PIPESTONE PIPELINE REROUTE PROJECT

DOCKET NUMBER: PPL-23-109

APPLICANT: MAGELLAN PIPELINE COMPANY L.P.

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Phase I Archaeological Survey, Route Alternative 2, Magellan Pipeline Company, L.P., Pipestone Reroute Project, Pipestone County, Minnesota

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December 29, 2023

MPUC Docket No. IP-7109/PPL23-109

Phase I Archaeological Survey, Route Alternative 2, Magellan Pipeline Company, L.P., Pipestone Reroute Project, Pipestone County, Minnesota

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Abstract

Magellan Pipeline Company, L.P. (Magellan) is proposing to relocate a short segment of an existing 8-inch refined products pipeline in Pipestone County, Minnesota referred to as the Pipestone Reroute Project (Project). The Project will relocate approximately 0.74 mile (mi) of the existing 8-inch diameter pipeline from federal lands managed by the U.S. Fish & Wildlife Service and National Park Service within the Pipestone Creek Unit of the Northern Tallgrass Prairie National Wildlife Refuge and the Pipestone National Monument, respectively. The segment of the pipeline that crosses federal lands was decommissioned on October 30, 2022. Final deactivation and abandonment of this pipeline segment occurred in December 2022.

On April 10, 2023, Magellan filed a route permit application with the Minnesota Public Utilities Commission (Commission) to relocate approximately 0.74 mi of its existing 8-inch petroleum pipeline from the federal lands. The proposed route is referred to as the Preferred Route and is 1.3 mi long and crosses private lands.

Several individuals, many of whom either actively quarry at the Pipestone National Monument or expressed a strong cultural or spiritual connection to the area and its pipestone, asked that route alternatives further from the Pipestone National Monument be considered by the Commission. During the Commission's comment and scoping period three route alternatives were submitted. Route Alternative 1 (13.1 mi in length) was identified by the Mille Lacs Band of Ojibwe and Route Alternative 3 (18.9 mi in length) was identified by the Upper Sioux Community. Following receipt of the comments received during the scoping period, Magellan worked to identify a route alternative that would be feasible while also moving the route further from the Pipestone National Monument and nearby federal lands, reducing the impacts to Pipestone Creek, and minimizing impacts to humans and other environmental features in the area. This alternative is referred to as Route Alternative 2.

Route Alternative 2 is 3.4 mi long and ties into Magellan's existing pipeline approximately 1,650 feet west of the northwest corner of 9th Street Northwest and 121st Street. Route Alternative 2 will then run north-south for approximately 2 mi to the north. This 2-mi section will parallel property lines and an existing Northern States Power Company (NSP) 115 kV transmission line until the pipeline crosses 131st Street. At 131st Street, the pipeline will turn to the east and parallel 131st Street for 1.4 mi where it will be tied into the existing pipeline at the southwest corner of 131st Street and Highway 75. Importantly, this alternative follows existing transmission and road rights of way for approximately 70 percent of its length. The remaining 30 percent generally follows property lines.

Route Alternative 2 crosses potential catlinite resources in parallel with the existing county road, which minimizes the potential for the pipeline to interfere with future, potential quarrying activity, should quarrying expand beyond the current boundaries of the Pipestone National Monument at some point in the future. Magellan would plan to cross beneath this catlinite feature using the horizontal directional drilling (HDD) method. The depth of the HDD would be designed to cross under the catlinite feature, reducing the potential for impacts to this resource.

Environmental Resources Management, Inc. (ERM) is assisting Magellan with its permitting efforts for the Project. On behalf of Magellan, ERM retained Commonwealth Heritage Group LLC dba Chronicle Heritage (Chronicle), to conduct archaeological survey on parcels along Route Alternative 2. Between October 16 and 19, 2023, Chronicle conducted archaeological survey along approximately 1.9 mi of Route Alternative 2 on private properties where survey permission had been granted. The fieldwork and reporting comply with requirements under the Minnesota Field Archaeology Act (MS 138.31-

138.42) and meets the standards outlined in the State Archaeologist's Manual for Archaeological Projects in Minnesota (2011).

This report provides a literature and background review of the Preferred Route and Route Alternatives 1, 2, and 3, summarizes the results of the October 2023 archaeological survey of 1.9 mi of Route Alternative 2, and assesses the archaeological potential of Route Alternatives 1 and 3. No survey was conducted along the Preferred Route in 2023.

Concurrent with the archaeological survey, a remote sensing survey of Route Alternative 2 was undertaken by GeoArc Research, Inc. to identify positions and depths of pipestone where Route Alternative 2 and other parcels cross the trend of known and suspected pipestone or catlinite beds using a non-invasive method. A summary of the results of that survey is provided in this report and the remote sensing survey report is attached as Appendix B.

Construction of Route Alternative 2 will require the acquisition of permanent right-of-way (ROW), temporary workspace and additional temporary workspace (ATWS) on private lands located west and north of the Preferred Route. The ROW generally would be 85-feet, consisting of 40 feet of permanent ROW and 45-feet of temporary workspace. In wetlands the temporary workspace will be 35 feet. Additional temporary workspaces would be required at the two tie-in locations, HDD locations, and bore locations.

For the 2.0 miles along the north-south portion of Route Alternative 2, the survey corridor is 200 feet, except where the ATWS for the HDD entry/exit locations extend outside of the survey corridor in an area measuring 45 ft by 170 ft. Along the remaining 1.4 miles of Route Alternative 2 where it is collocated with 131st Street, the survey corridor is 200 feet north of 131st Street to 70th Street. 300 ft between the ATWS east of 70th Street and the homestead west of 75th Street, and 200 feet south the 131st Street to the tie in location. The configuration of the route width contains all construction workspace and is offset from the centerline depending on the pipeline alignment, property boundaries, and utilities within existing easements and is wide enough to allow for minor route modifications.

The 2023 survey resulted in the identification of one archaeological site: an isolated, non-diagnostic lithic tool or preform (Field Site #W-2623-JRG-01). This lithic was recovered while shovel testing a cultivated field with low ground surface visibility near the south side of 131st Street. Due to its low informative value, this site is recommended not eligible for listing in the NRHP.

Chronicle will prepare a separate report presenting additional results of archaeological survey along Route Alternative 2 and the Preferred Route when survey permission is granted. If the Commission selects Route Alternative 1 or 3, Chronicle recommends the completion of archaeological survey in advance or construction.

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1. Introduction

Magellan Pipeline Company, L.P. (Magellan) is proposing to relocate a short segment of an existing 8-inch refined products pipeline in Pipestone County, Minnesota referred to as the Pipestone Reroute Project (Project). The Project will relocate approximately 0.74 mile (mi) of the existing 8-inch diameter pipeline from federal lands managed by the U.S. Fish & Wildlife Service (USFWS) and National Park Service (NPS) within the Pipestone Creek Unit of the Northern Tallgrass Prairie National Wildlife Refuge (Refuge) and the Pipestone National Monument (Monument), respectively. The segment of the pipeline that crosses federal lands was decommissioned on October 30, 2022. The relocation of the pipeline will occur on private lands. Environmental Resources Management, Inc. (ERM) is assisting Magellan with its permitting efforts for the Project.

Magellan evaluated the Preferred Route included in its Route Permit application with the Minnesota Public Utilities Commission (Commission), under the pipeline route selection procedures (Minnesota Administrative Rules [Minn. R.] Chapter 7852) in Docket No. IP-7109/PPL-23-109. Magellan identified a feasible route alternative based on direct feedback during Magellan's stakeholder and tribal outreach and comments offered to the Commission staff and Minnesota Department of Commerce, Energy Environmental Review and Analysis (EERA) staff at the in-person and virtual scoping meetings on July 11–12, 2023. This route, Route Alternative 2, is further from the Monument and nearby federal lands, reducing the impacts to Pipestone Creek, and minimizing impacts to humans and other environmental features in the area.

On behalf of Magellan, ERM retained Commonwealth Heritage Group LLC dba Chronicle Heritage (Chronicle), to conduct archaeological survey on parcels along Route Alternative 2 where survey permission was granted. Approximately 1.9 mi of Route Alternative 2 was surveyed.

Construction of Route Alternative 2 will require the acquisition of permanent right-of-way (ROW), temporary workspace and additional temporary workspace (ATWS) on private lands located west and north of the Preferred Route. The ROW generally would be 85 feet (ft), consisting of 40 ft of permanent ROW and 45 ft of temporary workspace except in wetlands where the temporary workspace will be 35 ft. Additional temporary workspaces would be required at the two tie-in locations, horizontal directional drilling (HDD) locations, and bore locations. The area surveyed for archaeological resources generally consisted of a 200-foot-wide corridor and additional temporary workspace that falls outside of this corridor. Chronicle conducted the archaeological survey on October 16–19, 2023. Survey occurred only on private properties where survey permission had been granted. Since permission had not been granted for all properties, less than the entire Route Alternative 2 survey corridor has been surveyed. No survey was conducted along the Preferred Route in 2023.

This report provides a literature and background review of the Preferred Route and Route Alternatives 1, 2, and 3, summarizes the results of the October 2023 archaeological survey of Route Alternative 2, and assesses the archaeological potential of Route Alternatives 1 and 3.

Concurrent with the archaeological survey, a remote sensing survey of Route Alternative 2 was undertaken by GeoArc Research, Inc. (GeoArc) to identify positions and depths of pipestone where Route Alternative 2 and other parcels cross the trend of known and suspected pipestone or catlinite beds using a non-invasive method. A summary of the results of that survey is provided in this report and the remote sensing survey report is attached as Appendix B.

Project Background

Magellan Pipeline

The existing 8-inch pipeline from Sioux Falls, South Dakota, to Marshall, Minnesota, was an active part of Magellan's 9,800-mi refined products pipeline network, the longest in the United States. Magellan's refined products pipelines primarily transport three types of product: gasoline, diesel and aviation fuel. This pipeline is constructed as a bidirectional pipeline, meaning that it can transport product both north from Sioux Falls or south from Marshall. On April 10, 2023, Magellan filed an application for a route permit to construct a pipeline and associated facilities to relocate approximately 0.74 mi of the existing 8-inch pipeline from federal lands managed by the U.S. Fish and Wildlife Service and National Park Service within the Pipestone Creek Unit of the Northern Tallgrass Prairie National Wildlife Refuge (Refuge), and the Pipestone National Monument (Monument). The reroute is necessary to restore operations to the existing 8-inch Magellan refined products pipeline that serves communities in western Minnesota, eastern North Dakota and eastern South Dakota.

Pipestone National Monument and Pipestone Creek Unit of the Northern Tallgrass Prairie National Wildlife Refuge

The Monument was established in 1937 to protect a quarry of pipestone (catlinite) of great cultural and historic significance. It is located northwest of the City of Pipestone where the catlinite outcrops on the west side of a low escarpment of Sioux Quartzite. Pipestone Creek flows through the Monument from east to northwest, falling over the escarpment at Winnewissa Falls. In 1910, alterations were made to the channel of Pipestone Creek above the escarpment that presumably changed the location of the falls (Scott et al. 2006:12). Railroad tracks used to run through the east side of the Monument.

The Refuge unit is on the north side of the Monument. Although federally owned, the unit was managed as a Minnesota state wildlife management area until recently. Pipestone Creek flows into the Refuge from the Monument to the southeast, where it forms a small lake behind a dam before draining north across 121st Street. As it passes out of federal lands, the creek turns to flow west again. The creek flows into the Lower Big Sioux River, a tributary of the Missouri River.

The Monument and Refuge unit are in Sections 1 and 2, Town 106 North, Range, 46 West, Sweet Township. Chronicle's 2023 survey was conducted outside of the Monument and Refuge in Section 2 of the above and in Sections 35 and 36 of Town 107 North, Range, 46 West, Troy Township.

Preferred Route and Route Alternatives

Several individuals, many of whom either actively quarry at the Pipestone National Monument or expressed a strong cultural or spiritual connection to the area and its pipestone, asked that route alternatives further from the Pipestone National Monument be considered by the Commission. During the Commission's comment and scoping period three route alternatives were submitted. Route Alternative 1 was identified by the Mille Lacs Band of Ojibwe and Route Alternative 3 was identified by the Upper Sioux Community. Following receipt of the comments received during the scoping period, Magellan worked to identify a route alternative that would be feasible while also moving the route further from the Pipestone National Monument and nearby federal lands, reducing the impacts to Pipestone Creek, and minimizing impacts to humans and other environmental features in the area. This alternative is referred to as Route Alternative 2.

Preferred Route

The Preferred Route traverses approximately 1.3 mi (2 kilometers [km]) between the two points where it intersects the existing pipeline (Figure 1). Southwest of the Monument, it departs the existing pipeline just southwest of the intersection of 121st Street and 116th Street. The Preferred Route runs northwest to 116th Street, then turns north, passing between St. Leo Cemetery and Woodlawn Cemetery. It then curves to the east, roughly paralleling 121st Street, and ties into the existing pipeline again northwest of the intersection of 121st Street and 75th Avenue. The Preferred Route crosses the Sioux Quartzite outcrop and ties into the existing pipeline immediately east of this outcrop. The route crosses Pipestone Creek and skirts the bank of it upstream from this point, near where the creek crosses 121st Street. Access roads to the Preferred Route are proposed off 75th Avenue, in at least two places along 121st Street, and from 60th Avenue to the west.

The project's associated facilities include one permanent and five temporary access roads. Additionally, the aboveground appurtenances include a new cathodic protection system and pipeline markers. None of the access roads will require upgrades or improvements for the proposed project. The cathodic protection system will include up to two additional test points and potentially one additional ground bed. No above ground facilities (e.g., valves, buildings, structures) are anticipated.

Pipestone Creek and the catlinite strata within the Sioux Quartzite will be crossed via the HDD method to avoid these resources.

Route Alternative 2

Starting at its connection to the existing pipeline approximately 0.3 mi west of the northwest corner of 9th Street NW and 70th Avenue, Route Alternative 2 heads north for approximately 1.9 mi and is collocated with an existing Northern States Power Company (NSP) 115 kV transmission line on the portion of the route north of Pipestone Creek. The route alternative then heads east parallel to the north side of 131st Street for 0.6 mi before crossing to the south side of 131st Street for the remaining 0.9 mi where it will tie into the existing pipeline at the southwest corner of 131st Street and Highway 75.

Route Alternative 2 measures approximately 3.4 mi in length and is collocated with the NSP 115 kV transmission line and 131st Street for 2.4 mi (70 percent of the route). The remaining 1.0 mi (30 percent of the route) generally follows property lines (Figure 1).

Route Alternatives 1 and 3

Route Alternative 1 bypasses the Monument further to the northwest than the Preferred Route or Route Alternative 2. It separates from the existing pipeline where it crosses 40th Avenue, then runs north along 40th Avenue for approximately 7.3 mi (11.8 km) to 151st Street, then follows that road east for approximately 5.75 mi (9.2 km) to rejoin the existing pipeline.

Route Alternative 3 is far to the southeast, bypassing the City of Pipestone, and is the longest alternative. It departs from the existing pipeline where it crosses 61st Street, follows that street east for approximately 8.3 mi (13.4 km) to 110th Avenue. It then runs approximately 10.6 mi (17 km) north along 110th Avenue to meet the existing pipeline north of 161st Street.

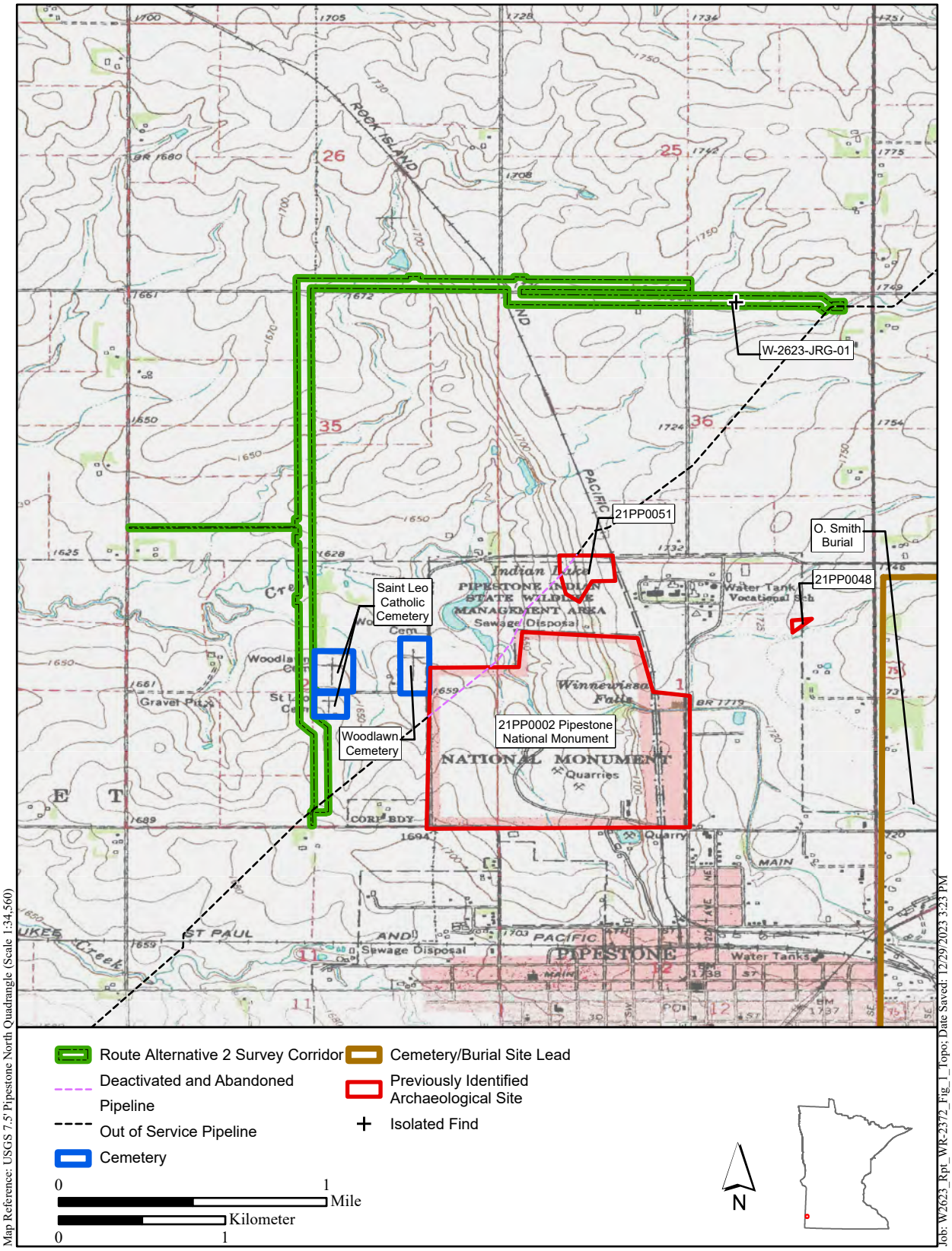

Figure 1. Survey Corridor and Previously Identified Archaeological Sites within One Mile

Report Contents

This report is organized into eight sections and two appendices. Following this introductory section, the environmental setting of the Project is presented in Section 2. Information on the cultural context of the pipestone quarries, the Monument, and previously reported archaeological and burial sites in the area are provided in Section 3. Field methods are presented in Section 4. The results of the field investigation are detailed in Section 5. The results of the GeoArc remote sensing survey along Route Alternative 2 are summarized in Section 6. Section 7 provides a project summary and recommendations. List of references cited follows in Section 8. The preliminary site form for site W-2623-JRG-01 is provided in Appendix A. Appendix B presents the report on the remote sensing survey conducted by GeoArc.

The Minnesota Office of the State Archaeologist (OSA) Portal provided the locations of previously recorded archaeological resources and cultural surveys within 1 mi of each of the four routes. The pre- field research was conducted by Steven Sabatke, Elissa Hulit, and Principal Investigator Rhiannon Jones. The 2023 Phase I survey was conducted by one crew supervised by crew chief John Griffin. Shaheen Christie, Tori Harrison, and Rebekah Gyger comprised the crew. Rhiannon Jones was present for survey on October 16th. Dr. Robert Watson served as Project Manager. Ms. Jones authored this report. Elissa Hulit managed the geospatial data and produced the report graphics.

2. Environmental Background

Bedrock Geology

Nearly all of Pipestone County is covered by Sioux Quartzite (Jirsa et al. 2012). This rock, and its interbedded layers of mudstone/argillite and conglomerate, dates to approximately 1,760–1,630 million years ago in the Paleoproterozoic Era. The conglomerate formed from fluvial and marine material. While Sioux Quartzite forms the bedrock surface in the Project area—and much of the county—in the northern and southeastern edges of the county this rock is covered by Cretaceous rocks (Jirsa et al. 2011). Dikes cross through the general vicinity of the Project.

The quartzite formed from a thick bed of quartz sand deposited in fluvial environments over 1.6 billion years ago (Graham 2017:3–9). This rock is very hard and weather-resistant, explaining why it can form the outcrops and escarpment seen in the Monument. The hard, pink Sioux Quartzite has been used in the construction of many buildings, including the National Register of Historic Places (NRHP)-listed Pipestone Indian School Superintendent's House south of 121st Street on the grounds of the local branch of Minnesota West Community and Technical College.

The pipestone is metamorphosed mudstone (or argillite) formed of clay. It is soft enough to be carved by hand. There are multiple sources of pipestone in North America, but these are mineralogically distinct (Graham 2017:12; Scott et al. 2006:21). The pipestone from the quarries at Pipestone National Monument uniquely contains little to no quartz. Hematite gives it its red color. The pipestone at the Monument has been called “catlinite” after George Catlin, an artist who documented the quarries in 1836 and collected samples of pipestone for mineralogical analysis (Graham 2017:13; Scott et al. 2006:9, 19, 23).

In the vicinity of the Pipestone Reroute Project, the Sioux Quartzite forms a shelf running north-northwest to south-southeast. From the northwest side of the City of Pipestone to approximately half a mile north of 131st Street, the top of this shelf is visible as a landform on topographic maps and

as a band where the Sioux Quartzite outcrops on the surface. In places atop the shelf where vegetation is kept short by grazing cattle, these outcrops—as well as numerous loose boulders and cobbles—are visible on the ground and in aerial imagery. Within Pipestone National Monument, the west side of this shelf forms a short escarpment. The quartzite, including its layers of pipestone, dips to the east (Graham 2017:1). The pipestone outcrops in the Monument just west of the escarpment, where current and historic quarries are located.

Glacial Geology

The Project area was not covered by ice during the last glacial maximum (Wisconsinan ice age). At that time, the ice sheet pushing down from the north split around the area, forming the Coteau des Prairies, or the Prairie Coteau. This is a highland that divides the drainage basin of the Minnesota River to the east from that of the James River to the west. Since the Prairie Coteau was not covered by ice during the last ice age, the surficial geology of the Project vicinity consists mainly of pre-Wisconsinan glacial till and other old glacial sediment, as well as loess (Lusardi et al. 2019). The bedrock may be shallowly buried by this overburden. Wisconsinan-age glacial outwash and modern alluvium are present along waterways, including Pipestone Creek.

Soils

Along the Preferred Route, most (80 percent) of the soils mapped by the United States Department of Agriculture (USDA) formed in loess or in silt over either outwash or sand and gravel deposits (USDA 2023). The loess caps either bedrock or glacial till. Approximately 15 percent of the survey corridor is covered in soils that formed in alluvium. The alluvial soils are found along Pipestone Creek and the drainage that crosses 131st Street. The remainder of the survey corridor is covered by soils that formed in other glacial material or are disturbed.

Most of the alluvial soil along Pipestone Creek is Lamoure-La Prairie complex soil. Both Lamoure and La Prairie series soils are cumulic and are expected to have an A horizon 48–69 centimeters (cm) (19–27 inches [in]) thick over a C horizon. The typical pedon for Lamoure series soils includes a buried surface (Ab) horizon between 109 and 132 cm (43 and 53 in) below the surface, with another C horizon below. It is possible this buried surface harbors deeply buried cultural deposits. The other alluvial soils along the Preferred Route are not cumulic and are not expected to have buried surface horizons.

In the Route Alternative 2 survey corridor, 71 percent of the survey corridor is covered by soils formed in loess, with 21 percent in alluvial soil and the rest in glacial materials. Route Alternative 2 overlaps an area of Lamoure-La Prairie complex soil at the Pipestone Creek crossing.

Paleoenvironment

As the glaciers to the north and east of the Project retreated at the end of the Pleistocene epoch, southwestern Minnesota was covered by an ancient form of boreal parkland consisting of a patchwork of grasslands and spruce-dominated forest. This forest did not have the same mix of conifer species as in boreal forests today but did support some deciduous species, including oak and black ash (Gibbon 2012:38–40; Pielou 1991:171). This was the environment of the Project area ca. 14,000 years ago, very different from the tallgrass prairie of the time of Euroamerican settlement in the 19th century or the open agricultural lands of today. The environment was colder than at present at the end of the glacial maximum but was warming. Animal species known in the forest of present-day northern Minnesota likely inhabited this late Pleistocene spruce parkland but were joined by

arctic species such as caribou and extinct species, including mammoths and mastodons (Gibbon 2012: 42). The open boreal forest encouraged browsing animals (Pielou 1991:171).

In southwestern Minnesota, this parkland was replaced by deciduous birch-alder forest ca. 14,000–13,000 years ago and then by oak-elm forest, which spread across the southern part of the state from the southwest (Gibbon 2012:40–43). These deciduous forests were the dominant vegetation regime in the southwestern part of the state ca. 10,500 B.C., during the Paleoindian tradition.

Approximately 5,000–9,000 years ago (ca. 7000–3000 B.C.), rapid warming occurred in the Northern Hemisphere during an event known as the Holocene Climate Optimum (Altithermal). This created warmer and dryer conditions that caused prairie to spread across much of Minnesota (Gibbon 2012:66–72). Prairie covered the Project region by 8,000 B.C. and continued to spread eastward, reaching its maximum eastward extent around 5800 B.C. This ancient prairie edge was east of the Mississippi River, further east than prairie exists at the latitude of southern Minnesota today.

The Holocene Climate Optimum partially overlapped the Archaic tradition, specifically the Early Archaic. Although the region had become predominantly prairie, small areas of trees may have persisted in stream valleys. Trees on the prairie were vulnerable to prairie fires, which occurred routinely, and to drought (Gibbon 2012:27). There are no natural lakes in the unglaciated part of southwestern Minnesota and wetlands often dried up during the Holocene Climate Optimum. As forest-dwelling species retreated with the forests and ice age megafauna went extinct, herds of bison roamed the prairies.

While the warming and drying trend had reversed by approximately 4900 B.C., southwestern Minnesota remained a prairie region, the eastern edge of the prairie attaining its modern configuration in the area around 2500–1200 B.C. (Gibbon 2012:72–73). At the time of Euroamerican settlement in the 19th century the region was tallgrass prairie. Deciduous forest was present in the central and southeastern portions of the state at that time, and coniferous forests grew in the north.

3. Cultural Background

This section describes developments across Minnesota and in the surrounding regions from the period of earliest human settlement to the arrival of European explorers. Anfinson (1990) first described archaeological regions in Minnesota to help understand the environment and where archaeological sites may be located. The Project area occurs within Archaeological Region 1, Southwest Riverine, which covers a small area in the southwest corner of the state. The region includes the southwestern two-thirds of Pipestone County along all of Rock County to the south, western Nobles County to the southeast, the southwest corner of Murray county to the east, and the southwestern corner of Lincoln County to the north (Anfinson 1990). This represents the small portion of the state that overlaps the unglaciated Prairie Coteau.

Paleoindian Tradition in (ca. 11,500–8,500 BP)

The earliest inhabitants of southwestern Minnesota clearly recognizable in the archaeological record were nomadic late Pleistocene hunter-foragers referred to by archaeologists as Paleoindians (e.g., Gibbon 2012:37–63). Human occupation of the region prior to the appearance of the first markers of the Paleoindian tradition (i.e., Clovis projectile points) may have occurred but current evidence for this is meager (Buhta et al. 2011:12–15; Gibbon 2012:61–63). In any event, early human occupation of the Project area would not have been hindered by the position of the ice sheet,

as it was elsewhere in the state, although the presence of nearby glacial ice would have had an effect on climate and resources.

Archaeologically, this tradition is divided into Early and Late stages distinguished by projectile point types: Early stage fluted varieties and Late stage unfluted types (Benchley et al. 1997:65; Gibbon 2012:48–50; Higginbottom 1998; Morrow et al. 2011:118–120). The Early Paleoindian period is identified with large, finely crafted fluted lanceolate stone points, with Clovis being the earliest documented complex (Gibbon 2012). Clovis technology is the earliest expression of the large-game hunting subsistence strategy that would later come to characterize the Paleoindian period. Folsom points overlap with Clovis and the lithic technology is typified by a thin, finely made spear point with a pronounced flute, fine marginal retouch, and a deeply concave base (J. Morrow 1996; Schermer et al. 1995). Folsom culture is broadly conceived as being largely like Clovis, with a very mobile hunter-gatherer population. Based on the recovery of fluted points in direct association with the remains of extinct Pleistocene mammals, Early Paleoindian peoples are inferred to have lived a highly mobile hunter-forager lifestyle focused on the hunting of large herd animals that existed at the end of the Pleistocene. It is assumed the Paleoindian diet also included significant amounts of smaller game and plant foods, but this facet of Paleoindian lifeways is simply not well understood relative to later time periods (Cleland 1966:49; Gregg et al. 2016:B.18).

Evidence for Early Paleoindian in southwestern Minnesota is scant but not non-existent (Buhta et al. 2011:29–30). One Folsom site is known at the northeastern edge of the Southwest Riverine region in southwest Murray County (Buhta et al. 2011:Figure 19)

The Late Paleoindian period in Minnesota is characterized by the appearance of non-fluted lanceolate point types such as Agate Basin, Plainview, Hell Gap, Scottsbluff, Browns Valley, (Benchley et al. 1997:66; Gregg et al. 2016:B.20–B.26; Morrow et al. 2015:124–129). The Late Paleoindian tradition coincides with the end of the Pleistocene epoch and the environmental changes that were occurring likely led to this change in projectile point technology (Theler and Boszhardt 2003:63).

Archaic Tradition (ca. 9,000–2,000 BP)

The Archaic tradition is regarded as a time when the pre-Contact inhabitants of the region undertook major changes in their adaptive strategies and lifestyles in response to changes in the post-glacial environment at the beginning of the Holocene. The beginning of the Archaic tradition coincided with the Holocene Climate Optimum when the region became far warmer. As discussed above, the temperate forests that had replaced the boreal parkland gave way to prairies. The Archaic tradition is defined in relation to the preceding Paleoindian tradition by changes in projectile point forms, a hunter-forager subsistence base that incorporated a more diverse range of plant and animal resources relative to the Paleoindian tradition, and evidence of increasing social complexity.

