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The Search for Fort Lisa in the Vicinity of Omaha, Nebraska: A GIS Site Location Model

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THE SEARCH FOR FORT LISA IN THE VICINITY OF OMAHA, NEBRASKA: A GIS SITE LOCATION MODEL

by

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Fort Lisa was one of several important Euro-American fur trade sites in the vicinity of what is today Omaha, Nebraska. It, along with the other sites on that stretch of the Missouri River, were key locations both for trade with local tribes and as waypoints for those travelling to northern tribes in the early 19th Century. With the decline of the fur trade era, most of the sites that were once so central to life on the Missouri were abandoned and lost to memory. Archaeologists have rediscovered many of the sites along the Missouri River, including Fort Clark and Fort Union on the upper Missouri and Cabannè's and Fontenelle's trading posts in Nebraska. Another important find from the 19th Century was Engineer Cantonment, the winter camp of Stephen Long's Yellowstone Expedition. While not a fur trade site, it is a vital component to identifying the location of Fort Lisa.

Due to a lack of precise data about the location of Fort Lisa, it is difficult to know exactly where to begin searching for the site. Fortunately, there are several contemporary accounts that discuss the fort and its proximity to other nearby landmarks. With this information, I employed Geographic Information Systems (GIS) to develop a site specific suitability model to identify areas with higher or lower likelihood of locating the fort. This model offers a starting point from which to commence an informed search for Fort Lisa.

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Chapter 1

Introduction

The history of the North American fur trade is complex, spanned several centuries, and involved many nations that all sought a stake in the lucrative business. Even prior to European colonization, Native American groups had developed extensive trade networks (Baugh and Ericson 1994). Additionally, numerous groups also practiced lifeways that relied at least partially on harvesting fur bearing animals for subsistence. As Europeans arrived on the continent they took advantage of the skills and networks that were already in place in order to maximize their personal and commercial gains. Moreover, as Dolin (2010) argues, these early interactions laid the foundation for colonial expansion in the nineteenth century as the United States laid claim to the lands west of the Mississippi. This was certainly true along the Missouri River.

As the fur trade era came to a close in the late 19th Century, many of the early forts and trading posts that were vital to the success along the Missouri River were abandoned, fell into ruin, and subsequently lost from the historic record. In recent decades, renewed interest in American history on the state and national scale has led to the rediscovery of many of these lost and forgotten sites. Along the Missouri River in particular, archaeological excavations of forts and trading posts have enriched our knowledge of the fur trade era as well as the early westward expansion of the United

States (Nassaney 2015). While the stretches of the upper Missouri in the Dakotas and Montana appear to have been the focus of trappers and traders, the events that occurred on of the middle section of the river that is now the eastern boundary of Nebraska, were vital to success in the north. Great effort has been made to find some of the important northern sites: Fort Clark, Fort Union, Fort Manuel, and others have been the subject of intensive archaeological investigation. These forts were large establishments that drew notable visitors like Maximilian of Wied and George Catlin; they have also captured the attention of modern audiences. Less attention, however, has been paid to the sites in what is now Nebraska on the middle Missouri River, despite their unquestionable importance. In fact, at least four trading posts were located near Omaha as well as a military post (Fort Atkinson) and temporary encampments of explorers and settlers moving west (Engineer Cantonment, Florence, Cantonment Barbour, and Cantonment Missouri).

The area around modern Omaha was an ideal location for establishing forts and trading posts for two reasons: (1) it was roughly the halfway point between St. Louis and the forts on the upper Missouri and (2) there were several tribes nearby with whom to trade. Even Lewis and Clark recognized the significance of the area, stopping for a large council with representatives of several tribes at the “Council Bluffs” - not to be confused with the modern city of Council Bluffs to the south and on the opposite side of the river (Sheldon 1904:40). While the Omaha area was a significant part of the Missouri River fur trade, it holds equal importance to Nebraska history.

Many of the earliest non-native events in what would become the state of Nebraska were associated with the fur trade posts that sprang up along the river. Numerous place names and settlements can be traced back to the early fur trade era: Bellevue, Sarpy, Fontenelle, and Council Bluffs to name a few (Sheldon 1904; Shallcross 1954). Manuel Lisa was connected to many of the earliest historical events and people in Nebraska. He was the first non-native farmer on Nebraska soil and his wife was the first recorded white female resident. Furthermore, it was Lisa's efforts as an appointed Indian agent operating from Fort Lisa that kept the numerous tribes along the Missouri River from joining the British during the War of 1812. His effort is credited with ensuring victory for the United States.

Archaeologists have found and excavated many fur trade sites from the early 19th Century. The trading posts of Lucien Fontenelle and Jean Pierre Cabannè were uncovered and excavated in the 1990s (Jensen 1998). Engineer Cantonment was located and excavated in 2003 (Carlson et al. 2004). Fort Atkinson was the subject of years of archaeological study and partially reconstructed based on the findings (Carlson 1979). One of the last remaining sites to be found is Fort Lisa, which is the objective of this thesis. Figure 1.1 shows the sites in the vicinity of Fort Lisa that have been positively identified in the area around the fort.

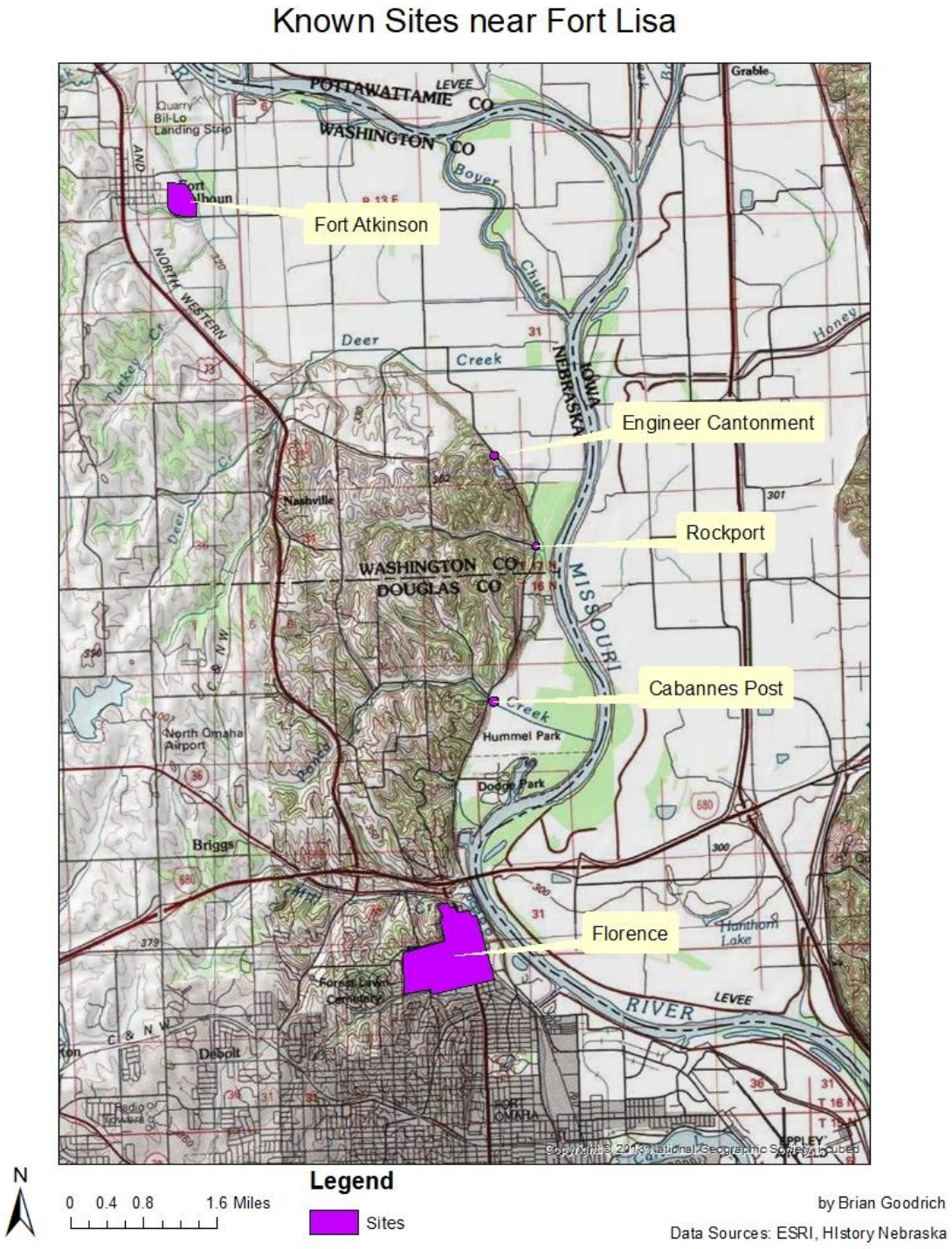

Figure 1.1

Sites near Fort Lisa that have been identified by archaeologists. Most of these places are mentioned in documents describing the fort's location

Previous attempts to locate Fort Lisa through traditional methods have been unsuccessful so I chose to employ suitability analysis in a geographic information system (GIS) to attempt to identify the location of the fort. To my knowledge, site specific locational modeling has not been utilized as often as predictive modeling in the field of archaeology. If proven successful, employing predictive modeling in order to locate individual sites may prove beneficial to the future of historical archaeology.

Following this introduction, I briefly introduce the wider setting of the North American fur trade in Chapter 2, before moving on to an account of Manuel Lisa and the various incarnations of his Missouri Fur Company. This history sets the stage for my discussion in Chapter 3 about the historical sources that mention Fort Lisa. These primary sources, though few in number, include critical details about the location of Fort Lisa that form a solid foundation for a site location model.

