Groundwater Modeling Report
Fairfield I-77 Development Site
Ridgeway, Fairfield County, South Carolina
S&ME Project No. 210730B

PREPARED FOR:
Luck Companies
Post Office Box 29682
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PREPARED BY:
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July 19, 2021

July 19, 2021

Luck Companies
Post Office Box 29862
Richmond, Virginia 23242

Attention: Mr. Bruce Smith Submitted via email: brucesmith@luckcompanies.com

Reference: **Groundwater Modeling Report**
Fairfield I-77 Development Site
Ridgeway, Fairfield County South Carolina
S&ME Project No. 210730B

Dear Mr. Smith:

S&ME, Inc. has completed groundwater modeling for the referenced property (i.e. the subject property), which was performed in general accordance with S&ME Proposal No. 210730A, dated May 24, 2021.

S&ME appreciates the opportunity to provide this groundwater modeling assessment for this project. Please contact us at your convenience if there are questions regarding the information contained in this report.

Sincerely,

S&ME, Inc.

SOUTH CAROLINA LICENSED PROFESSIONAL ENGINEER No. 27867 DAVID R. LOFTIS 7/19/21

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1.0 INTRODUCTION

S&ME, Inc. (S&ME) previously provided a *Limited Hydrogeologic Assessment* report dated March 22, 2021, for the subject property located north of S.C. Highway 34 near Ridgeway in Fairfield County, South Carolina. The *Limited Hydrogeologic Assessment* was prepared in general accordance with S&ME Proposal No. 42-2000424 Rev 1 dated January 21, 2021. A site vicinity map is shown on **Figure 1, Appendix I.**

1.1 Purpose

S&ME understands that Luck Companies (Luck) is considering the purchase of the subject properties for the purpose of developing a construction aggregate mine. The mining operations will use dry mining techniques; therefore, the proposed mining area will need to be dewatered via groundwater extraction points/sumps. The purpose of the groundwater modeling effort was to estimate the extent of magnitude of the dewatering of the aquifer.

1.2 Methodology

Luck provided information to S&ME that the lowest elevation of the planned mined pit is 30 feet mean sea level (MSL) with an average surface elevation around the pit of 515 feet MSL. Therefore, the pit may extend to an average depth of 485 feet below ground (BG).

This limited hydrogeology assessment relied on a process that began with the development of a preliminary site conceptual model. The preliminary model was based on known or expected main features of geology, hydrogeology, mine pit location and development, and site-specific relationships between geologic structures and groundwater flow. The collected data included site specific geophysical information. A computer aided mathematical model was then employed to provide predictive simulations of effects of future mine dewatering scenarios.

2.0 Site Setting

The subject site is located near the town of Ridgeway, Fairfield County, South Carolina. The approximate 404.11-acre site is located north of S.C. Highway 34, a two-lane highway bound to the north by railroad tracks, and west of Interstate Highway 77. The tax parcels comprising the site include 166-00-00-028-000 (107.96 acres), 166-00-00-018-000 (246.08 acres) and 166-00-00-030-000 (50.07 acres). The site consists of standing and harvested forestland with partially cleared areas along with two wood-framed structures or shelters. Properties surrounding the subject site consist primarily of forestland, and with areas of commercial and residential development generally south of the site and limited agricultural use west of the site.

The subject site is identified on the United States Geological Survey (USGS) 7.5-minute series Topographic Maps titled Winnsboro, South Carolina Quadrangle, dated 1969. The original map has a scale of one inch equals 2,000 feet. A USGS Topographic Map of the site vicinity is included as **Figure 2, Appendix I**.

The subject site topography is generally undulating and slopes towards the north and east. Based on a review of available topographic mapping, Dutchmans Creek and tributaries to Dutchmans Creek begin or flow thru the site ((https://gis.dhec.sc.gov/watersheds/) (**Figure 2, Appendix I)**. Surface elevations on the subject site range from approximately 420-620 feet above Mean Sea Level.

2.1 Planned Quarry Operations

The planned mining operations will take place in the north central portion of the subject property with the land east and southwest of the pit used for overburden storage. The initial plant area and the future final plant and facilities area for the facility will be located south of the Phase I mine pit and southwest of the completed mine pit, respectively. Buffer areas will be located on each property boundary. The rail/road entrance to the mine facility will be from the southwest off Highway 34 E. and will extend northeastward to the final process plant area southwest of the proposed mine pit.

The planned mining operations will begin with the excavation and removal of overburden and rock from the Phase 1 extraction area located in the northern portion of Parcel 166-00-00-018-000 **(Figure 3, Appendix I)**. The Phase 1 full depth of 235 feet BG is anticipated in Year 18 of operation. Mining in Phase 2, estimated to begin in Year 24, will reach a maximum depth of 285 feet BG in Year 29. Mining in Phase 3 is estimated to begin in Year 35 and will reach a maximum depth of 485 feet BG in Year 70. Phase 3 is estimated to end in Year 79.

2.2 Geology

According to the Geology of the Carolinas, (Horton, Jr. J. Wright and Zulu A. Victor, University of Tennessee Press, 1991), the Property lies in the Piedmont Physiographic Province. The Piedmont is characterized by rolling relief drained by numerous creeks. Generally, soils in the Piedmont formed by the weathering of the underlying rock. Parent material is felsic/mafic residuum weathered from metamorphic and igneous rocks.

Figure 4, Appendix I represents the *Geologic Map of the Winnsboro Mills Quadrangle, Fairfield County, South Carolina* (2016) (https://www.dnr.sc.gov/geology/images/publications/winnm.gif) with mapped local geologic units in the vicinity of the subject site shown. According to this map and accompanying text, the subject site and vicinity are likely underlain by one or more of the following rock types.

- Mylonitic Felsic Gneiss and Amphibolite (Zmfa) - Proterozoic. Consists of amphibolite facies mylonitic felsic gneiss and amphibolite, with Chappells deformation fabric resulting from incorporation into the lower and northwestern part of the Chappells shear zone.
- Simpson Metagranite (Zsm) - Proterozoic. Part of a northeast-southwest belt of variably foliated metagranite plutons.
- Dutchmans Creek Gabbro (Cdgb) – Carboniferous. Consists primarily of plagioclase, olivine, clinopyroxene and orthoproxene. Field mapping and geophysical studies indicate the gabbro is a relatively thin sheet with a nearly horizontal upper surface exposed by erosion in the valley of Dutchmans Creek.
- Jurassic-age Diabase dikes (Jd) have been mapped in the area and on the subject property. The dikes dip steeply and are up to 10 meters thick.

Based on a review of prior soil boring data gathered for Luck by others, The soil saprolite overburden thickness in the planned mine pit area ranges from 34 feet to 97 feet.

2.3 Hydrogeology

The hydrogeology of the Piedmont is typically characterized by surficial soils underlain by a weathered rock zone referred to as saprolite, which can range from a few feet to tens of feet thick. The saprolite transitions into bedrock with increased depth. In places the lowermost saprolite transition zone, just above bedrock, can be more permeable. Groundwater within the Piedmont generally moves from topographically high areas (recharge zones) to topographically low areas within and along stream valleys (discharge areas). Dutchmans Creek, and the other unnamed tributaries that bisect portions of the site, are the expected discharge zones for the shallow aquifer.

2.4 Site Conceptual Model

The generally accepted model for the Piedmont aquifers is a two layered system, built on the premise of an unconsolidated layer of soil and saprolite containing an unconfined aquifer that has a relatively high storage capacity supplying water to an underlying variably fractured crystalline bedrock aquifer that has low overall porosity and storage (Heath 1989). The low overall porosity and storage are due to the dense, somewhat impermeable bedrock that yields water primarily from secondary porosity and permeability provided by fractures, faults, joints and foliations. The saprolite aquifer and bedrock fractures zone are common targets for residential, industrial and irrigation water wells. It is important to emphasize that crystalline bedrock aquifers are irregular and heterogeneous in distribution, often highly localized, and exhibit discontinuous water bearing zones.

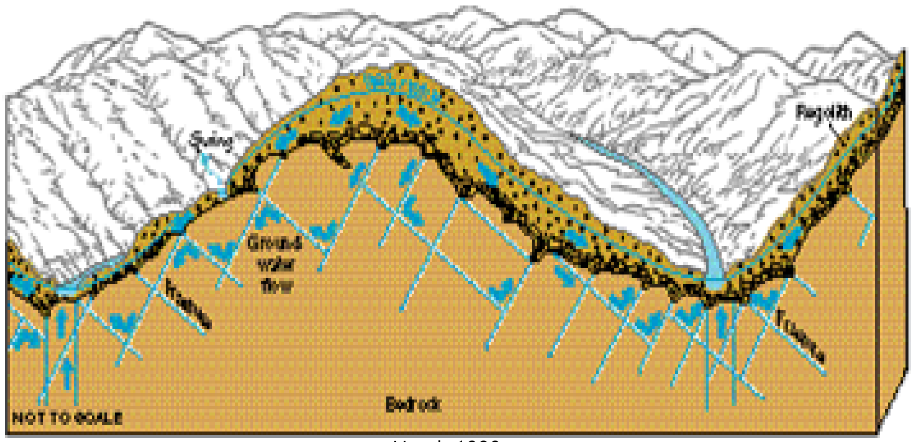
Although far more complex, the local aquifer system can be conceptually simplified and viewed as a two-layered system consisting of a shallow, unconsolidated, unconfined, porous regolith water aquifer that can supply water to surface water features and to the second layer, the underlying fractured bedrock aquifer.

Aquifer recharge in the Piedmont region is provided by precipitation which occurs in the form of rainfall and snow melt. Depending on factors such as ground saturation, ground cover, and slope, a portion of the precipitation forms runoff. This runoff flows to areas of lower elevation where some of the runoff water infiltrates in the unconsolidated material (i.e. soil) and some flows into local surface waters. The precipitation that does not form runoff infiltrates through the unsaturated zone where it can merge with underlying aquifers.

Most of the recharge in this region takes place in inter-stream areas. In general, recharge from precipitation enters the aquifer system through the saprolite zone. It is believed that much of the recharge water moves laterally through the saprolite zone and discharges to nearby streams. Under some conditions shallow groundwater can discharge at the ground surface down slope as seeps or permanent springs above these surface water bodies. Some of these seeps may occur on a seasonal basis or as short-term temporal responses to precipitation. This unconfined saprolite aquifer is generally expected to act as a storage reservoir for the underlying fractured bedrock aquifer.

Some of the water moves vertically downward through the saprolite until it reaches bedrock where it enters fractures in the crystalline rock. Groundwater within the consolidated fractured bedrock aquifer flows in accordance with hydraulic (i.e. pressure) gradients in the fracture network. Because of this, the groundwater does not necessarily flow in the direction of topographic gradients. Based on the site geology and Very Low Frequency (VLF) imaged fractures, flow likely occurs along rock fabric and fracture zones. Significant fracture zones have the potential to substantially influence groundwater flow and velocities.

Figure 2-1 Simplified Illustration of Groundwater Movement



Heath 1980

3.0 Water Well Inventory

3.1 Water Supply Well Database Review

On February 17, 2021, S&ME requested to review available environmental regulatory files pertaining to water supply wells located within one mile of the site from the South Carolina Department of Health and Environmental Control (SCDHEC) through its Freedom of Information (FOI) office. Due the volume of information provided by SCDHEC via S&ME's FOI request, the data was not included in this report but can be submitted electronically upon request by S&ME.

A review of database information does not indicate the presence of a well located within a 0.5-mile radius of the planned final mining pit. The database presents 14 wells located within a one-mile radius of the planned final mining pit. The majority of these wells (up to 10) are residential water supply wells and are generally located southeast, southwest, west and north of the site. The database provided the depth of five wells, located within 1 mile of the site, ranging from 170 to 605 feet BG (**Figure 5, Appendix I**).

Two private irrigation wells are present approximately 0.5 to 0.6 mile from the proposed mining pit, including one on a commercial property located southwest of the site, and one on an adjoining residential property southeast of the site. No information regarding the depth or date of installation of these wells was contained in the SCDHEC database.

A review of the SC Watershed Atlas website (https://gis.dhec.sc.gov/watersheds/) identified the presence of one public water supply well (#SC2010002) at the Hwy 34/Elv Tank (G20127) facility – approximately 3,200 southwest of the proposed mine pit area. The SC Watershed Atlas website also indicated that a Public Water Supply Well (PWSW) Protection Zone is defined by 2,180-foot radius from the well that encompasses approximately 341-acres.

Mr. James Ferguson, Hydrogeologist with the SCDHEC, Drinking Water Protection Division, provided additional information regarding the identified public water supply well via electronic mail on March 15, 2021. According to Mr. Ferguson, the public water supply well is identified as Well 6 and is owned and operated by the Town of

Ridgeway. Mr. Ferguson further indicated that, in 2013, the well yield for Well 6 was measured at 45 gallons per minute (gpm), and the well produced 32,000 gallon per day (gpd) on average.

On March 15, 2021, our David R. Loftis, P.E., spoke to Mr. Ferguson via telephone regarding the PWSW Protection Zone. According to Mr. Ferguson, PWSW Protection Zones were established at the direction of the United States Environmental Protection Agency (USEPA) in association with public water supply sources to identify potential contamination sources to the water supply within these zones. The zones were initially developed to allow municipalities to prepare land development ordinances/restrictions within these zones to reduce the potential for contaminants to be introduced to the water source. It was Mr. Ferguson's opinion that development of these land use ordinances/restrictions have not occurred. However, the PWSW Protection Zones are used by SCDHEC permitting agencies when reviewing permit applications, including, but not limited to water well permits, NPDES permits, mining permit and injection well permits.

On March 15 & 16, 2021, Mr. Loftis spoke with Mr. Robert Arndt, Town of Ridgeway Utilities Director. Mr. Arndt confirmed that the Town of Ridgeway owns and operates a public water supply well at the elevated water tank on Highway 34. Mr. Arndt indicated the well is in use about 18 hours per day and produces about 30,000 gpd. Mr. Arndt also stated that the Town of Ridgeway purchases some water from the Town of Winnsboro, but most of the Town of Ridgeway's water is sourced from this well.

On May 26, 2021, Mr. Loftis received electronic mail from Mr. Richard Welch, Jr., Manager with the SCDHEC Drinking Water and Recreational Waters Compliance Section. Mr. Welch provided a "screen shot" from the SCDHEC Environmental Facility Information System (EFIS) noting that the Town of Ridgeway well is an 400-foot deep open hole well into bedrock and contains a 20-horsepower submersible pump. In addition, the well produces an average of 32,060 gpd with a regulated capacity of 76,800 gpd.

3.2 Site Reconnaissance

During a site reconnaissance performed by S&ME on February 2, 2021, evidence of municipal water lines was observed, such as a fire hydrant observed near commercial property located on Highway 34 and near I-77. Areas located within 1 mile north, west and east, of the proposed mine pit were not accessible via public roads, with the exception of Barber Road west of the site. During the site reconnaissance, three residential water supply wells located within 1 mile of the mine site were observed. Ten residential wells and two irrigation wells identified within the search radius could not be observed from public roads. In addition, eight presumed water wells were observed from public roads within 1 mile of the mine site that were not identified in the FOI response.