The subsistence strategy of the Archaic period is characterized by hunters and foragers whose customary ways of behaving emerged in part as adjustments to the changing postglacial environment and the extinction of mammoth and other large ice age mammals (Bleed 1969; Dobbs 1978; Gibbon 1996, 1998; Michlovic 1985; Phillips and Brown 1983; Shay 1971; Steinbring 1974). Projectile point styles became more regional during the Archaic, without the extremely wide distributions seen with Paleoindian types such as Clovis and Folsom. This may reflect greater regionalization of adaptive strategies in response to the changing ecological character of the landscape across North America. It is during the Archaic tradition that notched and stemmed projectile points, hafted knives, ground stone tools, and—in some places—copper artifacts appear.

The Archaic tradition on the tallgrass prairie of Minnesota is not well understood (Benchley et al. 1997:85). It is thought that Archaic hunter-forager lifeways had a greater reliance on small game and wild plant foods compared to the preceding Paleoindian tradition, but subsistence likely revolved around bison hunting, as it had in the Late Paleoindian tradition (Benchley 35 al. 1997:61; Buhta et al. 2017:58, 66–68; Gregg et al. 1996:82). The Prairie Archaic likely was similar to the Plains Archaic tradition, with a bison-centric subsistence strategy that also incorporated hunting deer and other game and fish and shellfish from rivers (Buhta et al. 2017:58, 66–68). Side-notched projectile points, hafted knives, and ground stone tools enter the archaeological record. At the Cherokee Sewer site (13CK405) in northwestern Iowa, the only difference between the Paleoindian and Archaic strata was in the lithic technology, specifically the appearance of ground stone tools and a change in projectile point hafting methodology (Benchley 35 al. 1997:61). Prairie Archaic sites are widely distributed across Minnesota, although not in the Southwest Riverine region (Buhta et al. 2017:68, Figure 24). They are relatively numerous immediately to the northeast in the Prairie Lakes region, however.

Woodland Tradition (3,000-350 BP)

The Woodland Tradition in Minnesota (c. 3,000–350 BP) brought significant change and innovation: the manufacture of ceramic vessels, the construction of burial mounds, the harvesting of wild rice and the beginning of horticulture (Anfinson 1987; Arzigian 2008; Benn 1979; Gibbon 2012:93; Gibbon and Streiff 1990; Hudak 1974). These features did not all appear together at the same time, but rather were adopted at different times in different places, and in some cases are also known from Late Archaic contexts (Buhta et al. 2014; Theler and Boszhardt 2003:97). In Minnesota, Woodland cultures are separated into an earlier Initial Woodland (ca. 200 B.C.–A.D. 700) and a later Terminal Woodland (ca. A.D. 700–1200).

The earliest ceramics in southwestern Minnesota were similar to the La Moille Thick type (Gibbon 2012:101–102). These were followed by ceramics of the Fox Lake phase. These ceramics appear to have been produced by societies that continued to hunt bison but also created new forms of stone tools. Projectile points initially are stemmed varieties similar to Midwestern types to the east, such as Durst. Later styles were notched and were more closely affiliated with Plains projectile point styles such as Pelican Lake, Avonlea, and Oxbow (Gibbon 2012:104). While mounds were constructed elsewhere in the state during the Initial Woodland, they do not appear to be part of the Fox Lake tradition (Gibbon 2012:102). The bow and arrow was adopted in southwestern Minnesota during the Initial Woodland Fox Lake phase (Gibbon 2012:149).

In the Terminal Woodland, the Fox Lake Phase was replaced by the Lake Benton phase (Gibbon 2012:147–149). Lake Benton ceramics were tempered with crushed rock and frequently features cord-wrapped stick decorations. This latter feature was common in contemporary ceramics to the east and north than on the plains to the west. Projectile points tended toward small, side-notched varieties. Burial mounds appear in southwestern Minnesota with the Lake Benton phase, but evidence suggests horticulture was not much practiced in the region, unlike to the east and west (Gibbon 2012:156).

Late Pre-Contact

Great Oasis and Cambria

Agricultural groups inhabiting southwestern Minnesota in the early Late Pre-Contact era included the Great Oasis and Cambria cultures. The Great Oasis culture (ca. A.D. 900-1100) was first identified in Murray County, Minnesota, but extended across a broad area including Minnesota, Iowa, South

Dakota, and Nebraska (Alex 2000:139; Gibbon 2012:163–164). Great Oasis subsistence patterns were varied, with sites near the Missouri River having evidence of maize agriculture (Alex 2000: 138–150; E. Henning 1981). It is not certain if maize was grown by Great Oasis peoples in Minnesota or of it was imported from elsewhere (Gibbon 2012:163).

The Cambria phase (ca. A.D. 1000–1200) represents a first millennium A.D. cultural complex associated with the Middle Missouri tradition and Northeastern Plains Village Complex, and centered along the Minnesota River near Mankato, Minnesota (Benchley et al. 1997:171, 174–176; Gibbon 1991:211, 2012:165–167). The phase is marked by distinctive pottery, large village sites, mound building .

Oneota (ca. A.D. 1200-Contact).

Oneota represents a late prehistoric cultural tradition that arose during the time of the Middle Mississippian tradition—by about A.D. 1200 in southwestern Minnesota—and lasted to the time of European Contact in the A.D. 1600s (Benchley et al. 1997:145–154). Late Oneota cultures are thought to have been ancestral to historic Siouan-speaking peoples, including the Ioway and Otoe (Alex 2000:185–210; Benchley et al. 1997:137, 143–154; Henning 2007).

Oneota peoples practiced horticulture, lived in at least semi-permanent villages, and made distinctive pottery that was tempered with shell rather than grit (Benchley et al. 1997:145–154). In addition to shell tempering, Oneota ceramics have smoothed exteriors and incised linear decorations in chevron, triangle, and other geometric patterns (Alex 2000:189–190; Gibbon 2012:169, Figure 7.4). Some vessels have strap or small loop handles attached from the rim to the shoulder. Southern Oneota populations were agricultural societies that grew corn, beans, squash, tobacco and a variety of starchy and oily seeded annuals (Arzigian 1993; Egan and Brown 1995; Egan-Bruhy 2001). Villages were probably occupied year-round, representing a shift towards intensified agriculture, as people needed to remain close to where they grew and stored corn and other crops (Theler and Boszhardt 2003:143).

The Oneota tradition has been identified across an extensive portion of the north-central United States. It is likely that the tradition represents multiple related cultures that are distributed across this wide geographical area (Benchley et al. 1997:143–144; Boszhardt 1994). While these populations shared many cultural similarities, they appear to be temporally, geographically, and culturally distinct groups. The Blue Earth phase has been defined for portions of southern Minnesota, western Wisconsin, and northern Iowa, Including the upper Minnesota River (Benchley et al. 1997:172-173; Gibbon 2012:169).

Contact Period

The Project is located in an area occupied and used by many tribes since time immemorial. It is evident from both the oral traditions and early graphic representations of Native Americans that the post-Contact period in southwestern Minnesota had its cultural roots in Terminal Woodland and Late Pre-Contact cultures (Gibbon 2012:171). In addition, indigenous groups from the east were pushed westward into the region by European/Euroamerican expansion.

During the nineteenth century, the United States wanted to ensure that land was available for additional settlement. Two land cessation treaties with the United States were signed by the Upper Dakota Sioux and Yankton Sioux. The U.S. Constitution defines treaties as the supreme law of the land. Treaties recognize the unique relationship between the federal government and federally

recognized American Indian tribes as sovereign nations. Following is a discussion of the Traverse de Sioux Treaty of 1851 and the Yankton Sioux Treaty of 1858.

Traverse des Sioux Treaty of 1851

After Minnesota became a territory in 1849, immigrants moved into southwestern Minnesota to settle and establish farms on the fertile land. This influx of setters increased pressure on the Upper Dakota Sioux to give up their land. In 1851, the Treaty of Traverse des Sioux was signed between the U.S. government and the Sisseton and Wahpeton bands of the Upper Dakota Sioux. The Sisseton and Wahpeton ceded 21 million acres of land to the U.S. government, including most of present-day southwestern Minnesota, in return for cash and annuity payments as well as trade goods, education opportunities, and a reservation. During the treaty signing, the Dakota signed what they thought was a third copy of the treaty but was actually a document known as "traders' papers" that guaranteed some of the annuity payments would be made to fur traders who claimed the Dakota owed them unpaid debt.

The U.S. government also established two reservations along the Minnesota River. However, before the treaty was ratified, the U.S. government changed the terms and only allowed for the Dakota to live on the reservation land until it was needed for settlers, at which time they were forced to move off the land (Minnesota Historical Society [MHS] Undated, 2023).

The U.S. government did not fulfill its treaty obligations, building few schools, charging inflated prices for goods, and not allowing Dakota people to permanently live on the reservations established for them. The situation became dire by the summer of 1862, when scarce game and a poor harvest led to starvation. Tensions escalated and culminated in some Dakota attacking settlers, which led to an armed government response and the 6-week-long Dakota War of 1862. Upon conclusion of the war, the U.S. government publicly executed 38 Dakota, dissolved their reservation, nullified its treaties with the Dakota, and imprisoned 1,600 Dakota at a concentration camp at Fort Snelling (Zedeño and Basaldu 2004; MHS 2022).

Yankton Sioux Treaty of 1858

In 1858, the U.S. government signed a treaty with the Yankton Sioux Tribe (known as the Ihanktowan Oyate) in order to resolve their competing claims to lands ceded by the Sisseton. The Ihanktowan Oyate agreed to cede land if their ability to access and use the pipestone quarries was protected. This treaty allowed them unrestricted use of the Pipestone quarries.

In 1859, a 1-square-mile area around Winnewissa Falls was designated the Pipestone Indian Reservation to protect the tribe's interests in pipestone quarrying. Despite this designation, homesteaders attempted to settle on the land and trespassing and illegal settlement occurred. The Ihanktowan Oyate complained about the settlers taking their land, which led to the U.S government beginning to remove the homesteaders in 1887. The situation became more complicated when it was discovered that the Burlington, Cedar Rapids, and Northern Railway laid tracks through the Reservation and claimed title to the ROW (Zedeño and Basaldu 2004; NPS 2020).

In 1899, the U.S government convinced the Ihanktowan Oyate to sell their claim to the land while retaining access to the Pipestone quarries and a 40-acre tract of land. The U.S. Government agreed to retain and maintain the land as a national park or reservation land, land which became the Pipestone National Monument in 1937 (NPS 2020).

Pipestone Indian School

In 2022, the United States Department of the Interior (DOI) released an investigative report on American Indian boarding schools across the United States (DOI 2022). This report documented how, for about 150 years, the federal government removed American Indian children from their homes and placed them in boarding schools operated by the federal government and churches.

Indian boarding schools were established to assimilate American Indian youth into a modern U.S. society by separating them from their family, history, and culture, often without parental consent, and training them for futures in industry and farming, and not returning to their tribes.

Indian boarding schools emphasized vocational training and were run like military organizations and effectively destroyed many aspects of American Indian culture by removing youth from their homes, families, cultures, and communities, and suppressing Native languages and names. Assimilation methods included changing Indian names to English names, cutting hair, requiring the use of standard uniforms, and forbidding the use of Indian languages, cultural practices, and religious practices.

Boarding school rules to force this assimilation were often enforced through punishment. The care and conditions of the boarding schools were "grossly inadequate" and there are well-documented instances of abuse; disease; malnourishment; overcrowding; and lack of healthcare for the children. (DOI 2022; NPS 2020).

In 1893, the Bureau of Indian Affairs established the Pipestone Indian School, one of 21 boarding schools in Minnesota, in the northeast corner of the Pipestone Reservation (DOI 2022). The school grew from two buildings to a large complex of 63 buildings, including a hospital and staff housing. The school operated until 1953 when, due to changing government programs and funding, the Pipestone Indian School was closed (Emerson 2002; NPS 2020).

The land and buildings in which the reservation and school were situated are now part of USFWS lands, the Minnesota West Community and Technical College campus, and the Pipestone National Monument. The only extant building is the Superintendent's House, listed on the National Register of Historic Places in 1993, which is located on the Minnesota West Community and Technical College campus. Archaeological surveys conducted in the Refuge documented numerous historic artifacts in the area of the slope west of the school and noted that there is potential for the site to provide additional information about the Pipestone Indian School (Lashway and Bauermeister 2019; Ledezma et al. 2018).

The NPS believes that children who died at the Pipestone Indian School were buried between 1896 and 1904 in a cemetery within the current boundaries of the Monument; however, while a general location has been identified, the exact location is not known (Kuphal 2021).

Ethnohistory of Native Groups in the Project Vicinity after Contact

Numerous modern Native American groups cite what is now Minnesota as part of their traditional homeland. These include the Dakota, Cheyenne, Anishinaabe or Ojibwe, Arapahoe, Apache, Iowa, and Menominee tribes, among others. The Dakota, Yankton and Cheyenne were known to occupy southwestern Minnesota during the Contact period and their history is the focus of the following summaries.

The Dakota

The Dakota people are part of the Oceti Sakowin, or Seven Council Fires, commonly called the Sioux, or Great Sioux Nation. Dakota, Nakota, and Lakota comprise the three major divisions of the Oceti Sakowin. The Dakota include four of the Oceti Sakowin's seven council fires: the Bdewakantunwan, the Wahpetunwan, the Sisitunwan, and the Wahpekute. The Nakota, also known as the western Dakota, traveled west to present-day North and South Dakota. They include the Ihanktunwan and the Ihanktunwanna. The Lakota, made up the seventh council fire, and live further west in South Dakota and Montana. These seven groups are the Oyate or the People. The center of the Dakota homeland is Minnesota and many Dakota people believe they originated at the confluence of the Mississippi and Minnesota Rivers (Gibbon 2003).

Oral histories provide different narratives about how the Dakota arrived in Minnesota. One set of accounts has the Dakota landing on a peninsula on the east coast of North America and following a "Red Road" west to Minnesota. Another set of accounts places the ancestors of the Dakota somewhere very cold, from which they travelled southwest, first into Ojibwe territory around Lake Superior, and then into the upper Mississippi River valley. A third narrative group claims that Dakota ancestors resided in the general region for a long time, having emerged from the underworld through a cave, located somewhere in the Black Hills (Gibbon 2003:17–18).

Dakota groups were displaced from their ancestral homeland in the upper Midwest as a result of population and resource pressure from groups moving into the region in the seventeenth century. Fleeing attacks from the well-armed Iroquois, many eastern groups migrated west into the Great Lakes region, settling around Lake Michigan and Lake Superior, where they hunted and trapped to provide French traders with furs. The Ojibwe moved into Minnesota from the area around Lake Superior at this time as well, pushing the Dakota out of the heavily forested northeastern portion of Minnesota. Dakota groups moved into the southern portion of Minnesota in the early eighteenth century, along the Mississippi and Minnesota rivers and replaced wild rice harvesting with cultivation of maize as an economic mainstay. The Lakota and Yankton-Yanktonai, on the other hand, headed west across the Red River into the eastern Dakotas between 1700 and 1725. It is likely that they were familiar with the prairies of the eastern Dakotas from generations of hunting expeditions. They were attracted to the region not only because it offered bison for subsistence, but because of the prolific beaver population, which they could exploit to continue trade relations with the French. They hunted bison in the summer and trapped beaver during the winter. The western Sioux began acquiring horses, and by 1750 had adopted the lifestyle of Plains horsemen, hunting bison from horseback, moving from camp to camp in pursuit of the herds. The Lakota were very successful in this nomadic way of life and their numbers far outpaced the other Siouan groups (DeMallie 2001; Gibbon 2003:3–5; Hickerson 1970:71–75; Howard 1976:5; White 1978:321–323).

Yankton and Yantonai

Prior to the late fifteenth century, the Yankton and Yanktonai, or Western Dakota, lived together around Leech Lake in northern Minnesota. Subsequently, the Yankton moved to the prairie around the pipestone quarries in southwestern Minnesota, and in the early eighteenth century they moved to the lower James River valley in South Dakota. The Yankton and Yanktonai developed a nomadic existence on the Dakota plains and were less affected by Western diseases that wiped out large portions of the more agricultural tribes such as the Mandan, Hidatsa, and Arikara, who lived in densely populated villages. As a result, the Yankton-Yanktonai actually increased in numbers in the early nineteenth century. By the late eighteenth century, the Yanktonai, who occupied the area between the Missouri and Red rivers north to Devil's Lake, became less dependent on bison hunting

as the herds were depleted, but they still focused on trapping beaver for the fur trade. Some Yankton-Yanktonai adopted customs of their neighbors, the Mandan and Hidatsa who lived along the Missouri River, including earthlodge dwellings and styles of dress. The Yankton-Yanktonai served as middlemen in trade relations and as a communication link among Siouan groups to the east and west. Over time, as a result of their numeric strength and other advantages, the Lakota and Western Dakota Sioux gained control of the Missouri River nearly to the mouth of the Yellowstone River (DeMaillie 2001; White 1978:325–333; Wood et al. 2011).

Through the 1830s, the various Siouan tribes maintained friendly relations with the Americans—a marriage of convenience in which both parties benefitted in their efforts to control other tribes (White 1978:327). The Yankton ceded their Iowa lands, amounting to approximately 2.2 million acres, under treaties with the United States in 1830 and 1837. Eventually, however, the interests of the Sioux and the U.S. government came into conflict. The transcontinental Pacific Railroad was surveyed in 1853 through what was to become eastern Dakota Territory, and the advancing wave of American settlers pushing into western lands put intense pressure on Siouan groups, as well as other Native Americans in the region (McDermott et al. 2010). Armed conflict between the Sioux and the United States, known as the Sioux Wars, raged from 1850–1889. In 1858, over 11 million acres acquired by the U.S. through treaties, but a 430,000-acre reservation was retained near Fort Randall, South Dakota, as was the 650-acre Pipestone Reservation in Minnesota. Most of the tribe moved to the Yankton Reservation in South Dakota; others went to the Crow Creek and Lower Brûlé reservations in South Dakota and to the Fort Totten (now Devil's Lake) Reservation in North Dakota (Bureau of Reclamation 2012). In 1863, at Whitestone Hill in Dickey County, North Dakota, a major battle took place between the U.S. and the Sioux. There, Yanktonai, Dakota, Lakota, and Blackfeet were attacked by U.S. troops as punishment for the Dakota conflict in Minnesota the year before. The outcome was that approximately 100–300 Native American men, women, and children were killed, others were taken prisoner, and their camp and all of their possessions were destroyed, ensuring further misery and deaths among survivors in the coming winter (Bailey 2002).

After Red Cloud's War, the 1868 Treaty of Fort Laramie established reservations for several tribes in the region. At that time, most of the Yanktonai were assigned to the Standing Rock Reservation in North and South Dakota, but others went to the Devil's Lake Reservation (originally Fort Totten) in North Dakota, Crow Creek in South Dakota, or Fort Peck in Montana. The treaty also established a Great Sioux Reservation that was to include all of what is now South Dakota west of the Missouri River. The Sioux were to release all lands east of the Missouri, except for the Crow Creek, Yankton, and Lake Traverse (Sisseton) reservations. After the Battle of Little Bighorn in 1876, the Sioux not yet residing on the Great Reservation were forcibly relocated to it (Danzinger 1992).

Ultimately, the Dakota land holdings were diminished by the Dawes Allotment Act of 1887, which restricted families to parcels 160 acres or less, where they were expected to farm arid land. In concert with on-going efforts to dispossess indigenous groups of their land, the U.S. government pursued a policy of assimilation most vigorously in the 1870s and 1880s, implemented through Christian missionaries and Indian agencies. A major effort of assimilation involved promoting agriculture, which supported the government's goal of restricting the tribes to small parcels of land (Danzinger 1992; Galler 2002, Gibbon 2003).

The U.S. government also attempted to negotiate cession of the Black Hills. After Sioux refusal, Congress voted to take the land from the tribe in open violation of the Treaty of Fort Laramie. In 1889, the year of North Dakota's statehood, a federal commission broke up the Great Sioux Reservation, following passage of the Dawes Act two years earlier. Standing Rock was reduced to 2.5 million acres, individuals received allotments of land, and land not allocated to tribal members was seized by the federal government, with most of the best farmland taken away and opened to

homesteaders. Today, the Yanktonai mostly live on the North Dakota portion of the Standing Rock Reservation. The Yankton sold their Pipestone Reservation in 1929 for almost $330,000 plus guarantees of native access. Today, the Yankton Indian Reservation consists of 426,055 acres of land on the Missouri River at its confluence with the Choteau River (Brown 1970; Carrels 1999; Price 1996; United Tribes Technical College 2012).

The Cheyenne

Cheyenne oral history tells that the tribe once inhabited northeastern Canada, where they hunted game and gathered wild foods. They later moved into a marshy area between Ontario and Minnesota. At the time of first contact with Europeans around 1680, the Cheyenne were living at the mouth of the Wisconsin River, which joins the Mississippi River in southwestern Wisconsin. The name Cheyenne is derived from the Dakota word sha-hi'yela, meaning "Red Talkers" or "People of an alien speech." In the past, the Cheyenne referred to themselves as Tse-tsehese-staestse, meaning simply "People" (Campbell 2007:225; Mooney 1907:256–257). According to oral history maintained by the tribe, the Algonquin-speaking Cheyenne came to the Minnesota River valley in the seventeenth century from the Great Lakes, having been driven west by the Assiniboine and Chippewa. By 1700, a band had moved into the Sheyenne River valley in eastern North Dakota, where they lived in earthlodge villages and farmed corn, beans, and squash, much as other tribes of the Missouri River area like the Mandan, Hidatsa, and Arikara (Native American Net Roots 2011). The Cheyenne claimed territory in the easternmost Dakotas for a brief period in the eighteenth century before displacement by the Sioux (Secoy 1992 [1953]:71). The eighteenth-century Cheyenne occupation in eastern North Dakota is reflected in the Biesterfeldt archaeological site, located along the Sheyenne River (Wood 1971).

The Cheyenne continued to be pushed westward in the eighteenth century by the Plains Ojibwa, Plains Cree, and Assiniboine until they settled in the Black Hills area of western South Dakota. They mastered horseback riding and buffalo hunting, allying with the Arapaho, who had also occupied Minnesota before early European contact (Native American Net Roots 2011).

The Cheyenne had been wild rice harvesters and horticulturalists who also seasonally hunted bison on the prairies of North Dakota to the west of their Minnesota villages. On the Plains, the Cheyenne adopted a nomadic lifestyle centered on bison hunting. An alliance with the Arapaho allowed the Cheyenne to expand their territory from southern Montana, through most of Wyoming, the eastern half of Colorado, far western Nebraska, and far western Kansas (Ambler et al. 2008:53; Bruner 1961; Campbell 2007:226–227; Grinnell 1972:4–13; Moore et al. 2001:863).

With the 1833 construction of Bent's Fort, a trading post catering to the Cheyenne and Arapaho in southeastern Colorado, a large portion of the tribe moved farther south and stayed around that area. They became known as the Southern Cheyenne. The remaining portion of the tribe stayed in the north in a territory centered on the headwaters of the North Platte and Yellowstone rivers; they became known as the Northern Cheyenne. Despite geographical separation, the two divisions within the tribe remained in close communication over time (Berthrong 1963). The Northern Cheyenne were allied with the Lakota and Northern Arapaho against the U.S. government in Red Cloud's War in 1866–1868, a conflict over the opening of the Bozeman Trail, which ushered in new white settlement in the Powder River region. Following the war, the 1868 Treaty of Fort Laramie established reservations for several tribes in the region. The Cheyenne also were part of the allied Native American force who, along with the Lakota, other Sioux, and Arapaho, defeated General George Armstrong Custer and the 7th Calvary at the Battle of Little Bighorn. Despite their success at the Battle of Little Bighorn, the Cheyenne and their allies did not ultimately prevail in the Black Hills War of 1876–1877. In its wake,

the Northern Cheyenne were removed to Indian Territory (modern-day Oklahoma) and confined to reservation lands with the Southern Cheyenne.

Faced with an entirely new environment, given few rations, contending with malaria and other diseases, and forced to pursue a new way of life, some members of the tribe escaped and migrated back to Montana. After another attempt to force the group to return to Indian Territory, President Chester Arthur established the Tongue River Indian Reservation for them in 1884. Today, it is known as the Northern Cheyenne Indian Reservation and occupies approximately 444,000 acres in southeastern Montana, and northwestern South Dakota. Much of the Oklahoma reservation of the Southern Cheyenne was taken from them in 1890 and redistributed to white homesteaders under the provisions of the Dawes Act, with small parcels allocated to individual members of the tribes, totaling approximately 529,962 acres (Ambler et al. 2008; Berthrong 1992; Brown 1970; Glenn 2003; Moore 1996; Price 1996).

Although the Cheyenne left the Minnesota River valley in the eighteenth century and adopted a new way of life on the prairie, the tribe considers the region its ancestral home. Cultural properties within the area once occupied by the Cheyenne contribute to the tribe's identity and maintain its presence there (Limpy 2016).

Pipestone National Monument

Discussion of turning the area that is now the Monument into a park (local, state, or national) had been underway since the late 1800s (Scott et al. 2006:12–15). The Monument, located south and east of the Project area, was established in 1937 and expanded in 1956 to protect pipestone quarries and the native tallgrass prairie ecosystem (NPS 2017) (Figure 1).

Pipestone Creek flows through the Monument from the east, drops over the escarpment at Winnewissa Falls, and then flows northwest. As noted above, the falls may not be in their historical location. In an effort to reduce flooding of agricultural fields managed by the school, the section of Pipestone Creek between the railroad tracks and the escarpment was straightened and lowered in 1910 (Scott et al. 2006:12). According to the 1972 General Land Office (GLO) survey map, the creek meandered southeast to northwest in the southeast quarter of Section 1 at that time (Neely et al. 1872). The 1898 plat map also shows a meandering stream in this area, although flowing north and then making a right-angled bend to the west (Northwest Publishing Company 1898). The creek in this area had been straightened into its current channel by 1938 (Agricultural Stabilization and Conservation Service 1938a). The location of Winnewissa Falls on the 1872 GLO map appears to be nearly identical to that on the modern United States Geological Survey (USGS) topographic map, so the relocation of the falls may have been minor.

A railroad line once ran along the eastern edge of the band of outcropping quartzite, passing through the east side of what is now the Monument. The tracks were constructed in 1884 by the Burlington, Cedar Rapids, and North Railway, who had to pay compensation to the Yanktons for illegally laying the tracks through the reservation (Scott et al. 2006:11–12). This line was later operated by the Rock Island and Pacific Railway and then abandoned and the tracks removed. The tracks appear on the 1967 USGS topographic map but have been removed and no longer connect to the city of Pipestone by the time of a 1984 aerial photograph (Nationwide Environmental Title Research 2023; USGS 1967). At present, this former rail grade is largely invisible at ground level. Route Alternative 2 crosses the former rail grade near the intersection of 131st Street and 70th Avenue.

The Pipestone Quarry

Many American Indian tribes' perspective is that cultural resources have evolved in concert with natural resources and that no distinction is present between what is considered a cultural resource and a natural resource (Stults et al. 2016). Therefore, a natural resource is also one of cultural and spiritual value. Based on the sovereign, inherent right to self-determination, tribes collectively oversee sacred responsibilities to the land, waters, and people.

"Pipestone" is a generic term for soft (e.g., can be carved), fine-grained, sedimentary and metamorphic rocks such as the catlinite quarried at the Monument. As noted above, there are multiple sources of pipestone on the continent, although they are mineralogically distinct. Pipestone is considered a sacred resource wherever it occurs and is recognized as the blood of many Dakota tribes. The catlinite quarries in the Monument remain a pilgrimage location and a site of sacred importance for many American Indians. Tribal members quarry catlinite and carve it into objects, including pipes for ceremonial uses and sacred rituals such as individual and group pipe ceremonies, prayer and tobacco offerings, sweat lodges, sun dances, and vision quests.

The Monument is significant for its history of American Indian and European American contact and exploration in the early 1800s, specific quarrying rights, and the Pipestone Indian School (1893 to 1953). The Monument is considered sacred by many tribes because of the pipestone as well as the native prairie plants and animals, ceremonial uses of the landscape, and ancestral connections. Many tribes consider the area around the Monument to be part of the same sacred landscape.

Pipestone is used to carve ceremonial pipes and other objects. The current quarries pursuing beds of catlinite pipestone in the Monument are west of the Sioux Quartzite escarpment. The archaeological record from the Monument indicates human presence since at least the Late Archaic tradition, as projectile points similar to Late Archaic types have been recovered (Scott et al. 2006:214). Great Oasis, Middle Missouri tradition, and Oneota occupations are known archaeologically from the Monument (Sanders 2014:43).

The petroglyphs at the Monument are thought to date to between 200 B.C. and A.D. 1750 based on imagery depicted (Sanders 2014:6; Scott et al. 2006:281). At the Jeffers Petroglyphs site in south-central Minnesota, imagery includes atlatls and tanged copper projectile points indicates those glyphs were created during the Archaic tradition. This imagery is lacking from petroglyphs at the Monument, suggesting the petroglyphs at Pipestone were not created during the Archaic. The petroglyphs at the Monument also lack post-Contact imagery such as horses.

The quarries at the Monument appear to have been used since at least the Initial Woodland Tradition (beginning ca. 200 B.C.) but may not have been used continuously over that time (Graham 2017:13; Sanders 2014:43; Scott et al. 2006:9). Some quarrying may have occurred earlier, as catlinite has been found elsewhere in Early Woodland contexts (Sanders 2014:43).

The distinct mineralogy of catlinite and other pipestones had made it possible to determine whether pipestone artifacts found archeologically come from nearby sources of material or were the result of long-distance trade. For example, pipes made of catlinite have been found in Ohio (e.g., Emerson et al 2005) and catlinite artifacts are known from Alabama, northern Manitoba, and Oklahoma (Sanders 2014:43).

Previously Reported Archaeological and Burial Sites

Preferred Route and Route Alternative 2 Previously Reported Sites

No previously reported archaeological or burial sites overlap the survey corridor for the Preferred Route or Route Alternative 2 (Figure 1). Three archaeological sites are reported within 1 mi (1.6 km) of these routes : sites 21PP0002, 21PP0048, and 21PP0051. The following information was obtained from the OSA Portal.

