# Appendix D
# Deeply Buried Site Report

# GEOMORPHOLOGICAL MODEL FOR LOCATING AREAS WITH POTENTIAL FOR DEEPLY BURIED ARCHAEOLOGICAL DEPOSITS ALONG THE CENTER TO GRAND FORKS 345 KV TRANSMISSION LINE CORRIDOR IN NORTH DAKOTA.

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# INTRODUCTION

Geomorphological modeling of the proposed Center to Grand Forks Transmission Line corridor is focused on the identification and mapping of landforms and/or deposits that may have potential to contain deeply buried (>0.5 m below the modern surface) archaeological deposits. Potential is a qualitative measure of the likelihood that a particular geologic environment will contain archaeological deposits in primary context. During the assessment, archaeological variables (settlement and subsistence patterns for example) are not considered. Rather, three major geomorphic criteria are used when assigning a level of potential: (1) age of the deposits, (2) depositional environment, and (3) post-depositional modifications (Hudak and Hajic 2002). Human occupation within the project area occurred from the Late Pleistocene through Holocene (<14,000 $^{14}$C yrs BP). Consequently, sediments deposited during this time span are considered as having chronological potential. Depositional environments most conducive to burying and preserving the primary context of the archaeological assemblage are eolian (dunes, sand sheets, loess sheets), fluvial vertical accretion (floodplains, terraces, alluvial fans), near shore lacustrine, sheet wash colluvium, and mass-wasting off slopes. Post depositional modifications that may disturb the context of the archaeological deposits are pedogenic processes such as bioturbation and shrink-swell in clayey soils, and historic anthropogenic activities such as mining, agriculture, and various construction activities.

The three levels of potential and the criteria for there selection are listed below (modified from Hudak and Hajic 2002, Monaghan et al. 2006, Mayer and McFaul 2008)

> **High Potential:** depositional style yields stratigraphic sequences that are conducive to preserving buried archaeological deposits in primary contexts and with the potential for separation of some of the archaeological components in stacked paleosols or in accretionary deposits with relatively high sedimentation rates.
>
> **Moderate Potential:** (1) depositional style yields stratigraphic sequences that are conducive to preserving buried archaeological deposits but with possible physical modifications to the primary cultural context or; (2) landforms that are likely to have potential for buried archaeological deposits but the stratigraphic contexts of these landforms is unknown or geographically variable.
>
> **Low Potential:** deposits that are too old or too thin to contain buried archaeological deposits in primary context or deposits that accumulated in high-

energy depositional environments, fluvial channels for example, where any contained archaeological deposits are not in primary context.

## PREVIOUS RESEARCH

Previous research covers investigations of geologic environments where archaeological deposits may be preserved. In North Dakota most of the deposits of Late Wisconsinan and Holocene age are classified as the Oahe Formation (Clayton et al. 1980). The one exception pointed out by Clayton et al (1980) and relevant here are the early Holocene Lake Agassiz beach deposits that are, because of there grain-size and lack of organics, a part of the Coleharbor Group which underlies the Oahe Formation. The Oahe Formation includes sediment deposited in eolian, fluvial, and lacustrine/paludal depositional environments. The Oahe Formation is subdivided into four members (oldest to youngest): (1) Mallard Island, (2) Aggie Brown, (3) Pick City, and (4) Riverdale (Clayton et al 1980, Clayton and Moran 1976). The Mallard Island Member is Late Wisconsinan in age and tends to occur in areas not glaciated during the Late Wisconsinan and in lacustrine environments (Clayton et al 1976 and 1980). The Aggie Brown Member is Late Wisconsinan through middle Holocene in age and is often marked by the distinctive Leonard Paleosol in eolian depositional environments. The Pick City Member is middle Holocene in age and the Riverdale Member is late Holocene in age (Clayton et al 1980). The Riverdale Member contains the Thompson paleosol in its lower part. Characteristics of the Oahe Formation vary in the different depositional settings in which it occurs with reference to presence and strength of development of paleosols, texture, and fossil content.

### Eolian Environments

The eolian deposits of the Oahe Formation consist of relatively well-sorted sand in dunes and sand sheet, and silt (loess) that forms a blanket-type deposit on uplands and high terraces (Clayton et al. 1976). The Oahe Formation is most complete in eolian depositional settings where thick sequences of loess occur. Thick loess sequences are not ubiquitous but are preserved in landscape positions where slopes are less than about 5° (Clayton et al 1976) and on the lee side of ridges (southeast, east and south sides) and in swales and lows on uplands. In general the upland eolian deposits are thickest (1-2 m) along Missouri River valley (and to the west outside of the project corridor) and thin to the east where they are 0.2 to 1 meter thick (see map in Clayton et al. 1976). Dunes occur where there is a sand source especially on outwash plains and in spillways/meltwater stream valleys.

### Lacustrine Environments

The Oahe Formation has been documented in lakes, ponds and sloughs especially in central and eastern North Dakota (Clayton et al 1980, Bickley and Clayton 1972). The members above the Mallard Island Member are mostly silt and clay textured, stratified lacustrine deposits that often contain fossils. Water levels in these small basins certainly fluctuated with broad climatic shifts and wet and dry period on a century to decadal scale (Last 1984, Laird et al. 1996, Yansa 1998) causing the shorelines' positions to fluctuate up and down (mini- regressions and transgressions).

### Fluvial

River and alluvial fan sediments in the Oahe Formation are stratified channel and overbank deposits that contain weakly developed paleosols (Clayton et al 1980). Most of the exposed river sediment is a part of the Riverdale Member (Clayton et al 1980, Running 1996).

### Geoarchaeology

The Oahe Formation is the stratigraphic framework for understanding context where buried archaeological sites may and do occur. A thorough review of geoarchaeological research in North Dakota as well as the historic context of that research is presented by Artz (1995, 2000) Archaeological deposits have been documented in fluvial and eolian members of the Oahe Formation. Geologic contexts of many of these sites are summarized by Artz (1995) with details in the archaeological literature.

## METHODS

Four data sets are used to determine the level of potential for landforms in the study area: (1) extant geological and geoarchaeological publications and maps, (2) contour maps (1:24,000 scale), (3) NRCS soil maps on Web Soil Survey (USDA nd), and (4) aerial photographs.

Data sources have some limitations when applied to locating buried archaeological deposits and especially when trying to assess the potential conditions of the archaeological record at a particular locality. Surficial geology map units are small-scale making them limited at the scale of archaeological phenomena but do provide a broad landscape context for understanding landforms and deposits. Soil maps are larger scale but still too small scale to capture detail in many of the depositional settings where buried archaeological sites may occur. Soil mapping is based on the idea of a type soil (soil series) that is tied to a landscape segment and parent

material defined at the type section. The soil is then mapped by essentially extrapolating to similar landscape segments over a large area with minimal field verification (Soil Survey Staff 1951, see Holliday 2004, p. 57 for limitations of soil surveys for soil-stratigraphic studies). However, soil maps, especially when used with topographic maps, are a widespread and relatively accurate proxy for determining depositional environments that is critical in predicting the potential for buried archaeological deposits.

Landforms and deposits that have potential to contain buried archaeological deposits are not all equally "visible" using the above non-field techniques of identification. Landforms with high visibility have distinctive well-defined morphology and soil types, and therefore can be plotted relatively accurately using maps and aerial photographs. These include river valley bottoms and associated macro-landforms (terraces and channel belts for example), dune fields, alluvial fans, and colluvial slopes.

Landforms with moderate visibility have poorly defined morphology with multiple soil series and/or are too small to be captured in the soil mapping and therefore their boundaries will be gradational because the geologic phenomena is gradational or because the topographic-soils-aerial photo data resolution is too low. These include isolated low dunes, vertical accretion tributary alluvium, some meso-scale alluvial landforms on low terraces and floodplains. Field observations and probably subsurface investigation would be necessary to more accurately delineate the landform boundaries at an archaeological scale of investigation.

Landforms with low visibility have almost no morphological expression and are not visible on soil maps due to their generic parent material or small size. The existence of these landforms/deposits has been noted by other researchers based on field investigations and may or may not be geographically extensive. These are the loess sheets and sand sheets.

The first step in the process of mapping the potential for buried archaeological deposits is to examine the extant literature and determine (1) the context of known buried archaeological deposits, and, where possible, (2) the nature and location of Late Pleistocene and Holocene landforms. The second step uses soil maps/aerial photos and 1:24,000 scale topographic maps to determine where along the corridor landforms with potential for buried archaeological sites are located. This is an iterative process that involved finding landforms on topographic maps, such

as stream valleys or paleoshorelines, checking the soil types in those areas, then delineating the portion of the landscape where potential for deeply buried sites occurs.

Each landform will be assigned a level of potential for the presence of buried archaeological sites using the context of known buried sites and reconstructions from the literature of Holocene and late Pleistocene depositional environments and stratigraphic sequences.

The third step is to plot localities with high and moderate potential for buried archaeological deposits within the 1000 ft wide study corridor on 1:24,000 topographic maps. Landforms are determined by morphology as expressed on the topographic maps and by the distribution of soil series associated with those landforms and are listed in Table 1. Tonal changes on aerial photos will also be used to aid in the placement of landform boundaries.

## RESULTS

The proposed transmission line corridor crosses North Dakota west to east from the older glaciated terrain of the Missouri Plateau near Center, across the Missouri River valley, then across the Late Wisconsinan glacial deposits on the Missouri Coteau and in the lowlands to the east, and then across the abandoned basin of Lake Agassiz to Grand Forks. Due to differences in age and the dominant geologic processes the landscapes these different physiographic regions are very different.

Localities with high, moderate, and moderate to low potential for deeply buried archaeological deposits are plotted on the 1:24,000 scale maps provided by the client (see Appendix B). These potentials are also shown in table form in Appendix A. Low potential localities were eliminated during the first pass through the data.

### Eolian Landforms and Depositional Environments

Three eolian landforms occur in the project corridor: (1) loess blankets, (2) dunes, and (3) sand sheets. Loess blankets and sand sheets have very subtle morphological expression making them difficult to delineate on 1:24,000 topographic maps. Boundaries must be estimated from geologic maps and soil maps. Loess occurs in varying thicknesses along the entire corridor due to differential preservation. As stated earlier the thicker loess occurs near the Missouri River valley on slopes of less than 5° and on the lees side of ridges and in saddles and swales in

uplands. Well-developed paleosols occur in the thicker sequences indicating prolonged periods of geomorphic stability. Paleosols have high potential for buried archaeological deposits. In the thinner loess deposits paleosols soils may be welded with the surface soils creating a thick dark upper solum that also may contain buried archaeological deposits.

Dunes have a distinctive morphological expression especially if they occur in dune fields. Sand sheets do not have a distinct morphology but can often be detected by the soil type present. Geomorphic stability of sandy deposits is dependent on a number of geomorphic variables that are often tied to climate and land-use through their effects on vegetative cover.

**Fluvial Landforms and Depositional Environments**

Fluvial landforms are channel belts, floodplains, alluvial terraces, meltwater stream terraces and alluvial fans. In the lower order streams channel belts, floodplains, and low terraces cannot be separated using the data at hand so are referred to as valley bottoms. These landforms can likely be differentiated in the field. Small alluvial fans also cannot necessarily be delineated with the data at hand but they are assumed (for the purpose of this report) to be present at the mouths of tributary valleys along valley margins. These areas should be deep tested. Larger fans are visible on the 1:24,000 scale maps and do contain buried sites in fluvial and other depositional contexts (Running 1996).

**Lacustrine Landforms and Depositional Environments**

Two lacustrine geomorphic settings with potential for deeply buried archaeological deposits are present within the transmission line corridor: (1) shoreline zones around small lakes, ponds, and sloughs of glacial origin, and (2) shoreline complexes formed in proglacial Lake Agassiz. Small inland water bodies are resource loci that are utilized by human populations. Water levels in these lakes have fluctuated over the time span of the Holocene creating a shoreline zone where transgressions and regressions have occurred. Archaeological sites in the shoreline zone associated with low water can be buried and preserved during periods of high water. Intensive review of paleoenvironmental studies of lakes in the northern plains would likely provide data on the width of the active shoreline zone in different types of lakes.

Lake Agassiz was established in the southern end of the basin during the Cass and Lockhart Phases between 11,600 and 11,000 BP at which time its outlet was to the south through River Warren (Minnesota River valley) (Teller 1985). Beaches crossed by the transmission line

corridor formed during this time period. During the Moorehead Phase (11,000 and 9900 BP) the retreat of the glacial ice opened outlets to the east causing water levels drop precipitously exposing the former lake bottom to subaerial processes including soil formation and possibly human settlement. A re-advance of the glacier during the Emerson Phase (9900-9500 BP) cause water levels to rise in the southern part of the basin and the outlet again became the River Warren. During this time the lower beaches crossed by the transmission line corridor were formed. Archaeological deposits could be buried at these shoreline locations by nearshore lacustrine processes when Lake Agassiz was present or after the shorelines were abandoned by eolian or fluvial processes.

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# Appendix A

Deep Test Locality Soil and Geomorphic Data

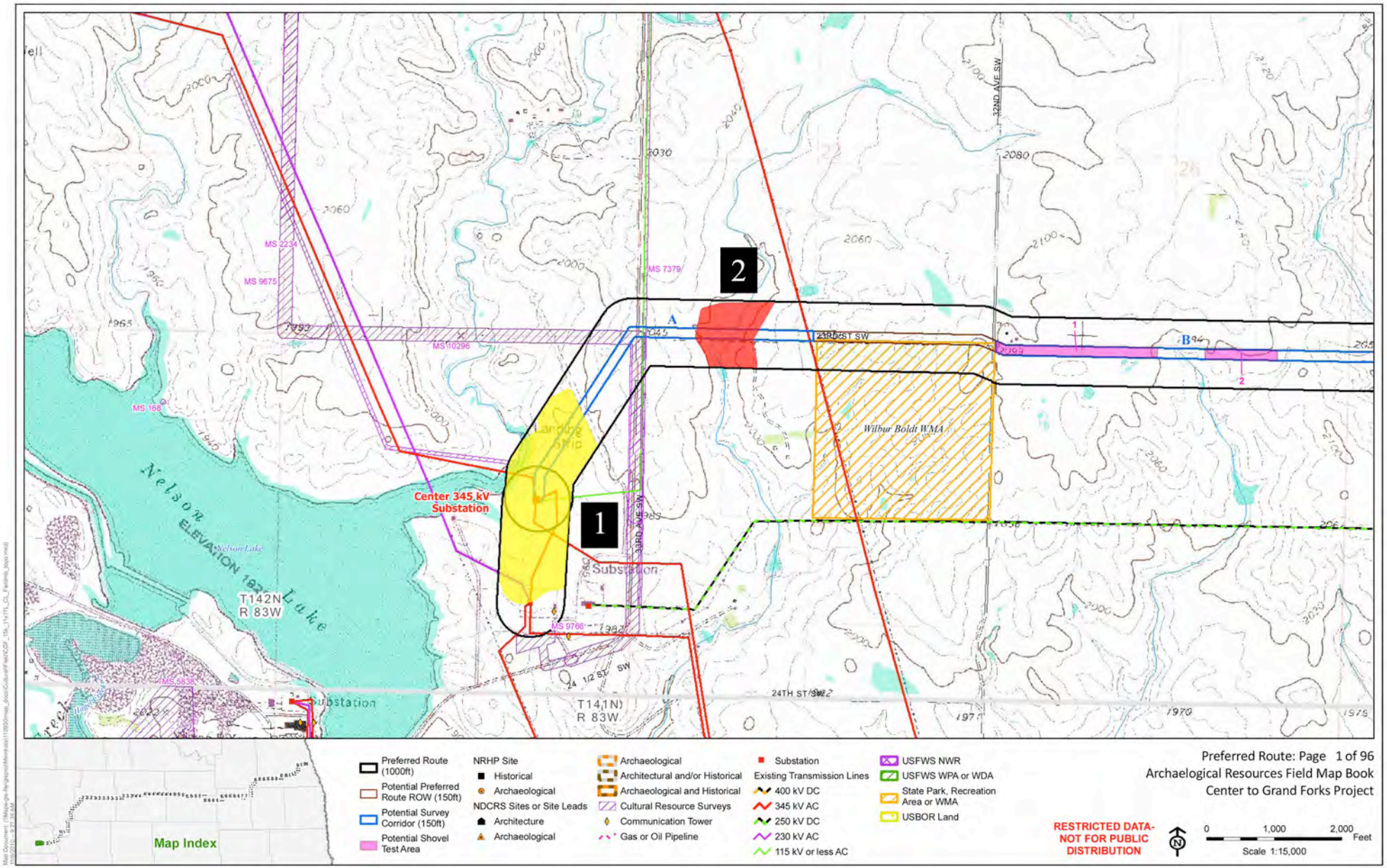
| Locality # | Locality Name | HDR Page # | Landform | Soil Series | Deposits | Geologic Potential |
|---|---|---|---|---|---|---|
| 1 | Nelson Lake | 1 | terace & alluvial fans | Arnegard, Williams | alluvium & till | moderate |
| 2 | Intermittent Stream 1 | 1 | valley bottom | Belfield, Daglum | allivium | moderate - low |
| 3 | Missouri River Trib 1 | 4 | alluvial fans/valley margin & valley bottom | Straw, Arnegard | alluvium | moderate |
| 4 | Sherk Creek | 4 & 5 | valley bottom & alluvial fans | Regan, Straw | alluvium | high |
| 5 | Missouri River Trib 2 | 4 | valley bottom, alluvial fans, terrace | Lehr, Straw, Arnegard | alluvium | high |
| 6 | Missouri River N | 5 | channel belt, floodplain & terraces | Havrelon, Mandan | alluvium | high |
| 7 | Missouri River S | 5 | alluvial fan, channel belt, floodplain & terraces | Havrelon, Harriet | alluvium | high |
| 8 | Missouri River East Uplands | 6,7 & 8 | valley bottoms & uplands with < 5° slopes | Temvik, Linton, Mandan and others | loess & alluvial | moderate |
| 9 | Intermittent Stream 2 | 7 | valley bottom & alluvial fan | Temvik, Arnegard | alluvium | moderate |
| 10 | Yanktonai Lake | 9 | valley bottom, high terrace and upland | Temvik, Harriet, Rhodes Complex | alluvium & loess | moderate |
| 11 | Yanktonai Creek | 9 | valley bottom & high terrace | Harriet | alluvial & loess | moderate |
| 12 | Grass Lake Inlet | 13 | valley bottom | Heil, Arnegard | alluvial | moderate |
| 13 | Painted Woods Creek | 14 & 15 | valley bottom | Harriet, Grail, Arnegard | eoilan & alluvial | moderate |
| 14 | ephemeral stream/wetland | 26 | lake edge & alluvail fan | Southham | lacustrine/colluvial & alluvial | moderate |
| 15 | Mertz Slough Shoreline & Inlet | 32 | lake edge & valley bottom | Parnell | lacustrine & alluvial | moderate |
| 16 | James River 1 | 38 | valley bottom, dunes & high terraces | Lowe, Egeland, Embden, Arvilla | alluvial & eolian | high |
| 17 | Alluvial Fan | 40 | alluvial fan | Emrick, Larson | alluvium | moderate |
| 18 | Rosefield Slough 1 | 48 | valley bottom | Lowe | alluvial | moderate-low |
| 19 | Rosefield Slough 2 | 48 | valley bottom & margin (dammed lake) | Lowe & Hecia | (dammed lake) alluvial & eolian | moderate - low |
| 20 | Rocky Run 1 | 49 | valley bottom | Lowe | alluvial | moderate to low |

| | | | | | | |
|---|---|---|---|---|---|---|
| 21 | Rocky Run 2 | 50 | valley bottom | Lowe | alluvial | moderate to low |
| 22 | Rocky Run 3 | 50 | valley bottom | Lowe | alluvial | moderate to low |
| 23 | Trib James River | 52 | valley bottom | Lowe | alluvial | moderate |
| 24 | James River 2 | 52 | channel belt, floodplain terrace, alluvial fan | Ludden, La Prairie | alluvium | high |
| 25 | Intermittent Stream3 | 55 | valley bottom | Lowe | alluvial | moderate to low |
| 26 | Intermittent Stream 4 | 56 | valley bottom & dunes ? | Lowe, Hecia, Towner | alluvial & eolian | moderate |
| 27 | Spillway Wetland | 57 | valley bottom/lake | Southham | alluvial & lacustrine | moderate |
| 28 | Baldhill Ceek | 64 | valley bottom | Lowe | alluvial | moderate to low |
| 29 | Spillway Wetland | 66 | abandoned lake & alluvial fans? | Southham | alluvial & lacustrine | moderate |
| 30 | Lake Norway | 67 | lake/shorelines | NA | lacustrine | moderate to low |
| 31 | Trib Sheyenne River | 70 | high terrace & valley bottom | Walsh, Swenoda, Barnes, Embden, Dicky | alluvial & eolian | moderate |
| 32 | Sheyenne River S | 70 | high terrace, floodplain, channel belt & alluvail fans | LaDelle, Ludden, Walsh | alluvial | high |
| 33 | Sheyenne River N | 71 | high terrace, floodplain, channel belt | LaDelle, Ryan, Ludden | alluvial | high |
| 34 | Pickeral Lake Creek | 72 | valley bottom | Lowe | alluvial | moderate to low |
| 35 | Goose Creek | 80 | valley bottom | Lowe | alluvial | moderate to low |
| 36 | Spring Creek 1 | 82 | valley bottom | Lowe | alluvial | moderate to low |
| 37 | Spring Creek 2 | 81 | valley bottom | Lowe | alluvial | moderate to low |
| 38 | Lake Aggassiz Shoreline | 83 & 84 | paleoshoreline | Antler, Renshaw, Divide, Colvin | nearshore lacustrine, eolian | moderate |
| 39 | Goose River | 84 | valley bottom | LaDella, Zell | alluvial | high |
| 40 | Little Goose River | 84 | valley bottom | LaDella, Lamoure | alluvial | high |
| 41 | L. Agassiz shoreline | 87 | paleoshoreline | Wyndmere, Hecia, Maddlock, Bearden, Antler, Renshaw, Divide, Covin | nearshore lacustrine, eolian | moderate |

| | | | | | | |
|---|---|---|---|---|---|---|
| 42 | L. Agassiz Shoreline N | 88 | paleoshoreline | Hecia, Maddock, Hamar, Marysland, Arvilla, Tiffany | nearshore lacustrine, eolian | moderte |
| 43 | L. Agassiz Shoreline S | 88 | paleoshoreline | Hecia, Maddock, Hamar, Marysland, Arvilla, Tiffany | nearshore lacustrine, eolian | moderate |
| 44 | EnglishCouleer/Lake Agassiz Shoreline Complex | 89 | paleoshoreline & valley bottom | Towner, Marysland, Arvilla, Antler, Velva | alluvial, eolian and near shore lacustrine | high |
| 45 | L. Agassiz Shoreline/English Coulee | 90 | valley bottom & paleoshorelne | Arvilla, Antler, Rockwell, Gilby, Sioux | alluvial and near shore lacustrine | high |
| 46 | L. Agassiz Shoreline/ English Coulee trib | 90 | valley bottom & paleoshorelne | Arvilla, Antler, Rauville | alluvial and near shore lacustrine | moderate |
| 47 | Lake Agassiz Shoreline | 91 | paleoshoreline | Arvilla, Embden, Antler | near shore lacustrine | |
| 48 | English Coulee Trib | 92 | valley bottom & upland margin | Ojata, Zell-La Delle, Renshaw | alluvial | moderate |
| 49 | Intermittent stream/paleochannel | 94 | valley bottom & upland margin | Bearden, Lallie | alluvial | moderate |
| 50 | English Coulee Ditch | 95 | valley bottom & upland margin | Bearden, Ojata | alluvial | moderate |

