Chapter 13 Soils and Geology

13.1 INTRODUCTION

This chapter discusses geology, soils, groundwater flow, and seismic activity in the proposed Project area, defined to be the area encompassing the limits of construction, or limits of disturbance (LOD), activities for the Build Alternative. Identifying soil types, surficial geology, and bedrock within the proposed Project area is important for construction planning of the proposed Project. Factors including erosion potential, slope gradient, drainage and run off potential also affect construction planning. The surficial geology must be understood to identify structural support requirements and avoid migration of contaminants that exist on-site (see Chapter 14, “Contaminated Materials”). Additionally, the characterization of hydric soils (i.e., soils that are permanently or seasonally saturated with water for a prolonged period of time) supports the potential for regulated wetlands in the proposed Project area (see Chapter 12, “Natural Resources”).

13.2 METHODOLOGY

The assessment of potential impacts of the Build Alternative includes:

- Review of existing data sources, including: State of New Jersey Geographic Information Systems (GIS) Database; New Jersey Geological and Water Survey guidance; and United States Geological Survey (USGS) maps. To assess the soil units located within the study area, the Soil Survey Geographic Database (SSURGO) and the United States Department of Agriculture Natural Resources Conservation Service (NRCS) Web Soil Survey (WSS) descriptions were utilized.
- Review of data from geotechnical investigation completed in 2017 for Preferred Alternative Project Components A and B.
- Description of the Main Facility site geology, which has been extensively characterized through site-wide soil borings, monitoring wells, and test pits (NJ TRANSIT 2010a).
- Review of maps delineating soil types and depth to bedrock in the proposed Project area.
- Description of the regional geology, tectonic setting and potential for seismic activity.
- A review of the facility’s ability to withstand seismic events.

13.3 AFFECTED ENVIRONMENT

The geology, soils, groundwater and seismology for the Build Alternative are discussed below. A comprehensive geotechnical investigation was completed at Preferred Alternative Project Components A and B between October and December 2017 to inform the project engineers designing the structures for the Main Facility. The preliminary results from these investigations were reviewed to inform the environmental analysis for this DEIS. In April and May 2018, geotechnical investigations were completed for Preferred Alternative Project Component D in Cedar Creek Marsh South.

13.3.1 Bedrock Geology

The predominant bedrock formation at Project Components A through D is the Passaic Formation, which traverses Pennsylvania, New Jersey and New York (USGS 1996). The Passaic Formation consists primarily of shale, siltstone, and mudstone, with conglomerate and sandstone beds occurring in the New Jersey portions of the formation. Based on a preliminary review of boring logs from the 2017 geotechnical investigation, bedrock in the area of Preferred Alternative Project Component A is encountered on average at approximate elevation of -62 feet (below sea level). Previous NJ TRANSIT projects (Access to the Region's Core EIS in 2008 and Portal Bridge Capacity Enhancement EIS in 2008) included geotechnical borings on the Kearny Peninsula (FTA, FRA 2008; FTA, DOT 2008). In the vicinity of Preferred Alternative Project Component B depth to bedrock is approximately 80 feet below ground surface and just north of the new Kearny Substation (Preferred Alternative Project Component D) location, depth to bedrock is approximately 75 feet below ground surface, according to these previous investigations. Where Preferred Alternative Project Component E exits the Main Facility Site, the electrical lines are within the boundaries of the Passaic Formation, however the Lockatong Formation begins before Preferred Alternative Project Component E crosses the Hackensack River.

The Lockatong Formation, also found in Pennsylvania, New Jersey and New York, is comprised of cyclical lacustrine deposits of silty argillite, laminated mudstone, siltstone, sandstone and an arkosic sandstone facies. In New Jersey, this formation includes diabase and basalt flows. Preferred Alternative Project Component E traverses the Upper Triassic Lockatong Formation, including the arkosic sandstone unit and continues over an igneous rock formation, known as the Palisades diabase, where the Morris & Essex Line's Bergen Tunnel passes through Bergen Hill. Preferred Alternative Project Component E then crosses the Stockton Formation, which is primarily sandstone, siltstone, mudstone with interbedded shale and argillite. In New Jersey, this formation includes conglomerates. Serpentinite is a mapped metamorphic unit that is exposed along the Hudson River near Hoboken at the terminus of Preferred Alternative Project Component E. Both the location of the proposed platform for the emergency generators (nanogrid) at the HBLR Headquarters and the electrical line route option for Preferred Alternative Project Component F are primarily within the Stockton Formation (USGS 1996). The HBLR alignment along which Preferred Alternative Project Component G is located is primarily within the Stockton and Lockatong Formations.

13.3.2 Surficial Geology

Based on a review of boring logs for the recent (2017) geotechnical investigation, six general overburden/ historically altered soil units have been identified on the Main Facility site (Preferred Alternative Project Component A): PDM[13], peat/tidal marsh, clay, sand, and glacial till followed by bedrock. The local subsurface geologic hierarchy where the Main Facility would be constructed may be viewed as three types