Site 21PP0002 (Pipestone National Monument)

Site 21PP0002 comprises Pipestone National Monument itself. This site encompasses multiple quarrying pits, artifact scatters, former mounds, petroglyphs, and other features. The defined site boundary does not extend west or north of 121st Street (Figure 1), although the areas beyond—including in the survey corridor for the Preferred Route or Route Alternative 2—have not been fully systematically surveyed for cultural materials or features. As a result, the site may extend outside of its current boundary and other as-yet unreported archaeological sites may be present nearby.

Site 21PP0048

Site 21PP0048 is a scatter of four catlinite artifacts. Three of these artifacts appear to have been worked with metal tools, thus dating to 1829 or later. The site was identified during archaeological survey in 2016 and is located east of Hiawatha Avenue and west of Highway 75 (Figure 1).

Site 21PP0051

Site 21PP0051 is a scatter of post-Contact artifacts on the south side of 121st St west of Hiawatha Avenue (Figure 1). It is west of the Minnesota West Community and Technical College campus, on the west side of the former railroad grade, atop the quartzite shelf. Artifacts were documented in this location in 2014, the scatter having been noticed some time earlier. Shovel testing and pedestrian survey following a controlled burn yielded dozens of post-Contact artifacts, including some dating to the time when the period of 1893–1953 when the Pipestone Indian Boarding School was operating. Site 21PP0051 was recommended eligible for the NRHP, as it could provide information on life at the boarding school.

Marked Cemeteries and Burial Leads

Minnesota Statutes (MS) 307.08 governs the treatment of human burials found outside of recorded cemeteries that were interred over 50 years ago, as well as unmarked human burials found within recorded cemeteries. The Minnesota State Archaeologist and the Minnesota Indian Affairs Council have roles in assessing non-American Indian and American Indian cemeteries. The Minnesota State Archaeologist is required to maintain a recordation system for known and suspected cemeteries. A study was completed to develop a database of unrecorded historic cemeteries through a combination of desktop research of maps, religious and local government records, photographs, and various reports. This research was supplemented with select field visits. The cemetery study identified 5,876 cemeteries or burials in Minnesota, but also found that cemetery locations or coordinates were not always accurate and often encompass large areas because they have not been field verified (Vermeer and Terrell 2011). Nevertheless, these leads are included in the OSA Portal to highlight areas that may warrant further investigation during project planning.

Two known cemeteries are located near but are not crossed by the Preferred Route and Route Alternative 2: St. Leo Catholic Cemetery and Woodlawn Cemetery (includes both Old and New Woodlawn Cemetery) (Figure 1). St. Leo Cemetery is at the far end of 116th Street on the south and north side of 116th Street, while the Woodlawn cemetery on the north side of 116th Street west of 70th Avenue. The Preferred Route passes between these cemeteries, while Route Alternative 2 is located on the west side of St. Leo Cemetery. These two cemeteries are well marked and there is a fence along the west side of St. Leo Cemetery. The cemetery boundaries are depicted on Figure 1.

Burial leads are also recorded for these cemeteries, covering a much larger area than the cemeteries themselves and do not offer additional information about these cemeteries.

A large burial site lead for the "O. Smith Burial – Pope and Fee Cemetery 8 Feb 1895 – Family Burial Plot" is located southeast of the project area (Figure 1). This site lead covers the entirety of Town 106 North, Range, 45 West—a 36 mi^2 area. This burial site lead has not been field verified to date and it is uncertain if there is a more specific location where a human burial is likely. No cemeteries are indicated in the O. Smith Burial site lead area on the 1898 or 1914 plat maps (Northwest Publishing Company 1898; Webb Publishing Company 1914) or the 1967 USGS topographic map (USGS 1967) and none are discernable on recent aerial imagery.

Route Alternatives 1 and 3

Route Alternatives 1 and 3 do not overlap any reported archaeological sites. The 1967 USGS topographic map indicates a "grave" at a farmstead on the north side of 61st Street between 30th and 40th avenues (USGS 1967). This is in the southeast quarter of Section 32, Town 106 North, Range, 46 West, Sweet Township (Figure 2). The Route Alternative 3 alignment crosses through this general location.

A burial site lead is not recorded on the OSA Portal at this location and no cemetery is shown here on the historic plat maps consulted (Northwest Publishing Company 1898; Webb Publishing Company 1914). A cemetery is not visible on aerial imagery at the farmstead or in adjacent fields, but it is likely a small family plot that would not be visible in any areas with tree cover. This location will have to be field checked if Route Alternative 3 is selected by the Commission.

Route Alternative 3 also crosses through the site lead for the O. Smith Burial, but as stated above, the lead encompasses an extensive area and Alternative 3 does not overlap a known burial site within the site lead area (Figure 2).

MnModel Probability

To assess whether Route Alternatives 1 and 3 could impact significant archaeological resources, Chronicle reviewed MnModel, a GIS-based archaeological predictive model developed by the Minnesota Department of Transportation. The model integrates known archaeological site locations that pre-date 1837 several environmental attributes through statistical correlation to delineate areas of high archaeological potential and also identify areas with low survey coverage where archaeological efforts should be concentrated (Minnesota Department of Transportation (2019). The following four site probability categories are used in the Phase 4 Survey Implementation Model (2019):

- High Site Potential/Well Surveyed. There is a high degree of confidence in these areas as a result of good survey coverage and site identifications.

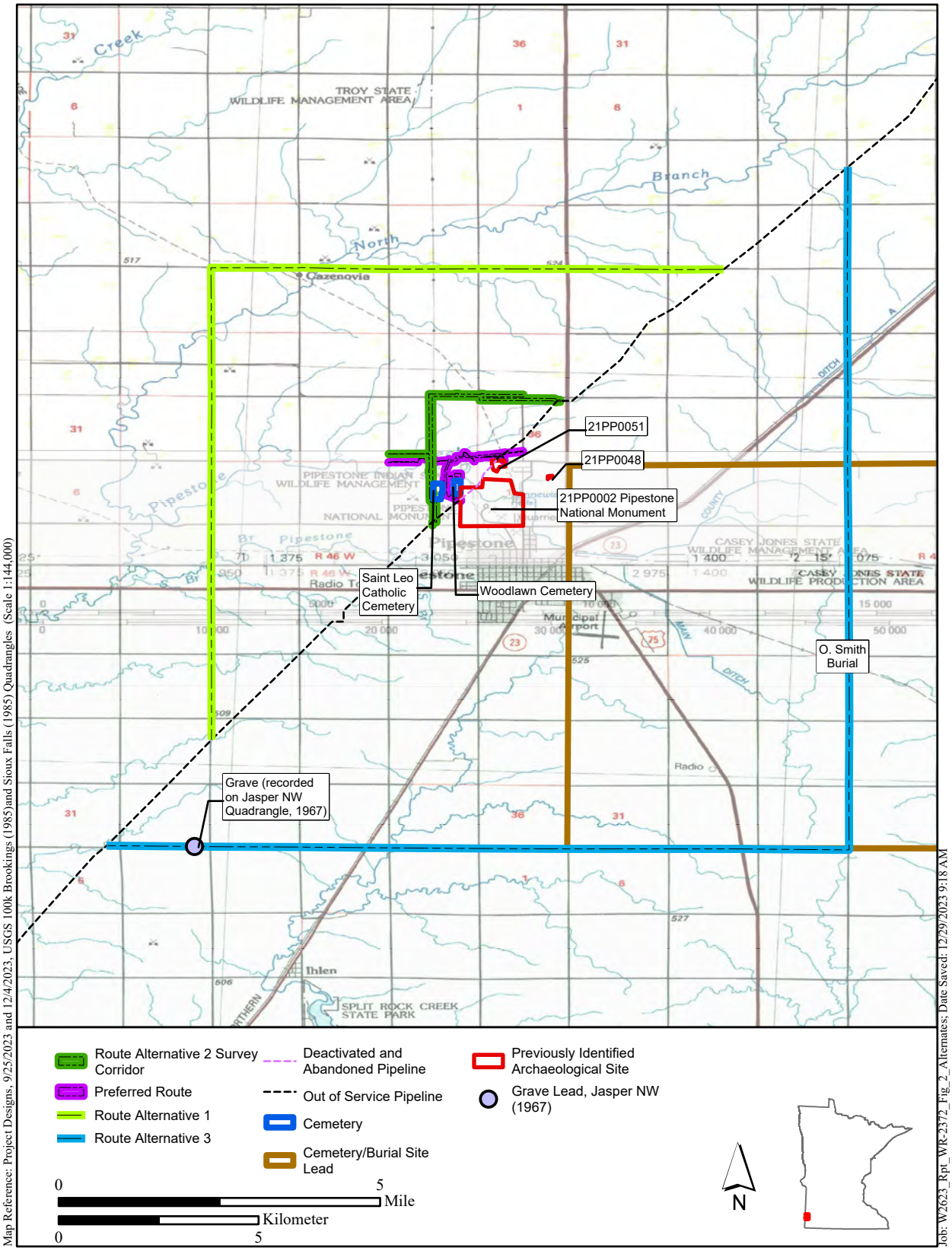

Figure 2. Route Alternates 1 and 3 Relative to Previously Identified Archaeological Resources

- High Site Potential/Poorly Surveyed. There is less certainty about site potential in these environments because they have not been as well surveyed.
- Low Site Potential/Well Surveyed. Includes types of environments that have been well surveyed, but sites are less likely to be found.
- Unknown Site Potential/Poorly Surveyed. In areas classified as unknown, due to low survey coverage and unknown site potential.

The archaeological potential of most of Route Alternatives 1 and 3 is unknown due to lack of survey coverage (Figure 3). According to MnModel, the centerline of Route Alternative 1 does not cross through any areas of low or high potential for near-surface archaeological sites (Table 1). The centerline of Route Alternative 3 crosses small, noncontiguous areas of low probability but does not pass through any areas of high probability (Table 1). Were a corridor to be drawn around these centerlines, it is possible either corridor would slightly overlap areas of high site potential (poorly surveyed)(Figure 3).

Table 1. Total Miles of MnModel Site Potential, Route Alternatives 1 and 3[a]

Route Alternative	Unknown Site Potential/Poorly Surveyed (miles)	Low Site Potential/Well Surveyed (miles)	High Site Potential/Poorly Surveyed (miles)	High Site Potential/Well Surveyed (miles)
1	13.07	0	0	0
3	18.82	0.11	0	0

[a] Chronicle estimated the mileage presented in this table based on publicly available data.

Route Alternatives 1 and 3 largely cross agricultural fields adjacent to roads, similar to the Route Alternative 2 alignment. Based on the results of this review, very little of routes likely hold high potential for near-surface archaeological site identification.

4. Archaeological Survey Methods

The objective of the archaeological survey was to gather data relevant to the nature and integrity of archaeological deposits within the archaeological survey corridor and assess the Project's potential effect on any identified archaeological resources. The 2023 Phase I survey consisted of pedestrian survey, shovel testing, and visual inspection of locations disturbed by buried utilities and road construction. Survey was conducted by a four-person crew.

The survey corridor was identified in the field through use of Project plans, project workspace, and survey corridor uploaded onto a global positioning system (GPS) unit to assist the field crew in accurately delineating the survey area. GPS data was collected using the ESRI Collector app on a Samsung, Galaxy Tab A, SM-T290, tablet running Android version 9 (Lollipop). Notes regarding date of survey, surface visibility, presence of utilities and other ground disturbance, survey coverage, shovel test locations, and results of the survey were recorded on the tablet and in daily field notes.

Pedestrian Survey

During survey, ground surface visibility was varied between 0 and 90 percent. Systematic pedestrian reconnaissance was conducted in cultivated fields with at least 25 percent ground surface visibility at 5-meter (m) (16-ft) intervals. Visibility in pedestrian survey areas ranged from 40 to 90 percent, with 60 to 70 percent being typical.

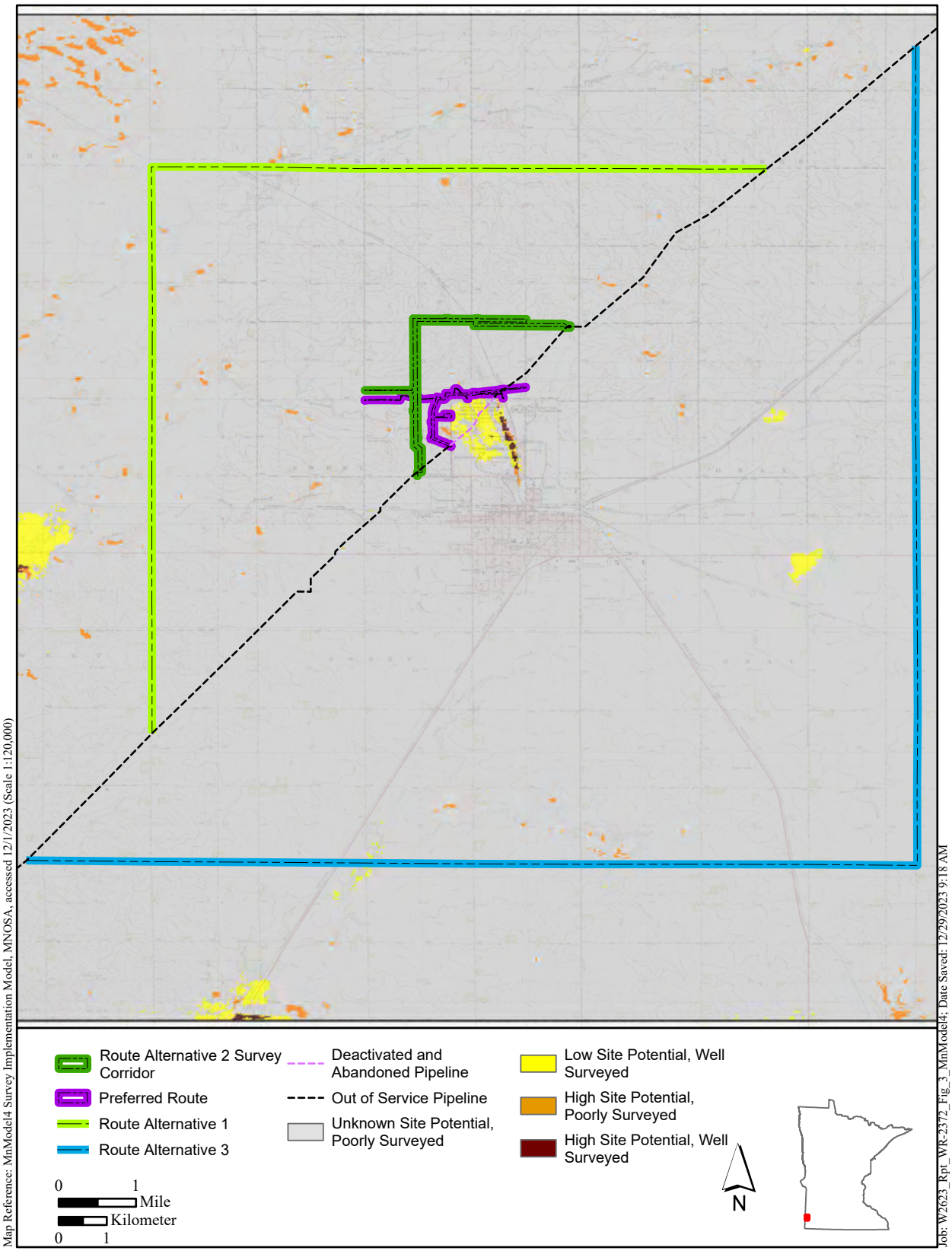

Figure 3. Archaeological Site Potential Relative to Project Area

Shovel Testing

Areas with less than 25 percent ground surface visibility were shovel tested at 15-m (49-ft) intervals. At the time of survey, this low visibility occurred either in pasture or in harvested fields covered with a thick mat of downed corn stalks. Shovel testing was not conducted on areas that were excessively sloped (greater than 15 degrees), wetland or inundated, paved, visibly disturbed, within 7.5 m (25 ft) of buried pipelines, or within 1.5 m (5 ft) of other buried utilities. Prior to survey, requests for utility locates were made through Gopher State One Call accordance with Minnesota Statutes Chapter 216D. Shovel testing was only conducted in areas with valid utility locate tickets.

Each shovel test measured at least 35 cm × 35 cm (14 in × 14 in) in diameter, and all were excavated to at least 10 cm (4 in) below the transition to the subsoil. The excavated matrix was screened through ¼- in mesh hardware screen and checked for soil changes or the presence of cultural material. Shovel tests were numbered, their locations recorded as points using ESRI Collector on the tablet, and all observations recorded in field notes and on shovel test forms. Observations include the depth, texture, and Munsell color of encountered soils. The soil profile was recorded on standard forms. The presence/absence of cultural materials in the screened matrix was also recorded. Once documentation was completed, each shovel test was immediately backfilled.

Deep Auger Testing

The alluvial soil along Pipestone Creek may have a deeply buried surface horizon that could harbor cultural materials below what is reachable by conventional shovel testing. Chronicle did not survey this portion of the survey corridor because landowner permission had not been granted. Chronicle anticipates surveying the cumulic alluvial soils in this area via deep auger testing at 15-m intervals. No deep auger testing was conducted during the October 2023 survey. Additionally, Pipestone Creek will be crossed using the HDD method. Additionally, Pipestone Creek will be crossed using the HDD method.

Site Delineation

No pre-Contact or significant post-Contact artifacts or features were identified on the surface, and thus no collection or site delineation methods were employed during pedestrian survey.

When cultural material was encountered in a shovel test, the test was bracketed with radial shovel tests excavated at 5m (16 ft) out in the cardinal directions. One shovel test was positive for one lithic artifact on the south side of 131st Street. No positive shovel tests were located close enough to the edge of the survey corridor or to buried pipelines, roads, or other obstructions that would constrict radial shovel testing. No radial shovel tests were positive for cultural material.

Survey Records

Field notes, forms, digital records, and photographs are currently maintained at the Commonwealth facility in Milwaukee, Wisconsin.

5. Survey Narrative and Results

The 2023 Phase I survey was limited to those privately-owned portions of the Route Alternative 2 survey corridor where landowner permission had been granted (Figure 4). No survey was conducted on public lands (i.e., road rights-of-way) nor along the Preferred Route. Survey areas discussed in this report are numbered on Figure 4.

Field Conditions and Ground Surface Visibility

As discussed above, the Route Alternative 2 survey corridor extends north from near 111th Street to the north side of 131st Street, then east to tie into the existing pipeline. Field conditions included standing corn, harvested corn, harvested soybeans, and pasture. Some harvested fields had been turned over after harvest and prior to survey and some had not.

The southern end of the north-south segment is in a cultivated field south of St. Leo Cemetery and a pasture west of the cemetery (Figure 5a). The field north of 111th Street (and south of St. Leo Cemetery) had been most recently planted in corn and was harvested and turned over before survey.

North of the pasture, the survey corridor crosses through parcels where landowner permission had not been granted for survey in 2023 (Figure 5a–e). Survey could not pick up again until north of 131st Street. The portion of the east-west segment of the survey corridor north of 131st Street consists of cultivated fields bisected by the quartzite shelf—the band of outcropping quartzite—which is used for cattle pasture (Figure 5e–f). West of the pasture were harvested soy and standing corn fields, while east of the pasture was a field of standing corn on the west side of 70th Avenue. East of 70th Avenue was a harvested soybean field.

Route Alternative 2 survey corridor extends along the north and south sites of 131st Street east of 70th Avenue (Figure 5f-h). This part of the east-west segment is in cultivated fields but crosses through a farmstead on either side of the road west of 75th Avenue.

South of 131st Street was a harvested corn field that initially did not have enough visibility for pedestrian survey, but over the course of the 2023 survey the field was turned over, allowing for pedestrian surface reconnaissance. This portion of the survey corridor also slightly overlaps another area of pasture on the quartzite shelf (Figure 5f). At the farmstead, the survey corridor consists of a lawn with trees, driveways, and various farmstead buildings. East of the farmstead, the fields on both sides of 75th Avenue were harvested corn fields with little to no ground surface visibility, as the flattened corn stalks covered the ground (Figures 5g–h).

North of 131st Street, the harvested soybean field on the east side of 70th Avenue extended east to the farmstead on the north side of the road (Figure 5f–g). During the 2023 field effort, the farmstead and cultivated field on the east side of the farmstead were determined to have insufficient ground surface visibility for pedestrian survey. A utility locate had not been planned for the farmstead or this field, therefore, no shovel testing was conducted in these areas. Archaeological and architectural/history survey of the farmstead will be completed in 2024.

