quality of waters of the US as applied under the CWA within the jurisdiction of Indiana's water quality standards under IAC 327. Indiana's water quality standards have been reviewed and approved by the USEPA which maintains oversight of IDEM's approvals of 401 WQCs.

Under the Indiana Wetlands Regulatory Program, Isolated Wetlands Law (IC 13-18-22) and the rule implementing the law (327 IAC 17), IDEM regulates wetlands that do not fall under USACE jurisdiction (isolated wetlands). Isolated wetlands that are open water ponds constructed in upland areas for agricultural or recreational use are not regulated by IDEM. It is anticipated that implementation of any of the working alignments would require issuance of an Isolated Wetland General Permit or an Isolated Wetland Individual Permit.

All working alignments would be subject to the requirements of a NPDES permit for stormwater discharges from construction sites. NPDES coverage is required when a construction project disturbs 1 acre or more of total land area, or is part of a larger common plan of development that ultimately disturbs 1 or more acres of total land area. Permit coverage would be obtained from IDEM. Permit requirements would include preparation of a SWPPP. The SWPPP would identify potential sources of pollution and would describe or identify practices to be used to reduce the discharge of pollutants associated with construction site activity. The permit would require the installation, maintenance, repair, and inspection of BMPs and reporting.

The Indiana DNR has the jurisdictional responsibility for approving any construction within a floodway of any river or stream under IC 14, the Flood Control Act. The proposed project will have several stream and river crossings requiring approval of construction within floodways of any river or stream.

In Indiana, a detailed review of Soil Erosion and Sedimentation Control plans would be conducted by IDEM under Rule 5. Rule 5 applies to construction activities that result in the disturbance of 1 acre or more of total land area. Implementation of any of the working alignments would require issuance of this General Permit. An Individual Stormwater Permit may be required if an adverse environmental impact from a project site is evident. Generally, an Individual Stormwater Permit is typically required only if the IDEM determines the discharge will significantly lower water quality.

3.17 Mineral and Geologic Resources

This section describes mineral and geological resources within the Study Area and corridors, and discusses the potential for the working alignments to be affected by or cause impacts related to these resources and conditions. The mineral resource analysis involved assessment of sand and gravel, limestone, coal, and natural gas and oil resources, including any associated past or existing mining operations. Geologic risks to the project that may be associated with these resources and other geologic conditions including mine subsidence, weak and compressible soils, expansive soils, karst topography, and seismicity were considered. Potential avoidance and measures to minimize the effects of the identified resources and hazards are presented in this section.

3.17.1 Existing Conditions

3.17.1.1 Geologic Setting

Topography

In general, the highest ground surface elevations within the Study Area are located in and encompass the entire central portion of the Study Area. Topography within this area is gently rolling to hummocky and is dissected by southwestward trending streams which drain towards the Kankakee and Des Plaines rivers, and northeastward trending streams which drain towards Lake Michigan. The remainder of the Study Area is relatively flat-lying, sloping gently downward towards the west within the Kankakee and Des Plaines River basins. The elevations within the Study Area range from a maximum of about 850 feet National Geodetic Vertical Datum (NGVD) within the central portion of the area to a minimum of about 500 feet NGVD in western Will County.

Physiographic Provinces

The Study Area lies within the area of the most recent glacial advance in North America, the Wisconsin glaciation, which ended about 12,000 years ago. Thus, the surficial soil types within the Study Area are all entirely glacial or post-glacial in origin. The Study Area encompasses or immediately adjoins portions of three Physiographic Provinces, which relate to the glacial processes that shaped the landforms of these areas. The three Physiographic Provinces are briefly described below from north to south:

- Chicago Lake Plain Division, Great Lakes Section, Central Lowland Province (Illinois) and Lake Michigan Border, Northern Moraine and Lake Region (Indiana) - As the glaciers melted a series of glacial lakes were impounded, ultimately creating the modern-day Lake Michigan shoreline. As the glacier receded, new drainage outlets were exposed and new shorelines formed. A series of beach ridges and glacial lakebed deposits is associated with the various lake stages. The northern edge of the Study Area adjoins this Physiographic Province.
- Wheaton Morainal Country Division, Great Lakes Section, Central Lowland Province (Illinois) and Valparaiso Morainal Country, Northern Moraine and Lake Region (Indiana) - A terminal moraine forms when the glacial ice advance stops for a period of time and ice-contact glacial till and water-sorted sand are deposited creating a ridge at the limit of glacial advance and a morainal area of hilly, hummocky terrain. Blocks of glacial ice may be incorporated in the deposition and subsequently melt, forming kettle holes which often fill with organic matter, creating peat and muck deposits. A major morainal deposit trends through the corridor, referred to as the Wheaton Moraine in Illinois and the Valparaiso Moraine in Indiana. The moraine soils are low plasticity glacial tills containing varying percentages of sand, gravel, cobbles and boulders, and zones of water-sorted sands. Glacial outwash channels filled with sand and gravel or, in some areas, organic

peat/muck, are incised into the moraine soils and drained towards the Kankakee Plain to the south.

- Kankakee Plain Division, Till Plains Section, Central Lowland Province (Illinois) and Kankakee Drainageways, Northern Moraine and Lake Region (Indiana) - The present-day Kankakee River flows through a broad glacial outwash valley that was deposited by the ice-melt flows from the Valparaiso/Wheaton Moraine. Sands and gravels predominate, deposited within the fast-flowing meltwaters. Organic matter forming peat and muck deposits accumulated in local areas that became cut off from the main flow; this is similar to modern oxbows.

The Physiographic Provinces within the Study Area are shown on Figure 3-40.

Surficial Soils

Surface soil information for the Study Area is based on county-wide mapping by the USDA NRCS. Predominant soils within the Study Area based on this mapping are shown on Figure 3-41.

The majority of soils in the Study Area are comprised of morainal till deposits, predominately the Yorkville and Wadsworth Glacial Tills. These morainal tills consist primarily of mixtures of clay, silt, sand, and gravel, with interstratified water-bearing sand and gravel layers resulting from ice-contact deposition. Dissecting these till moraines are outwash and alluvial deposits, primarily the Cahokia Alluvium in Illinois and "Mixed Drift" in Indiana, leading to the outwash deposits of the Kankakee Plain. Outwash deposits of the Kankakee Plain include Parkland Sand, Dolton Member, and Mackinaw Member in Illinois and undifferentiated outwash in Indiana. To a much lesser extent, areas of highly organic post-glacial soils (peat and muck) also occur, predominantly in the Indiana portion of the Study Area. Peat and muck-filled depressions are attributed to the dynamic processes of glacial retreat occurring in areas with poor drainage, limited water circulation, and local climates.

Bedrock

Throughout the Study Area, Paleozoic Era sedimentary rock formations directly underlie, and are much older than the glacial soils. The overlying younger rock formations were subsequently eroded or scoured away by glaciation. Throughout the westernmost portion of the Study Area in Illinois and through all the Study Area in Indiana, the uppermost rock formations are of the Ordovician, Silurian, Devonian, and Mississippian Period ages; the most recent of which ended about 320 million years ago. During these periods, shallow seas covered Illinois and Indiana, and limestone, dolomite, and shale were deposited. The westernmost portion of the Study Area is within the Illinois Basin, and younger Pennsylvanian Period formations are present. The Pennsylvanian Period ended about 290 million years ago. During this period, the area was covered by swamp forests, coal, shale, sandstone, and clay. The uppermost bedrock formations through the Study Area are shown on Figure 3-42.