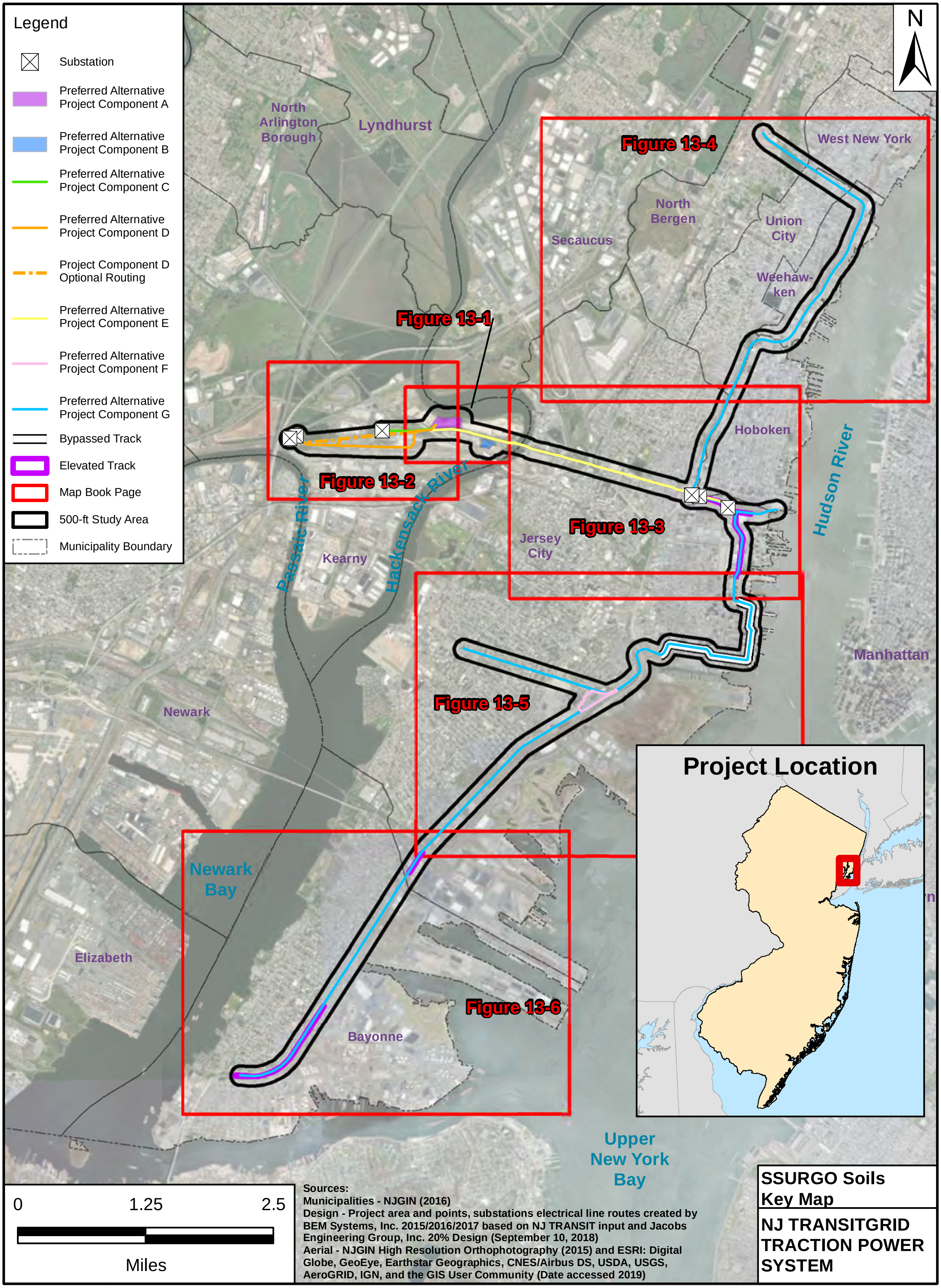
[13] Processed dredge material, or PDM, is dredge material that has been treated or otherwise processed into engineered structural fill for reuse. At Koppers Koke Site, the PDM has been placed in order to cap existing environmental contamination, preventing it from leaching offsite.

of quaternary unconsolidated materials: 1) upper alluvial and marsh deposits, including PDM and fill materials, 2) glacial deposits from meltwater, and 3) weathered bedrock (Stanford 1995). The overburden subsurface strata are defined as fill (including PDM), peat/tidal marsh, upper sand, varved clay, glacial till, and bedrock. The PDM fill layer was found to range in thickness from 18.5 to 33.5 feet across Preferred Alternative Project Component A, with an average of 28.7 feet thick. The peat/tidal marsh layer is composed of organic soils that include variable amounts of sand, silt and/or clay containing fibrous vegetation. The meadow mat or peat layer is very soft to soft, is highly compressible and has very low shear strength. This unit ranges from 2 to 13.5 feet thick. The upper sand layer beneath the peat layer are alluvial deposits composed of a fine to medium-grained sand unit with variable amounts of silt. This sand layer was not encountered in all borings at Preferred Alternative Project Component A. Where the sand layer was encountered it ranged from 3.5 to 15 feet, with an average thickness of 6.5 feet. The varved clay beneath the upper sand unit is a continuous (confining) layer of varved, or quickly deposited, clay composed of a sequence of lacustrine deposits formed as a result of melting glaciers. The consistency of the stratum varies from soft to very soft and ranges from 16.5 to 48.5 feet in thickness. The glacial till layer mainly consists of varying amounts of gravel, sand, clay or silt and occasional cobbles and boulders. The glacial till is typically dense to very dense and was encountered between 43.5 to 88.5 feet below ground surface and ranged from 13 to 26 feet in thickness. The bedrock layer was found at elevations ranging from -39.9 feet to -85.1 feet (below sea level) and consists of weathered and fractured rock at the interface with the glacial till and transitions to more competent bedrock with depth. The bedrock aquifer consists of fractured sedimentary rocks interlaid with basalt units.

13.3.3 Soils and Topography

The United States Department of Agriculture (USDA) mapped soils are presented in Figures 13-1 through 13-6. As shown on Figures 13-1 and 13-2, the entire Kearny Peninsula is comprised of soil units identified as hydric, according to the NRCS. The Secaucus series (Sec) consists of very deep, moderately well drained soils with moderately low through moderately high saturated hydraulic conductivity. Secaucus soils are on nearly level to gently sloping artificially created landforms, often adjacent to areas of wetlands and waterbodies. These soils comprise human transported material consisting of construction debris intermingled and mixed with natural soil materials which was used to fill wet areas. These soils occur on modified landscapes in and near major urbanized areas of the Northeastern United States, including the location of Project Components A, B, C, D and parts of Preferred Alternative Project Component E. The predominant surficial geologic unit across the Kearny peninsula and into Jersey City is a salt-marsh and estuarine deposit and artificial fill (Stanford 1995). The salt-marsh and estuarine deposit unit consists of organic silt and clay, salt-marsh peat, and some black to dark brown and gray sand with shells (Stanford 1995).