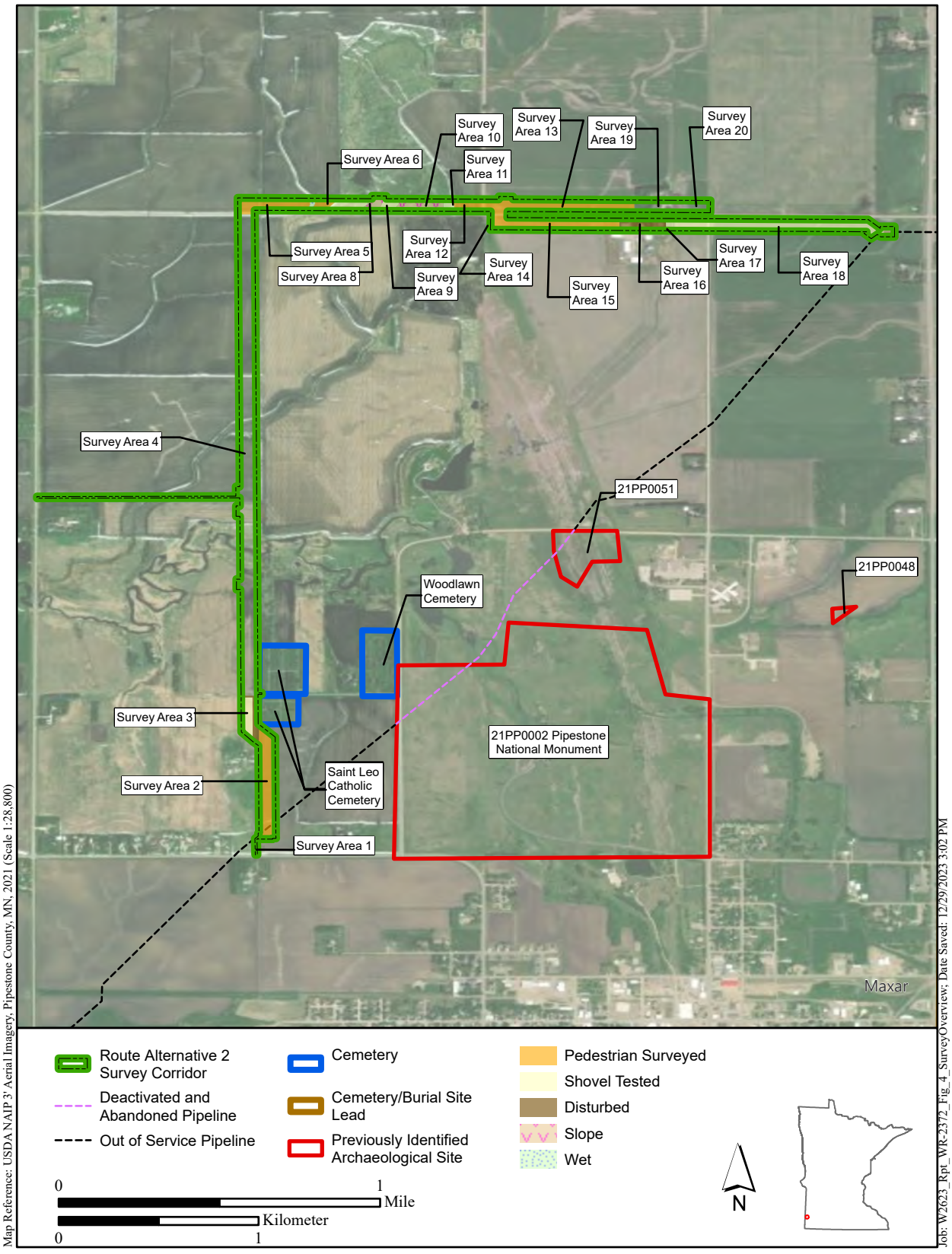

Figure 4. Survey Coverage Overview

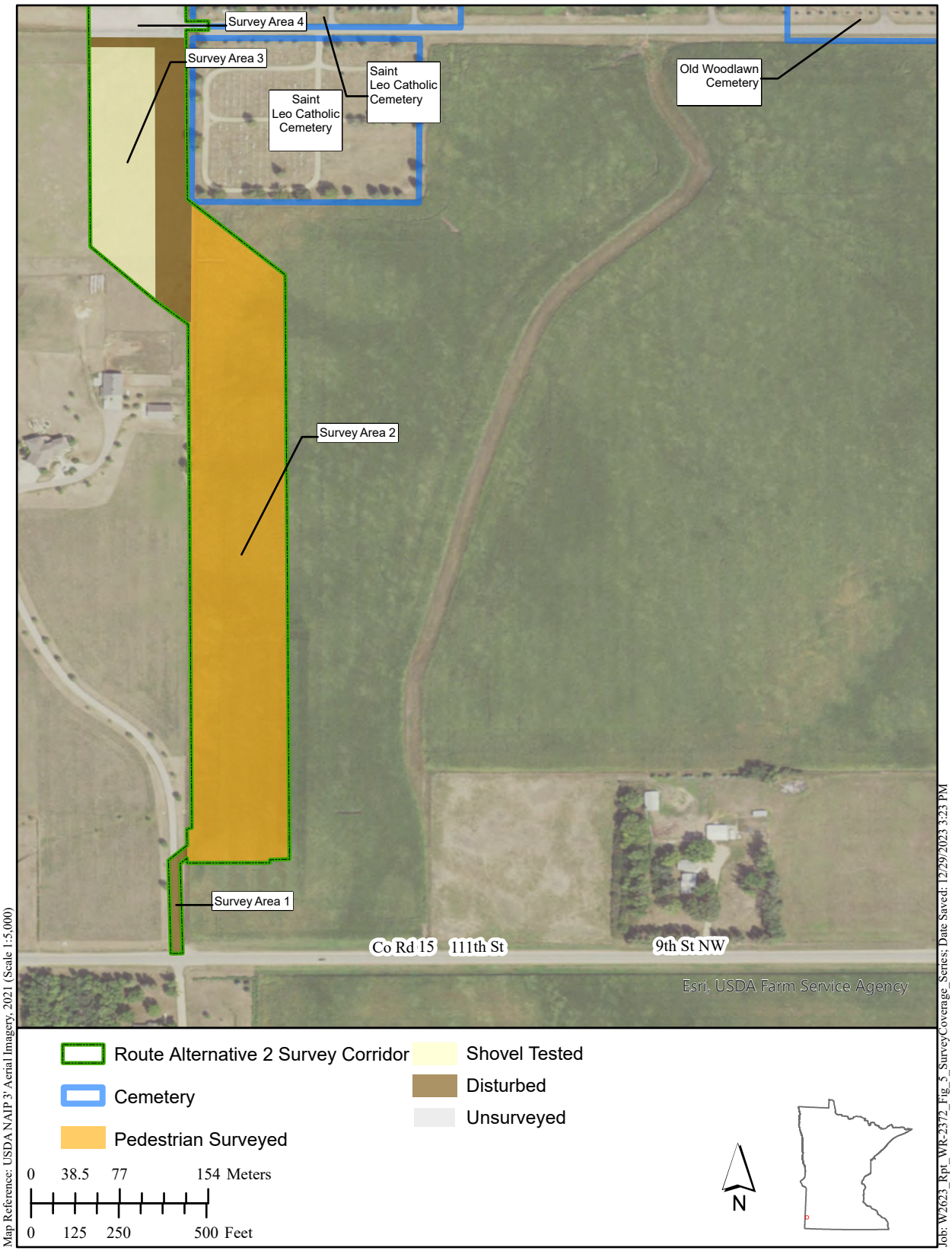

Figure 5a. Survey Coverage

Magellan Pipeline Project
Pipestone County, Minnesota

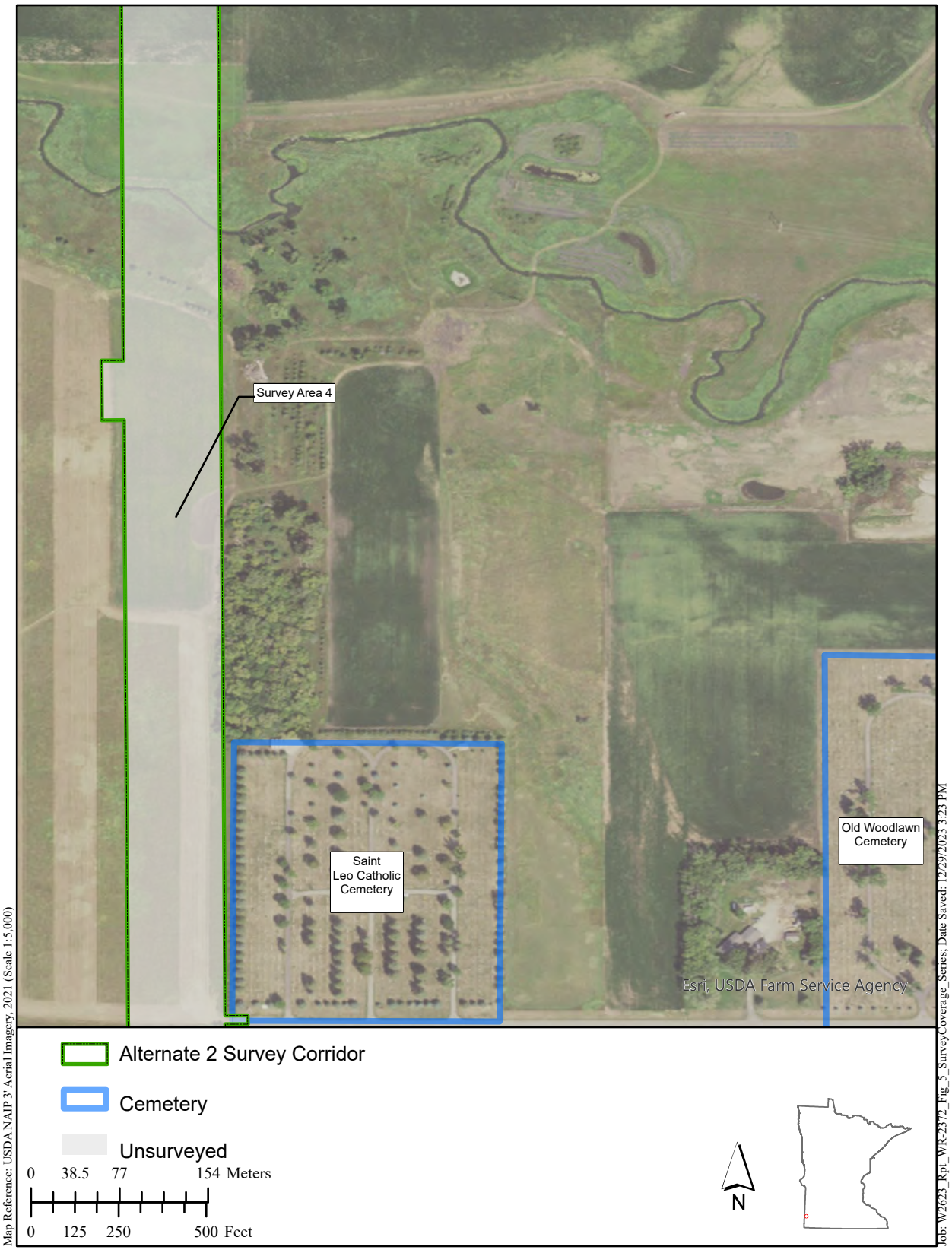

Figure 5b. Survey Coverage

Magellan Pipeline Project
Pipestone County, Minnesota

Figure 5c. Survey Coverage

Magellan Pipeline Project
Pipestone County, Minnesota

Figure 5d. Survey Coverage

Magellan Pipeline Project
Pipestone County, Minnesota

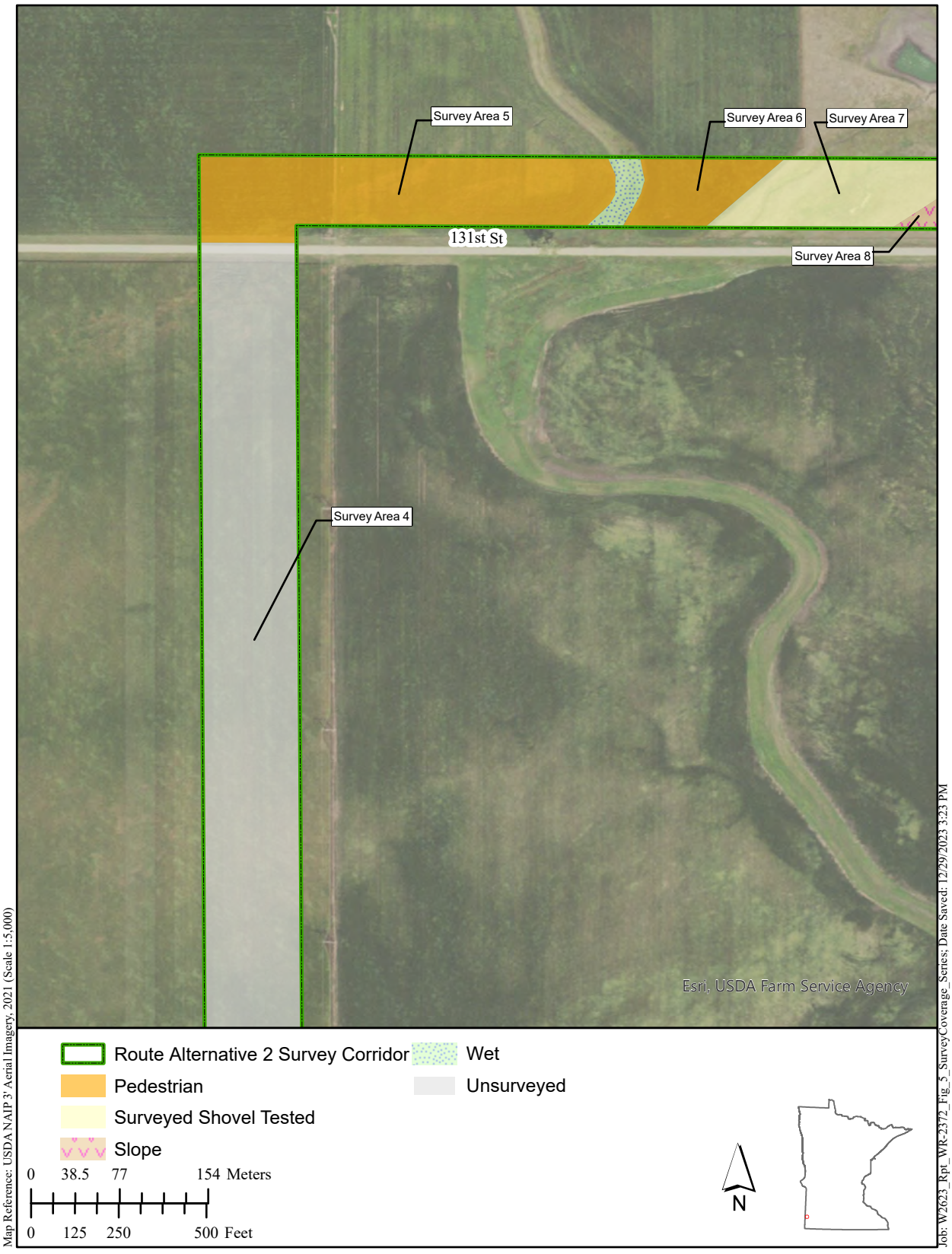

Figure 5e. Survey Coverage

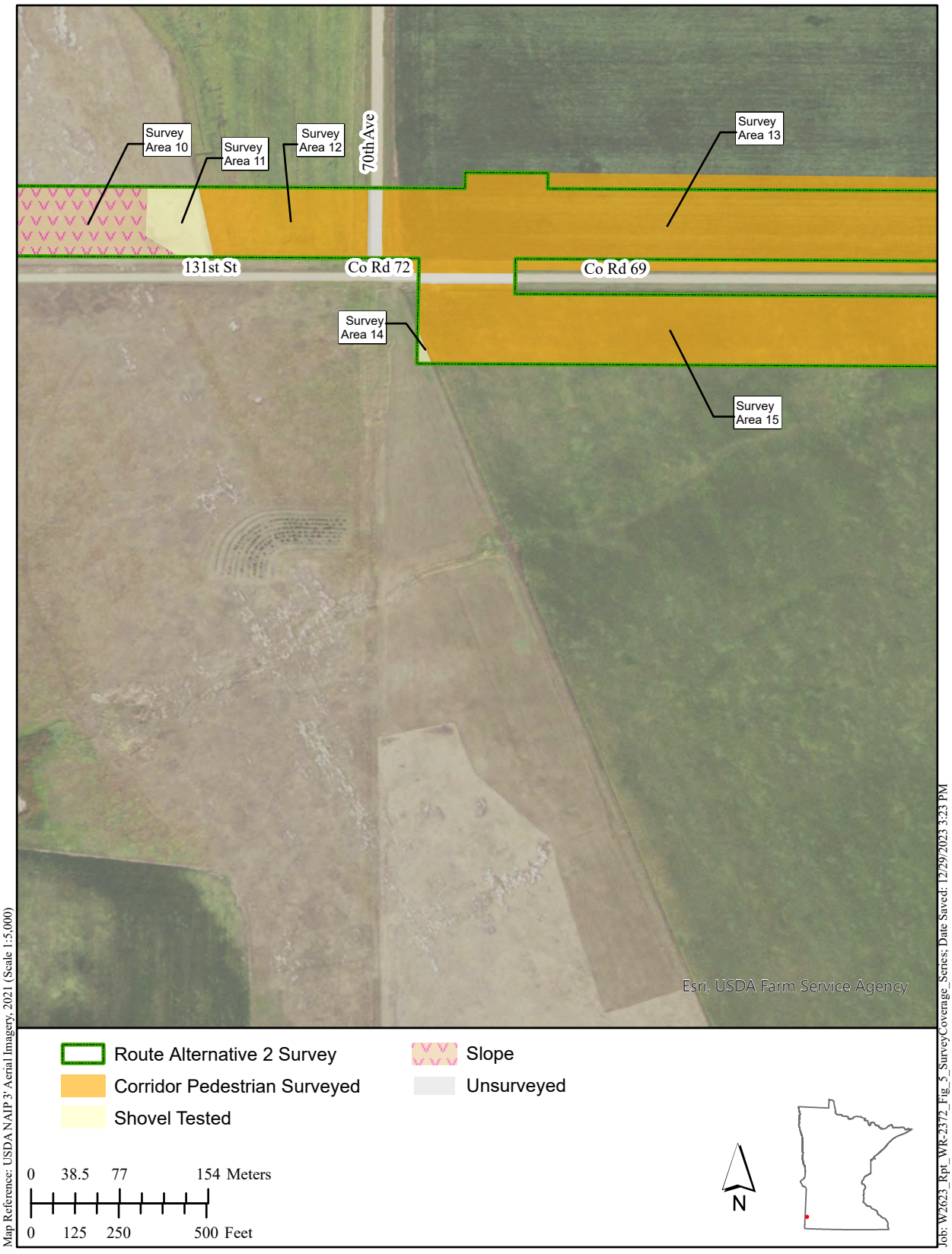

Figure 5f. Survey Coverage

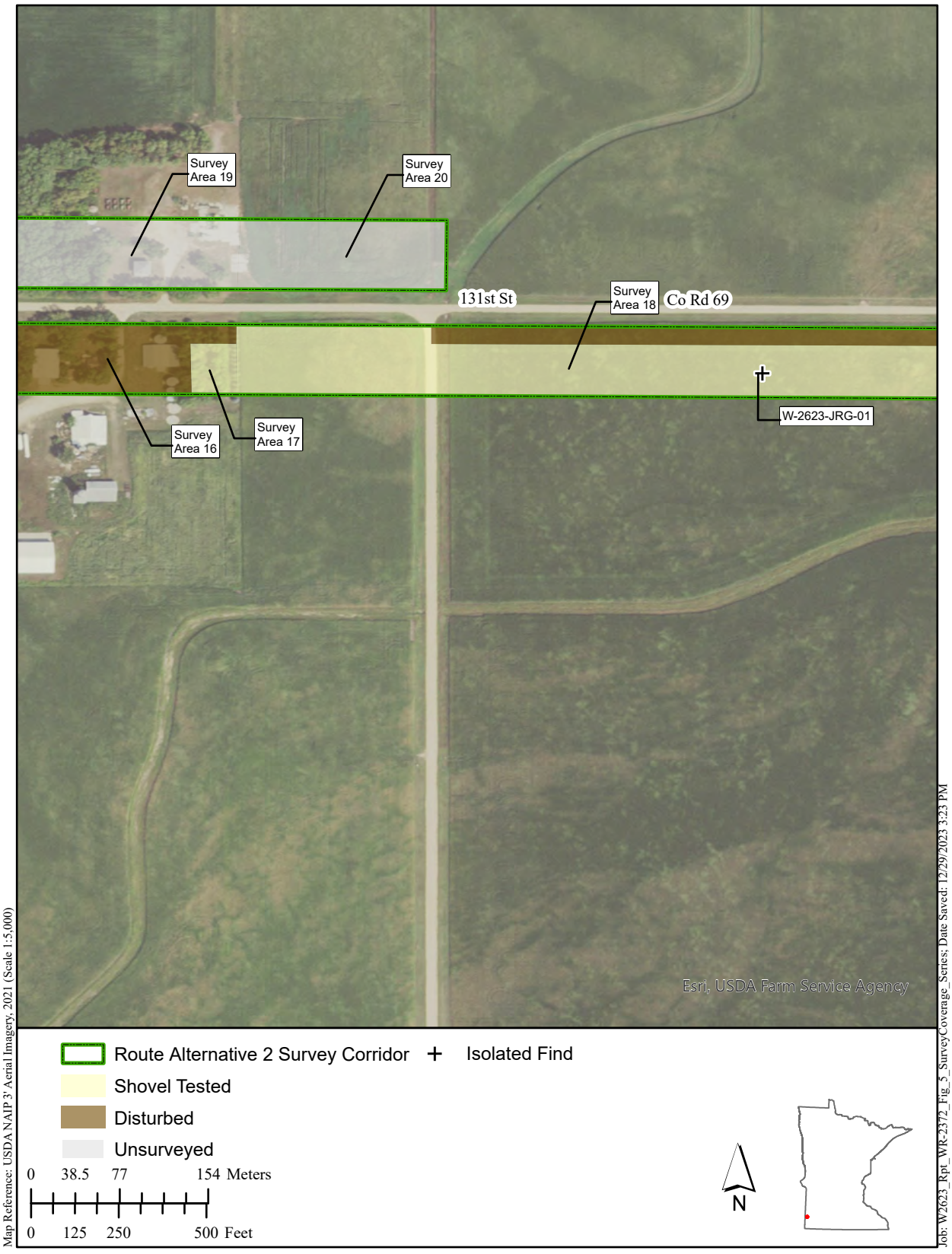

Figure 5g. Survey Coverage

Magellan Pipeline Project
Pipestone County, Minnesota

Figure 5h. Survey Coverage

Phase I Survey

Pedestrian Survey

Pedestrian survey was conducted where ground surface visibility was sufficient (at least 25 percent). Pedestrian survey predominantly occurred in the harvested fields to either side of 131st Street and on the north side of 111th Street. Visibility in pedestrian survey areas ranged from 40 to 90 percent, with 60–70 percent being typical.

Field conditions included standing corn, harvested corn, and harvested soybeans. Some harvested fields had been turned over after harvest and prior to survey and some had not. The field north of 111th Street (and south of St. Leo Cemetery) (Survey Area 2) had been last planted in corn and was harvested and turned over before survey (Figure 6). North of 131st Street, a harvested soy field and a standing corn field lay west of the quartzite shelf (Survey Areas 5 and 6) (Figure 7), while a field of standing corn was located immediately to the east, between the pasture and 70th Avenue (Survey Area 12) (Figure 8. East of 70th Avenue was a harvested soy field, extending to the farmstead on the north side of the road (Survey Area 13) (Figure 9). South of 131st Street was a harvested corn field that initially did not have enough visibility for pedestrian survey, but over the course of the 2023 survey the field was turned over, allowing for pedestrian surface reconnaissance (Survey Area 15) (Figure 10).

Figure 6. Survey Area 2, Harvested Field North of 111th Street, View North.

Figure 7. Survey Area 5, Harvested Field North of 131st Street, View East.

No archaeological materials or features were encountered during pedestrian survey. Some cobbles of quartzite were observed in the fields along 131st Street nearest the quartzite shelf, such as the field of standing corn on the west side of 70th Avenue (Survey Area 12).

Shovel Testing

East of the farmstead on the south side of 131st Street, the fields were harvested corn fields with little to no ground surface visibility, as the flattened corn stalks covered the ground (Survey Area 18). While the other cultivated fields surveyed in 2023 were covered by pedestrian survey, this area was shovel tested instead. The other areas of shovel testing were pasture on either side of 131st Street and on the west side of St. Leo Cemetery (Survey Areas 3, 7, 9, 11, and 14), and an area of tall grass and trees on the east side of the farmstead south of 131st Street (Survey Area 17).

Survey Area 3: South Pasture (West of St. Leo Cemetery)

Shovel testing in the pasture west of St. Leo Cemetery revealed disturbed soils in all but three of the 30 shovel tests excavated in this area. The eastern third and northern edge of this area had buried electrical lines and were not shovel tested (Figures 11–12). A typical disturbed soil consisted of light yellowish brown (2.5 6/4) clay mottled with olive brown (2.5Y 4/3). Intact soils, which were found only at the southern end of the pasture, had a dark grayish brown (10YR 4/2) A horizon to 30 cm below the surface (cmbs) over a B horizon of light yellowish brown (2.5 6/4) clay. All shovel tests west of St. Leo Cemetery were negative for cultural materials or features.

Survey Areas 7, 9, and 11: North Pasture (Quartzite Shelf)

Shovel testing was conducted in the pasture that overlaps the quartzite shelf north of 131st Street. At the base of the shelf on its west side is a drainage that flows south into Pipestone Creek (Figure 13). The Route Alternative 2 survey corridor crosses this stream. To the north, outside of the survey corridor, this stream drains the land east of the shelf and then crosses the shelf at the northern end of the shelf where it ceases to be a topographic feature and disappears into the landscape (Figures 1 and 4). The drainage arcs around and flows south, crossing 131st Street at the southwest corner of the pasture. It is at this corner of the pasture where the survey corridor crosses the drainage. While there is no exposed rock escarpment here as there is in the Monument to the south, the west-facing slope up the shelf is steep in places (Figures 14–15). Two sections of the survey corridor in this area were not shovel tested due to excessive slope, but shovel testing was conducted between them and on the west and east sides of the pasture.

A total of 55 shovel tests were excavated in three transects with one extra shovel test to cover a bump-out in the northern edge of the survey corridor. Shovel testing proceeded from west (lower elevation) to east (higher elevation). The transects began on the west side of the drainage and climbed to the top of the quartzite shelf, skipping over the two sections of steep slope.

Figure 8. Survey Area 12, Standing Corn North of 131st Street, West Side 70th Avenue, View East.

Figure 9. Survey Area 13, Harvested Field North of 131st Street, East Side 70th Avenue, View East.

Figure 10. Survey Area 15, Harvested Field South of 131st Street, West of Farmstead, View West.

Figure 11. Survey Area 3, Pasture West of St. Leo Cemetery, View North.

Figure 12. Survey Area 3, Buried Electrical Line, Pasture West of St. Leo Cemetery, View East.

Figure 13. Survey Area 7, Shovel Testing West of Quartzite Shelf Pasture, View West.

Figure 14. Survey Area 9, Shovel Testing Quartzite Shelf Pasture, View East.

Figure 15. Survey Area 10, Slope in the Pasture, View West.

Figure 16. Survey Area 10, Slope and Quartzite Outcrops in the Pasture, View East.

Figure 17. Survey Area 11, Quartzite Outcrop, Top of the Slope, View East.

The A horizon in this area was most commonly black (10YR 2/1) or very dark brown (10YR 2/2). Some shovel tests, typically along the northernmost transects, revealed a dark yellowish brown (10YR 4/4) A horizon. The surface horizon varied in texture from clay to silt loam. A clay texture was more commonly encountered in the western, downslope shovel tests. The thickness of the A horizon varied greatly, between 10 and 60 cm. Average thickness was greater in the shovel tests at the western end of the pasture near the stream and shallower on the top of the quartzite shelf, but there was little consistency from one shovel test to the next along a transect and the thickest A horizon was in a shovel test halfway up the slope. This variation is likely due to the actions of the meandering stream, material slowly moving downslope, and the variable depth to the bedrock. The B horizon was typically silt loam or clay loam, although sandy soils were also present. This horizon varied more widely in color than the A horizon, with darker colors such as dark grayish brown (10YR 4/2) more common to the south and colors as light as yellow (10YR 7/8) to the north.

All shovel tests in the pasture north of 131st Street were negative for cultural materials or features. Many outcrops, boulders, and cobbles of quartzite were observed on the surface (Figures 15–17)

Survey Area 14: Railroad Grade

Two shovel tests were excavated in a pasture on the quartzite shelf south of 131st Street, where the survey corridor turns east again after crossing the road. Only the corner of the survey corridor clips this pasture and the rest of the survey corridor in this area is in the adjacent cultivated field. This is the former location of the railroad tracks that once ran along the east side of the monument. The rail grade was no longer visible at the time of survey.

Two shovel tests were excavated in the survey corridor here and both hit disturbed gravel from the former rail grade. Both shovel tests were negative for cultural materials and features.

Survey Area 16:South Farmstead

Shovel testing was conducted in a small area of trees and tall grass on the east side of the farmstead south of 131st Street (Figure 18). The rest of the farmstead was not shovel tested due to buried utility lines and other disturbance.

Survey Area 18:East Fields

The fields south of 131st Street east of the farmstead had last been planted in corn and had been harvested by the time of survey. The thick layer of corn stalks laying on the ground reduced the ground surface visibility to near zero, however (Figures 19-20). These fields—on both sides of 75th Avenue—were shovel tested. One artifact was recovered from a shovel test in the field east of 75th Avenue. This was assigned field site #W-2623-JRG-01 and is discussed below.

Twenty seven shovel tests were excavated west of 75th Avenue and 111 shovel tests were excavated east of 75th Avenue. Six shovel tests were not excavated due to the presence of the extant pipeline corridor or other disturbances. Four east-west transects were excavated west of 75th Avenue, while only three east-west transects were excavated east of the road due to a strip of disturbed ground along the south side of 131st Street.

Figure 18. Survey Area 17, Shovel Testing East of the Farmstead, View South.

Figure 19. Survey Area 18, Shovel Tested Corn Field East of the Farmstead, View East.

Figure 20. Survey Area 18, Shovel Tested Field Near Northeast Project Terminus, View West.

Shovel tests in these fields were very consistent. The Ap horizon (plowzone) averaged 30 cm thick and consisted of black (10YR 2/1) clay loam or dark gray (10YR4/1) silty clay loam The B horizon below was clay either grayish brown (2.5Y 5/2) or very dark brown (10YR 2/2) in color.

Disturbed and Sloped Areas

The access road to the southern end of the Route Alternative 2 survey corridor is coincident with a residential driveway and this area was found to be disturbed (Survey Area 1) (Figure 21. The farmstead on the south side of 131st Street was also disturbed by buried utilities, driveways, and construction of the nearby farm buildings (Survey Area 16)(Figure 22). No standing structures in the farmstead overlap the survey corridor. Two areas of the pasture north of 131st Street were found to be excessively sloped, where the survey corridor climbed the quartzite shelf (Survey Areas 8 and 10) (Figures 14–16). These areas were not shovel tested with the rest of the survey corridor in the pasture.

Areas Not Surveyed

A total of 1.5 mi of the survey corridor, labeled Survey Area 4 on Figures 4 and 5a–e and Survey Areas 19 and 20 on Figures 4 and 5g, were not investigated during October 2023, due to a lack of survey permission or absence of a valid utility locate ticket, but will be included in future survey efforts for Route Alternative 2.

Route Alternative 2 crosses roads but no survey of road ROW was conducted in 2023.

Figure 21. Survey Area 1, Disturbed Driveway North of 111th Street, View South.

Figure 22. Survey Area 16, Farmstead South of 131st Street, View Southeast.

Site W-2623-JRG-01 (Isolated Lithic Artifact)

While shovel testing the agricultural field on the south side of 131st Street east of 75th Avenue (Survey Area 18), one lithic artifact was recovered from Shovel Test B12 (Figure 5g). The site was assigned the field site #W-2623-JRG-01. This lithic isolate is a non-diagnostic tool or preform.

The findspot is on a very gentle southwest facing slope between two minor drainages that flow to the quartzite escarpment and into Pipestone Creek (Figure 23 and 24). As stated above, this part of the survey corridor had very low ground surface visibility as stalks of the harvested corn were covering the ground (Figures 25–26).

Transect B was the middle of the three east-west shovel test transects excavated in this part of the survey corridor. Shovel Test B12 as about 50 m south of 131st Street, 208 m east 75th Avenue, 423 m west of the extant Magellan pipeline, and 585 m west of US 75 (Figure 23 and 24).

For a site datum, two points were used: Datum #1 was a stop sign to the east at the southeast corner of 131st Street and US 75, and Datum number 2 the northeast corner of a farmstead structure to the west. The structure is the easternmost rectangular building in the southern farmstead and is separated from the site by 75th Avenue and the trees on the east side of the farmstead. Both site data are on the south side of 131st Street.

The artifact was recovered from 30 cmbs, the boundary between the plowzone and the subsoil. In this shovel test, the Ap horizon was dark gray (10YR 4/1) silty clay loam over a B horizon of grayish brown (2.5Y 5/2) clay. This was typical for shovel tests in this field. Radial shovel tests were excavated at 5 m from the positive shovel test. No additional artifacts were encountered. The radial

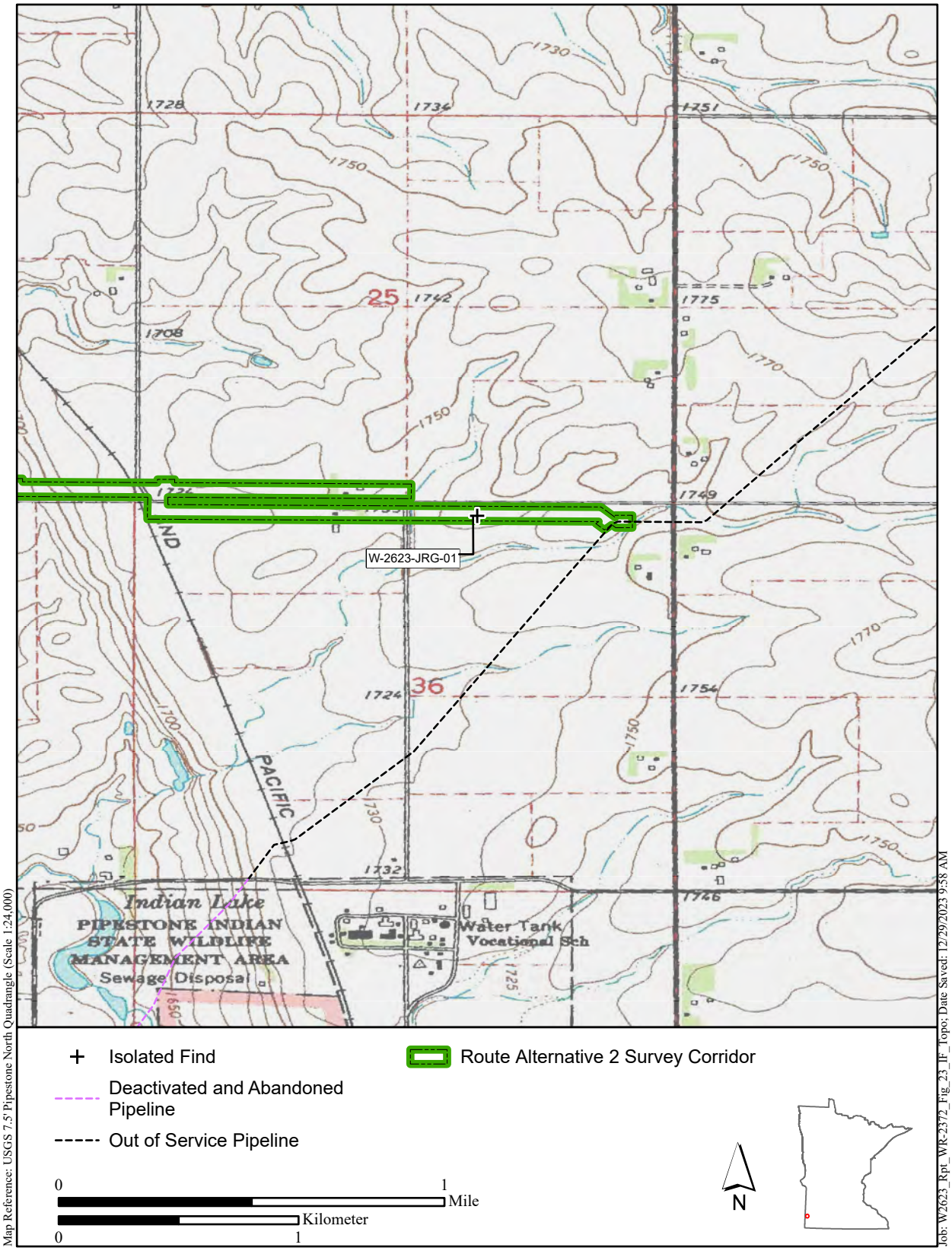

Figure 23. Site W-2623-JRG-01 Location

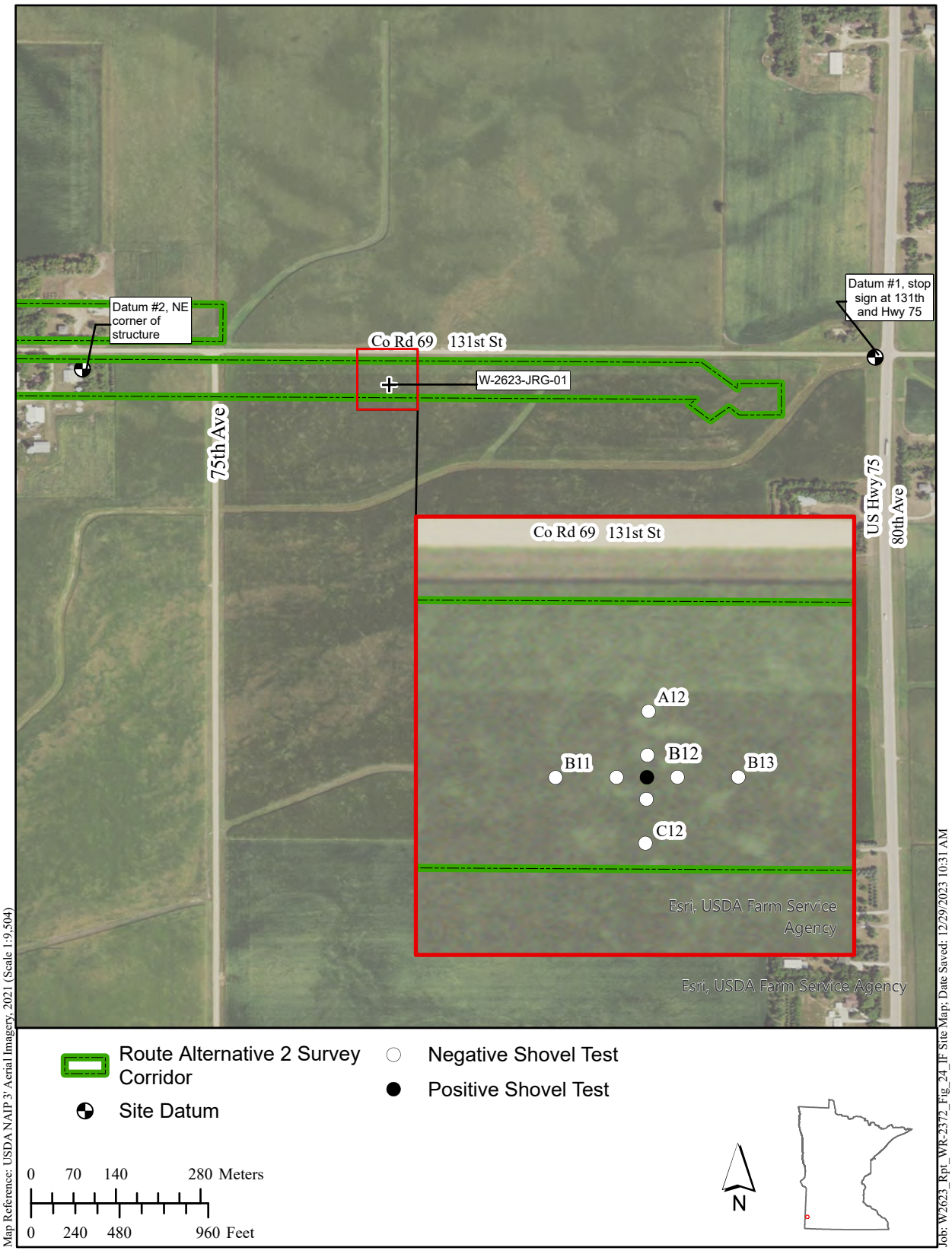

Figure 24. Site W-2623-JRG-01 Plan

Figure 25. Site W-2623-JRG-01, View Northwest.