3.17.1.2 Mineral Resources

Industrial mineral resources are generally classified as either metallic or non-metallic. As measured by total consumption, the most important metallic resources throughout the US are iron, aluminum, copper, zinc, and lead. The most important non-metallic resources in the US are crushed stone, sand and gravel, cement, clays, salt, and phosphate. In addition to these industrial minerals, mineral fuels otherwise known as fossil fuels are a significant national resource. Such resources include carbonaceous fuels that are mined or otherwise recovered from the earth such as petroleum, coal, shale oil, and tar sands.

The USGS uses a classification system that evaluates the degree of certainty about the existence and magnitude of mineral resource supplies and the economic feasibility of recovering them. In this system, mineral reserves are defined as those supplies known to exist that are also economically and technologically recoverable. This can be quite different from mineral resources, which include all known, inferred, and potential supplies, whether or not they are economically and technologically recoverable.

The predominant mineral resources found in Illinois and Indiana includes sand and gravel, limestone, coal, oil, and natural gas. These resources have many uses including, but not limited to, the generation of electricity for homes and offices, gas for transportation, heating and cooling for homes, and building products.

Sand and Gravel Resources

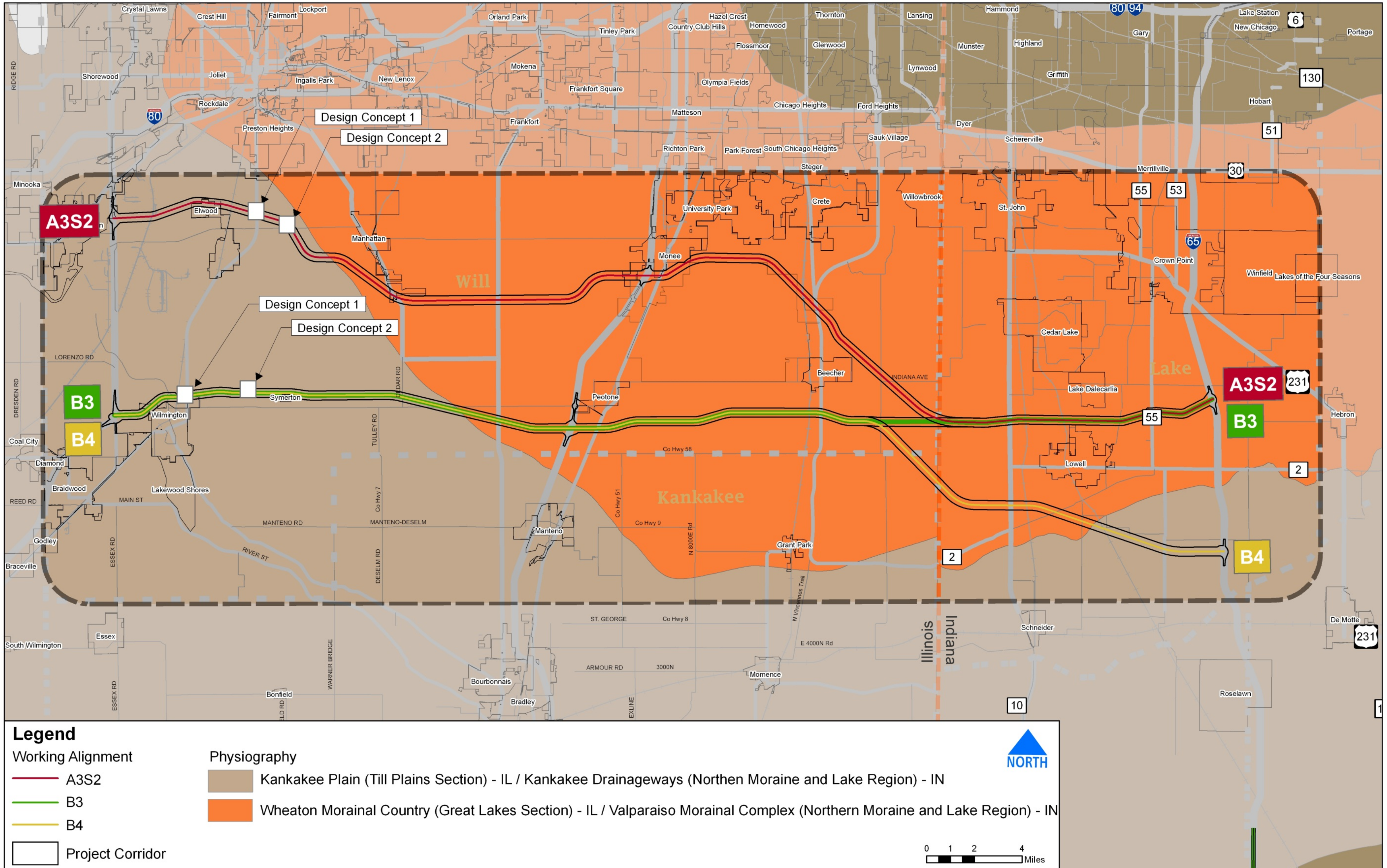
Sand and gravel deposits are widely distributed in select locations across both Illinois and Indiana. They are most abundant, and of highest quality, in northeastern Illinois, but less abundant and lower quality elsewhere. Large areas of sand and gravel deposits occur adjacent to and along the Kankakee River Valley in Illinois and in the southern portion of Study Area in Indiana. These outwash and alluvial deposits, primarily the Cahokia Alluvium in Illinois and "Mixed drift" in Indiana, lead to the outwash deposits of the Kankakee Plain. The outwash deposits of the Kankakee Plain include Parkland Sand, Dolton Member, and Mackinaw Member in Illinois, and undifferentiated outwash in Indiana.

There are two active and four abandoned sand and gravel pits located within the Study Area. These pits are all located in the southern portion of Lake County (south of Lowell, Indiana) and are not located within any of the corridors. The locations of the identified sand and gravel pits within the Study Area are shown on Figure 3-43.

Limestone and Dolomite Resources

Limestone and dolomite are the most widely quarried rock in Illinois and Indiana; with crushed stone being one of the most important rock products. Millions of tons of stone are crushed annually for use as construction aggregates, road surfacing material, agricultural limestone, and lime. High calcium limestone is also used as a scrubbing agent for pollution control in power plants and incinerators and as a major ingredient of cement, the binding agent used in concrete pavements and foundations.