3.3 Data Summary

The findings of our receptor survey, including the parcels with water supply wells located within a 1-mile radius of the proposed mine pit are summarized on **Figure 5, Appendix I**. Well symbols are shown on the parcels of interest to indicate that a well is present on the parcel, but do not indicate the location of the wells.

Twenty-two properties with registered water wells, or observed properties with a presumed water supply well, are located at distances greater than 0.5-mile and less than 1-mile of the proposed mine pit. Multiple additional properties in apparent residential use, suspected to be without access to water service, are located within 1 mile of the subject property. The PWSW Protection Zone for the Town of Ridgeway public water supply well extends within approximately 1,040 feet southwest of the proposed final mine pit limits.

4.0 Field Methods

4.1 Geophysical Survey

The site conceptual model assumed that bedrock fractures would provide primary control over groundwater movement in the bedrock aquifer. Characterization of fractured bedrock aquifers can be aided by the utilization of certain non-invasive geophysical survey tools. For this project, S&ME subcontracted THG Geophysics for the collection of VLF profile data for imaging steeply dipping fractures in the immediate vicinity of the proposed mine site. Electrical imaging was also performed at selected locations.

From February 1, 2021, to February 6, 2021, THG Geophysics collected data along 11 profiles covering approximately 34,200 linear feet, as depicted in **Figure 6, Appendix I**. THG Geophysics collected electrical imaging data along six profiles covering approximately 1,950 linear feet, as depicted in **Figure 6, Appendix I**.

The THG Geophysics report dated February 12, 2021, was included in the *Limited Hydrogeologic Assessment* report and includes figures illustrating the VLF profiles and the points along each profile where fractures were imaged. The post-processed VLF data was presented in both plan and cross-sectional view to illustrate the interpreted dip of the imaged fractures. The VLF data was examined and utilized to make interpretations of the subsurface fracture patterns and inferred diabase dikes within the study area. The green lines depicted on **Figure 6, Appendix I** illustrate the interpreted location and orientation of the imaged fractures, with arrows depicting the down-dip direction of these features. The orange lines depicted on **Figure 6, Appendix I** illustrate the interpreted location and orientation of imaged vertical diabase dikes. Although the lines shown are straight and continuous, actual fracture patterns and diabase dikes are not always linear and/or as laterally continuous as shown.

5.0 Groundwater Modeling

The projections for the dewatering operations were performed utilizing groundwater flow simulation models. Groundwater simulations were performed using MODFLOW-2000 or MODFLOW-2005 through the graphical user interface Groundwater Vistas, version 7.22. Groundwater Vistas is a reliable and commonly used graphical user interface for MODFLOW and the MODFLOW family of groundwater modeling codes. It aids in the construction of model input files and is particularly helpful for data organization for three-dimensional models with multiple hydrogeologic zones. It also facilitates model calibration and the rapid visualization of simulation results.

A discretized model was used to evaluate site-specific variables pertaining to fracture zones and pit configurations. Fracture orientations at the site define a primary trend, generally northwest to southeast as depicted in **Figure 6, Appendix I**.

An equivalent porous media (EPM) model was constructed from the foundations of two previous fractured bedrock models prepared for Luck simulating mine dewatering in two Piedmont counties: the Chester Greenfield Site in Chester County, and the Enoree Hannah Site in Spartanburg County. The EPM models were calibrated to pumping test data at both sites in generally similar hydrogeologic settings, with regional systematic fractures in bedrock, overlain by weathered bedrock or saprolite. The model simulates specific phases of the proposed mining operations, over time.

The model domain is regional and sufficiently large to minimize the effect of model boundaries on the simulation of the mining operation. The model uses general aquifer parameters unit thickness, water table elevations, and fracture orientations summarized in the *Limited Hydrogeologic Assessment* report, and including hydraulic conductivity (Water Resource Report 24, 2002). The critical parameter of aquifer anisotropy, which is defined by the ratio of the hydraulic conductivities parallel and perpendicular to the presumed groundwater flow direction, is based on a comparison of site fracture patterns and other hydrogeologic characteristics with those of the two other Piedmont sites (Chester and Enoree) and their respective calibrated anisotropy values. Based on this evaluation, the site was assigned a range of realistic anisotropy values which was applied to the mine dewatering simulations.

5.1 Model Construction

Figure 5-1, Appendix III is a map of the model domain and grid. The model is rotated so that the y-direction is generally parallel to the northwest-southeast trending primary fracture pattern and represents the primary flow direction, whereas the x-direction is generally perpendicular to fractures and dikes, and represents the minor axis of the flow anisotropy ellipse. The model is rotated 34 degrees west of north (counterclockwise) to align model columns with fracture and dike traces. The model covers 35,000 feet in both the x-direction and y-direction. The model has 100-foot by 100-foot cells in the central area covering the proposed mine property and surrounding area, including the location of the Town of Ridgeway water supply well. The model expands to 500 by 500 cells feet outside of the one-mile buffer area.

The model has two layers. Layer 1 (ground surface) is at an elevation of 515 feet mean sea level (MSL), while Layer 2 is at an elevation of 415 feet MSL. The starting water table is 465 feet MSL. The base of Layer 2 has an elevation of 30 feet MSL to accommodate the depth of the mining excavation. The top layer generally represents partially weathered rock.

5.2 Aquifer Storage Properties

Aquifer storage properties are based on pumping tests at the two Piedmont sites referenced above. Specific yield (S_y) in Layer 1 is 0.02, representing weathered rock. Pumping test calibrations of fractured bedrock wells at the two Piedmont sites yielded specific storage (S_s) of the fractured bedrock (Layer 2) on the order of 1×10^{-7} per foot.

5.3 Hydraulic Conductivity Zones

The EPM model has a consistent set of directional hydraulic conductivity values representing vertical and horizontal anisotropy introduced by the regional fracture trends. Layer 1 represents approximately 50 feet of saturated, weathered rock with hydraulic conductivity of 0.1 ft/day in both the Kx and Ky directions, as determined by the Chester and Enoree models.

Estimates of hydraulic conductivity in Layer 2 for the site range from 0.0440 ft/ day (lower end) to 0.4860 ft/day (higher end), and 0.1700 ft/day represents a median value. These estimates are based on a range of literature values of transmissivity in bedrock in the area (Water Resources Report 24, 2002). The horizontal hydraulic conductivity in the y-direction, K_y, reflects flow in the direction of the primary fracture trend. The horizontal hydraulic conductivity in the x-direction, K_x, reflects flow in the direction perpendicular to the general trends of both fractures and dikes. The mining operation was simulated with two different anisotropy conditions:

- Model "an25" has Kx = 0.0068 ft/day, Ky = 0.1700 ft/day, and Ky/Kx = 25
- Model "an35" has Kx = 0.0049 ft/day, Ky = 0.1700 ft/day, and Ky/Kx = 35

The two anisotropy ratios, 25 and 35, represent conservative (low anisotropy) and moderately conservative (higher anisotropy) estimates of site conditions, respectively. The vertical hydraulic conductivity, K_z, reflects the aggregate effect of flow along the steeply dipping fractures and through intervening matrix rock. Its value is estimated to be approximately 3 times Ky and 100 times Kx.

It should be noted that the presence of the diabase dikes has the potential to restrict flow in the east-west direction – potentially exaggerating the anisotropic conditions and lending to a higher Ky:Kx ratio.

5.4 Boundary Conditions

The model applied a general head boundary (GHB) around the one-mile ring from the mine to simulate a water table with no drawdown at a large distance from the edge of the model. The closest significant surface water bodies are lakes and rivers located approximately 70,000 feet east and west of the site. Because of its topographic setting, stream recharge effects will be less pronounced in the immediate vicinity of the Fairfield mine, and therefore even a relatively low Ky:Kx ratio will create a strong ellipsoidal effect. As a conservative assumption, the contribution of streams is not simulated in the Fairfield site model.

5.5 Transient Model Simulation

Model runs are transient to realistically represent gradual increases in mine depth over time. Steady state runs risk over-predicting drawdown, unless there is a well-connected source of water within the model that is known to create equilibrium in a certain number of years. The depth of pumping at the mine site and low K values in the rock and fractured rock require transient simulation of the mining operation.

The model simulates the progression of the three mining phases – Phase 1, Phase 2 and Phase 3 – with a sequence of seven model stress periods:

- Stress Period 1: Year 6 – Half of the depth of Phase 1, 115 feet (400 feet MSL).
- Stress Period 2: Year 18 – Full depth of Phase 1, 235 feet (280 feet MSL
- Stress Period 3: Phase 2 begins – Year 24.
- Stress Period 4: Phase 2 reaches maximum depth of 285 feet (230 feet MSL) – Year 29.
- Stress Period 5: Phase 3 begins – Year 35
- Stress Period 6: Phase 3 reaches maximum depth of 485 feet (30 feet MSL) – Year 70.
- Stress Period 7: Phase 3 ends – Year 79.

5.6 Dewatering and Drawdown Estimates

5.6.1 *Groundwater Elevation and Dewatering Rate*

Figure 5-2, Appendix III follows the mine dewatering effects on the water table over 40 years with anisotropy ratio (Ky:Kx) of 25. The objective of the screening model is met with a two-step mining schedule, reflected by the inflection point at 18 years in the solid black line representing the pit level in feet MSL (the left-hand vertical axis). The water level in feet MSL in the bedrock aquifer immediately adjacent to the Town of Ridgeway water supply well Hwy 34/Elv Tank (G20127) is shown as a solid blue curve. The chart also shows the predicted mine pit dewatering flow rate in gpm as a gray curve (the right-hand vertical axis). Water level plots are also shown for conceptual compliance wells MW-1D (dark green), MW-2D (dashed blue), MW-3D (green), and MW-4S (dotted black) mentioned later in Section 5.6.2. The latter two curves coincide. Water level in a proposed 5-year calibration well (Cal1), that will also be discussed later, is shown as a red line.

Figure 5-3, Appendix III shows the same set of graphs as **Figure 5-2, Appendix III** for the model with anisotropy ratio (Ky/Kx) of 35.

5.6.2 *Drawdown Estimates*

Figure 7, Appendix I shows estimated drawdown contours after 40 years

The *Groundwater Monitoring Plan,* dated March 15, 2021, and prepared by S&ME, recommended the installation of conceptual compliance wells MW-1D, MW-2D, MW-3D, and MW-4S, as depicted in **Figure 8, Appendix I**.

Figure 5-4, Appendix III shows drawdown (vertical axis) in feet (instead of water elevation) at the Town of Ridgeway water supply well Hwy 34/Elv Tank (G20127) as a solid blue curve for anisotropy ratio (Ky/Kx) of 25. As with the water elevations shown in **Figure 5-2, Appendix III**, these are predicted bedrock aquifer elevations. Drawdown measured inside the Town of Ridgeway water supply well casing will reflect drawdown in the aquifer plus well inefficiency effects which the simulation does not reflect. Drawdown curves are also shown for the four conceptual compliance wells, and for the proposed 5-year calibration well, as in **Figure 5-2, Appendix III**.

Figure 5-5, Appendix III shows the same set of graphs as **Figure 5-4, Appendix III** for the model with anisotropy ratio (Ky:Kx) of 35.

5.7 Drawdown Simulations

Figure 5-4 and Figure 5-5, Appendix III are the drawdown graphs for anisotropy ratios of 25 and 35, respectively. The blue Town Well line represents estimated drawdown at the location of the Town of Ridgeway water supply well Hwy 34/Elv Tank (G20127). Model "an 25", with anisotropy ratio of 25 (most conservative) and a Kx of 0.0068 ft/day, shows approximately 15 feet of drawdown at the Town of Ridgeway water supply well at Year 40. Model "an 35", with anisotropy ratio of 35 (moderately conservative) and a Kx of 0.0049 ft/day, shows approximately 10 feet of drawdown at the Town of Ridgeway water supply well at Year 40.

6.0 Assumptions and Limitations

6.1 Significant Assumptions

- The assessment assumes that the proposed mine pit and operations would be configured as provided by Luck and outlined in this report.
- The interpreted fracture/dike patterns are the main drivers of groundwater flow within the bedrock aquifer.
- Aquifer K values approximate those estimated for the Chester and Enoree sites.
- Aquifer K values approximate those provided in Water Resources Report 24, Ground-Water Resources of Kershaw County, South Carolina; State of South Carolina Department of Natural Resources (2002)

6.2 Limitations and Exceptions of Assessment

- Information obtained regarding off-site water supply wells was limited to that provided by SCDHEC through its FOI office and off-site features visible from public roadways.
- This evaluation is based on data available at this time. The estimates and opinions contained herein may need to be revised if significant additional information becomes available. Nevertheless, the opinions are well-founded and consistent with observed conditions at the site.
- S&ME used generally accepted industry practices to characterize site conditions.
- Geologic features imaged using geophysical methods have not be field verified using subsurface exploration and additional testing methods.
- The techniques used in preparing the modeling evaluation were based upon generally-accepted industry standards, the current understanding of site conditions, and literature values for some model parameters. Subsurface data is always limited in its spatial coverage and subsurface hydraulic testing produces only approximate results. Furthermore, numerical models are simplified approximations of a complex subsurface. Estimates and projections about groundwater and subsurface behavior have inherent and unavoidable uncertainties. This is particularly true for potential local-scale variations in bedrock depth, fracture distribution and subsurface permeability. By using good, industry standard, generally-accepted methods and best practices, we believe this assessment provides useful and reasonable guidance concerning expected site behavior. Model simulation data outputs should be viewed as estimates. Contour lines shown depicting future groundwater drawdowns scenarios should be viewed as reasonably anticipated conditions, not actual. Results for actual mine operations may be different from model simulated results.
- This report does not warrant against future operations or conditions, nor does it warrant against operations or conditions of a type or at a specific location not evaluated.
- This evaluation was prepared by S&ME specifically for use by the Client and SCDHEC. Use of or reliance upon this information by any other party without express written permission granted by S&ME and the Client is not authorized and is completely at the risk of the user.

7.0 Conclusions

S&ME has completed groundwater modeling activities in association with the approximate 404-acre site located near Ridgeway, in Fairfield County, South Carolina. The purpose of the modeling requested by Luck was to better understand potential impacts of dewatering on neighboring wells, including the Town of Ridgeway water supply well.

The areas east, north and west, and within approximately 1-mile of the proposed mine, are predominantly rural properties developed for agricultural use and sparse residential and commercial use. One public water well owned and operated by the Town of Ridgeway is located approximately 3,200 feet southwest of the proposed mine pit. Multiple water supply wells included in the reviewed database, or presumed wells observed by reconnaissance, are located generally greater than 0.5-mile and less than 1-mile from the proposed mine area, and in areas not known to be served by the municipal water service, including State Highway 34, Barber Road, Lookout Tower Road, Cook Road, Gracie Land, Crossbow Road, Van Exum Road, and on Simpson Road adjoining the Property.