Figure 26. Site W-2623-JRG-01, View Southeast.

shovel test had the same soil profiles as Shovel Test B12 and the surrounding shovel tests on the transects.

The lithic artifact is not temporally diagnostic. It is only very roughly worked and may be a preform (Figure 27). The artifact is oval in shape with one narrow end being flat, likely the striking platform of a large flake. It is made of pale buff-colored chert and has been worked primarily unifacially, although with limited working along one edge on the other face. Since chert is not known to outcrop locally (Gibbon 2012:27) this material may be glacial in origin. The artifact weighs 16.35 grams and measures 40 millimeters (mm) long, up to 33 mm wide, and up to 12 mm thick. The less worked face has an area of reddish cortex.

The preliminary site form is provided in Appendix A. The site form will be submitted to the OSA to receive an official Minnesota archaeological site number.

Figure 27. Lithic Artifact from Site W-2623-JRG-01.

6. Remote Sensing Survey

GeoArc conducted remote sensing on available parcels along Route Alternative 2 to identify positions and depths of pipestone/catlinite where Route Alternative 2 crosses the trend of known and suspected catlinite beds.

One objective of this survey was to detect presence or absence of the main buried catlinite stratum (or strata) along the most likely sections of occurrence on Route Alternative 2. A second objective of the remote sensing survey was a search for potential unmarked burials on two tracts along Route Alternative 2, to the immediate west and south of the St. Leo Cemetery boundary.

On October 16 and 17, 2023, GeoArc conducted noninvasive geophysical survey at four locations on parcels where survey permission was granted. Location A was to establish baseline data for

catlinite, Locations B and C were to identify positions and depths of catlinite where Route Alternative 2 crosses the trend of known and suspected pipestone beds, and Location D was the area adjacent to the St. Leo Cemetery boundary to search for unmarked burials. The report detailing results of this survey is included in Appendix B.

Remote Sensing Survey Summary

Location A, 121st Street

Location A was used to collect baseline data for catlinite strata and the values obtained were used to calibrate over the surveyed portions. The data were examined within the context of responses from the known geology and soils, and with respect to historic topographic maps, historic aerial photography, and detailed geomorphology as mapped by GeoArc.

Location B, 151st Street

No catlinite was identified during the remote sensing survey.

Location C, Route Alternative 2, 131st Street

No catlinite was identified during the remote sensing survey.

Location D, Route Alternative 2, West and South of St. Leo Cemetery

Remote sensing was conducted in this location to search for evidence of unmarked burials on the west and south sides of St. Leo Cemetery. While anomalies were found, they do not appear to be consistent with graves, nor are they attributable to ore-bearing rocks in underlying till. The anomalies are likely responses to small metallic objects consistent with farming-related metal cast off over the past century that are scattered throughout the pasture. GeoArc recommends that Magellan monitor anomaly locations within the project construction workspace during construction if this route is selected by the Commission. Additionally, GeoArc recommends the development of a monitoring plan and coordination with the Office of the State Archaeologist and the Minnesota Indian Affairs Council as needed.

7. Conclusions

On October 16–19, 2023 Chronicle conducted Phase I archaeological survey of Route Alternative 2 of the Pipestone Reroute Project. The 2023 survey was limited to those privately-owned portions of the route where landowner permission had been granted. No survey was conducted on public lands (i.e., road ROW) and no survey was conducted for any other route alternative.

The 2023 survey yielded a single non-diagnostic lithic artifact (Field Site #W-2623-JRG-01). This was recovered while shovel testing a cultivated field with low ground surface visibility near the south side of 131st Street. Due to its low informative value, this site is recommended not eligible for listing in the NRHP.

Archaeological survey will be completed for the remainder of Route Alternative 2 as well as the Preferred Route when survey access is granted. A report presenting the results of this survey will be prepared and submitted to the Minnesota State Historic Preservation Office for review.

8. References Cited

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Appendix A. Preliminary W-2623-JRG-01 Site Form.

Rev.: 7/1/09

MINNESOTA ARCHAEOLOGICAL SITE FORM

OFFICE OF THE STATE ARCHAEOLOGIST
Fort Snelling History Center, St. Paul, MN 55111 (612) 725-2729

SITE #: 21- Site Name: 131st Street Isolate Agency/Field #: W-2623-JRG-01
(OSA assigns if New Site)

_X_ New Site __ Site Update OSA License #: SHPO RC #:

Type of Fieldwork: _X_ Reconnaissance/Phase I Date(s) of This Fieldwork: October 17, 2023
___ Evaluation/Phase II
___ Excavation/Phase III

NRHP Status: __ Listed __ Determined Eligible __ CEF(106) __ CNEF(106) _X_ Undetermined

LOCATIONAL INFORMATION

County: Pipestone City/Twp. Name: Troy Township SHPO Sub-Region: 1
(see map in instructions)

USGS 7.5' Quadrangle Map *(name and year):* Pipestone North Quadrangle (1967)

Township: 107 North Range: 46 West Section: 36 ¼ Sections (at least 2): NW, NE
Township: Range: Section: ¼ Sections (at least 2):
Township: Range: Section: ¼ Sections (at least 2):

UTM Coordinates: (*less than 10 acres use center; over 10 acres define polygon around site; draw points on USGS*)
Zone: _14T___ Datum: ___ 1927 _X__ 1983 Method: ___ USGS Map _X__ GPS ___ Other
Point 1: Easting 715126 Northing 4879498
Point 2: Easting Northing
Point 3: Easting Northing
Point 4: Easting Northing
Point 5: Easting Northing

SITE CHARACTERISTICS

Acreage: 0.8 Site Dimensions: N-S _10 m__ E-W _10 m__ Maximum Cultural Depth (if known) __30 cm___

Site Description *(√all that apply, but only one check per line):*
_X_ single artifact __ lithic scatter __ artifact scatter
__ burial mound (number of mounds _____) __ non-mound lone grave __ non-mound cemetery
__ petroglyph __ pictograph __ petroform
__ surface features (list below)
__ other: _____

Surface Features (*√all that apply*): __ earthwork __ pit/depression __ foundation/ruin __ other: _____

Inferred Site Function (*√all that apply*): __ habitation __ mortuary __ farm __ industrial __ transportation
__ Other (*list*): _____ _X_ unknown

Current Land Use (*list approximate % for all that apply):*
_X_ cultivated ___ fallow ___ commercial ___ recreational ___ industrial ___ residential
___ woodland ___ grassland ____ water-covered ___ other: _____

Surface Visibility (*list approximate % for all that apply):*
___ excellent ___ good ___ fair _X_ poor/none

Degree of Disturbance (*list approximate % for all that apply or √ unassessed):*
___ minimal _X_ moderate ___ heavy ___ completely destroyed ___ unassessed

Current Threats to Site: (*√all that apply or √ none known)*
__ erosion __ development _X_ agricultural __ other: _____ __ none known

SITE #: 21- Site Name: 131st Street Isolate Agency/Field #: W-2623-JRG-01

CULTURAL/TEMPORAL AFFILIATION

(list all that apply by level of certainty: 1 = confirmed; 2 = probable or √"not determined"):

Period: X not determined; __ Contact (1650-1837); __ Precontact (9500 BC - 1650 AD); __ Post-Contact (1837-1945)

Precontact Context: *(list all that apply by level of certainty; if unable to discern specific context, √here __)*

Paleoindian Tradition __ not determined __ Folsom __ Lanceolate Point/Plano __ Clovis __ Eastern Fluted __ other: _____

Archaic Tradition __ not determined __ Prairie __ Riverine __ Shield __ Lake-Forest __ other: _____

Woodland Tradition __ not determined __ Fox Lake __ Laurel __ SE Mn Early __ C Mn Transitional __ Lake Benton __ Brainerd __ Blackduck-Kathio __ Psinomani/Sandy Lake __ Havana-Related __ SE Mn Late __ Rainy River Late __ other: _____

Plains Village Tradition __ not determined __ Cambria __ Great Oasis __ Big Stone __ other: _____

Mississippian Tradition __ not determined __ Silvernale __ other: _____

Oneota Tradition __ not determined __ Blue Earth __ Orr __ other: _____

Contact Context: *(list all that apply by level of certainty; if unable to discern specific context, √here __)*

American Indian __ not determined __ Dakota __ Ojibwe __ other: _____

Euro-American __ not determined __ British __ other: _____ __ French __ Initial US

Post-Contact Context: *(list all that apply by level of certainty; if unable to discern specific context, √here __)*

__ Indian Communities & Reservations (1837-1934)
__ Early Agriculture & River Settlement (1840-1870)
__ Northern MN Lumbering (1870-1930s)
__ Tourism & Recreation (1870-1945)
__ St. Croix Triangle Lumbering (1830s-1900s)
__ Railroads & Agricultural Development (1870-1940)
__ Iron Ore Industry (1880s-1945)
__ Urban Centers (1870-1940)

Approximate Post-Contact Occupation/Site Formation Date(s): _____

Context Assignment/Dating Methods *(√all that apply):*

X artifact type/style __ feature type __ radiometric __ relative stratigraphy __ geomorphology
__ historic accounts (list) _____
__ historic maps (list) _____
__ other(s) (*specify*): _____

(For radiometric dates, attach photocopies of laboratory sheets if available.)

MATERIALS PRESENT *(√all that apply):*

Basic Artifact Categories

Ceramics	*Lithics*	*Biological Remains*	*Historic Materials*
__ Aboriginal	__ projectile points	__ animal	__ glass
__ Euro-American	X other chipped stone tools	__ human	__ metal
	__ debitage	__ unidentified bone	__ brick
	__ ground/pecked stone	__ seeds/nuts	__ other: _____
	__ FCR	__ charcoal	
	__ aboriginal copper	__ wood	

SITE #: 21- Site Name: 131st Street Isolate Agency/Field #: W-2623-JRG-01

Major Exotic Materials *(√all that apply):*

__ catlinite __ native copper __ Hixton orthoquartzite
__ Knife River Flint __ obsidian __ other: _____

Diagnostic Artifacts:

Ceramics: Prehistoric Types/Wares/Temper _____
Historic _____
Prehistoric Lithics: _____
Glass: _____
Metal: _____
Other: _____

ENVIRONMENTAL DATA **Current Topographic Setting** *(√all that apply):*

Away from Water	*Riverine*	*Lacustrine*
X general upland	__ fan	__ inlet/outlet
__ terrace edge	__ terrace/bluff top	__ peninsula
__ hilltop	__ stream-stream junction	__ island
__ glacial beach ridge	__ bluff-base	__ isthmus
__ rock outcrop	__ cave/rockshelter	__ general shoreline
__ other: _____	__ floodplain	__ bog/slough/lake bottom
	__ other: _____	__ other: _____

Topographic Feature Name from USGS Map: _Pipestone Creek_____

OWNERSHIP INFORMATION

Source and Date of Ownership Information *(e.g., plat map, county recorder's office, personal communication, etc.):*
provided by client

Ownership Type (*list approximate % for all that apply; if unknown √here __):*

___ Federal ___ State ___ Local (public) ___ Tribal X Private

Land Owner *(name and address if known):*
SMA Farms LLP
18895 Meadow View Boulevard
Prior Lake, Minnesota, 55372

CURRENT INVESTIGATION INFORMATION

Methods/Techniques Employed *(√all that apply):*

__ informant report __ small diameter soil coring (≈ 1" diameter) __ surface survey
X shovel testing __ formal test units __ mechanical testing max. test depth _____
__ geomorphological survey *(specify)*: _____
__ geophysical survey *(specify)*: _____
__ other: _____

Informant Name and Address (if known):

Known Collectors/Collections:

Artifact Repository *(name and accession numbers or repository agreement number):*

Most Recent Survey Report – Title, Author, Date:
Rhiannon Jones.
2023 *Phase I Archaeological Survey, Route Alternative 2, Magellan Pipeline Company, L.P., Pipestone Reroute Project, Pipestone County, Minnesota*. Technical Report No.: PC-00675/WR-2372. Chronicle Heritage, Milwaukee, Wisconsin.

Major Previous Bibliographic Reference(s) to Site:

Principal Investigator *(name and affiliation):*
Rhiannon Jones, Chronicle Heritage

Form Completed By *(name and date):* Rhiannon Jones, December 6, 2023

MAPS: *Attach/include original scale copy of 7.5' USGS map with site location clearly outlined or designated. Attach a sketch map if surface features present, if sub-surface testing done, or if complicated boundaries/setting. Sketch map must have re-locatable datum, scale, north arrow, and legend if symbols are used.*

SITE #: 21- Site Name: 131st Street Isolate Agency/Field #: W-2623-JRG-01

ADDITIONAL INFORMATION *(Reason for Update or Survey, Location, Site Characteristics, Materials Present, Setting, Archaeological Methods, etc.; attach extra sheets as needed.)*

An isolated, non-diagnostic chipped stone tool or preform was recovered at 30 centimeters below the surface in a shovel test. The shovel test was in a cultivated field on the south side of 131st Street, east of 75th Avenue and west of US 75. At the time of survey, the field was harvested, having most recently been planted in corn. Harvest had left a thick mat of downed corn stalks covering the ground, providing little to no ground surface visibility. Shovel testing at 15-meter intervals was employed instead of pedestrian survey. The positive shovel test is about 50 meters south of 131st Street, 208 meters east 75th Avenue, and 585 meters west of US 75.

Radial shovel tests were excavated in the cardinal directions at 5 meters from the positive shovel test but no additional artifacts were encountered. No other cultural material was found during survey.

The lithic artifact is only very roughly worked and may be a preform. The artifact is oval and may have been made from a large flake. It is made of pale buff-colored chert and has been worked primarily unifacially, although with limited working along one edge on the other face. Since chert is not known to outcrop locally, this material may be glacial in origin. The artifact weighs 16.35 grams and measures 40 millimeters (mm) long, up to 33 mm wide, and up to 12 mm thick. The less worked face has an area of reddish cortex.

The artifact was recovered from the boundary between the plowzone and the subsoil. The soil profile in the shovel test had a dark gray (10YR 4/1) silty clay loam Ap horizon over a B horizon of grayish brown (2.5Y 5/2) clay. This was typical for shovel tests in this field, including the radial shovel tests.

Appendix B. Electromagnetic Induction for the Pipestone Reroute Project by GeoArc Research, Inc.

Geophysical Survey by Electromagnetic Induction for the Pipestone Reroute Project,

Pipestone County, Minnesota

MPUC Docket No. IP-7109/PPL-23-109

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December 2023

GEOPHYSICAL SURVEY BY ELECTROMAGNETIC INDUCTION FOR THE PIPESTONE REROUTE PROJECT, ROUTE ALTERNATIVE 2

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ACRONYMS

AC	Apparent Conductivity
bgs	below ground surface
DEM	digital elevation model
EERA	Minnesota Department of Commerce, Energy Environmental Review and Analysis
EMI	electromagnetic induction instrutment
ft	feet
GPS	global positioning system
HCP	horizontal co-planar
HDD	horiztontal directional drill
LiDAR	light detection and ranging
Magellan	Magellan Pipeline Company, L.P.
MPUC	Minnesota Public Utilities Commission
m	meter
Monument	Pipestone National Monument
MS	magnetic susceptibility
mS/m	milliSiemens per meter
NRCS	Natural Resource Conservation Service
Project	Pipestone Reroute Project
PRP	perpendicular
SB	soil bore

GEOPHYSICAL SURVEY BY ELECTROMAGNETIC INDUCTION

PIPESTONE REROUTE PROJECT

1.0 INTRODUCTION

Magellan Pipeline Company, L.P. (Magellan) is proposing to relocate a short segment of an existing 8-inch refined products pipeline in Pipestone County, Minnesota referred to as the Pipestone Reroute Project (Project). The Project will relocate approximately 0.74 mile of the existing 8-inch diameter pipeline from federal lands managed by the U.S. Fish & Wildlife Service and National Park Service within the Pipestone Creek Unit of the Northern Tallgrass Prairie National Wildlife Refuge and the Pipestone National Monument (Monument), respectively. The segment of the pipeline that crosses federal lands was decommissioned on October 30, 2022. The relocation of the pipeline will occur on private lands. Environmental Resources Management, Inc. (ERM) is assisting Magellan with its permitting efforts for the Project.

Magellan evaluated the Preferred Route included in its application with the Minnesota Public Utilities Commission (Commission), under Docket No. IP-7109/PPL-23-109 (Preferred Route). Magellan identified a feasible route alternative based on direct feedback during Magellan's stakeholder and tribal outreach and comments offered to the Commission staff and Minnesota Department of Commerce, Energy Environmental Review and Analysis (EERA) staff at the in-person and virtual scoping meetings on July 11-12, 2023. This route, Route Alternative 2, is further from the Pipestone National Monument (Monument) and nearby federal lands, reducing the impacts to Pipestone Creek, and minimizing impacts to humans and other environmental features in the area.

On behalf of Magellan, ERM retained GeoArc Research Inc. (GeoArc), to conduct remote sensing survey on available parcels along Route Alternative 2 and other locations where access permission was granted to identify positions and depths of pipestone where Route Alternative 2 and other parcels cross the trend of known and suspected pipestone or catlinite beds using a non-invasive method. Route Alternative 2 crosses the projected trend of catlinite strata north of the federal lands (Figures 1 and 2). Within the Monument, a belt of catlinite trends north-northwest to south-southeast. Catlinite is a highly significant resource to tribal groups in the region and beyond. The Monument protects catlinite resources that have been mined and used by American Indians from pre-contact times to the present. Tribal members actively quarry in the Monument.

Between October 16 and 17, 2023, GeoArc, in coordination with Tremaine & Associates (Tremaine), conducted noninvasive geophysical survey at locations on parcels where survey permission was granted (see Figures 1 and 2):

- Location A: Baseline data collection for catlinite and quartzite strata along 121st Street
- Location B: Remote sensing survey along 151st Street
- Location C: Remote sensing survey of Route Alternative 2 along 131st St
- Location D: Remote sensing survey west and south of St. Leo Cemetery (Route Alternative 2)

The primary goals of this geophysical survey project include:

1. Collect and establish baseline data for the overlying Sioux quartzite (quartzite) and catlinite.

2. Detect the presence or absence of the main buried catlinite stratum (or strata) along the most likely sections of occurrence on Route Alternative 2 and other locations where access permission was granted.

3. Search for evidence of unmarked burials outside of the St. Leo Cemetery boundary to the west and south along Route Alternative 2 (Figures 1 and 2, Location D).

This report is organized into the following sections: Introduction, Methodology, Results and Interpretation, and Conclusions and Recommendations.

2.0 METHODOLOGY

2.1 INSTRUMENTATION

A frequency-domain electromagnetic induction (EMI) instrument, the DualEM 21, was chosen for the geophysical survey because of its ability to detect and image a wide variety of materials, objects, and conditions (Figure 3). This instrument consists of a transmitter and two dual-geometry receivers: Horizontal Co-Planar (HCP) and Perpendicular (PRP) orientations. These receivers are arrayed along a two-meter-long boom supported on a wheeled non-metallic carriage which was towed by an all-terrain vehicle. As a towed array, data are rapidly collected, resulting in an efficient approach.

The transmitter, operating at 10 kHz, generates a primary electromagnetic (EMI) field that extends into the ground, in turn, inducing a secondary magnetic field from objects, discontinuities and other conditions below the surface. Data collection includes bulk measurements of apparent conductivity and magnetic susceptibility for four depths of exploration: 0-0.2 feet (ft); 0-1.8 ft, 0-3.7 ft, and 0-8.9 ft below ground surface (bgs). These data are tagged with geospatial coordinates using a Trimble base station, and Trimble mobile antenna/receiver system. The EMI and GPS data were recorded on a Trimble Yuma field tablet. The tablet recorded the DualEM data at a rate of 5 samples per second.

Apparent Conductivity (AC) measures how well electric current travels through a soil matrix. This property, measured in milliSiemens per meter (mS/m), is governed by factors of soil moisture, dissolved electrolytes in groundwater, soil/sediment grain size, temperature, compaction (porosity), and the surface chemistry of the clay fraction (McNeill 1980a & 1980b). Generally, sand, gravel, and unweathered rocks are poor conductors, in contrast to clays that are highly conductive (Palacky, 1989). Such measurements are useful for revealing lateral variations in response related to differences in either subsurface materials and/or conditions over a given distance and soil volume. These variations can represent transitions between geomorphological/geotechnical units, modified/engineered terrain, or buried features (i.e., archaeological resources or infrastructure).

Magnetic Susceptibility (MS) gauges the degree to which soil components or buried objects become magnetized by EMI. Variations in response, measured in parts per thousand (ppt), are primarily dependent on the soil and material types, oxidation state, and stability of magnetic iron minerals in soil, and on the presence and mobility of magnetic ions in solution. MS

responses are governed by three factors in soil /sediment contexts: the iron oxides inherited from parent rocks; enhancements through pedogenic processes; and, anthropogenic causes including midden, hearths and burning, and floor compaction. Strong MS responses can also be associated with disturbed soils.

2.2 GEOPHYSICAL DATA PROCESSING AND ANALYSIS

Data were processed and analyzed by Tremaine. For Project goals 1 and 2, the objective was to identify anomalous signatures indicative of lateral and vertical changes among the geological units, particularly catlinite strata, with respect to the geomorphology. For Project goal 3, the objective was to identify anomalies that could potentially represent burials outside of the boundary of St. Leo Cemetery. Data were rendered to produce plan view depth slices for both AC and MS using ArcView GIS software.

Renderings of the data were prepared by visualizing the complete spread of values obtained for each data set using a standardized color spectrum ranging from blue to red (low to high responses). After basic characterization, the EMI data were examined within the context of responses from the known geology and soils, and with respect to historic topographic maps, historic aerial photography, and the bore logs of Magellan's recent geotechnical coring.

2.3 GEOMORPHOLOGY MAPPING

The four areas where geophysical surveying was to occur, including the baseline data collection Location A, were assessed for landform and landscape components at a high degree of resolution utilizing Light Detection and Ranging (LiDAR)-derived shaded relief digital elevation models at two different vertical exaggerations (1x, 3x), and accompanying 0.30 meter (m) contour lines. LiDAR-derived layers served as proxies for interpreting and mapping upland and alluvial landforms of intermediate to fine scale. With these and other aerial imagery resources for reference, the project area was systematically examined and evaluated for type and distribution of landforms, and likely underlying sediment sequences and their depositional environments as context for the geophysical survey. Apparent soil-geomorphic relationships were utilized, to the extent possible given the generalized character of Natural Resource Conservation Service (NRCS) soil mapping, ultimately to help interpret likely sediments, depositional environments and their extents. In general, NRCS descriptions of soil series are important for textural information, and the thinking at the time of original mapping about the origin of soil parent material, but they have their limitations in terms of spatial reference of mapped soil boundaries.

2.4 PHYSIOGRPAHIC SETTING

The Monument is situated on, and exposures of the main bed of relatively soft catlinite are beneath, a nearly north – south oriented bedrock bench (Mbcs1: Table 1; Figures 4 and 5), with a gentle slope to the west, at the head of a broad reach of the incised east – west oriented Pipestone Creek valley to the west (Figures 1, 2 and 4, 5). To the east, is a second, higher westward sloping bench (Mbcs2) that backs up to a third, more steeply sloping bench (Mbcs3). These surfaces are underlain with bedrock (quartzite) with generally progressively westward – thickening discontinuous mantles of fine grain sediment. To the east of these surfaces, a distinct bedrock scarp (Ubs) ascends eastward to a bedrock, and locally, glacial drift – floored bench (Ubb, Ugb). Collectively these surfaces locally define the western edge of the Coteau de Prairies, an extensive north-northwest – south-southeast broad bedrock – controlled ridge that was scoured by multiple glacial advances of pre-Wisconsin age. At its core are Paleozoic quartzite buried beneath glacial drift. Subsequent erosion of overlying till has led to a dendritic drainage

network cut into the drift with often stepped descending spurs (Uss, Ust) and local alluvial (Maf) and colluvial (Mcf) fans. Younger loess mantles the drift in this upland landscape, with weathered, eroded and redeposited loess comprising minor alluvial and colluvial fans (Maf, Mcf), colluvial slope (Mcs), and floodplain and valley (Ff1, Ff2, Fwbu), sediment assemblages, as well as contributing an admixture among outcropping bedrock (Figures 4 and 5).

The scarp (Ubs) and at least uppermost part of the bench (Ubb) are formed in highly resistant quartzite that is exposed along much of the scarp and discontinuously in association with the lower sloping surfaces (Mbcs1, Mbcs2 and Mbcs3). Catlinite is interstratified within apparently lower sections, and the main stratum that is mined is along the Mbcs1 surface (Figures A1 and A2). Additional lower bench levels are defined by slight changes in hillslope segment slope. The main bed of soft catlinite is relatively thin. Other, generally much thinner strata (laminae to very thin beds) of catlinite, can have a variable content of sand, and are less desirable for carving. Both catlinite and quartzite dip on the order of 7° - 8° to a little north of east.

TABLE 1

Summary of Geomorphology Map Units in the Project Area and Areas of Geophysical Survey

Landscapes	Landform Label [a]	Landform Description
Floodplain		
	Fr	river channel
	Fcb	channel belt
	Ff	floodplain, undifferentiated
	Ff1	floodplain, youngest
	Ff2	floodplain, next-to-youngest
	Fpc	paleochannel, undifferentiated
	Fpcb1	paleochannel, youngest
	Fpcb2	paleochannel, next-to-youngest
	Fpcb3	paleochannel second next-to-youngest
	Fpcbu	paleochannel, undifferentiated
	Fr	reservoir
	Fwb	wash belt
	Fwbu	wash belt, undifferentiated
Terrace		
	Tt1	terrace, youngest
	Tt2	terrace, next-to-youngest
	Tbt1	terrace, bedrock, youngest
	Tbt2	terrace, bedrock, next-to-youngest
	Ttu	terrace, undifferentiated
Valley Margin		
	Maf	alluvial fan
	Mcf	colluvial fan
	Mcs	colluvial slope
	Mcs	colluvial slope
	Mbcs1	Bedrock and colluvial slope, 1

TABLE 1

Summary of Geomorphology Map Units in the Project Area and Areas of Geophysical Survey

Landscapes	Landform Label [a]	Landform Description
	Mbcs2	Bedrock and colluvial slope, 2
	Mbcs3	Bedrock and colluvial slope, 3
Upland		
	Uss	stepped spur
	Ust	stepped spur tread
	Usd	stepped spur saddle
	Ubb	bedrock bench
	Ubs	bedrock scarp
	Ugb	glacial drift bench
	Uu	undifferentiated

[a] Capital letter refers to landscape. lower case letters following a capital letter refer to landforms. Numbers reflect relative age relationships internal to each location only. “u” refers to undifferentiated. Numbers increase with increasing relative age.

The main exposed bed of catlinite immediately east of the Monument’s visitor center is about 12 - 15 ft below the bench ground surface. The trend (and strike) of the catlinite in this vicinity is suggested by the line of quarry excavations revealed in the digital elevation model (DEM), of which the visitor center example is but one exposure (Figures 1-2, 4-5). There are other unmapped quarry areas closer to the foot of the scarp (Ubs). North of these more or less contiguous areas, there are relatively few small, isolated potholes. Heading northward from the visitor center, the valley margin surfaces (Mbcs1, Mbcs2 and Mbcs3) gradually taper in width, and pinch out against the west - facing scarp (Ubs) (Figures 1-2, 4-5). Slightly farther northward, the scarp (Ubs) disappears near the north edge of Location C, likely buried beneath glacial drift (Figures 1 and 2). Immediately north of area B, near where Mbcs2 pinches out to the north, there is a mechanical excavation of fair size, purpose unknown, cut into the surface just beyond the foot of the steeper scarp (Ubs; Figure 2).

On the Couteau de Prairies, Pipestone Creek valley, and numerous low order tributaries to the north and south, drain this segment of the eroded till plain.

Pipestone Creek is canalized, but remnants of paleochannels (Fpc1, Fpc2 and Fpc3) mark former courses (Figures 4 and 5). To the east of the Project area, Buffalo Ridge of the Coteau de Prairies exhibits the highest elevations in the state of Minnesota. Pipestone Creek descends the scarp (Ubs) and flows westward in its valley. A number of the other smaller drainages also cascaded down the scarp. The north-south linear discontinuity between the scarp (Ubs), its lower benches (Mbcs1, Mbcs2, Mbcs3), and Pipestone Creek valley beyond to the west (Figures 1-2, 4-5) is the result of eons of stream and sheetflood erosion resulting in exposure of the quartzite bedrock, with its interbedded catlinite. Downvalley to the west, Pipestone Creek valley exhibits a number of floodplain levels, as well as multiple terrace levels that record its history of net incision. Till plain flanks either side of Pipestone Creek valley. Where Route Alternative 2 and Location B were surveyed, as well as at the St. Leo Cemetery (Location D), the till plain ranges from broad,

gently sloping stepped upland divides to eroded stepped spurs (Uss, Ust) and intervening drainageways with a dendritic drainage pattern.

3.0 RESULTS AND INTERPRETATION

The results of the geophysical survey of the four Locations A, B, C and D are described below. These include locations along 121st St (baseline reference, Location A); 151st Street (Location B); 131st St. (Route Alternative 2, Location C); and the west side of St Leo Cemetery (Location D) (Figures 1 and 2).

3.1 FIELD SURVEY

The electromagnetic survey was conducted on Monday, October 16th and Tuesday, October 17th, 2023. This work was conducted by Vitaliy Selyuzhitskiy and Carlos Morales of Tremaine, with assistance from Ed Hajic of GeoArc. The survey area was 200 ft wide in parcels where survey access was granted. In all, 28 linear miles of data were collected, with transect spacings ranging from 2-20 ft, depending upon the goals for specific areas (Table 2). In all, over 1 million data points were gathered, with half representing apparent conductivity readings and the other half magnetic susceptibility. Positional GPS data were recorded with an RTK-GNSS unit capable of near-centimeter precision (a Horizontal Dilution of Precision of 0.8 was obtained with an average number of 13 satellites present during the survey).