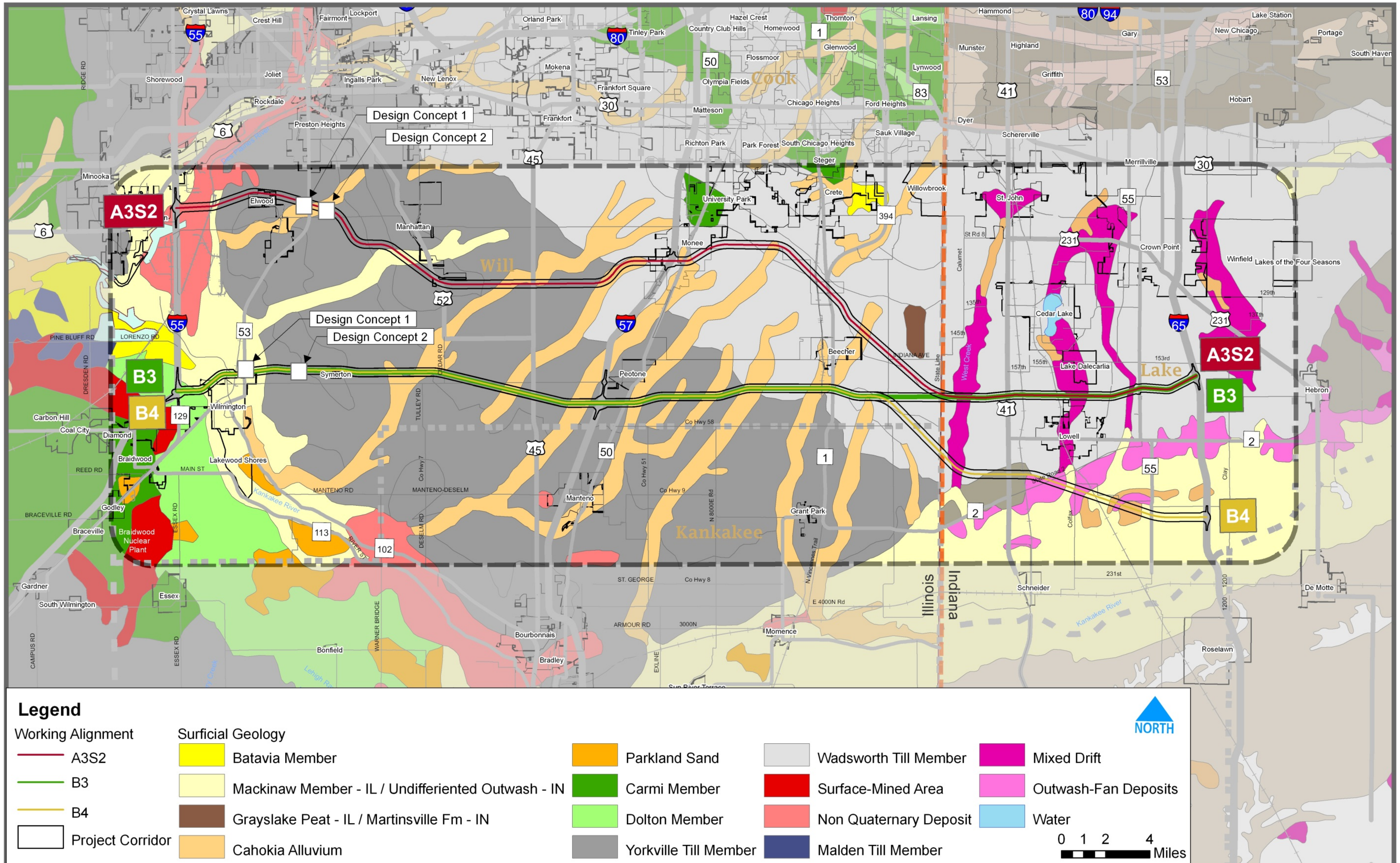
Figure 3-40. Physiographic Provinces



Source:
lnmap.indiana.edu, Illinois Natural Resources Geospatial Data Clearinghouse

THIS PAGE INTENTIONALLY LEFT BLANK

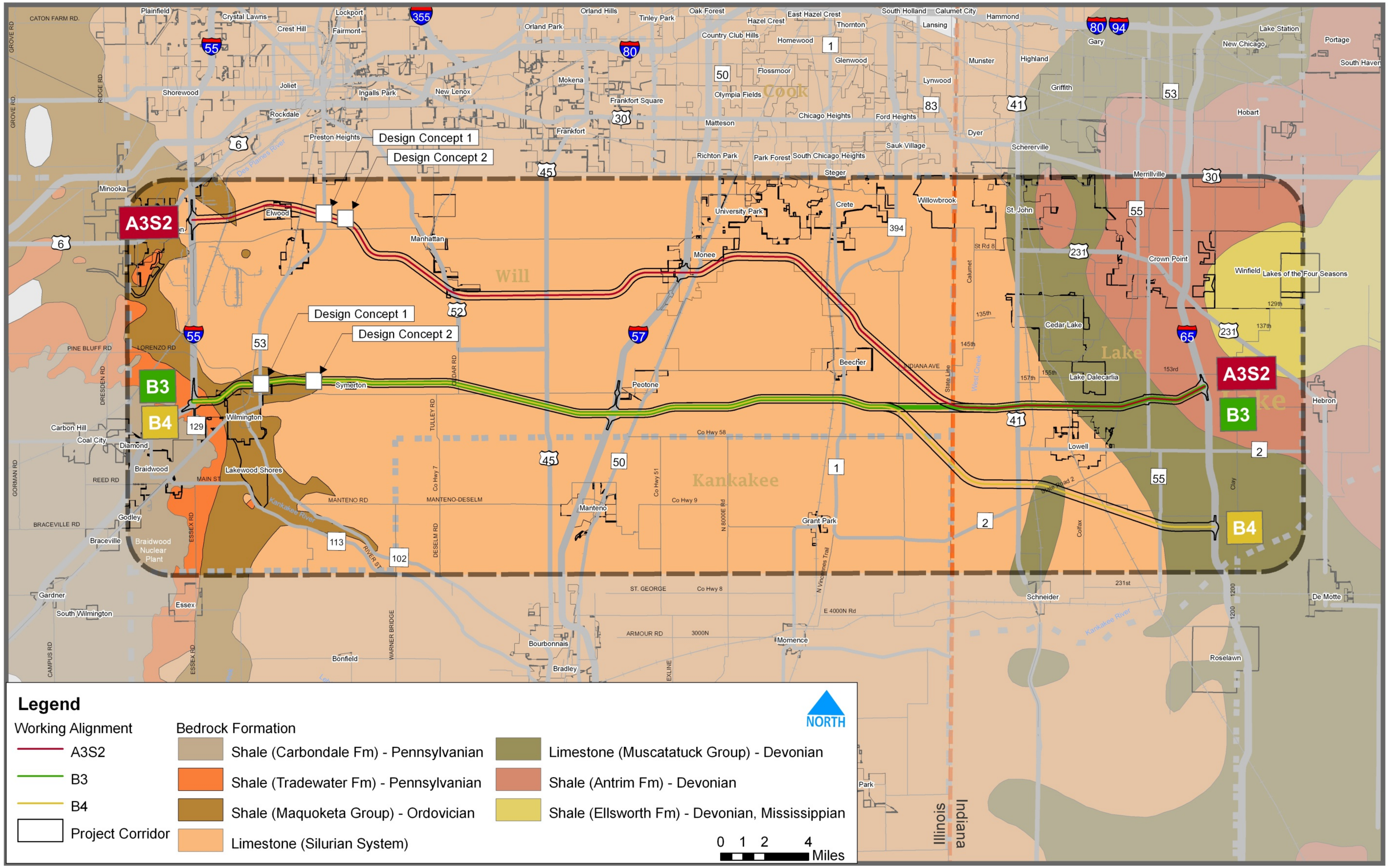
Figure 3-41. Predominant Surficial Soil Types



Source:
lnmap.indiana.edu, Illinois Natural Resources Geospatial Data Clearinghouse

