadbeds and Road Segments. I used

three source roads' datasets to accomplish this, as together they combined into the best comprehensive inventory of roads for the Mark Twain National Forest, which is the largest scale that this project references. During the modeling process, accuracy was cross-checked regularly with satellite imagery and road' attributes.

General Road Form One: Modern

This class was determined using the MoDOT road's layer and attributes. The FS roads data did not include larger public roads so that data was not used for this process except as an eliminator. A simple Boolean expression was used to extract any roads that did not equal "National Park Service," OR did not equal "National Forest," OR did not equal "county roads." To check for accuracy, I used the ESRI satellite World Imagery to determine that the roads in this category met the requirements needed for Modern Road classification. Paved roads on satellite were identified by their grey color, with very clear-cut lines and edges, and typically, a painted median is visible. (See Figure II in Appendices). I also checked the attributes of each road to ensure that it corresponded with the other data.

Once all roads within my area of study were correctly identified, and I was confident in the expressions and parameters used, I moved on to identify the next class of roads.

General Roads Form Two: Limited Use, passable roadways

These roads should have had attributes that were slightly modified from the original roads in the 1830s with the use of some widening and minimal modern intrusions. This road form was identified using a combination of the Forest Service Roads layer, the

USGS local roads layer, and the MoDOT dataset. I set various parameters around each layer to extract the information that I needed.

I set the Boolean operations and other logistical operations, along with accuracy checks from the World Imagery layer, until the model correctly identified the class of roads set to the parameters and intent within my area of study. These roads were not paved but were topped with gravel, dirt, or other native materials. They were maintained in some manner. These attributes were evident by the color of the roads in the imagery, which were brown to yellowish, and the lines were not as clear-cut but more organic. Occasionally, patches of a green median could be seen, indicating vegetation.

I also checked against the various documented attributes of each road to determine if it meets Road Form Two criteria. In cases where there was overlapping geometry, I used a set of geoprocessing tools, such as the erase function and buffer zones, until the data was accurately displayed with one polyline geometry. (See Figure III in Appendices).

General Roads Form Three: Abandoned

This classification of roads that had the most constricting definition, in that these roads should not be maintained or considered in-use, that there should be no modern intrusions within the area, and they should be in their original 1830s setting. Evidence of these on the ground are indicated by ruts and swales to provide a sense of destination (Patterson 2013: E3).

To determine this road form, I only used the FS Roads layer that documented the attributes of road form three. Logically, if the MoDOT or Local road layers indicated only in-use, documented roads, then this automatically means that form three cannot exist if

overlapping a classified road form two. I used a set of Boolean expressions and geoprocessing tools to separate the roads that met these criteria. It should also be noted that there are likely segments of this road form that may not be documented, specifically because they were abandoned and forgotten. (In this context, LiDAR analysis may have been very useful in identifying these abandoned segments of the Trail of Tears. However, any indicators of abandoned segments should be verified and contextualized in a systematic process. So, while outside the scope of this thesis, LiDAR analysis should be conducted in future research projects.)

The parameters set included closed roads, surface types of native materials, and were described as “not maintained for passenger vehicle”.

It is also here that some more logical operations needed to be put in place to account for any potential discrepancies and competing variables. For example, if Road Form Two overlapped with any roads of Form Three, the default was set to Road Form Two because logically, if Road Form Two exists, then Road Form Three cannot exist. So, if a road had been modernly modified in any capacity but was presently closed off, that road still fell under form two. A similar logic was used for roads meeting criteria three. If road form three neighbored any other road forms (one or two) within 60 meters, then the model reverted to road form three symbology for that neighboring space, as form three is subject to greater sensitivity.

The same accuracy check method was used for Road Form Three as the other forms via satellite imagery. Indications for these forms were typically not as noticeable as road forms one and two and retained heavy vegetation covering the abandoned road. Satellite indicated areas with mostly trees or thick vegetation, with faint, organic linear

openings in which the surface of the ground was consistent with the surrounding vicinity. (See Figure IV in Appendices). Once I was confident in the outputs that the model was projecting, I then moved on to the final stages.

Stages Three/Four

Identifying these form classifications of the general roads led to the final stages of the development of the model. These road form classifications were able to determine the roadbed/ road segments identification of spatially related Trail of Tears segments. These stages added more parameters, logistical and Boolean operations, and several more geoprocessing operations to the previously completed processes. The processes at this stage become increasingly complex and intricate.

The first step was to use the newly identified roads data that were classified by the three basic forms to determine the spatial relationships with segments of the Trail of Tears.

The roads are not processed in any specific order but undertake a series of narrowing parameters and specific conditions that were established based on a series of logic operations and spatial analysis. The methods used included buffering at a 60-meter interval in order to establish spatial relationships between the Trail of Tears and the individual general roads. I then used the merge tool to connect various outputs that had some sort of relationship with other outputs. The same thing was used with the intersect tool that extracted data from a specific output that intersected another output. Logic operations used included “If Spatial Relationship is…” to define rules on which the model operates when going forward to conduct other geoprocessing functions with

more outputs. The outputs of this then followed the set of interwoven rules and parameters that had been laid out in the preceding logic operation.

The geoprocessing method of merging two features together into one feature and then subsequently erasing another set of features that meet a particular parameter from that merged layer was also used throughout the development of the Basic Linear Predictive Model. This left an output of a feature that followed a set of rules to exist as its own standalone feature. The intersect geoprocessing methods ensured that between a set of two features, only the intersecting portions of those individual layers would result in an output of an entirely new feature. The logistical operations used mostly included “If spatial relationship (insert parameter) is True, the model will continue to process the proceeding data under this rule. If the relationship is False, the model stops processing any data that doesn’t meet the requirements set by the logic operator.

After these stages were completed, an accuracy check was performed for each segment form that was produced from the model within the Area of Study until all segments were projecting as expected.

RESEARCH DESIGN – PART II

Three and Four (Repeat)

After I was satisfied that the model was demonstrating accurate projections, I applied it to the larger context of the entire Mark Twain National Forest by removing the spatial limits of the area of study and applying the limits within the Mark Twain National Forest boundaries.

Based on the accuracy of the model projections within the Area of Study, I expected that when applied at the forest level, the model would predict and identify the various forms of each segment of the Trail of Tears within MTNF boundaries correctly.

However, because my parameters were only based on a small area, there may have been other factors of which I am not aware that would have affected the accuracy of the model's prediction. Because there are hundreds of miles of the Trail of Tears that intersects MTNF, I used the "Create Accuracy Assessment Points: random selection" in ArcPro to account for this possibility. This identified 20 random segments of the Trail that I used as a representative sample of all segments on the forest. Here, I started the process of cross-checking those randomly selected segments for accuracy with the same methods used for accuracy checking within my controlled Area of Study. If the projected segment of the Trail of Tears was not what was expected, and the surrounding environmental variables confirm that, a look at other variables and possible miscalculations was conducted. This process continued until all randomly selected segments produced the correct expected projection. This helped to refine the model and increase the likelihood of accurate outputs throughout the forest.

The visual representation (workflow) of the exact geoprocessing methods, map algebra, and logics used to program this model at the forest-wide scale can be found on Figure I in the Appendices, courtesy of ModelBuilder in ArcGIS Pro.

Statistical Analysis of the Draft Model

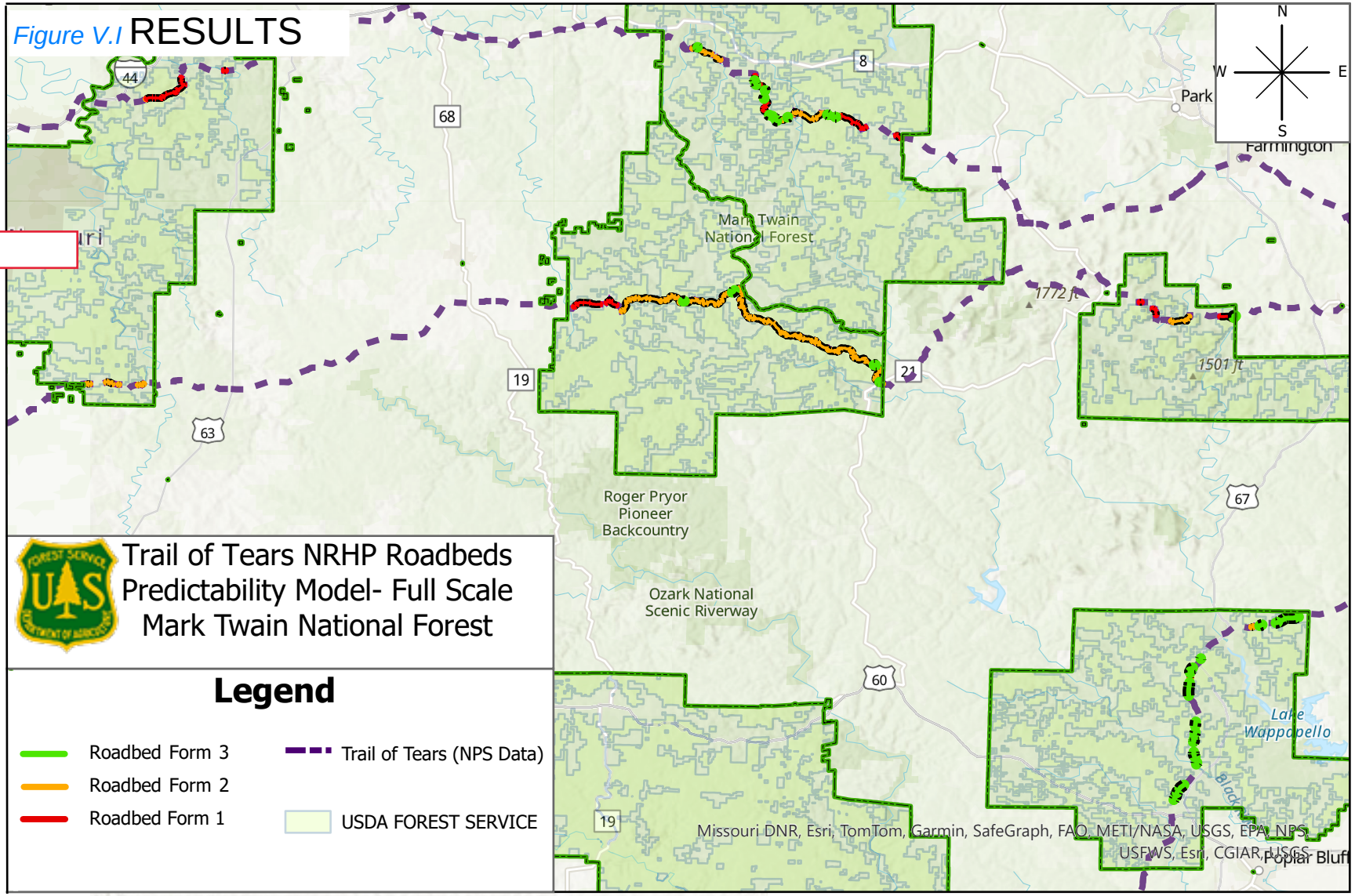
To answer the last part of the research question of what other information can be gained from this approach, a basic statistical analysis is completed. Since the model is

assumed to be operating correctly at this point, basic statistical analysis of the data obtained through these processes should help explore what else we can learn from the results of this thesis. These included percentages, most common lengths, and findings of difference to compare the spread of data that was obtained. The full account of these analyses is presented in the analysis chapter VI.

Wrap-Up

With these methods completed, my results and subsequent analysis should be able to answer the following questions in full: How can we efficiently use the processes of categorization and Geospatial Information System (GIS) methods and analyses to help identify the ‘form’ of various segments on the Trail of Tears, specifically the listed National Historic Trail (NHT) of the “Cherokee Trail of Tears in Missouri, 1837-1839”? Can a predictive model be developed by looking at the spatial relationships between modern roads and the suspected paths taken by the Cherokee in 1837- 1839? If so, what other information can be gained from this approach?

Figure V.I RESULTS



(V) Results

The results of this thesis, as shown in Figure V.I, should be able to adequately answer the research questions presented for this thesis: How can we efficiently use the processes of categorization and Geospatial Information System (GIS) methods and analyses to help identify the ‘form’ of various segments on the Trail of Tears, specifically the listed National Historic Trail (NHT) of the “Cherokee Trail of Tears in Missouri, 1837-1839”? Can a predictive model be developed by looking at the spatial relationships between modern roads and the suspected paths taken by the Cherokee in 1837- 1839? If so, what other information can be gained from this approach?