TABLE 2

Geophyisical Survey Statistics

Location	Linear Miles	Q/IP Data Points	Average Transect Spacing
B: 151st Street	4.5	187,600	10 ft
C: 131st Street	8.2	271,200	15-20 ft
D: St. Leo Cemetery	15	696,000	2-3 ft
A: Baseline	0.3	18,400	Single line
Total	**28**	**1,173,200**	**N/A**

NA = Not applicable

Figure 6 presents the combined sets of AC data showing the comparability between Locations. The lefthand side shows results from AC HCP, Receiver 1 (3.7 ft bgs). The righthand side shows results from AC HCP, Receiver 2 (8.9 ft bgs).

3.1.1 Baseline data collection (Location A)

As an initial step, the field team gathered baseline data on two lithologies while statically positioned over known quartzite strata, and a projected position for the main soft bed of catlinite, to assist in interpretation of the data collected along Route Alternative 2 (Location C) and Location B. Baseline data was collected on a private land tract (Location A) with rock outcroppings about 0.7 mile north of the Monument (Figures 7 and 8).

This tract is situated over the entire breadth of the Couteau de Prairies bedrock-cored upland scarp (Ubs) and the two lower sloping bench levels (Mbcs2 and Mbcs1; Figures 7, 8 and 9). Downslope of the scarp, geophysical survey crossed, from east to west, a colluvial slope of

shallower angle (Mcs) that has a narrow belt of discontinuous rock outcrop with colluvium at a slightly greater slope than the main colluvial slope; and, a broad alluvial fan (Maf,) at a considerably lower slope angle, fed by a dry drainageway.

Quartzite in thin to very thick, very shallowly dipping beds, was examined for exposed strata of pipestone. Only rare very thin to thick discontinuous laminae of potential catlinite, with a high content of sand, were observed interstratified with the quartzite. A nearly level slab of quartzite in the main outcrop belt of the scarp (Ubs) was selected for static baseline data collection (Figure 9).

While not ideal for the main catlinite bed, which if present, was buried, the field team extrapolated along the strike of the catlinite in the Monument to get an assumed baseline reading for the catlinite. This was projected to the intermediate bench (Mbcs2) between the two outcrop belts of quartzite (Figures 7 and 9). The projection of the catlinite from the Monument to Location A is depicted in Figure 9. A third location was selected downslope of the lower quartzite belt, on the western part of the proximal colluvial slope (Mcs). The values obtained for the quartzite belt and assumed buried catlinite bed were used to calibrate over the portions of alignment of interest, namely along 131st Street (Location C) and 151st Street (Location B).

The quartzite belt yielded an average measurement of 5 mS/m (Figure 9). The location where the catlinite is projected to be (based on an extrapolation from the exposed strike within the Monument, at surface elevation of 1659 to 1660 ft, and assuming the main catlinite bed is continuous to the north of the Monument), yielded measurements between 9 and 12 mS/m. The proximal colluvial slope toward the west of our baseline collection, is thought to represent redeposited weathered loess with a silt loam texture, potentially overlying silty clay loam floodplain overbank deposits. This location yielded higher conductive measurements, around 21 mS/m.

3.1.2 North of 151st Street (Location B)

Geophysical survey was conducted in Location B in an irregularly shaped parcel that was in grasses (Figures 10 and 11). The bulk of the parcel was situated over a low terrace (Tt1) of a canalized watercourse of low order, just upstream of its flowing into the valley of North Branch Pipestone Creek to the west. The eastern point of the available tract was on a slightly higher intermediate terrace (Tt2). The west part of the south edge of the tract caught the lower sideslope of an upland stepped spur (Uss).

Figure 12 presents AC results with the color scale relative to this specific dataset focused on HCP, Receivers 1 and 2. MS data for this survey area are not shown as they are not informative as relates to the location of catlinite.

Values matching the suspected catlinite range are limited, with no apparent strata represented. Rather, conductive values apparently reflect landform – sediment sequences of the low and intermediate terraces (Tt1, Tt2) of the low order drainageway within the field. Relatively low conductive values, in blue, are seen in the southwest corner of the surveyed area over the lower upland sideslope. The central to eastern portion of the surveyed area appears to reflect different sediment sequences. In both receivers, a likely infilled paleochannel, and sliver of the pre-cannelized channel, appear in reddish tones, whereas the floodplain appears in aqua and some of the darker blue tones. One of the reddish paleochannels appears to course along or near the foot of the higher Tt2 terrace, as might be expected.

3.1.3 Route Alternative 2, North and South of 131st Street (Location C)

Geophysical survey along 131st Street occurred south of 131st Street to the east of 70th Avenue and north of 131st Street west of 70th Avenue near HDD entry/exit workspaces, labeled HDD #1 and HDD #2 on Figures 13 and 14. The cross-over is located at the toeslope of a broad stepped spur (Uss) where it descends to the bench (Ubb) atop the bedrock scarp (Ubs). In this location, the bench has a more or less continuous thin mantle of fine grain wash and / or loess. Quartzite with an admixture of finer grain colluvial material is exposed down the scarp. No bed of catlinite was observed down the scarp or to the east and west.

West of the scarp (Ubs), there is a north – south oriented hill that basically represents a spur tread (Ust) at a lower level than the upland to the east (Figures 13 and 14). Between the scarp (Ubs) and this hill (Ust) lies a swale (Ttu) at the head of a short drainageway to the south that is eroding headward. HDD#2 is situated on a narrow point of the spur and the uppermost part of the western sideslope (Figures 13 and 14). West of the hill, the spur slope descends steeply, with local quartzite exposures, then more gently, to a tributary floodplain (Ff), near its headwaters area to the northeast. In roughly the lower- to mid-slope position, there are several clusters of enormous quartzite boulders resting within depressions suggestive of catastrophic flood scour. This creek is tributary to Pipestone Creek.

East of the cross-over (Figures 13 and 14), the survey gently ascended a low-angle alluvial fan (Maf), then crossed a stepped spur tread (Ust) and descended to a low terrace (Ttu) (or blunt upland spur) at a second unnamed drainageway tributary to Pipestone Creek, stopping short of 75th Avenue. A farm with outbuildings and old trees occupied the stepped spur tread and limited the area of survey that was available without undue influence from the related infrastructure and obstacles.

Figure 15 illustrates the tracks of the survey equipment, and Figure 16 illustrates AC results from west of 70th Avenue. In the westernmost part of the field, higher conductive AC values represent finer grain alluvial sediment soil sequences consistent with the NRCS – mapped Ihlen silty clay loam soil (Figure 16). Values in the eastern part of the field west of 70th Avenue meeting the presumed signature of catlinite, between 9 and 12mS/m, are seen as two parallel belts straddling the spur tread summit (Ust), at approximately 1690 ft surface elevation, and into the swale (Ttu) to the east (Figures 16). HDD #2 of Route Alternative 2 is situated in part on the summit of this landform. The belts, however, are at a slightly oblique angle to the streamlined hill, and appear consistent with the known general strike orientation of catlinite within the Monument. This pattern is more apparent in results recorded in the shallower of the two HCP receivers, at 3.7 ft bgs, but are expressed at slightly deeper depths in results recorded in the deeper of the two HCP receivers as well. This might suggest the presence of a relatively shallow bed of buried pipestone could be represented in this location. However, the log for nearby test boring #SB3 records a dark sandy clay in the position of a B horizon of the surface soil at the shallower depth. It overlies a ‘dry light brown sandy clay’ downward to a ‘coarse light brown sand’ at the 10 foot depth. Between 13 – 20 ft, coarse sand is recorded over several strata of light brown clay to silty clay. The uppermost bed is described as ‘plastic’, while the lowest bed is described as ‘hard’ and ‘gravel mix’. Immediately below this, thin ‘glacial till’ is noted atop quartzite at about 22 ft. Whether any of the clay would be soft catlinite is unknown without examining a sample.

East of these belts, on the bedrock scarp (Ubb), is a low conductive zone consistent with the expected quartzite belt (Figure 16).

On the south side of 131st Street, east of 70th Avenue, higher conductive responses were obtained than would be expected for catlinite, ranging from 24 to 79 mS/m (Figure 17). Variations likely represent horizontal differences in near surface soil properties and locally, buried infrastructure associated with the adjacent farmsteads.

3.1.4 Route Alternative 2, West and South of St. Leo Cemetery (Location D)

The objective of the survey west and south of St. Leo Cemetery (Figures 1-2, 18-19), Location D, was to identify possible evidence of burials, including those who attended Pipestone Reservation Indian Boarding School. Based on historic records, these burials are thought to occur within the current Monument boundary, but based on tribal feedback Magellan elected to conduct geophysical survey outside of the St. Leo Cemetery boundary (Scott et al. 2006).

In 1998, a fluxgate magnetometer and electrical resistivity instrument were used in an attempt to locate the cemetery (Nickel and Frost 2000) in National Park Service Locality 17 within the Monument where a concrete “marker” had been found earlier by Sigstad (1965). No grave shafts were detected and there remains uncertainty regarding the location of the burials of these individuals.

St. Leo Cemetery is located on the noseslope of a stepped descending spur (Uss; Table 1) between two small, more level, treads (Ust: Figures 18 and 19). The southwest corner of the cemetery occurs on the summit of the spurs higher tread (Ust). Geophysical survey areas include gently sloping upper sideslopes (Uss) on either side of this higher tread.

To the south-southwest, the tread extends into a pasture toward a house and related outbuildings that are located on the next higher level spur tread (Ust; Figures 18 and 19). To the north of the nose slope at the southwest cemetery corner, the spur (Uss) axis descends down a moderate slope to lower levels of the spur. The west-northwest and eastern sides of the spur also descend gently to moderately. West of St. Leo Cemetery, the descent is across the same pasture as at the south end of the spur segment that is beyond project limits. South of the cemetery, the field was in freshly disced corn stubble. The lower half of the side slope faintly expresses the heads of two short, moderately broad and very shallow swales that descend the east-facing slope to an intermittent drainageway (Fwb); Figures E3 and E4). Tonal contrasts on several aerial images suggest a somewhat higher content of soil moisture than immediately upslope. It is through parts of these two fields that Route Alternative 2 passes and geophysical survey was conducted for possible burials. In this setting, loess, weathered by the surface soil, overlies till. The contact between these two deposits could be as shallow as about 0.6 and 1.2 m (2.0 and 3.9 ft) deep, based on general NRCS soil mapping and descriptions in Pipestone County, but it may be deeper as well.

Barb wire fencing between pasture and St. Leo Cemetery, and a second, east-west, fence that partitions the northern part of the pasture, were potential local sources of interference. The latter was given some leeway and appears as a blank area in the survey coverage.

Figures 20 and 21 present AC and MS results, focused on HCP, receivers 1 and 2. AC values in Figure 20 do not correspond to expected catlinite values; they likely represent landscape features influenced by soil moisture content. They exhibit little significant differences at the two different depths (3.7 and 8.9 ft) suggesting that a contact with till is either not represented in the upper 8.9 ft, or if present, is very shallow. The higher conductive zone in the southern portion of this segment may correlate with a change in soil type, potentially with a somewhat different soil moisture content associated with the swales and / or lower hillslope position.

The MS data in Figure 21 provides insight into what are likely small bits of metal scattered throughout the pasture west of the cemetery, and is most prominently seen in Receiver 2, 2.7 m (8.9 ft) below surface (Figure 21). The multiple, closely spaced north – south traverses of the survey are reflected to some degree in Figure 21. MS data resulted in 27 focal anomalies identified within the project easement (Figure 22). These are likely to represent bits of metal scattered throughout the field west of the St. Leo Cemetery. These are seen most prominently in Receiver 2 representing depths up to 8.9 ft bgs. Seven of the 27 anomalies fall within the Route 2 Alternative workspace (Table 3; Figure 23).

Western and southern slopes of the local tread summit in the southwest corner of the cemetery have been locally eroded beyond the St. Leo Cemetery limits over the years due to livestock activity (up to about 1.0 ft to the west) and row cropping (up to 2.0 ft to the south). This degree of erosion could have removed evidence, if originally present, of potential shallow unmarked burials close to the western and southern limits of St. Leo Cemetery.

The only other anomaly of note is a buried utility running north - south with slight deviation from the centerline of Route Alternative 2.

TABLE 3

Geophysical Anomalies in Survey Corridor

Anomaly[a]	Anomaly Size (feet diameter)[b]	GPS Coordinates (Decimal Degrees)
A1	4.6	96.3386700°W 44.0159861°N
A2	6.2	96.3384833°W 44.0159628°N
A3	6.1	96.3380274°W 44.0159354°N
A4	7.0	96.3383971°W 44.0157651°N
A5	7.2	96.3384900°W 44.0156802°N
A6	5.8	96.3380555°W 44.0155993°N
A6	8.9	96.3385040°W 44.0155151°N
A8	6.1	96.3382465°W 44.0153643°N
A9	8.6	96.3389754°W 44.0153682°N
A10	7.1	96.3389936°W 44.0151043°N
A11	9.3	96.3382305°W 44.0148735°N
A12	8.6	96.3382077°W 44.0147959°N
A13	8.7	96.3385577°W 44.0147696°N
A14	7.2	96.3384781°W 44.0147415°N
A15	9.9	96.3383270°W 44.0147104°N
A16	4.2	96.3385016°W 44.0145954°N
A17	7.5	96.3381350°W 44.0144502°N
A18	8.2	96.3382589°W 44.0144137°N
A19	8.3	96.3381878°W 44.0144170°N
A20	10.9	96.3379433°W 44.0144209°N
A21	10.8	96.3377079°W 44.0144966°N
A22	7.7	96.3378454°W 44.0143314°N
A23	10.6	96.3371728°W 44.0141177°N

TABLE 3

Geophysical Anomalies in Survey Corridor

Anomaly[a]	Anomaly Size (feet diameter)[b]	GPS Coordinates (Decimal Degrees)
A24	10.8	96.3371790°W 44.0138522°N
A25	10.7	96.3373320°W 44.0138347°N
A26	8.1	96.3371755°W 44.0137776°N
A27	8.0	96.3378038°W 44.0132578°N

[a] Listed anomalies were plotted based on Tremaine's Acute Anomaly Finder algorithm and criteria applied across signals recorded in Rx1-HCP/Rx2-HCP coil receivers in both Apparent Conductivity and Magnetic Susceptibility.

[b] Sizes of anomalies in are estimates of the signals received, and are not necessarily reflective or directly related to an objects size. Simply put, the listed anomalies' size is exaggerated relative to the buried objects size due to measurement of the surrounding halo effect rather than the surface of the buried object itself.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 151ST STREET (LOCATION B)

Location B did not offer convincing evidence of a catlinite stratum at the anticipated depth. Rather, although there are limited results in the range anticipated for catlinite, it appears that fluctuations in the receiver values are mimicking changes in alluvial landform – sediment assemblages at this location.

4.2 ROUTE ALTERNATIVE 2 (LOCATION C)

Despite patterned values at Location C within the range of potential catlinite, ground truthing provided in the geotechnical boring Number SB3 documents unlithified clayey, sandy material to a depth of 22 ft, at which depth a possible glacial diamicton overlying quartzite was encountered. No catlinite was identified in the log beneath the 22 ft depth.

No evidence of an apparent stratum of catlinite was detected east of 70th Street down to a depth of 10 ft.

4.3 ROUTE ALTERNATIVE 2 (LOCATION D)

While acute focal anomalies were found in the magnetic susceptibility data at St. Leo Cemetery, Location D, these do not appear to be consistent with graves, nor are they attributable to ore-bearing rocks in underlying till. While the sizes are small enough to represent bits of metal potentially associated with clothing apparel that may have been part of pre-contact unmarked burials, the depth doesn't necessarily comport with the shallow model for such early burials. The anomalies are likely responses to small metallic objects scattered throughout the pasture.

Given relative abundance and seemingly random distribution of anomalies throughout the pasture, there is a low likelihood the anomalies identified west and south of the St. Leo Cemetery represent possible evidence of interments. They are, however, consistent with farming-related metal cast off over the past century. Nevertheless, in an abundance of caution, GeoArc and Tremaine recommend that Magellan monitor anomaly locations within the project construction workspace during construction if this route is selected by the Commission. Additionally, GeoArc

recommends the development of a monitoring plan and coordination with the Office of the State Archaeologist and the Minnesota Indian Affairs Council as needed.

To better determine the approximate size and depth of anomalies (and greater confidence in interpretation), a more in-depth field analysis would be required, including obtaining higher resolution magnetic susceptibility and perhaps ground penetrating radar results over specific anomalies with hand-propelled geophysical equipment. Additionally, or alternatively, identification of anomalies can be obtained through some level of ground-truthing.

5.0 REFERENCES

Holmes, W.H. 1919. The Red Pipestone Quarry. In, Handbook of Aboriginal American Antiquities, Part I, pp. 253-265. Smithsonian Institution, Bureau of American Ethnology Bulletin 60. Government Printing Office, Washington, D.C.

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Disclaimer

No single geophysical method should be regarded as an absolute means of detecting all subsurface features. TREMAINE qualifies that detection of anomalies is only possible if the subsurface objects/features and their surrounding matrix have contrasting physical properties. Without sufficient contrast, features may not manifest themselves as discrete variations distinct from the typical background signal. Too, different subsurface conditions can produce similar geophysical signatures (e.g., high conductivity may be caused by conductive clay OR conductive brackish saturated sand), making interpretation difficult without some level of ground truth. This potential equivocal outcome stems from the various factors governing apparent conductivity (e.g., soil moisture, grain size, temperature, and porosity). Thus, it is cautioned that the results are not intended to be comprehensive.

APPENDIX 1A

Figures

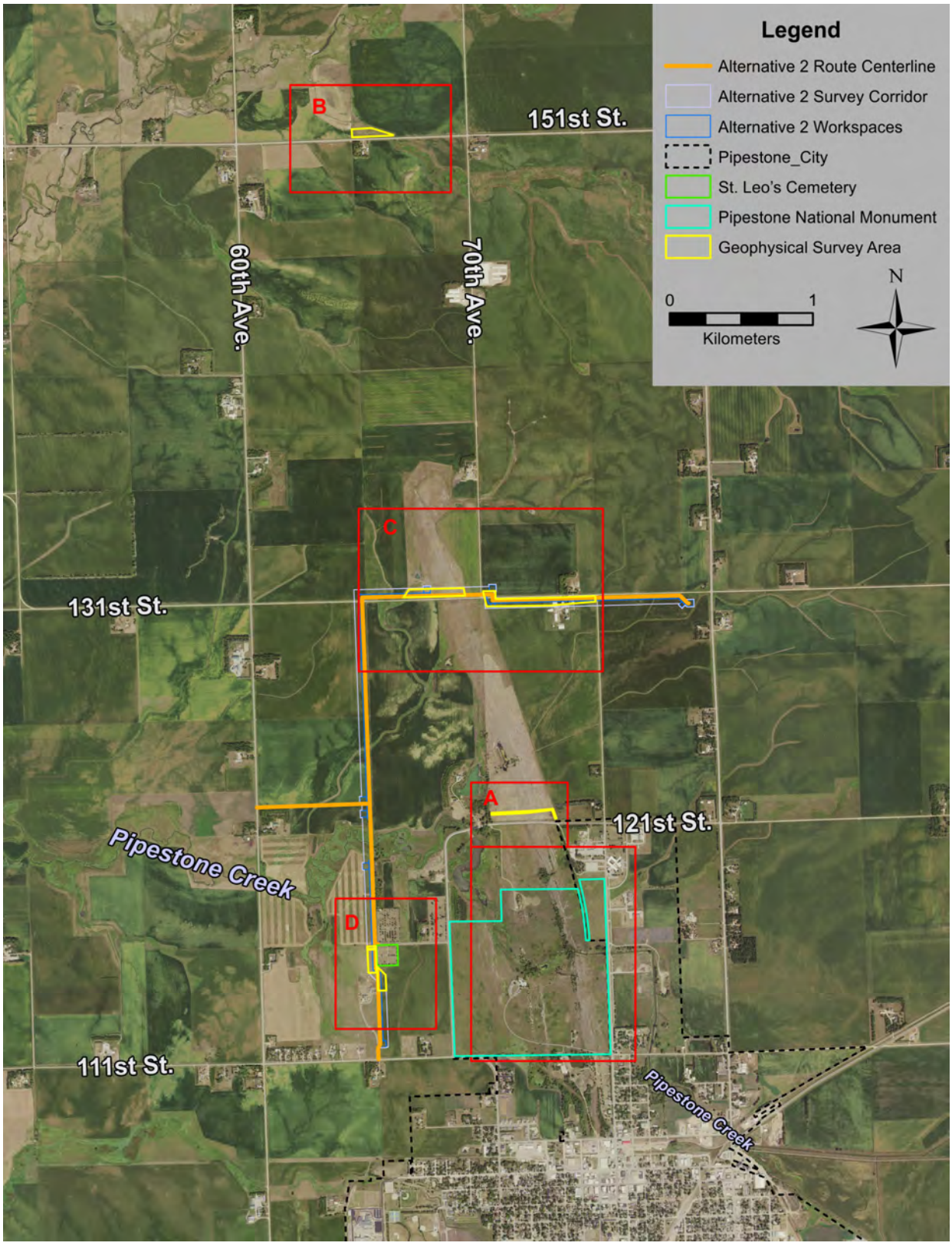

Figure 1. Project area illustrating geophysical survey Locations A-D relative to Pipestone National Monument north of Pipestone, Minnesota, on a color aerial imagery base.

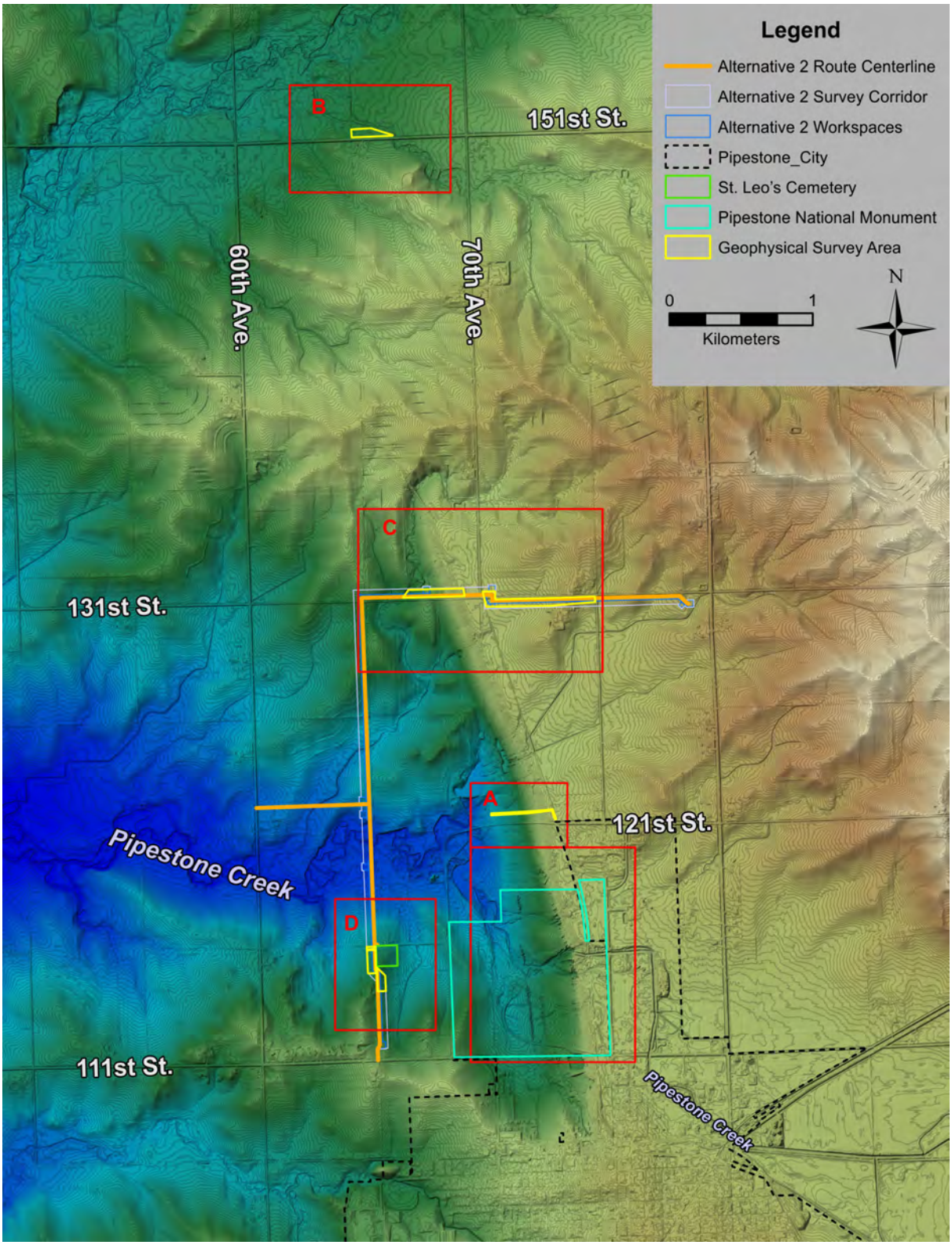

Figure 2. Project area illustrating geophysical survey Locations A-D relative to Pipestone National Monument north of Pipestone, Minnesota, on a color shaded relief digital elevation model base (ve=3x).

Figure 3. The Tremaine DualEM 21 frequency-domain electromagnetic induction (EMI) instrument utilized in the geophysical survey.

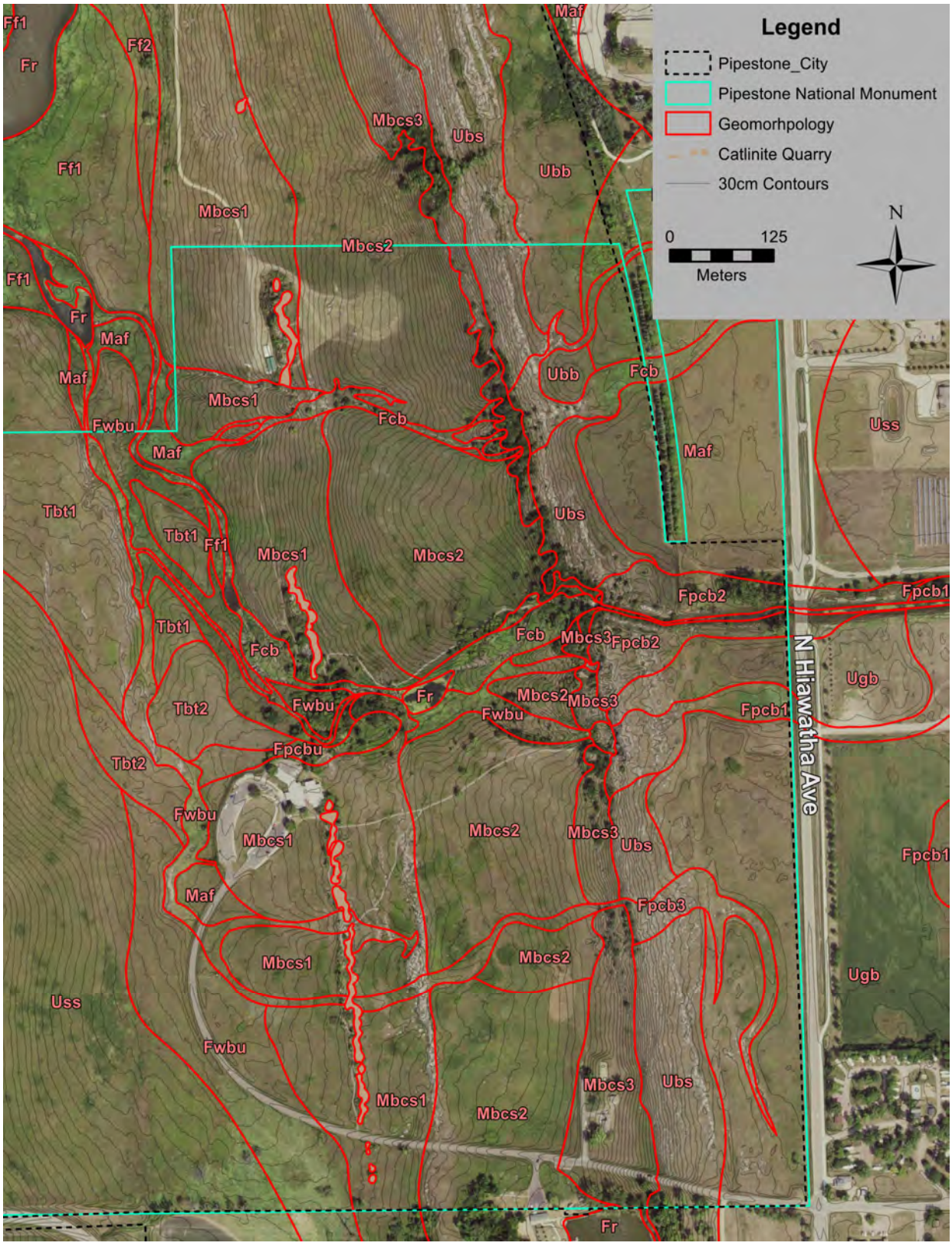

Figure 4. Geomorphology of the Pipestone National Monument and main catlinite quarry areas on a color aerial imagery base.