Chapter 4 begins with a history of the use of predictive modeling in archaeology. While predictive models can be very helpful in many circumstances, the approach has some flaws that have plagued their use from the very start. After discussing the principle arguments against the use of modeling, I offer a potential use of predictive locational modeling that may overcome some of these problems. I present my methods for creating a site location model to determine a suitable location to search for Fort Lisa. In Chapter 5, I present a preliminary plan for testing the predictive capability of the model and actually attempting to find the physical location of the fort. Finally, in

Chapter 6 I conclude with a discussion of small-scale predictive modeling and its potential for future use in the location of archaeological sites.

Chapter 2

Manuel Lisa and the Missouri Fur Company

Early History of the Fur Trade

The French and British were the first Europeans to establish organized trade networks in the New World. The French operated primarily around the St. Lawrence Seaway and the British worked their way inland from Hudson Bay. The Dutch and Spanish also had small areas of influence but all these territories were fairly ephemeral throughout the sixteenth and seventeenth centuries as countries struggled for power (Nassaney 2015:44). In the mid-18th century, independent trappers and traders began to experience pressure from larger organized companies. The Hudson's Bay Company was established in 1670, but it was not until the North West Company formed around 1770 as several independent traders and small companies banded together that rivalries between companies, rather than countries, began to really develop (Dolin 2010). As settlers explored more of the continent, commercial fur trade was introduced to new regions in order to fill growing demand for quality pelts in Europe (Chittenden 1902:4-5).

Large companies like Hudson's Bay Company and the American Fur Company seemed to control the North American fur trade. However, there was a host of smaller companies that rose and fell from the 17th Century to the decline of the fur trade in the

mid-19th century. Examples include the Mackinaw Company that operated around the Great Lakes or the Maxent, Laclede, and Company based in St. Louis (Chittenden, 1902:95). Some outfits became successful enough to be seen as a threat by larger operations and were subsequently absorbed or targeted for elimination to mitigate competition (Nassaney 2015:58). One of the better known examples of this phenomenon is the merger of the Hudson's Bay Company with the North West Company in 1821 (Wishart 1971:112). Competition between those two British companies became so fierce that the matter had to be settled in an English court. The judgement of the magistrate led to the consolidation of the entities and an essential monopoly of the fur trade in Canada (Chittenden 1902:94). By 1800, the fur trade was established from the east coast to the west, mainly in Canada and the northern United States, what was at the time mostly unorganized territory.

Fur trading along the Missouri and Mississippi rivers was not a new idea in the early 19th Century. The Mississippi River was already an important conduit for commerce and travel, and likely had been long before the arrival of European and American colonists. French and Spanish trappers traversed the Missouri River in both directions as early as 1673 (Wood et al 2011:35, Jensen 1998:8) and probably earlier. It was not until James Mackay led an expedition up the Missouri in 1795 under Spanish authority that the fur trade began to take shape as an organized industry in that area. Mackay built a trading post in what is now northern Nebraska and called it Fort Carlos (also known as Fort Charles). The goal of that expedition was to reach the Mandan tribe

in North Dakota, with whom Mackay had previous trading experience while an employee of the North West Company in Canada (Jensen 1972; 1998:8). This was relatively short-lived because the Louisiana Purchase was finalized eight years later, opening the door for American companies to control trade on the Missouri River.

Less than a year after the acquisition of the Louisiana territory from the French in 1803, Lewis and Clark set out from St. Louis to explore the Missouri. President Thomas Jefferson had already ordained plans for an expedition to the Pacific coast prior to the Louisiana Purchase (Van Every 1964:46). Instead of traversing though Spanish or French territory, Lewis and Clark's party explored more friendly territory, at least in the sense that they did not have to contend with any European governments. The return of the expedition to St. Louis in 1806 and the report they brought about the rich potential of the land to the west, opened the floodgates for traders and trappers to ascend the Missouri (Chittenden 1902; Oglesby 1963; Utley 1997). Manuel Lisa wasted no time in founding the Missouri Fur Company and ventured out from St. Louis, establishing a chain of trading posts and forts from there to present day Montana (Wishart 1971:107). Some notable establishments were Lisa's Post in the North, Fort Manuel a little further south, Fort Lisa in the Omaha vicinity, and others in between (Wishart 1971:107,110). Spurred on by Lisa's initial success and driven by the desire to capitalize on the vacancies left by the Hudson's Bay Company and others in the new American territory, John Jacob Astor established the American Fur Company in 1808 and a second branch,

the Pacific Fur Company in 1810 (Ronda 1990). However, Astor did not breach the Missouri River trade based in St. Louis for another decade (Oglesby 1963).

The American Fur Company and its several branches soon came to dominate the fur trade in the United States. The process of developing transportation routes between St. Louis, Missouri and Astoria, Oregon laid the foundation for the Oregon Trail (Chittenden 1902:213) and led to the founding of several more trading posts including Fort Union and Fort Clark in North Dakota (Nassaney 2015:60). The entrance of the American Fur Company into trade on the Missouri River did not coincide with the demise of the Missouri Fur Company. Lisa found a new partner in Joshua Pilcher who aided in revitalizing the company's influence until its end in 1824 (Jensen 1998:10).

The Missouri Fur Company was not a continuous entity during its years of operation. Several iterations came and went, and the common denominator in all of them was Manuel Lisa. Little is known about his early life though there is no question that his role as a fur trader and businessman was instrumental in opening commerce on the Missouri River as well as fostering positive relationships between Euromerican settlers and First Nations tribes. Lisa's presence on the Missouri is an important part of the history of what would become the state of Nebraska, but his actions also had far reaching effects on the nation as a whole.

Manuel Lisa and the St. Louis Missouri Fur Company

Manuel Lisa was born around the year 1772 to Spanish parents. The exact date and place of his birth remain in doubt, ranging anywhere from the West Indies to New Orleans. The tombstone on Lisa's grave lists his birth place as New Orleans and the year 1772, however his older brother's birth certificate was dated 1774 so it is unlikely that Lisa was born as early as recorded on his tombstone (Oglesby 1963:9; Chittenden 1902:125). Accurate documentation of Lisa's life starts much later- around the time he came to St. Louis. By the time he arrived at St. Louis around 1790, he was already a skilled businessman and had experience in the fur trade as well. In the year 1800, the Spanish governor in Louisiana granted him the exclusive rights to trade with the Osage Indians (Chittenden 1902:126). Soon after, Lisa directed all of his efforts to expanding the fur trade up the Missouri River.

Prior to the Louisiana Purchase, there were some unsuccessful efforts to begin fur trading up to the northern stretches of the Missouri, primarily in North and South Dakota and Montana, by Spanish outfits in St. Louis (Oglesby 1963:18). With the transfer of the territory to the United States in 1803 and the grant of citizenship to the residents that settled there (Goodwin 1967:72), a door was opened for Lisa to act on his ambitious plan. While the Corps of Discovery led by Lewis and Clark was exploring a path to the Pacific coast, Lisa was planning an expedition up the Missouri to establish trade with the northernmost tribes in the territory. In 1807 he set out with a crew of around 50 and a keelboat with enough provisions to establish a fort and begin trading (Wishart 1979:42). The party arrived at the mouth of the Yellowstone River with the guidance of John Colter and George Drouillard, both former members of the Lewis and Clark expedition (Utley

1997). At a fork created by the confluence of Bighorn and Yellowstone Rivers, they built the first trading post on the Upper Missouri and called it Fort Manuel (Wishart 1972:42). This fort was also referred as Fort Lisa, Manuel's fort, and Fort Raymond (Chittenden 1902:119, Oglesby 1963:54). The group wintered at the new fort and commenced trade with the Crow as well as trapping and hunting to boost their profits. This was first of many sites to bear the name of Manuel Lisa but is not the subject of this undertaking.

Upon returning to St. Louis in the fall of 1808, the St. Louis Missouri Fur Company was organized by Lisa, William Morrison, and Pierre Menard (Oglesby 1963:69). After the company was officially founded in the spring of 1809, Lisa set out for Fort Manuel with 150 trappers and provisioning for several more forts (Chittenden 1904:140; Goodwin 1967:116). It is possible that this was when the Fort Lisa (also called Fort Hunt in some early documents) located near Omaha was first established, though there is no concrete evidence to confirm that date.

Reorganization of the Company

The first version of the Missouri Fur Company was disbanded just before the end of its charter term in 1812 and a new association was formed by some of the original founders (Chittenden 1904: 147). While moderately successful, the first three years of operations did not meet expectations due to a variety of factors. Hostilities from the Blackfeet and Sioux led to the loss of goods and life, and sometime between the end of 1811 and 1813 many of the forts on the upper Missouri were relocated downriver

(Chittenden 1904:149; Pepperl 2010:82). Even removed from hostile territory and with new leadership, the company did not perform as well as desired, which ultimately led to further reorganizations in 1813, 1817, and 1819 (Goodwin 1967:118; Wishart 1979:46). As a constant presence throughout the many restructurings, Lisa was the public face and the driving force of the Missouri Fur Company.

During the War of 1812 the focus of the Missouri Fur Company shifted from the north to the area around the Council Bluffs, north of present day Omaha. Fort Lisa became the base of operations for both trading and political maneuvering. Lisa's good relationship with the tribes along the Missouri River led to him being appointed sub-agent of all the tribes north of the Kansas River (Sheldon 1913:47; Oglesby 1963:152). He is credited with singlehandedly keeping the numerous tribes along the Missouri from joining tribes of the Mississippi region, who were supported by the British, in attacking Americans during the War of 1812 (Wishart 1979:46). In fact, his influence was so great that he even convinced 43 local chiefs to send out a large war party to attack the Mississippi tribes, though the war ended before they were mobilized (Sheldon 1904:43).

While the war occupied the attention of most of the United States, two things happened to increase the importance of the Fort Lisa located in Nebraska. The first was Manuel's wedding to the daughter of a chieftain of the Omaha tribe. Lisa was already married, but polygyny was fairly common among several Native American tribes and many fur traders adopted the practice (Lansing 2000). The second event that elevated Lisa's importance is the withdrawal of the other traders on the Missouri, which left the Missouri Fur Company as the sole American trading company in operation on the river

(Goodwin 1967:118). Thus, Lisa strengthened his already strong relationship with the tribes through marriage and monopoly.