THIS PAGE INTENTIONALLY LEFT BLANK

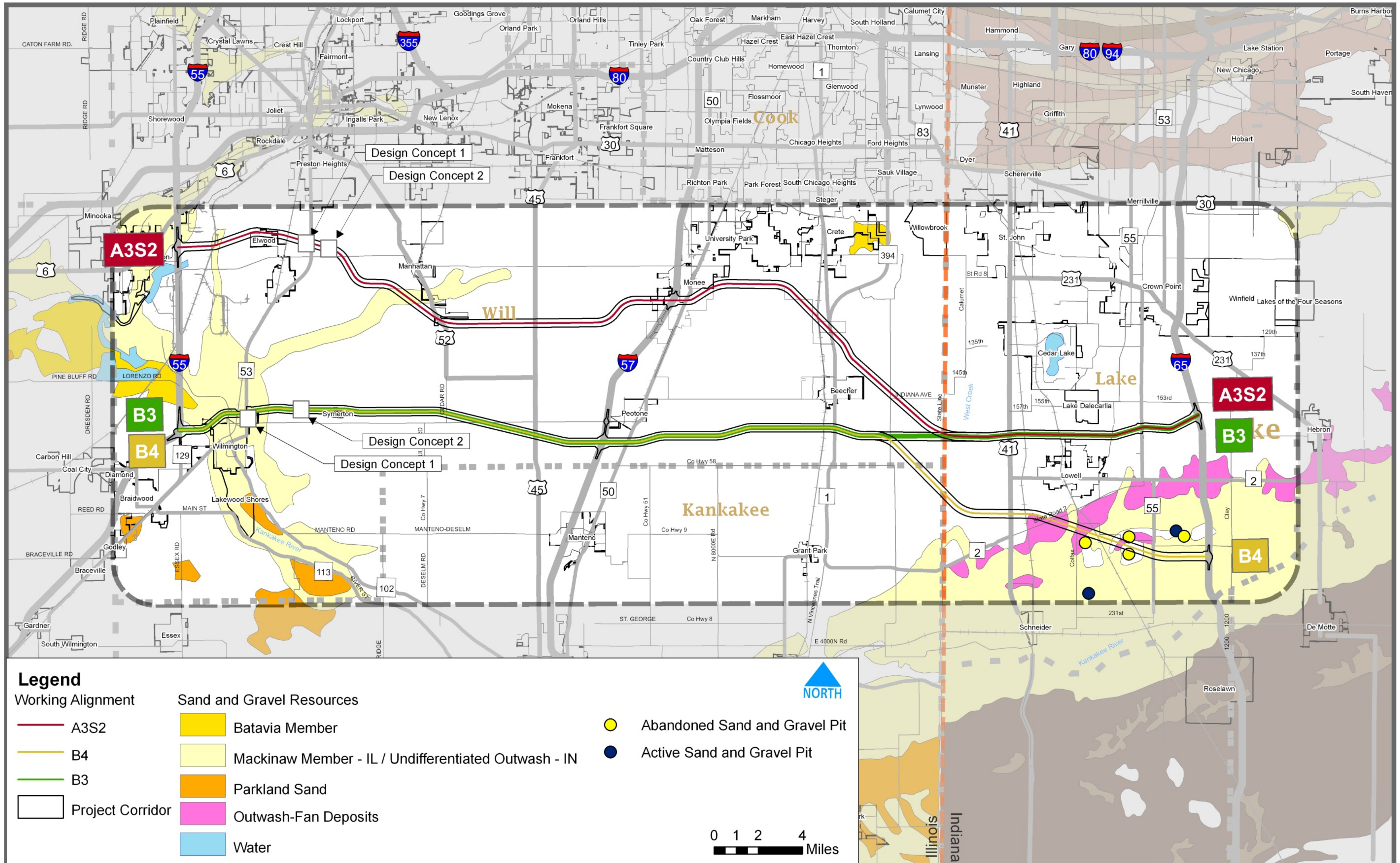
Figure 3-42. Uppermost Bedrock Formations



Source:
Inmap.indiana.edu, Illinois Natural Resources Geospatial Data Clearinghouse

THIS PAGE INTENTIONALLY LEFT BLANK

Figure 3-43. Sand and Gravel Resources and Pits



Source:
Inmap.indiana.edu, Illinois Natural Resources Geospatial Data Clearinghouse

THIS PAGE INTENTIONALLY LEFT BLANK

In Illinois, limestone and dolomite quarries are located where thick stone deposits occur near the surface, mainly in the northern quarter, the western portion, and the southern end of the state. Mineable limestone deposits in Indiana are generally located within the south-central portion of the state in a corridor ranging from Putnam County to the Ohio River. Mineable dolomite deposits in Indiana are located in the northwest corner of the state (Jasper, Pulaski, Fulton White, and Cass counties) and the northeastern portion (Wells Adams, Jay, Blackford, Delaware, and Randolph counties).

Two active limestone quarries are located in the Illinois portion of the Study Area near Manteno, Illinois. One of these quarries (Manteno Quarry) is located approximately 2.5 miles south of Manteno on IL-50. The facility is operated by Vulcan Materials Company for the production of crushed stone. The second quarry (Aggregate Yard 95) is located approximately 2.5 miles southwest of Manteno on US 45. The facility is operated by Prairie Materials also for the production of crushed stone.

There is one active limestone quarry in the Indiana portion of the Study Area on W. 205th Avenue approximately 3.5 miles southwest of Lowell, Indiana. The facility is operated by Vulcan Materials Company for the production of crushed stone. Additionally, there are two abandoned limestone quarries located southwest of Lowell between the active Vulcan Materials Company quarry and Indianapolis Boulevard.

The locations of the identified limestone quarries within the Study Area are shown on Figure 3-44. None of these active or abandoned quarries are located within the limits of any of the corridors.

Due to the amount of glacial material present, few outcrops of limestone or other bedrock occur within the Study Area. The depth to the uppermost limestone bedrock units exceeds 50 feet over most of the Study Area; with the depth exceeding 100 feet in many areas (see Figure 3-44). Such depths significantly limit the ability of the limestone or dolomite resources within the Study Area to be economically mined.

Coal Resources

According to the ISGS publication titled *Directory of Coal Mines in Illinois-Will County* (2011), there is no active coal mining within the Illinois portion of the Study Area. The only known coal resources within the Study Area are located in the extreme southwest corner of Will County, southwest of Wilmington, Illinois, where underground coal mining occurred between 1864 and 1928. Coal mining continued in the area using strip mining methods from 1935 through 1974. Based on the historical mining activities, coal in this area is largely mined out.

The nearest known abandoned coal mines within the Illinois portion of the Study Area are located approximately 0.5 miles southwest of the western terminus of the working alignments within Corridors B3 and B4. The location of coal resources, including mined and unmined areas, within the Illinois portion of the Study Area are shown on Figure 3-45.

According to the INSGS's *Coal Mine Information System* (INSGS, 2012b), there are no coal reserves or coal mines within the Indiana portion of the Study Area.

Natural Gas and Oil Resources

According to the *Illinois Oil and Gas Resources (ILOIL) Internet Map Service* (ISGS, 2012), there are no natural gas or oil well fields in the Illinois portion of the Study Area. Similarly, according to the INSGS's *Petroleum Database Mgmt. System* (INSGS, 2012a), there are no natural gas or oil well fields in the Indiana portion of the Study Area.