The prior limited hydrogeologic assessment began with the development of a preliminary site conceptual model. The preliminary model was based on known or expected main features of geology, hydrogeology, mine pit location and development, and site-specific relationships between geologic structures and groundwater flow. Site specific data was collected for the purpose of further characterizing the hydrogeologic system and refining the site conceptual model. A standard computer aided three-dimensional mathematical model was then employed to provide predictive simulations of effects of future mine dewatering scenarios. The model used conservative assumptions about aquifer properties and is consistent with standard best practice in numerical finite-difference modeling of flow in porous and fractured media.

S&ME modeled three future mine pit development scenarios. The Phase I pit scenarios involved the expansion and gradual dewatering of the Phase I pit down 235 feet after 18 years. The pit will begin to be expanded to form the Phase II pit to an approximate depth of 285 feet below grade after 29 years of operations. The mining operation will begin to be expanded into the Phase III pit after 35 years of operation. The total depth of the Phase III pit will be approximately 485 feet below grade after 70 years. The life of the aggregate mine is estimated to be approximately 79 years.

The model predicts an elliptical-shaped drawdown cone with the long axis of the ellipse in the northwest-southeast direction, consistent with the orientation of dominant fracture patterns imaged on the subject site using geophysical tools. After 40 years of operation of the mine, the regional model simulations estimates a 10-foot (Ky:Kx=35) to 15-foot (Ky:Kx=25) drawdown at the Town of Ridgeway water supply well Hwy 34/Elv Tank (G20127).

8.0 Considerations for Model Refinement

The groundwater model can be calibrated using groundwater elevation data obtained during dewatering activities associated with the mining operations. The calibrated model would reflect the site-specific hydrogeologic conditions, i.e., aquifer conditions, and will increase the reliability of the estimated groundwater drawdown in the future.

Additional groundwater models were used to estimate the drawdown after five years of mine operations using anisotropy ratios (Ky:Kx) of 25 and 35. The drawdown results along with the compliance wells (MW-1D, MW-2D, MW-3D, and MW-4S) proposed in the *Groundwater Monitoring Plan* dated March 15, 2021, and prepared by S&ME, are depicted in **Figure 8, Appendix I**. The five-year simulation time was selected to estimate if adequate aquifer drawdown would be achieved to allow model calibration soon after mine operations began.

Based on a review of the estimated drawdown at Year 5, it was determined that the proposed compliance wells would likely see too much or too little aquifer response to serve as data points for model calibration. As such, S&ME recommends the installation of bedrock calibration well CAL-1 (see **Figure 8, Appendix I**) at a location between the proposed mine pit and the Town of Ridgeway water supply well to serve as an adequate data point for model calibration.

9.0 References

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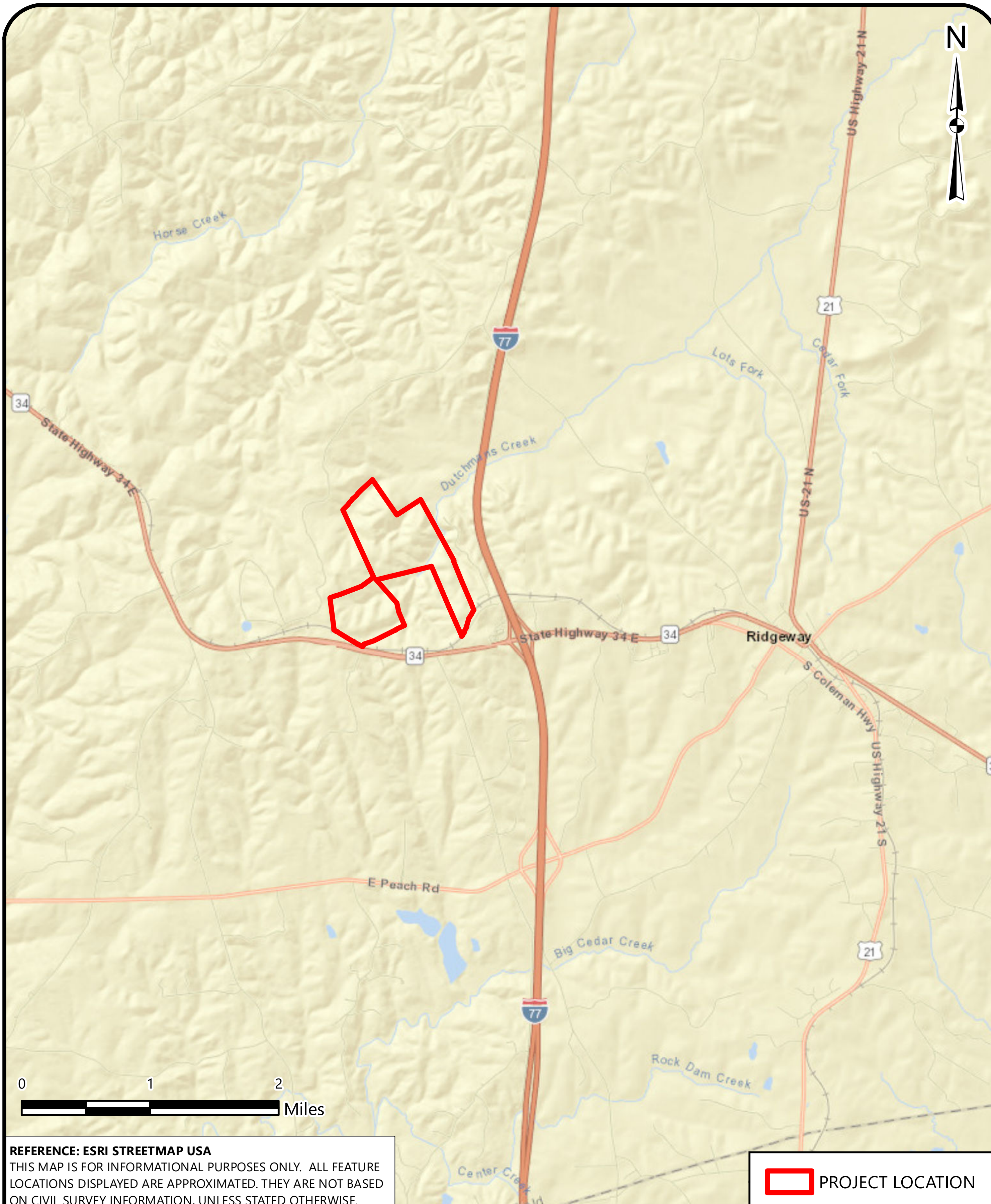
Appendix I – Figures



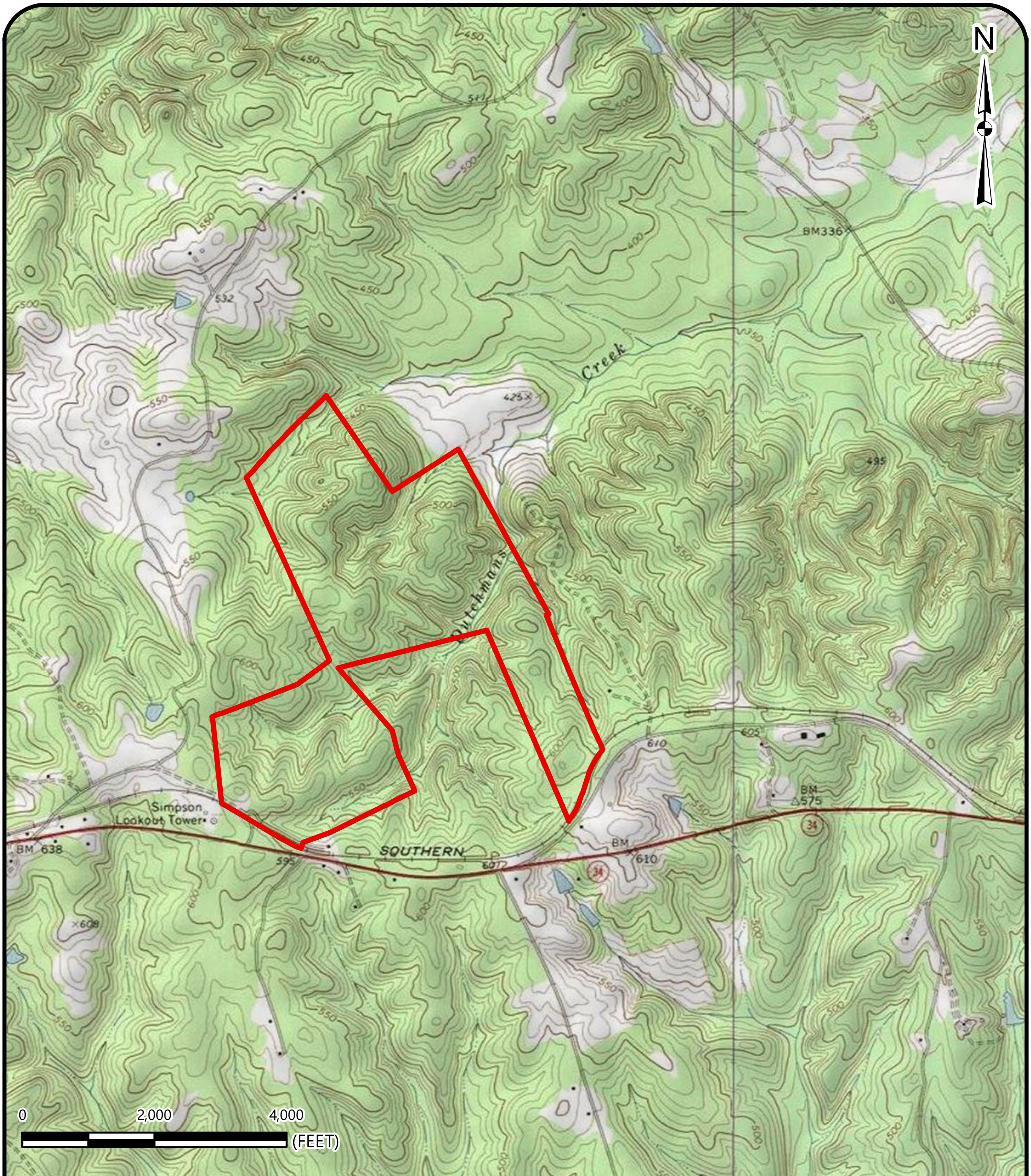
REFERENCE: ESRI STREETMAP USA
THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.

PROJECT LOCATION

SITE VICINITY

GROUNDWATER MODELING REPORT
FAIRFIELD I-77 DEVELOPMENT SITE
RIDGEWAY, FAIRFIELD COUNTY, SOUTH CAROLINA

SCALE: 1 " = 1 miles
DATE: 7-15-21
PROJECT NUMBER 210730B
FIGURE NO. 1



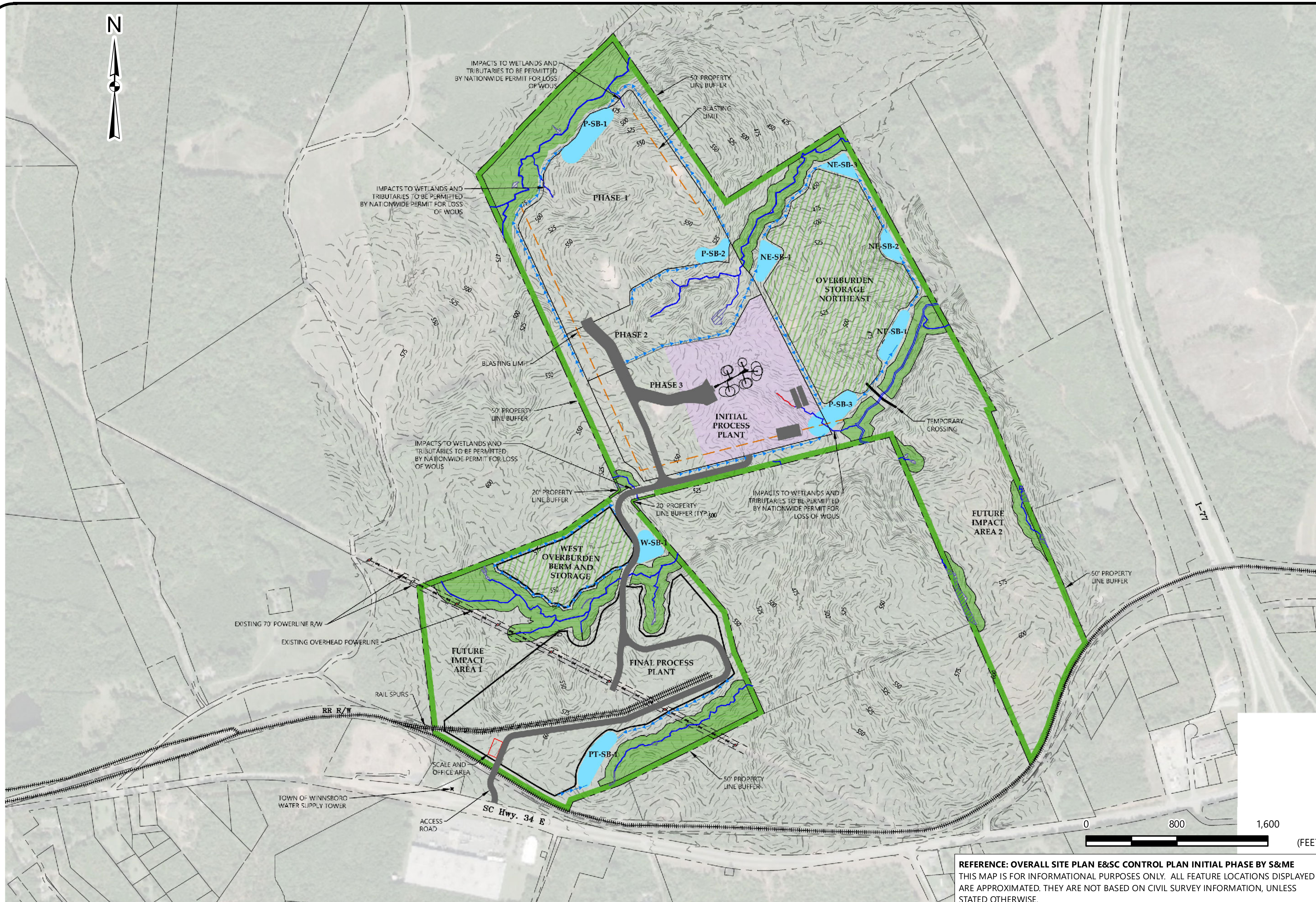
REFERENCE: 1969 WINNSBORO [SC] USGS 1:24,000 QUAD SHEET MAP
THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.