In 1818, shortly after the death of his first wife Polly, Lisa married Mary Hempstead Keeney, the daughter of one of his partners in the Missouri Fur Company (Oglesby 1963:167). At the same time he remained married to his Omaha wife and fathered two children with her, Raymond and Rosalie (Sheldon 1913:38). Manuel spent most winters at the fort and was only in St. Louis for a short duration every year(Chittenden 1904:149). It was somewhat unusual that in 1819, following yet another reorganization of the company, Mary accompanied Manuel to Fort Lisa rather than remaining in St. Louis. Mary was the first white female resident in Nebraska, though she only resided there for about a year (Sheldon 1904:44; 1913:38; Nichols 1969:76). She was quite popular among the Native Americans around Fort Lisa and came to be known as Aunt Manuel (Oglesby 1963:174).

In 1820, Mary and Manuel returned to St. Louis and he unexpectedly fell ill and died a short time later (Oglesby 1963:176). However, this was not the end of the Missouri Fur Company. Joshua Pilcher, a newcomer to the fur trade, had directed operations during Lisa's declining health, replaced him as the head of the company (Sunder 1968:30). Prior to his death, Lisa had begun to make plans to re-establish the network of trade on the upper Missouri. From 1821 to 1823, Pilcher directed great efforts to build a network of forts that stretched the length of the Missouri River and beyond to the Pacific coast (Sunder 1968:32; Wishart 1979:48). That dream was never realized. In 1823, the furthest post of the Missouri Fur Company was Fort Benton, which was built on the site

of Fort Manuel at the confluence of the Yellowstone and Bighorn rivers. It was not long before the Blackfeet, possibly incited by British agents, again forced the Americans back down the river at the cost of many lives and the loss of a large quantity of furs and horses (Oglesby 1963:186). Just like a decade before, the activities of the Missouri Fur Company were constrained to the area around Fort Lisa. At some point between 1821 and 1823, Pilcher moved the operation from Fort Lisa a few miles south to Bellevue (Jensen 1998:11) and much like a decade earlier, the new post became the base of a greatly reduced operation.

The losses at the hands of the Blackfeet as well as growing competition from other companies proved too much, and the Missouri Fur Company was finally liquidated in 1824 (Wishart 1979:48). Pilcher continued in the fur trade independently at Bellevue for several more years but was never able to match the former influence of Manuel Lisa. Instead, John Astor and the American Fur Company became the dominant trading force on the Missouri River.

Chapter 3

Fort Lisa in Historical Literature

Unfortunately, there is a dearth of sources that discuss Fort Lisa and most that do provide very few details about the construction and location of the post. Fortunately, Lisa built and managed the Nebraska post during a pivotal time of exploration and expansion so there is at least some sparse information with which to build a site location model. The members of Stephen H. Long's expedition built Engineer Cantonment a short distance from Fort Lisa and provide some of the best accounts. Also informative are some of the other travelers along the Missouri like Father Jean Pierre De Smet and military personnel stationed at Fort Atkinson. In addition to these historical accounts, there was an effort at the turn of the 21st century to relocate some of the sites that were important to the earliest years of Nebraska history, which produced some potentially helpful documents.

Primary Sources

The journals from members of Long's 1820 expedition are some of the best sources about Fort Lisa. One member of the expedition, Edwin James, compiled an official account of the journey from the collective journals of other members of the party. He describes the location of their winter camp, Engineer Cantonment, as "…about a half a mile above Fort Lisa, five miles below Council Bluff, and three miles above the mouth

of Boyer's river (James 1823a: 146)." He goes on to say that the area they chose for the camp was on a narrow strip of land between the river and bluffs and that there was plenty of wood and limestone with which to build (1823:147).

Unfortunately, later in his account, James offers some contradictory information regarding the distance from the Boyer River to the cantonment. In a subsequent journal entry the cantonment is listed as six miles away instead of three (James 1823a:422). Some clarification is offered by Goodman and Lawson (1995) who retraced the route of the expedition. They note that the confluence of the Boyer River with the Missouri was purposely moved five miles north in modern times and that it originally was located about three quarters of a mile south of the Washington and Douglas County line (1995:3). This would place the distance from the river to the camp much closer to three miles, which would put Fort Lisa roughly one and a half miles north of the county line.

Another rich source of information about Fort Lisa is the journal of John Gale, a surgeon attached to the Missouri Expedition- the military counterpart to Long's scientific mission. Not long after Engineer Cantonment was established, Gale's party established Missouri Cantonment three miles above Council Bluffs and roughly eight or nine miles north of Fort Lisa. Gale offers a little more detail about the physical setting of Fort Lisa, saying that it was "…situated below some hills on the south and two miles above the Bowyer's river (Nichols 1969:75)." He also states that Engineer Cantonment is located one mile above Fort Lisa, rather than the half a mile offered by James. Gale included one final gem about the fort, mentioned in passing, that I have not found in any other source. He describes Lisa's return to the fort with his wife on September 30, 1819 saying: "Mr.

Manuel Lisa and Lady arrived this day from St. Louis which was announced by the firing of swivels from his works vis a stockade (Nichols 1969:76).” Fort Lisa possessed a wall sturdy enough to support a terreplein and small cannons. This is consistent with Chittenden’s (1902:45-45) description of “typical” defensive structures at fur trade forts on the Missouri.

These journals, while somewhat contradictory, help narrow the search area significantly - especially since the exact location of Engineer Cantonment was discovered in 2003 (Carlson et al 2004). It would be easy to define the boundaries of the search to between half a mile to one mile south of the cantonment based on these reports but there is no way to determine the paths travelled between each site. Movement between Engineer Cantonment and Fort Lisa would have been very different depending on whether the route ran along the top of the bluffs or along the river at the base of the bluffs. James noted the great height of the bluffs but was sure to add that they were ascended with relative ease, so travel along the bluff top was certainly an option. Travel along the base of the bluffs would also have been a viable option, even though the course of the Missouri River at that time ran very near the bluffs (Chittenden 1904:26; Sheldon 1904:42; James 1823a:153), as depicted in paintings by Titian Peale and Karl Bodmer (Goodman and Lawson 1995).

Father Pierre Jean De Smet also briefly mentions Fort Lisa in a letter to N. Ranney of the St. Louis Historical Society regarding the location of Fort Atkinson. De Smet places Fort Lisa one mile above Cabannè’s trading post (De Smet 1885). Because

we know the location of the latter, it should help narrow further the potential site of the former.

Secondary Sources

Later, but not far removed from the fur trade era, are the writings of Addison E. Sheldon and Robert F. Gilder. Both men were prominent figures in Nebraska in the early 20th Century. Sheldon, who would become the director of the Nebraska State Historical Society, wrote two books about the early history of the state, one in 1904 and one in 1917. He describes the location of Fort Lisa as five miles south of Fort Atkinson, half mile south of Engineer Cantonment, and ten miles north of Omaha "…where the bluffs jut farthest to the east (Sheldon 1904; 1917)." Moreover he claims to have visited each site while the ruins of the former establishments were still visible on the landscape and even provides a photo of the location of Fort Lisa (Figure 3.1).

Robert F. Gilder (1905), who was a journalist and archaeologist, also describes the ruins of Fort Lisa and several associated sites in a 1905 article in the Omaha World-Herald. He places Fort Lisa a half mile south of Engineer Cantonment. Interestingly, he asserted that the town of Rockport was built on top of Manuel Lisa's farmstead (Gilder 1905) - a site that no other source even mentions. At Rockport there was a lime kiln (Schrader 1937:142) which was investigated by Nebraska State Historical Society archaeologists and is no longer extant (Bozell, personal communication).

Site of Old Fort Lisa

Figure 3.1

Sheldon's personal photograph of the "Site of Old Fort Lisa" does not contain any distinct features but does provide support that the fort was located on a relatively flat landscape (Sheldon 1904:43).

Fortunately, in a later document, Gilder (1908) shows the location of Fort Lisa on a map just north of the Washington/Douglas county line with a road running directly though it (Figure 3.2). Unfortunately, it is possible that road construction has eradicated what is left of Fort Lisa.

An important note about Fort Lisa that is overlooked in the primary accounts is the size of the fort, which could assist with relocating the site by excluding areas that do

not meet a minimum size. Chittenden (1902:45) estimated the size of a small fur trade fort at 100 feet in length for each wall of a stockade. Furthermore, there would have needed to be room to house a minimum of twenty to forty men which was the required manpower to propel a keelboat (Chittenden 1902:33). This would have been a sizeable establishment, especially compared to Engineer Cantonment which accommodated just twenty men. However, the entirely of the establishment was not necessarily confined to the stockade and some components were likely located outside the walls.

One of the last accounts possibly describing Fort Lisa is that of Maximillian of Wied. On his journey up the Missouri in 1833 he wrote:

> "Before one reaches the Council Bluffs, but close nearby, the ruins of a wood house apparently of two stories, now almost concealed by a few tall cottonwoods, can be found under the summit. Now only the rattlesnakes are supposed to inhabit this lonely place (Jensen 1998:11)."

As Jensen notes, this may not be Fort Lisa, but it could be one of the outbuildings associated with it- perhaps Lisa's farmstead.

Identifying a particular location from historical documents is difficult due to the contradictions between the accounts. Given the compiled evidence, I propose that Fort Lisa was located between half a mile to one mile south of Engineer Cantonment, five to six miles south of Council Bluff/Fort Atkinson, and around two miles north of Cabannè's trading post. Furthermore, in regard to environmental setting, the preceding descriptions suggest that it is on or adjacent to an eastward jutting outcrop of the bluffs close to the Missouri River. I also contend that the area would need to be relatively large with a low degree of slope to accommodate a stockade as well as enough buildings and farmland to

support the crews necessary to maintain the post and operate the keelboats.