# Appendix B

Location of Deep Test Localities on 1:24,000 Topographic Maps

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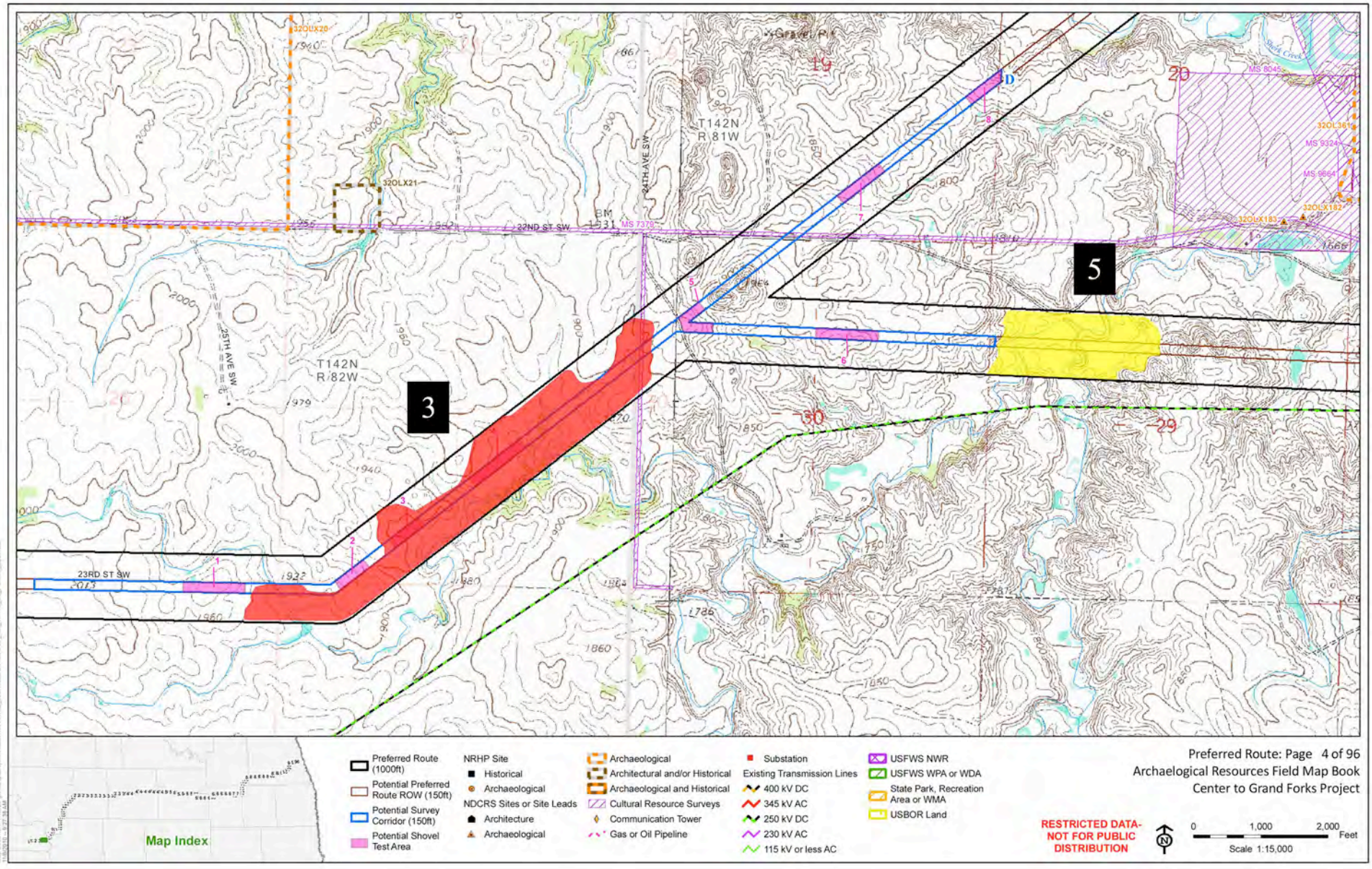
High Geologic Potential

Moderate Geologic Potential

Moderate - Low Geologic Potential

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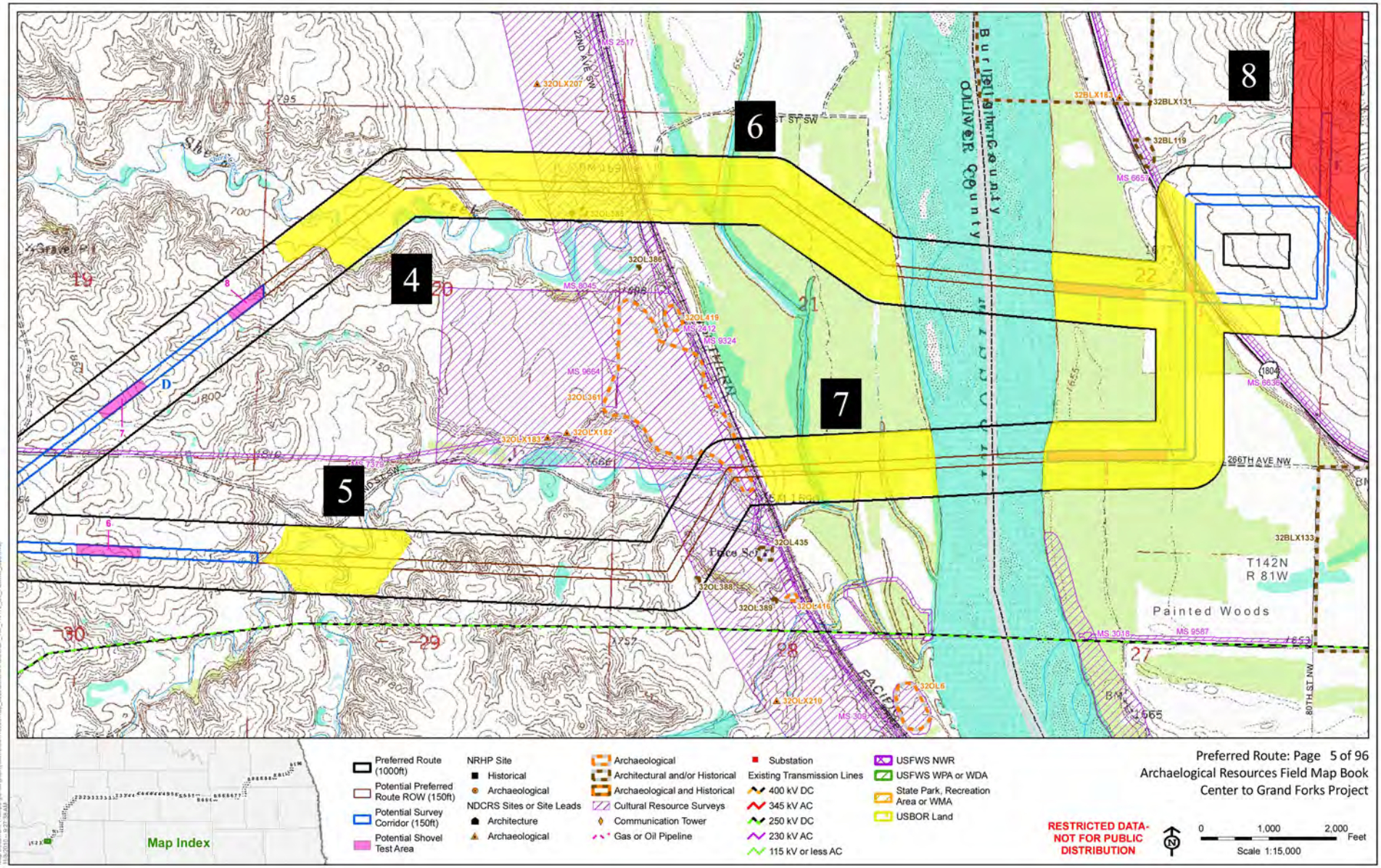


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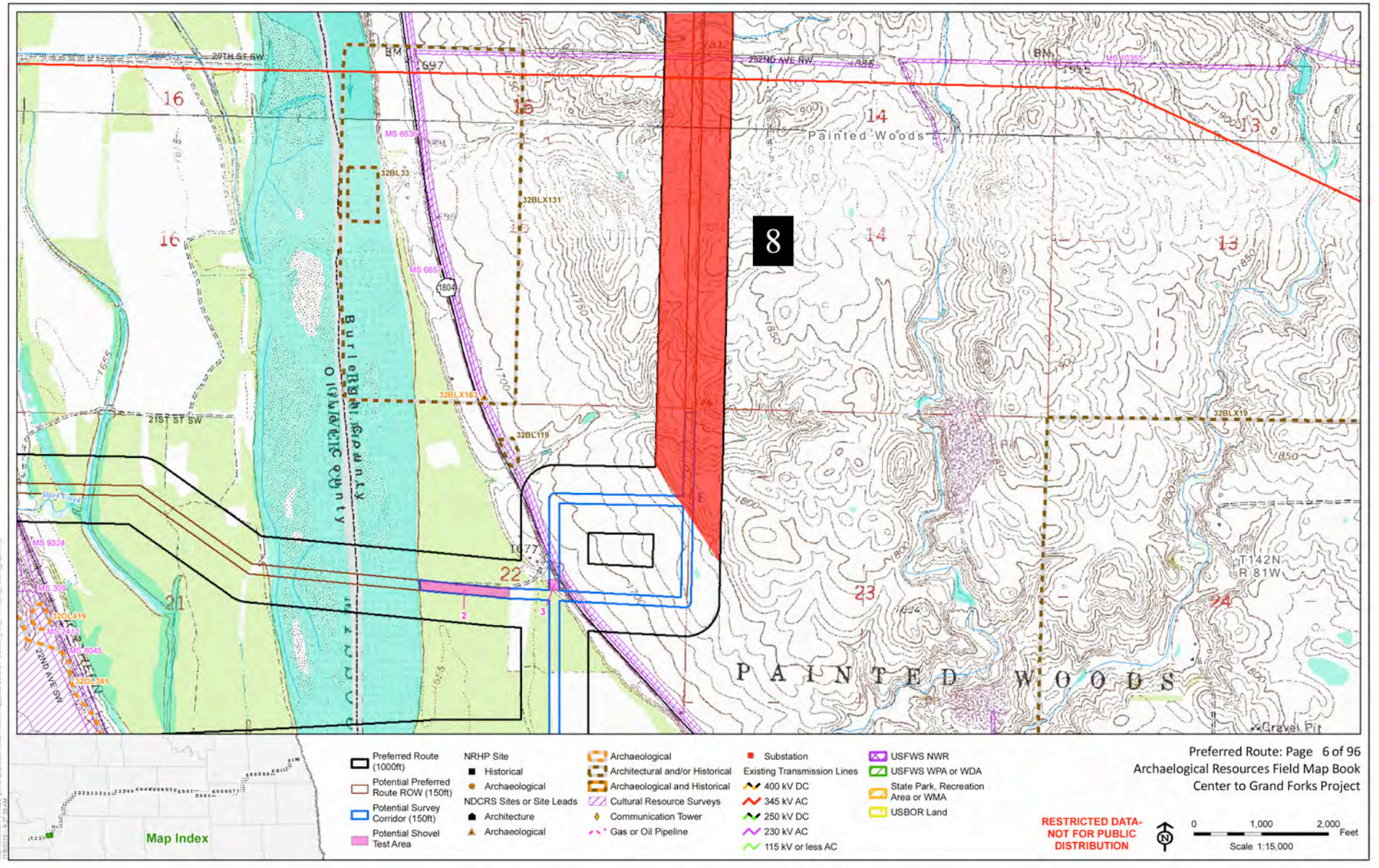


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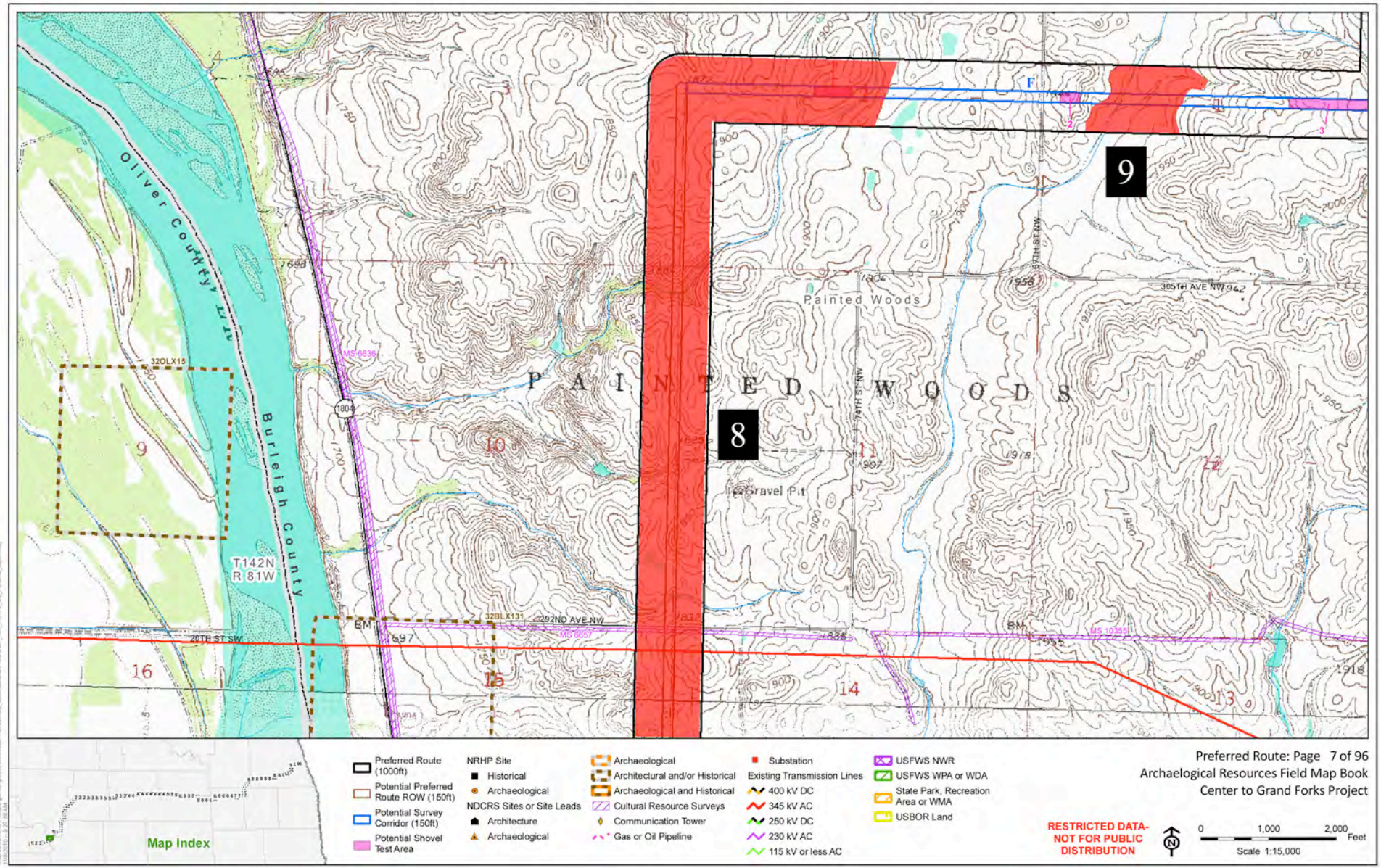


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Moderate Geologic Potential

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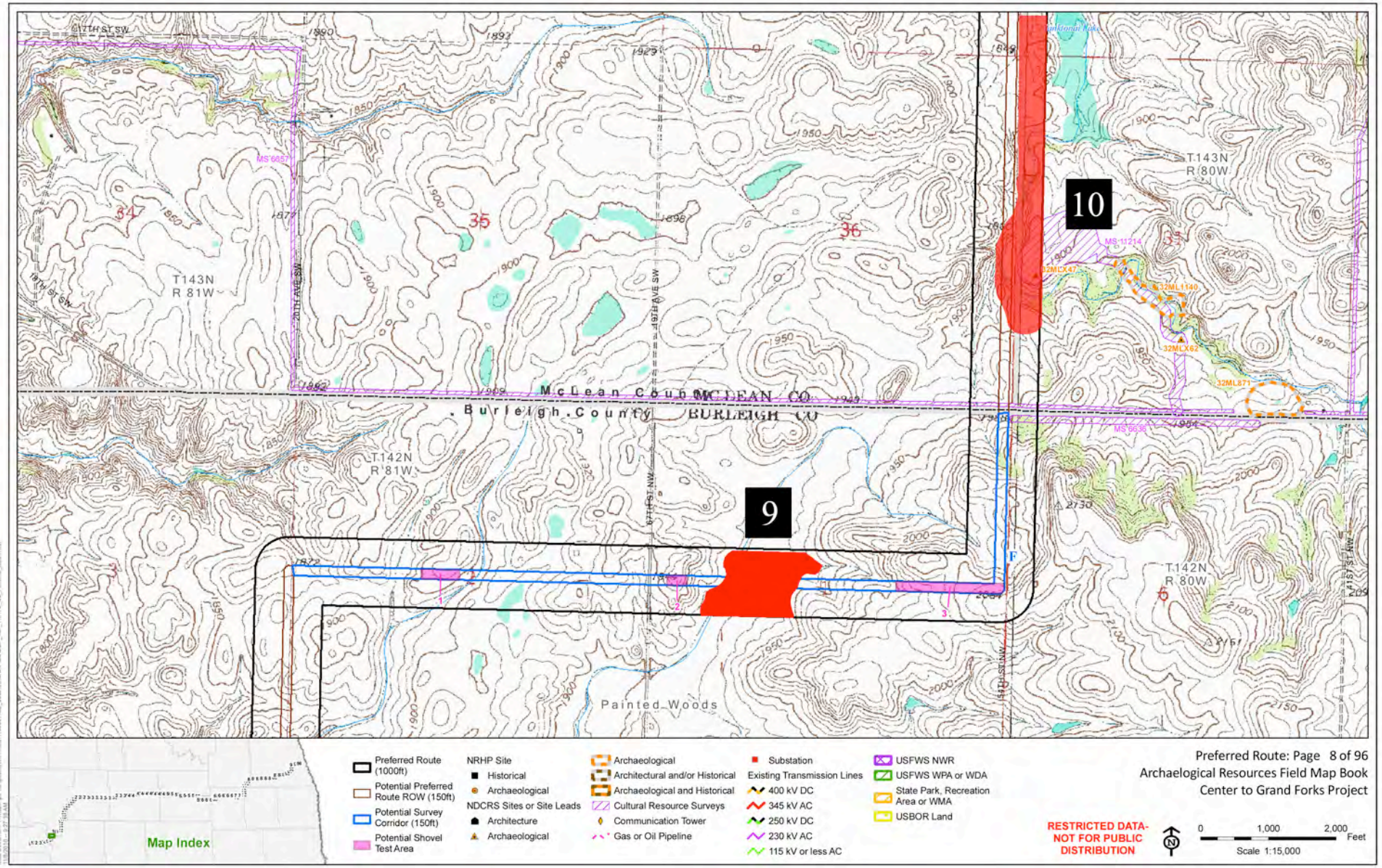