PROJECT BOUNDARY

USGS TOPOGRAPHIC MAP

GROUNDWATER MODELING REPORT
FAIRFIELD I-77 DEVELOPMENT SITE
RIDGEWAY, FAIRFIELD COUNTY, SOUTH CAROLINA

SCALE: 1 " = 2,000 '
DATE: 7-15-21
PROJECT NUMBER 210730B
FIGURE NO. 2



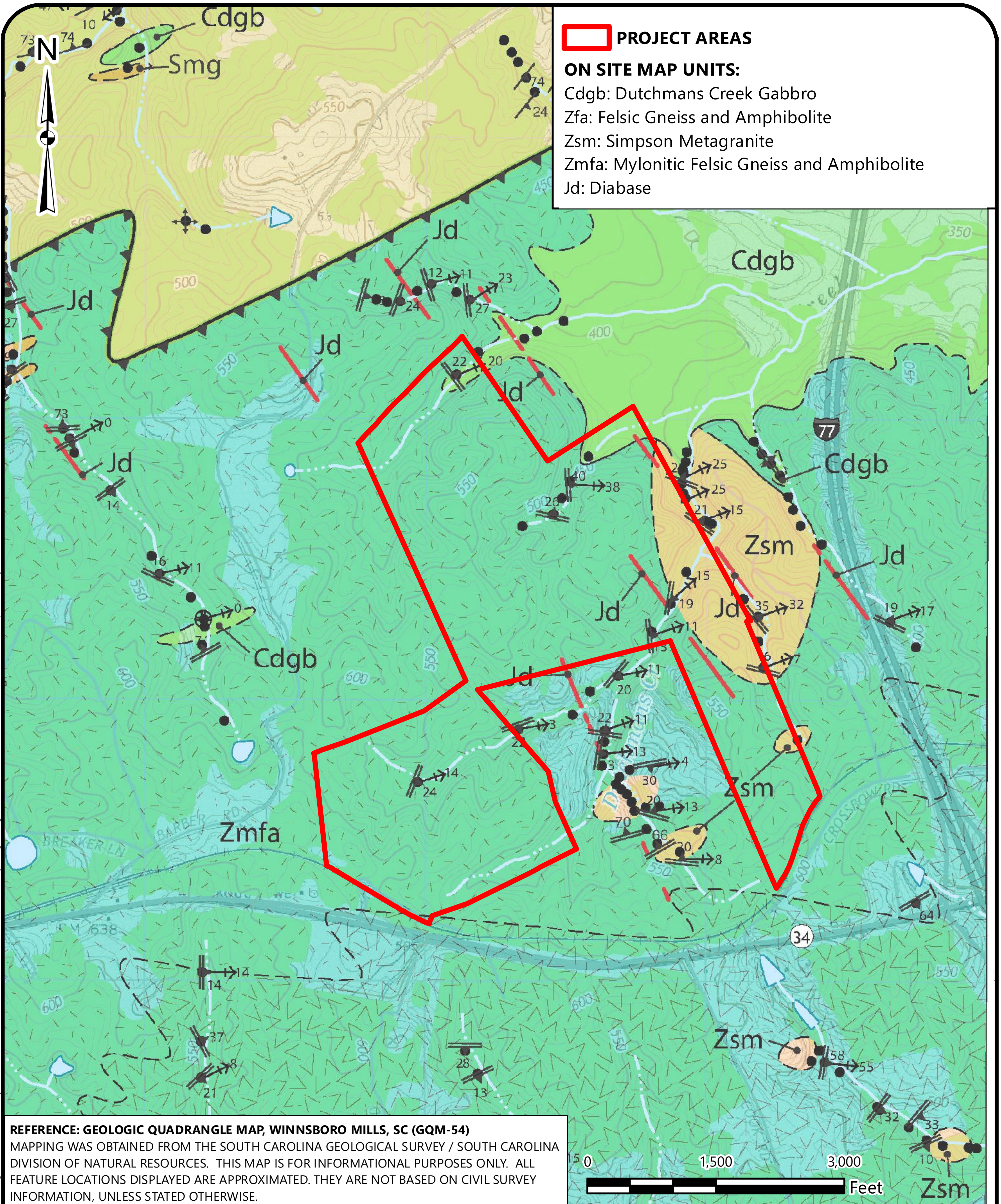
REFERENCE: OVERALL SITE PLAN E&SC CONTROL PLAN INITIAL PHASE BY S&ME

THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.

PROPOSED MINE OPERATION AREAS

GROUNDWATER MODELING REPORT
FAIRFIELD I-77 DEVELOPMENT SITE
RIDGEWAY, FAIRFIELD COUNTY, SOUTH CAROLINA

SCALE:	1 " = 800 '
DATE:	7-15-21
PROJECT NUMBER	210730B
FIGURE NO.	3



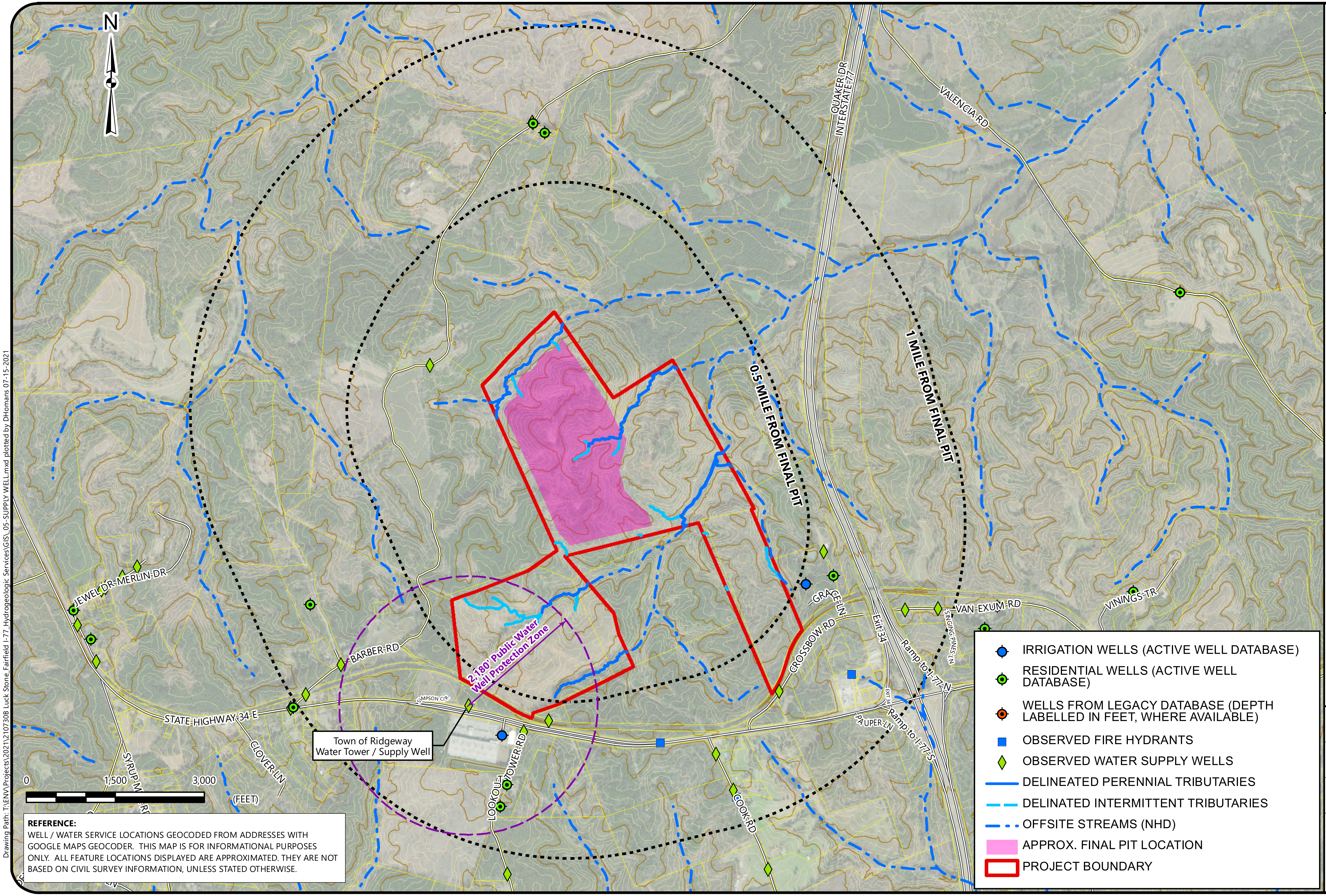
REFERENCE: GEOLOGIC QUADRANGLE MAP, WINNSBORO MILLS, SC (GQM-54)
MAPPING WAS OBTAINED FROM THE SOUTH CAROLINA GEOLOGICAL SURVEY / SOUTH CAROLINA DIVISION OF NATURAL RESOURCES. THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.

Drawing Path: T:\ENV\Projects\2021\210730B Luck Stone_Fairfield I-77_Hydrogeologic Services\GIS_04-LOCAL GEOLOGY.mxd plotted by DHomans 07-15-2021

LOCAL GEOLOGY

GROUNDWATER MODELING REPORT
FAIRFIELD I-77 DEVELOPMENT SITE
RIDGEWAY, FAIRFIELD COUNTY, SOUTH CAROLINA

SCALE:	1 " = 1,500 '
DATE:	7-15-21
PROJECT NUMBER	210730B
FIGURE NO.	4



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SUPPLY WELL LOCATION MAP

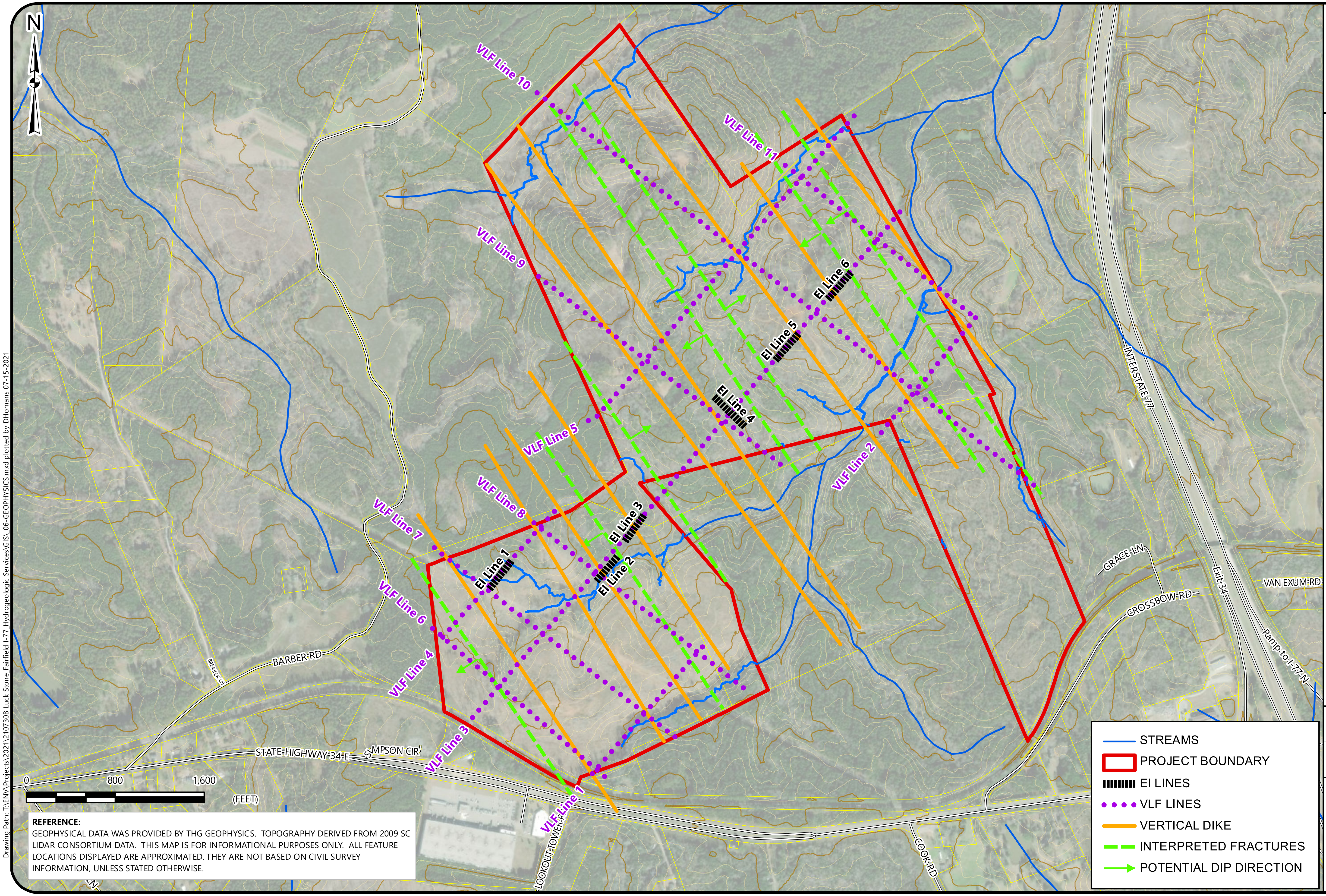
GROUNDWATER MODELING REPORT
FAIRFIELD I-77 DEVELOPMENT SITE
RIDGEWAY, FAIRFIELD COUNTY, SOUTH CAROLINA

SCALE: 1 " = 1,500 '