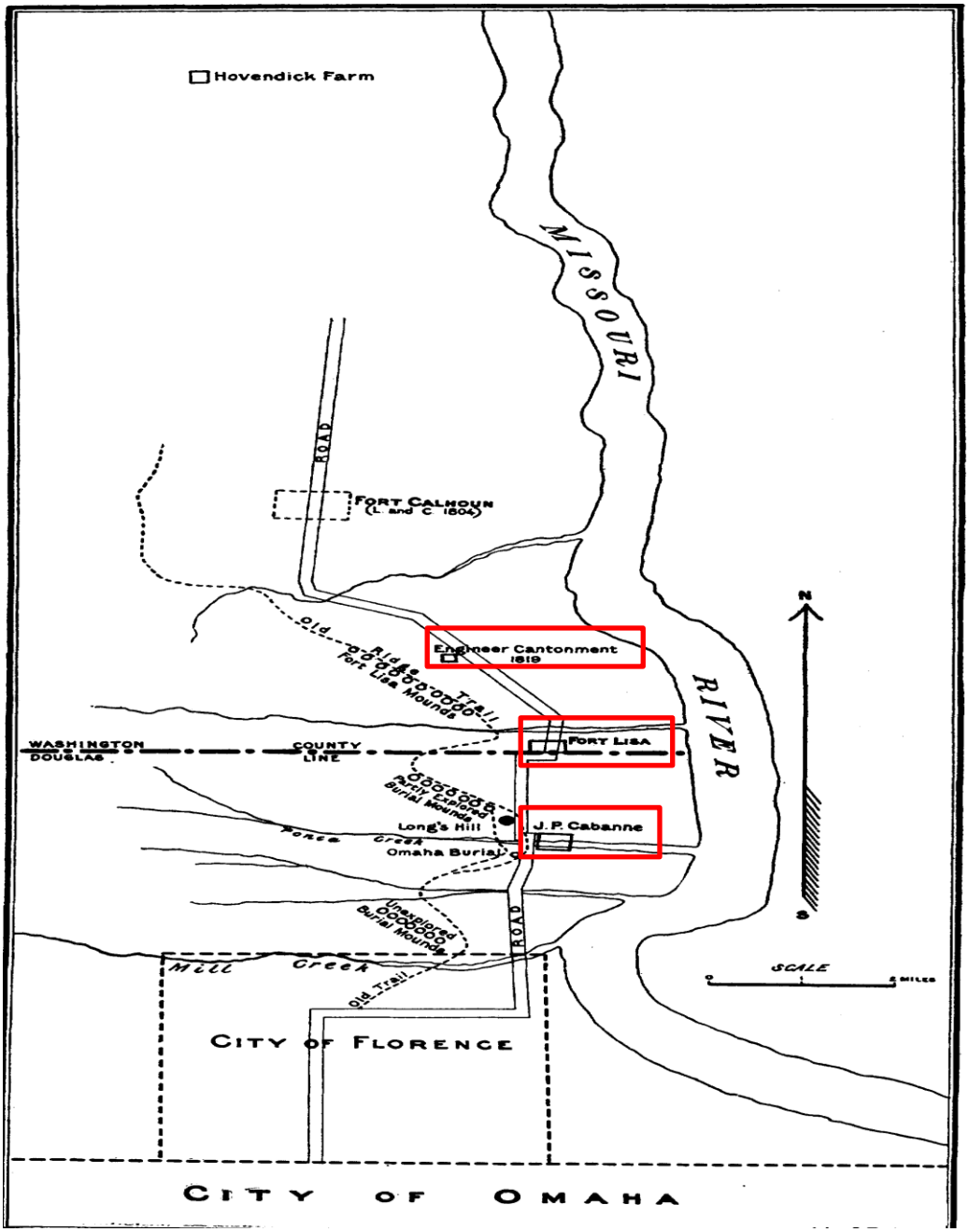

Figure 3.2
Robert F. Gilder's map showing Engineer Cantonment, Cabannè's Post, and Fort Lisa north of Omaha, outlined in red (Gilder 1908:61).

Chapter 4

Digital Approaches to Locating Fort Lisa

A Geographic Information System (GIS) is a multi-functional tool that archaeologists began to implement soon after its inception in the 1970s (Verhagen 2018). One of the many uses of GIS in the field of archaeology is the development of predictive models in order to calculate the locations of a type or class of site based on data gathered from existing sites and environmental variables. At first glance, predictive modeling seems like a straightforward process, however the development and use of site location models has been somewhat controversial in the decades since it was first introduced. Numerous problems are cited regarding the development of predictive models that range from poor and incomplete data to accusations that predicting site locations is environmentally deterministic (Kammermans 2004; Conolly and Lake 2006; Mehrer and Wescott 2006; Verhagen 2018). Furthermore, the question has been posed whether or not we can infer the behaviors of people in the past using modern reasoning and datasets (Mehrer and Wescott 2006:7; Richards-Rissetto 2017). Despite the many criticisms of locational modeling, it can still be a useful tool when implemented carefully and with its potential limitations in mind (Richards-Rissetto 2017:11).

Typical uses of Locational Models

Predictive modeling in archaeology has primarily served two purposes: cultural resource management (CRM) and research into human behavioral patterns (Kamermans 2004; Verhagen 2018). Cultural resource managers employ site location modeling to identify areas that have a high likelihood to contain archaeological sites, in order to avoid adverse effects to cultural resources. In the academic world archaeologists employ a similar process to study the behaviors of past peoples, attempting to prove or disprove the theories upon which predictive models are developed (Verhagen 2018). The theories and methodologies that go into making a predictive model are relatively uniform across the spectrum of research goals, as are the end results. Ultimately an accurate site location model will predict probable locations for a specific type of site in a particular region. For example, a model attempting to identify the locations of Late Archaic habitations on the Central Plains would not necessarily be applicable to Southwestern deserts or the Pacific Northwest because settlement patterns were most likely quite different for groups in each of those areas. Therefore, in order to create an accurate prediction, data specific to a particular landscape, time period, culture, etc. must be compiled and then translated into the variables that comprise a site location model.

Once a model has been developed, whether for the purpose of cultural resource management or academic study, the end result is a map identifying the likelihood of sites existing in specific locations. In some cases, like CRM projects, this might be sufficient for the purposes of avoidance however best practice would involve testing the models for accuracy through fieldwork. In other words, if a predictive model is created for the area around a development project, construction plans can avoid locations likely to contain

archaeological sites. However, even the best model cannot account for human nature so it should always be assumed that sites may be present at any place regardless of what a model may show. Site location models should be an aid in the process of locating sites, not a substitution. Thus, ground checking is still necessary for any model.

Development of Locational Models

Traditionally there have been two schools of thought regarding the principles upon which models are created: inductive and deductive applications (Verhagen 2018). Predictive models employing an inductive methodology are based on empirical patterns in the archaeological record. Patterns of site location are identified from archaeological survey and excavation in the target area of the model. Then those patterns are input to the GIS and projected to areas where little or no archaeological data has been collected.

On the other hand deductive models rely on theoretical patterns that are developed based on perceived interactions between humans and the landscape. It is just as important to know where sites have been recorded when developing locational models as it is to know where sites are not (Conolly and Lake 2006). Excluding certain areas on the landscape based on theoretical or empirical evidence can help refine the parameters of the model as well as validating the accuracy of the final product.

Despite the benefits of each type of model, there are some weaknesses that could potentially affect the performance of the model as a locational tool. Inductive models are highly statistical and do not account for human agency in predictions of site locations.

Deductive models, on the other hand, are more theory driven and can include assumptions regarding behavior. Models can only be as good as the assumptions and hypotheses on which they are built. Flawed assumptions and hypotheses will yield faulty predictions. Kvamme (1990) proposes that the best models should include both deductive and inductive methodologies, drawing on environmental and spatial variables, thus minimizing potential errors.

Here I present a simplified overview of how to create a predictive model in a GIS. The steps in creating a predictive model are fairly straightforward however it requires knowledge to select appropriate data and then implement it in a way that yields an appropriate model. Most site location models draw on a subset of features that include environmental variables like elevation, soil type, vegetation, hydrology, and geographic features. From these initial data, additional data can be generated within the GIS including slope, aspect, distance to water and other resources, viewsheds, as well as other variables (Conolly and Lake 2006). The next step is to weight the selected variables based on cultural knowledge and/or empirical data so that variables more likely to impact site location influence the model to a greater degree. Not every site is identical and therefore not every parameter included in the model applies in every instance. For example, in a desert environment distance to reliable water sources and shelter would probably have been more important in deciding settlement location than factors like the slope of the landscape. Land can be adapted to become suitable for specific activities while water and shelter are critical for survival. Therefore in a predictive model, distance to water and shelter would be weighted higher than slope. Next, logistic regression

analysis is applied to the model which yields predictions for site locations. Conolly and Lake (2006:183) explain that logistic regression uses a set of variables and seeks to fit an S-shaped probability curve. The regression analysis is applied to each pixel of the raster and a predictive value is assigned based on the likelihood of site presence. The output map will depict the probability of a site existing in each pixel (Conolly and Lake 2006). The final step is testing the accuracy of the model by either comparing the map known sites or ground checking predicted locations. Finally, if necessary, the parameters can be adjusted to increase the accuracy of the model. For a more technical explanation of locational modeling see Conolly and Lake (2006), Mehrer and Wescott (2006), or Wescott and Brandon (2000).

Criticisms of Predictive Models

Despite the relatively quick adoption of predictive modeling in the field of archaeology and its many potential benefits, there are some valid concerns about the accuracy of locational models. Verhagen (2018) identified five key issues that could be problematic when developing models. The first argument commonly cited in opposition to the use of predictive models is that modern data is not wholly representative of the past. Landscapes and other environmental variables are most likely very different than they were in the past- rivers change course, erosion and deposition changes landmasses, and climatic fluctuations may even lead to changes in vegetation. Therefore, even the oldest historic maps used to create predictive models may not yield accurate results

because present-day site context may vary from the original context. This is not always the case but is certainly a detail not to be overlooked. Second, and related, the focus of the model is extremely restricted temporally based on the limited scope and accuracy of the available data (Verhagen 2018). In other words, the archaeological and environmental data that are used to build a model restrict the model's effectiveness to the time from which the data originated.