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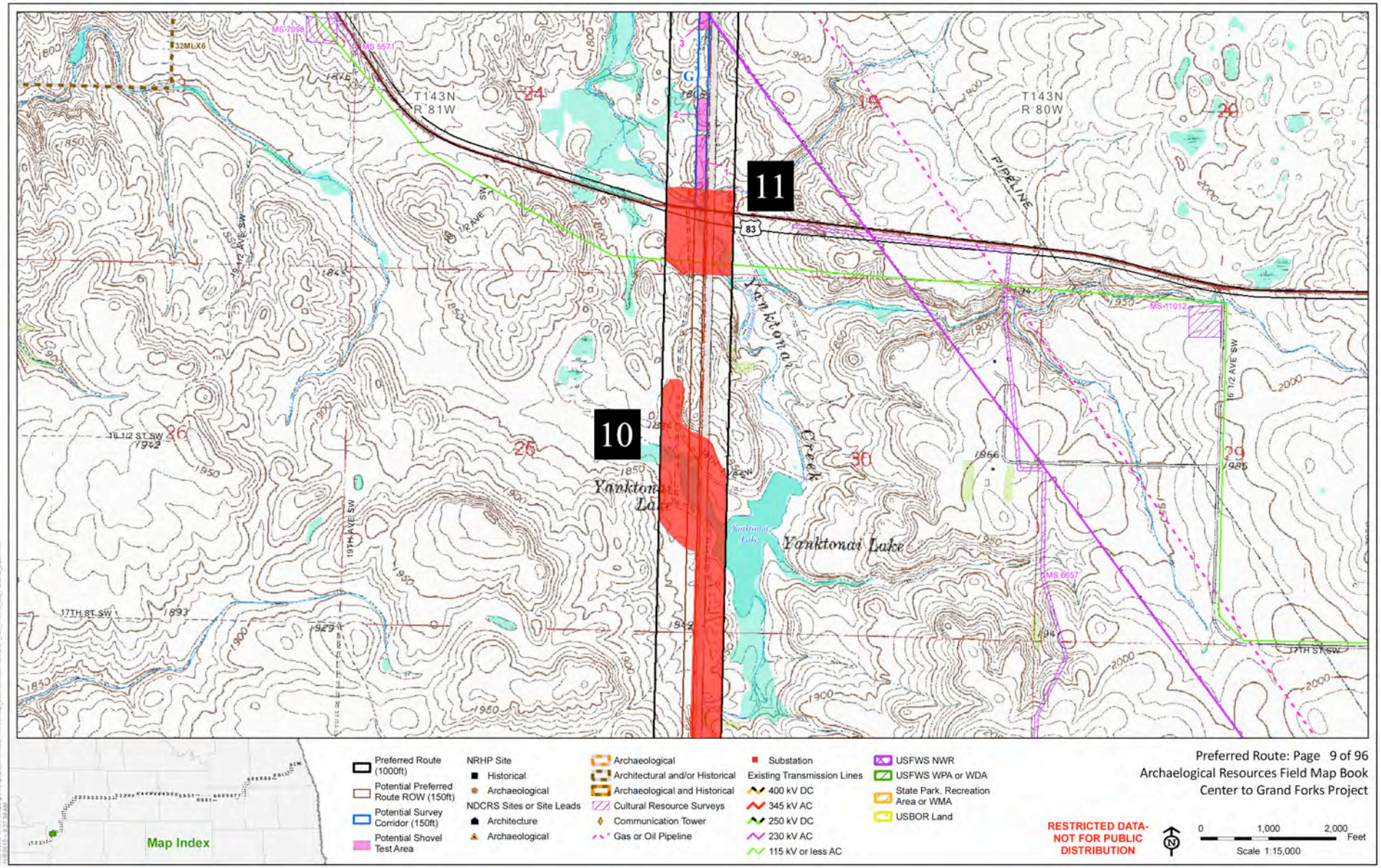
High Geologic Potential

Moderate Geologic Potential

Moderate - Low Geologic Potential

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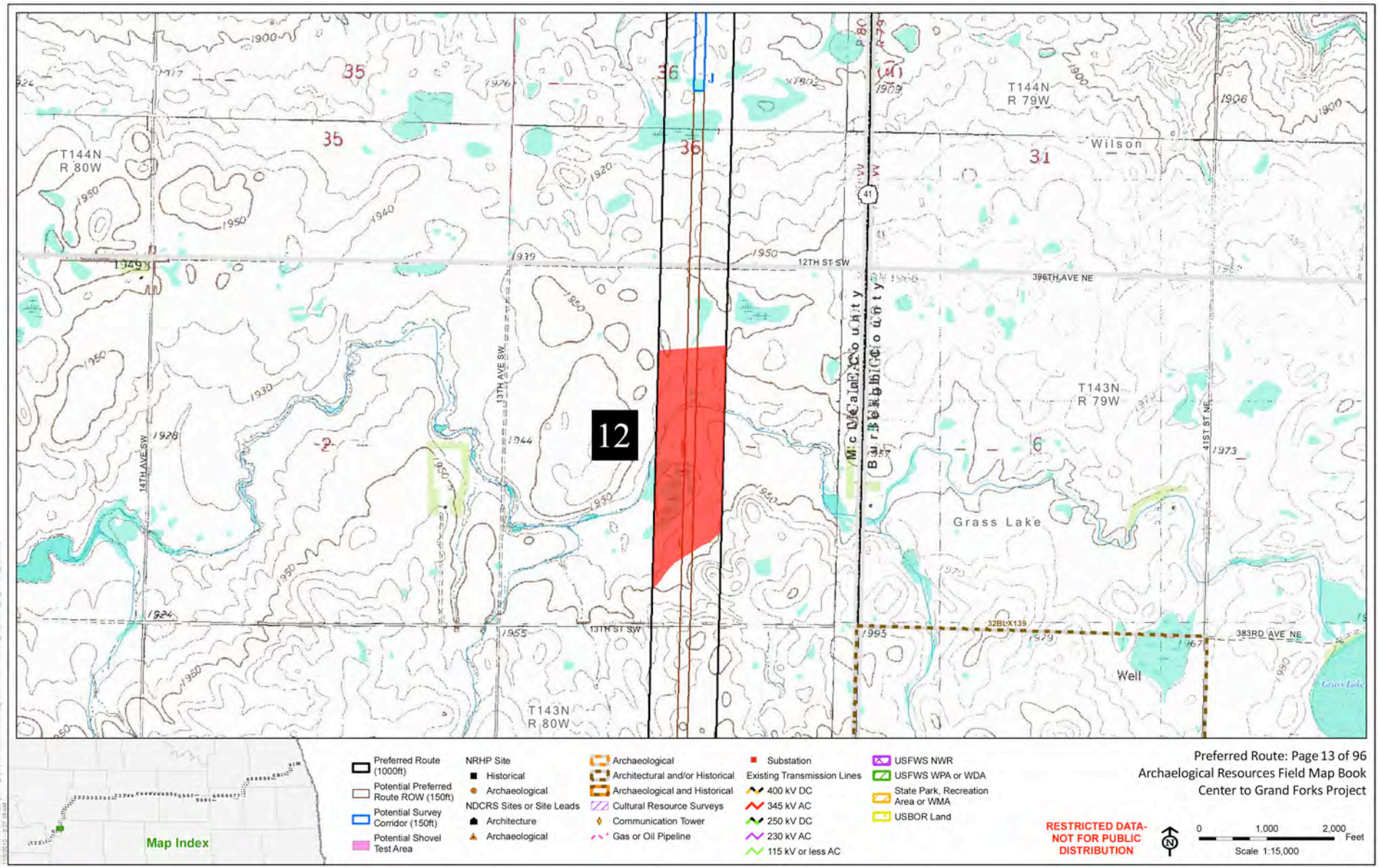
High Geologic Potential

Moderate Geologic Potential

Moderate - Low Geologic Potential




High Geologic Potential

Moderate Geologic Potential

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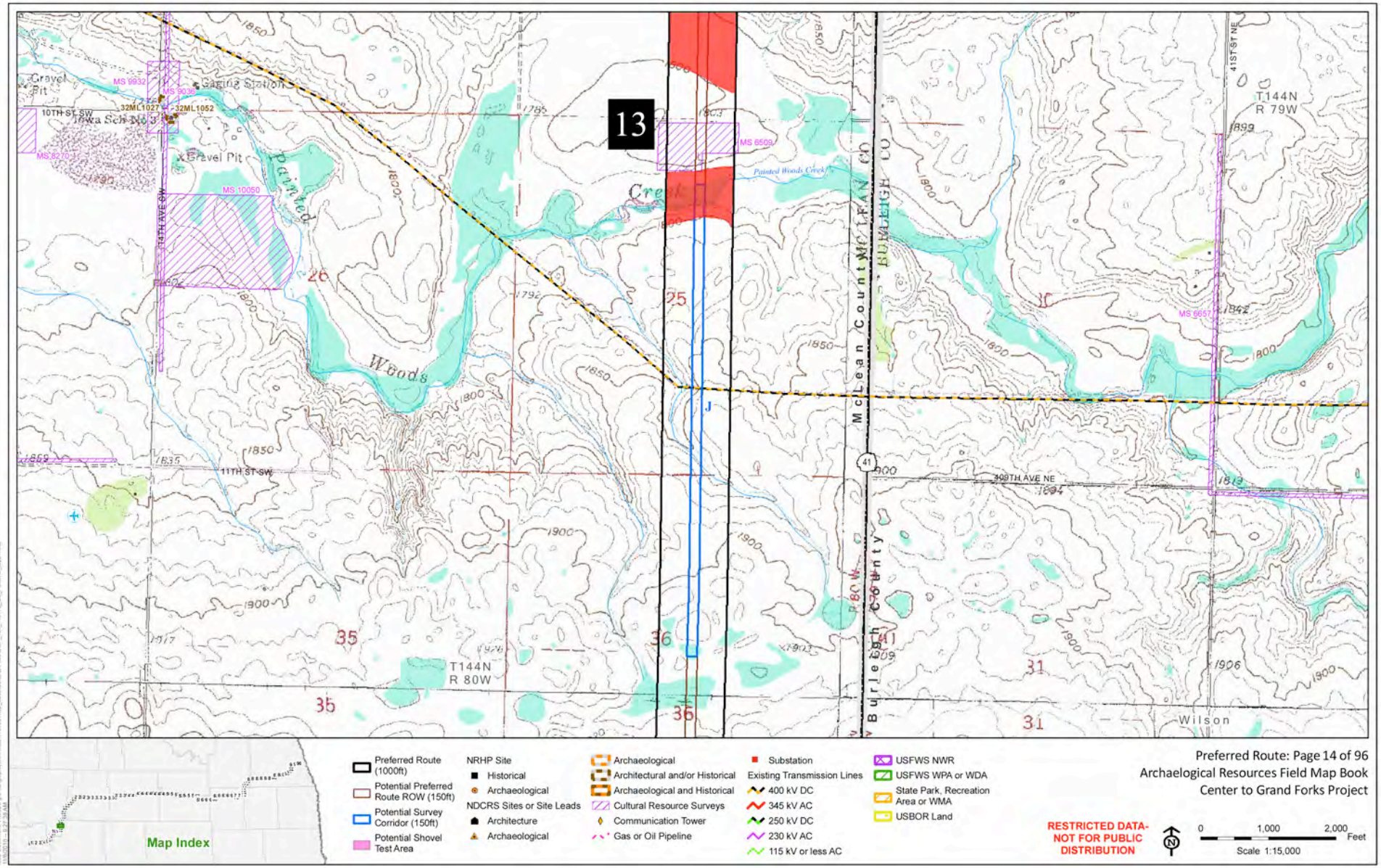


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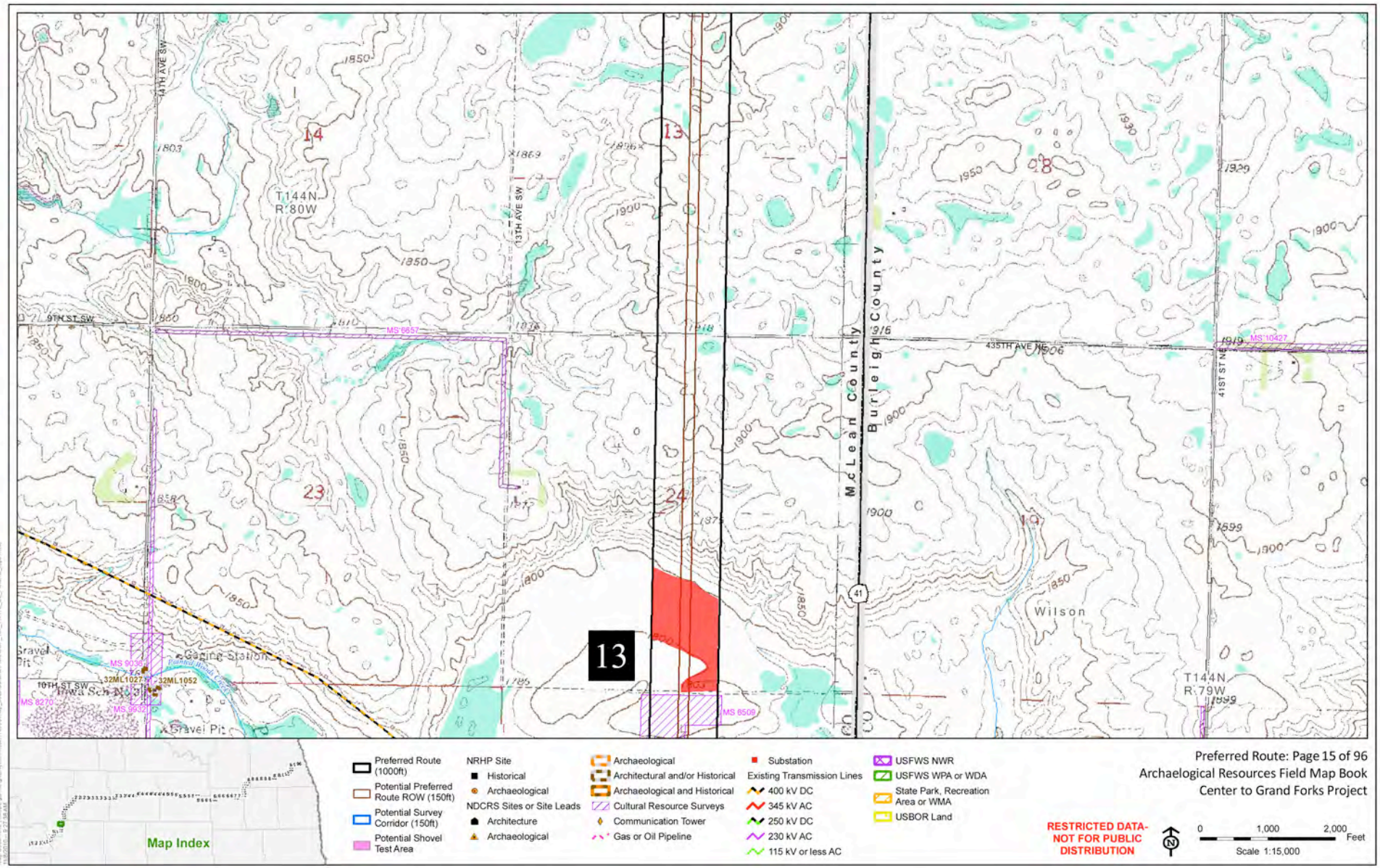
High Geologic Potential

Moderate Geologic Potential

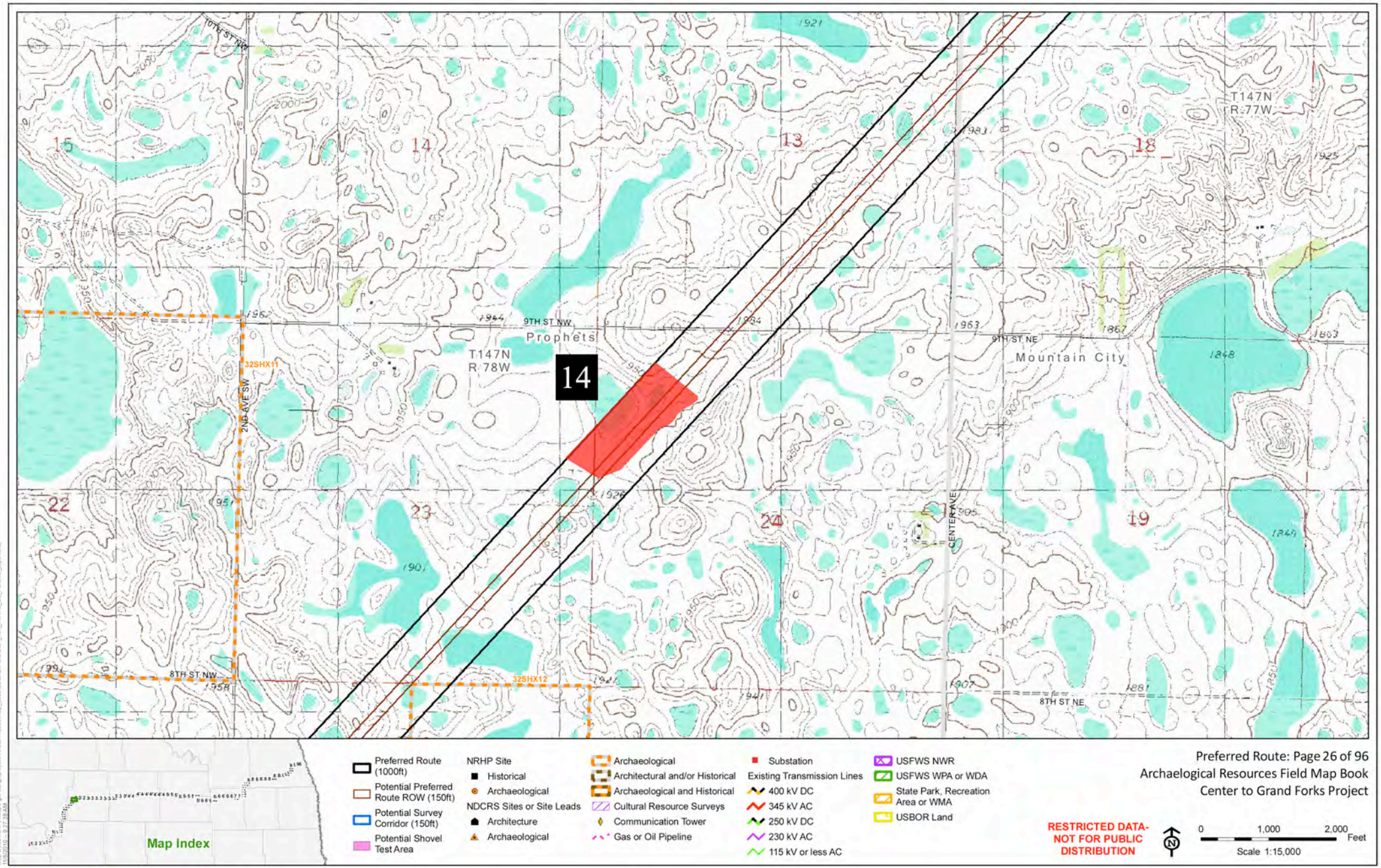
Moderate - Low Geologic Potential




High Geologic Potential

Moderate Geologic Potential

Moderate - Low Geologic Potential

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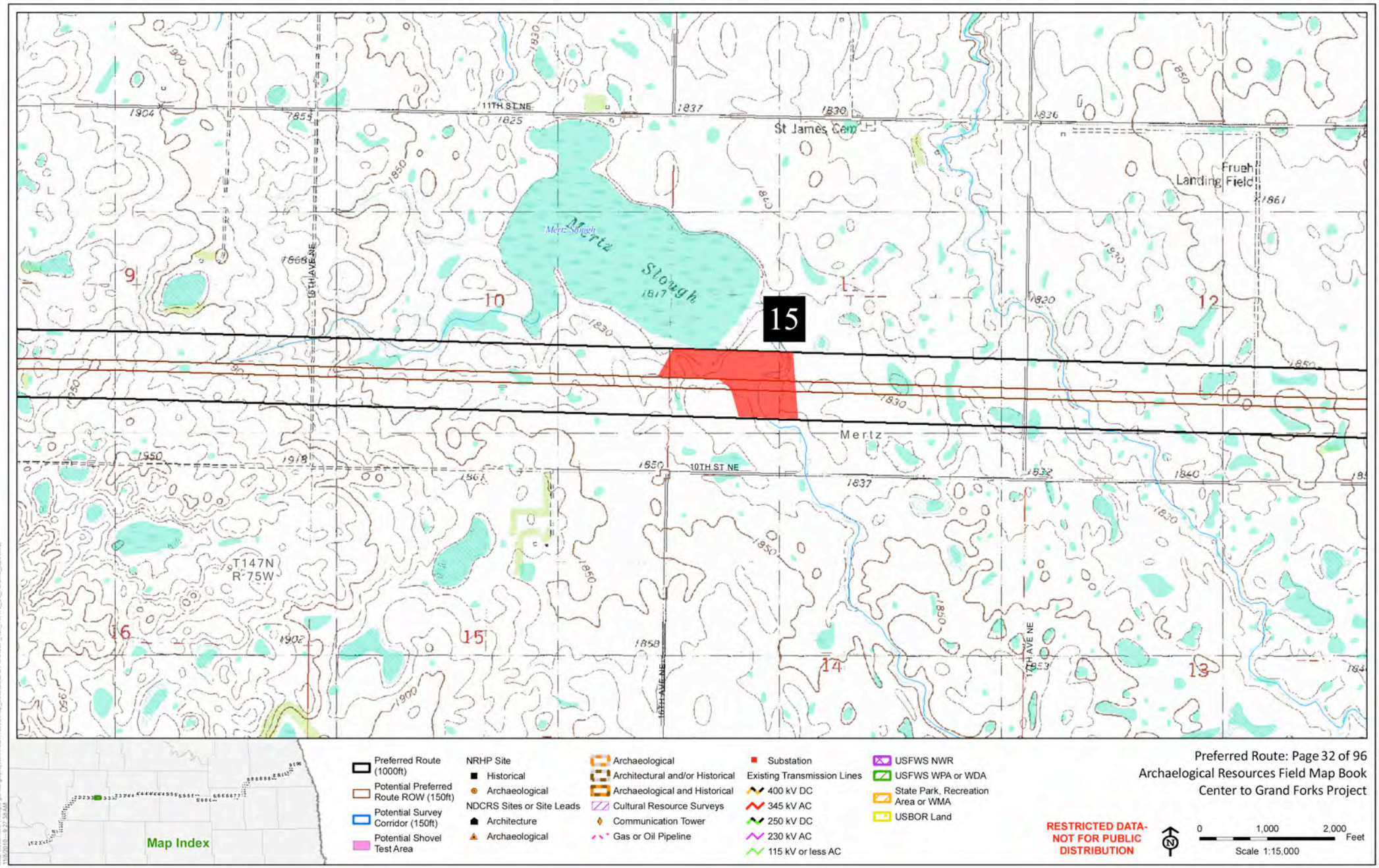
High Geologic Potential

