Appendix D
Geotechnical Engineering

Table of Contents

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1 EXISTING CONDITIONS

1.1 PROJECT LOCATION AND HISTORY

The study area consisting of 5,930-acre (9.3 square mile) upper River Des Peres watershed, located in eastern Missouri just to the west of the City of Saint Louis. The watershed contains approximately 11 miles (17 km) of streams. Refer to Appendix C – Civil Engineering for additional details on location, history, and survey data currently being utilized.
This appendix provides information on the geotechnical engineering aspects of the project features.

1.2 EXISTING FEATURES

The existing project area does not have any flood control measures, such as levees, berms, floodwalls, detention basins, etc. The Non-Federal Sponsor, University City, does have an existing partial flood warning system that was installed in 2018.

2 MEASURES

2.1 DETENTION BASINS 3 & 4

The TSP does not currently contain any detention basin (DB) features. However, the Project Delivery Team (PDT) will consider adding DB3 and/or DB4 to the TSP as a refinement that may optimize annual net benefits. Therefore, these detention basins will be carried forward for further analysis in the study. Refer to the main report and Appendix C – Civil Engineering for additional details on each detention basin alternative.

2.2 SUBSURFACE DATA

2.2.1 Geology

The bedrock geology within the area consists of Carboniferous-aged cyclical deposits of Pennsylvanian sandstones, shales, clays, and coal; these deposits occur beneath upland areas. Underlying these Pennsylvanian formations and outcropping in the southern reaches of the basin are extensive deposits of Mississippian limestones. Karst features associated with limestone occur in the area, and several sink clusters appear to be associated with the Deer Creek drainageway. A geostructural feature called the Clayton Syncline is responsible for the presence of Pennsylvanian deposits in the northeastern part of the watershed and is the controlling factor in the surface exposure of limestone in the southwest. The Black Creek tributary follows the syncline axis to the northwest and may be structurally controlled.
Surficial material consists of loess. Two distinct loess formations have been recognized in the area: the Peoria loess, which is varies from 0-8 feet thick in the Deer Creek basin, and the underlying Roxana loess, which varies from 5-15 feet thick in the area. The Roxana loess has a slightly higher clay content (average 31%, maximum 52%) than the overlying Peoria loess (average 28%, maximum 40%). Clay minerals within these sediments have been identified from in order of abundance from montmorillonite, illite, and kaolinite. The uppermost 6 to 8 feet is

composed of silty alluvium derived from the Peoria loess. These uppermost layers have been reworked and modified by fluvial processes, as well as human activity. A large percentage of the Deer Creek floodplain contains variable amounts of fill material, and it is estimated to be as thick as 14 ft. deep.

2.2.2 Exploration

Limited subsurface data associated with heat well pumps and monitoring well installation is available through the general vicinity at the Missouri Department of Natural Resources website. A total of 506 monitoring wells, 105 heat pump wells, and ten well logs were identified within the project vicinity. The ten well logs are dated from 1903 through 1936 and do not provide legible information. The heat pump wells and monitoring well data is dated from the 1990's through early 2000's. The available data suggests top of bedrock varies within the vicinity, with depths ranging from a minimum of 8 feet below ground surface (bgs) to up to 80 feet bgs., with an average recorded top of rock of approximately 26 feet bgs.

No sinkholes have been documented by the Missouri Department of Natural Resources database within the project area. However, the extent and impact to the project will be evaluated along with additional subsurface geotechnical exploration during preconstruction engineering and design (PED).

Additional subsurface exploration will need to be obtained for all modification features. The additional exploration should consist of Standard Penetration Test (SPT), auger borings with undisturbed samplings, and laboratory testing to characterize the subsurface conditions for each modification feature. The subsurface investigation is needed for the design of detention basins, weir control structures, levees, floodwalls or other water flood control features to be constructed.

The locations of the borings will be finalized when each feature location is finalized. It is assumed that a minimum of one boring will be needed for each feature or structure with significant loading. Testing will vary for each structure, but at a minimum testing will include soil classifications (sieve and atterberg limits), moisture contents, as well as UU triaxial strength testing and consolidation testing under structures with significant loading. All testing will follow the appropriate ASTMs.

Borings will also be needed throughout the basin area(s) to verify suitability of materials; testing will include soil classifications (sieve and atterberg limits) and moisture contents.

After appropriate subsurface information is obtained, the foundation for each concrete weir control structure and containment levees will be designed via geotechnical analyses. The basin bottom elevations will also be verified based on subsurface data.

2.3 SURVEYING

Post- exploration surveying will need to be completed at each boring location.

2.4 GENERAL DESIGN INFORMATION

Geotechnical will coordinate with and provide soil material properties to the structural engineer for control structure shallow or deep foundation design. Geotechnical will coordinate all cross-section limitations and elevations for the basins and containment levees to the civil engineer. Analyses will include settlement, seepage, and stability as appropriate per each feature to meet the needs of the project and USACE criteria.

3 BORROW

All borrow is anticipated to come from onsite material. Excavated material from the basin will be used for embankment material.

Material classification of borrow material could influence the design and slopes of the levee containment modifications.