A third issue is that cultural differences between past peoples and the archaeologists developing the models may lead to fundamental errors in the data used. Much like any attempt to interpret the past, it is imperative that cultural biases are not projected onto past actions. Moreover it is difficult to quantify and apply cultural motivations, let alone individual agency, of past peoples to locational models (van Leusen and Kamermans 2005).

The fourth issue is related to the datasets from which predictive models are built. In most cases the archaeological data that is used to create predictive models is incomplete because very few places have been entirely tested or excavated. This means that predictions are based on potentially incomplete information because there may be sites where the model assumes that there are none. Finally, Verhagen (2018) claims that testing of the accuracy of predictive models is often inadequate and in some cases neglected entirely. Whether time constraints limit sampling or the sheer size of a project impedes fully testing a model's results, it is difficult to know for certain the full extent of a model's predictive accuracy.

Despite these potential drawbacks, predictive modeling is useful in archaeology. One example of successful predictive modeling is Duncan and Beckman's (in Wescott and Brandon 2000) models of prehistoric site in four areas of Pennsylvania and West Virginia. They started by gathering primary data sources: known sites, trails and roads, hydrology, soil type, and a digital elevation model. Secondary data were generated in the GIS for slope, aspect, and the distance from known sites to water. Twenty-six variables, distance to water and trails, solar insolation, and slope to name a few, were identified as important contributors to site location. Logistic regression was applied to the identified variables and a relative weight was assigned to each. The resulting predictive model was a weighted sum for every cell in the study areas describing their suitability for prehistoric sites. Testing of the model showed an accuracy rate of around 78% which the authors deemed significant. Furthermore, when applied to other areas, the model remained an accurate indicator of site suitability. This is just one of many examples of successful predictive modeling in archaeology. For more case studies see Wescott and Brandon (2000) and Mehrer and Wescott (2006).

Localized Modeling

Kenneth Kvamme, a longtime advocate for the use of locational modeling in archaeology, suggests that perhaps rather than trying to model human behavior archaeologists should instead embrace advances in modern technology to directly find sites (Mehrer and Wescott 2006:32). Satellite imaging and high resolution LiDAR have

increased the quality and availability of data with which to create digital elevation models (DEMs) that can help identify human landscape modifications. Light Detection and Ranging (LiDAR) is a type of aerial remote sensing that uses pulses from a laser scanner to create a point cloud of the terrain below. The laser scanners are capable of penetrating vegetation so not only does LiDAR provide a detailed model of vegetation, but also of the earth (Masini and Lasaponara 2013). Additionally, tools and approaches for analyzing data have advanced in recent years. One of these methods, similar to predictive modeling, is suitability analysis. The methodology is less complicated than that of predictive modeling, however, the end-result is a map that shows suitable locations for sites based on the input parameters. The decision of which type of model to employ comes down to the types of data available and the sample size of known sites. On the one hand, large landscapes with many sites yield high quantities of data that can be formatted and input into a model to calculate predictions. On the other hand, if there is a small dataset from a limited number of sites, like the case with Fort Lisa, it is still possible to make predictions about areas that would be suitable for the type of site in question by employing suitability analysis.

Suitability analysis does not solve all of the potential problems of predictive modeling, however shortcomings can be minimized. For example, environmental changes may be easier to account for in a localized area rather than a broad landscape, allowing researcher to make adjustments to the model to increase its potential accuracy. There is no way to entirely remove the cultural bias of modern observers or to understand the decisions of past people without any form of documentation. Likewise, there is little that

can be done about incomplete datasets because it is impractical, and unethical, to practice one-hundred percent excavation. Thus, datasets are always incomplete; however, on a smaller scale, gaps in information may be overcome through testing or modern technology like geophysical sensing. Finally, testing is far more feasible for a focused locale than across a landscape so issues like limited funding or inaccessible areas are less likely to impact field checking models.

Methods for the search for Fort Lisa

To achieve my research goal, namely to identify the potential site location(s) of Fort Lisa, I chose to employ suitability analysis rather than a predictive model for two reasons. The first is, despite the fact that there were a large number of fur trade sites on the Missouri River, very few have been excavated and the resulting dataset is therefore very small. Second, as I compiled the accounts describing Fort Lisa, the potential locations of the site shrank to the point where a predictive model encompassing a large landscape would have been more effort than the results were worth.

I acquired one meter LiDAR data from the Nebraska Natural Resource Conservation Service (NRCS). The data were packaged as four tiles so I created a mosaic to fuse them together into a single cohesive raster. The data were already post-processed into a digital terrain model (DTM) with the vegetation removed. From the DTM, I generated slope and aspect - the two primary parameters I used to create a site location model.

I received shapefiles of the locations of Fort Atkinson, Cabbanè's Post, Rockport, and Engineer Cantonment, the reference points mentioned in the historical sources I drew on, from History Nebraska (formerly the Nebraska State Historical Society). I created a layer file in the GIS for known sites and drew new polygons from the shapefiles in that layer. This layer allows a visualization of the greater landscape around Fort Lisa when viewed in conjunction with a base map. Furthermore, it allowed me to use the buffer tool, as I will explain below, in ArcMap to visualize distances around each site for the site location model.

The landscape of the west bank of the Missouri north of Omaha comprises a continuous line of steep bluffs with a flat floodplain between them and the river. As stated previously, the river flowed very near the bluffs during the early 19th Century so there would have been little area on the floodplain to accommodate a sizeable fort. Therefore I deduced that Fort Lisa must have been located very near or on the bluffs. Moreover, documents indicate that Manuel Lisa was quite proud of introducing new vegetables and the plow to the Missouri River tribes and had his company blacksmiths work for the tribes for free (Chittenden 1902:901). Furthermore, Gilder (1905) suggested that Lisa had a farmstead near the fort that would have required a large tract of flat land. With this information in mind, I chose a 25% slope as the first parameter for my model. This degree of slope is probably too steep for growing crops and is marginally suitable for building without terracing or otherwise altering the landscape. There is no indication of terracing in historical documents or on the present landscape, so I chose a slope of 25% as the greatest possible incline on which Fort Lisa could have been situated. It is

likely that the location is on much more level ground but I chose to err on the side of including too much area instead of too little in the initial suitability model. As shown in Figure 4.1, the slope of the area ranges from very flat to very steep and there few locations with moderate incline near the river that are both sizeable enough to accommodate farming and the industries of the fort. While I am interested in locating all of the components of Fort Lisa, my focus remains the fort itself. Limiting the search to areas of 25% slope or less should be inclusive enough to identify all suitable areas.

Apart from the descriptions of Fort Lisa being a certain distance from different nearby locations, there was not another obvious parameter to input into the model. Trees and stone were readily available for building all along the bluffs in that area and distance to water was not an option because apart from the Bodmer depiction at Engineer Cantonment, I cannot be positive of the course of the river in the 19th century. Consequently, I decided to use aspect (Figure 4.2) as my other primary parameter In James's account of the overland trek from St. Louis to Engineer Cantonment he states that they saw Fort Lisa from the east side of the river, looking west (James 1823a:422). Furthermore, areas facing east towards the floodplain receive more direct sunlight throughout the day than west facing slopes, which are in the shadow of the bluffs. An east facing location therefore would be ideal for farming as well as offering some protection from inclement weather moving in from the west.

There are two common techniques for suitability analysis: Boolean and Fuzzy Membership. I decided to use both and compare the results. Boolean suitability uses the