Moderate Geologic Potential

Moderate - Low Geologic Potential

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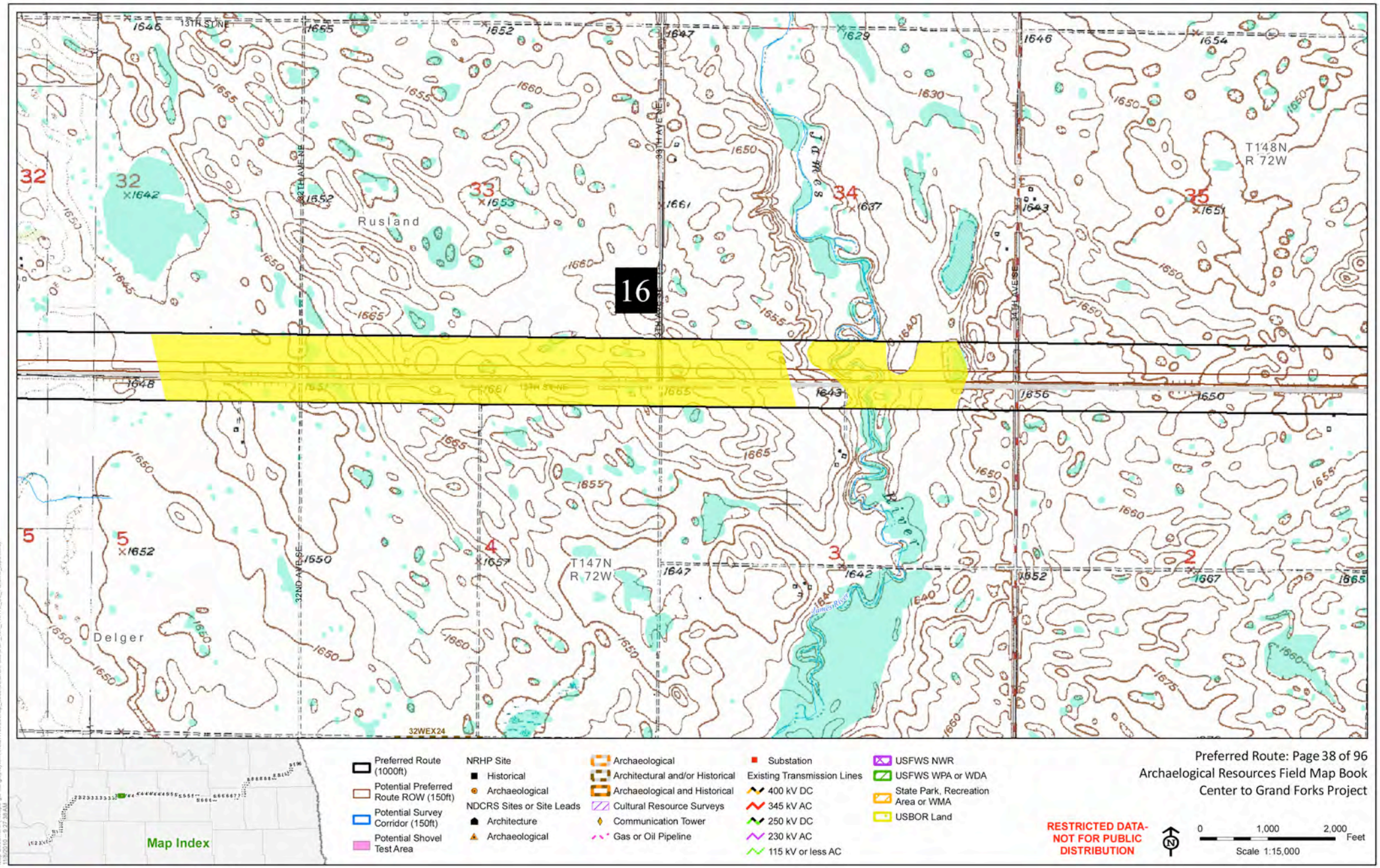
High Geologic Potential

Moderate Geologic Potential

Moderate - Low Geologic Potential


Rusland
Delger
T148N
R 72W
T147N
R 72W
16
32
33
34
35
5
4
3
2
32WEX24
Preferred Route (1000ft)
Potential Preferred Route ROW (150ft)
Potential Survey Corridor (150ft)
Potential Shovel Test Area
NRHP Site
Historical
Archaeological
NDCRS Sites or Site Leads
Architecture
Archaeological
Archaeological
Architectural and/or Historical
Archaeological and Historical
Cultural Resource Surveys
Communication Tower
Gas or Oil Pipeline
Substation
Existing Transmission Lines
400 kV DC
345 kV AC
250 kV DC
230 kV AC
115 kV or less AC
USFWS NWR
USFWS WPA or WDA
State Park, Recreation Area or WMA
USBOR Land
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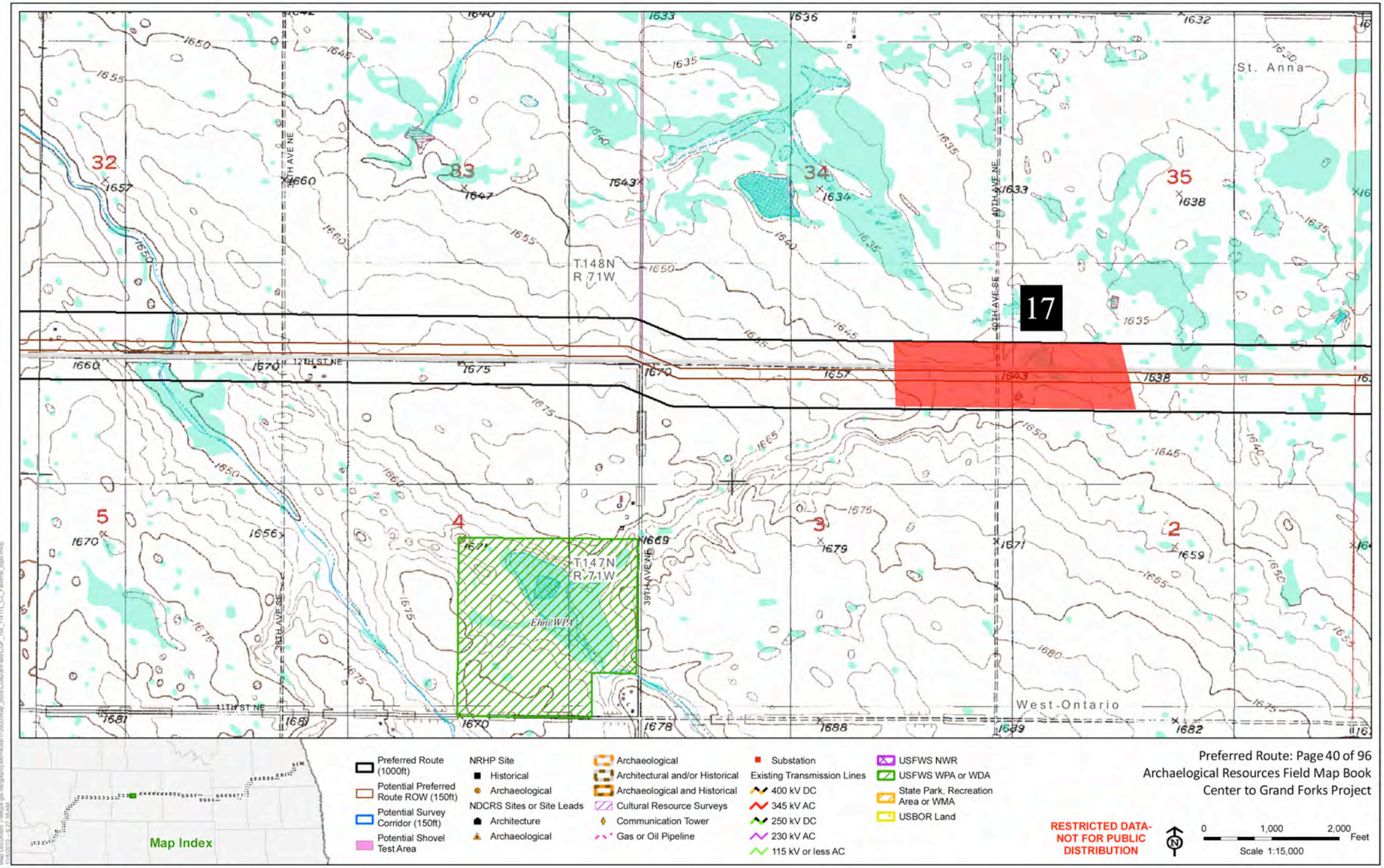
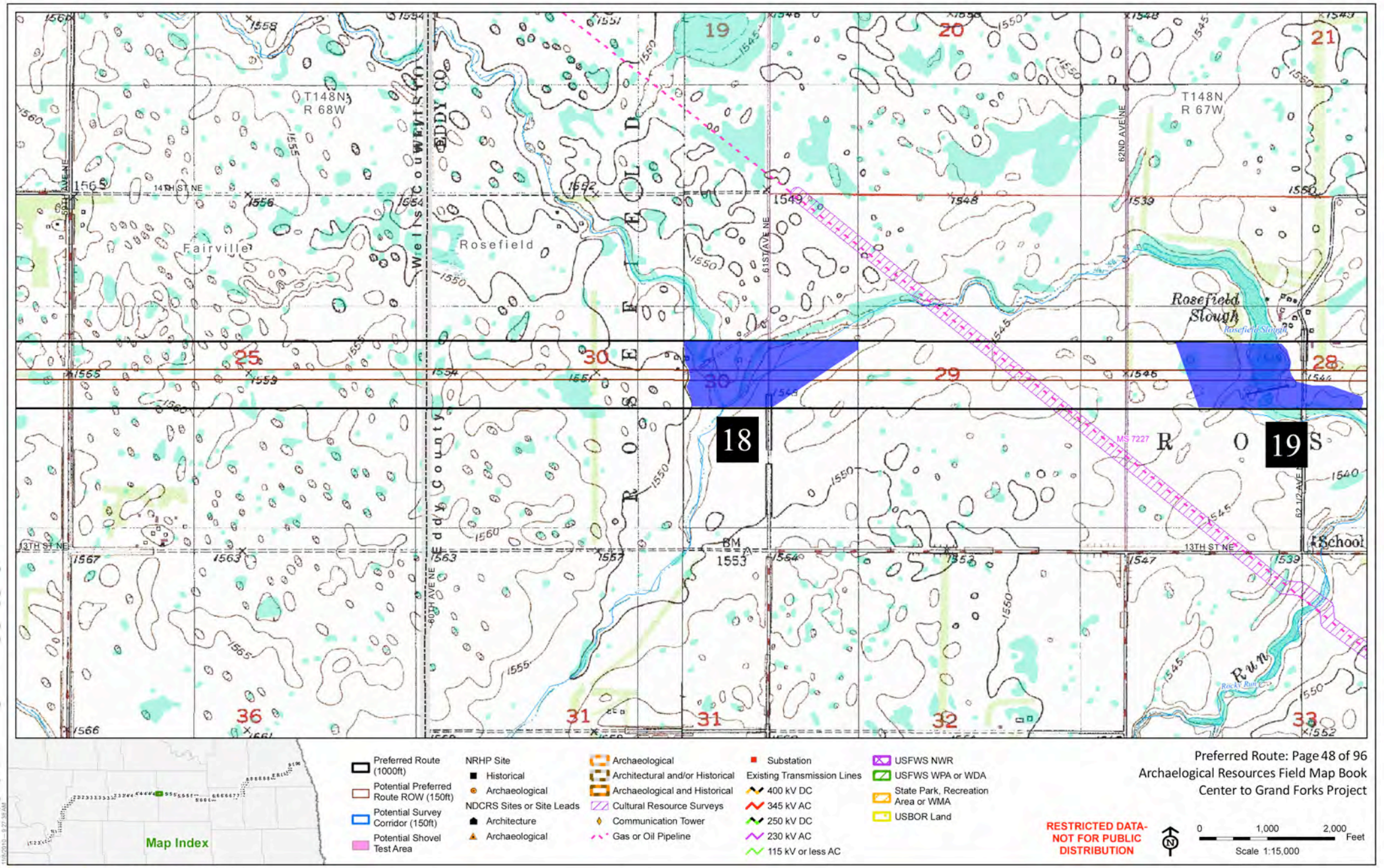
RESTRICTED DATA- NOT FOR PUBLIC DISTRIBUTION
0 1,000 2,000 Feet
Scale 1:15,000
High Geologic Potential
Moderate Geologic Potential
Moderate - Low Geologic Potential




High Geologic Potential

Moderate Geologic Potential

Moderate - Low Geologic Potential

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- Preferred Route (1000ft)
- Potential Preferred Route ROW (150ft)
- Potential Survey Corridor (150ft)
- Potential Shovel Test Area

NRHP Site
- Historical
- Archaeological

NDCRS Sites or Site Leads
- Architecture
- Archaeological

- Archaeological
- Architectural and/or Historical
- Archaeological and Historical
- Cultural Resource Surveys
- Communication Tower
- Gas or Oil Pipeline

- Substation

Existing Transmission Lines
- 400 kV DC
- 345 kV AC
- 250 kV DC
- 230 kV AC
- 115 kV or less AC

- USFWS NWR
- USFWS WPA or WDA
- State Park, Recreation Area or WMA
- USBOR Land

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RESTRICTED DATA- NOT FOR PUBLIC DISTRIBUTION

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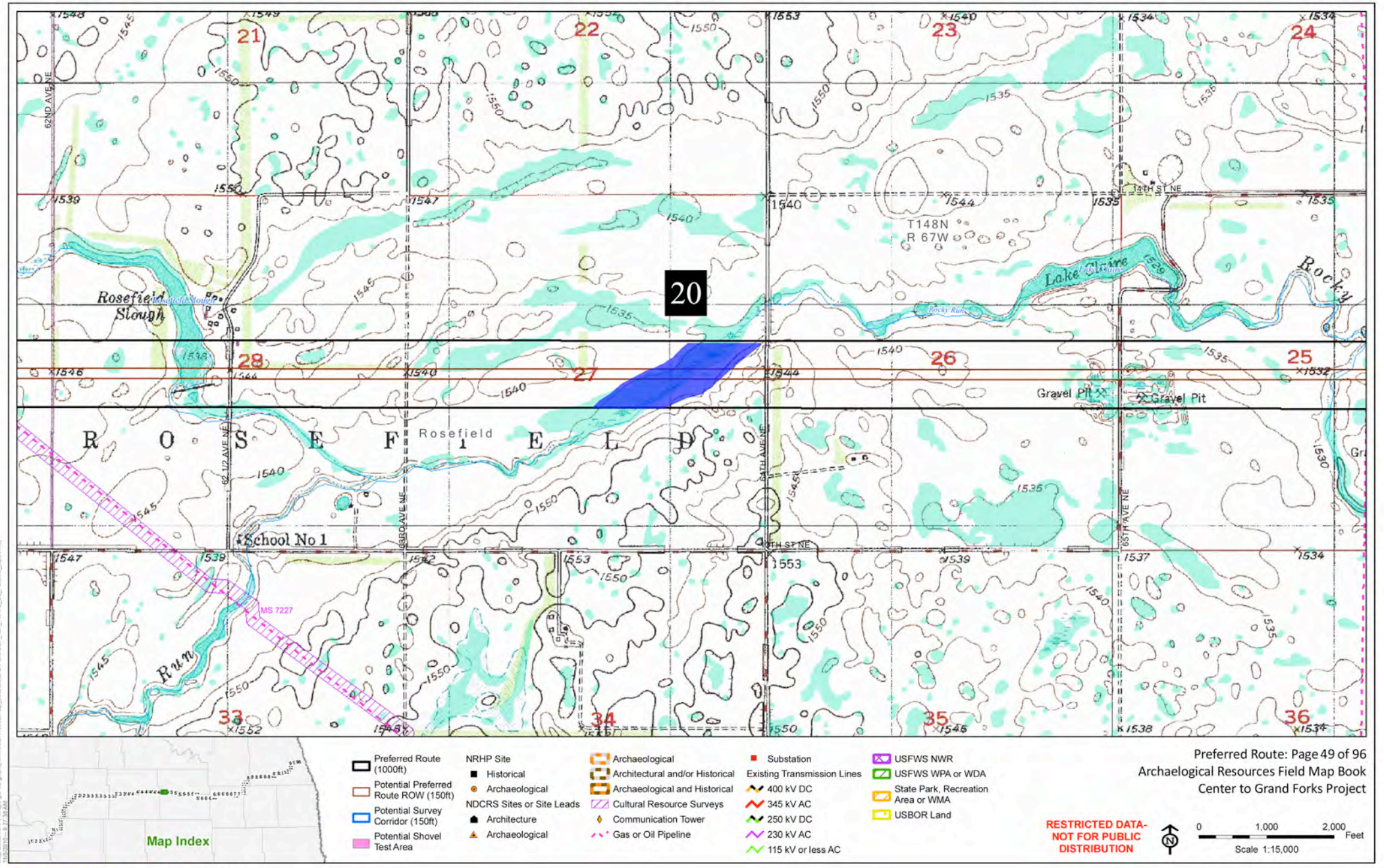
Scale 1:15,000

- High Geologic Potential
- Moderate Geologic Potential
- Moderate - Low Geologic Potential