In this section, I will present my results of the performance of the Draft model. I will first describe my results for Part I, in which I intersected the Trail of Tears polyline with the Mark Twain National Forest polygon and attempted to classify all existing roads into three categories defined by the NRHP Multiple Property Document Form (MPDF), Trail of Tears in Missouri, 1837-1839. I also used spatial analysis and geoprocessing tools to determine any spatial relationships between the Trail of Tears on the MTNF and the preceding categorized general road forms. After determining these spatial relationships, I then use these results to categorize segments of the Trail of Tears into the three forms of roadbeds and road segments. Part I is conducted within my Area of Study as a controlled environment to program and train the model to make accurate predictions.

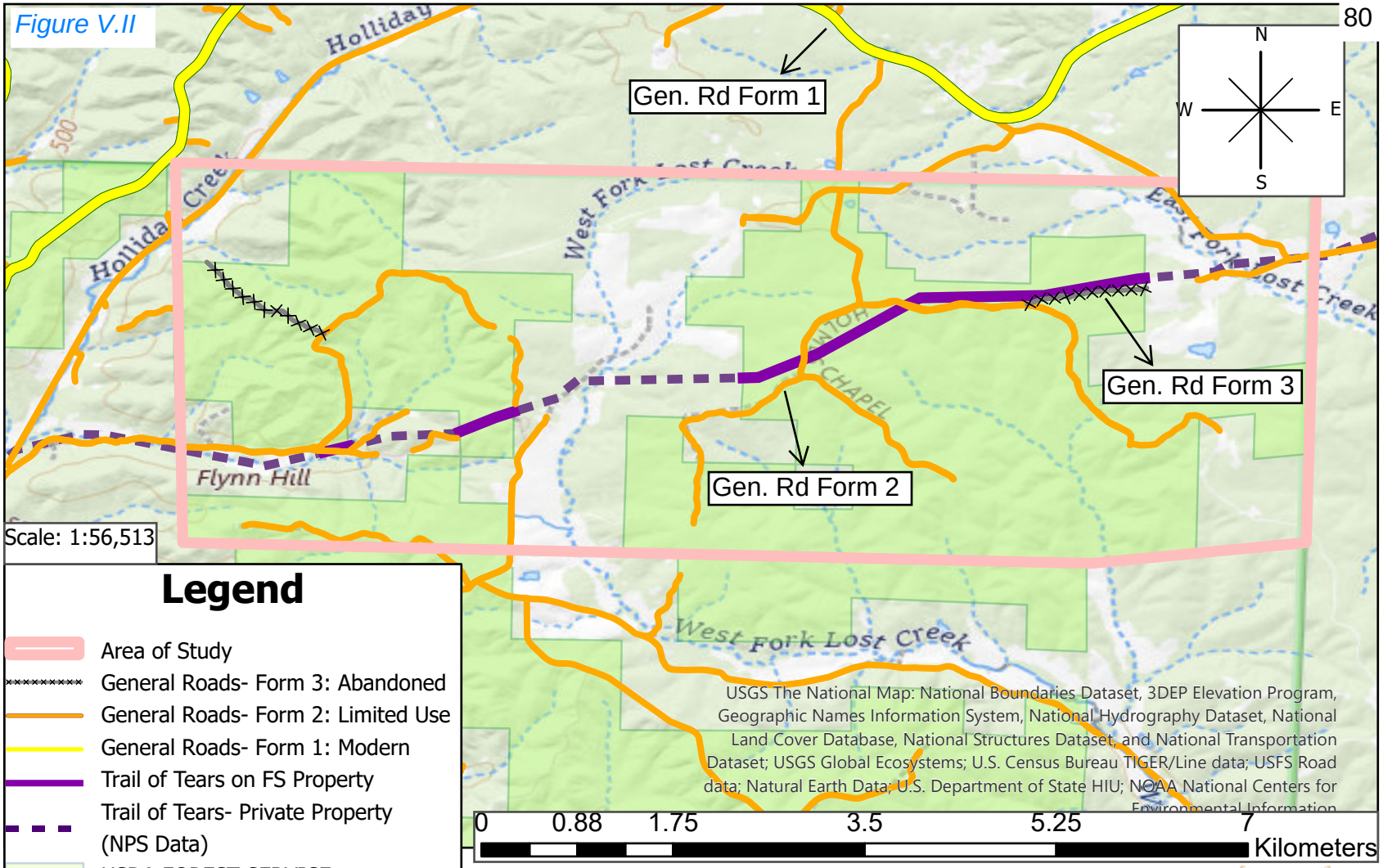
I then discuss my Part II results in which I applied the model to the full extent of the Mark Twain National Forest. I will discuss the implications and analyses of these results in the analysis chapter, VI.

Part I Results

The first stage in developing this model was to separate out the NPS' Trail of Tears polyline data to only apply to segments located on Mark Twain National Forest managed lands in Missouri. There were no issues or complications in carrying this function out, and it was deemed successful (See Figure VI.I). The results confirm that there are several segments of the Trail of Tears that cross through Forest Service lands, equaling about 69 linear miles.

For the second stage, I was able to effectively separate the general road data into the three identifiable forms defined in the Cherokee Trail of Tears in Missouri MPDF, although this was not without its complications. There were several roads that overlapped with each other and projected different outputs due to the limits of the data sources. The MoDOT roads data was labeled in acronyms under the field "designation," which were not clearly defined in any metadata. After a very long search online, I located the full names associated with the acronyms in the 2024 Missouri Uniform Crash Report Preparation Manual. After finding that the abbreviation CRD translated to "county roads," I was then able to apply further parameters and Boolean operations that allowed me to separate the data in a productive way for the consideration of this thesis. It was a tedious process of deductions, eliminations, and logical expressions, but it was fruitful all the same. See Figures V.II and V.III for the results of this process.

Figure V.II



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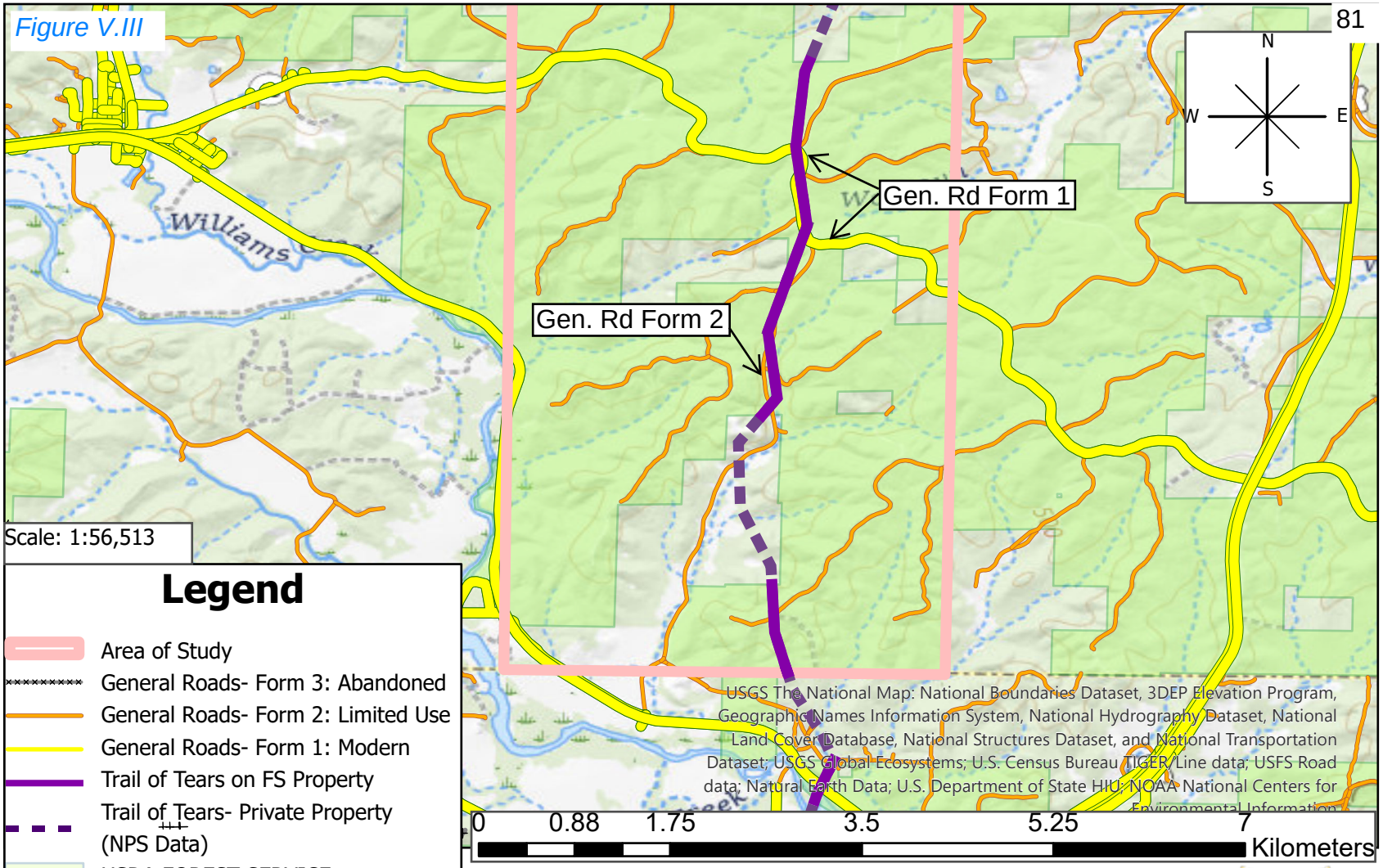
Trail of Tears NRHP General Road Forms
Area A - Mark Twain National Forest

Figure V.III



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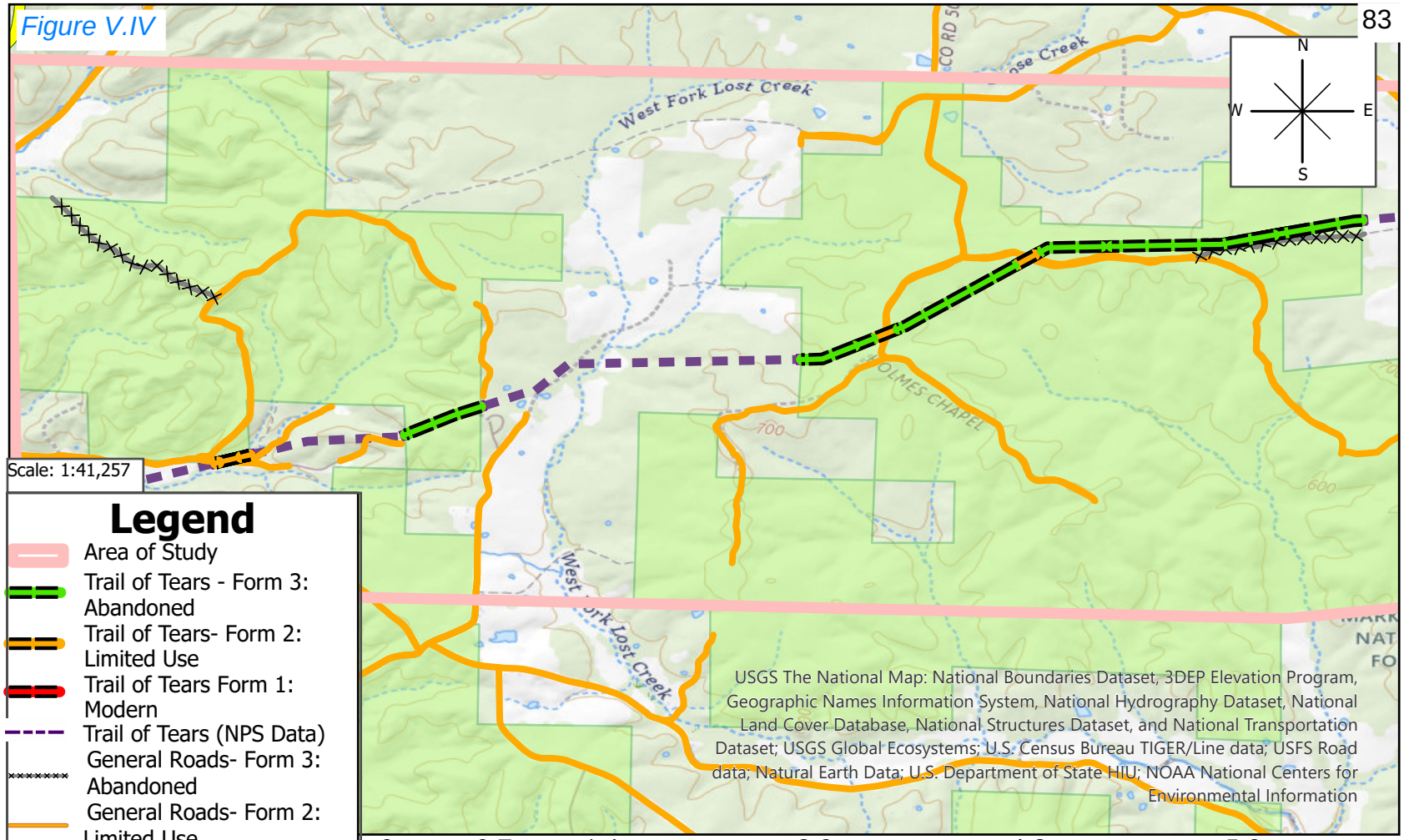
Trail of Tears NRHP General Road Forms
Area B - Mark Twain National Forest

Now that I had my general roads classified into the three forms listed in the MPDF, I could begin to identify the spatial relationships between the Trail of Tears and the roads surrounding it for Stage Three. See Figures V.IV-V, which depict the model and the categorized roads used for the model's development in both Area A and Area B, illustrating the relationship between the classified roads and segments of the Trail. This was also a tedious process that involved many mistakes, trials and errors, and troubleshooting to determine the exact right set of geoprocessing efforts needed, along with the correct usage of logical operators and Boolean expressions. This process took several weeks and espressos to get right. If one step or output was incorrect, the whole set of operations after that would be incorrect. I would use my methods of checking for accuracy until the outputs would produce the expected result. This is how I trained the model. Satellite imagery was extremely useful in determining if an output was right or wrong. The satellite imagery served as my controlled check point in which all other sources would be checked for accuracy. I repeated this process until my accuracy was at 100%. This set up the control data for when I would apply the model to a larger scale.