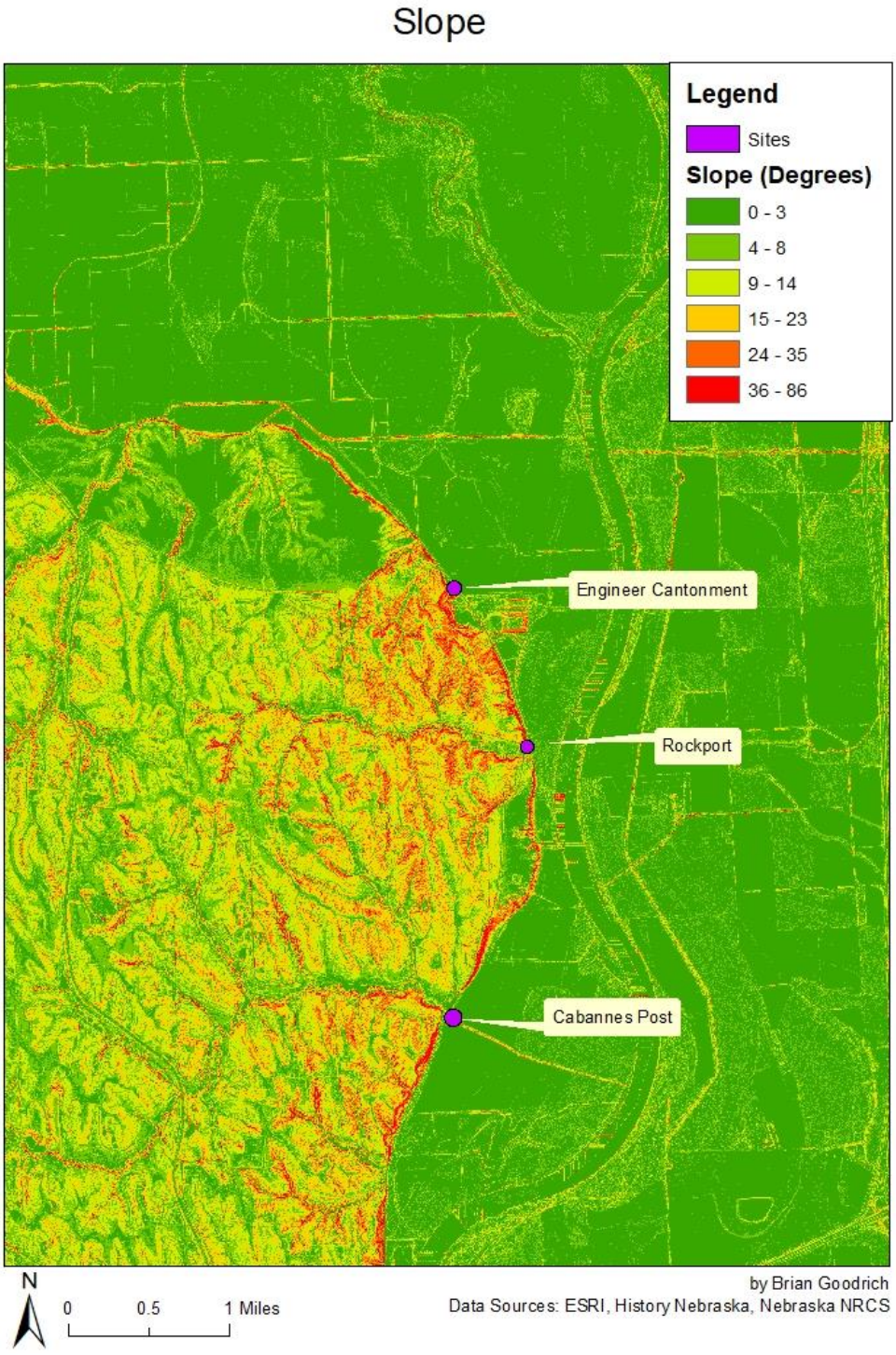

Figure 4.1
Slope of the landscape in the area around Fort Lisa where red is steeply inclined and green is flat.

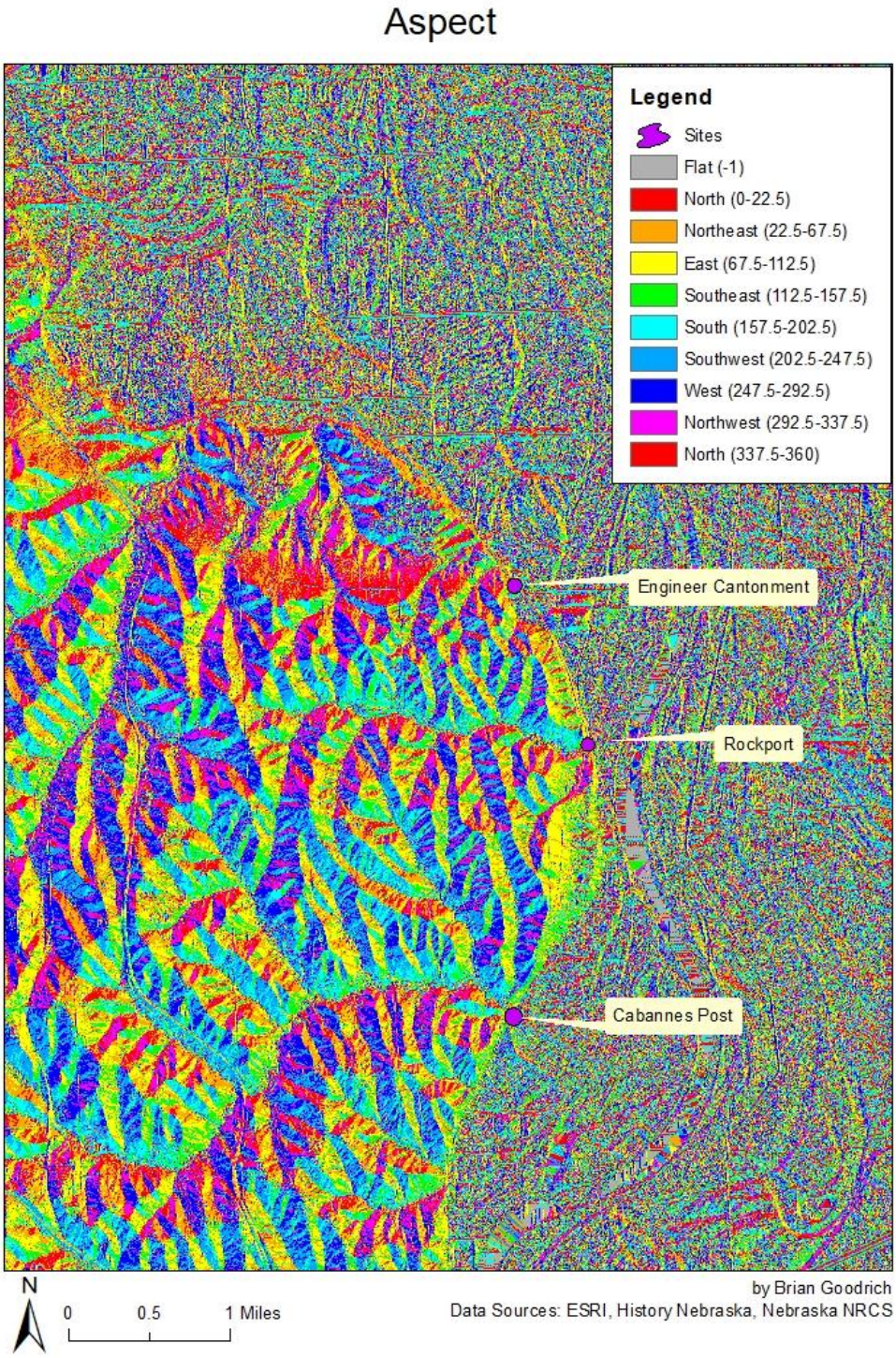

Figure 4.2

Aspect of the slopes in the vicinity around Fort Lisa. For the purposes of this analysis, slopes pictured in orange, yellow and green represent suitable locations for the Fort.

input raster and assigns each pixel either a yes value (1) for meeting a parameter or a no value (0) for failing to meet the criteria. The result is a binary output that offers a narrow definition of areas that either fulfill or fail to meet a specific parameter. In order to incorporate multiple raster datasets into a Boolean suitability model, each layer must be multiplied together using raster math. The only two possible results from multiplying pixels in a Boolean analysis are either one or zero. After applying map algebra, each pixel must meet all of the parameters in each layer to receive a positive designation.

Humans and cultural practices are rarely black and white; therefore, an alternative to the Boolean approach is fuzzy suitability, which assigns values to each pixel of the raster according to how well each spot meets the designated parameters. It is based on the concept of fuzzy membership which reclassifies input data on a scale from zero to one, depending on the likelihood of each datum belonging to a specific class or criteria. In order to incorporate multiple raster layers into a fuzzy suitability model, the layers must be added rather than multiplied. Adding the pixels with map algebra combines the fuzzy values assigned to each pixel in each layer. The result is map with graduated areas of suitability. In other words, areas that meet more parameters are rated more suitable than those that meet fewer.

For my Boolean model, I reclassified slope and aspect so that all pixels that are greater than 25% slope and do not face east, southeast or northeast received a zero, or unsuitable, designation. Conversely, the pixels that met both parameters received a one, representing their suitability. The resulting map is Figure 4.2 in which the blue areas represent suitable locations for the fort and the brown areas are unsuitable.

The fuzzy membership model followed a similar process. For aspect, I used Gaussian membership which uses a midpoint value as ideal and the further away in either direction from the midpoint the less ideal the location is. In this case my range was 45-135 degrees with the midpoint of 90 degrees representing due east. Therefore the closer to each end of the range the pixel is, the less suitable it is rated. For the slope I used linear membership, which simply means that the further from the established criteria the less ideal the location. In this case, the closer to 0% slope, the higher the likelihood that each pixel is a member of the suitable area, thus receiving a rating closer to one. Figure 4.3 shows the results in a map where the darker the shade of red the lower the suitability and the darker the blue the higher the suitability of being the site of Fort Lisa.

Finally, taking into account all of the historical sources that provide information on the relative location of Fort Lisa, especially concerning its proximity to other known sites, I created multiple buffers to create zones around the nearby sites. I used zones of .5, 1, and 2 miles because most of the accounts situate Fort Lisa between half mile to one mile south of Engineer Cantonment and roughly two miles north of Cabannè's trading post. Figure 4.4 shows the town of Rockport appears to be in the same vicinity of an ideal search area for Fort Lisa based on the distances from each site, possibly confirming Gilder's (1905) observation that the town was built on the site of Lisa's farmstead.