The major soil components located on the Kearny peninsula (Project Components A, B, C, D and parts of E) include the Secaucus artifactual fine sandy loam and the Westbrook mucky peat. Both are identified as hydric soils defined by the NRCS as “soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part” and are a major component in defining wetlands (USDA Soil Conservation Service [SCS] 1994). Wetlands are discussed in detail in Chapter 12, “Natural Resources.” The Secaucus artifactual fine sandy loam is



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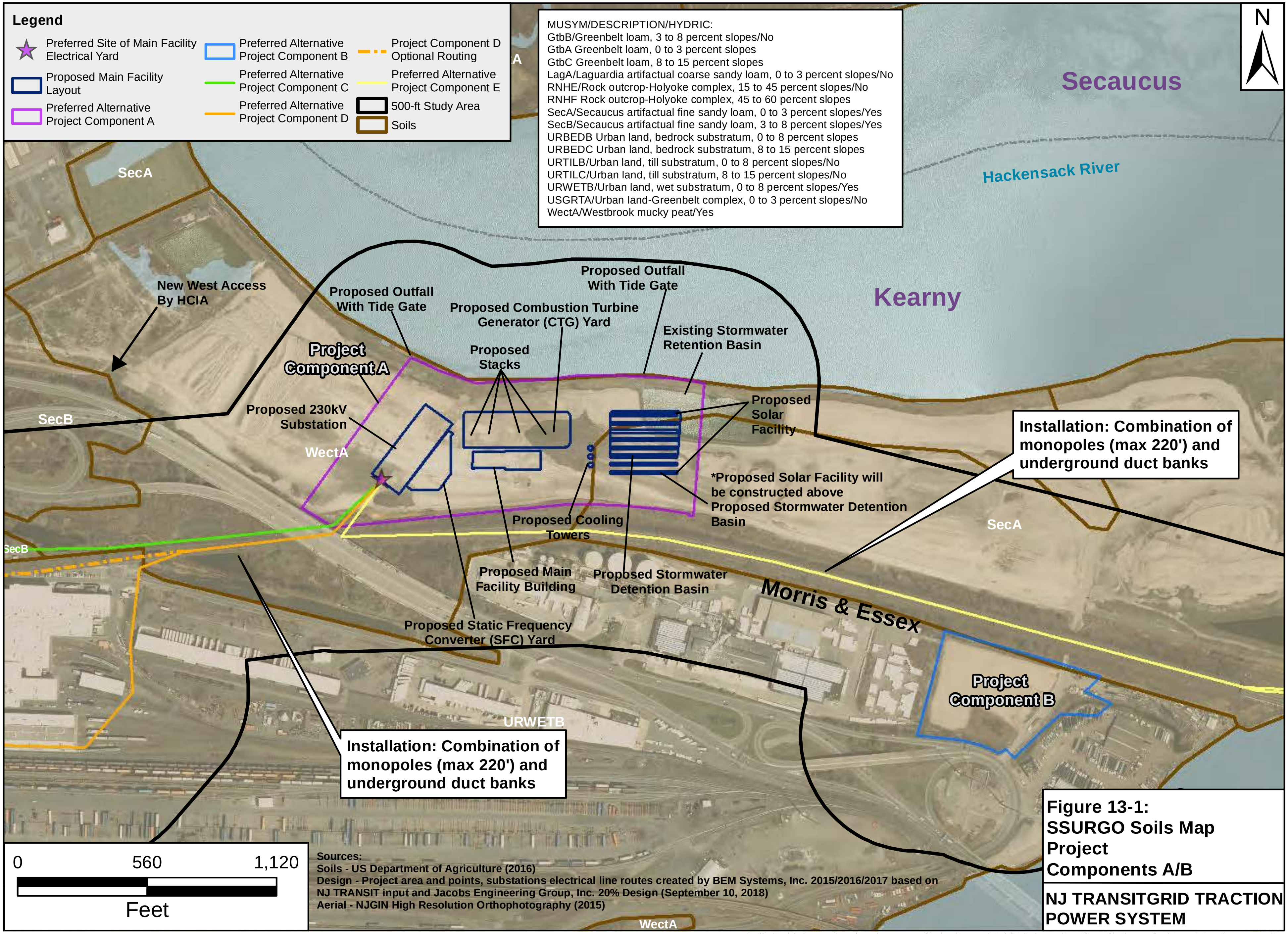

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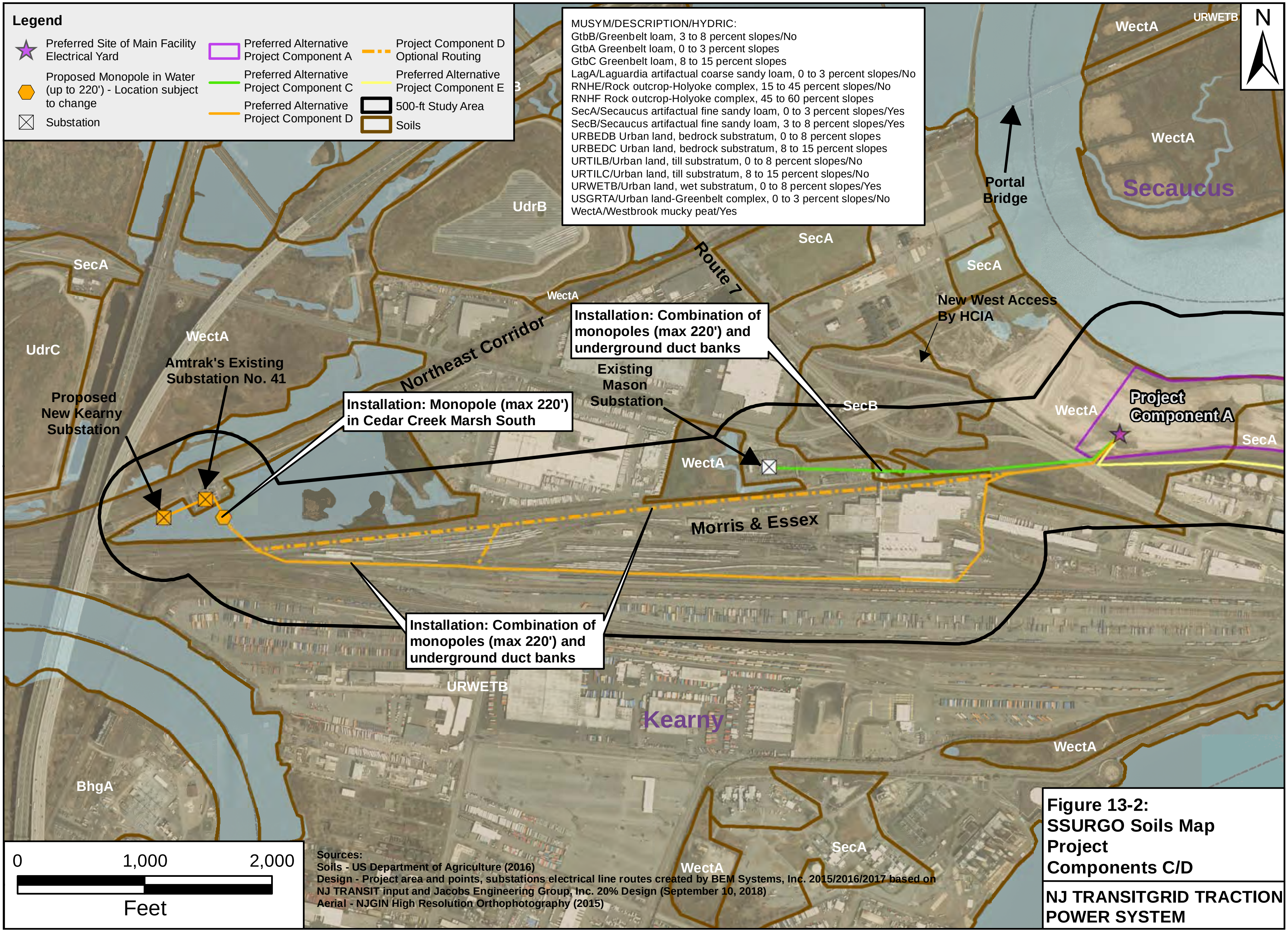