DATE: 7-15-21

PROJECT NUMBER: 210730B

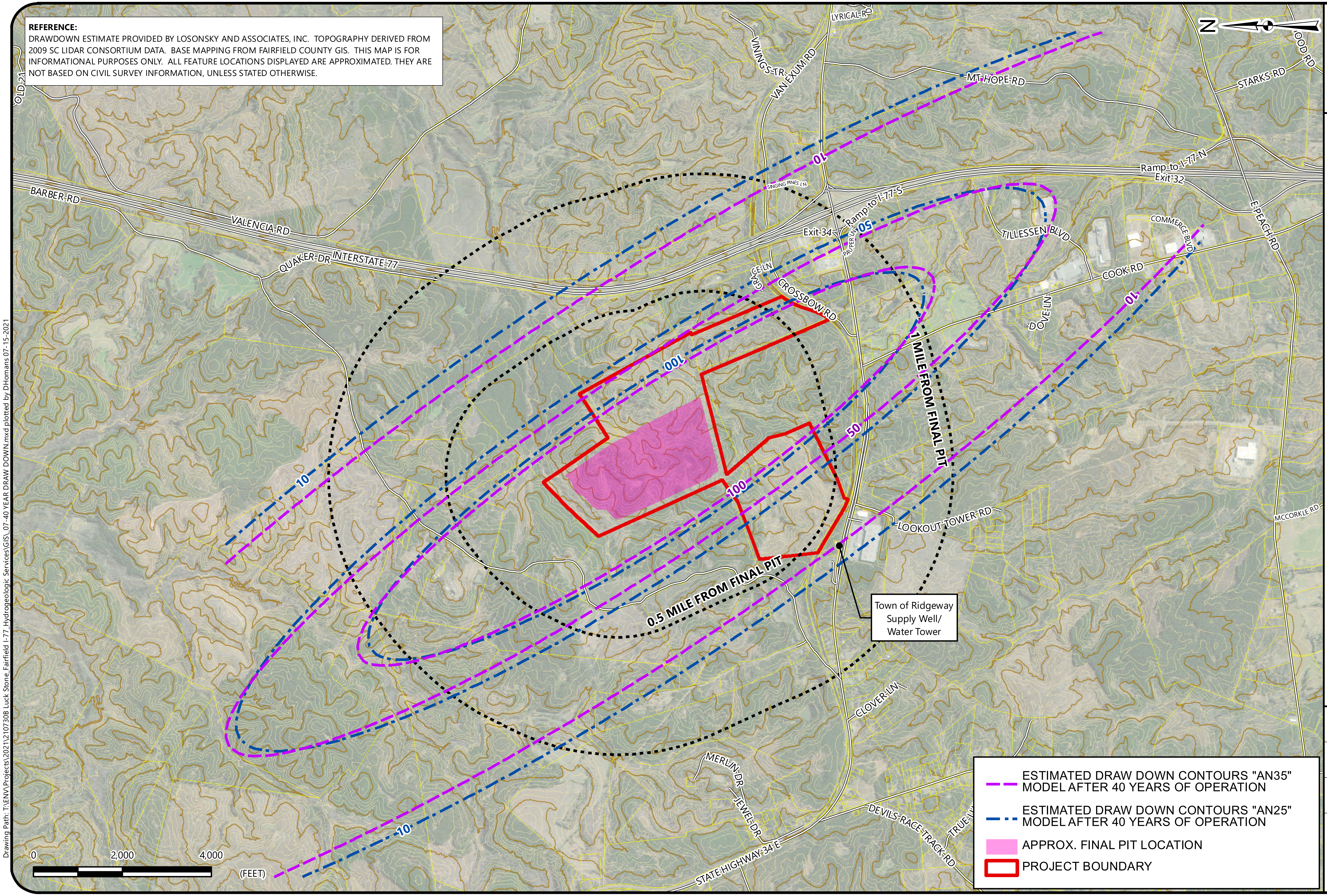
FIGURE NO. 5



VLF SUREY – BEDROCK FRACTURE MAP

GROUNDWATER MODELING REPORT
FAIRFIELD I-77 DEVELOPMENT SITE
RIDGEWAY, FAIRFIELD COUNTY, SOUTH CAROLINA

SCALE:	1 " = 800 '
DATE:	7-15-21
PROJECT NUMBER	210730B
FIGURE NO.	6



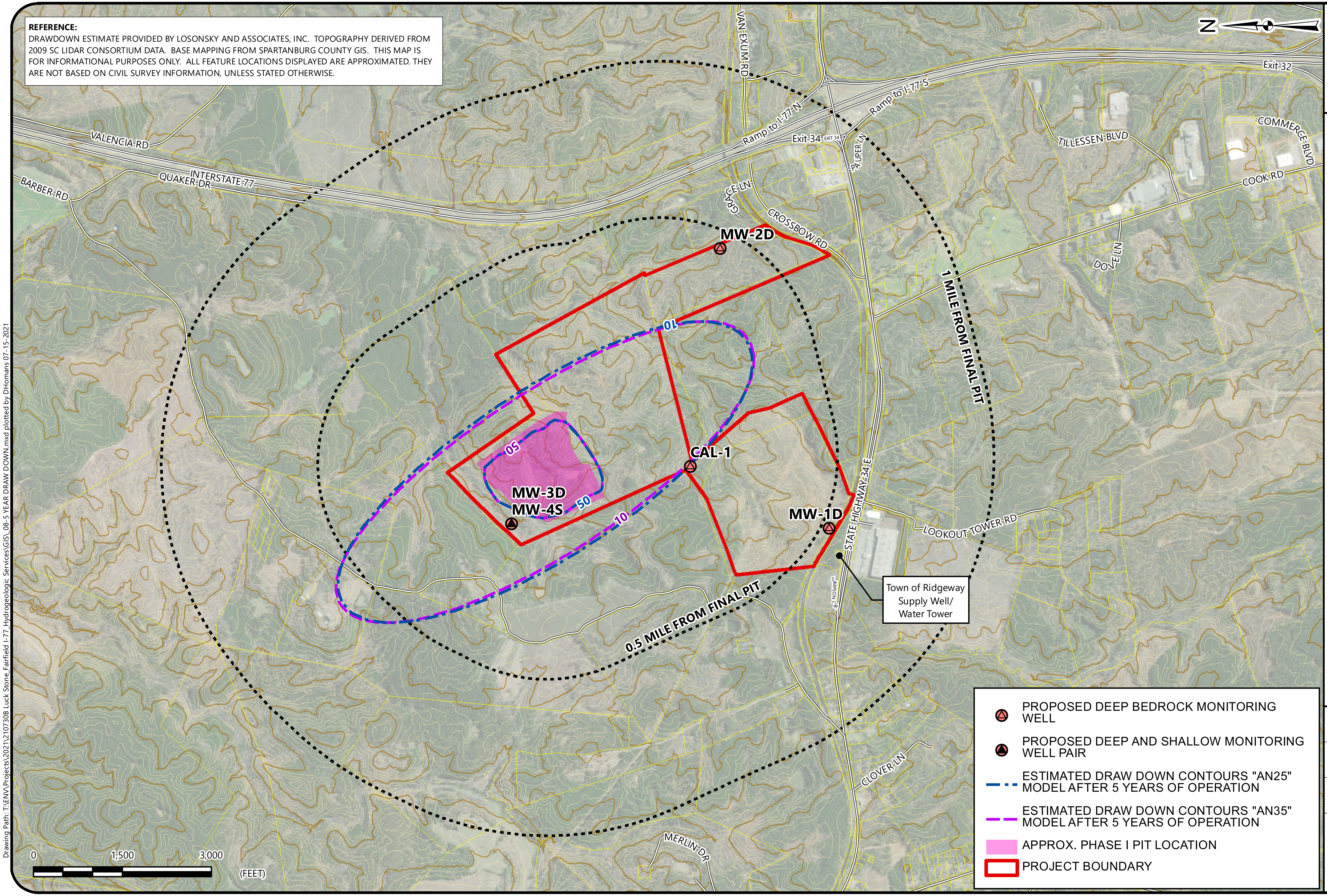
Drawing Path: T:\ENV\Projects\2021\210730B Luck Stone Fairfield I-77_Hydrogeologic Services\GIS\ 07-40 YEAR DRAW DOWN.mxd plotted by DHomans 07-15-2021

REGIONAL MODEL DRAW DOWN: AFTER 40 YEARS OF OPERATION

GROUNDWATER MODELING REPORT
FAIRFIELD I-77 DEVELOPMENT SITE
RIDGEWAY, FAIRFIELD COUNTY, SOUTH CAROLINA

SCALE:	1 " = 2,000 '
DATE:	7-15-21
PROJECT NUMBER	210730B
FIGURE NO.	7

REFERENCE:
DRAWDOWN ESTIMATE PROVIDED BY LOSONSKY AND ASSOCIATES, INC. TOPOGRAPHY DERIVED FROM 2009 SC LIDAR CONSORTIUM DATA. BASE MAPPING FROM SPARTANBURG COUNTY GIS. THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.



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REGIONAL MODEL DRAW DOWN: AFTER 5 YEARS OF OPERATION

GROUNDWATER MODELING REPORT
FAIRFIELD I-77 DEVELOPMENT SITE
RIDGEWAY, FAIRFIELD COUNTY, SOUTH CAROLINA

SCALE: 1 " = 1,500 '

DATE: 7-15-21

PROJECT NUMBER 210730B

FIGURE NO. 8

Appendix II – Geophysical Survey Report

GEOPHYSICAL INVESTIGATION
Luck Stone Corporation
Tombo Site
Winnsboro, South Carolina

Prepared for:
S&ME, Inc.
8646 W. Market Street, Suite 105
Greensboro, NC 27409

February 12, 2021

Prepared by:
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THG Project No. 459-10551

TABLE OF CONTENTS

FIGURES

1.0 INTRODUCTION

1.1 BACKGROUND

S&ME contracted with THG Geophysics, Ltd (THG) to image bedrock fractures at the approximately 410-acre Tombo site located in Winnsboro, South Carolina (**Figures 1 and 2).** The scope of work is to identify bedrock fractures for the installation of pump and observation wells for future bedrock aquifer pump tests.

1.2 WORK SCOPE

The scope of work included the collection of Very Low Frequency (VLF) data to map regional fractures. The proposed scope of work includes the acquisition of 11 VLF lines totaling approximately 34,200 linear feet (~6.5 miles) **(Figures 3, 4, 5, and 6).** To further characterize interpreted fractures, THG collected electrical imaging profiles at six (6) locations (1,950 ft; **Figure 7**).

2.0 GEOPHYSICAL INVESTIGATION

2.1 VLF SURVEY

A VLF bedrock fracture survey was conducted using an ABEM WADI meter to collect 11 profiles (**Figures 3, 4, 5, and 6**). The VLF method can be used to find steeply dipping structures that differ from their surroundings with regard to electrical resistance. VLF transmitters, the strongest located in Cutler, Maine, send out low frequency military radio signals (15-30 kHz). When the field emitted by one of the transmitters strikes an anomaly, secondary currents are created that can be read and recorded by the WADI VLF meter.

Cables, metal pipes, and electrical fences can also cause very strong anomalies because they are grounded, which permits a large ground-return current loop to form, showing a similar signature to that of fractured bedrock (ABEM Geophysics, 1989).

When a field emitted by a transmitter strikes a body having low electrical resistance, secondary circuits are created in the body. Fraser filtering, a numeric algorithm is performed on the real part of the VLF data to enhance the anomaly. Fraser filtering is based upon the work of Karous and Hjelt (1983):

$$F_o = -\,0.102\,H_{-3} + 0.059\,H_{-2} - 0.561\,H_{-1} + H_0 + 0.561\,H_1 - 0.059\,H_2 + 0.102\,H_3$$

Where; F_0 is the filtered result and H_{-3} to H_3 are the original VLF data.

Approximately 34,200 feet of VLF data were collected in 11 profile lines; VLF Lines 1 through 5 are oriented southwest to northeast and VLF lines 6 through 11 are oriented northwest to southeast (**Figures 3, 4, 5, and 6**).

The VLF profile is a graphic depth profile, generated through a Fraser-filtering algorithm and is a rough estimate of the presence and dip of fractures, where the portion of the image in red is considered to be the profile of a fracture (however, power lines and fences can create noise within this image).

2.2 ELECTRICAL IMAGING

2.2.1 Introduction

Electrical resistance is based upon Ohm's Law:

$$R = \frac{V}{I} \quad [ohms]$$

Where, resistance, **R**, is equal to the ratio of potential, **V** (volts) to current flow, **I** (amperes). Resistivity is the measure of the resistance along a linear distance of a material with a known cross-sectional area. Consequently, resistivity is measured in Ohm-meters. This report presents the geophysical results as geo-electrical profiles of modeled resistivity versus depth, in units of feet.

Electrical currents propagate as a function of three material properties (1) ohmic conductivity, (2) electrolytic conductivity, and (3) dielectric conductivity. Ohmic conductivity is a property exhibited by metals. Electrolytic conductivity is a function of the concentration of total dissolved solids and chlorides in the groundwater that exists in the pore spaces of a material. Dielectric conductivity is a function of the permittivity of the matrix of the material. Therefore, the matrix of most soil and bedrock is highly resistive. Of these three properties, electrolytic conductivity is the dominant material characteristic that influences the apparent resistivity values collected by this method. In general, resistivity values decrease in water-bearing rocks and soil with increasing:

a. Fractional volume of the rock occupied by groundwater;
b. Total dissolved solid and chloride content of the groundwater;
c. Permeability of the pore spaces; and,
d. Temperature.

Materials with minimal primary pore space (i.e., basement rocks) or lack groundwater in the pore spaces will exhibit high resistivity values (Mooney, 1980). Highly porous, moist or saturated soil, such as fat clays, will exhibit very low resistivity values. Most soil and bedrock exhibit medium to low resistivity values.

In homogeneous ground, the apparent resistivity is the true ground resistivity; however, in heterogeneous ground, the apparent resistivity represents a weighted average of all formations through which the current passes. Many electrode placements (arrays) have been proposed (for examples see Reynolds, 1997); however, the Schlumberger array has proven to be an effective configuration for imaging voids in bedrock settings.

2.2.2 Method

The resistivity survey was performed using the ARES multi-electrode cable system (GF Instruments, s.r.o., Brno, Czech Republic). The survey was conducted using stainless steel electrodes and stainless-steel cylinder-bearing cables.

Approximately 1,950 linear feet of EI data were collected in 6 profiles. EI profiles 1, 2, 3, 5, and 6 are oriented southwest-northeast and EI profile 4 is oriented northwest-southeast (**Figure 7**). The EI profiles are located where fractures or diabase dike are located in the subsurface.

2.2.3 Processing

A forward modeling subroutine was used to calculate the apparent resistivity values using the EarthImager program (AGI, 2002). This program is based on the smoothness-constrained least-squares method (deGroot-Hedlin and Constable, 1990; Loke and Barker, 1996). The smoothness-constrained least-squares method is based upon the following equation:

$$J^T g = (J^T J + \mu F)d$$

Where, **F** is a function of the horizontal and vertical flatness filter, **J** is the matrix of partial derivatives, **μ** is the damping factor, **d** is the model perturbation vector and **g** is the discrepancy vector.

The EarthImager program divides the subsurface 2-D space into a number of rectangular blocks. Resistivities of each block are then calculated to produce an apparent resistivity pseudosection. The pseudosection is compared to the actual measurements for consistency. A measure of the difference is given by the root-mean-squared (rms) error.

2.3 QUALITY ASSURANCE AND QUALITY CONTROL

The interpretation of geophysically-generated data is not an exact science since the responses to induced disturbance is affected by many phenomena including buried metals, operator error, precipitation, and net changes in ground saturation conditions. Some sources of spurious data can be overcome through a QA/QC program and use of multiple geophysical methods. The quality control program employed with this study included frequent checks of the equipment and resurveys of lines and locations. The QA/QC program indicates that all geophysical equipment functioned as designed during the survey program.

3.0 GEOLOGY

Westward of the Atlantic Coastal Plain is a region of South Carolina referred to as the Central Piedmont. This area is northwest of the Fall Line, the line dividing the basinward younger sedimentary deposits from the exposed older igneous and metamorphic rocks (Offield and Sutphin, 2000; Secor et al., 1986; and Pray, 1997). The age of the rocks in this area is considered to be Neoproterozoic to Late Paleozoic (Dallmeyer et al, 1986).

The site consists primarily of felsic gneiss and amphibolite of Proterozoic age (Horton and Dicken, 2001). Exposed within the gneiss are several small exposures of the Simpson Metagranite (Barker and Secor, 2005). To the north of the site is an exposure of the Carboniferous-aged Dutchman's Creek Gabbro (Secor, Barker, and Howard, 2016). Intruded into these rocks are the Jurassic-aged intrusive diabase dikes.