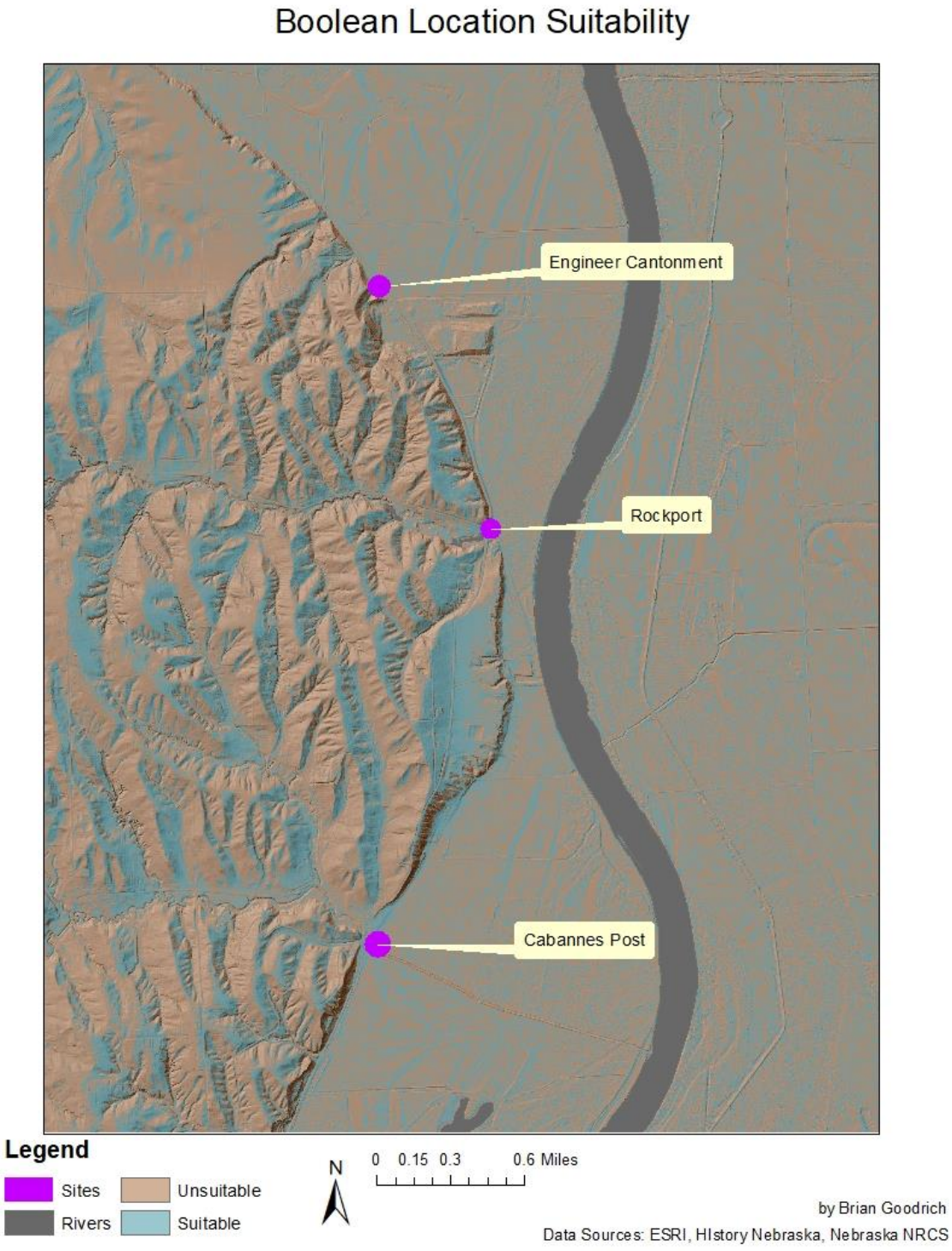

Figure 4.3
Boolean suitability prediction.

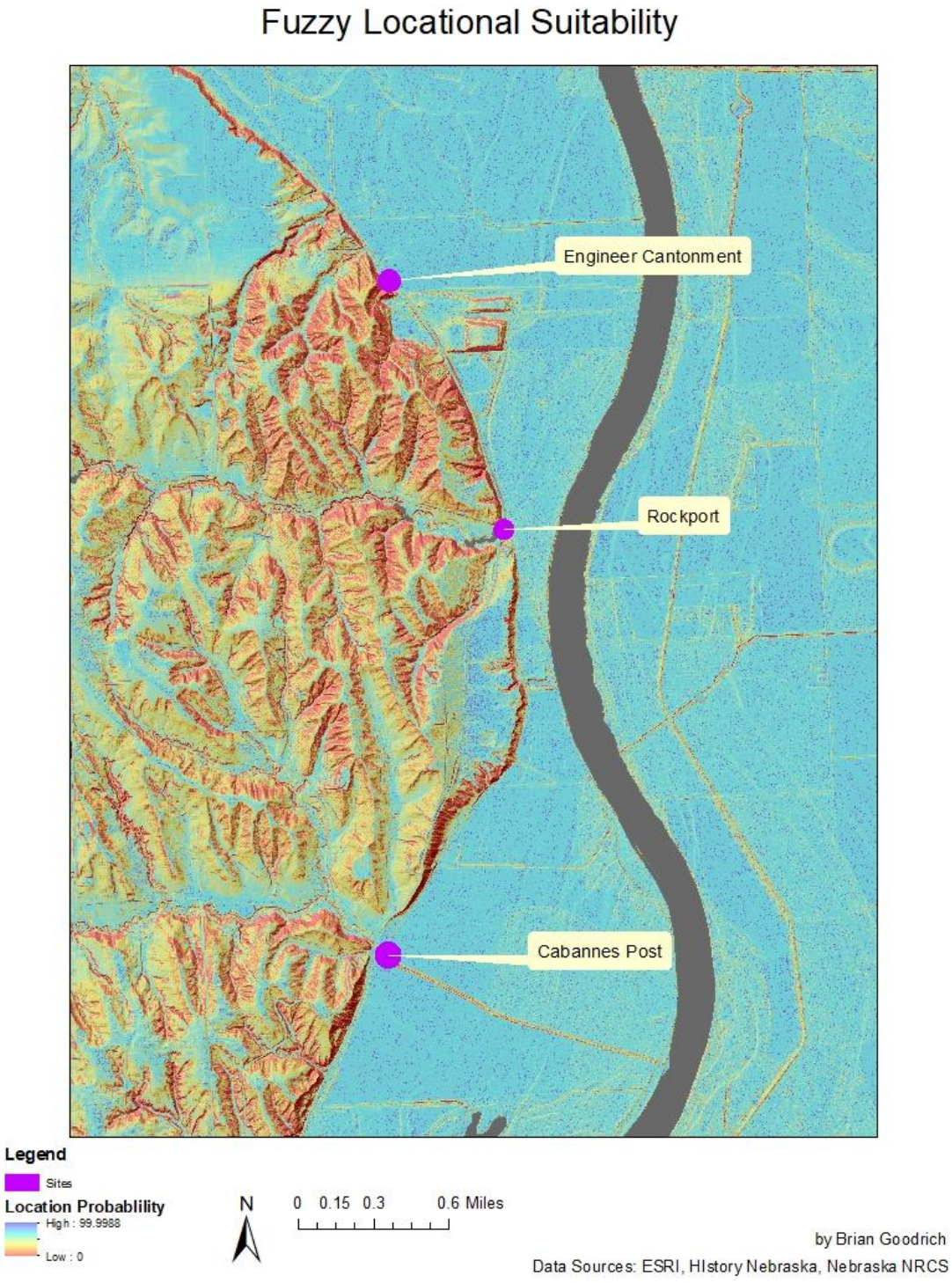

Figure 4.4
Fuzzy membership suitability prediction.

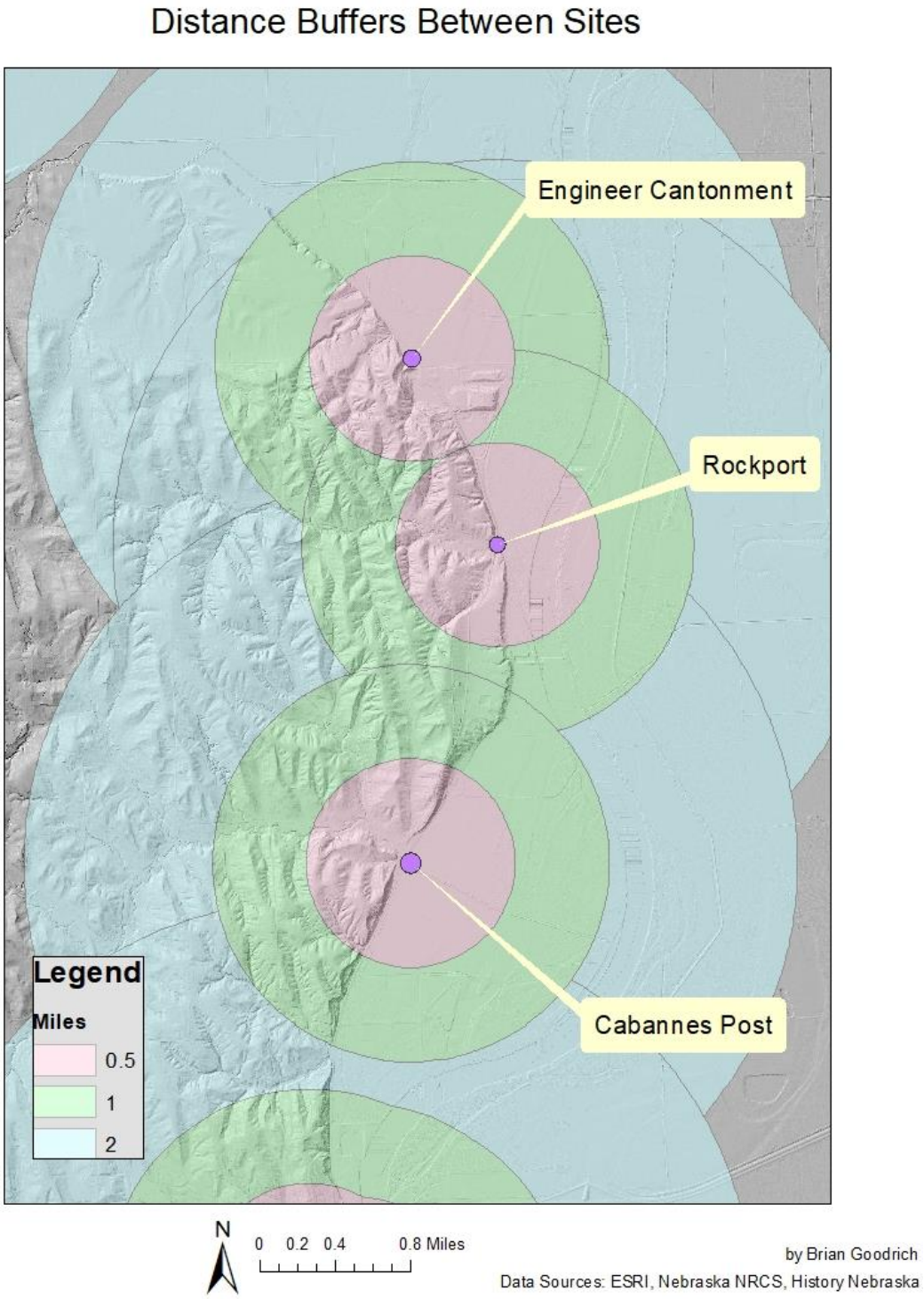

Figure 4.5
Distances between sites in the Fort Lisa area showing probable search radii**.**

Chapter 5

Discussion

The suitable locations in the models I created are promising however, some shortcomings must be noted. The primary limitation of my site location model is the lack of consistency in the documented distances from known sites. None of the sources identify the route between Fort Lisa and these other known sites. Travelling by river between Cabannè's and Fort Lisa would have been very different than trekking along the top of the bluffs. In no case is there a clear path between any of the sites. Without knowing the route travelled, it is difficult to determine exact distances. Furthermore, the measurements recorded in each source are likely estimates and none of the chroniclers cite how they measured from site to site. The difference between James's half a mile and Gale's one mile may not have been all that different depending on how they each calculated distance or which route they took between the two locales. Therefore, if none of the likely locations identified in my site location model reveal compelling evidence of Fort Lisa, I can expand the search area to account for the variability among the sources.