3.17.1.3 Geologic Hazards

The physical and/or chemical properties associated with mineral or other geologic resources may pose risk or constraints to the use of the project and the proposed improvements. In addition, past human activities, such as mining, can also create risks and hazards. Potential geologic hazards and corresponding engineering constraints considered in this analysis include mine subsidence, weak and compressible soils, expansive soils, karst topography, and seismicity. For purposes of this Tier One DEIS analysis, a geologic hazard is defined as "a geologic phenomenon which is adverse to foreseeable construction or land use as to constitute a hazard to public health and safety or to property."

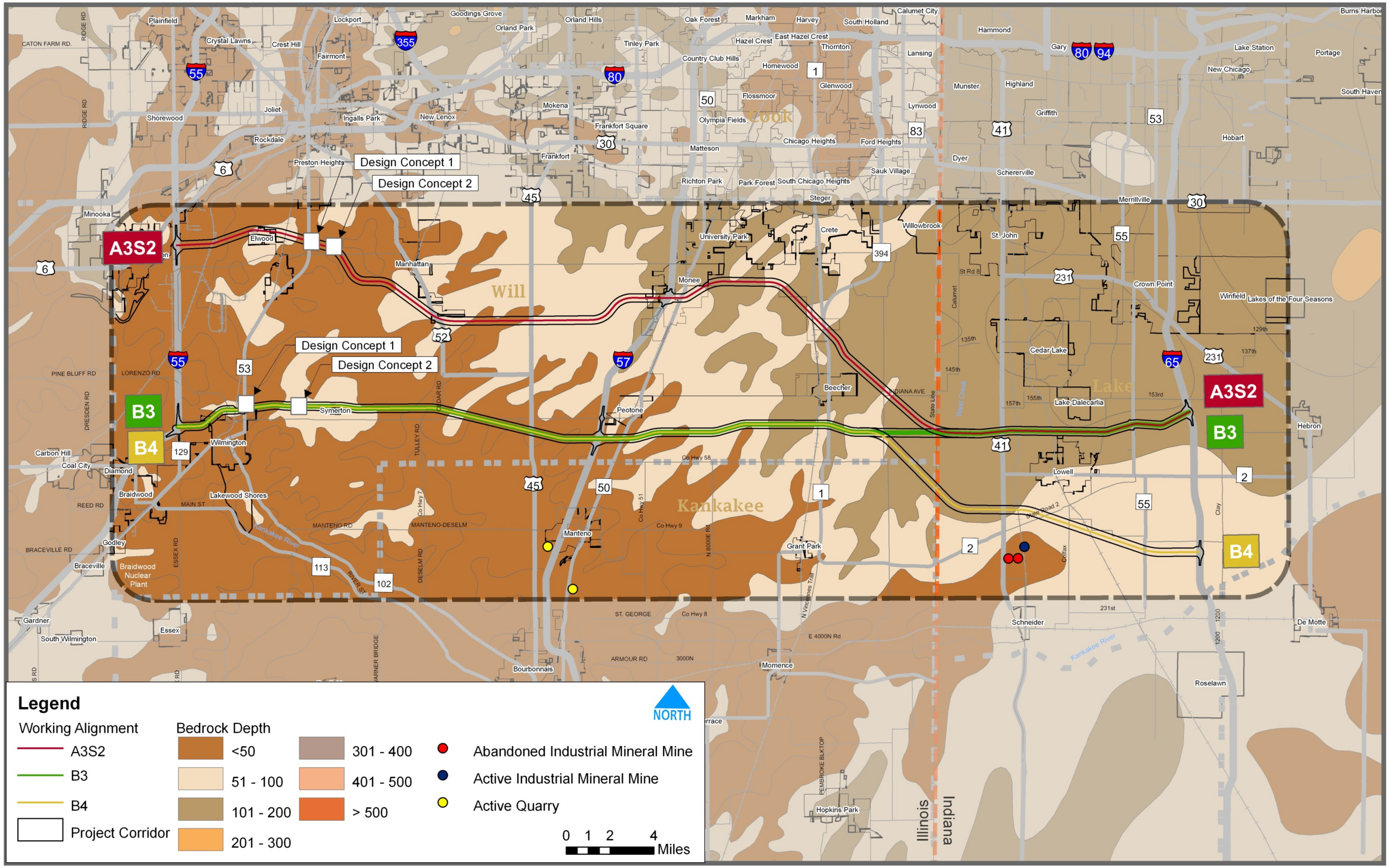
Mine Subsidence

As previously discussed, coal mining historically occurred in the extreme southwest section of the Study Area from the mid-1800s through approximately 1974. The coal within this area was typically between 55 and about 125 feet below the ground surface, so early mining was underground (Obrad and Chenoweth, 2007). The underground mining was performed using an early form of longwall mining in which a central shaft was sunk, a coal pillar area left in place around the shaft, and the coal mined outwards to a continuously advancing perimeter that was typically circular or near-circular. The entire coal seam was mined (100 percent extraction) and in order to maintain access for the miners the mine entries were supported by piling up walls of waste rock to support the roof. The remaining mine spoil (gob) was placed between theses pack walls. The supporting materials became greatly compressed about 200 to 300 feet behind the mine face, with subsidence occurring as this compression occurred (Bauer, 2008).

Because of the complete or near-complete extraction, and the limited support provided by the waste rock and gob, subsidence occurred rapidly. Based on monitoring performed in the 1920s, subsidence was generally complete within about 3 years following mining (Herbert and Rutledge, 1927). There is low likelihood of additional subsidence over these early longwall underground mines since the last underground coal mining activity in the Study Area was approximately 1928 or earlier.

By comparison, surface mining ended in the Study Area in 1974. After almost 40 years, self-weight settlement of mine spoil is expected to be complete or largely-complete with little settlement occurring in the future in the mined-out areas.