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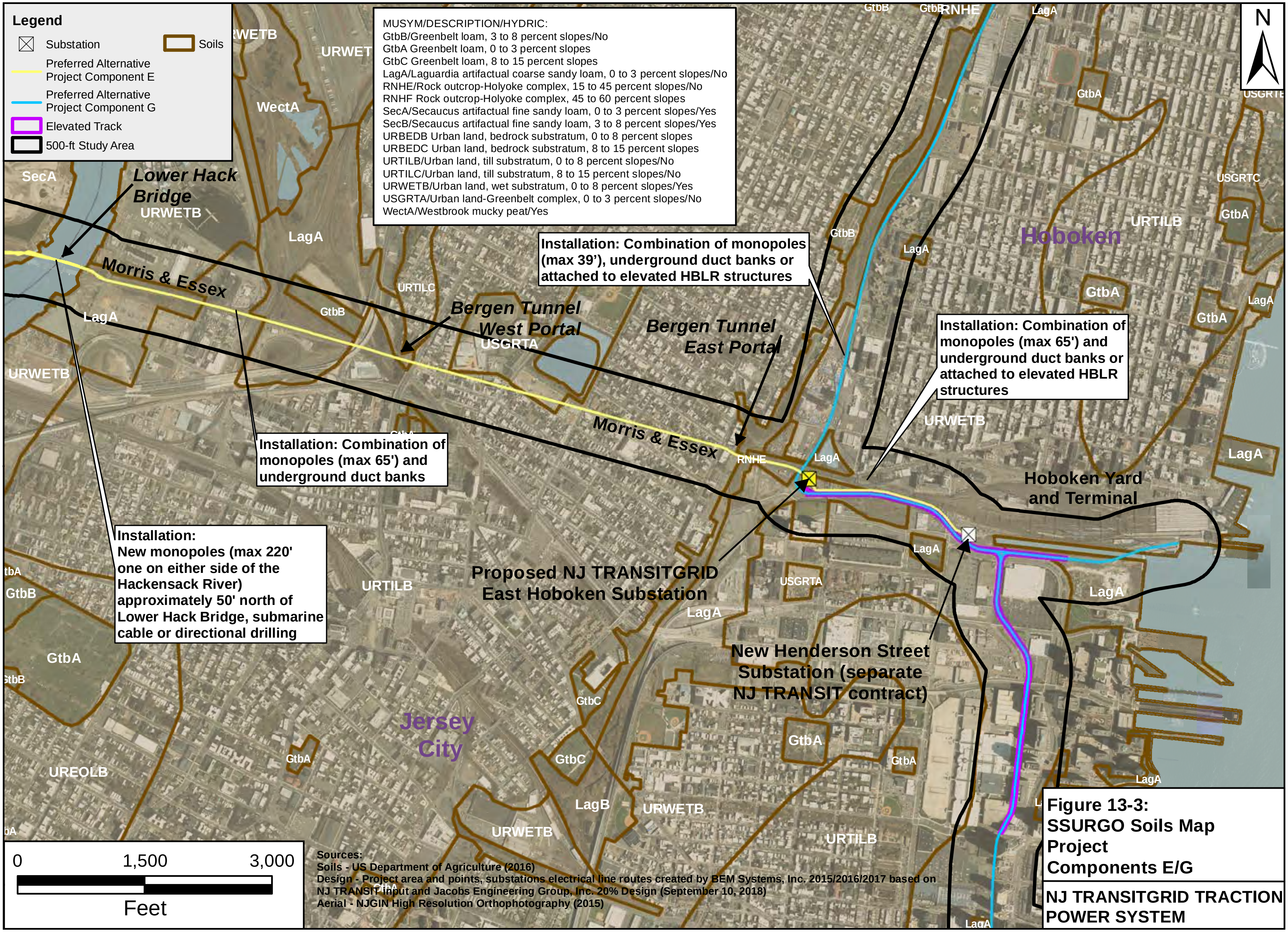