The final results for the draft model operating within the Area of Study, with the classified roads layer removed, can be seen in Figure V.VI for Area A. Area B results are shown in Figure V.VII, while the bottom section of Area B, described as Area B.2 are shown in Figure V.VIII.

Figure V.IV



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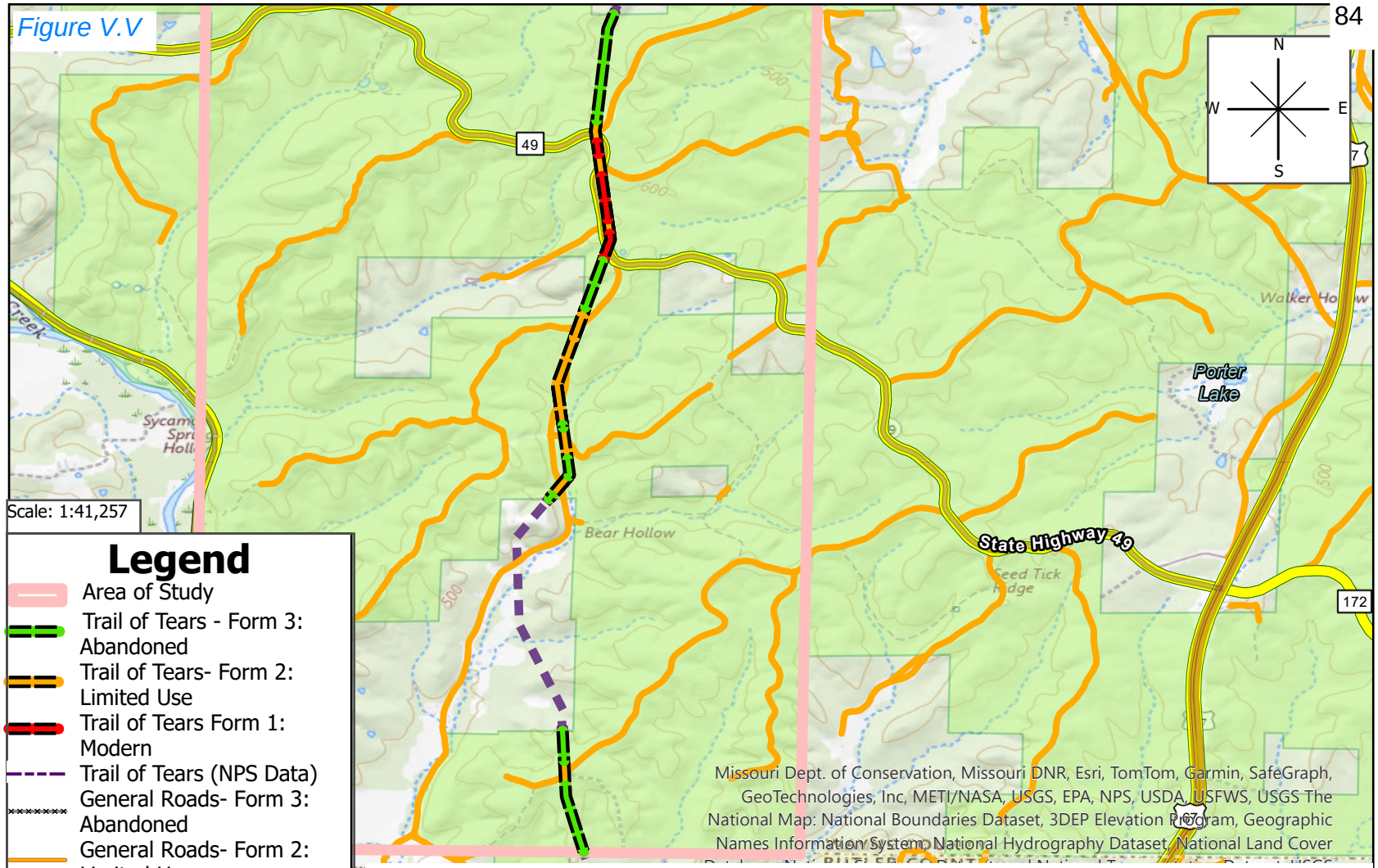
Trail of Tears NRHP Roadbeds Predictability Model and Road Forms: Area A - Mark Twain National Forest

Figure V.V



NRHP Roadbed Forms: Trail of Tears and General Roads
Area B - Mark Twain National Forest

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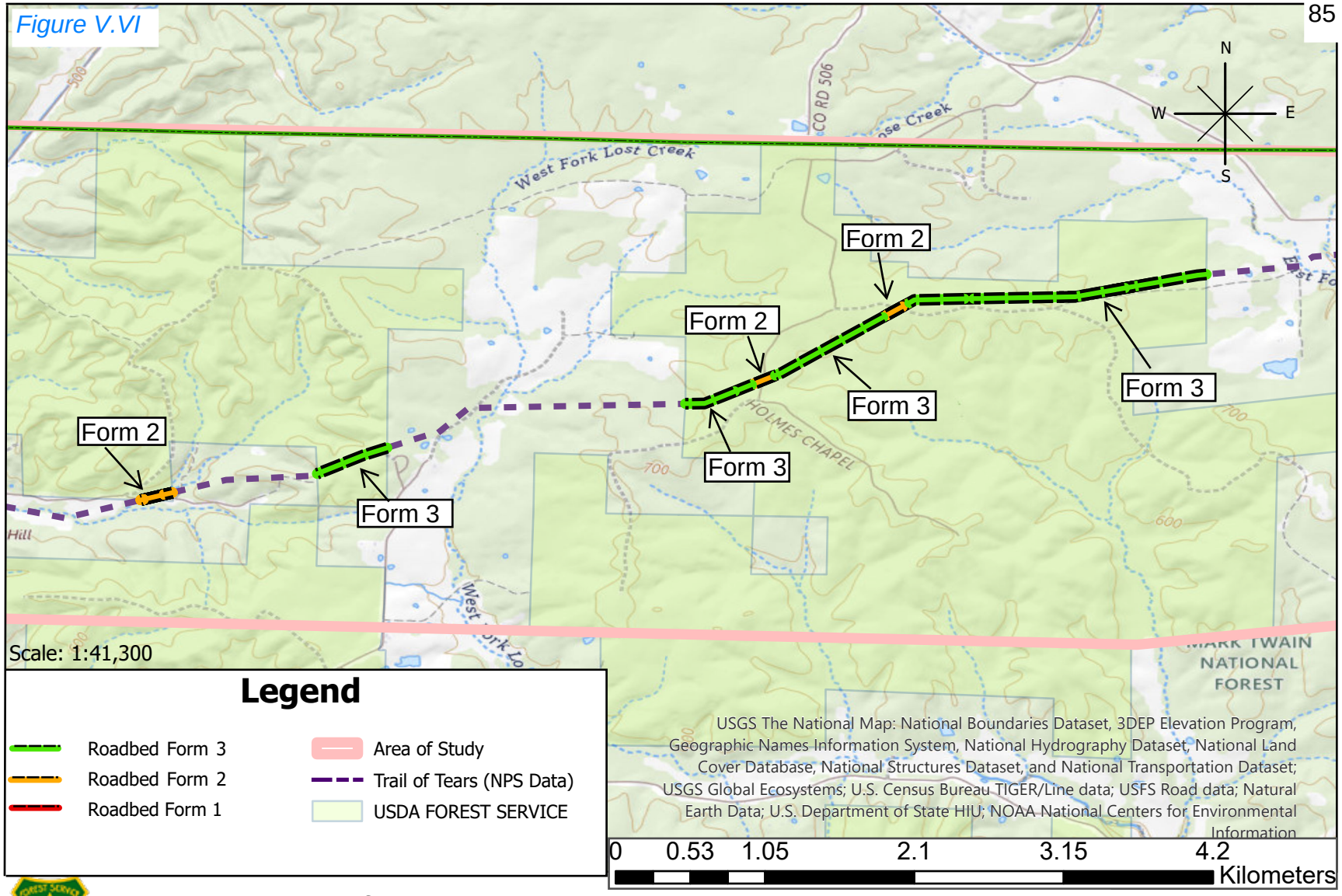
Figure V.VI



Trail of Tears NRHP Roadbeds Predictability Model
Area A- Mark Twain National Forest

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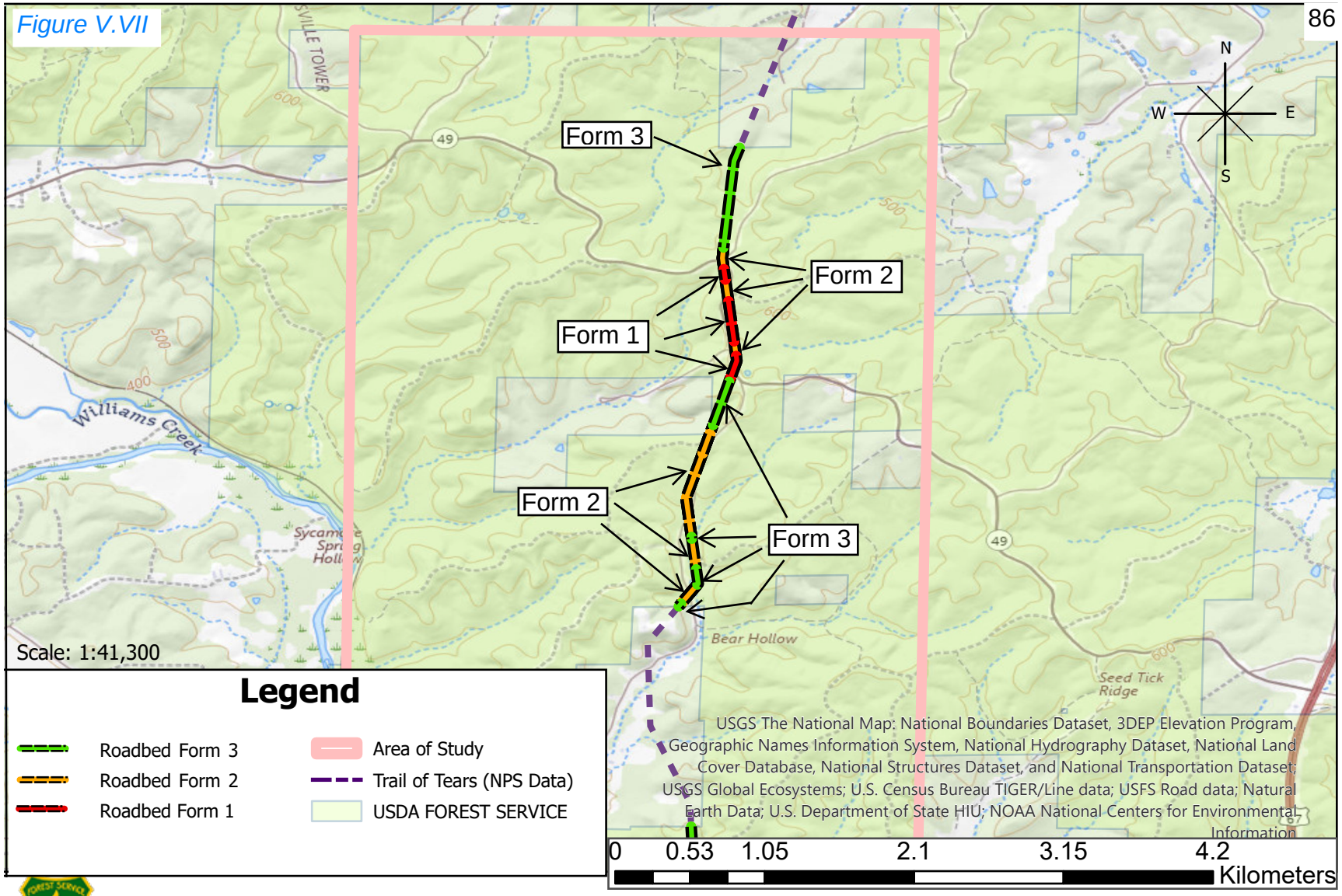
Figure V.VII