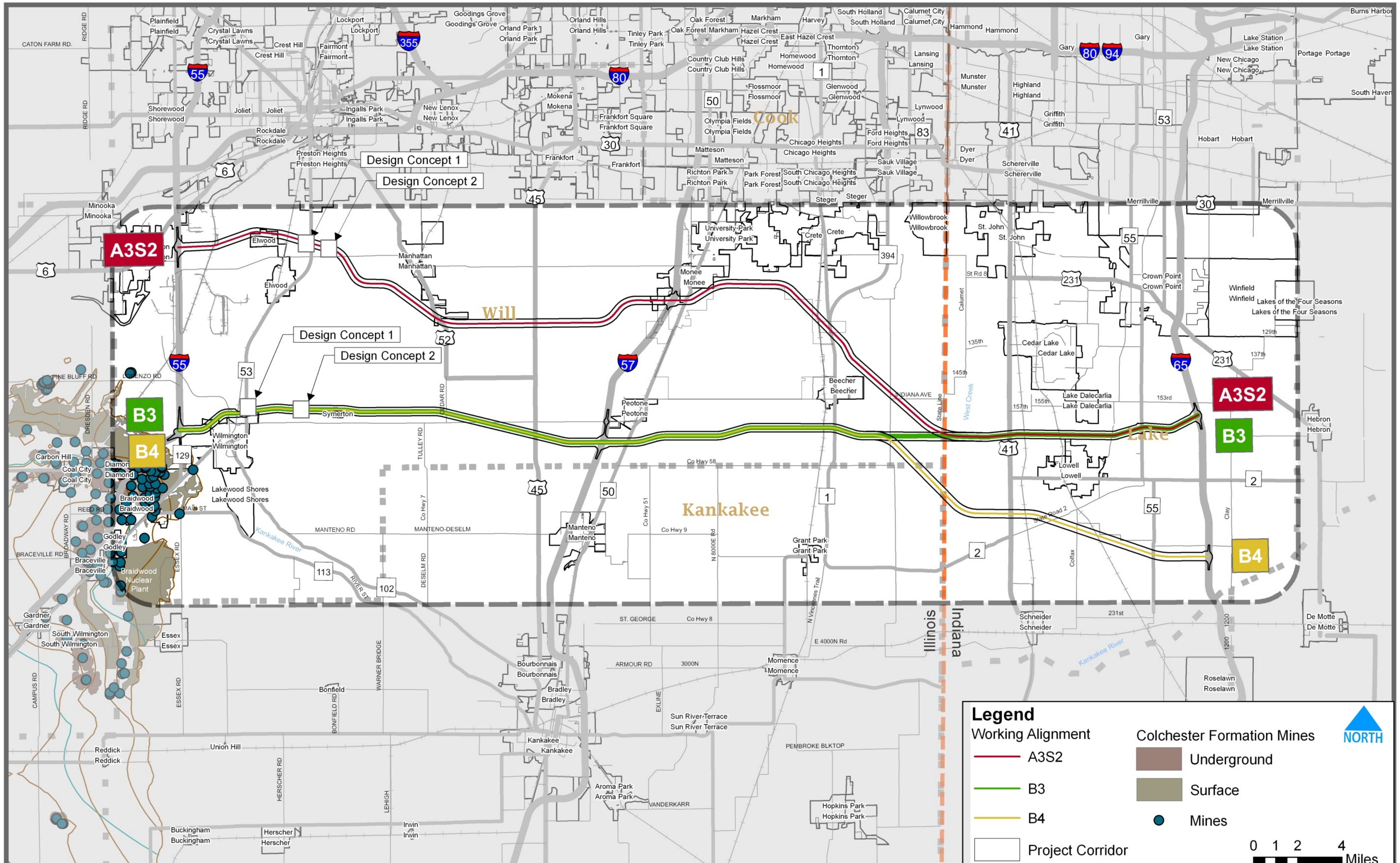
Figure 3-44. Limestone Quarries and Bedrock Depths



Source:
Inmap.indiana.edu, Illinois Natural Resources Geospatial Data Clearinghouse

THIS PAGE INTENTIONALLY LEFT BLANK

Figure 3-45. Coal Resources and Mines



Source:
Inmap.indiana.edu, Illinois Natural Resources Geospatial Data Clearinghouse

THIS PAGE INTENTIONALLY LEFT BLANK

Weak and Compressible Soils

Areas underlain by loose compressible sediments, particularly peat/muck and lake deposits could be subject to ground settlement during and after construction. Known deposits of peat and muck exist at various locations throughout the Study Area as shown on Figure 3-46. Limited occurrences exist in the northeast section of the Illinois portion of the Study Area. These deposits occur with a higher frequency and wider distribution in the Indiana portion of the Study Area. Construction of highways over deposits of peat and muck is made difficult, and involves a higher cost for excavation, due to the low shear strengths, high compressibility, and excessive amounts of creep typically associated with soils of this type.

In addition to peak and muck, another soil mapped within the Study Area that characteristically is subject to high compressibility and low strength is the Carmi Member, glacial lakebed clay. This soil is predominantly located in the southwestern portion of the Study Area. The Carmi Member is considered a weak and compressible soil, although not to the same severity as peat/muck.

Expansive Soils

Expansive soils are characterized by a shrink-swell characteristic in which cyclical expansion and contraction that occurs in fine-grained clay sediments from wetting and drying. Structures located on soils with this characteristic may be damaged over a long period of time, usually as the result of inadequate foundation engineering or the placement of structures directly on expansive soils.

Expansive soils are largely comprised of clays and silts, which expand in volume when water is absorbed and shrink when dried. As the soil water content increases, the soil swells and heaves upward. As the soil water content decreases, the soil shrinks and the ground surface recedes and pulls away from the foundation. Therefore, these problems are of particular concern with structures constructed on shallow foundations such as roadway pavements.

The predominant soil types throughout the Study Area consist of clayey as well as silty soils. Due to their small particle sizes, such soils are subject to varying degrees of shrink-swell based predominantly on their particle size distribution. The shrink-swell characteristics of soils located throughout the Study Area vary widely from low to high due to the wide range of soil types present. A more detailed analysis of the shrink-swell potential of soils and their resulting impacts on the individual working alignments will be performed as part of the Tier Two NEPA studies.

Seismicity

The Study Area is located in the relatively seismically inactive mid-plate section of the US. The Sandwich Fault Zone is the only mapped fault system within the Study Area and is generally considered dormant. The Sandwich Fault Zone trends southwest from Ogle County through Lee, DeKalb, Kendall counties and into west-central Will County in Illinois.

The Modified Mercalli Intensity (MMI) scale is commonly used to express the earthquake intensity and damage severity caused by earthquakes. It expresses ground shaking relative to actual physical effects observed by people and, therefore, is a useful scale for comparing different seismic events. MMI values range from I (earthquake not felt) to XII (damage nearly total). The Study Area is located in an area generally characterized as having an MMI value of V. Such intensity is characterized as resulting in having some dishes and windows broken with a few instances of cracked plaster.

According to the USGS National Earthquake Information Center, there have been 15 documented earthquake epicenters within a 75 mile radius from the center of the Study Area since the late 1800s; with no earthquakes having originated within the Study Area. The recorded Richter magnitudes for these tectonic events range from 2.3 to 4.2 and the MMI values range from II (felt only by a few persons at rest, especially on upper floors of buildings) to VII (damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken). Of these 15 earthquakes, 13 were located to the northwest of the Study Area in Illinois, and the remaining two epicenters were located to the east of the Study Area in Indiana (in Porter and Warren counties). In addition, a seismic event of apparent non-tectonic origin occurred in the area on February 9, 1899 reportedly due to ice breakup on Lake Michigan.

Karst

The term "karst" refers to a landscape that typically is pockmarked with sinkholes, may be underlain by caves, and has many large springs that discharge into stream valleys. Karst landscapes form when water from rain and snow melt seeps through a relatively thin soil cover and into fractured and soluble bedrock (limestone or dolomite). As water moves through the fractured rock it slowly (over thousands to tens of thousands of years) dissolves and enlarges pathways along the fractures and bedding planes of the rock. Two conditions are necessary for karst landscapes: soluble rock, generally limestone and dolomite, must lie at or near the surface of the ground, and the loose soil covering the soluble bedrock must be thinner than approximately 50 feet.