Figure 13-3: SSURGO Soils Map Project Components E/G

NJ TRANSITGRID TRACTION POWER SYSTEM

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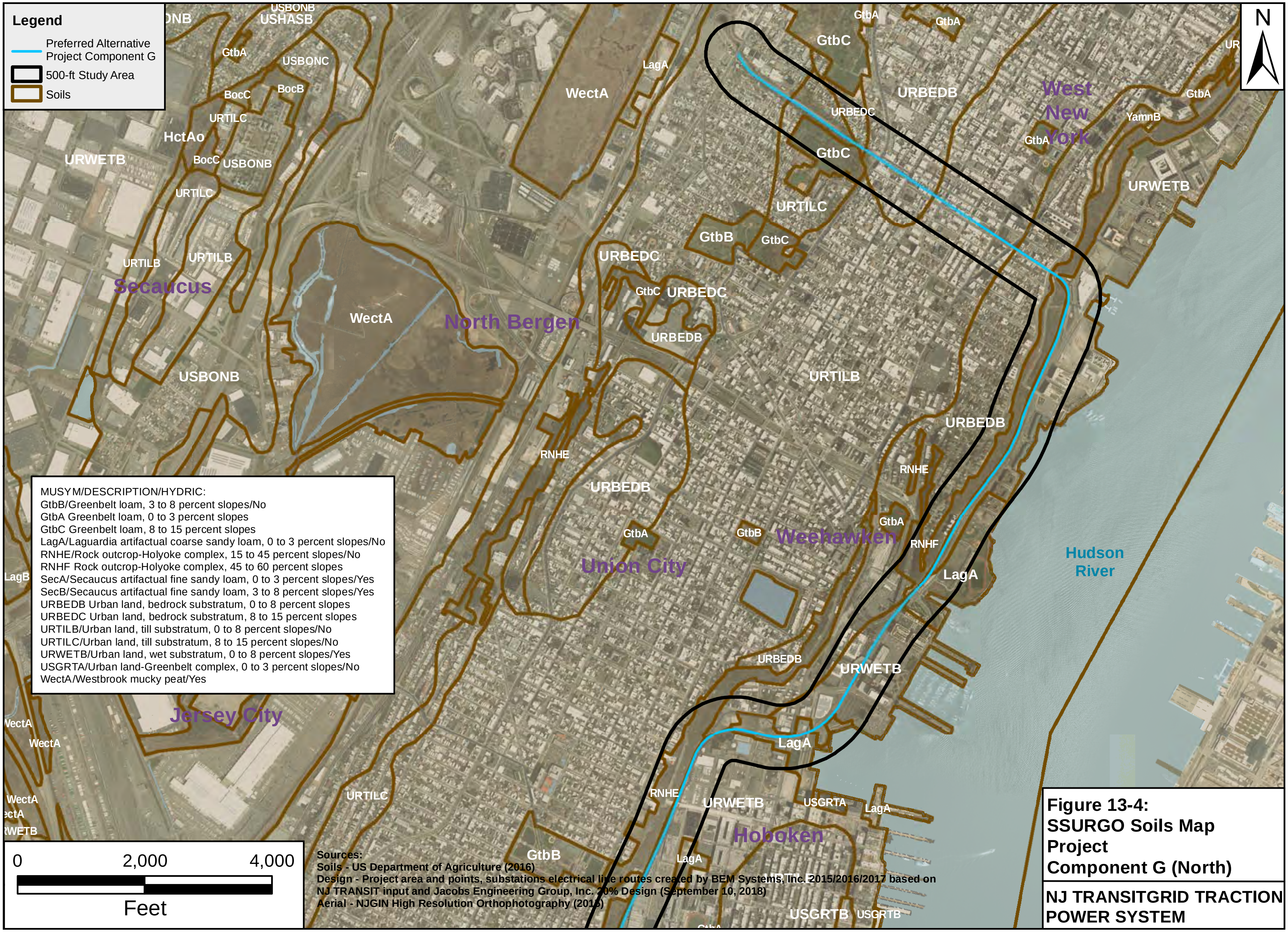

MUSYM/DESCRIPTION/HYDRIC:
GtbB/Greenbelt loam, 3 to 8 percent slopes/No
GtbA Greenbelt loam, 0 to 3 percent slopes
GtbC Greenbelt loam, 8 to 15 percent slopes
LagA/Laguardia artifactual coarse sandy loam, 0 to 3 percent slopes/No
RNHE/Rock outcrop-Holyoke complex, 15 to 45 percent slopes/No
RNHF Rock outcrop-Holyoke complex, 45 to 60 percent slopes
SecA/Secaucus artifactual fine sandy loam, 0 to 3 percent slopes/Yes
SecB/Secaucus artifactual fine sandy loam, 3 to 8 percent slopes/Yes
URBEDB Urban land, bedrock substratum, 0 to 8 percent slopes
URBEDC Urban land, bedrock substratum, 8 to 15 percent slopes
URTILB/Urban land, till substratum, 0 to 8 percent slopes/No
URTILC/Urban land, till substratum, 8 to 15 percent slopes/No
URWETB/Urban land, wet substratum, 0 to 8 percent slopes/Yes
USGRTA/Urban land-Greenbelt complex, 0 to 3 percent slopes/No
WectA/Westbrook mucky peat/Yes

Sources:
Soils - US Department of Agriculture (2016)
Design - Project area and points, substations electrical line routes created by BEM Systems, Inc. 2015/2016/2017 based on NJ TRANSIT input and Jacobs Engineering Group, Inc. 30% Design (September 10, 2018)
Aerial - NJGIN High Resolution Orthophotography (2015)

Figure 13-4: SSURGO Soils Map Project Component G (North)

NJ TRANSITGRID TRACTION POWER SYSTEM

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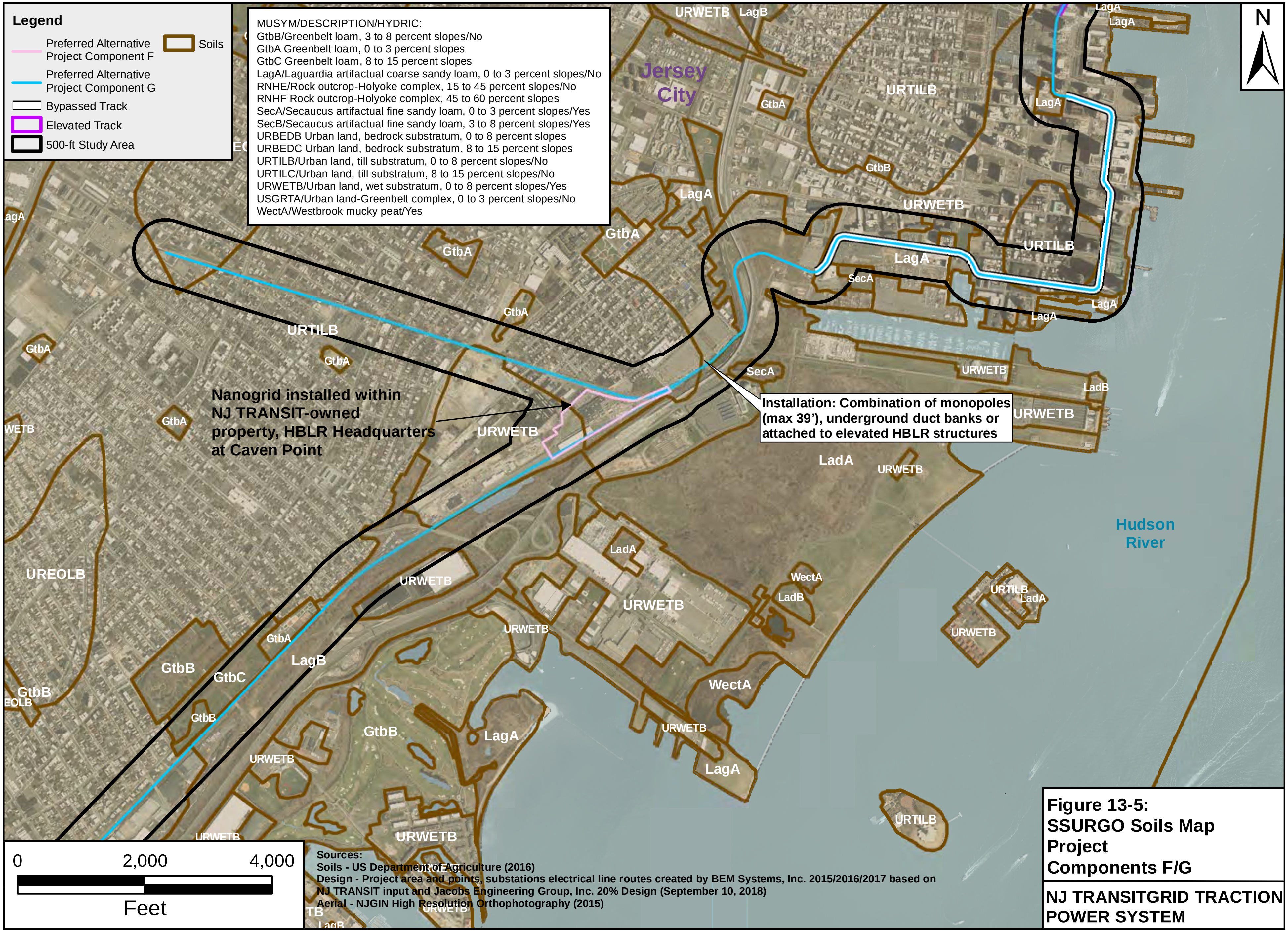