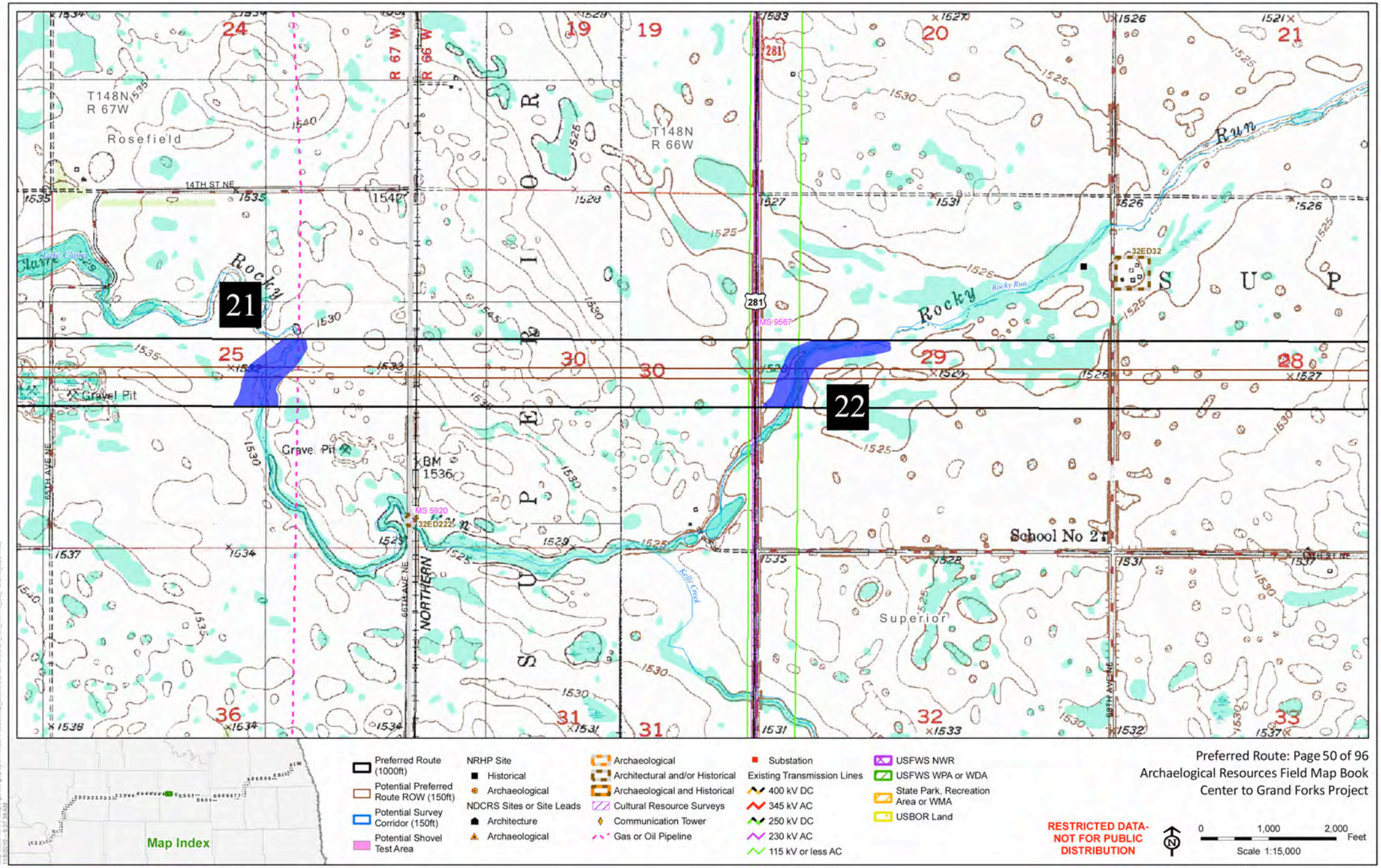





High Geologic Potential

Moderate Geologic Potential

Moderate - Low Geologic Potential


T148N
R 67W
Rosefield
T148N
R 66W
14TH ST NE
Rocky
Rocky Run
21
22
25
30
29
28
36
31
32
33
Gravel Pit
Grave Pit
BM
1536
MS 5920
32ED222
MS-9567
32ED32
65TH AVE NE
66TH AVE NE
68TH AVE NE
NORTHERN
PACIFIC
R 67 W
R 66 W
281
School No 21
Superior
Kelly Creek
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Potential Preferred Route ROW (150ft)
Potential Survey Corridor (150ft)
Potential Shovel Test Area
NRHP Site
Historical
Archaeological
NDCRS Sites or Site Leads
Architecture
Archaeological
Archaeological
Architectural and/or Historical
Archaeological and Historical
Cultural Resource Surveys
Communication Tower
Gas or Oil Pipeline
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Existing Transmission Lines
400 kV DC
345 kV AC
250 kV DC
230 kV AC
115 kV or less AC
USFWS NWR
USFWS WPA or WDA
State Park, Recreation Area or WMA
USBOR Land
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RESTRICTED DATA- NOT FOR PUBLIC DISTRIBUTION
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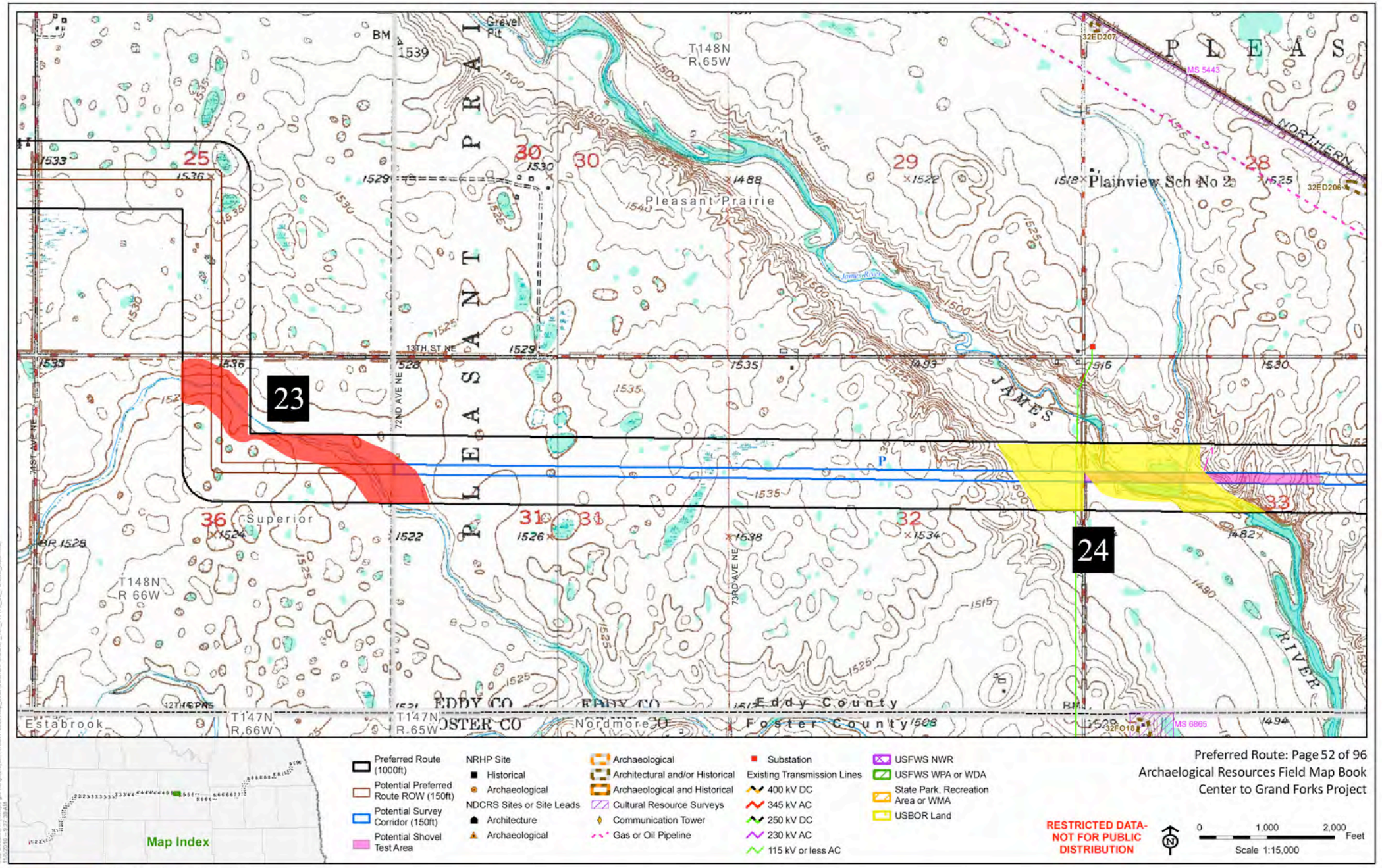
1,000
2,000
Feet
Scale 1:15,000
High Geologic Potential
Moderate Geologic Potential
Moderate - Low Geologic Potential

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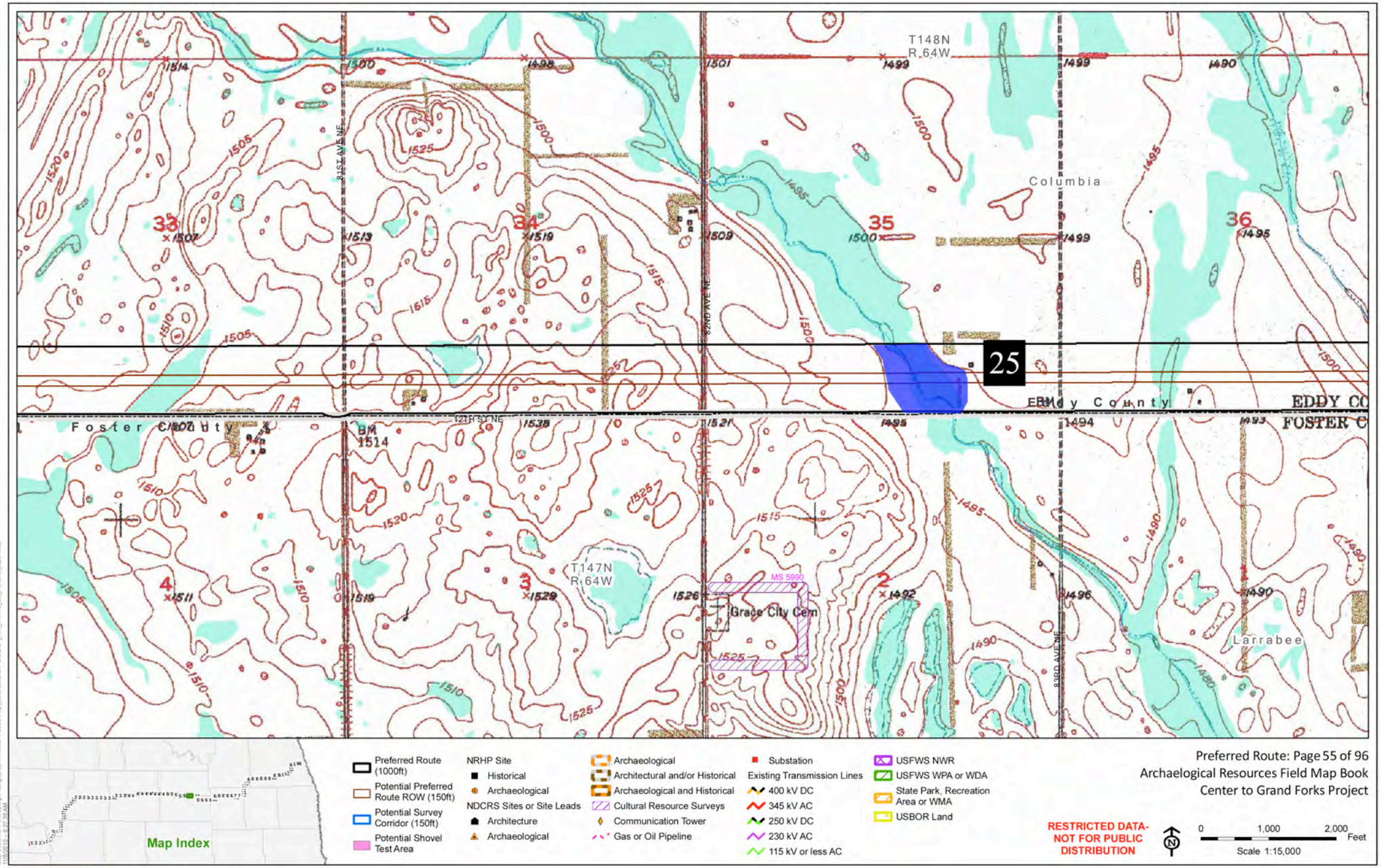
High Geologic Potential

Moderate Geologic Potential

Moderate - Low Geologic Potential

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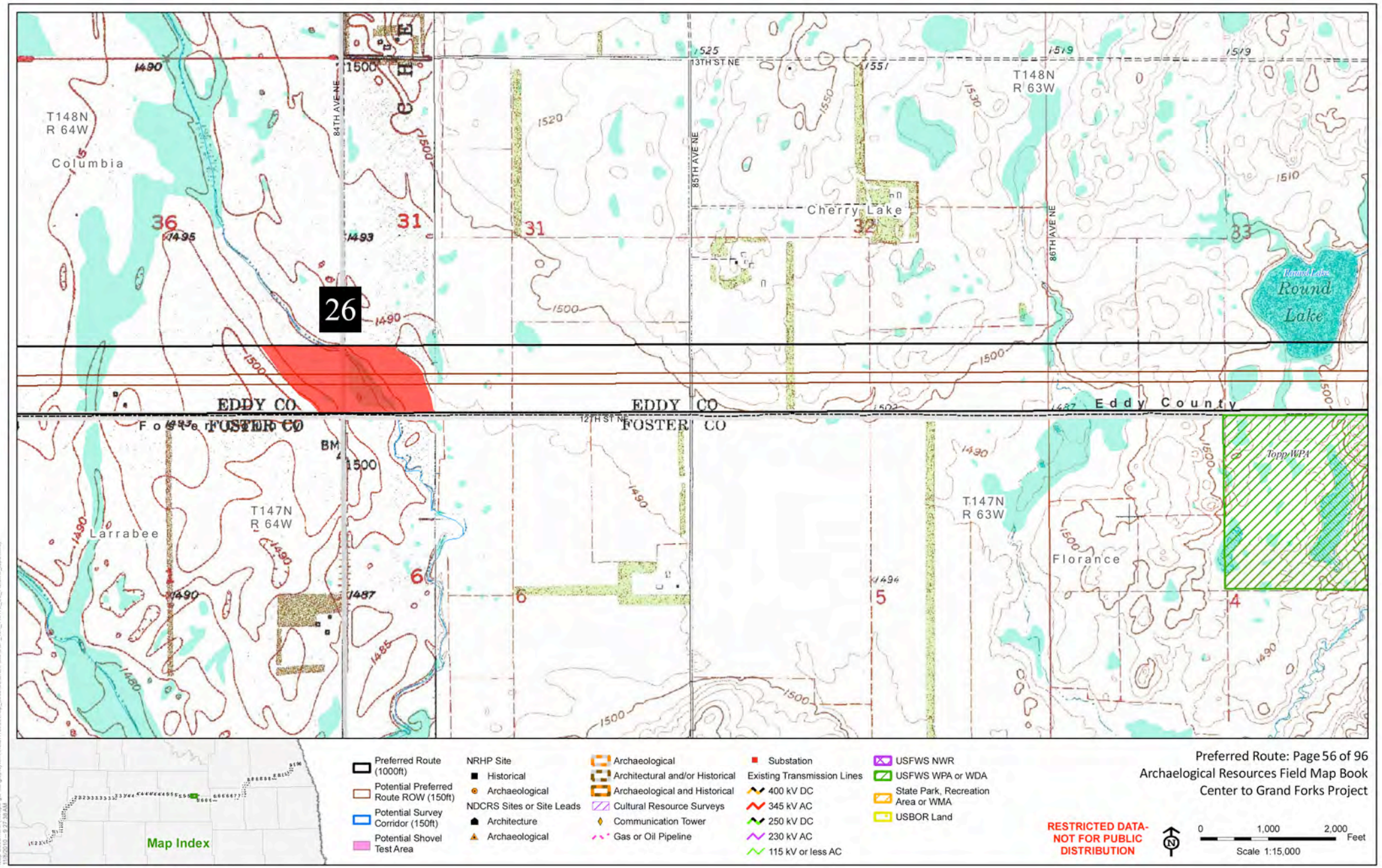
High Geologic Potential

Moderate Geologic Potential

Moderate - Low Geologic Potential

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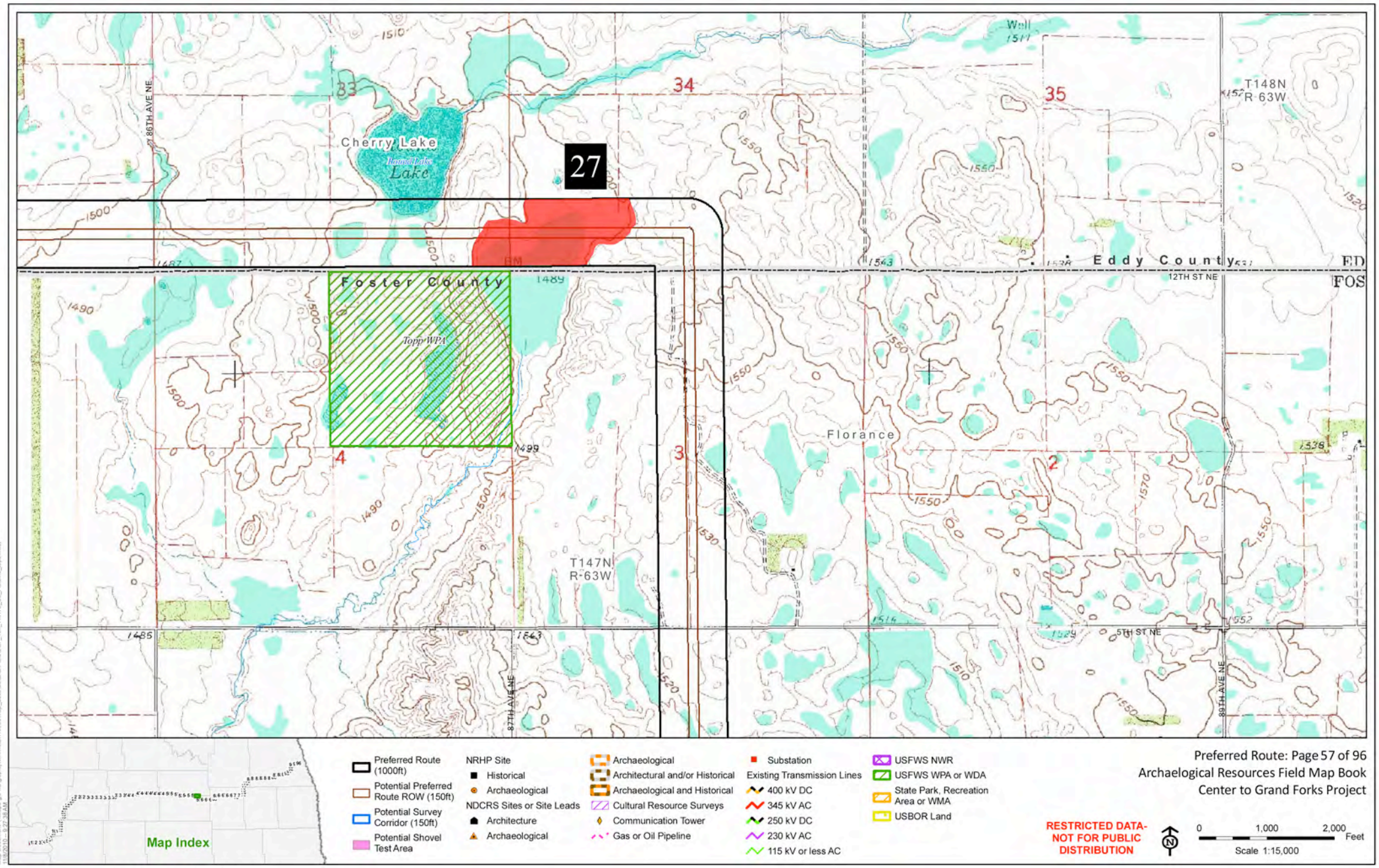
High Geologic Potential

Moderate Geologic Potential

Moderate - Low Geologic Potential

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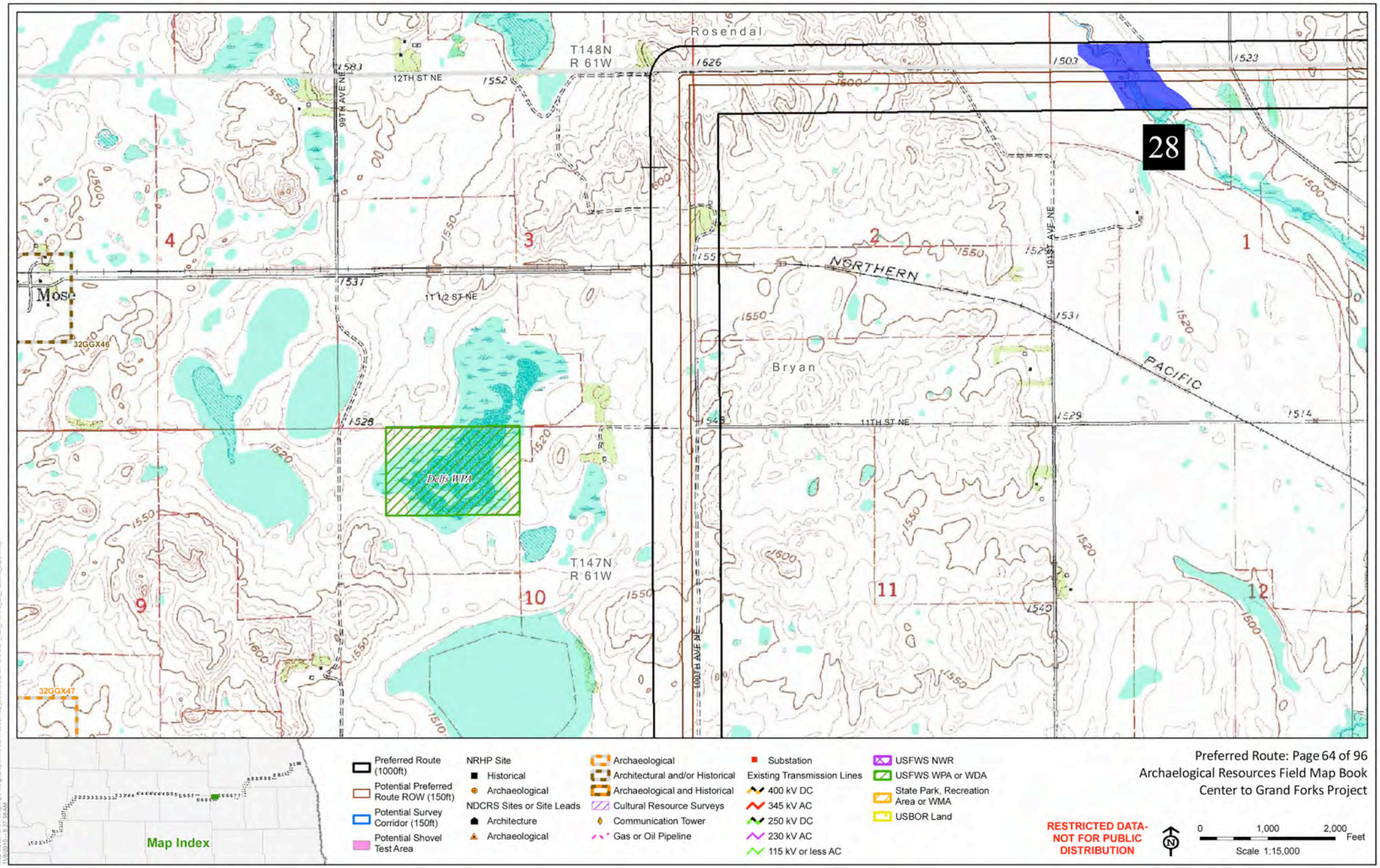
High Geologic Potential