The most suitable areas in both models seem to indicate the gently sloped creek drainage directly west of Rockport (area 1) and on top of the bluffs directly to the north (area 2) and south (area 3) of the drainage (Figure 5.1). These areas each contain enough room for all of the components of the fort. Based on spatial requirements alone, I contend that Fort Lisa could not have been located on the floodplain because there would not have

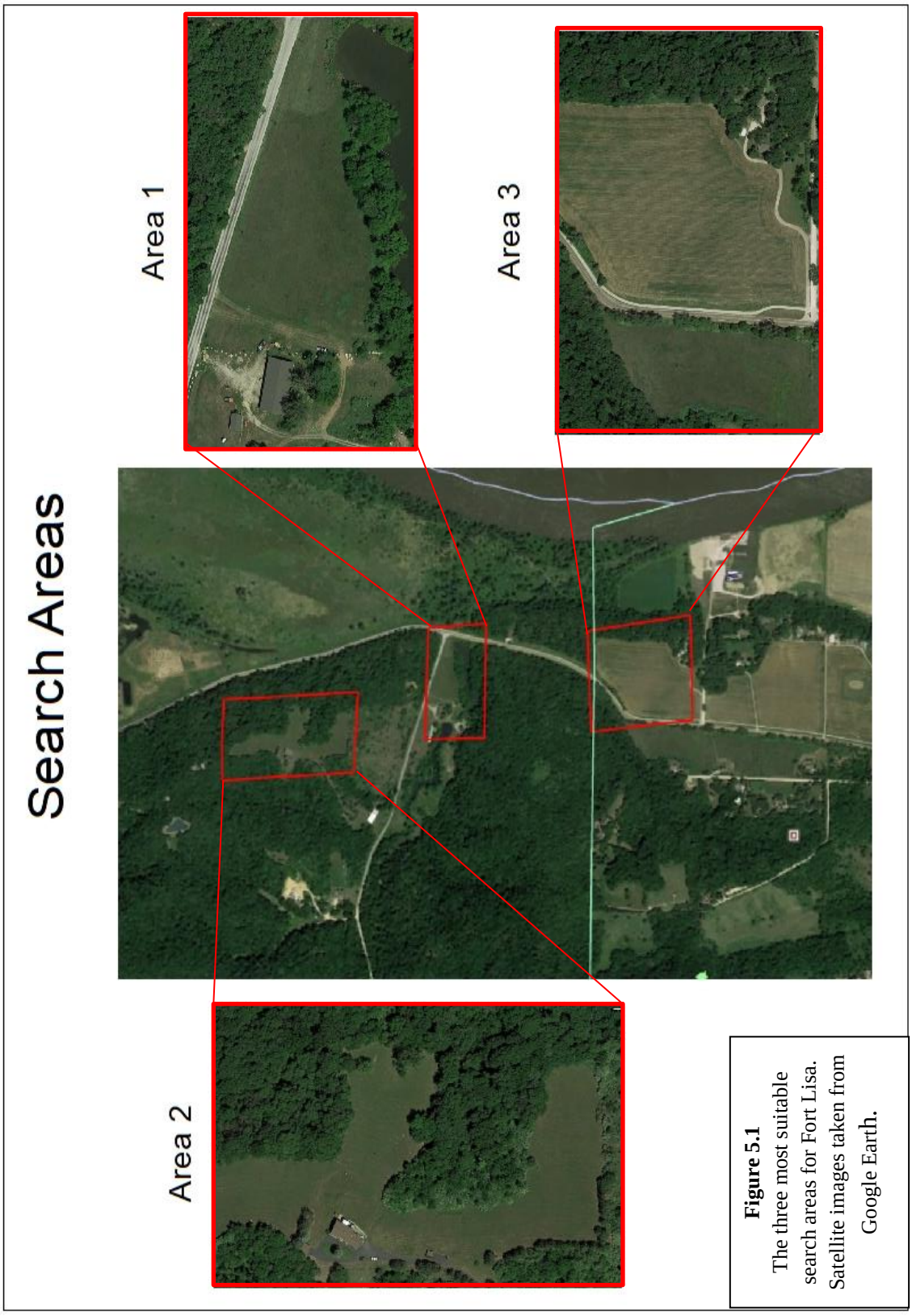

Figure 5.1
The three most suitable search areas for Fort Lisa. Satellite images taken from Google Earth.

been enough space. The bluffs to the south are least likely because they are on the verge of being too far away from the cantonment and too close to Cabannè's trading post. However, the northern bluff is half to one mile from Engineer Cantonment and around two miles from Cabannè's post. Furthermore, this bluff is at the latitude 41° 24'13" which was derived from sextant readings taken at Fort Lisa by members of Long's party (James 1823b:432).

On 1 March 2019, Rob Bozell, State Archaeologist at History Nebraska, and I toured the search area. He noted that the high probability area in the drainage was reported to have been mechanically graded down several feet and the landowner had previously denied access to the property for investigation. The north bluff top is private property as well so access to the area may prove to be a large obstacle. All of the high probability areas appear to have been heavily impacted by modern activity. In addition to the drainage being graded, the large rectangular features to the southeast of Engineer Cantonment are the dump piles from a modern gravel quarry within the search area. Construction from two roads is also likely to have impacted subsurface remains as well as residential construction activity on the bluffs. Finally, between the wandering of the river prior to its channelization and the flooding that has happened in recent years, there is a chance that there truly is very little, if anything left to find of Fort Lisa.

Despite the limitations and challenges, site location modeling might eventually help to relocate Fort Lisa. Engineer Cantonment was a small establishment that was occupied for less than a year and it was found with intact features, as was Cabannè's post (Jensen 1998; Carlson et al 2004). Both were likely subject to many of the same post

depositional forces and remained surprisingly intact until excavation. The current (Spring 2019) flooding and probable need for repair of roads and structures may uncover evidence that leads to a positive identification of the site. Unfortunately, that same flooding has prevented even preliminary testing of the predictive models.

Ultimately, the site location model narrows the potential area of the site of Fort Lisa to a reasonable size. The models revealed three potential areas that would have been suitable for an establishment of the size of Fort Lisa. This combination of geospatial approaches and historical documentation offers a way to closely examine landscapes using quantitative and qualitative data. When employed on a small scale, as presented in this thesis, site location modeling can be a useful tool in the spheres of both CRM and academic archaeologists.

Plans for Future Testing

Based on the results of the predictive models and my observations driving along the bluffs, the most likely possible location of Fort Lisa is the area around the junction of county roads P50 and P40. However, completion of the locational model and narrowing down the search area was not my intended end point. My next steps will be ground truthing the model through fieldwork and hopefully locating evidence of early 19th century activity, if not Fort Lisa itself. Efforts to conduct fieldwork prior to completion of this thesis were hindered by an unusually snowy winter followed immediately by record

rainfall and flooding in in the spring. Nonetheless, it is necessary to test my model for accuracy as well as attempt to find the specific location of the fort.

Because of the relatively small area a full pedestrian survey could be completed in two to three days. However, it will be difficult to conduct survey in straight transects because most of the bluff is heavily wooded. There are a few areas on the top of the bluff that have been cleared for crops and the areas along county road P40 have been developed and are covered in short crass or bare. In the areas that allow it, 5 meter transects should be sufficient and in the heavily wooded areas meandering transects will be necessary. The area south of the road that may have been graded will probably not yield much in the way of surface finds but the wooded areas have potential to yield surface finds.

In the event that pedestrian survey yields surface finds, those locations will provide starting points for subsurface testing. If possible, geophysical sensing would be the next step. Magnetometry or ground penetrating radar could reveal buried anomalies that point to components of the fort or its associated structures. However, there are two problems that may inhibit the use of those instruments. First, much of the area is heavily wooded so maneuvering bulky equipment may prove difficult. Second, much of the area appears to have been disturbed my modern activity so there is the possibility that debris deposited above any buried components of the fort will skew the results.

In the absence of relevant surface finds and in the event that geophysical sensing proves unhelpful, the areas of highest probability as shown by the locational suitability

model will be gridded into ten by ten meter squares and every fifth square will receive a test unit. For the sake of expedience and to manage the large sample size, test units will be dug with a motorized auger that can be run by a single person. All sediment will be screened through ¼ inch mesh and then the unit backfilled. If any yield positive evidence for early 19th century activity, further adjacent test units in the same grid square will be dug to try to identify any features.

In the event that any test units indicate the presence of Fort Lisa, or other features that may be associated with either it or the town of Rockport, arrangements for further excavation will have to be arranged. Ideally, several one by one meter units would be opened to explore any leads and further excavation continued upon the discovery of more features. At the very least, exploratory trenches could be expediently dug with a utility-cable trencher, like was done in the search for Engineer Cantonment (Carlson et al. 2004). All of the preceding plans are contingent on the permission and cooperation of the individual landowners. Documentation of all plans for testing will be provided to each private individual to whose land access is needed and written authorization will be acquired before the commencement of any archaeological activity.

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