Sources:
Soils - US Department of Agriculture (2016)
Design - Project area and points, substations electrical line routes created by BEM Systems, Inc. 2015/2016/2017 based on NJ TRANSIT input and Jacobs Engineering Group, Inc. 20% Design (September 10, 2018)
Aerial - NJGIN High Resolution Orthophotography (2015)

Figure 13-5: SSURGO Soils Map Project Components F/G

NJ TRANSITGRID TRACTION POWER SYSTEM

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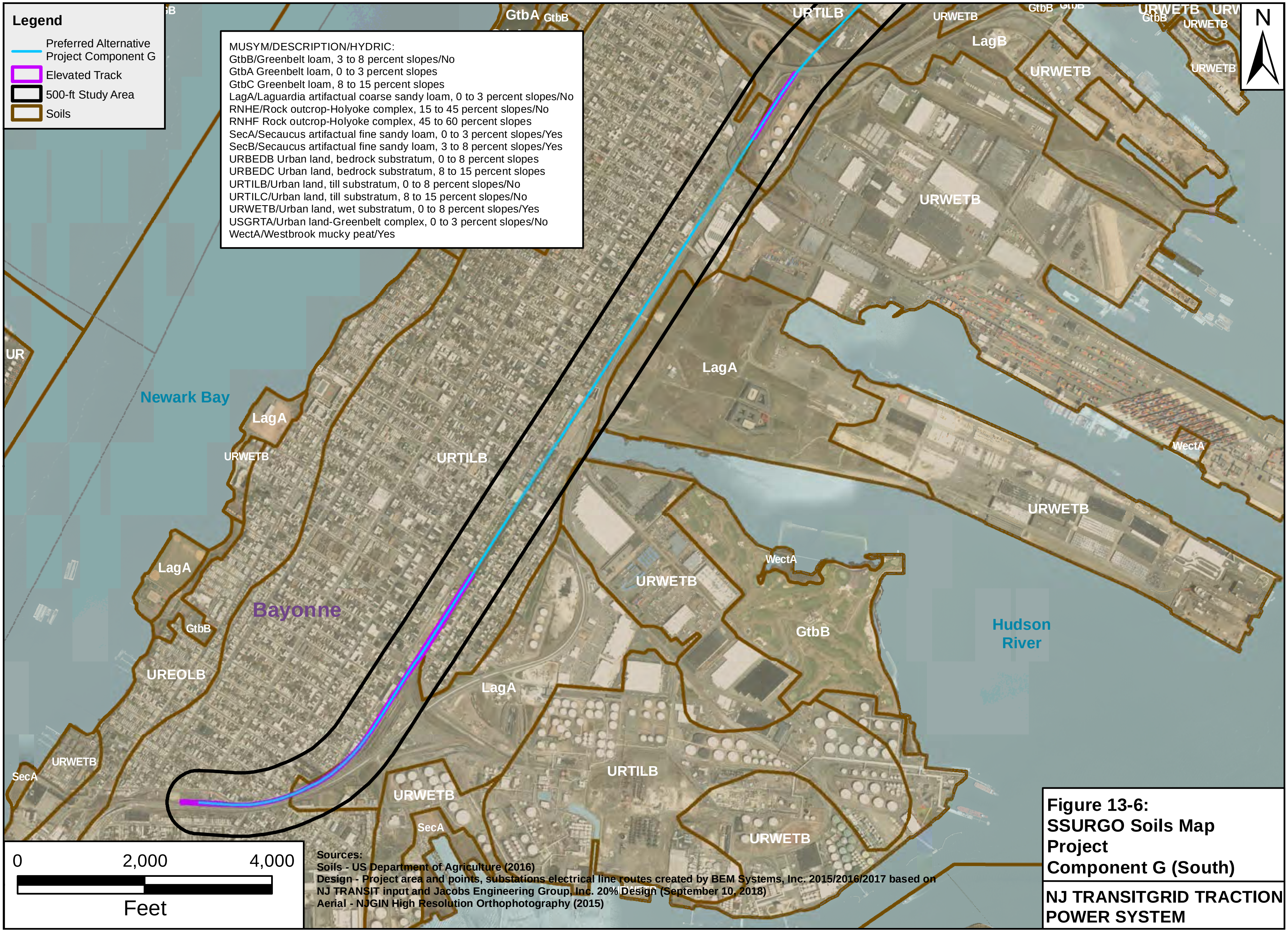

Figure 13-6: SSURGO Soils Map Project Component G (South)

NJ TRANSITGRID TRACTION POWER SYSTEM

Sources:
Soils - US Department of Agriculture (2016)
Design - Project area and points, substations electrical line routes created by BEM Systems, Inc. 2015/2016/2017 based on NJ TRANSIT input and Jacobs Engineering Group, Inc. 20% Design (September 10, 2018)
Aerial - NJGIN High Resolution Orthophotography (2015)

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characterized as a moderately drained soil with varying slopes and medium run-off potential. The Westbrook mucky peat is characterized as a very poorly drained tidal salt marsh exposed to frequent flooding.