Felsic Gneiss and Amphibolite – The protoliths for the felsic gneiss and amphibolite unit were predominantly intrusive igneous rocks in the Charlotte terrane varying from mafic to felsic (Secor, Barker, and Howard, 2016). During the Horse Creek deformation, these rocks were complexly deformed and metamorphosed into felsic gneiss and amphibolite. The southeastern portion of the felsic gneiss and amphibolite unit has been incorporated into the northwestern portion of the Chappells shear zone, resulting in the mylonitization of this part of the sequence.

Simpson Metagranite – The suite of metagranite plutons, termed Simpson Metagranite (Secor, Barker, and Howard, 2016), intrude mylonitic felsic gneiss and amphibolite contained in the Chappells shear zone that separates the Carolina terrane from the Charlotte terrane. The metagranite was emplaced either late synkinematically or post-kinematically relative to the mylonitic fabric in the surrounding rocks. Age dating is interpreted to indicate an episode of strong deformation (the Chappells deformation) in the Carolina terrane during the Late Proterozoic and/or Early Cambrian. The above suite of metagranite plutons in the Winnsboro Mills quadrangle are here collectively referred to as the "Simpson metagranite.

Dutchmans Creek Gabbro – The gabbro consists primarily of plagioclase, olivine, clinopyroxene, and orthopyroxene in varying proportions, with lesser amounts of biotite, hornblende, and opaque minerals (McSween and Nystrom, 1979). The gabbro is interpreted to have been emplaced post-metamorphically. The gabbro is a relatively thin sheet with a nearly horizontal upper surface. A Carboniferous age has been assigned to the gabbro (Mobely et al., 2014).

Diabase – The diabase dikes typically have subophitic texture containing plagioclase, augite, pigeonite, olivine, and Fe-Ti oxides. Dikes dip steeply, are up to 10 meters thick, and contain cooling joints oriented both perpendicular and parallel to the walls of the dikes. Saprolitic outcrops exhibit spheroidal weathering with residual corestones concentrated at the surface. These dikes have been assigned a Jurassic age. These dikes, due to their inherent intrusion into existing fractured rock, are excellent sources of water.

4.0 ANALYSIS

VLF mapping located at least nine (9) diabase dikes and several fractures as part of a dike swarm that invaded the host rock in this area during the Jurassic (**Figures 3, 4, 5, and 6**). Diabase dikes, emplaced by exploiting fractures in the host rock, are excellent sources of permeable and fractured rock. VLF mapping methods can easily detect these dikes because of the high concentration of ferrous and magnetic minerals within the dikes.

The predominant orientation of the dike swarm is N36^{o}W and the dikes are nearly vertical. The individual dikes have been mapped as up to ten (10) m wide (~33') (Secor, Barker, and Howard, 2016); however, this study shows that they are approximately forty (40) feet wide possibly due to the non-normal orientation of data collection to the dikes. Further, several of the VLF profiles show that individual dikes can be composed of several intrusions. For example, the portion of VLF Line 3 from 1,750 to 2,200 feet shows at least 2 dikes, probably representing an *en echelon* set of dikes.

Six (6) EI profiles (1,940') were collected to document the presence of the dikes and to determine the approximate width of a dike. EI Line 2 shows a forty (40) foot wide dike between 175' and 215' and likely shows the end of an *en echelon* dike between 225' and 245' (**Figure 7**). EI Line 3 shows a well-developed forty-five (45) foot wide dike between 160' and 205' along the profile. Finally, EI Line 6 shows a forty (40) foot wide dike between 100' and 140' along profile. The image of the dike in EI Line 6 is interesting as there may be several dikes shown on the profile and the base of the dike shows low apparent resistivity, an indication of saturation.

Seven (7) large fractures are present and sub-parallel the dikes. Five (5) of the fractures dip to the southwest at approximately 45^{o}, and two (2) dip with an approximate dip of 45^{o} to the northeast

Since the study area is within a dike swarm, the potential for productive groundwater wells is great. Drilling locations on either side of a dike can prove to be very productive depending upon the depth to and gradient of groundwater within the area of interest. Four (4) likely productive sites have been identified within the rocks on either side of the respective dikes (**Figure 2**). However, locations favorable to the operator of the site but adjacent to the dikes and along their predicted path, are also acceptable for groundwater production.

5.0 CONCLUSION

A geophysical survey of the approximately 410-acre Tombo site located southeast of Winnsboro, South Carolina shows that the site is within a Jurassic dike swarm. The rocks on either side of a vertical dike can produce excellent productive groundwater wells. The findings and conclusions in this report are stated with a reasonable degree of scientific certainty. THG's findings and conclusions are as follows:

1. Approximately 34,200 linear feet of VLF data were collected in eleven (11) profiles;
2. Five (5) VLF profiles were collected from the southwest to the northeast and six (6) VLF profiles were collected from the northwest to the southeast;
3. Six (6) EI profiles (1,950 feet) were collected in areas predicted to have dikes or fractures present;
4. The site consists of Proterozoic-aged felsic gneiss and amphibolite facies; and Simpson Metagranite;
5. The primary host rock within the study area is the dense, non-porous felsic gneiss and amphibolite facies;
6. The Carboniferous Dutchmans Creek Gabbro is located to the north;
7. The site is intruded by at least nine (9) Jurassic-aged diabase dikes as part of a dike swarm;
8. The intrusion of the dike swarm exploited an existing fractures and/or fractured the host rock during emplacement;
9. The dikes are oriented N36^{o}W, nearly vertical, and approximately forty (40) feet wide;
10. Seven (7) fractures were identified in the study area and are oriented N36^{o}W and dip either 45^{o}S or 45^{o}N, respectively;
11. The rocks on either side of the diabase dikes can be make excellent groundwater production wells based upon the fracturing of the rock;
12. Four locations have been identified as having the potential for groundwater production; however, the interpretation herein is that a boring in most any location in the rocks along a dike would make a productive groundwater well.

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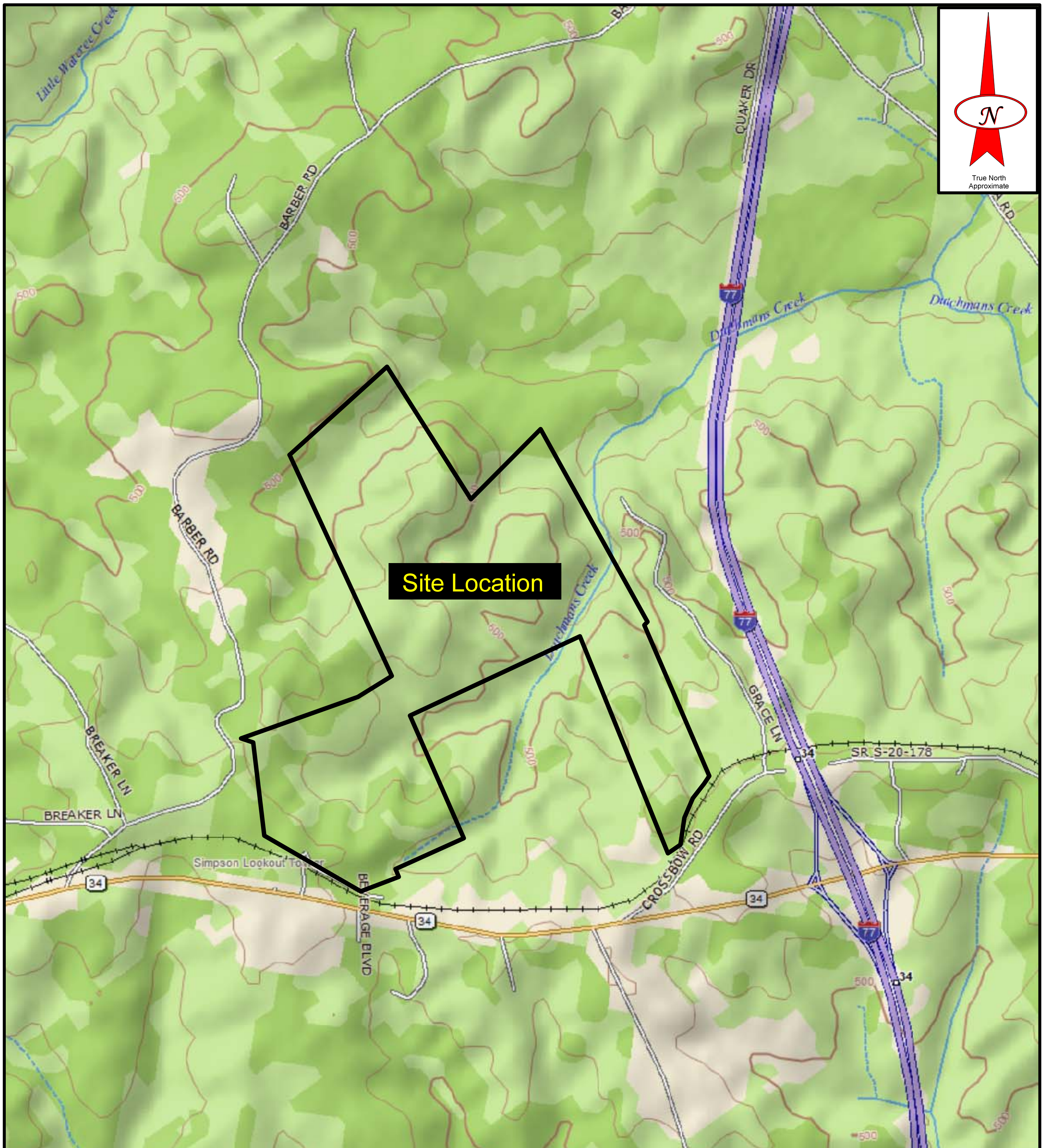

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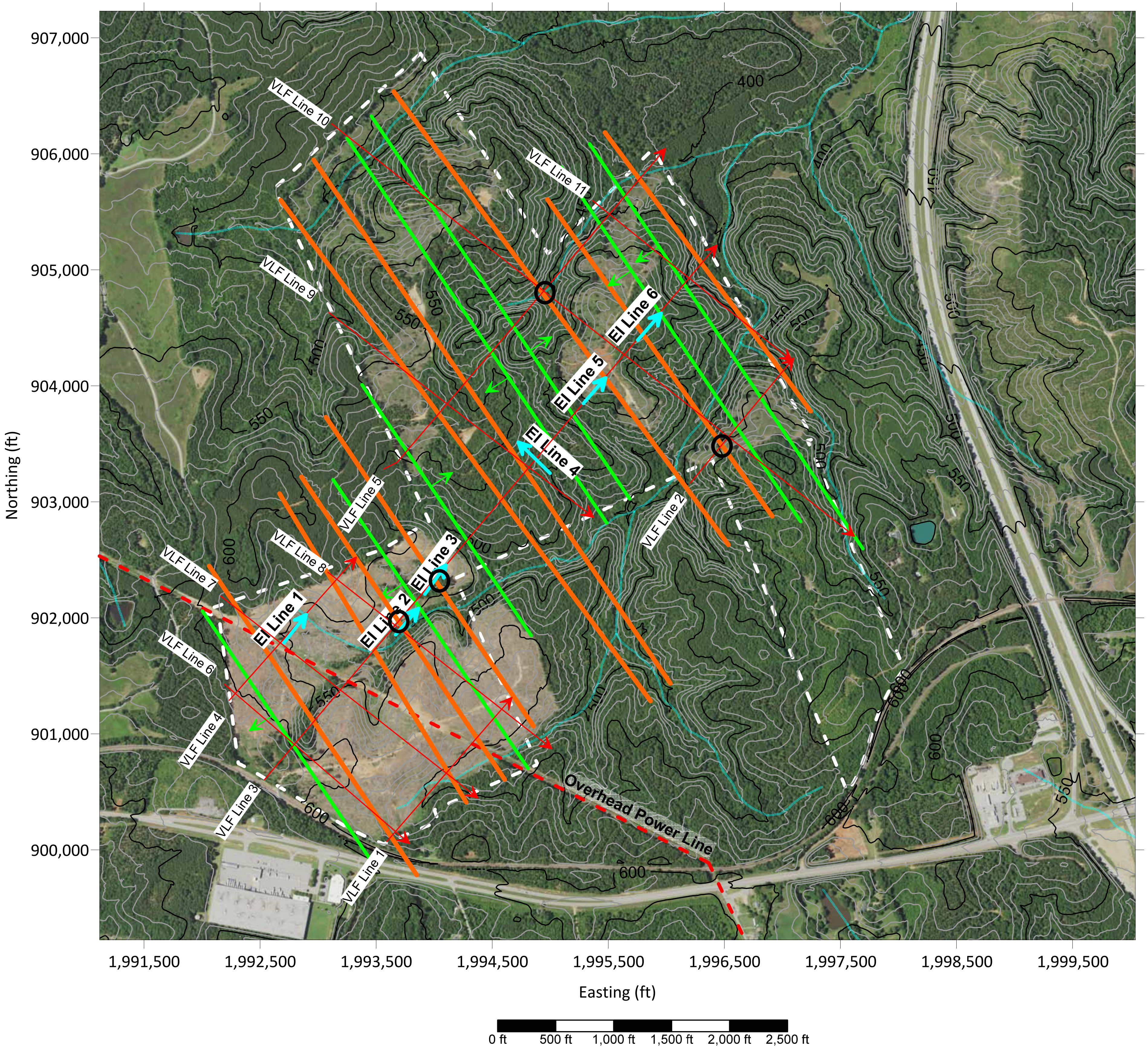
www.thggeophysics.com

0 ft 1000 ft 2000 ft 3000 ft 4000 ft 5000 ft

Figure 1
Site Location Map

Geophysical Investigation
Luck Stone Corporation - Tombo Site
Winnsboro, South Carolina

SCALE: 1:24,000	PROJECT NO.: 459-10551	DRAWING NO.: DWG10551F1
DATE : 2/11/2021		
DRAWN BY: MNH	SOURCE: 1969 Winnsboro Mills (Sc) USGS 7.5 Minute Topographic Quadrangle	
CHECKED BY: PJH		



True North Approximate

Legend

- VLF Profile (arrow indicates direction)
- Electrical Imaging Profile (arrow indicates direction)
- NHD Flowlines
- Vertical Dike
- Fracture (showing dip direction)
- Possible location for a production well

Notes

Geophysical survey conducted February 1-6, 2021 using ABEM Wadi Very Low Frequency Meter and GF Instruments ARES II electrical resistivity meter with active multi-electrode cable sections.

Real-time positioning of data using fully integrated Trimble Geo-7X global positioning system set to NAD 1983 US State Plane (South Carolina) coordinate system in US Survey feet.

Locations are approximate.

Topographic Contours = 10 ft (NAVD88, ft amsl)
Topographic data from 1/9 arc-second (~11-ft horizontal resolution) NED LIDAR survey dated 2008.