Trail of Tears NRHP Roadbeds Predictability Model
Area B- Mark Twain National Forest

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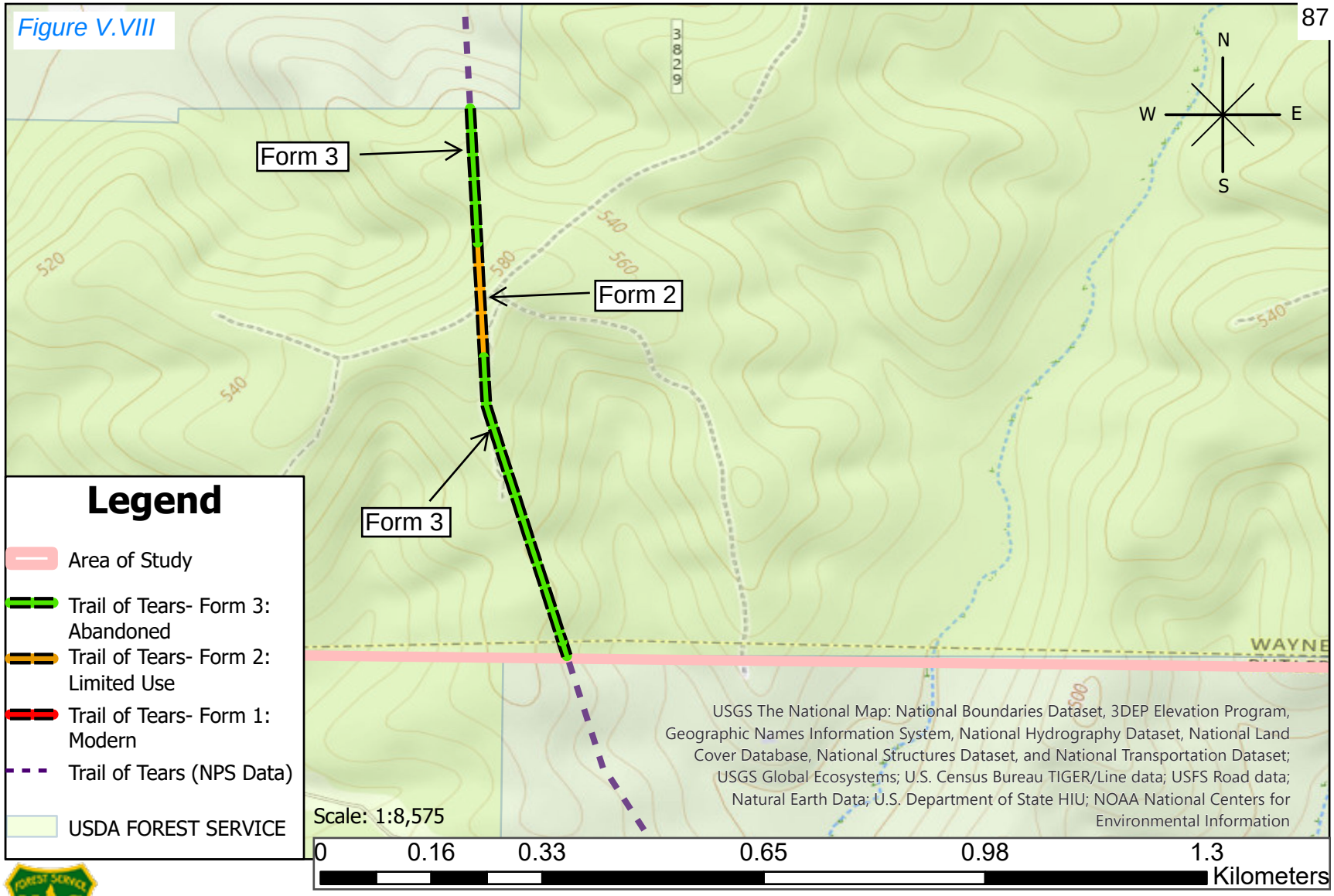
Figure V.VIII



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Trail of Tears NRHP Roadbeds Predictability Model - Area B.2
Mark Twain National Forest

Part II Results

Once I was satisfied with the accuracy of the results within my area of study, I then applied my model and its processes to the extent of the whole Mark Twain National Forest. Again, to check for accuracy, the same parameters that were used in my area of study are applied here. However, as there were hundreds of miles of segments that needed to be verified, I decided to run the random accuracy points function in ArcPro to select a sample of the Trail of Tears segments that would represent all of the segments within MTNF jurisdictions.

This produced a total of 20 accuracy points along the Trail of Tears on the forest, which represented the segments of the Trail the point was associated with. I began to implement my accuracy check process as I had done within my area of study. I immediately noticed discrepancies in the data outputs. There were contingencies in that environment that I had not planned for, such as an intersection that encompassed all three road forms but did not overlap each other. This led me to go back to the model and see where, in the process, things went wrong and then rerun the model to see if the problem was corrected without damaging the controlled data. The control data was very useful because, if these outputs changed in any way, then it was evident that a geoprocess had a broken connection somewhere else in the model, and the preceding correction, was in-fact, not correct. Through a very painstaking process, every incorrect random sample was evaluated (and reevaluated) until the problem was resolved. This added many more parameters and geoprocessing functions to the model so as to account for these contingencies. Just like verifying the results within the Area of Study, I kept going until I obtained 100% accuracy without having to modify the model in any

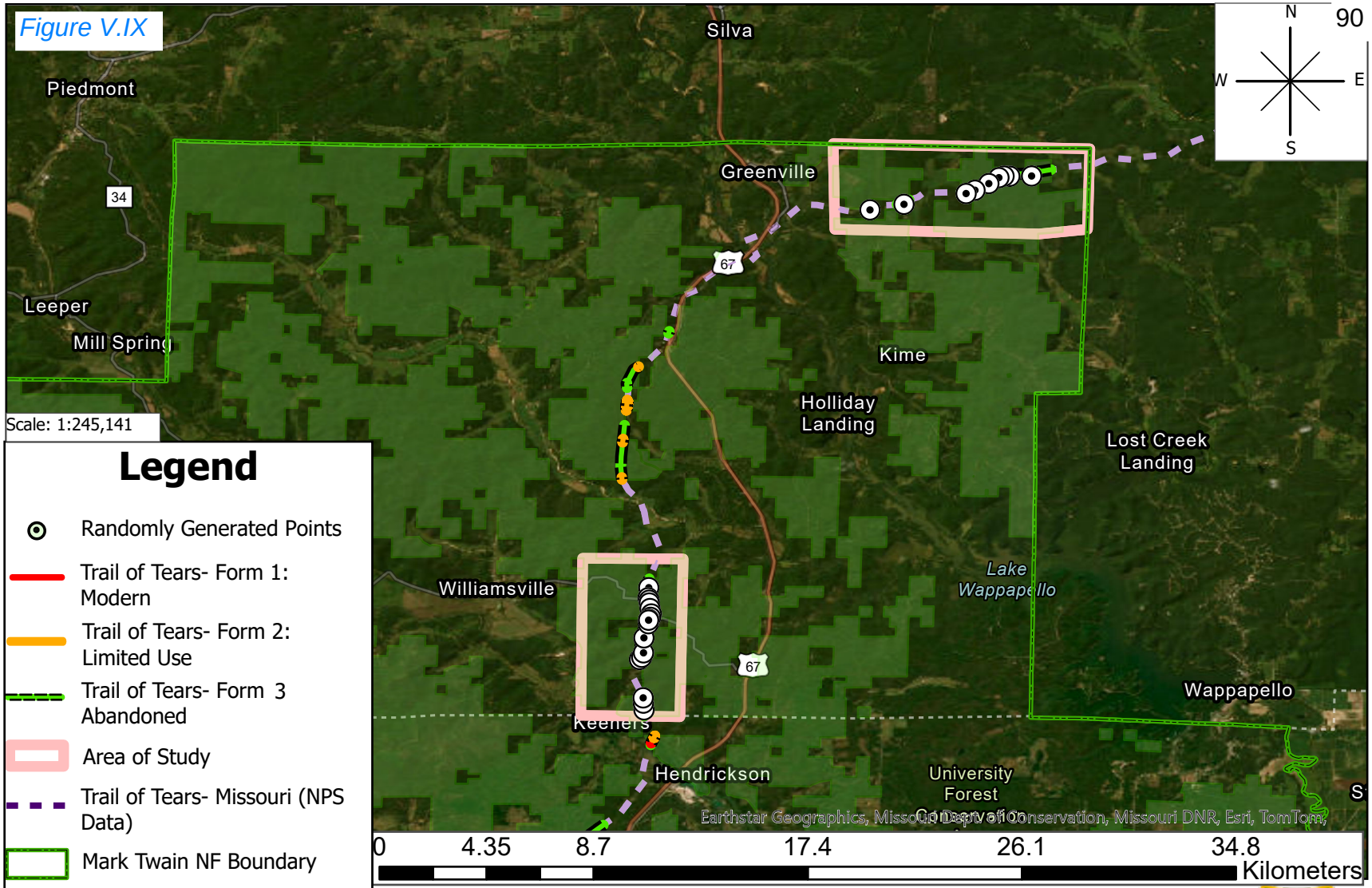
way and was satisfied with the outputs it was projecting. The first three randomly selected segments needed troubleshooting, and after these were resolved, the remaining randomly selected segments were correctly identified by the model with no modifications to the workflow. The model processes took a full hour and 43 minutes to complete each run, and the final results can be seen in Figure V.I. at the beginning of this chapter.

Tables that show the results of the final accuracy assessment within the Area of Study (Table V.I) and when applied to the MTNF (Table V.II) follow Figure V.IX and Figure V.X in sequential order. Each final accuracy assessment of the sample segments was gauged to be at 100% accuracy within the scope of this thesis. During my assessment, I was also able to record some basic information about each of the sample sets, which I will list below and compare further in the next chapter using some basic statistical analyses.

Table V.I

Controlled Sample Trail of Tears Info- Area of Study

Shape	Roads_Accuracy	Satellite_Accuracy	Length (m)	NRHP Class
Point	y	y	182.04	3
Point	y	y	23.09	3
Point	y	y	164.29	2
Point	y	y	103.79	3
Point	y	y	1051.31	2
Point	y	y	307.03	3
Point	y	y	178.57	2
Point	y	y	433.64	3
Point	y	y	63.84	1
Point	y	y	80.42	2
Point	y	y	294.6	1
Point	y	y	136.68	2
Point	y	y	84.34	1
Point	y	y	147.81	2
Point	y	y	624.59	3
Point	y	y	63.84	0
Point	y	y	16.75	2
Point	y	y	1246.97	3
Point	y	y	205.5	2
Point	y	y	175.18	3
Point	y	y	262.14	2
Point	y	y	658.52	3
Point	y	y	257.1	2
Point	y	y	353.44	3
Point	y	y	439.22	3
Point	y	y	192.3	2