The Westbrook (Wect) series is described to be very deep, poorly drained soil series formed from decomposing organic deposits, usually found in tidal marshes subject to daily salt-water inundation. Gradient water flow during saturated conditions is excellent within the upper organic layers, decreasing in conductivity in the lower underlying materials. As such, the soils present within the proposed Project areas on the Kearny peninsula represent typical soils common to freshwater wetlands and historic tidal mapped wetland areas. Hydric soil units are generally associated with wetland areas; however, in highly disturbed, urbanized environments wetlands may no longer exist in areas historically mapped to contain hydric soil units. The majority of Preferred Alternative Project Component A is mapped as Westbrook mucky peat (WectA) and Secaucus artificial fine sandy loam, 0 to 3 percent slopes (SecA). Preferred Alternative Project Component A, however, is confirmed today to be modified by upland disposal of PDM placement. Preferred Alternative Project Component B and the majority of Project Components C and D consist of urban land, wet substratum, 0 to 8 percent slopes (URWETB). As Project Components C and D exit Project Component A, the soils are mapped as Westbrook mucky peat (WectA). At the terminus of Preferred Alternative Project Component D where the new Kearny Substation would be constructed is an open water area, Cedar Creek Marsh South.

The soils along the portion of Preferred Alternative Project Component E into Jersey City (Figure 13-3) are designated as Laguardia artifactual coarse sandy loam, 0 to 3 percent slopes (LagA), and urban land, till substratum, 0 to 8 percent slopes (URTILB). The Laguardia series consists of very deep, well-drained soils. Both soil series are described as soils that have been disturbed or reworked over time providing very high runoff potential. Where Preferred Alternative Project Component E exits the Bergen Tunnel, the electrical line route passes through a small area of rock outcrop-Holyoke complex, 15 to 45 percent slopes (RNHE) (Figure 13-3). Preferred Alternative Project Component E in Jersey City is mapped with hydric soils, URWETB, only at the eastern terminus near the new NJ TRANSITGRID East Hoboken Substation and Henderson Street Substation.

For Preferred Alternative Project Component F (Figure 13-5), the emergency generator storage platform for the nanogrid would be installed within the property boundaries of the HBLR-Headquarters facility. Soils at the facility consist of urban land, till substratum, 0 to 8 percent slopes (URTILB) and urban land, wet substratum, 0 to 8 percent slopes (URWETB).

The soils along Preferred Alternative Project Component G (Figure 13-3 through 13-6) consist of Laguardia series artifactual coarse sandy loam, 0 to 3 percent slopes (LagA) and 3 to 8 percent slopes (LagB), Urban land, till substratum, 0 to 8 percent slopes (URTILB) and 8 to 15 percent slopes (URTILC). Preferred Alternative Project Component G also consists of Rock outcrop-Holyoke complex, 15 to 45 percent slopes (RNHE) and 45 to 60 percent slopes (RNHF), Urban land, wet substratum 0 to 8 percent slopes (URWETB), Urban land, bedrock substratum, 0 to 8 percent slopes (URBEDB), Greenbelt loam, 0 to 3 percent slopes (GtbA), 3 to 8 percent slopes (GtbC) and 8 to 15 percent slopes (GtbC) and Urban land, eolian substratum 0 to 8 percent slopes (UREOLB). Small pockets of LadyLiberty fine sandy loam with 0 to 3 percent slopes

(LadA) and Secaucus artifactual fine sandy loam, 0 to 3 percent slopes (SecA) are also found along Preferred Alternative Project Component G.

The study area's native mapped soil layers as indicated on Figures 13-1 to 13-6 have in certain locations been modified, filled by historic fill activities performed to raise elevations. The "Brownfield and Contaminated Site Remediation Act" (N.J.S.A. § 58:10B-1 et seq. [1993]) requires the NJDEP to map regions of the state where large areas of historic fill exist and make this information available to the public. This map shows areas of historic fill covering more than approximately 5 acres. Historic fill is non-indigenous material placed on a site in order to raise the topographic elevation of the site (Stone, et al. 2002). From the NJDEP's online mapping program, GeoWeb (NJDEP 2017) it is clear that there are historic fill materials at the preferred site of the Main Facility and the six-acre parcel (Preferred Alternative Project Components A and B), areas along the proposed electrical lines proceeding to Mason Substation and Amtrak's Substation No. 41, with the exception of Cedar Creek Marsh South, (Preferred Alternative Project Component C and Project Component D, both Preferred Alternative and optional routing) and along Preferred Alternative Project Component E from the Main Facility site to the Lower Hack Bridge. Historic fill is also present in industrial Jersey City from the Lower Hack Bridge to West Side Avenue along the proposed electrical line route for Preferred Alternative Project Component E. A break in the mapped historic fill is evident along Preferred Alternative Project Component E from West Side Avenue through the Bergen Tunnel. Mapped historic fill is present where Preferred Alternative Project Component E exits the tunnel to its terminus at Henderson Street substation. Approximately two-thirds of the HBLR Headquarters facility is not mapped as historic fill, as historic fill is only present in the southwest one-third of the property. Historic fill is also present along Preferred Alternative Project Component G.

New Jersey is divided into the Valley and Ridge, Highlands, Piedmont, and Coastal Plain Physiographic Provinces. Each province defines a region in which relief, landforms, and geology are significantly different from that of the adjoining and nearby regions. The boundary between each province is determined by a major change in topography and geology. The entire Build Alternative is within the Piedmont Province. The Piedmont Province is an area that makes up about one-fifth of the state of New Jersey. It is mainly underlain by slightly folded and faulted sedimentary rocks of Triassic and Jurassic age and igneous rocks of Jurassic age. The Piedmont Province consists mainly of low rolling plain divided into a series of high ridges (NJDEP 2003).

13.3.4 Groundwater

There are no USEPA designated sole source aquifers (SSA) in the project area. USEPA defines sole source as: *1. The aquifer supplies at least 50 percent of the drinking water for its service area. 2. There are no reasonably available alternative drinking water sources should the aquifer become contaminated.* The build alternative is completely within an undesignated SSA boundary- Hudson County with no SSA. This resource is further discussed as an underlying natural resource in Chapter 12. In addition, the proposed Project has been designed to comply with N.J.A.C. 7:8 Stormwater Management Rules. Water quality and water quantity requirements have been met in accordance with these rules.