Moderate Geologic Potential

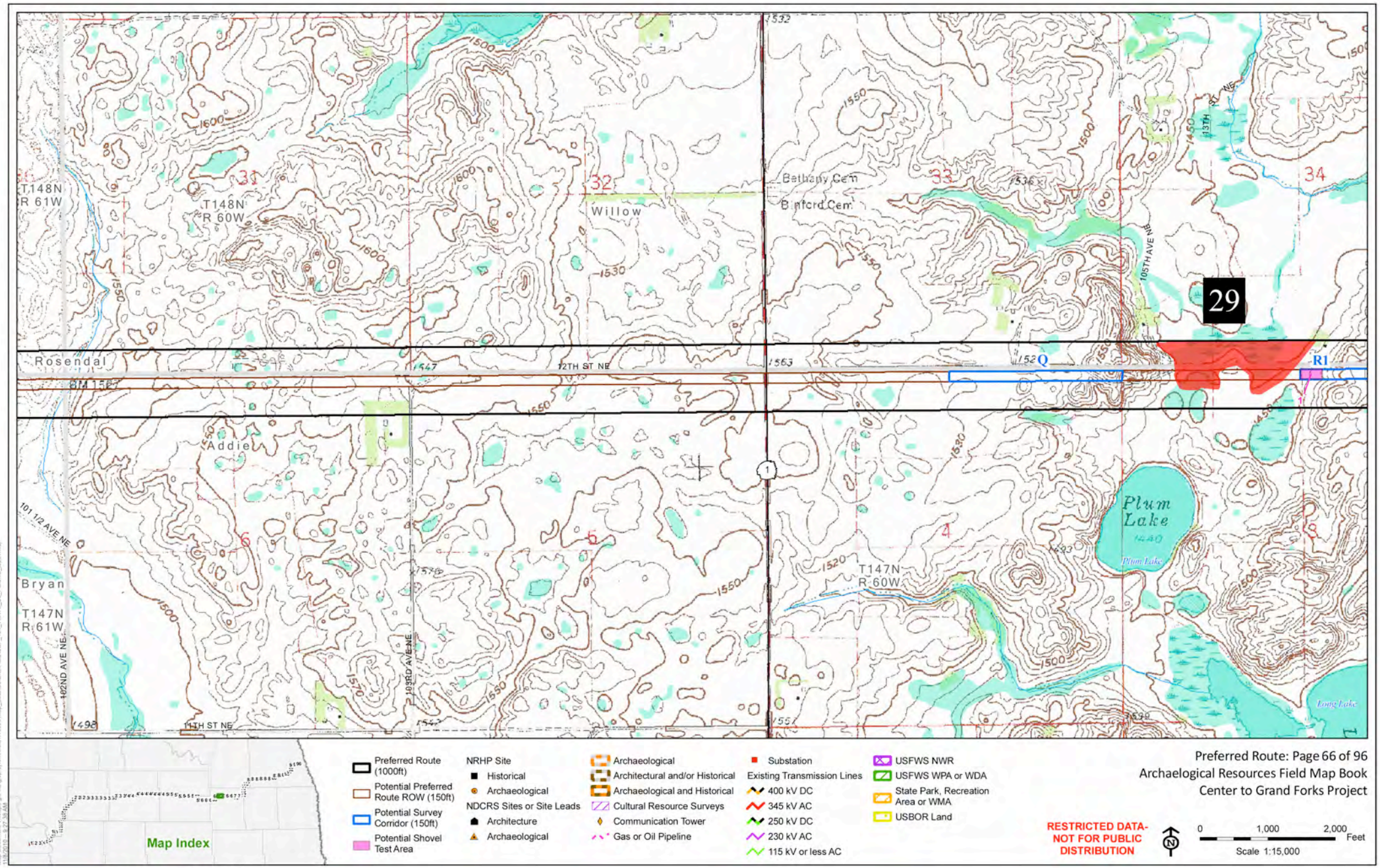
Moderate - Low Geologic Potential




High Geologic Potential

Moderate Geologic Potential

Moderate - Low Geologic Potential

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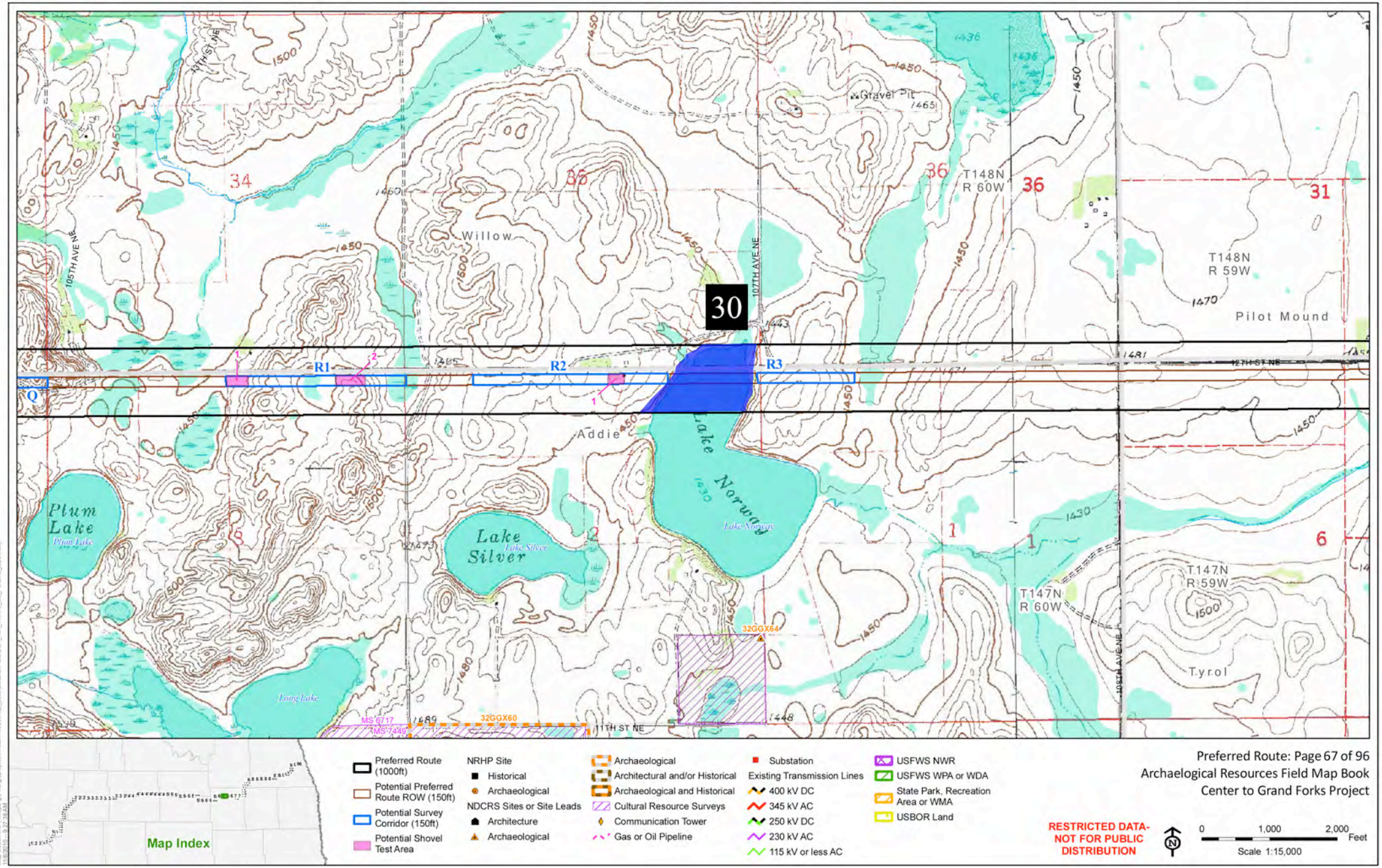
High Geologic Potential

Moderate Geologic Potential

Moderate - Low Geologic Potential

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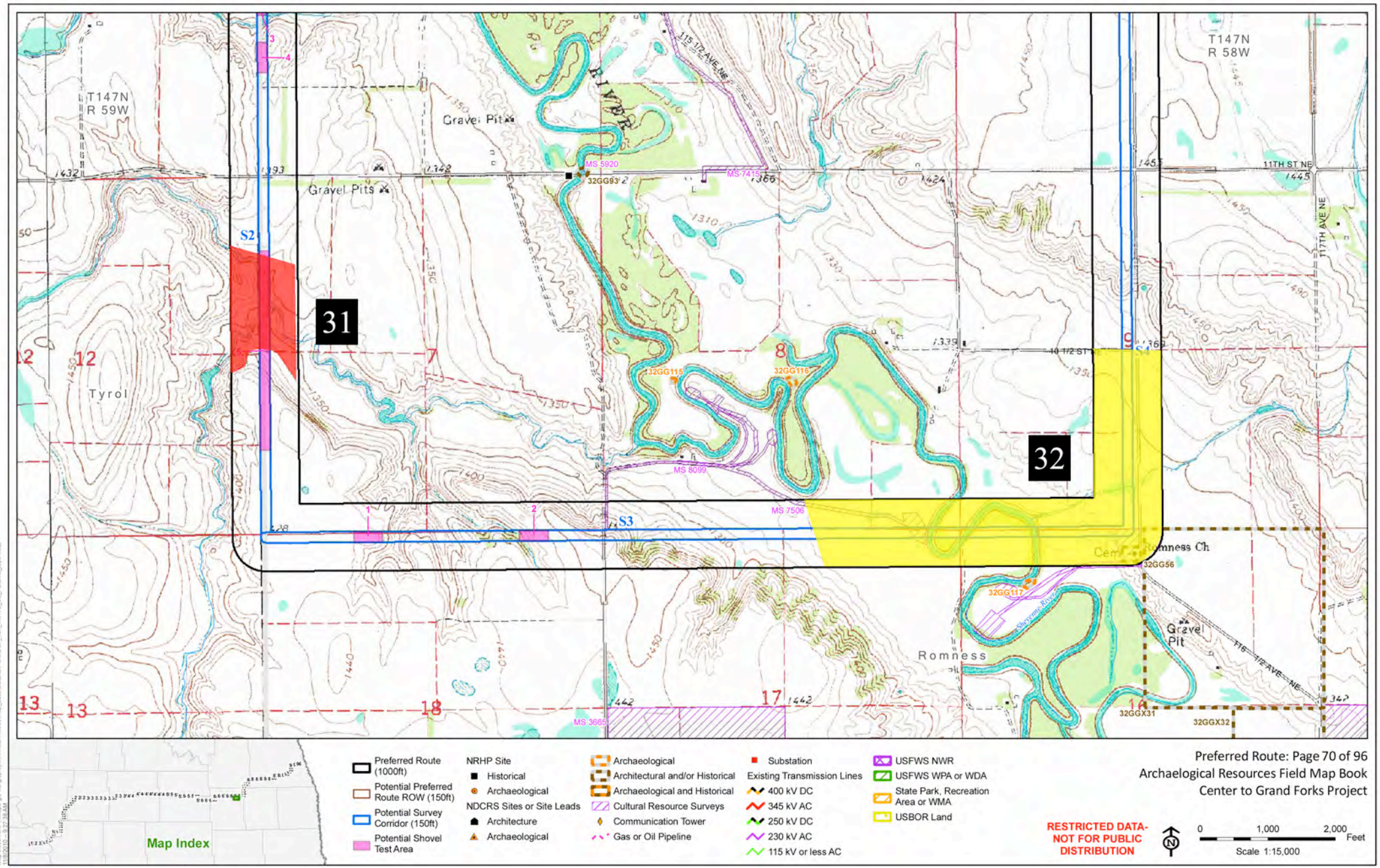
High Geologic Potential

Moderate Geologic Potential

Moderate - Low Geologic Potential

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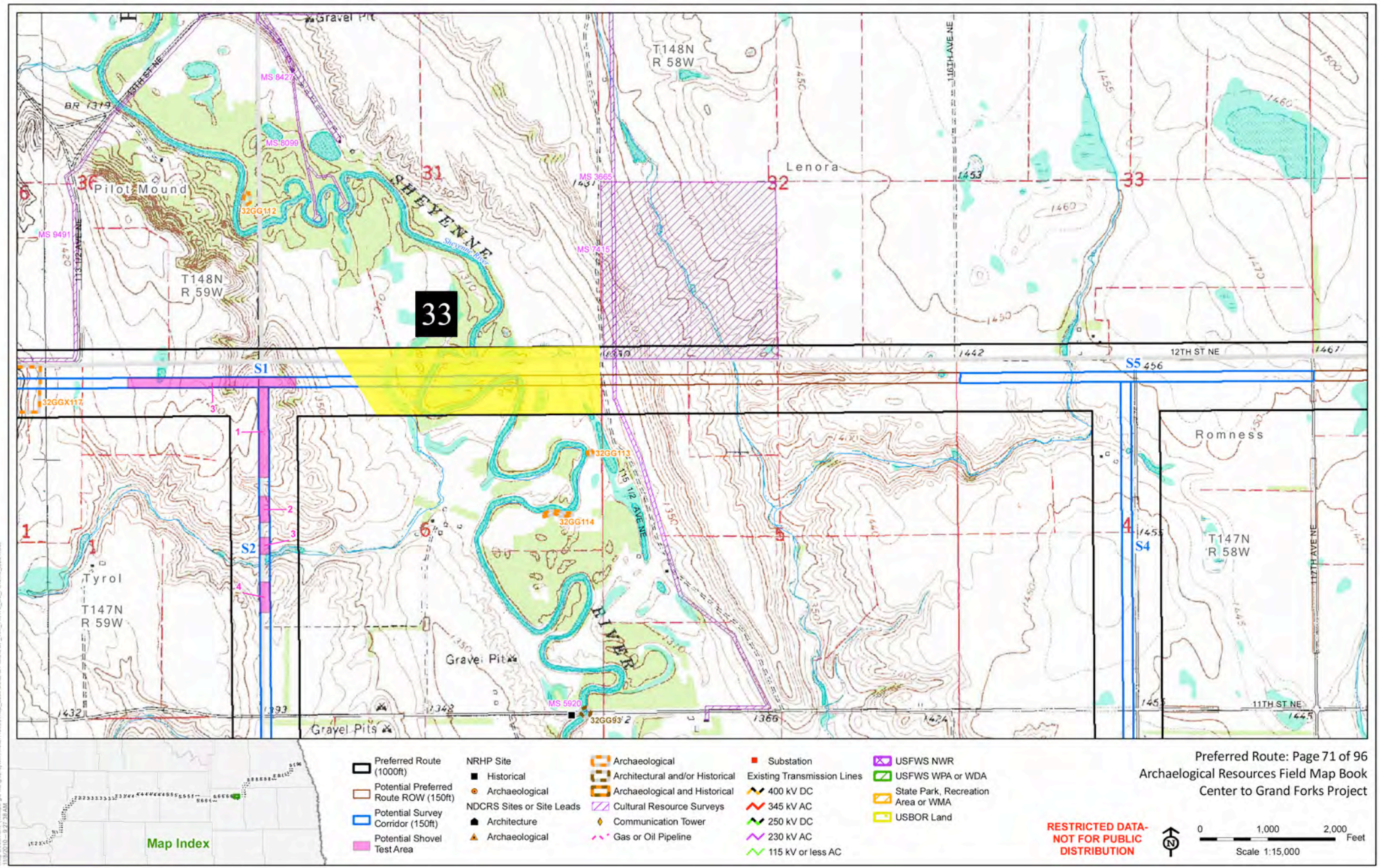
High Geologic Potential

Moderate Geologic Potential

Moderate - Low Geologic Potential

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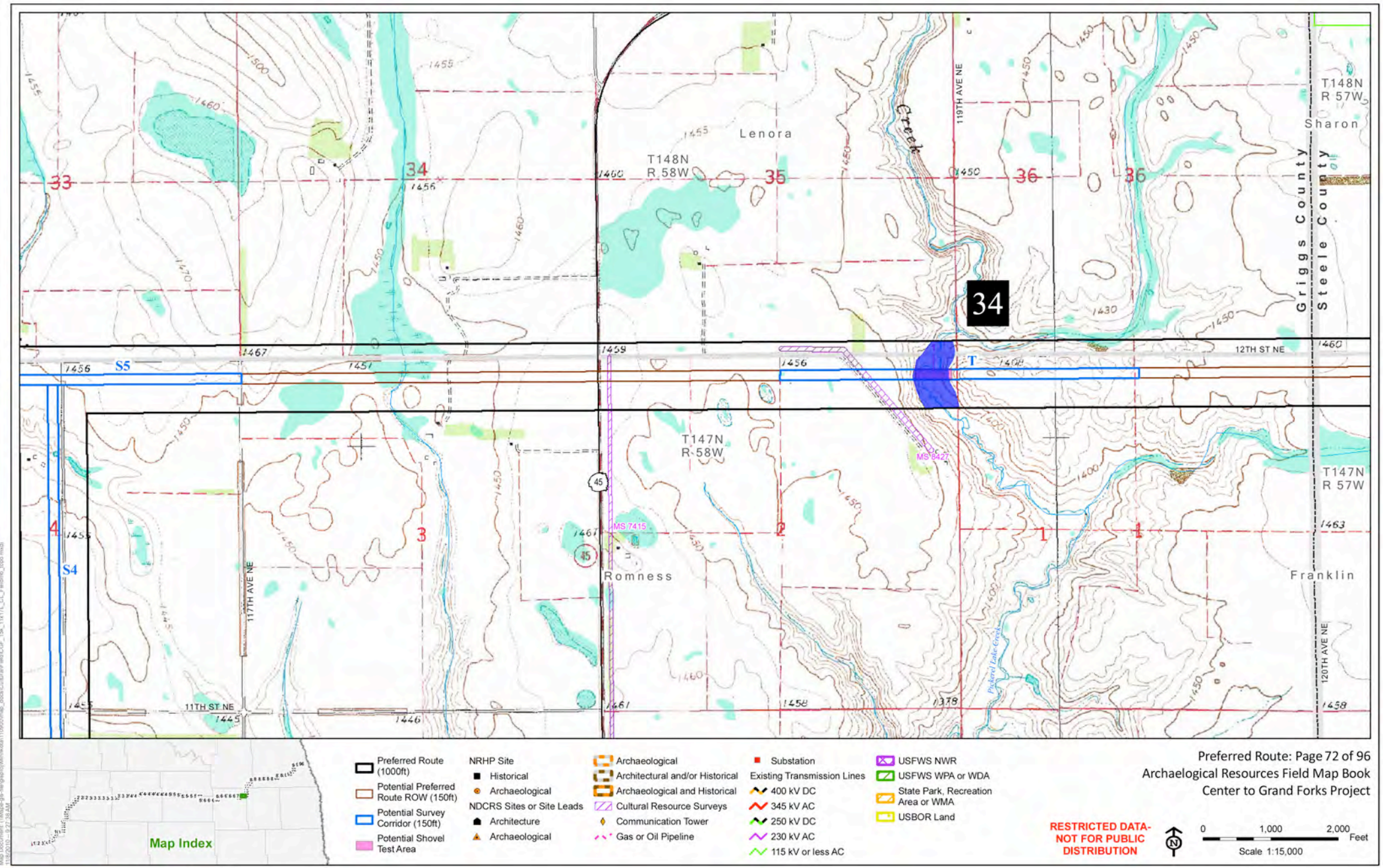
High Geologic Potential

Moderate Geologic Potential

Moderate - Low Geologic Potential

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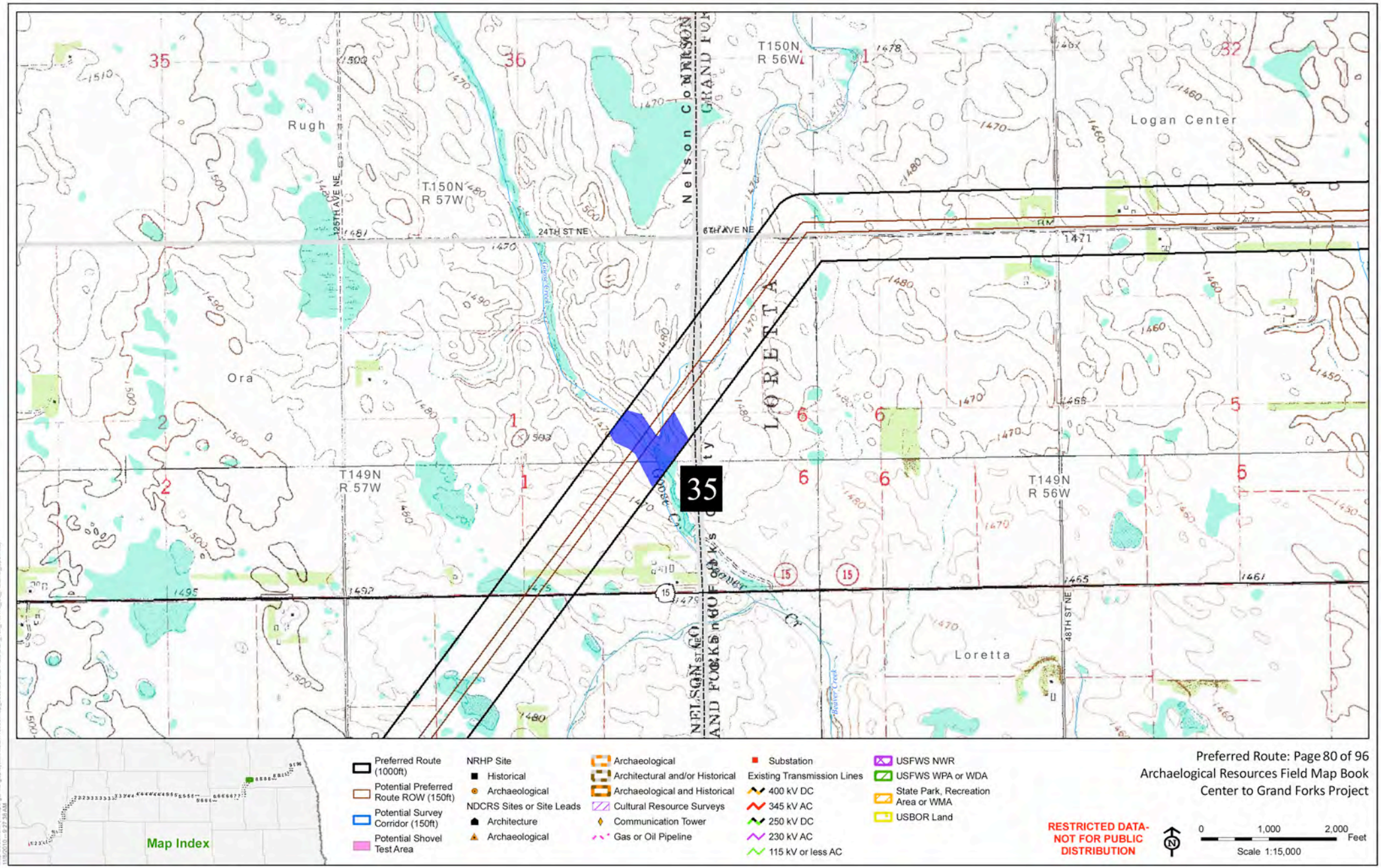
High Geologic Potential