GEOPHYSICS
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DRN	PJH	2/3/21
DES	PJH	2/3/21
CHK	MLT	2/12/21
REV		
PROJ. MGR.	ARB	2/12/21
SCALE:	1" = 1,000'	
SOURCE:		

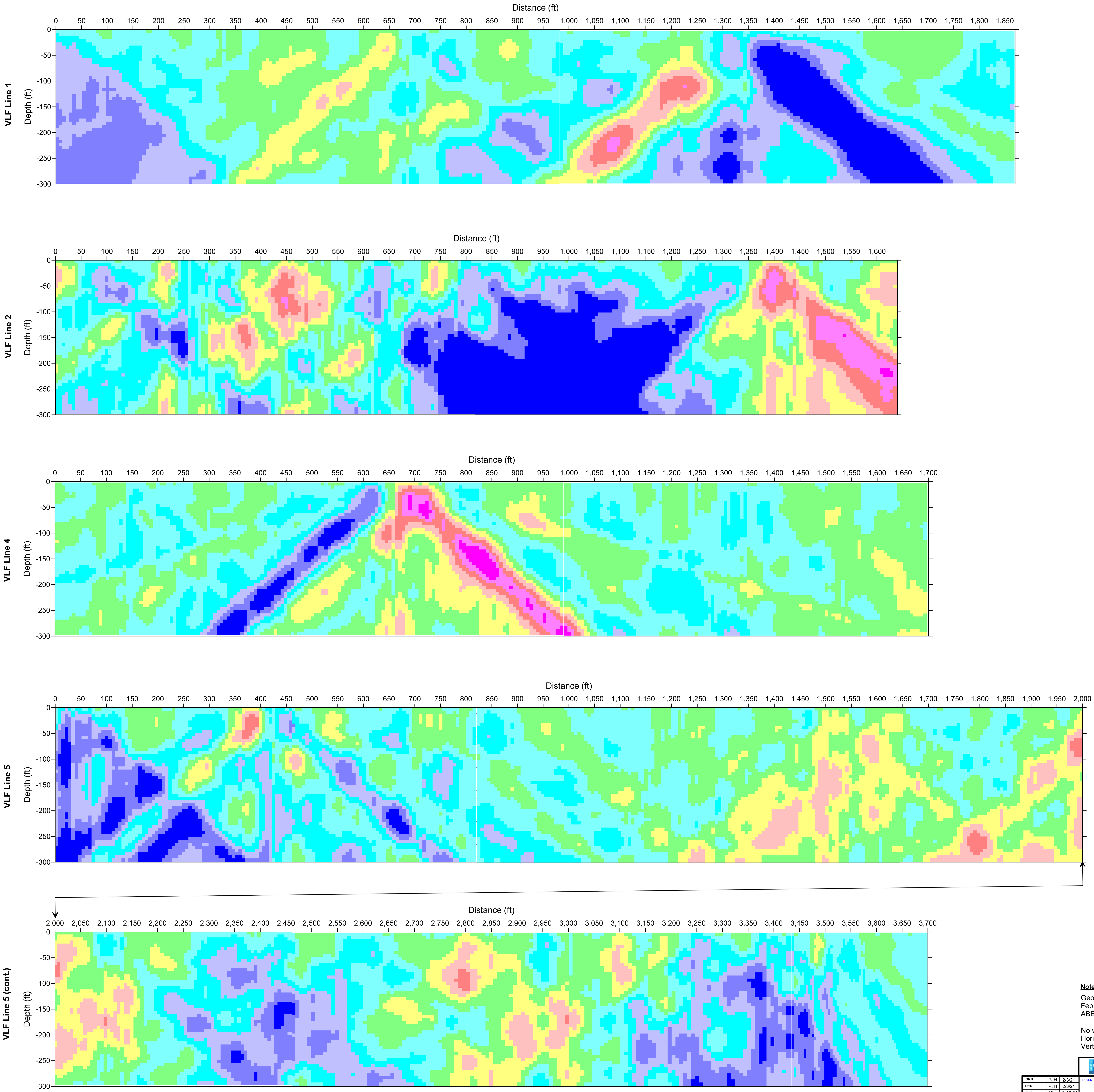
PROJECT:
Geophysical Investigation
Luck Stone Corporation
Tombo Site
Winnsboro, South Carolina

DRAWING NO.:
Geophysical Location Map

PREPARED FOR: S&ME

PROJECT NO.: 459-10551

SHEET TITLE: DWG10551F2



Notes

Geophysical survey conducted February 1-6, 2021 using ABEM WADI VLF meter.

No vertical exaggeration
Horizontal scale 1" = 100'
Vertical Scale 1" =100'

THG GEOPHYSICS
4280 Old William Penn Hwy
Murrysville, Pennsylvania 15668
(724) 325-3996 Fax: (724) 733-7901
www.thggeophysics.com

DRN	PJH	2/3/21
DES	PJH	2/3/21
CHK	MLT	2/12/21
REV		
PROJ. MGR.	ARB	2/12/21

SCALE: 1" = 100'

SOURCE:

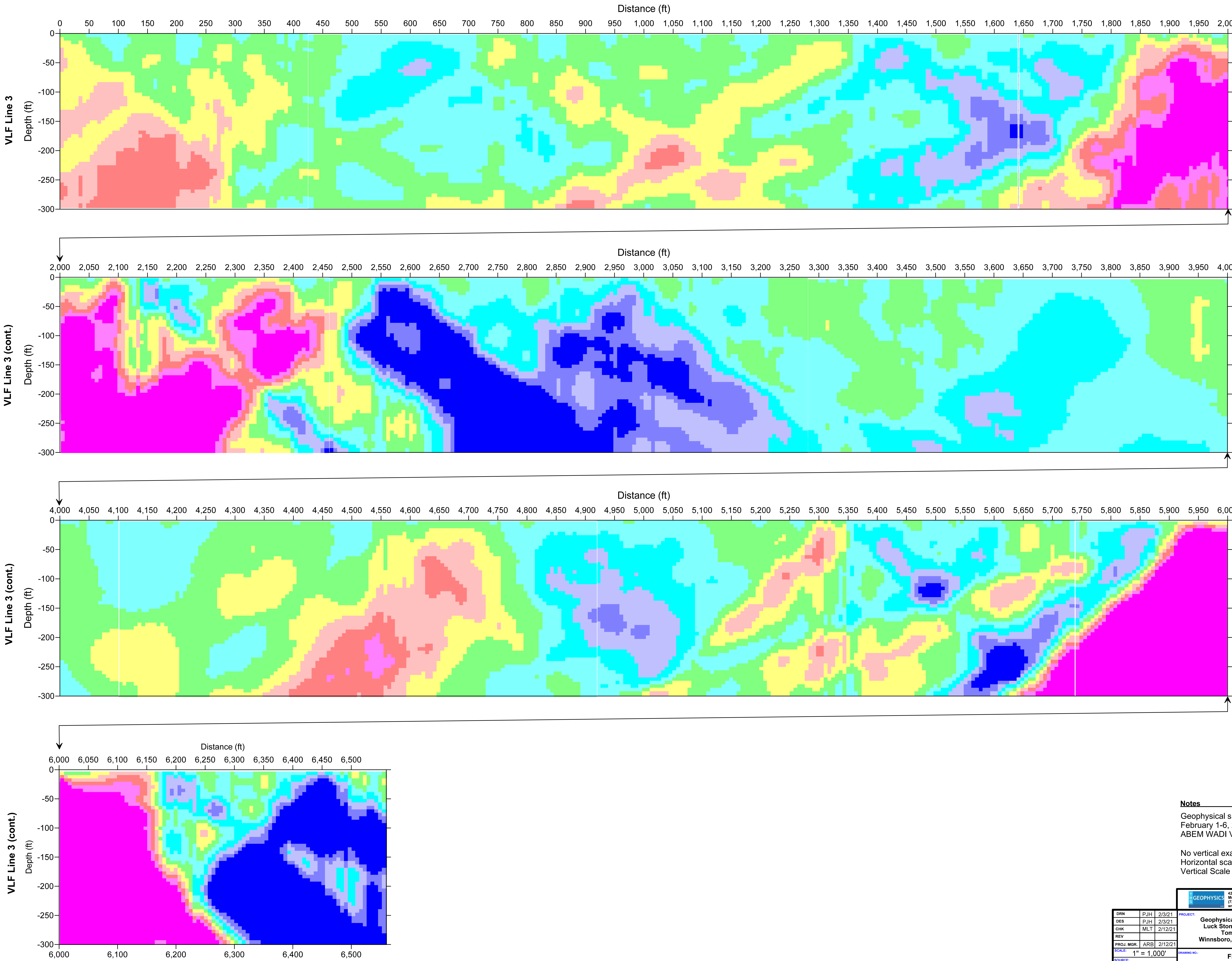
PROJECT: Geophysical Investigation
Luck Stone Corporation
Tombo Site
Winnsboro, South Carolina

DRAWING NO.: Figure 3
SW-NE VLF Profiles 1, 2, 4, and 5

PREPARED FOR: S&ME

PROJECT NO.: 459-10551

SHEET TITLE: DWG10551F3



Notes

Geophysical survey conducted February 1-6, 2021 using ABEM WADI VLF meter.

No vertical exaggeration
Horizontal scale 1" = 100'
Vertical Scale 1" =100'

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DRN	PJH	2/3/21
DES	PJH	2/3/21
CHK	MLT	2/12/21
REV		
PROJ. MGR.	ARB	2/12/21

SCALE: 1" = 1,000'

SOURCE:

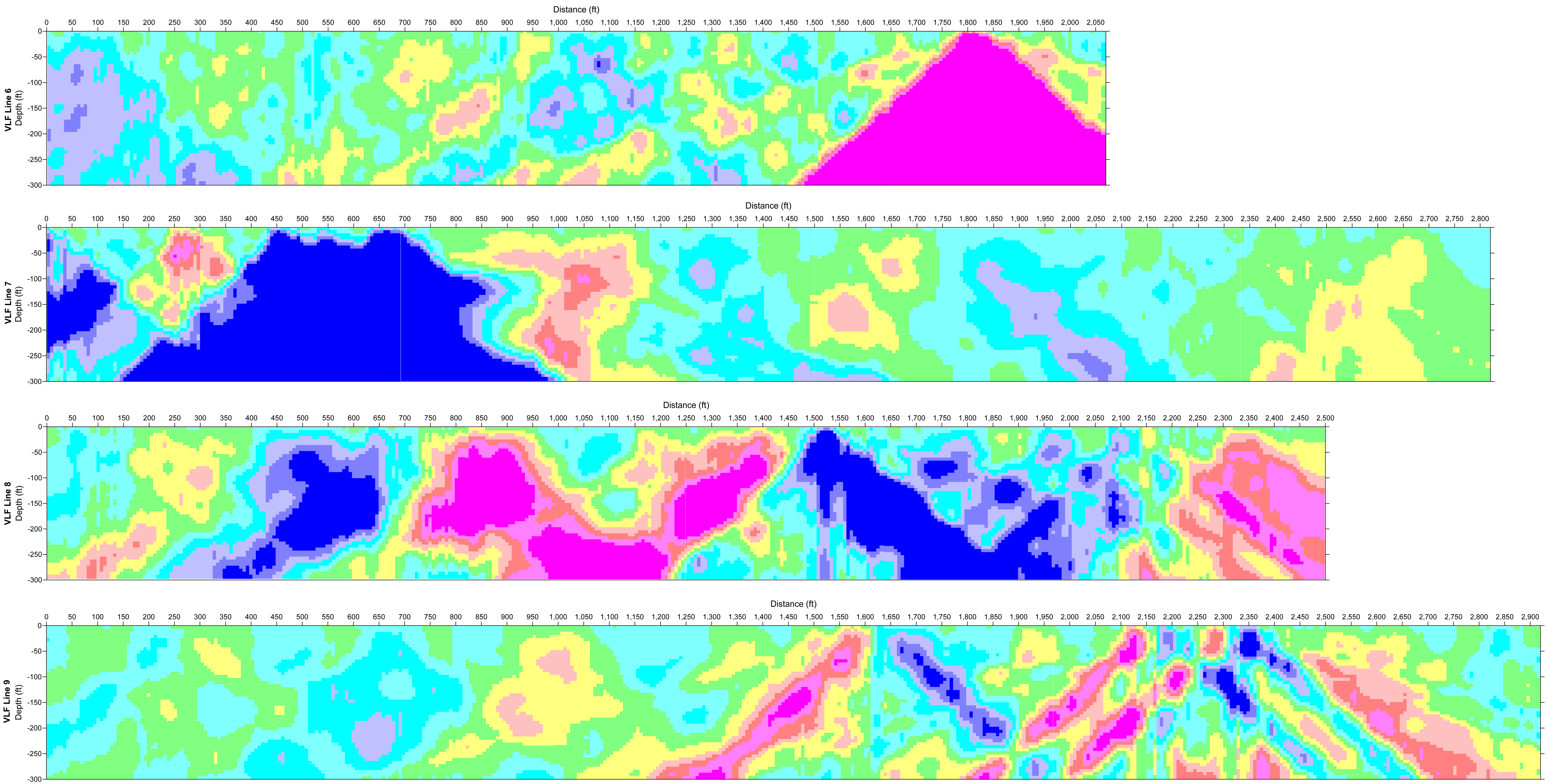
PROJECT: Geophysical Investigation
Luck Stone Corporation
Tombo Site
Winnsboro, South Carolina

DRAWING NO.: Figure 4
SW-NE VLF Line 3

PREPARED FOR: S&ME

PROJECT NO.: 459-10551

SHEET TITLE: DWG10551F4



Notes

Geophysical survey conducted February 1-6, 2021 using ABEM WADI VLF meter.