Groundwater flow in aquifer systems of the Piedmont Region is described as local with flow path from recharge areas to neighboring groundwater discharge areas. Surficial units are hydraulically connected to the bedrock aquifer. Regional groundwater flow in the bedrock aquifer is to the south following net Hackensack River flow. Groundwater is present under water table conditions in the historic fill, under confined or semi-confined conditions in the upper sand unit, and under confined conditions in the glacial till. The two shallower water bearing units (i.e., fill and sand/silt units) are separated throughout most of the proposed Project area by the meadow mat. However, they are in direct contact where the meadow mat is absent. The deeper overburden water bearing zone, the glacial till, is separated from the upper zones by the relatively thick and continuous varved clay and silt unit.

The presence of four groundwater zones have been identified at the Koppers Koke Site, including three overburden water bearing units (historic fill, sand/silt unit, and till layer) and the bedrock aquifer. Readings obtained from monitoring wells installed in the three different water bearing strata in 1987 and 1997 (prior to implementation of environmental remediation at Koppers Koke Site) indicated that groundwater in the fill material above the impermeable marsh deposits, is at or very close to the then existing ground surface (NJ TRANSIT 2010b). Water levels in the deeper aquifers, measured from deep wells screened in the sand stratum confined between the marsh deposits and the varved clay, and the glacial till stratum confined between the varved clay and bedrock, indicate that the piezometric level in both aquifers is generally at the same elevation as that in the Koppers fill stratum The depth to groundwater is shallow and present at approximately 8 feet below ground surface (ft bgs) at the shallowest groundwater zone.

This approximate depth to groundwater is applicable to the Preferred Alternative Project Components A, B, C, D and western portion of Project Component E. Appropriate remedial measures (such as double/multiple cased piles) will be used guided under the NJDEP Licensed Site Remediation Professional (LSRP), Site Remediation program and Administrative Requirements for the Remediation of Contaminated Sites (ARRCS) at N.J.A.C. 7:26C-3.3. The depth to the water table varies between 10 to 15 ft bgs throughout the eastern portion of Project Component E, and all of Project Components F and G. As discussed in Chapter 17, measures will be in place during construction to reduce spread of contamination to groundwater.

13.3.5 Seismology

Although they may occur, earthquakes in New Jersey are rare because the existing faults commonly do not break the ground surface. The Ramapo Fault, the most prominent of faults in New Jersey, separates the Piedmont and the Highlands Physiographic provinces, and is located as close as 20 miles northwest of the Main Facility site. Generally, the activity associated with this fault has occurred along the Ramapo Fault Zone, the 10 to 20 miles wide area lying adjacent to, and west of the actual fault. Another fault, referred to as the 125th Street or the Manhattanville fault, begins just south of the George Washington Bridge and cuts along under Queens. This fault has been associated with causing several small earthquakes with a magnitude of 4 or less. These faults are monitored within the Lamont-Doherty Cooperative Seismographic Network (Dombronski 2005)

13.4 PROBABLE IMPACTS OF THE PROJECT ALTERNATIVES

13.4.1 No Action Alternative

Under the No Action Alternative, the proposed Project would not be constructed and NJ TRANSIT and Amtrak would continue to be served by the existing commercial grid. Without the microgrid, commuter and intercity rail service in Amtrak's and NJ TRANSIT's core service territory would remain vulnerable to power outages. Under the No Action Alternative, other planned and programmed transportation improvements for which commitment and financing have been identified would take place by 2021. These include projects in NJ TRANSIT's Resilience Program, Amtrak initiatives that will affect operations on the Northeast Corridor, and HCIA plans for warehousing development on portions of the Koppers Koke property.

In the absence of the proposed Project, Amtrak has plans to completely replace and rebuild Substation No. 41. Amtrak is also currently proceeding with reconstruction of certain elements of Substation No. 42, located east of the project area at the entrance to the North River Tunnels in Weehawken, NJ, including the installation of a new Control House. Under the No Action Alternative, NJ TRANSIT intends to acquire the 20-acre parcel (Preferred Alternative Project Component A) on the Koppers Koke property as well as the six-acre parcel (Preferred Alternative Project Component B) located south of the Morris & Essex Line (due to a property settlement, as described in Chapter 2, "Project Alternatives"). Under the No Action Alternative, the 20 acres that NJ TRANSIT is acquiring and would likely be used for ancillary railroad purposes which would require some development on the property, creating additional impervious surface in comparison to what exists today.

13.4.2 Build Alternative

At the Main Facility (Preferred Alternative Project Component A), the primary impervious surface will be at the location of the Main Facility Building and associated parking. The remainder of the parcel will be covered with gravel and/or crushed rock, maintaining the current pervious surface. This includes the substation, combustion turbine generator yard and the detention basin underneath the solar panels. The limit of disturbance (LOD) for the new Kearny Substation (Preferred Alternative Project Component D) is a known area of 1.7 acres in Cedar Creek Marsh South. The NJ TRANSITGRID East Hoboken Substation (Preferred Alternative Project Component E) and the nanogrid (Preferred Alternative Project Component F) will be constructed on previously developed land and will therefore not increase impervious surface or result in impacts to soils and geology.

All electrical lines would be installed in previously developed land, within transportation rights-of-way. Where electrical lines (Preferred Alternative Project Components C, D, E and G, Project Component D optional routing and the electrical lines for Preferred Alternative Project Component F within HBLR Headquarters property) are installed on monopoles, the construction footprint is relatively small and would not result in adverse impacts to soils or geology. In areas where electrical lines are installed in underground duct banks (maximum of five feet deep), the only impacts to local soils would be during construction, as discussed in Chapter 17, "Construction Effects." There would be no permanent impacts resulting from installation of electrical lines on monopoles, in underground duct banks or attachment to existing infrastructure (i.e., HBLR bridges).

13.5 SUMMARY OF SIGNIFICANT ADVERSE IMPACTS AND MITIGATION MEASURES

Development of the unvegetated and vacant site will eliminate fugitive dust at the Main Facility once the Build Alternative is operational. The Build Alternative would not result in significant adverse impacts related to regional soils and native geology, impede groundwater flow or induce seismologic conditions within the proposed Project or adjoining areas. Mitigation measures for operation of the proposed Project are not warranted.