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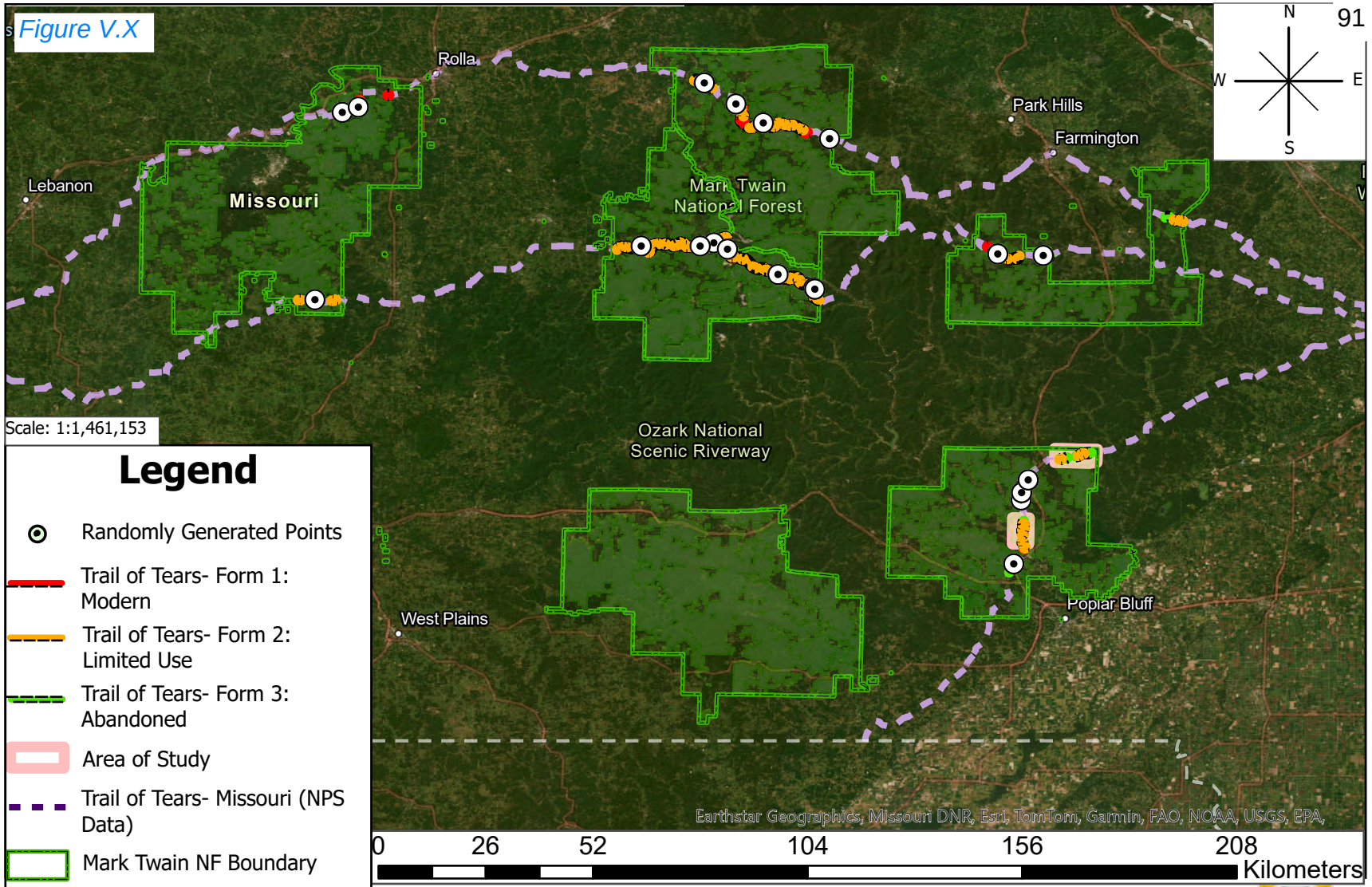
Trail of Tears- NRHP Roadbeds Predictability Model
Random Points Generated for Accuracy
Mark Twain National Forest



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Trail of Tears- NRHP Roadbeds Predictability Model
Random Points Generated for Accuracy
Mark Twain National Forest

Table V.II

Random Sample of Trail of Tears - Mark Twain National Forest				
Shape	**Roads_Accuracy**	**Satellite_Accuracy**	**Length (m)**	**NRHP Class**
point	y	y	2941.74	2
point	y	y	125.41	3
point	y	y	255.8	1
point	y	y	469.3	2
point	y	y	439.73	1
point	y	y	6073.69	2
point	y	y	1235.48	1
point	y	y	1629.78	2
point	y	y	10374.16	2
point	y	y	1575.5	1
point	y	y	2570.94	1
point	y	y	457.56	1
point	y	y	330.06	3
point	y	y	243.01	3
point	y	y	4251.67	2
point	y	y	909.62	2
point	y	y	943.01	3
point	y	y	381	2
point	y	y	126.72	3
point	y	y	943.1	3

In summary, this is the workflow that was used to obtain a generic classification for a linear feature. If this model were to be implemented in another location, it is possible that the inputs and variables may need to be adjusted, but the methodology should still stand. I will discuss this further in the Implications section of Chapter VII.

Generic methodology that can be used with other linear features for classification:

1) Determine what linear feature you want to study and the geographic area of interest.
2) Determine a set (or sets) of defined criteria that you want to identify for that linear feature.
3) Determine any existing datasets (for inputs and variables) or features that would assist in identifying said criteria throughout the intended linear feature.

4) Identify any spatial relationships using a variety of spatial analysis techniques and geoprocesses (such as map algebra, Boolean operations, and logic expressions) between the linear feature, any defined criteria set, and the preexisting datasets or features that illustrate those criteria.
    - 4a) At what spatial interval are these considered ‘associated’?
5) Use these results to identify the criteria for the selected linear feature.
6) Have a controlled data source that is already verified to cross-reference the results with (i.e., satellite imagery, LiDAR, etc.)

This thesis focused specifically on the Trail of Tears as the linear feature and the NRHP defined criteria for Roadbeds/ Road Segments using existing general roads data that was spatially related to the Trail of Tears to obtain specific attributes about segments of the Trail of Tears as classifications.

These results attempt to answer the first two questions this thesis set out with: how can we efficiently use the processes of categorization and Geospatial Information System (GIS) methods and analyses to help identify the ‘form’ that various segments on the Trail of Tears, specifically for the listed National Historic Trail (NHT) of the “Cherokee Trail of Tears in Missouri, 1837-1839” that crosses the Mark Twain National Forest? Can a predictive model be developed by looking at the spatial relationships between modern roads and the suspected paths taken by the Cherokee in 1837- 1839?

Chapter VI, Analysis, will attempt to decipher the third question as to what information can be gained from the results of this model, and a more thorough analysis of the first two questions will be discussed as well.

(VI) Analysis

The results presented in the previous chapter attempt to answer the research questions of this thesis: how can we efficiently use the processes of categorization and Geospatial Information System (GIS) methods and analyses to help identify the 'form' that various segments on the Trail of Tears, specifically for the listed National Historic Trail (NHT) of the "Cherokee Trail of Tears in Missouri, 1837-1839" that crosses the Mark Twain National Forest? Can a predictive model be developed by looking at the spatial relationships between modern roads and the suspected paths taken by the Cherokee in 1837- 1839? If so, what other information can be gained from this approach?

This chapter will analysis the results of this thesis and conduct some simple statistical analyses to extract information from the final draft model.

Chapter VI, Analysis, will attempt to decipher the third question as to what information can be gained from the results of this model, and a more thorough analysis of the first two questions will be discussed.

Summary of Results

Part I (Area of Study)

Within my area of study, I trained the model with parameters, Boolean expressions, logic operations, and a series of geoprocesses until all segments in the area were accurate with the cross-referenced satellite imagery. If a generated outcome was clearly inaccurate based on the imagery, I went back and reviewed the parameters, Boolean expressions, and geoprocesses to troubleshoot the problem until all predicted outcomes aligned with the expected outcomes. Cross-referencing my results with a continuous

and reliable source, such as the satellite imagery, allowed me to recognize what my expectations should be of the model's outcomes and thus, allowed me to troubleshoot and remedy problems when required.

My goal for the model was to identify the roadbed forms for all general roads layers that corresponded with the satellite imagery. This took several parameters and Boolean operations to express, precisely, what I needed from the various roads' datasets. I applied the outcomes of the roadbed form for all general roads to the same kinds of parameters to define the relationships between the general roads and segments of the Trail of Tears. As each input dataset was organized and defined differently, accommodations were made to fill data gaps between the inputs. This required a thorough understanding of each dataset and its attributes. Without this knowledge, extracting the right parameters for each dataset would not have succeeded.

Part II (Applied to the Mark Twain National Forest)

Satisfied that all segments of the Trail of Tears were accurately classified within the Area of Study, the model was applied to the wider scale of the whole Mark Twain National Forest. Instead of checking every segment on the MTNF, I used randomized points to represent a sample of the segments in this thesis. I immediately began to notice discrepancies in the outputs at this scale when I began to review the associated segments. I proceeded to use the same process as before, where I would return to the model workflow to resolve the problem and identify solutions. All problems and glitches were determined to be resolved when the model began representing the expected results at those accuracy checkpoints without the need to troubleshoot any problems. The model had identified every segment of the Trail of Tears that crossed through the

Mark Twain National Forest and applied an expected roadbed form to it. Based on the accuracy results from sample data, the final draft model was assumed to be predicting at 100% accuracy for the full forest.

Discussion of Research Questions

1) How can we efficiently use the processes of categorization and Geospatial Information System (GIS) methods and analyses to help identify the 'form' that various segments on the Trail of Tears, specifically for the listed National Historic Trail (NHT) of the "Cherokee Trail of Tears in Missouri, 1837-1839" that crosses the Mark Twain National Forest?

A systematic and efficient method to identify all Property Type One forms of the Cherokee Trail of Tears in Missouri on MTNF lands was proven obtainable by this thesis. This draft model identifies or predicts which characteristics a segment holds to depict which form the segment will take. Using a defined set of criteria, such as the NRHP classifications for roadbeds/ road segments, presents a uniform way of addressing such a large and vast linear resource.

Using these methods, it is possible to define different characteristics along such large linear resources that different segments may hold. Often, with this type of resource, the environment and subsequent characteristics that make the resource significant will change. The Trail of Tears crosses multiple states and different biomes, from the mountains of Appalachia and the plains of Arkansas to the Ozarks in Missouri. For such resources, the characteristics that make each section special can change over the course of thousands of miles. By using a uniform system of categorization to define

these differences, a more detailed approach to how we preserve and study these resources can take place.

2) Can a predictive model be developed by looking at the spatial relationships between modern roads and the suspected paths taken by the Cherokee in 1837- 1839?

The predictive model was developed using a series of spatial analyses and geoprocesses. Initially, standing on the theory that segments of the Trail of Tears have evolved to modern road standards, as suggested by the NRHP Multiple Property Documentation Form, it seems that this argument holds weight.

Where no roads were documented, segments of the Trail of Tears in these areas appeared undisturbed from satellite view, suggesting that those areas may hold more physical integrity relating to the late 1830s. Where segments of the Trail crossed through highways and modern roads, those highways and modern roads also appeared on the satellite and as documented roads. For segments that appear to be gravel or less utilized, indications for this were present on the satellite and USFS roads. By using these indicators and with the assumption that the model is operating at 100% accuracy, this theory is solid. The spatial relationships exist and can be used as a way to predict the form of the roadbeds/ road segments on the Trail of Tears.

Statistics and Analysis

3) If so, what other information can be gained from this approach?

To answer this question, we need to look at our results and the corresponding statistics. Statistics are used here as a common method to understand what our data means at face value.

I will first discuss what the outcomes of the draft model when applied to full scale Mark Twain National Forest. I will then narrow my discussion to the sample data gathered in the accuracy check, and will, finally, compare the statistics between the data gathered at full-scale and the sample data.

As discussed in Chapter II, the three classifications of roadbeds/ road segments forms outlined in the MPDF, are Form One: Modern Roads, Form Two: Limited Use Roads, and Form Three: Abandoned Roads.

Form One includes all modern roads that have been modified with pavement, graded and edged, and are rated for a large amount of traffic. When the Trail of Tears overlaps with these roads, the segments are considered to hold the least amount of integrity in regard to what the original trail would have looked like in 1837-1839. While still important and federally protected due to its location, this would likely be a highly disturbed area with little research value in comparison to the other two forms and is less likely to be dramatically impacted by any undertakings.

Form Two includes all roads that have been minimally modified with gravel or dirt, some grading and edging, and are rated for a small amount of traffic, including the average-sized vehicle. Throughout the Mark Twain, many of these roads are forest roads or have been closed off in recent years. Many county and local roads also meet this criteria when weaving through the forest. This form holds a bit more integrity than form one. The setting often resembles what the original setting would have looked like in the late 1830s. The path is cut in an organic way (not as uniform as the modern roads) and has had little grading of the landscape so that the original shape is preserved. This area still

holds much integrity and is more likely to be impacted by undertakings, especially with ground disturbance, timber harvesting, and development.