Moderate Geologic Potential

Moderate - Low Geologic Potential


35
36
T150N
R 56W
T150N
R 57W
T149N
R 57W
T149N
R 56W
Rugh
Ora
Logan Center
Loretta
Nelson County
Grand Forks County
LORETTA
24TH ST NE
125TH AVE NE
48TH ST NE
Preferred Route (1000ft)
Potential Preferred Route ROW (150ft)
Potential Survey Corridor (150ft)
Potential Shovel Test Area
NRHP Site
Historical
Archaeological
NDCRS Sites or Site Leads
Architecture
Archaeological
Archaeological
Architectural and/or Historical
Archaeological and Historical
Cultural Resource Surveys
Communication Tower
Gas or Oil Pipeline
Substation
Existing Transmission Lines
400 kV DC
345 kV AC
250 kV DC
230 kV AC
115 kV or less AC
USFWS NWR
USFWS WPA or WDA
State Park, Recreation Area or WMA
USBOR Land
Map Index
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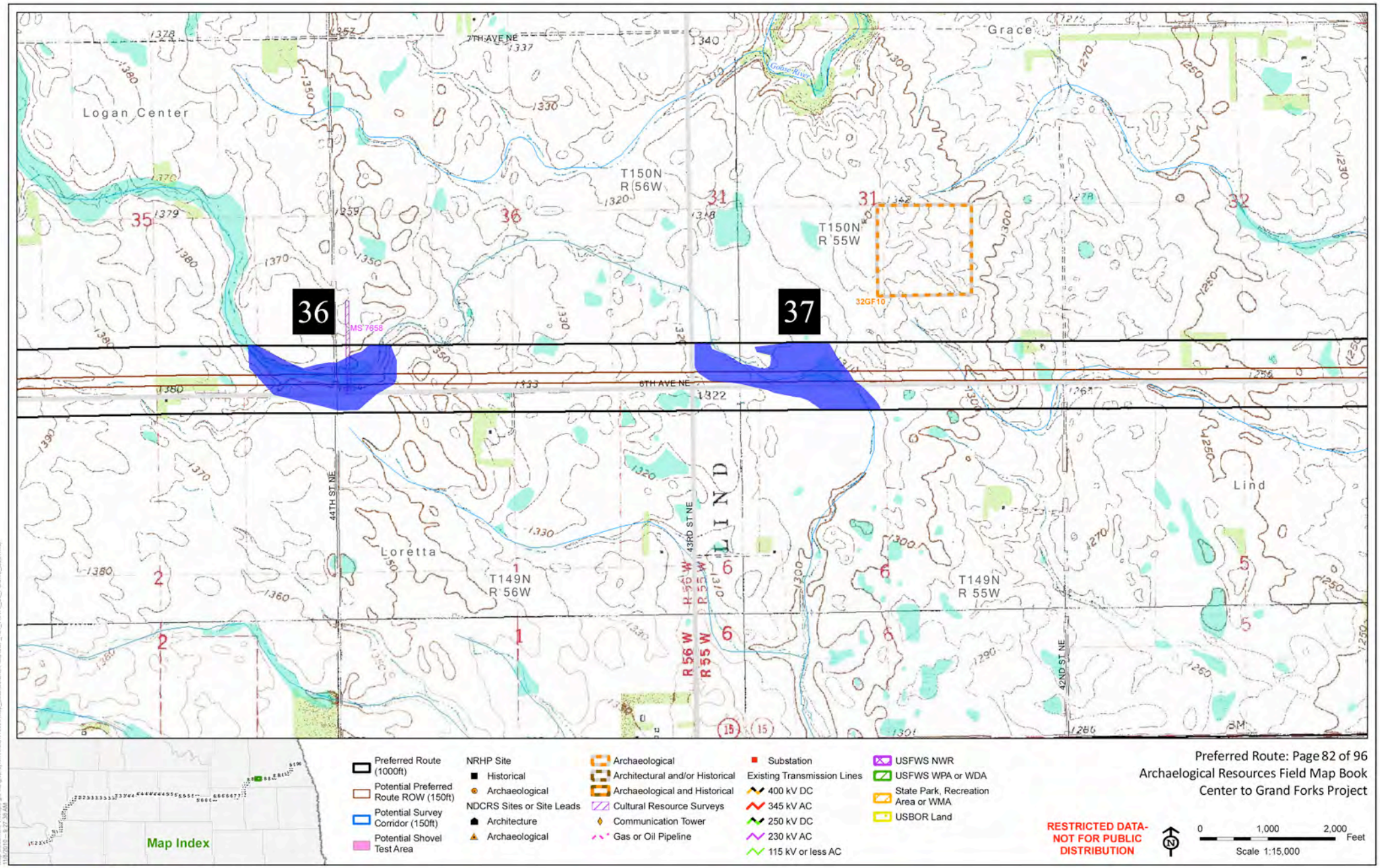
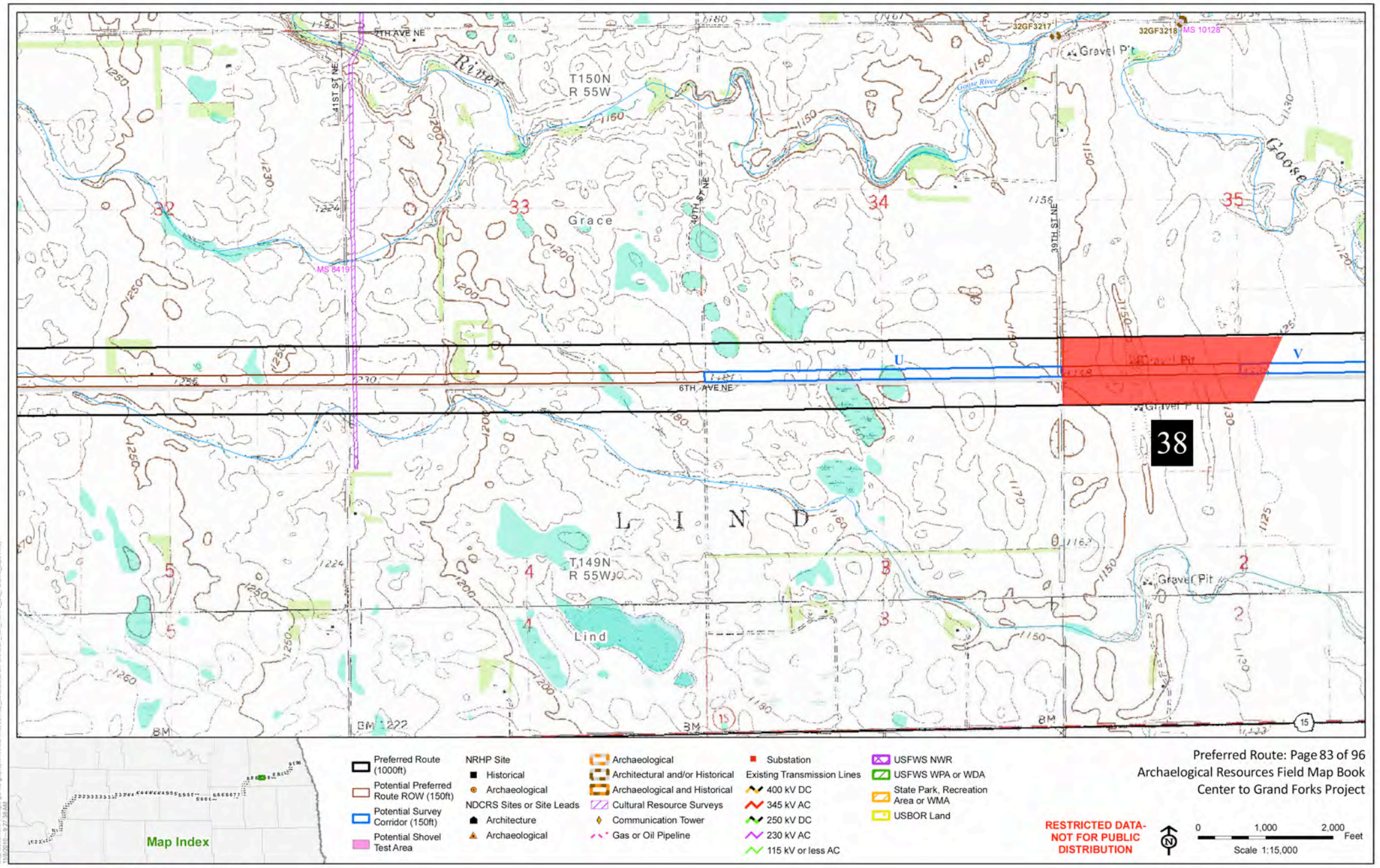
RESTRICTED DATA- NOT FOR PUBLIC DISTRIBUTION
0
1,000
2,000
Feet
Scale 1:15,000
High Geologic Potential
Moderate Geologic Potential
Moderate - Low Geologic Potential




High Geologic Potential

Moderate Geologic Potential

Moderate - Low Geologic Potential

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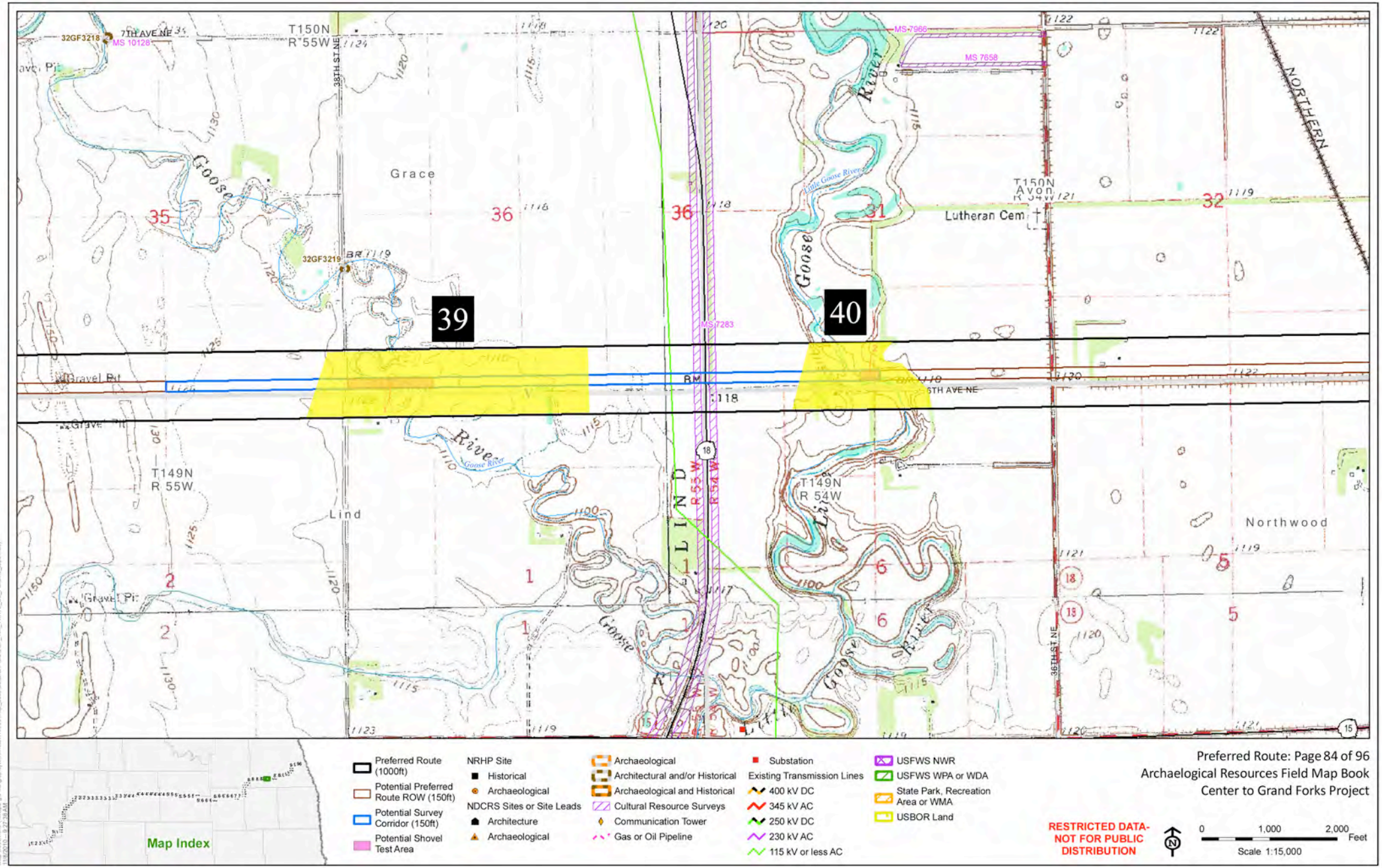
High Geologic Potential

Moderate Geologic Potential

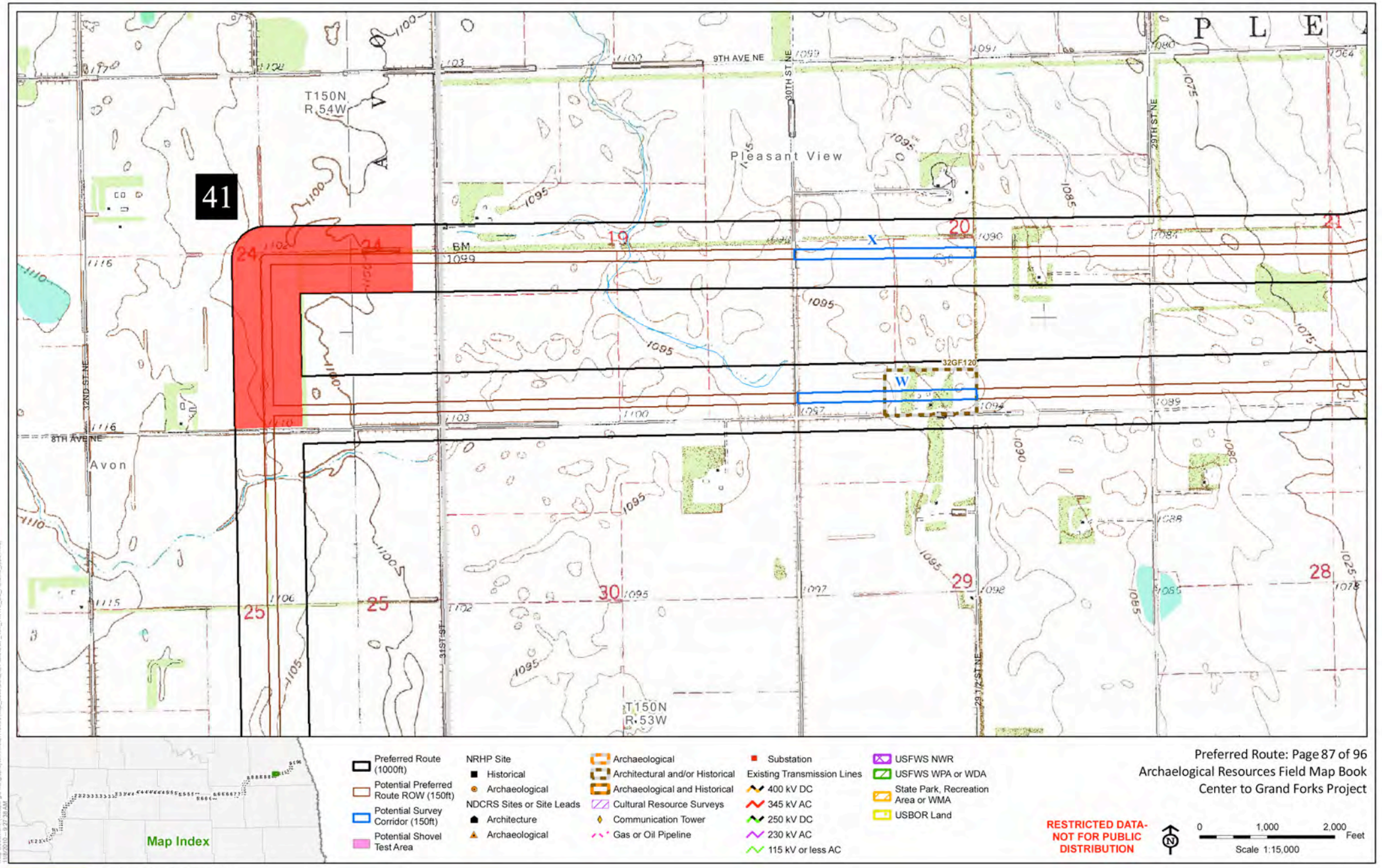
Moderate - Low Geologic Potential




High Geologic Potential

Moderate Geologic Potential

Moderate - Low Geologic Potential

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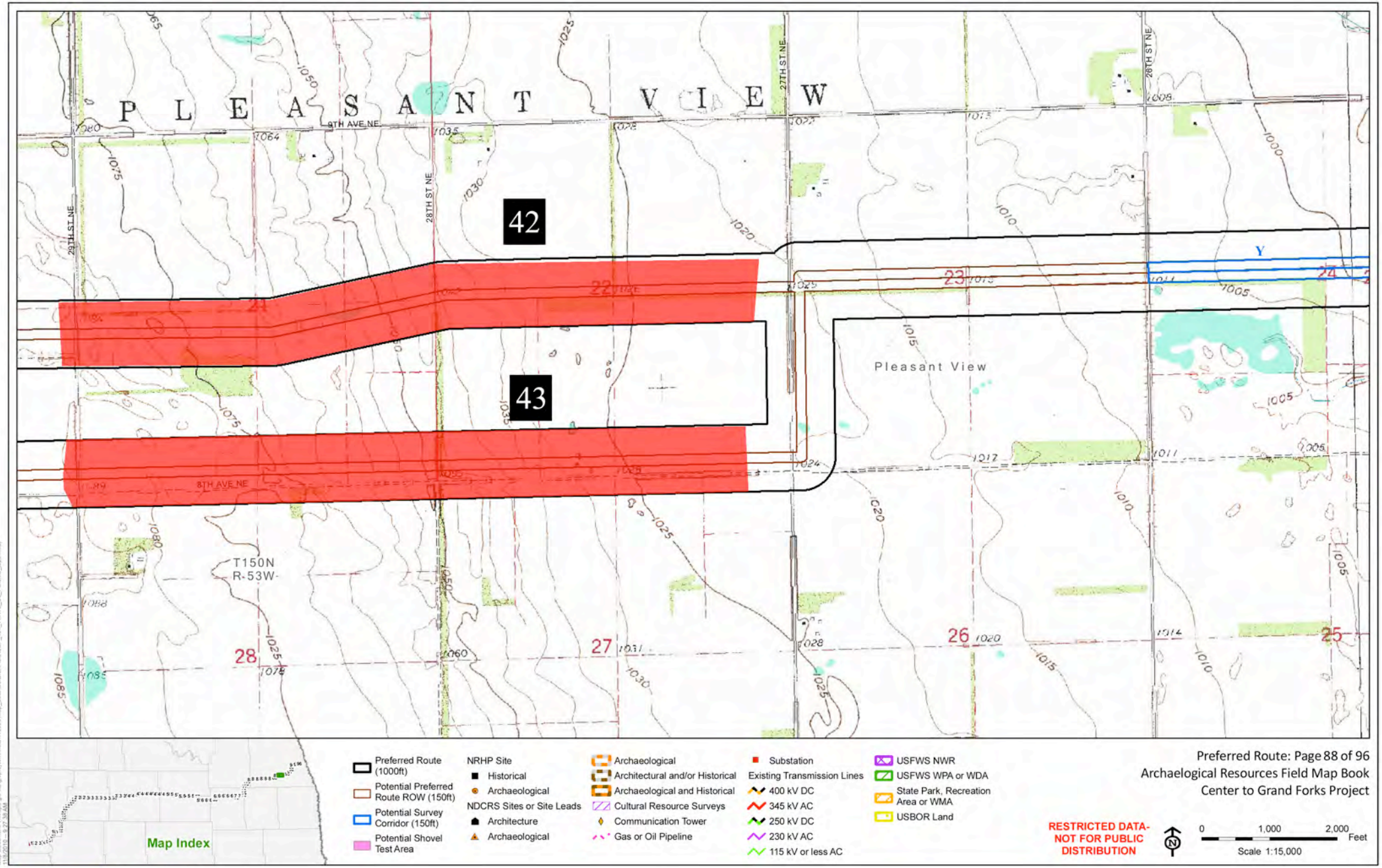
High Geologic Potential

Moderate Geologic Potential

Moderate - Low Geologic Potential

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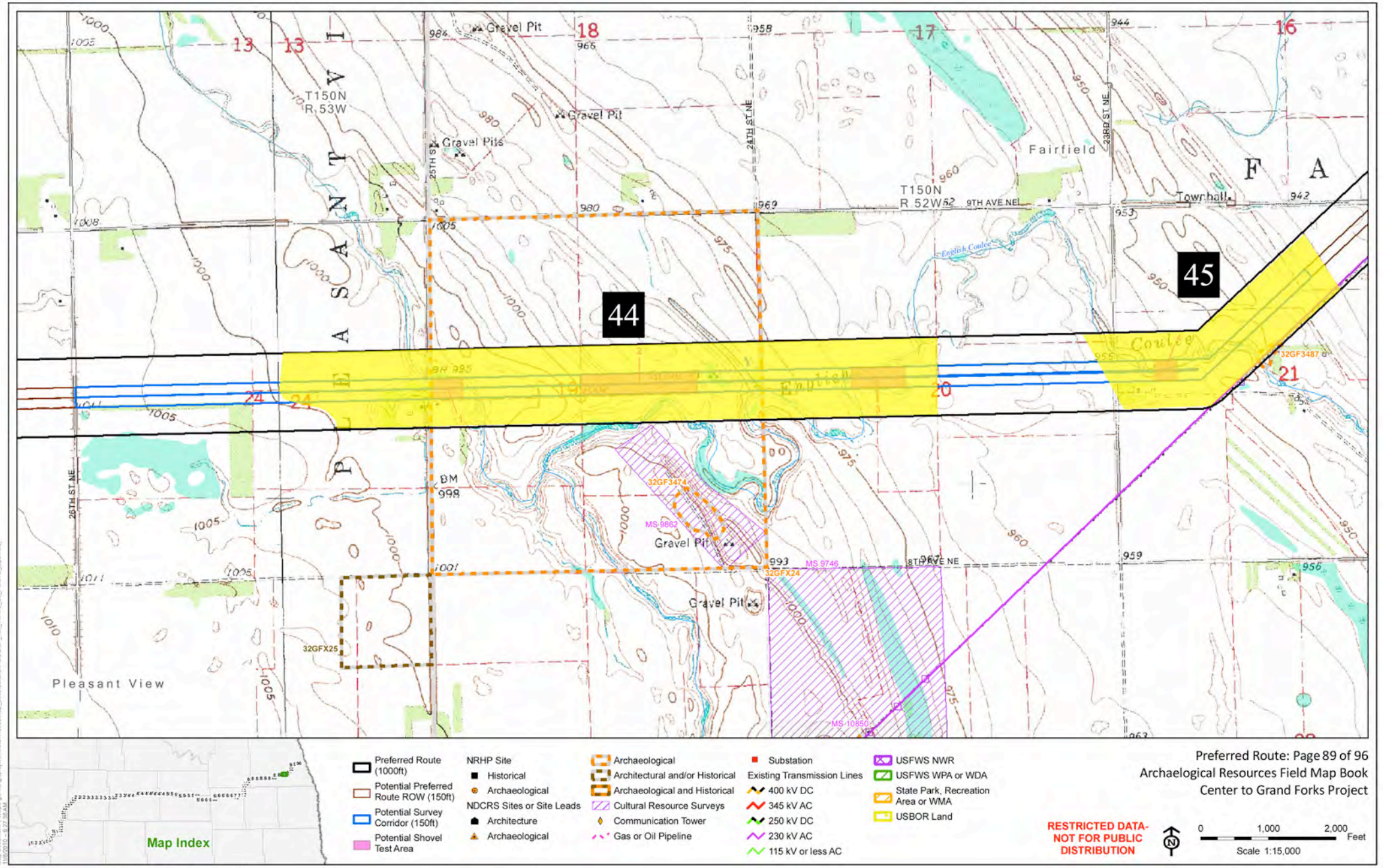
High Geologic Potential