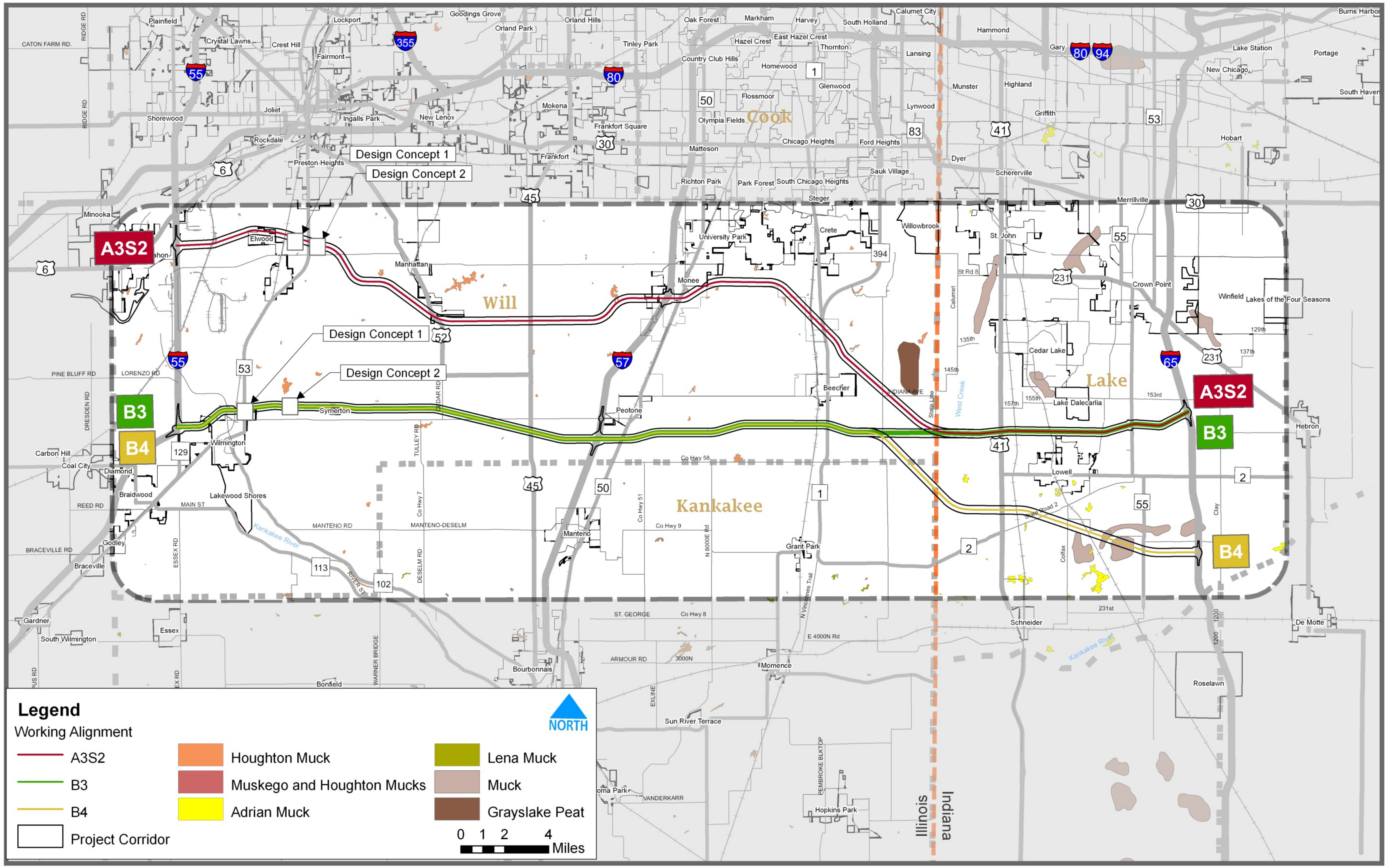
In Illinois, karst areas exist predominantly in the western and southern part of the state along and near the Mississippi and Ohio rivers. Two well-developed areas of karst landscape exist in southern and southeastern Indiana near the Ohio River. There is no known karst topography within the Study Area, nor are the uppermost bedrock units in the Study Area considered susceptible to karst formation.

3.17.2 Methodology

Mineral and geological hazard information for the corridor was obtained through review of GIS data/mapping and other publically available technical publications available from the USGS, ISGS, the INSGS, Illinois DNR, and USDA-NRCS.

The analysis of mineral resource impacts in this Tier One DEIS is a qualitative assessment of the working alignments to be affected by or cause impacts to mineral resources. The assessment also includes the identification of potential conflicts between

Figure 3-46. Weak and Compressible Soils



Source:
lnmap.indiana.edu, Illinois Natural Resources Geospatial Data Clearinghouse

THIS PAGE INTENTIONALLY LEFT BLANK

past and existing mineral extraction operations. Predominant mineral resources in the vicinity, with an emphasis on those resources that are considered economically recoverable, were considered and included sand and gravel, limestone, coal, natural gas and oil.

The presence of potential geologic hazards including karst topography, expansive soils, weak and compressible soils, mine subsidence, and seismicity were reviewed with respect to the working alignments and associated design concepts. Evaluation of these conditions was based on proximity, history of occurrence, and potential impact of their occurrence on highway systems.

A qualitative rating of the frequency or seriousness of the potential impacts related to geologic and soil conditions were assigned as follows:

- A low rating (L) was given to an impact that would have a low potential of occurring or if the impact would only occur in a localized area.
- A moderate rating (M) was given to an impact that would have a moderate potential to occur or if the impact would occur at multiple locations.
- A high rating (H) was given to an impact that would have a high potential to occur or if it could cause major impacts; this rating triggers the need for more detailed studies.

Based on the information available when performing this analysis, none of the impacts were determined to be a fatal flaw (an undue risk) that would prevent construction of the proposed project. In all cases, the evaluation determined that the severity or frequency of the hazard or effect could be avoided or minimized using conventional design and construction methods. Where impacts are listed as being moderate to high, more detailed analysis will be performed during the Tier Two NEPA studies to evaluate the significance of the impact and to identify measures to minimize impacts.

3.17.3 Impact Evaluation

3.17.3.1 Mineral Resources

Table 3-80 summarizes the impacts associated with the working alignments, including the associated design concepts, for the mineral resources.

Sand and Gravel Resources

The presence of sand and gravel resources is limited to the Kankakee River Valley along the western end of the Study Area and the southern portion of the Study Area in Indiana. Corridor A3S2 does not cross any mapped sand and gravel resources. At the western terminus of Corridors B3 and B4, approximately 2.3 miles of these resources are crossed. In addition, approximately 5.5 miles of Corridor B4 crosses these resources in the southeastern portion of the Study Area. In total, Corridor B3 crosses approximately 2.3 miles of sand and gravel resources and Corridor B4 crosses approximately 7.8 miles.

Table 3-80. Summary and Comparison of Mineral Resource Impacts

Mineral Resource	Linear Miles of Resource Crossed (Percent of Corridor Length)					
	A3S2 Working Alignment		B3 Working Alignment		B4 Working Alignment	
	IL	IN	IL	IN	IL	IN
Sand and Gravel	0 (0%)	0 (0%)	2.3 (4.9%)	0 (0%)	2.3 (4.7%)	5.5 (11.2%)
Limestone	38 (75%)	10.9 (22%)	28.9 (62%)	10.1 (22%)	29.9 (61%)	12.5 (26%)
Coal	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Natural Gas and Oil	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Corridor A3S2 does not cross any mapped sand and gravel resources and, therefore, would not be expected to impact any current or future planned exploitation of sand and gravel resources. Sand and gravel resources exist within the limits of Corridors B3 and B4, but there is no active or inactive sand and gravel mining in these areas. Therefore, Corridors B3 and B4 are not expected to have any impact on the current exploitation of sand and gravel resources. Since these resources are recovered through surface mining, future access to these resources within the limits of either Corridors B3 or B4 would be eliminated with their implementation. However, even if future extraction of the resource were to occur, the narrow corridors limit the likelihood that conflict would occur between future resource development and the transportation system.