Form Three includes all roads that have been abandoned, undeveloped, or modified and are not rated for any traffic use. There has been no alteration to the surface of the road, which should resemble that of the surrounding ground surface materials. These areas are typically highly vegetated and sometimes obscure by satellite, with only the suspected NPS documented Trail location indicating there was once a road in the area. These roads are sometimes documented and remain closed off, or they may not be documented by any road authority at all. These segments are of particular interest because they are known to contain the most physical integrity representative of 1837-1839. They are completely undeveloped and unaltered from their original form for use by horse and wagon. These segments remain some of the least documented known areas. They are highly sensitive to any undertaking and may need extra point protection measures from any activity. They are completely unmaintained and would not be passible with any vehicle. These are prime areas that need to be further researched and can answer questions related to travel on the Trail of Tears as it was in the late 1800s. By using the NRHP criteria to classify segments of the Trail of Tears, segments that meet Form Three can be more easily identified.

Randomly Selected Sample Segments

As discussed previously, the model was applied to the Area of Study (as the controlled environment) for training and development. Each segment resulting from this application was documented and tested for accuracy. Basic statistics were also recorded for this area. For the model to be applied to the full scale of the forest, it was not efficient to

check every segment for model accuracy. It was decided to use the Random Accuracy Point generator in ArcPro to identify 20 different segments to verify. Both of these datasets, as shown in Tables V.I and V.II in the previous chapter, were reviewed for accuracy and finalized the programming for the draft model. For analysis purposes, these datasets were combined to showcase a representative sample of the full-scale model; see Table VI.I. The sample set measured a total of 44.02 kilometers or 27.36 miles of segments that were verified as correct outputs.

Within this total of 27.36 miles of Trail, it was identified that 4.34 miles (15.87%) of the Trail has Roadbed Form One characteristics, 18.51 miles (67.66%) of Roadbed Form Two characteristics, and 4.51 miles (16.48%) have Roadbed Form Three characteristics, see Figure VI.I.

Roadbed Form One ranks the least in volume of Trail segments, with Roadbed Form Three consisting of a slightly higher volume of Trail segments. Roadbed Form Two accounts for over half of the total sum of the representative sample of Trail segments in the forest and ranks highest in miles of segments.

Figure VI.I

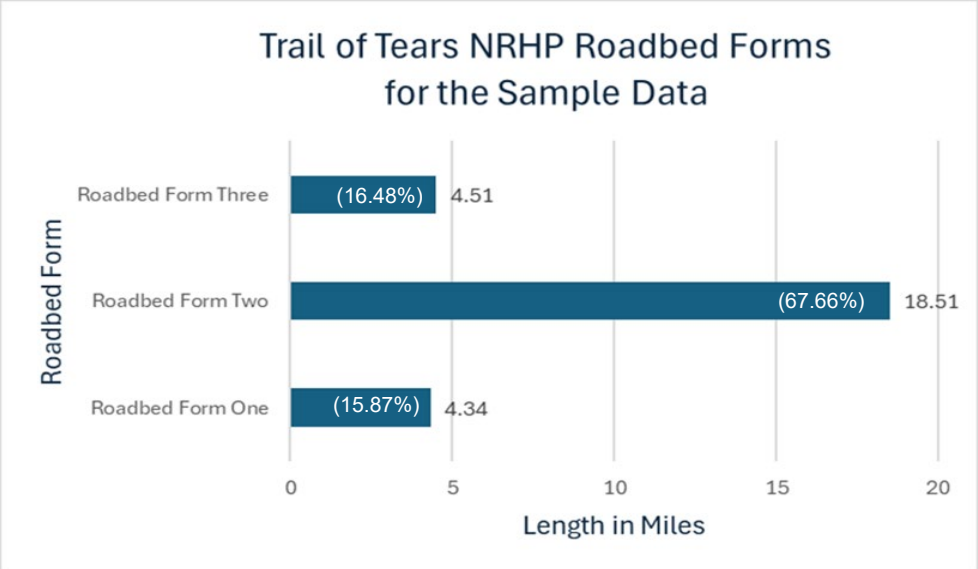


Table VI.I

All Sample Trail of Tears Segments

Shape	Roads_Accuracy	Satellite_Accuracy	Length (m)	NRHP Class
Point	y	y	182.04	3
Point	y	y	23.09	3
Point	y	y	164.29	2
Point	y	y	103.79	3
Point	y	y	1051.31	2
Point	y	y	307.03	3
Point	y	y	178.57	2
Point	y	y	433.64	3
Point	y	y	63.84	1
Point	y	y	80.42	2
Point	y	y	294.6	1
Point	y	y	136.68	2
Point	y	y	84.34	1
Point	y	y	147.81	2
Point	y	y	624.59	3
Point	y	y	63.84	2
Point	y	y	16.75	2
Point	y	y	1246.97	3
Point	y	y	205.5	2
Point	y	y	175.18	3
Point	y	y	262.14	2
Point	y	y	658.52	3
Point	y	y	257.1	2
Point	y	y	353.44	3
Point	y	y	439.22	3
Point	y	y	192.3	2
point	y	y	2941.74	2
point	y	y	125.41	3
point	y	y	255.8	1
point	y	y	469.3	2
point	y	y	439.73	1
point	y	y	6073.69	2
point	y	y	1235.48	1
point	y	y	1629.78	2
point	y	y	10374.16	2
point	y	y	1575.5	1
point	y	y	2570.94	1
point	y	y	457.56	1
point	y	y	330.06	3
point	y	y	243.01	3
point	y	y	4251.67	2
point	y	y	909.62	2
point	y	y	943.01	3
point	y	y	381	2
point	y	y	126.72	3
point	y	y	943.1	3

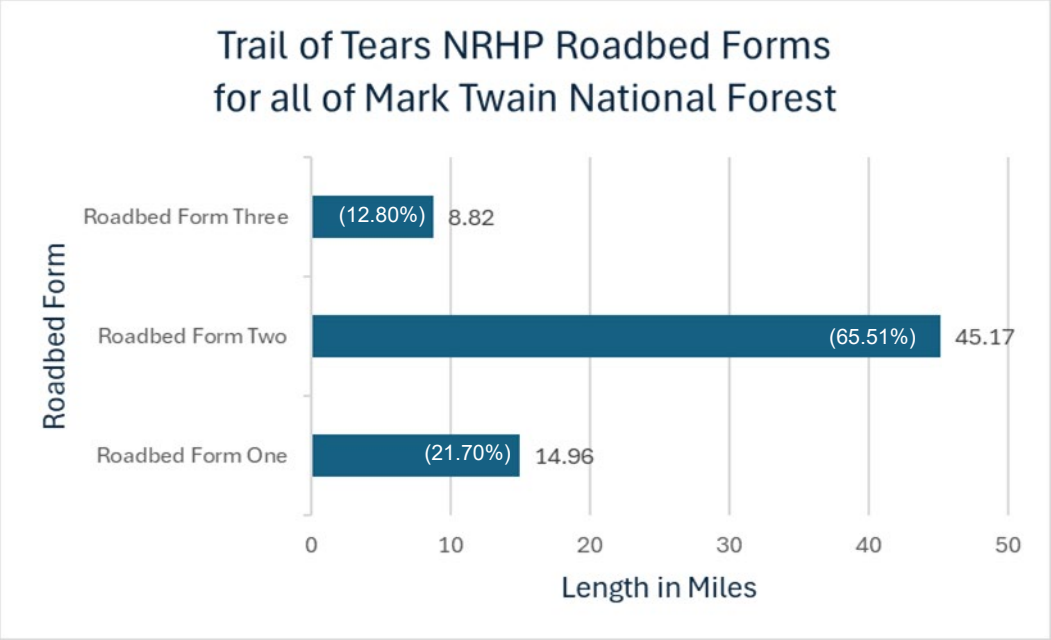
Implemented at Full-Scale (MTNF)

When the draft model was applied to the whole of the Mark Twain National Forest (after all discrepancies were resolved), a total of 68.94 miles of the Trail of Tears were evaluated for roadbeds/ road segments forms.

Within this total of 68.94 miles of Trail, it was identified that 14.96 miles (21.70%) of the Trail has Roadbed Form One characteristics, 45.17 miles (65.51%) of Roadbed Form Two characteristics, and 8.82 miles (12.80%) have Roadbed Form Three characteristics, see Figure VI.II.

Roadbed Form Three ranks the lowest in volume of Trail segments, with Roadbed Form One consisting of a slightly higher volume of Trail segments. Roadbed Form Two, again, accounts for over half of the total sum of the representative sample of Trail segments in the forest and ranks highest in miles of segments.

Figure VI.II



Comparison

A total of 27.36 miles of Trail of Tears segments were verified with correct model outputs out of a total of 68.94 miles that crosses through the Mark Twain National Forest. Simply put, 39.70% of individual Trail segments were verified as accurate. To determine if this is indeed a representative sample of the whole, a comparison of the total percentages with the results of the full-scale percentages needs to be conducted.

Roadbed Form One accounted for 21.70% of the sample data and 15.87% of the whole forest, with a difference of 5.83%.

Roadbed Form Two accounted for 67.66% of the sample data and 65.51% of the whole forest, with a difference of 2.15%.

Roadbed Form Three accounted for 12.80% of the sample data and 16.48% of the whole forest, with a difference of 3.68%.

In comparison, each Roadbed Form calculation between the sample dataset and the whole forest indicates an average difference of 3.9% with each other. This low percentage indicates that the sample segments indeed reflect an accurate representation of the larger-scale outcomes. It can be assumed, then, that if the verified model outputs from the sample segments are projecting at a 100% accuracy rate, the outputs that this same model, when applied to the whole forest, should also operate at 100% accuracy or very close to it. This low difference in the percentages between the two datasets is further indication that the model is accurately predicting the correct outputs based on the NRHP MPDF criteria.

Additional Results

As part of the results of this model, seventeen segments of the Trail of Tears on the MTNF were identified as likely having the characteristics of Roadbed Form Three. These segments were previously unclassified areas that have now been flagged for further study and enhanced protection measures. These segments will be given priority status for recommended future efforts, such as ground-truthing and LiDAR analysis. These areas also identify priority areas in which co-stewardship can take place between the Forest Service and the Cherokee.

So, to answer part three of the research question, we can interpret a vast amount of information by using a predictive model to identify the roadbeds/ road segments forms for segments of the Trail of Tears. Through this simple statistical analysis of the, all of the research questions of this thesis are answered through using this predictive model. Future research efforts resulting from the outcomes of this thesis are sure to provide an even more detailed analysis of the different segments of the Trail of Tears.

Implications of Results

The objective of this research was to build a predictability model that would predict which roadbed/ road segment form that the Trail of Tears may hold with reference to the NRHP Cherokee Trail of Tears in Missouri, 1837-1839 criteria. This gives us a wider view to evaluate the Trail of Tears on a large scale within the Mark Twain National Forest managed lands. It also identified areas of potential segments that may still hold all of its integrity and will need to be assessed at a local level. With this model,

assumptions can be made about various characteristics of different segments where no modern in-field recording has taken place.

Using extant roads and documented road layers to determine if these segments of the Trail would have any relationship proved this assumption correct. The results demonstrate that much of the Trail of Tears, in the context of the period of significance, falls within modern and limited-use extant roads that are used today.

It also implies that this methodology would work on other segments of the Trail of Tears in other states with similar environments. The inputs would need to be changed to fit the specific needs of the area of study, and different parameters would need to be added depending on other relevant variables, but the basic methodology would remain the same. This model can also be adapted to future research or consultation information that may be pertinent to its protection. It can be adapted to fit in more variables if used as a sensitivity index of sorts, which would identify areas of extra sensitivity if the right variables were present. The buffer area would be updated to reflect this additional information, and the outputs of the NRHP roadbeds and road segments would also be modified as a result. Emergency situations such as natural or human disasters could also use this as an efficient means to focus on additional protection efforts in a certain area indicated by the model if a situation were to arise.

However, it is important to note that while the input data may change with further research, the methodologies behind this model will not. The inputs should be representative of the best-estimated location of the Trail of Tears, which is currently posed by the National Park Service, and that is what this model is based upon. Future research gives the possibility that our understanding may change, and the model can

adapt to those future needs. The road information and the documented segments of the Trail of Tears locations may change. This model uses a combination of the Missouri Department of Transportation's road data and the US Forest Service's Road data and is set to the parameters that best fit the specific needs of the Trail as it pertains to the Mark Twain National Forest. However, where the Trail intersects other states or lands, the road information would change and would need to be adapted as such. The possibility also implies that this type of methodology would be applicable to other long-distance cultural resources.

It should also be mentioned that this is a model projected and developed with the available digital public data quality, which is not always complete and may contain errors but is less likely to include errors starting with authoritative data from reliable sources. Because of this, the need to research and understand the data being used is important. The quality of the model (or any model for that matter) is only as good as the data being inputted that the model will base its processes on. That means that there is some degree of limitations the model may contain, and a field verification should be done, but it gives cultural resource managers a pretty useful place to start.