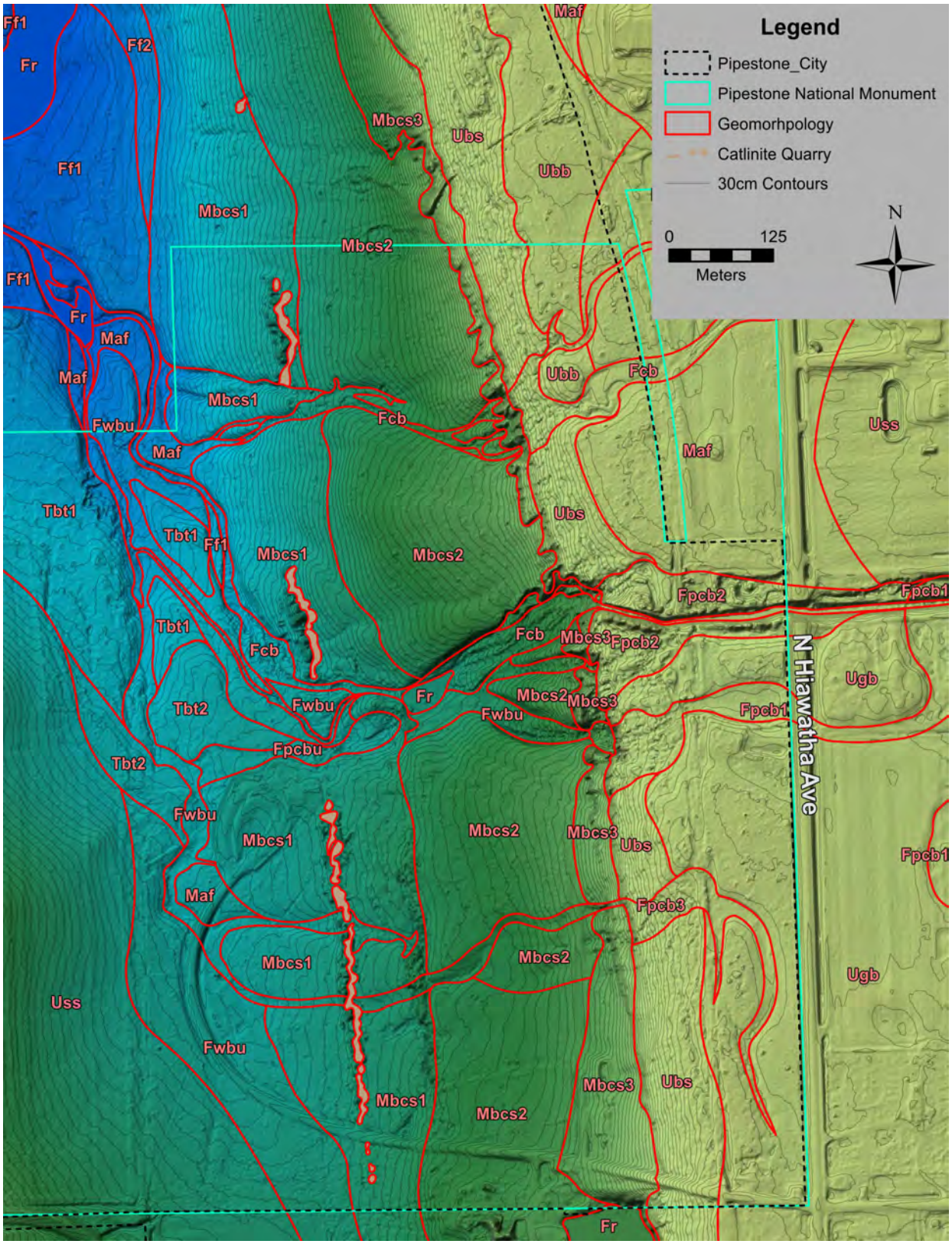

Figure 5. Geomorphology of the Pipestone National Monument and main catlinite quarry areas on a color shaded relief digital elevation model base (ve = 3x).

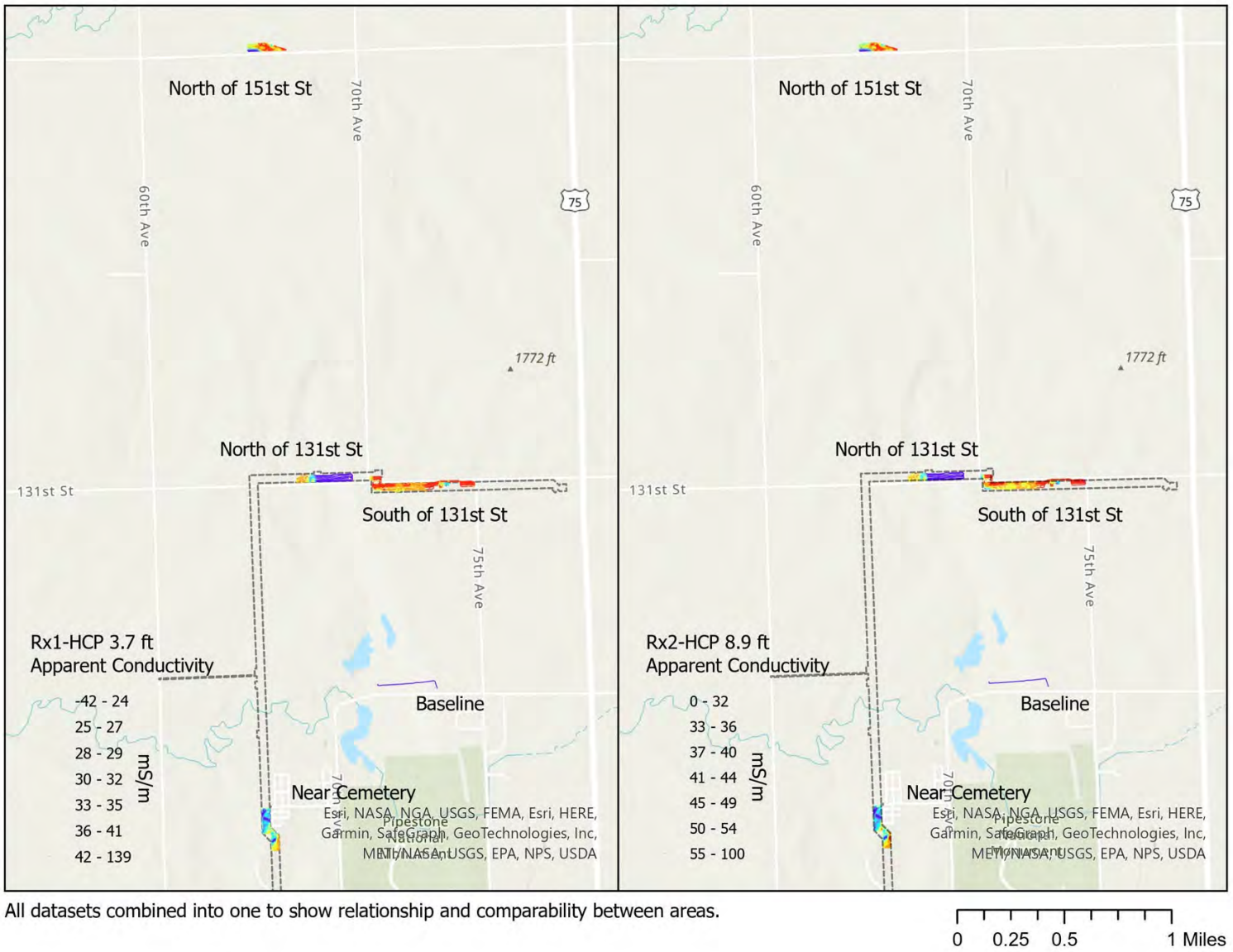

Figure 6. Summary of all AC data sets illustrating relationship and comparability among Locations A through D.

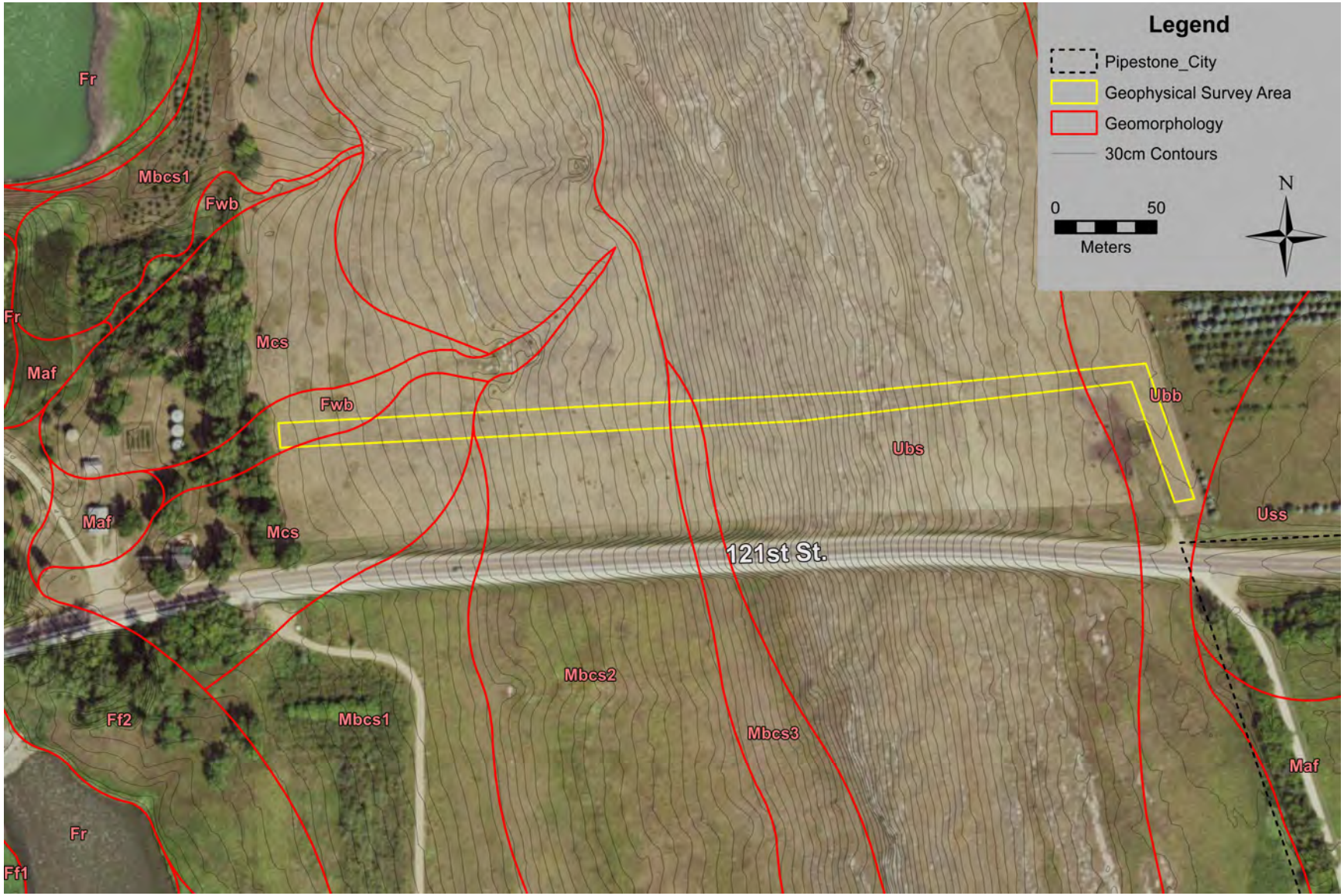

Figure 7. Geomorphology at the baseline data collection Location A on a color aerial imagery base.

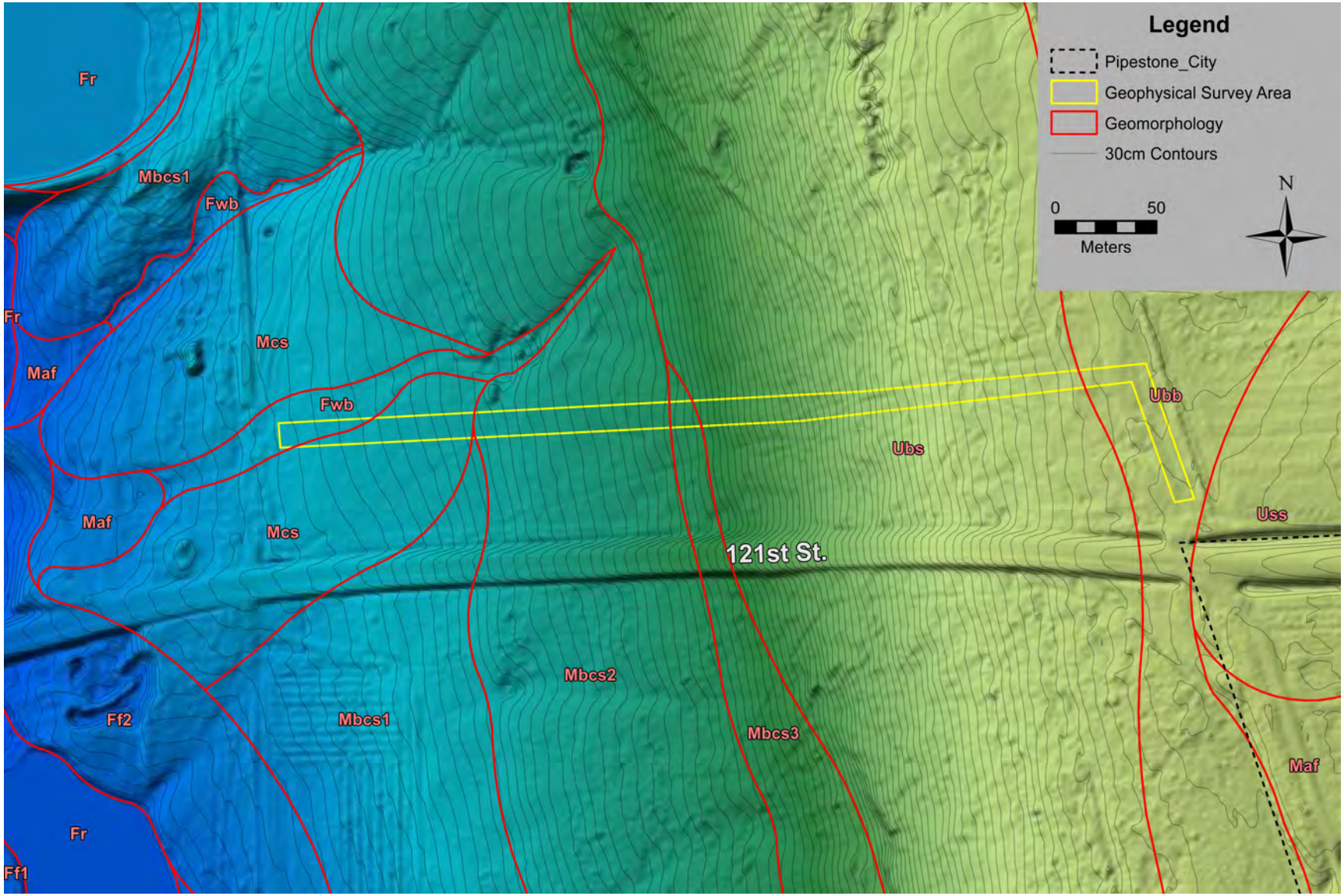

Figure 8. Geomorphology at the baseline data collection Location A on a color shaded relief digital elevation model base (ve=3x).

Figure 9. Apparent conductivity at Location A showing locations of baseline data collection.

Figure 10. Geomorphology at 151st Steet, Location B, on a color aerial imagery base.

Figure 11. Geomorphology at 151st Steet, Location B, on a color shaded relief digital elevation model base (ve=3x).

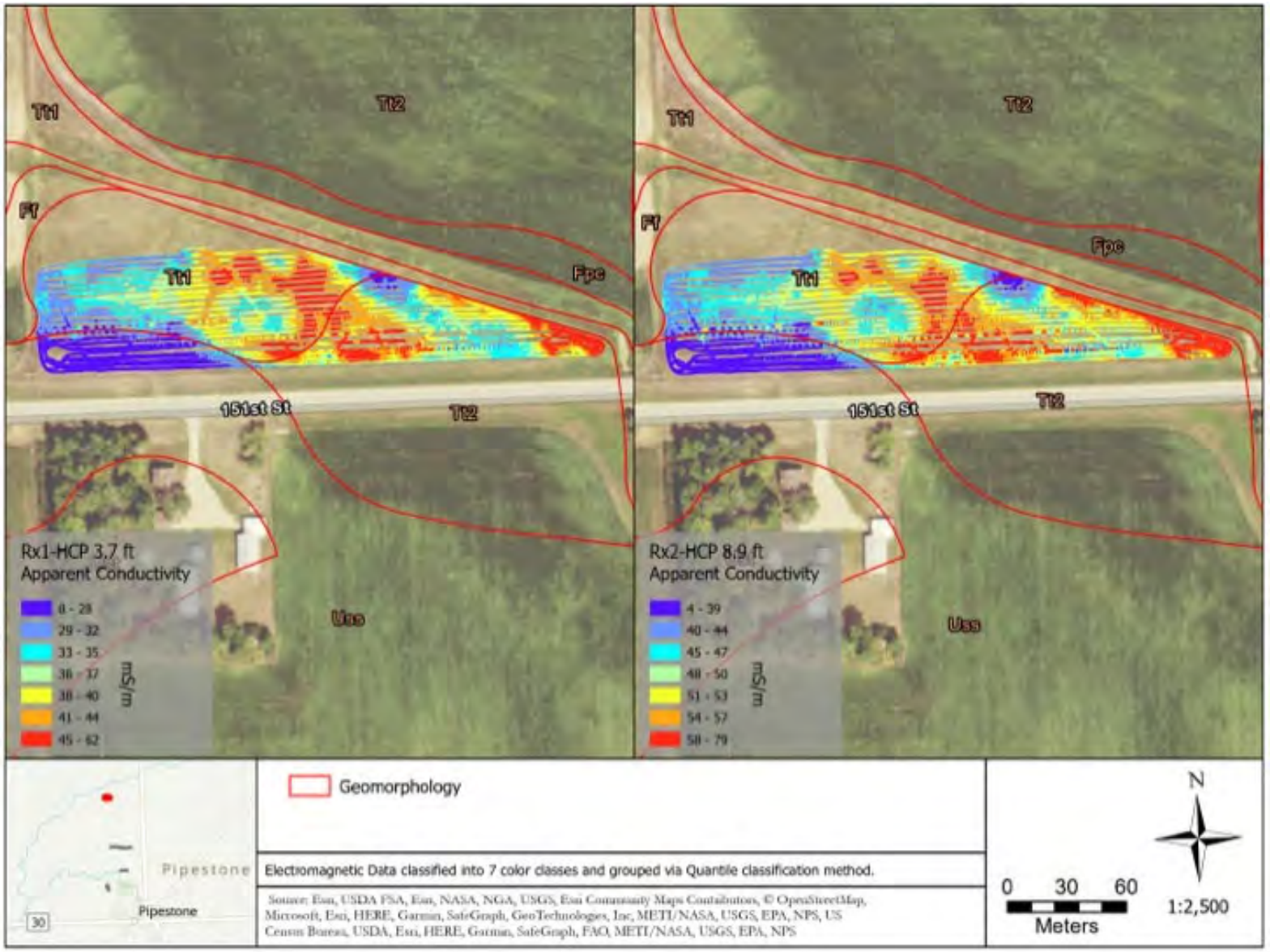

Figure 12. Apparent conductivity north of 151st Street, Location B, Rx1-HCP, 3.7 ft and Rx2-HCP, 8.9 ft.

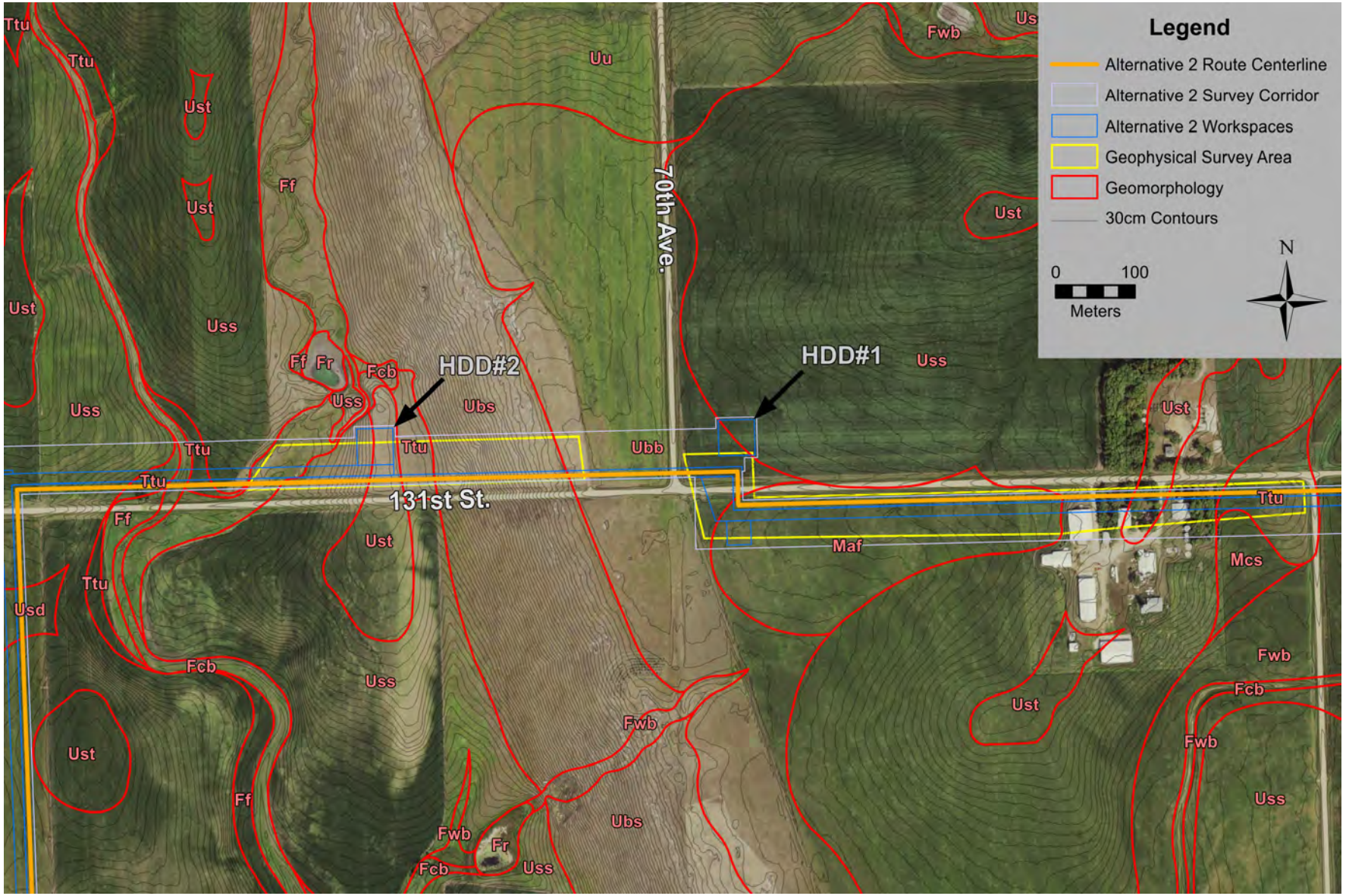

Figure 13. Geomorphology at Route Alternative 2, 131st Steet, Location C, on a color aeral image base.

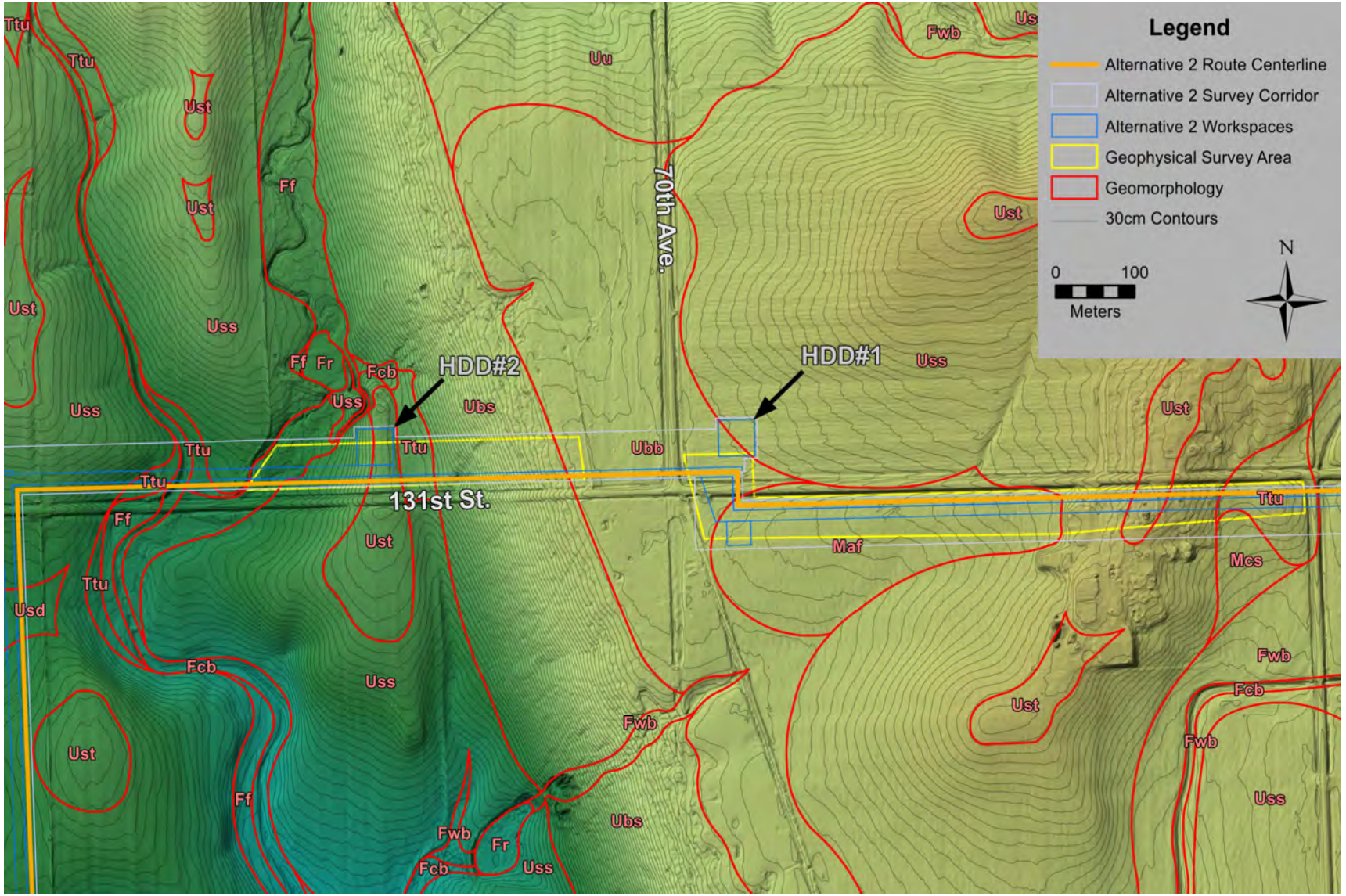

Figure 14. Geomorphology at Route Alternative 2, 131st Steet, Location C, on a color shaded relief digital elevation model base (ve=3x).

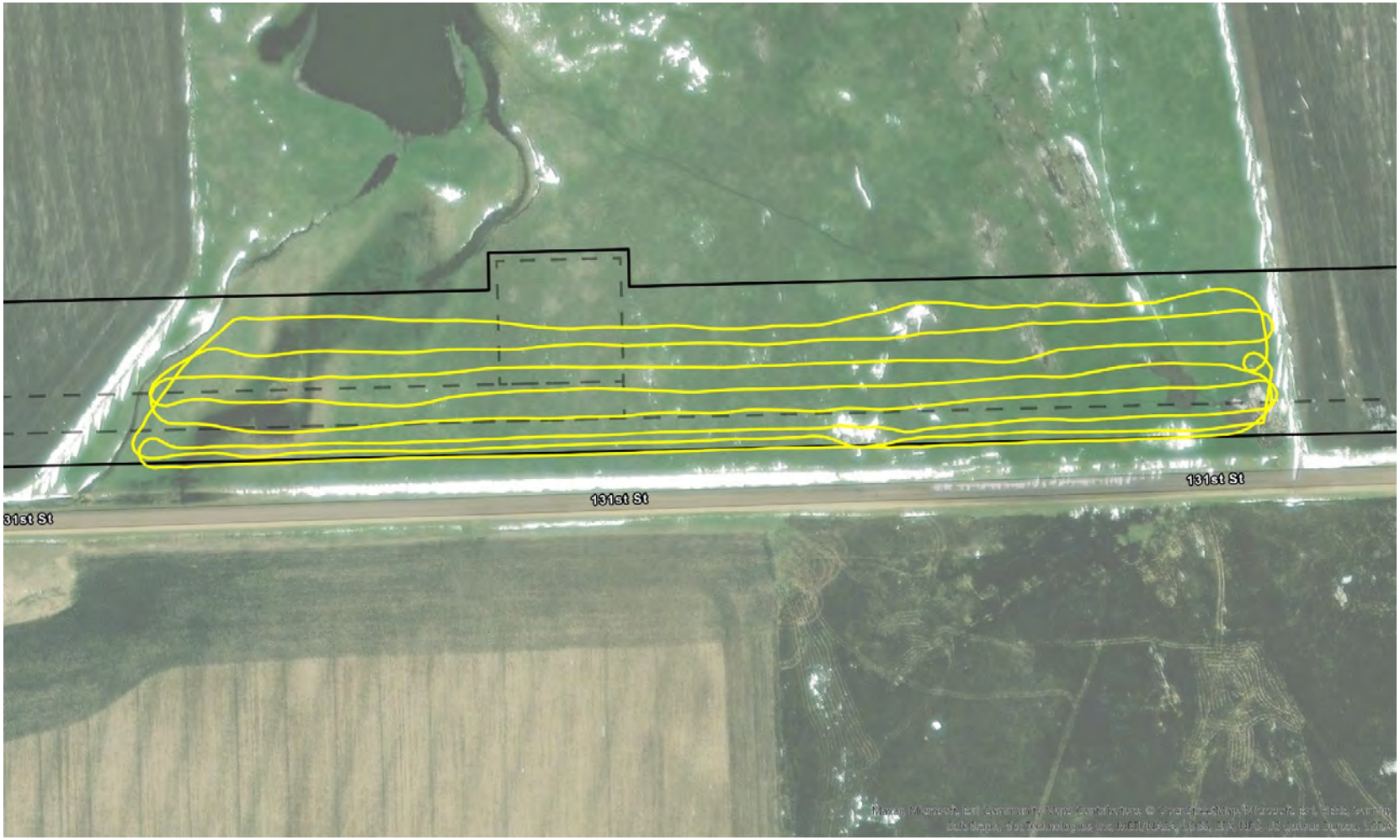

Figure 15. Survey tracks at Location C west of 70th Avenue.