Limestone Resources

Limestone resources occur as the uppermost bedrock unit within each of the corridors. These resources are present throughout 97 percent of Corridor A3S2. By comparison, limestone is present as the uppermost bedrock unit across approximately 84 percent of Corridor B3 and approximately 87 percent of Corridor B4. Cost effective mining of limestone in the Study Area is limited, at least in part, due to the significant depths at which the bedrock occurs. As a result, no inactive or active limestone/dolomite quarries exist within the corridors and future exploitation of these resources would generally be limited to those localized areas along the corridors where the bedrock is shallow. Even if future extraction of the resource were to occur, the narrow corridors decrease the likelihood that conflict would occur between future resource development and the transportation system. Nonetheless, construction within any of the corridors would eliminate the possibility of future exploitation of these resources in the selected corridor(s) due to land use incompatibility.

Coal, Natural Gas, and Oil Resources

There are no coal, natural gas, or oil resources within the Study Area or within the limits of any of the working alignments. Therefore, no direct impacts to these resources would be anticipated due to construction of any working alignment.

3.17.3.2 Geologic Hazards

Table 3-81 summarizes the likelihood of potential impacts to geologic and soil conditions associated with the working alignments, including the associated design concepts.

Table 3-81. Summary and Comparison of Geologic Hazard Potential

Geologic Hazard	Hazard Potential					
	A3S2 Working Alignment		B3 Working Alignment		B4 Working Alignment	
	IL	IN	IL	IN	IL	IN
Mine Subsidence	N	N	L	N	L	N
Weak and Compressible Soils	L	M	L	M	L	M
Expansive Soils	M	M	M	M	M	M
Karst Topography	N	N	N	N	N	N
Seismicity	M	M	M	M	M	M

Rating Legend:

H = High potential of occurring or has major impact, could cause major impacts, could significantly affect construction costs, and would require detailed studies.

M = Moderate potential of occurring or occurs in multiple locations. Could have some impacts and would require special consideration. Can be addressed using normal design and construction methods.

L = Low potential of occurring or localized occurrence and does not appear to represent a significant design or construction issue. Only a few locations would require consideration during design.

N = Little to no potential of occurrence.

Mine Subsidence

As previously stated, coal mining historically occurred in the area near the western terminus of Corridors B3 and B4. There is a low likelihood of additional subsidence over these longwall underground mines since underground coal mining in this area ceased by 1928. Since it has been nearly 40 years since surface coal mining operations ceased in this area, settlement of mine spoils is expected to be largely complete with limited potential for further settlement occurring in the future. Although the likelihood for future subsidence or settlement to occur in these previously mined-out areas is considered low, the potential impacts to overlying roadways and other structures could be significant if such hazards were to occur.

The nearest abandoned coal mines are located within approximately 0.5 miles from the western terminus of Corridors B3 and B4, and none are in the vicinity of Corridor A3S2. Therefore, none of the working alignments are expected to encounter any previously mined areas or be affected by any associated subsidence of settlement hazards. However, there is the possibility that mine spoils were used as fill materials in the westernmost portions of Corridors B3 and B4 due to the proximity to previously mined lands. This possibility and any consequent impacts will be evaluated as part of the Tier Two NEPA studies.

Weak and Compressible Soils, Expansive Soils

Each of the corridors covers a range of soil types that have varying shrink-swell properties. In addition, areas of peat and muck are extensively known to exist particularly throughout the Indiana portion of the Study Area. Therefore, each of the working alignments may be expected to encounter expansive and weak/compressible soils. Additionally, the potential exists that unmapped areas of weak and compressible soils exist within the corridors due to the limitations of the regional mapping used in this Tier One DEIS. The presence of such soil conditions over time could cause damage to structure foundations, surface pavements, and utilities, resulting in higher maintenance costs as well as short-term restricted or limited use of the roadway system to complete necessary maintenance activities. Construction of highways over deposits of peat and muck is made difficult and involves a higher cost for excavation due to the low shear strengths, high compressibility, and excessive amounts of creep typically associated with soils of this type.

Seismicity

Each of the working alignments is located in the relatively seismically inactive mid-plate area. Earthquakes within the mid-plate area generally have a Richter magnitude less than 5.0. A total of 15 documented earthquakes are known to have occurred in the vicinity of the Study Area and similar seismic events are likely to occur in the future. The Richter magnitudes for future seismic events in the area of the corridors are anticipated to be in the range of two to four, typically resulting in negligible damage to structures of good design and construction. Therefore, minimal and comparable impacts on pavement and structures constructed in each of the working alignments and associated design concepts would be expected due to seismic events, particularly with such considerations factored into the structure and pavement design as discussed in the mitigation section below.

Karst Topography

There are no known karst features in the Study Area. Additionally, the uppermost bedrock units in the Study Area are not considered susceptible to karst formation. Therefore, none of the working alignments are considered at risk to sinkholes or similar bedrock dissolution hazards.

3.17.4 Mitigation

Conditions that have been identified along the corridors that may require mitigation during construction include weak and compressible soils, expansive soils, and seismicity. The direct impacts associated with these conditions could be mitigated through several standard techniques and with a facility designed to conform to the IDOT and INDOT Standard Specifications for Road and Bridge Construction.

Future planning efforts undertaken during the Tier Two NEPA studies will include site-specific surveys to identify the presence of any weak and compressible native soils that could impact the project and potential opportunities for avoidance will be considered.

Expansive soils and bedrock could be mitigated at structure locations by designing deep foundation systems, such as driven H-piles or drilled piers, rather than on shallow foundations. Structural retaining walls, such as soil nail walls, ground anchors, mechanically stabilized earth walls, cantilever walls, or reinforced soil slopes may be built to stabilize slopes, steep gradients (e.g., 3 horizontal to 1 vertical), or where potential slope failures may occur due to the presence of water and loose material. Expansive subgrade soils under pavement sections could be stabilized with chemicals (e.g., lime), removed and recompacted, or removed and replaced with imported structural fill of better quality. Future planning efforts in the Tier Two NEPA studies will include more detailed assessment of the extent to which these conditions exist and better characterize necessary and appropriate mitigation measures.

Potential impacts of the proposed project on the local production capacity of rock for aggregate, asphalt, and concrete and the economic benefits to the local resource companies will be completed during the Tier Two NEPA studies. To assess impacts on the local and regional availability of aggregate and identify any concerns regarding resource depletion, the projected aggregate resource needs for the proposed project will be quantified. The analysis will consider changes in demand due to continued population growth in the Region as well as potential planned expansion of existing mines or development of new mines.

3.18 Visual Resources

This section assesses the existing visual conditions of regional landscapes in the Study Area and discusses qualitative impacts to potential viewers of the corridors. Mitigation strategies to be considered during project design and implementation are also discussed.

3.18.1 Existing Conditions

The Study Area is a mix of landscapes, including urban and suburban development, rural communities, farmland, industry, transportation infrastructure, and vast areas of open space. Two distinct regional landscapes were categorized within the Study Area: the Grand Prairie and the Upper Illinois.