(VII) Conclusion

This thesis aimed to answer the following questions: How can we efficiently use the processes of categorization and Geospatial Information System (GIS) methods and analyses to help identify the 'form' that various segments on the Trail of Tears, specifically the listed National Historic Trail (NHT) of the "Cherokee Trail of Tears in Missouri, 1837-1839"? Can a predictive model be developed by looking at the spatial relationships between modern roads and the suspected paths taken by the Cherokee in 1837- 1839? If so, what other information can be gained from this approach?

These were answered within the context of this research project by the preceding chapters.

This thesis discussed the theoretical background of governance which directly applies to the intent of the NRHP and the movement around conducting better consultation between agencies. A historical background on the events happening around the time of the Indian Removal Act was also described in detail to give a sense of why this particular National Historic Trail is so significant in the history of those that were directly affected and for generations thereafter. The historical context illustrates the importance of the Trail of Tears and why we should find better ways to manage such large, significant cultural resources. I then described my methods used to create the model using a series of logical expressions, Boolean operations, and geoprocessing analysis functions. The results identified seventeen segments of potential roadbed integrity where the historic alignment of the Trail of Tears was not modified or developed in line with extant modern roads. The results also confirmed that the Trail has a spatial relationship with many modern and limited-use roads that are still used today. (I mean,

why forge your own path if there is already one cleared and maintained? Work smarter, not harder.) Basic statistical analysis was also conducted to understand more about the results of this study. It confirmed that the sample segments used to develop the draft model are representative of the model's outcomes when applied to a forest-wide scale. It was determined that there is a total of 68.94 miles of Trail of Tears crossing through the Mark Twain National Forest, with 14.96 miles (21.70%) of the Trail having Roadbed Form One characteristics, 45.17 miles (65.51%) of segments with Roadbed Form Two characteristics, and 8.82 miles (12.80%) of Trail with Roadbed Form Three characteristics. Roadbed Form Two classified segments are the most common of the Forms on the Trail of the MTNF.

With these results, the draft of this model gives archaeologists a useful starting point for properly managing a vast and meaningful linear cultural resource, such as the Trail of Tears, and identifying segments that are considered at-risk for potential undertakings. These results also identify areas that can be prioritized for future research efforts.

Future Directions

This predictive model is not just an identification tool but a way in which better management decisions and practices can be addressed. Through consultation and partnerships with the Cherokee, the people who have the greatest claim over the Trail of Tears will be empowered to further assert their voice in the stewardship and protection of the Trail of Tears, which is a testament to their survival as a people. This is in alignment with the Forest Service's goals of implementing greater multiagency collaborations, tribal partnerships, and public collaborations. This model and subsequent methodologies can also provide many opportunities for future groundwork

or GIS research. The model itself can also be shared to allow others to refine and modify it to fit their needs. It can also be shared and potentially to identify other characteristics of other linear resource in collaboration with other agencies and stakeholders. It is important to note that this model will not just be the end result of this research but also the way forward for collaboration to identify a variety of other characteristics that the Trail of Tears segments may contain, which will further our knowledge and understanding of both physical and intangible qualities of the Trail.

Collaborative/ Participatory GIS

With the heavy use of GIS used in the creation of this draft model, it will be an important concept moving forward with consultation and future research efforts. This is where Participatory GIS methods will be utilized to ensure equal opportunity for stakeholders to collaborate. GIS can be used as an interactive vehicle for spatial learning, discussion, information exchange, analysis, decision making and advocacy (Rambaldi et al. 2006).

By sharing the results, methodology, and the model as a GIS tool with our partners, they will be able to comment, change, revise, and refine any part of this model as needed. Mapping attachments, map packages, and layer/data sharing can aid in conveying the results of this model with the opportunity to merge the results with Cherokee Nation's own internal GIS database and perspectives. The compatibility between the GIS software of the Forest Service and the Cherokee Nation will heavily influence what type of methodologies can be used to share any and all data necessary as conversations evolve. It will likely resemble previous data-sharing efforts of site and survey data between the Mark Twain and Cherokee Nation via email and map packages. It will be left to their discretion to share their own findings in as little or as

much detail as is preferred. In an effort to make the tool's use more efficient and to accurately capture all participants' views and knowledge, the Forest Service can use any shapefiles or criteria shared in the confidentiality of consultation to revise the model to fit the appropriate needs. The results of this consultation will not be shared externally, and when/if it results in an altered model output, it can be used to detect other potential areas of significance and sensitivity without revealing details.

As stated in Chapter II, this draft model only incorporates significant variables and inputs that identify the physical integrity of the roadbeds and road segments. The question is, how else can we define significance from this draft model onto the Trail of Tears' segments in an adapted version of the model? Is there something else that can be added to this model that is of significance to preservation or research? In collaboration with the Cherokee THPO, we hope to finalize this as a useful management tool that identifies significant and integral parts of the Trail of Tears by including all perspectives. The results of this thesis provide an opportunity for further collaboration between the two entities. This draft model will not be considered complete and ready for implementation until the consultation process has found agreement on all sides for future use(s).

The way in which this model is programmed, several more inputs (or characteristics) can be woven into the workflow to project future needs or variables that need to be taken into consideration. The model produced in this thesis is considered to be a draft model pending consultation until finalized. In this way, GIS can be used to communicate the needs and perspectives of all participants.

Future Research Recommendations

Some suggested next steps are recommended in regard to the results of this thesis. In addition to consultation, it is recommended that this model be ground-truthed and that the suspected seventeen Roadbed Form Three areas be thoroughly documented. Because these areas will likely need specific protections from any undertaking, a plan to mitigate the impacts of an undertaking should be addressed, whether a larger avoidance buffer needs to be put in place or if specific fire protection should be implemented, etc. Also, because LiDAR is such a useful data source, it is highly recommended that some form of analysis be done between the relationships of LiDAR imagery and suspected Trail of Tears routes. Once a thorough study is done, the results of this can be integrated into this model to further refine areas of interest.

Co-stewardship opportunities should be identified between the Cherokee Nation and Forest Service and discussed as part of the consultation of this model. Research opportunities should be addressed in much the same way, with an emphasis on collaboration. As needs evolve, this model can be adapted to suit different objectives. If the objective involves specific protection measures for the different segment forms, then those measures can be adjusted to suit those needs. The same can be done for a specific research objective as well. This draft model prospects the potential for multiple adaptations and more research questions to be explored. It is purposely meant to be open-ended to allow for a variety of modifications.

This model also has the potential to operate in other national forests or land managing agencies to assist in managing the Trail of Tears. While a few parameters may need to be changed or added, and the local state roads data would likely be different, the model

should work, as is, to classify segments of the Trail of Tears into the three roadbeds/ road segments form based on the same criteria laid out in the Multiple Property Documentation Form.

National Historic Trails, such as the Trail of Tears, are important linear cultural resources that hold significance to the nation. In addition to research and protection measures, there is also the need for public outreach opportunities such as heritage tourism and public education. This can include anything from signages along the route, to hiking trails that highlight the Trails of Tears significant features for public education and reflection. As modern development begins to overtake many of our natural resources, it is becoming increasingly important for the public to understand why we focus on preserving these expansive linear cultural resources similar to the Trail of Tears and why protecting its environment is essential to its preservation. Without passing down this knowledge, we cannot hope to convey the significance of these sites and why cultural resource management is necessary. While following this notion, the basic methodology steps used for this thesis, outlined in Chapter IV, can also be employed for these other long linear cultural resources. The inputs and certain variables would change, along with the set of criteria used to make classifications, but the methodology would stand.

Archaeologists and cultural resource managers often look at cultural resources on the local level and then apply that knowledge in the context of a wider geographic area. We identify similar sites across a region and make connections between them. We should start looking at these linear resources in much the same way. These resources often cross a variety of environments and biomes that affect the way significance is

conveyed. Different segments of the route would have different defining characteristics. If we can begin to identify those characteristics to geographical segments of a route, we are likely to make connections that would apply to the route in its entirety or to the surrounding physical and cultural environment that we would not have made before.

A Final Note

Routes, paths, roads, trails, and other vehicles of transportation are so important in human history. From migration patterns, food networks, trading routes, and the ability to connect to people in different geographical locations, these pathways help to identify where we came from, where we are going, and how we got there. As they typically cover thousands of miles with entirely different environments, political boundaries, and numerous other variables, the ability to properly manage such vast resources can become complex. This model aims to ease that burden by locating a specific characteristic on the route that needs to be studied and/or protected. And predict other segments of that route that hold the same or similar characteristics of interest, thus making management much less complex.

In conclusion, the success of this model has identified new information related to the Trail of Tears and opened the door for similar research to take place. Its intent is to help cultural resource managers efficiently identify areas of interest on the Trail for additional protection measures or future research and documentation needs. By defining a spatial relationship between segments of the Trail of Tears to documented roads, the model was able to predict which form of property type one: subset one: roadbeds and road segments should be classified under. These classifications can help us to narrow down research ideas that specifically address questions about the Trail of Tears in certain

environments. Defined by the National Register of Historic Property's Multiple Property Documentation Form for the "Cherokee Trail of Tears in Missouri, 1837-1839", the classifications allow us to determine the physical integrity of segments and separate them in a meaningful way. These categories allow us to think about specific research ideas or determine localized solutions for any challenge that may arise. Though sometimes a point of contention between archaeologists, the NRHP can be quite helpful in managing our vast number of cultural resources, but it does not encompass the best way to fully understand cultural resources. To do this, consultation with stakeholders is essential. This is where, historically, archaeologists have taken a backseat. This thesis offers a way forward: to do better. You can't truly know what is significant if you do not ask the people whose heritage it originated from.