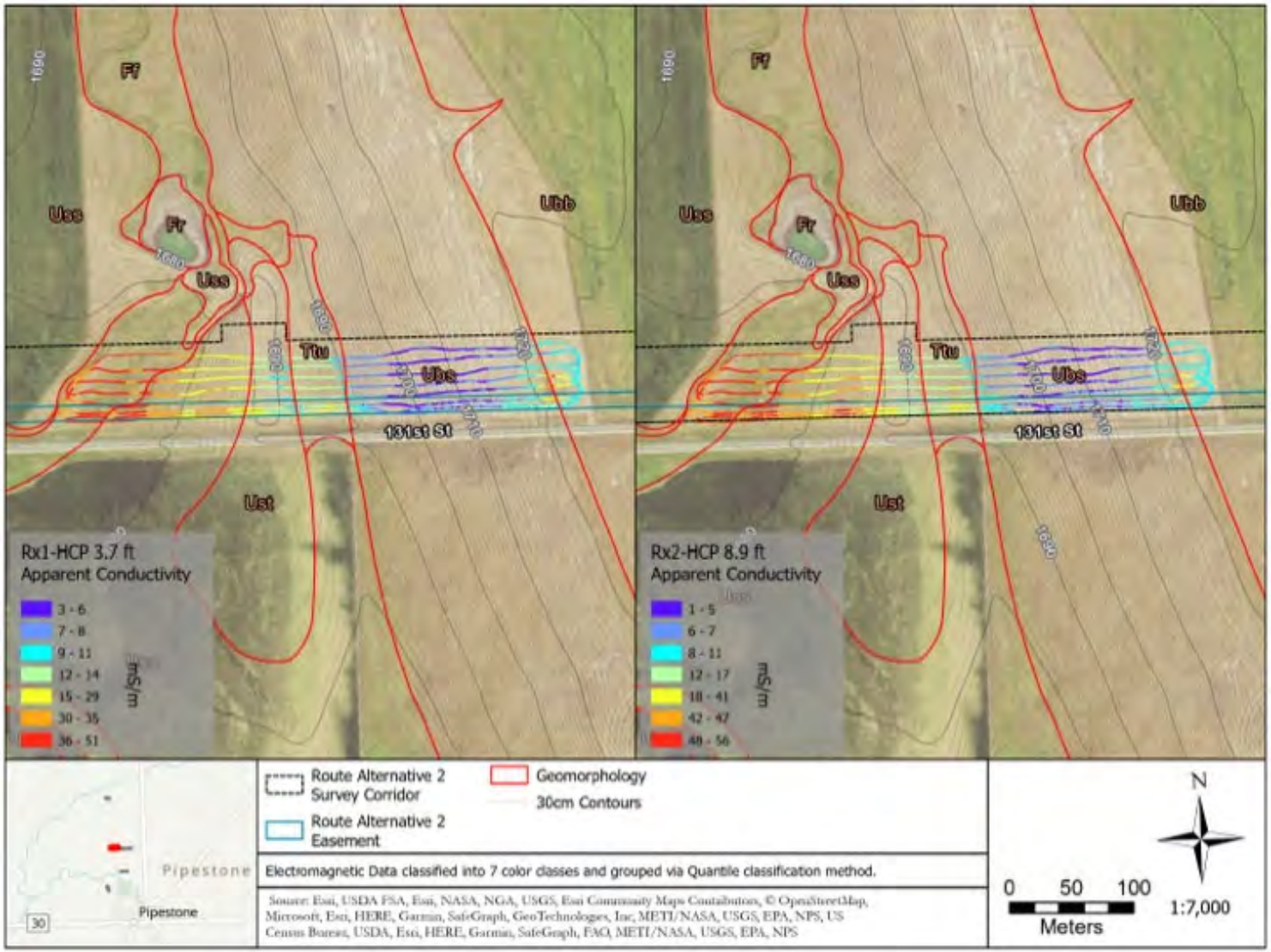

Figure 16. Apparent conductivity, Location C west of 70th Avenue, Rx1-HCP, 3.7 ft and Rx2 HCP, 8.9 ft, with AC values comparable to presumed catlinite values in the HDD#2 workspace vicinity.

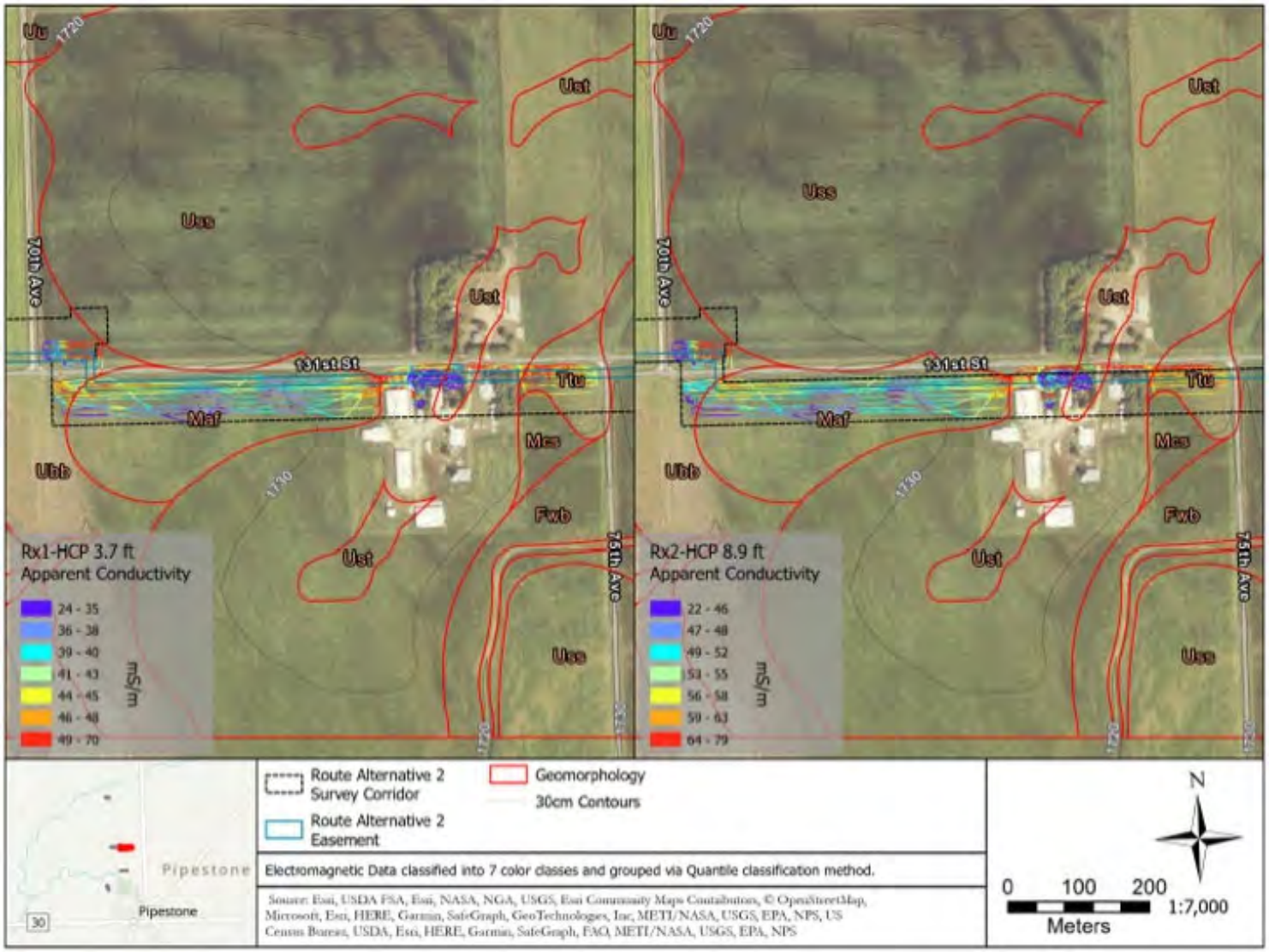

Figure 17. Apparent conductivity, Location C east of 70th Avenue, Rx1-HCP, 3.7 ft and Rx2 HCP, 8.9 ft.

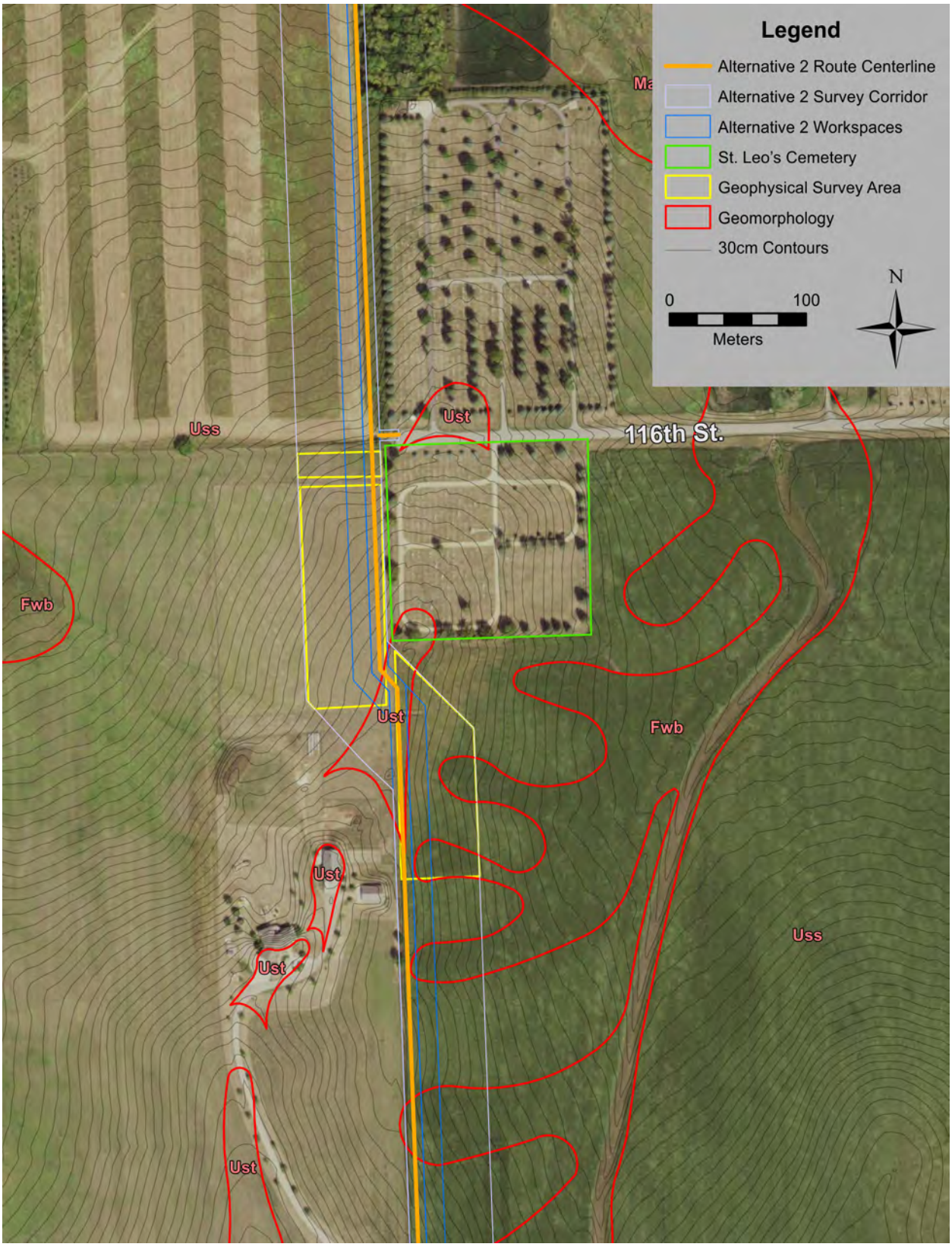

Figure 18. Geomorphology at St. Leo Cemetery, Location D, on a color aerial imagery base.

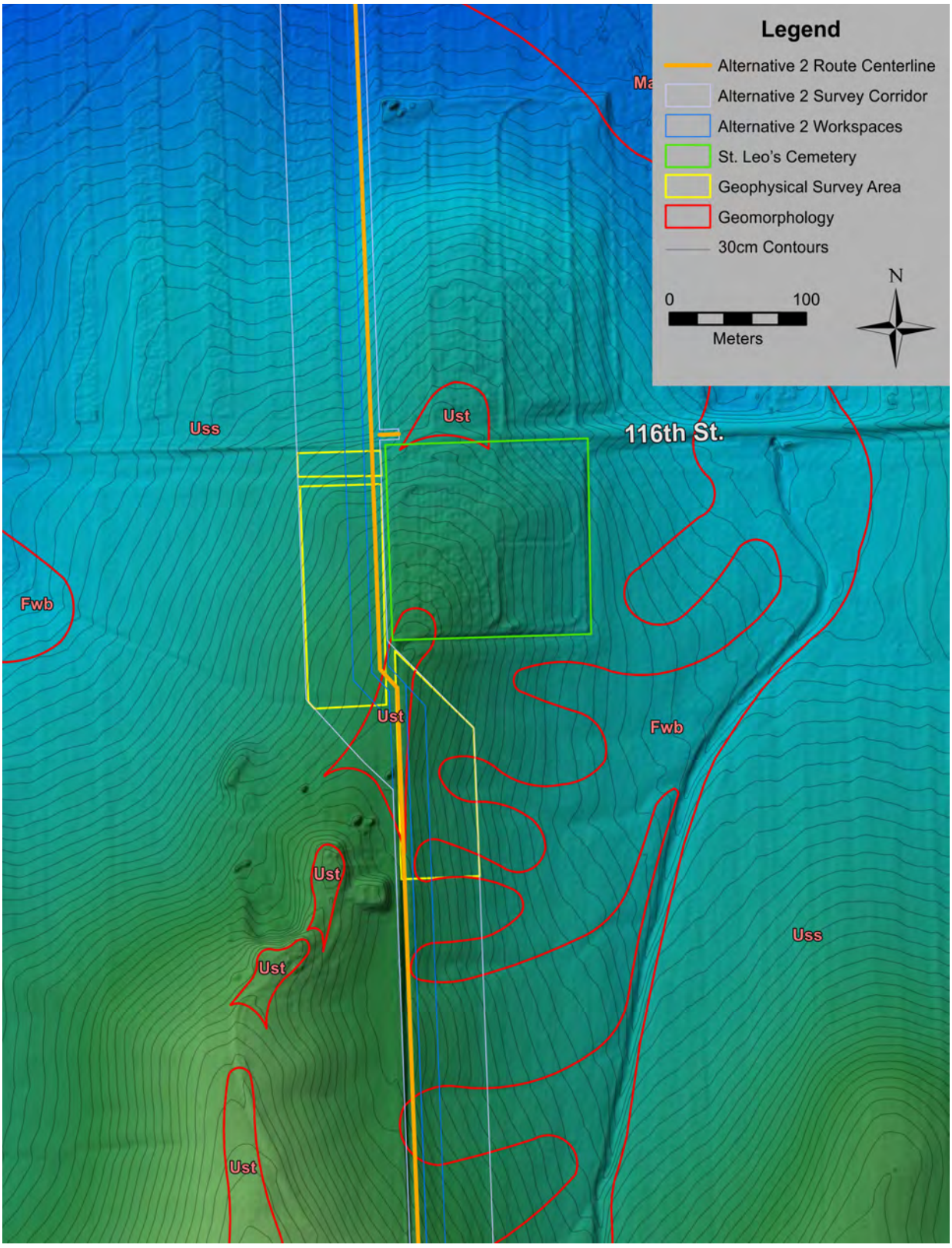

Figure 19. Geomorphology at St. Leo Cemetery, Location D, on a color shaded relief digital elevation model base (ve=3x).

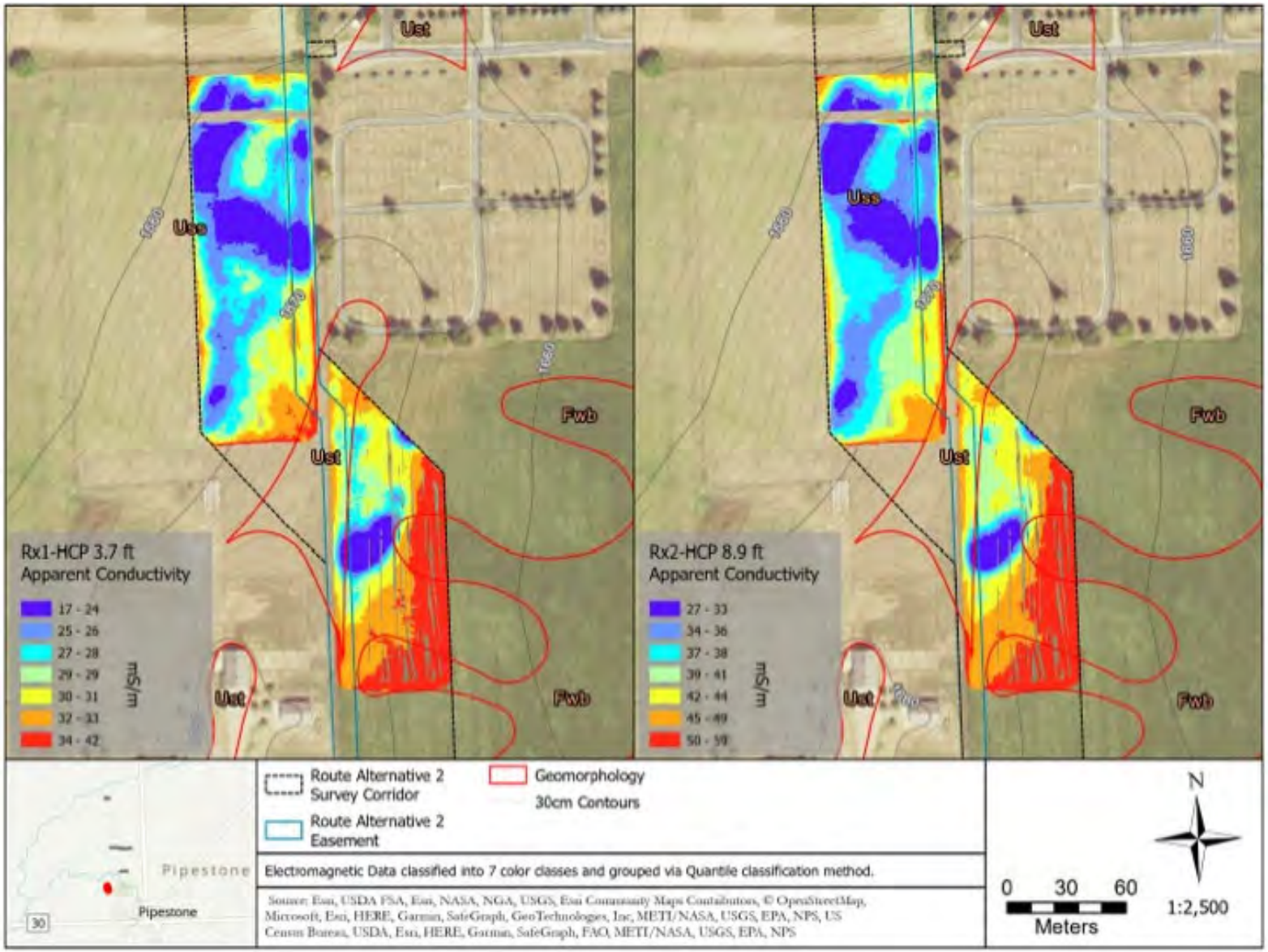

Figure 20. Apparent conductivity west and south of St. Leo Cemetery, Location D, Rx1-HCP, 3.7 ft and Rx2-HCP, 8.9 ft.

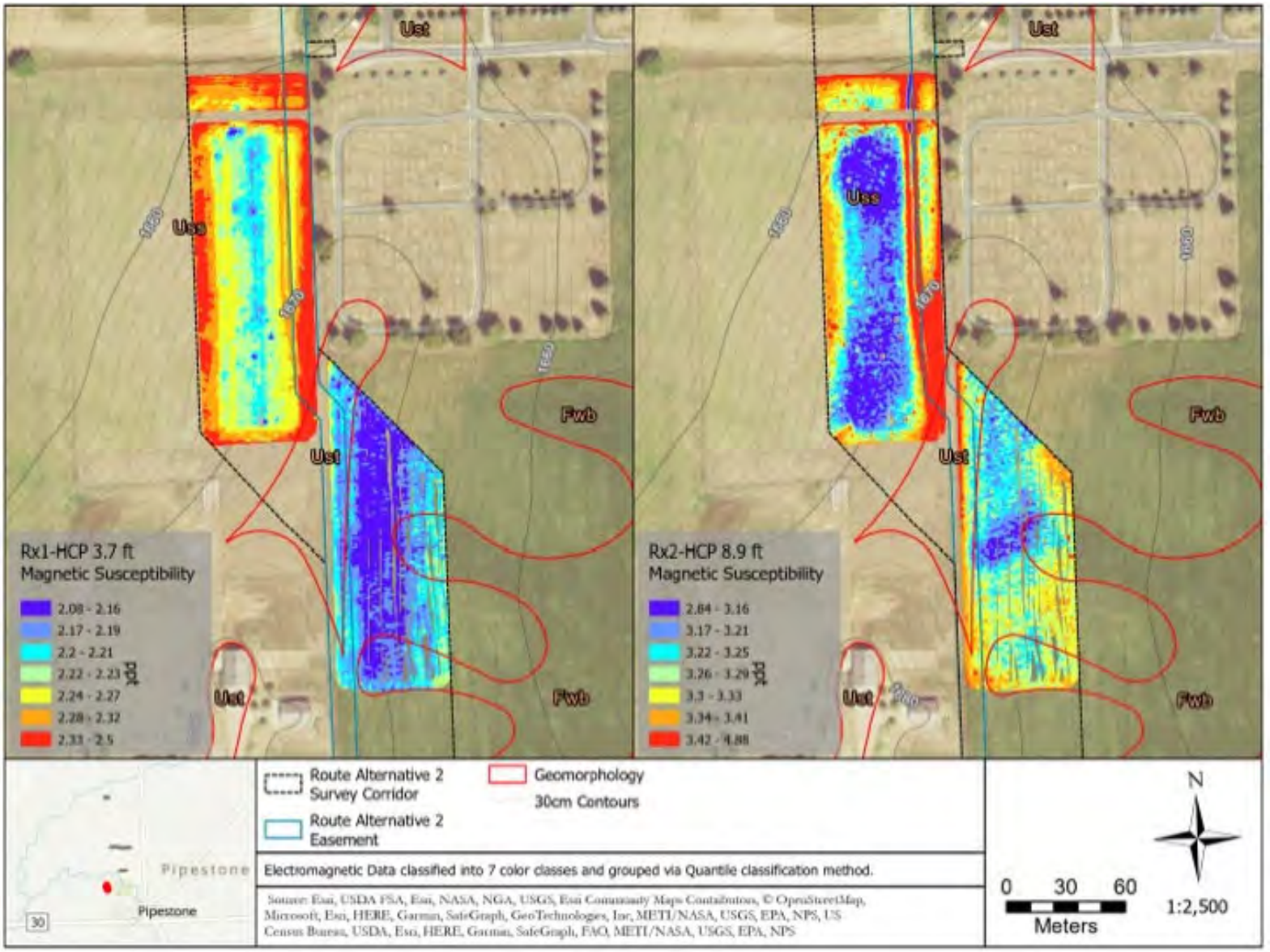

Figure 21. Magnetic susceptibility west and south of St. Leo Cemetery, Location D, Rx1-HCP, 3.7 ft and Rx2-HCP, 8.9 ft.

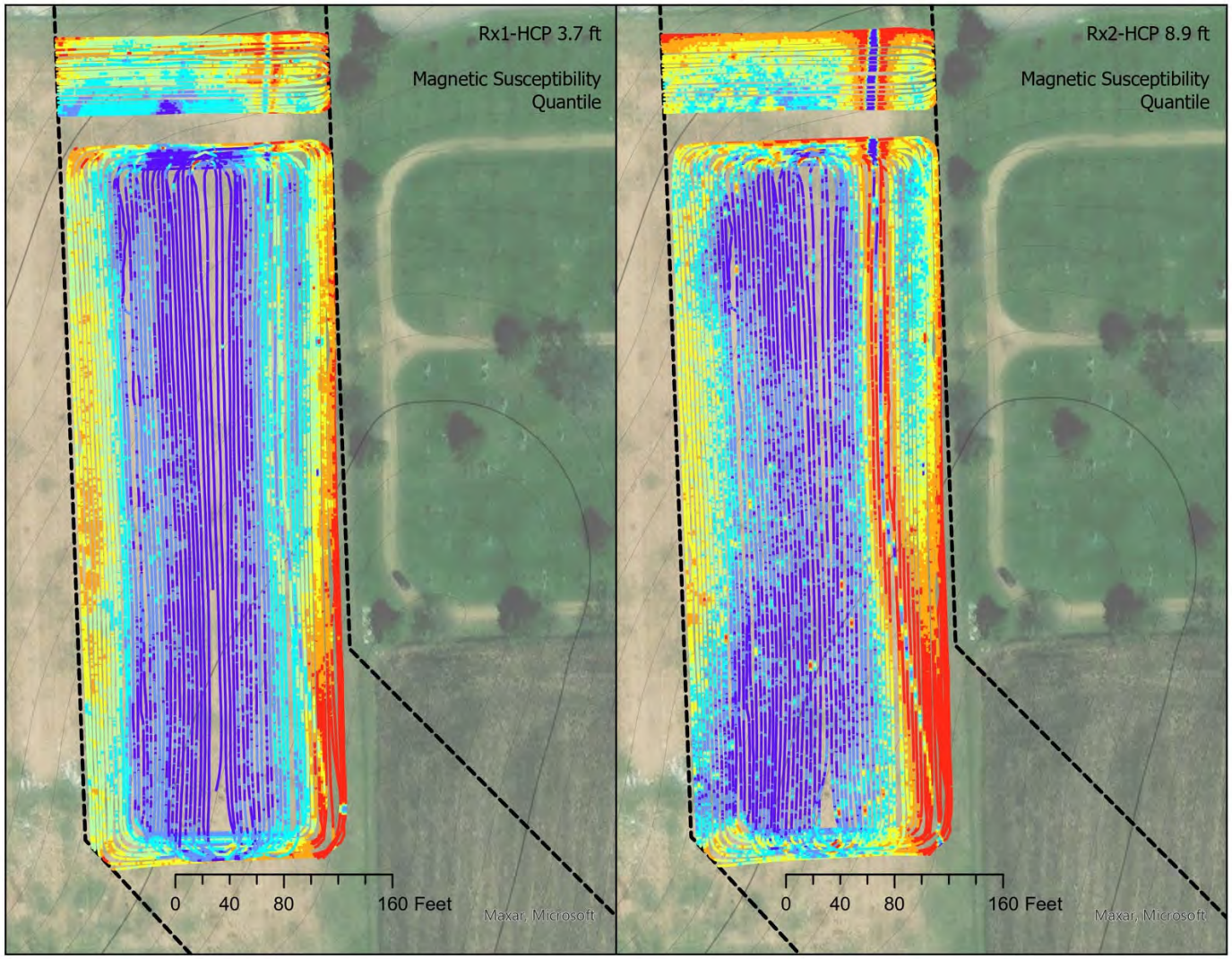

Figure 22. Magnetic susceptibility quantile west of St. Leo Cemetery, Location D, Rx1-HCP, 3.7 ft and Rx2-HCP, 8.9 ft, also reflecting survey tracks.

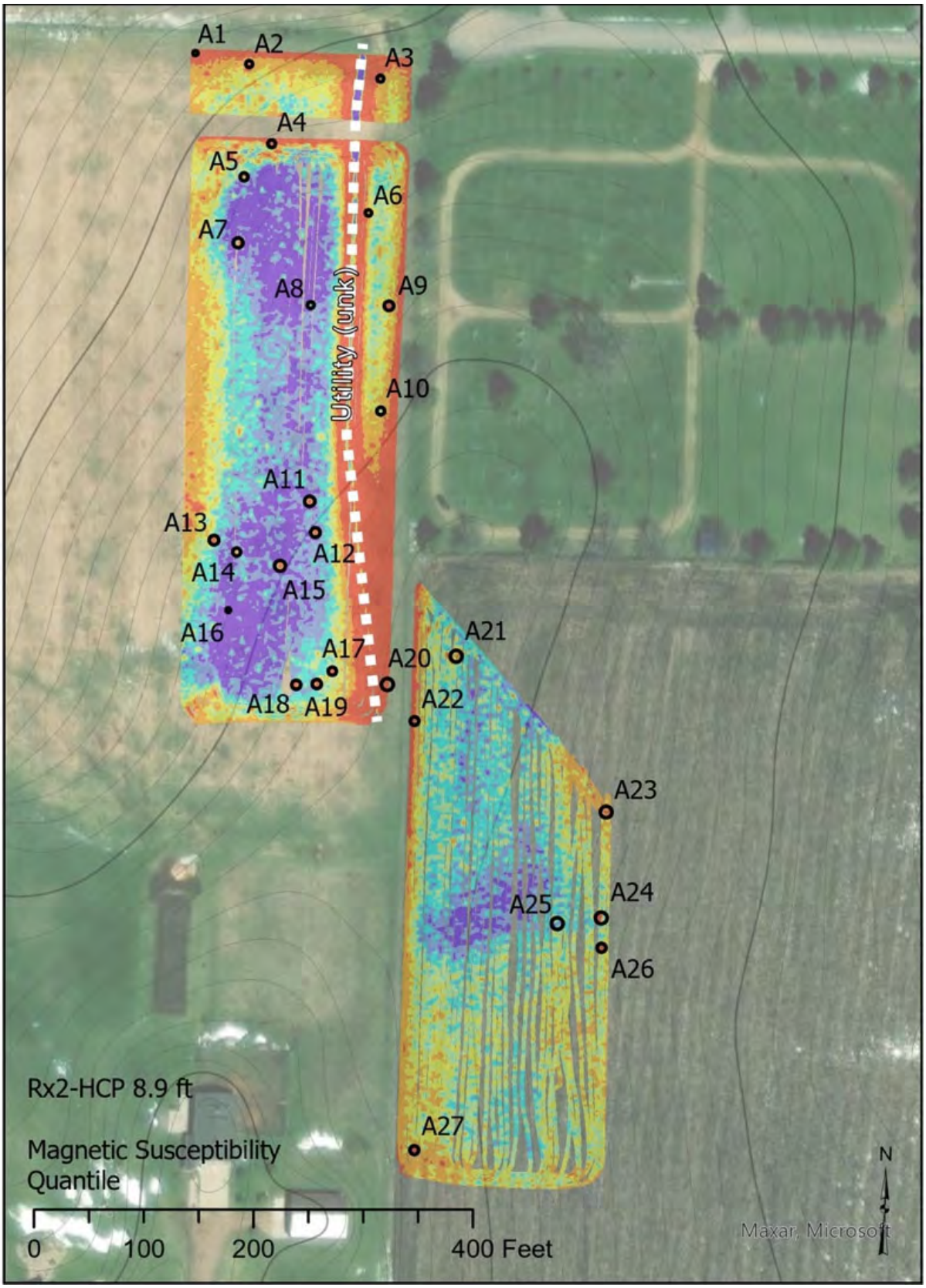

Figure 23. Geophysical anomalies west and south of St. Leo Cemetery, Location D.

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