Moderate Geologic Potential

Moderate - Low Geologic Potential


T150N
R 53W
T150N
R 52W
Fairfield
Townhall
Pleasant View
Gravel Pit
Gravel Pits
44
45
32GF3474
32GF3487
32GFX24
32GFX25
MS-9862
MS-9746
MS-10850
BM
998
9TH AVE NE
8TH AVE NE
24TH ST NE
25TH ST
26TH ST NE
23RD ST NE
English Coulee
Preferred Route (1000ft)
Potential Preferred Route ROW (150ft)
Potential Survey Corridor (150ft)
Potential Shovel Test Area
NRHP Site
Historical
Archaeological
NDCRS Sites or Site Leads
Architecture
Archaeological
Archaeological
Architectural and/or Historical
Archaeological and Historical
Cultural Resource Surveys
Communication Tower
Gas or Oil Pipeline
Substation
Existing Transmission Lines
400 kV DC
345 kV AC
250 kV DC
230 kV AC
115 kV or less AC
USFWS NWR
USFWS WPA or WDA
State Park, Recreation Area or WMA
USBOR Land
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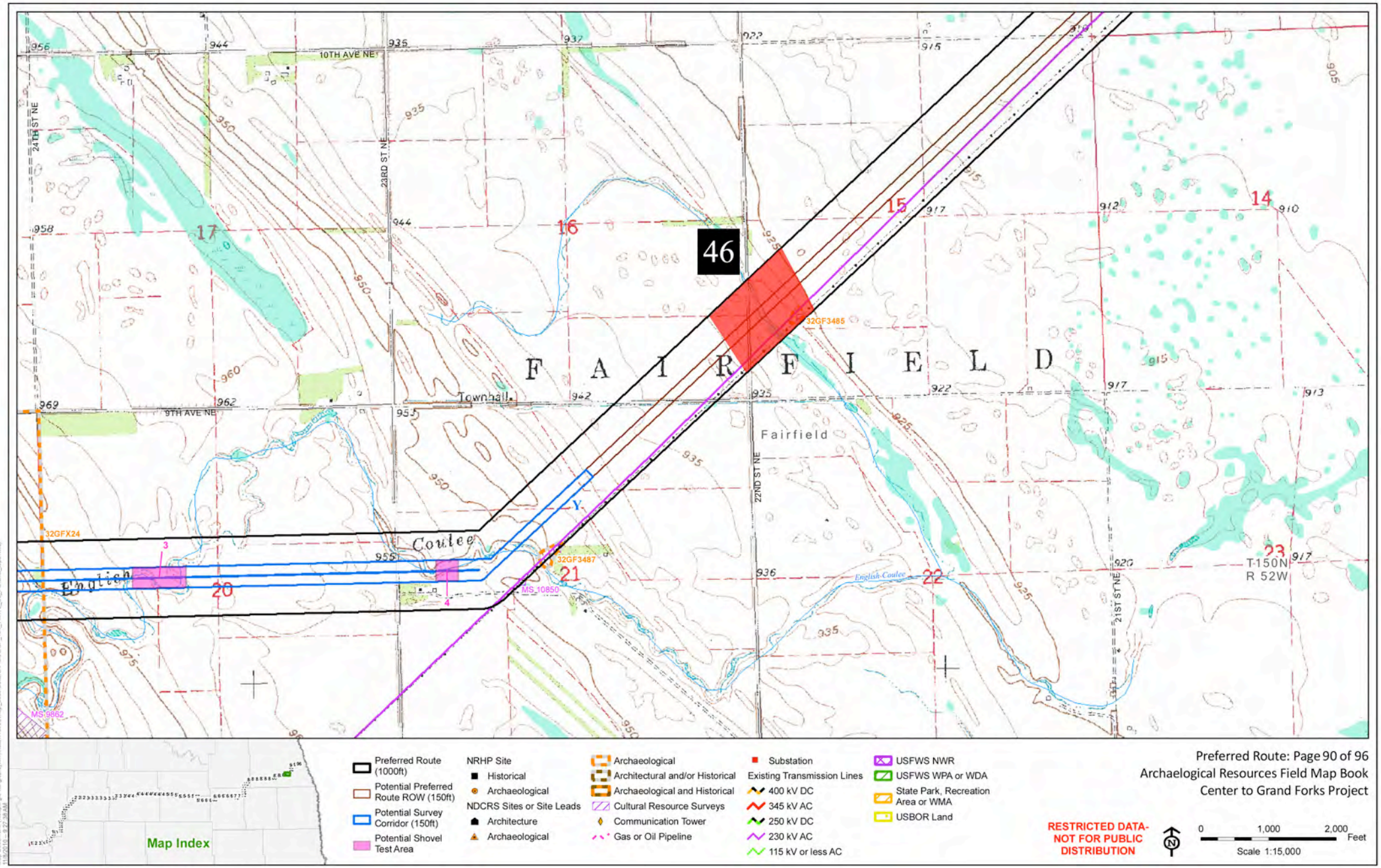
RESTRICTED DATA-
NOT FOR PUBLIC
DISTRIBUTION
0
1,000
2,000
Feet
Scale 1:15,000
High Geologic Potential
Moderate Geologic Potential
Moderate - Low Geologic Potential

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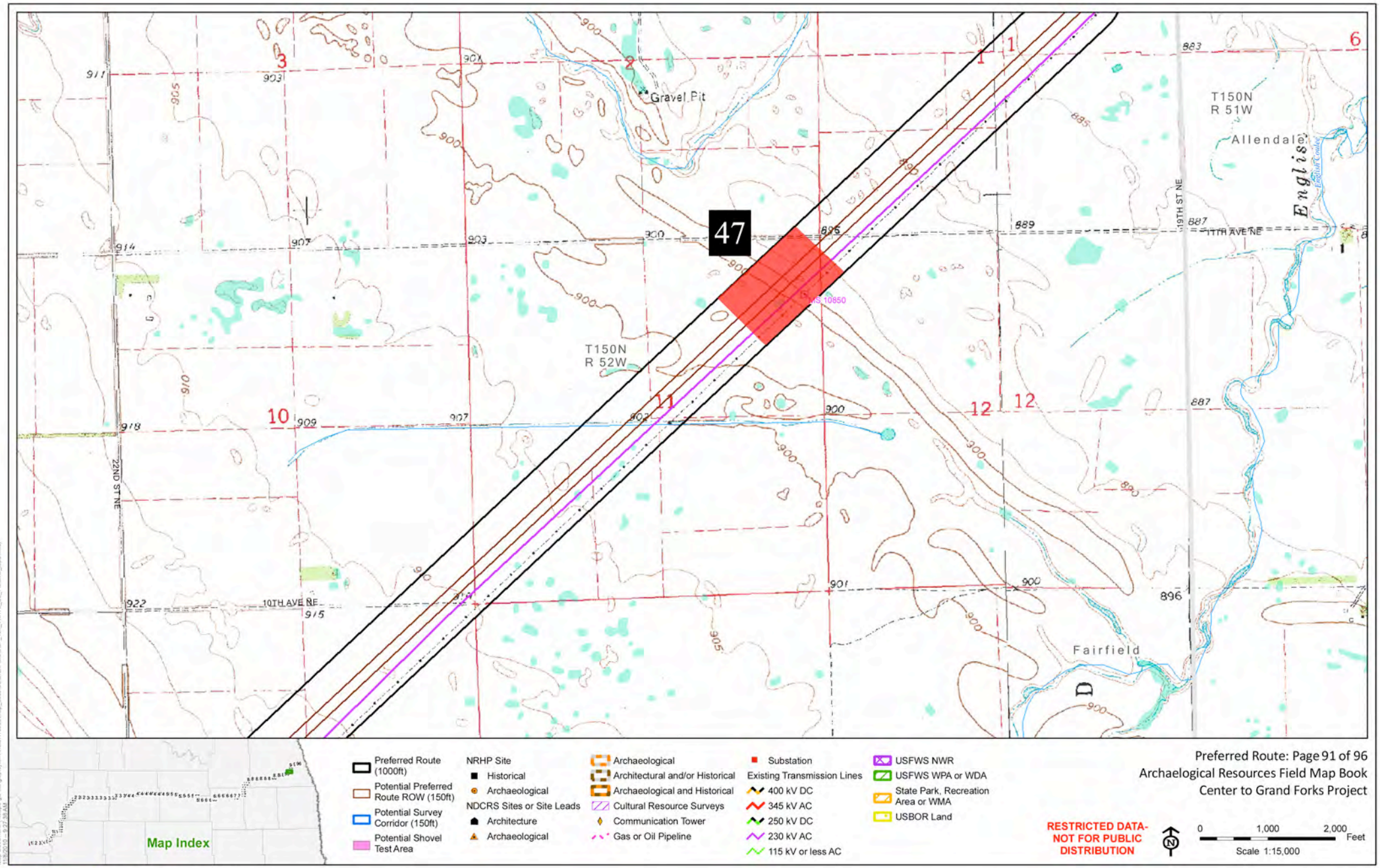


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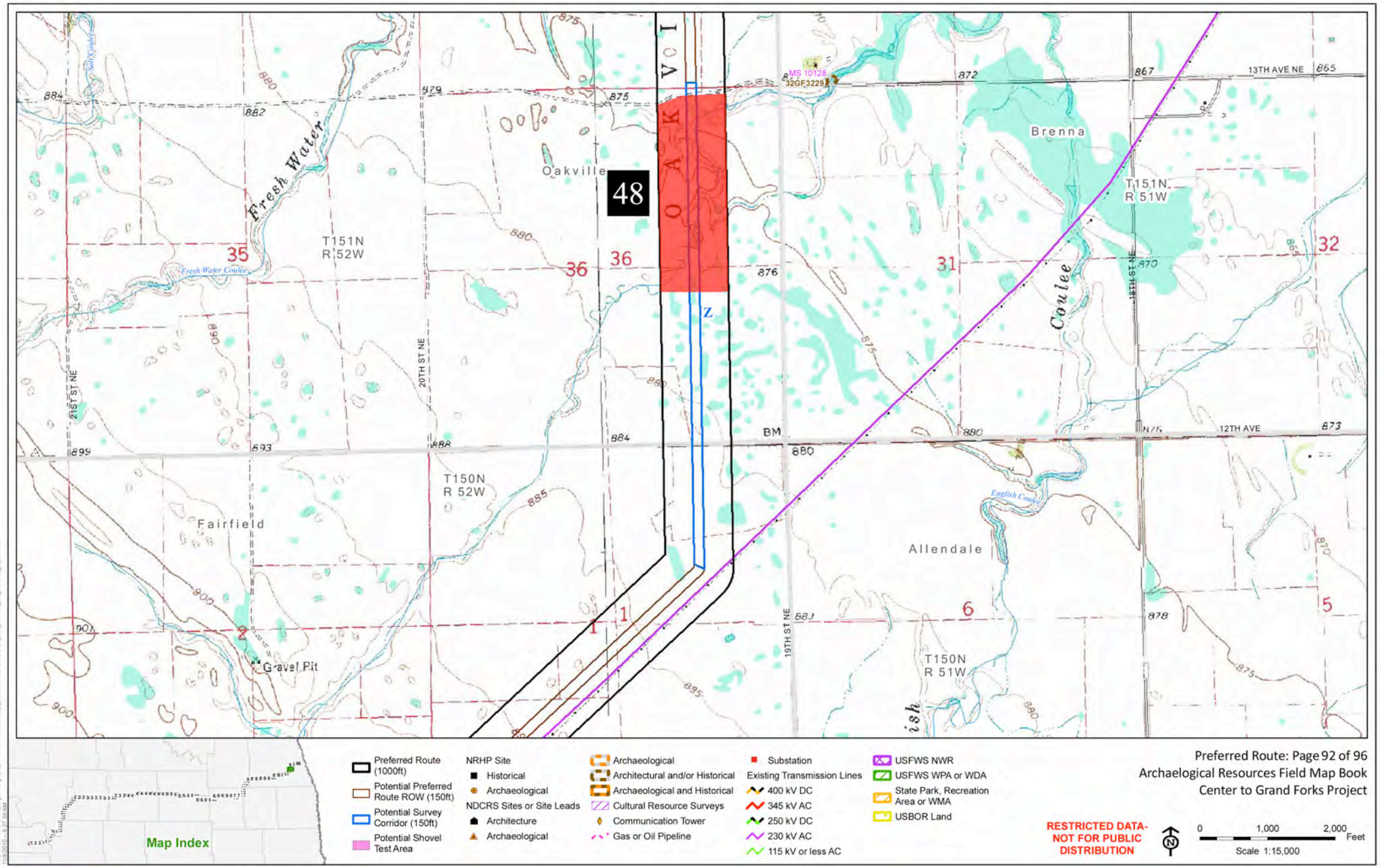
High Geologic Potential

Moderate Geologic Potential

Moderate - Low Geologic Potential

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Preferred Route (1000ft)
Potential Preferred Route ROW (150ft)
Potential Survey Corridor (150ft)
Potential Shovel Test Area

NRHP Site
Historical
Archaeological
NDCRS Sites or Site Leads
Architecture
Archaeological

Archaeological
Architectural and/or Historical
Archaeological and Historical
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400 kV DC
345 kV AC
250 kV DC
230 kV AC
115 kV or less AC

USFWS NWR
USFWS WPA or WDA
State Park, Recreation Area or WMA
USBOR Land

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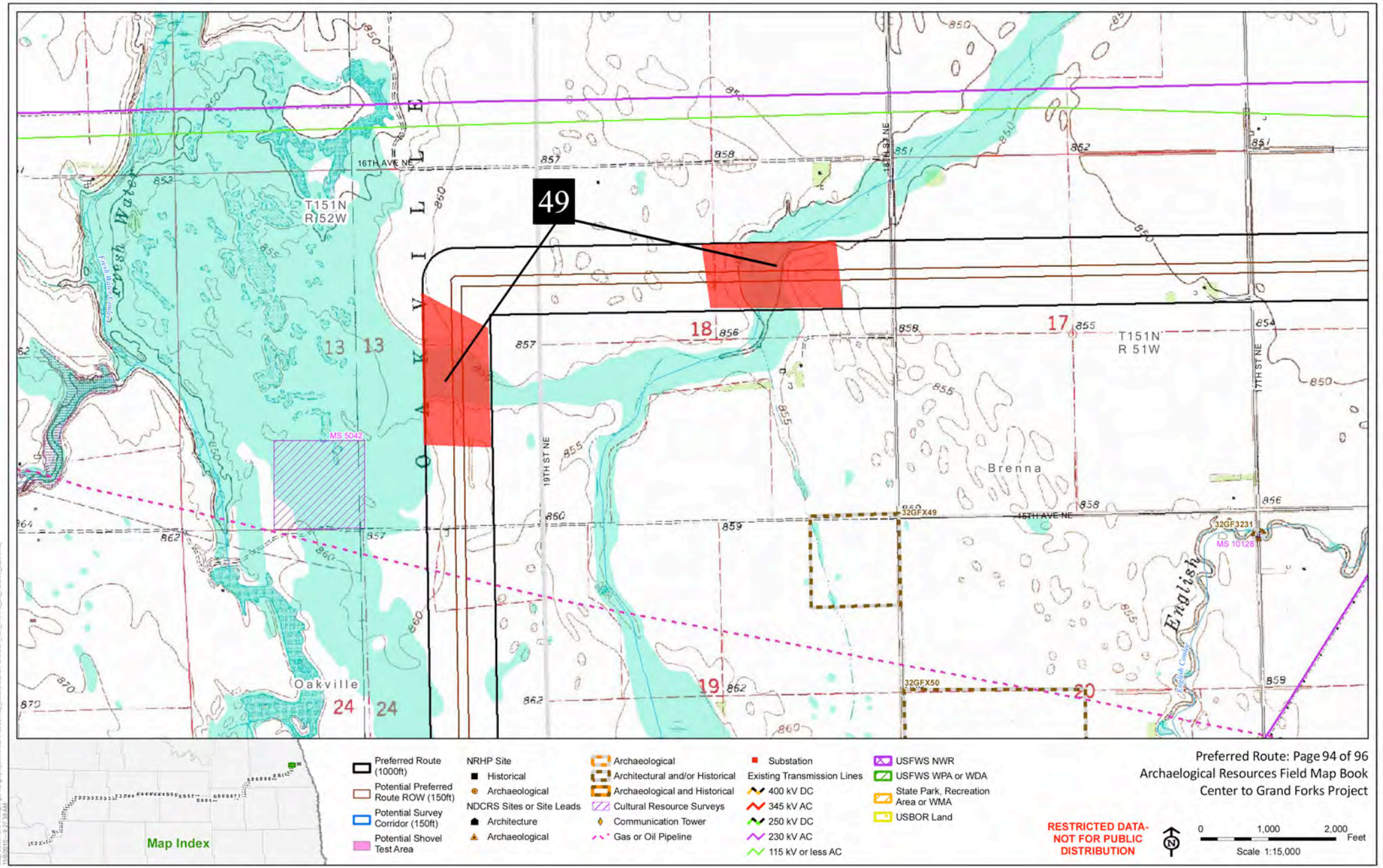
0 1,000 2,000 Feet
Scale 1:15,000

High Geologic Potential
Moderate Geologic Potential
Moderate - Low Geologic Potential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T151N
R52W
T151N
R 51W
Oakville
Brenna
16TH AVE NE
15TH AVE NE
18TH ST NE
19TH ST NE
17TH ST NE
MS 5042
MS 10128
32GFX49
32GFX50
32GF3231
Ash Water
English
Map Index
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Potential Preferred Route ROW (150ft)
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Archaeological
NDCRS Sites or Site Leads
Architecture
Archaeological
Archaeological
Architectural and/or Historical
Archaeological and Historical
Cultural Resource Surveys
Communication Tower
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400 kV DC
345 kV AC
250 kV DC
230 kV AC
115 kV or less AC
USFWS NWR
USFWS WPA or WDA
State Park, Recreation Area or WMA
USBOR Land
RESTRICTED DATA- NOT FOR PUBLIC DISTRIBUTION
0
1,000
2,000
Feet
Scale 1:15,000
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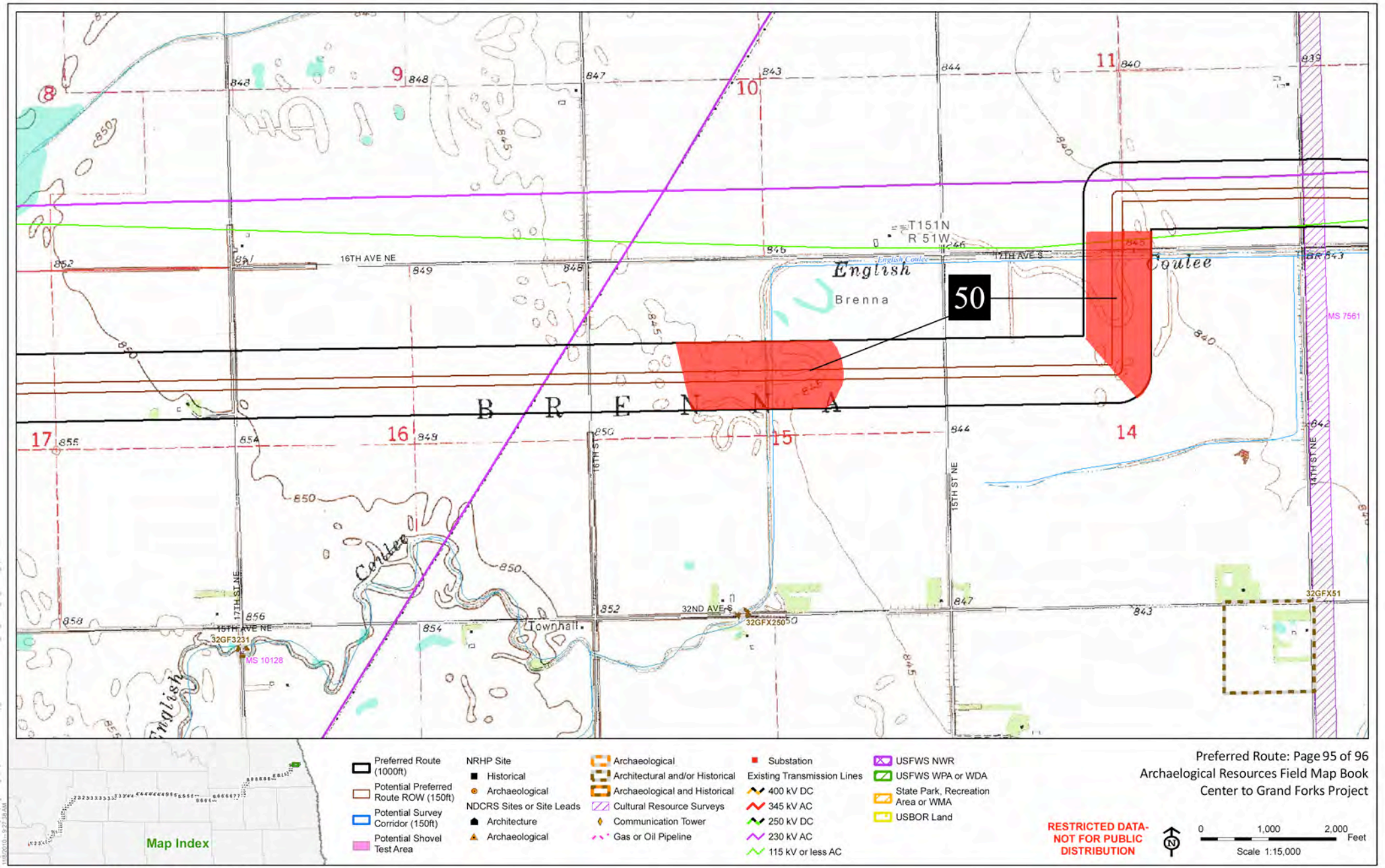
Center to Grand Forks Project
High Geologic Potential
Moderate Geologic Potential
Moderate - Low Geologic Potential




High Geologic Potential

Moderate Geologic Potential

Moderate - Low Geologic Potential