Appendices

Figure I

Model for Predicticing Road Type NRHP Classifications for the Trail of Tears

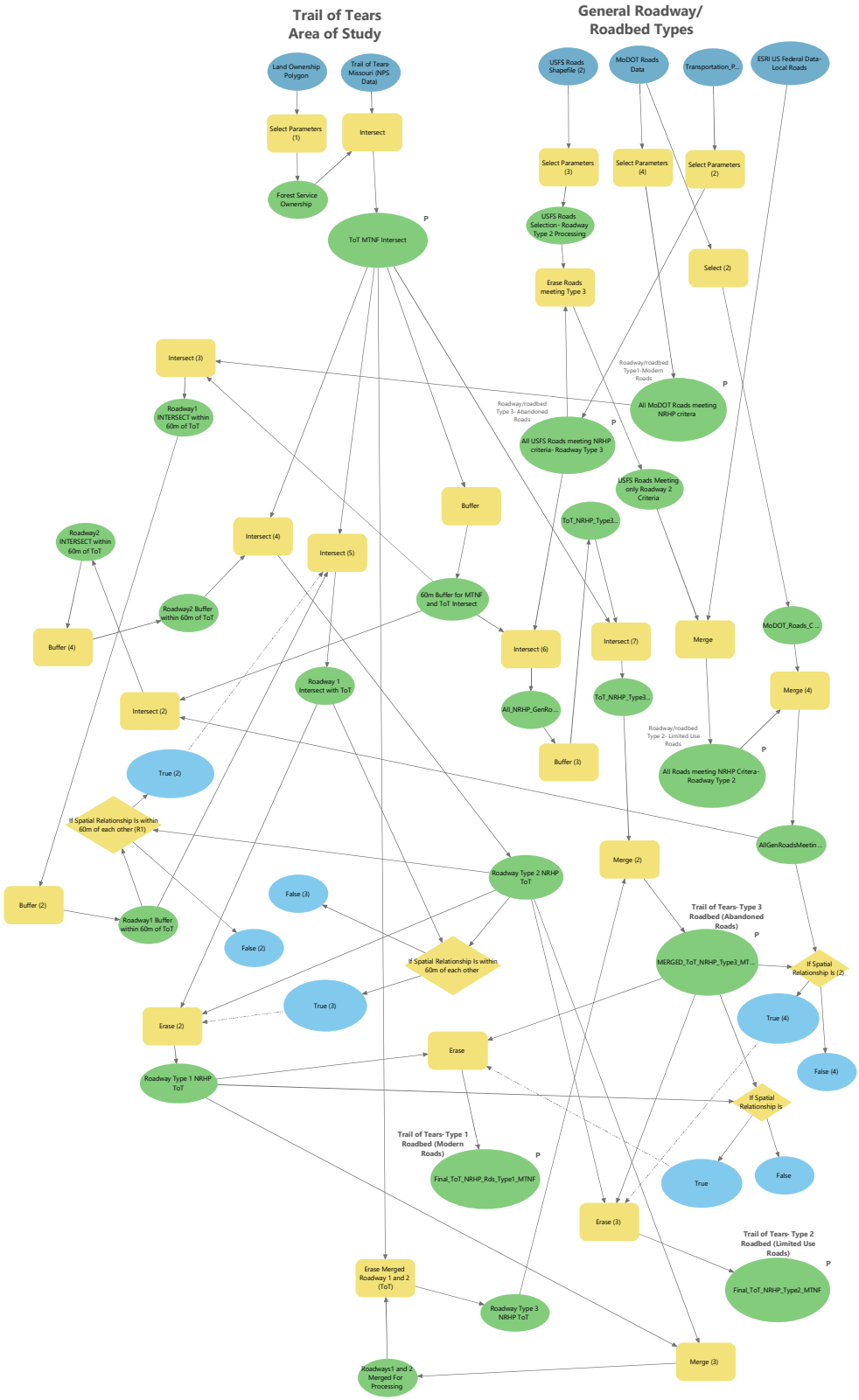
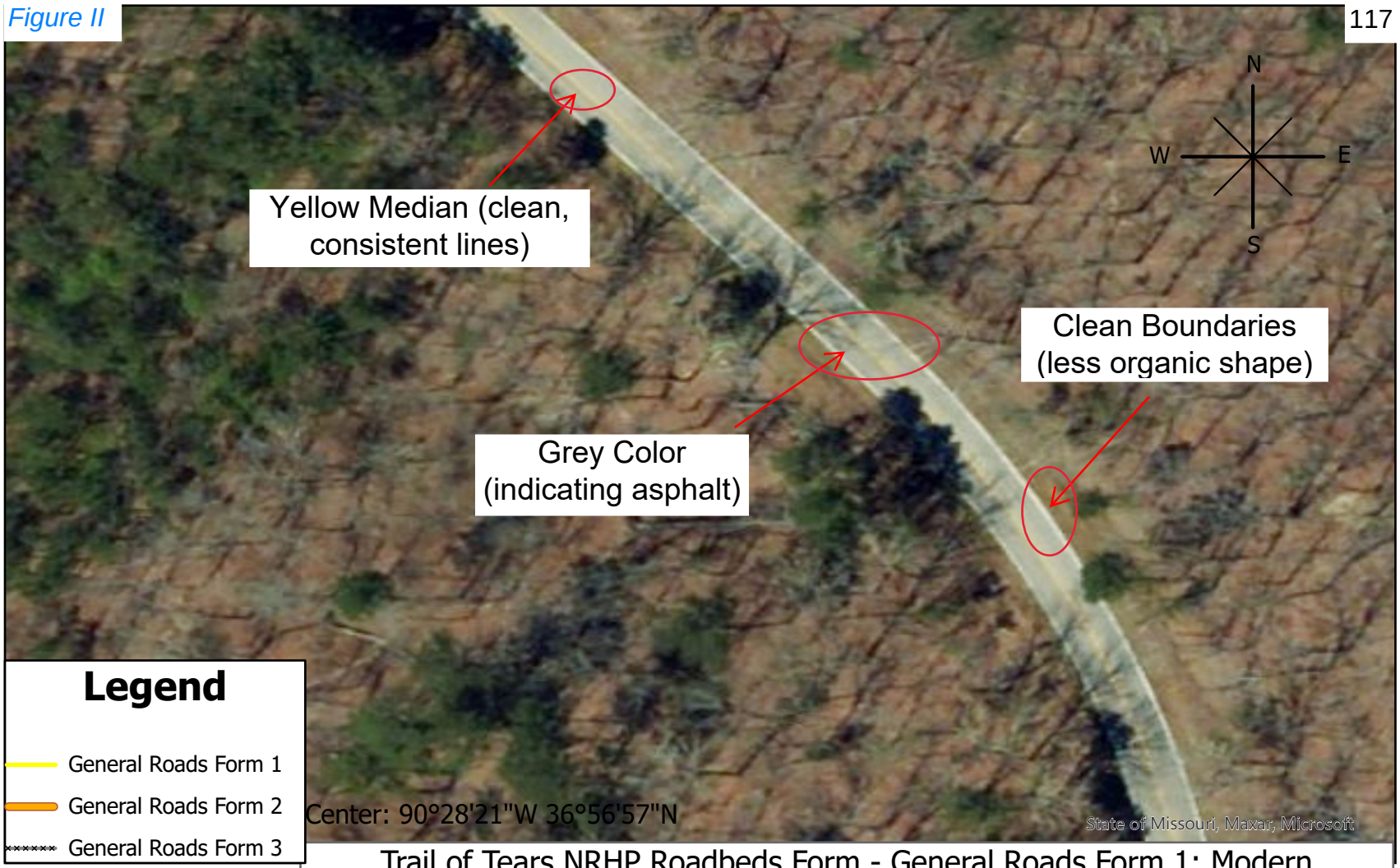
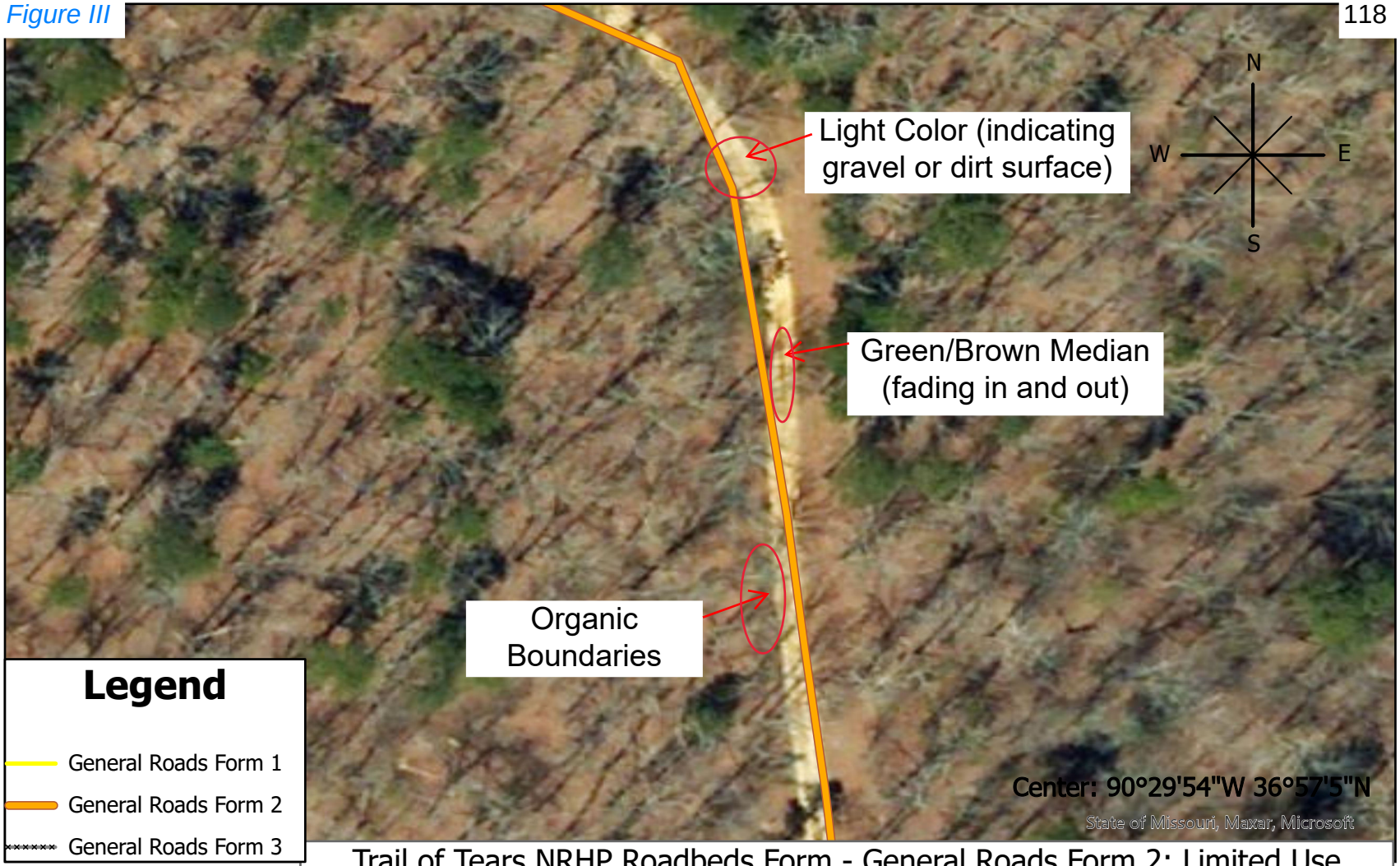


Figure II



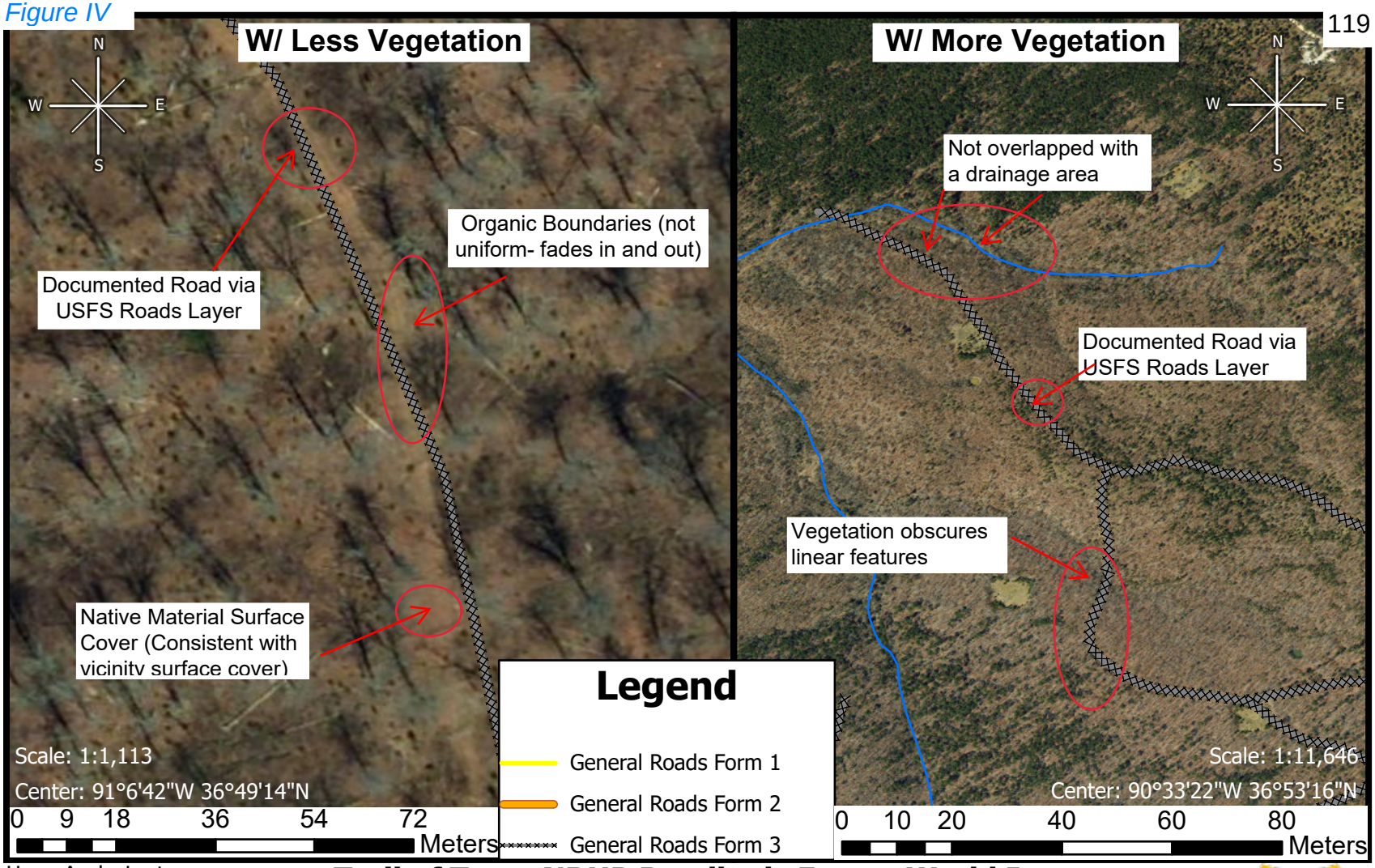
Trail of Tears NRHP Roadbeds Form - General Roads Form 1: Modern World Imagery Satellite Basemap, Mark Twain National Forest

Figure III



Trail of Tears NRHP Roadbeds Form - General Roads Form 2: Limited Use
World Imagery Satellite Basemap, Mark Twain National Forest

Figure IV



User: AnsleyLester

Date Saved: 8/1/2024

Trail of Tears NRHP Roadbeds Form - World Imagery
General Roads Form 3: Abandoned
Mark Twain National Forest

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