No vertical exaggeration
Horizontal scale 1" = 100'
Vertical Scale 1" =100'

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DRN	PJH	2/3/21
DES	PJH	2/3/21
CHK	MLT	2/12/21
REV		
PROJ. MGR.	ARB	2/12/21
SCALE:	1" = 100'	
SOURCE:		

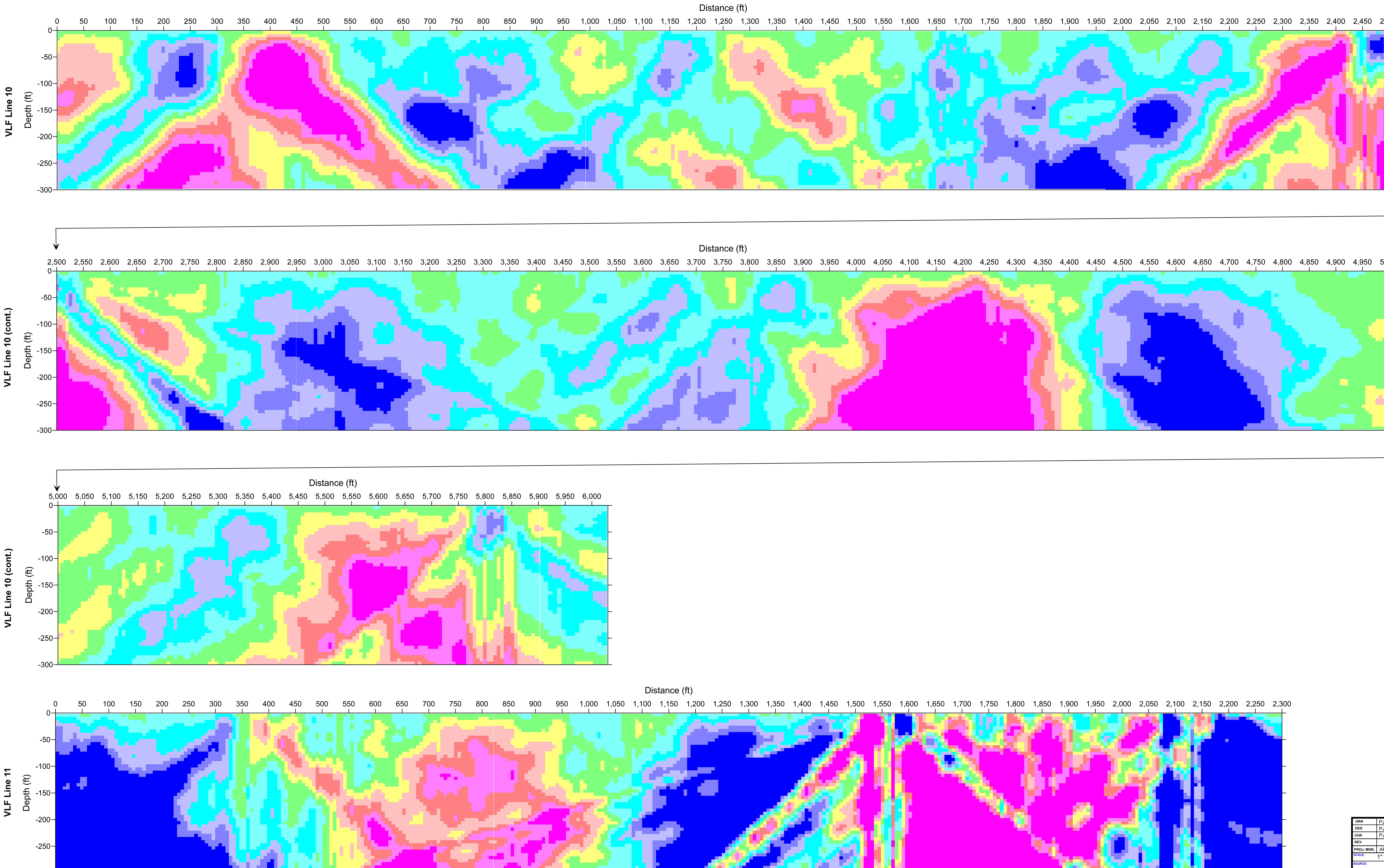
PROJECT: Geophysical Investigation
Luck Stone Corporation
Tombo Site
Winnsboro, South Carolina

DRAWING NO.: Figure 5
NW-SE VLF Profiles 6, 7, 8 and 9

PREPARED FOR: S&ME

PROJECT NO.: 459-10551

SHEET TITLE: DWG10551F5



Notes

Geophysical survey conducted February 1-6, 2021 using ABEM WADI VLF meter.

No vertical exaggeration
Horizontal scale 1" = 100'
Vertical Scale 1" =100'

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DRN	PJH	2/4/21
DES	PJH	2/4/21
CHK	PJH	2/4/21
REV		
PROJ. MGR.	ARB	2/4/21

SCALE: 1" = 100'
SOURCE:

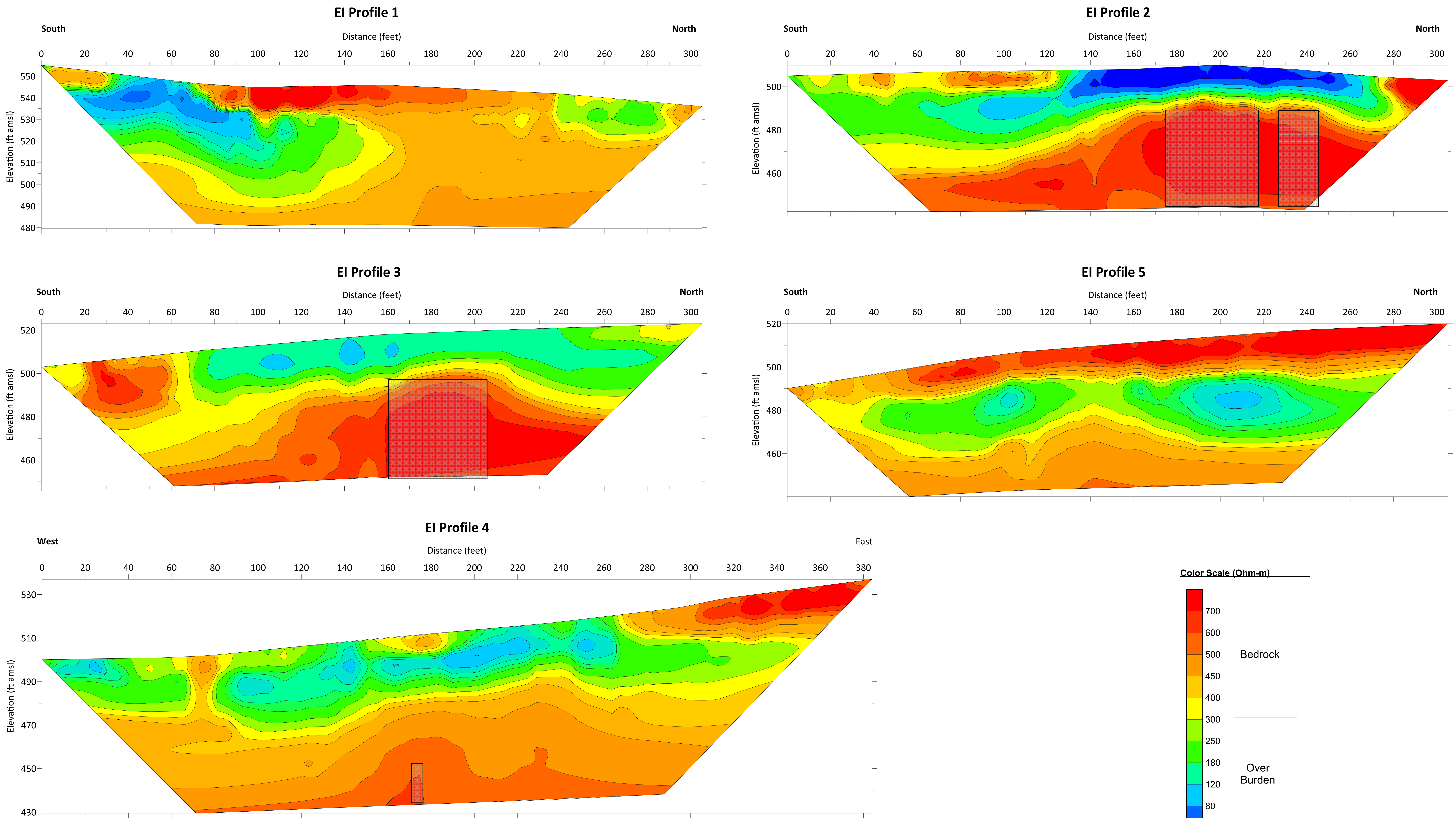
PROJECT: Geophysical Investigation
Luck Stone Corporation
Tombo Site
Winnsboro, South Carolina

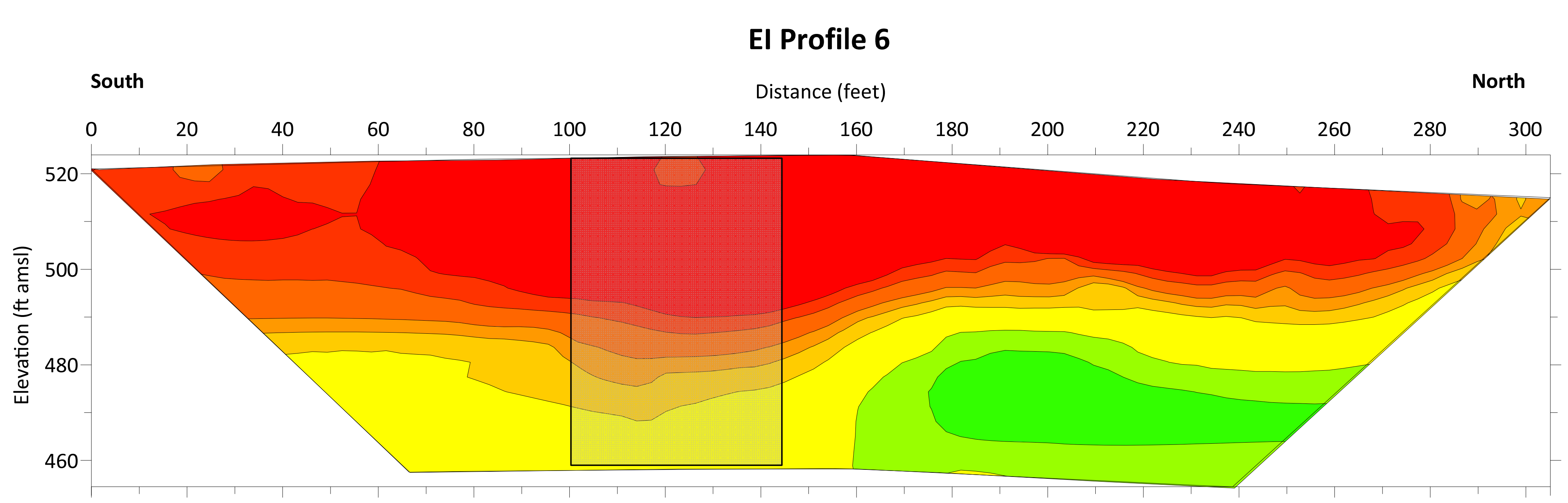
DRAWING NO.: Figure 6
NW-SE VLF Profiles 10 and 11

PREPARED FOR: S&ME

PROJECT NO.: 459-10551

SHEET TITLE: DWG10551F6





Legend

Approximate Location of a diabase dike

Notes

Geophysical survey conducted February 1-6, 2021 using GF Instruments ARES II electrical resistivity meter with active multi-electrode cable sections.

No vertical exaggeration
Horizontal scale 1" = 30'
Vertical Scale 1" =30'

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DRN	PJH	2/4/21
DES	PJH	2/4/21
CHK	MLT	2/12/21
REV		
PROJ. MGR.	ARB	2/12/21

SCALE: 1" = 100'

SOURCE:

PROJECT: Geophysical Investigation
Luck Stone Corporation
Tombo Site
Winnsboro, South Carolina

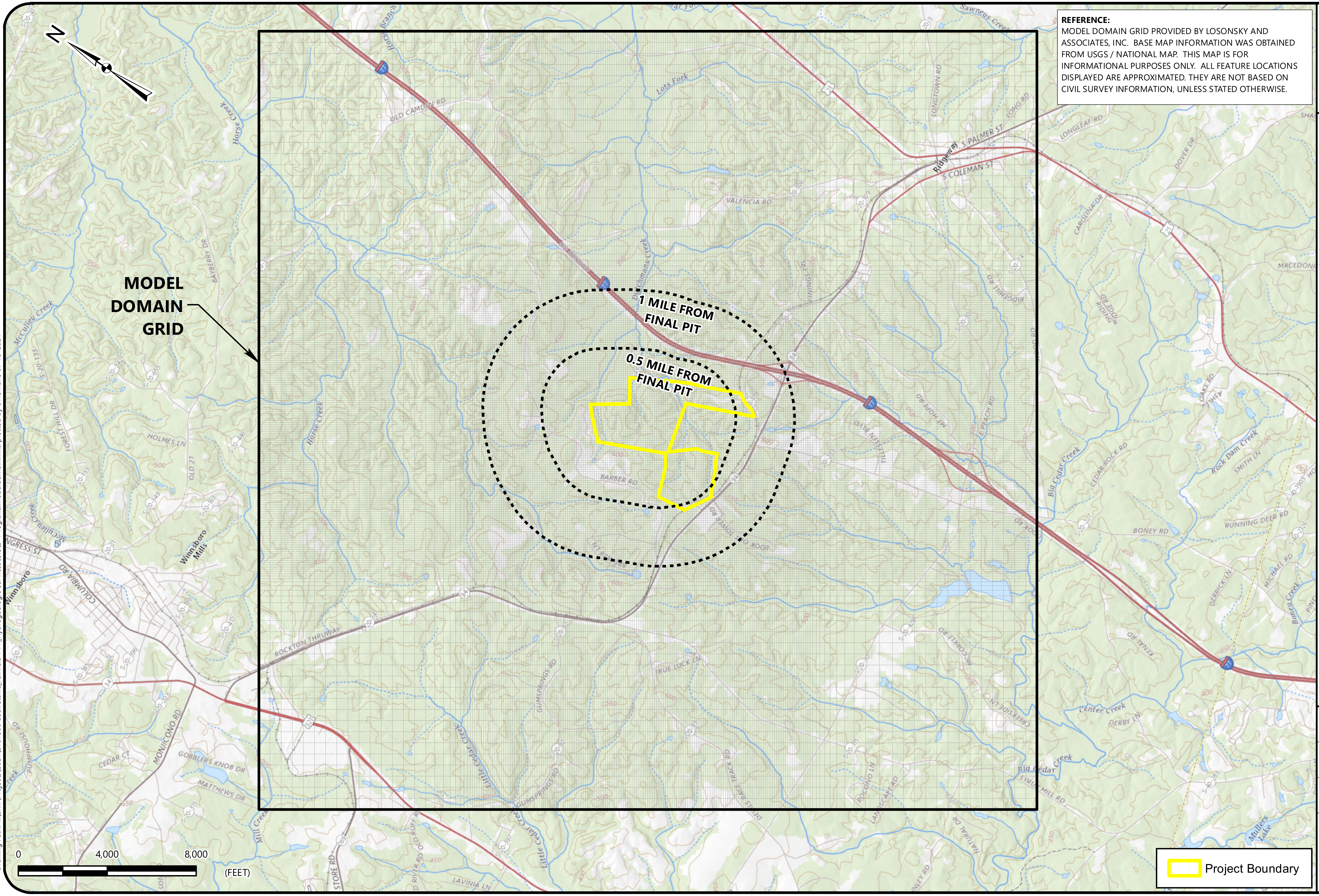
DRAWING NO.: Figure 7
Electrical Imaging Profiles

PREPARED FOR: S&ME

PROJECT NO.: 459-10551

SHEET TITLE: DWG10551F7

Appendix III – Model Grid Map and Ground Model Charts



REFERENCE:
MODEL DOMAIN GRID PROVIDED BY LOSONSKY AND ASSOCIATES, INC. BASE MAP INFORMATION WAS OBTAINED FROM USGS / NATIONAL MAP. THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.

REGIONAL MODEL GRID MAP

GROUNDWATER MODELING REPORT
FAIRFIELD I-77 DEVELOPMENT SITE
RIDGEWAY, FAIRFIELD COUNTY, SOUTH CAROLINA

SCALE: 1 " = 4,000 '

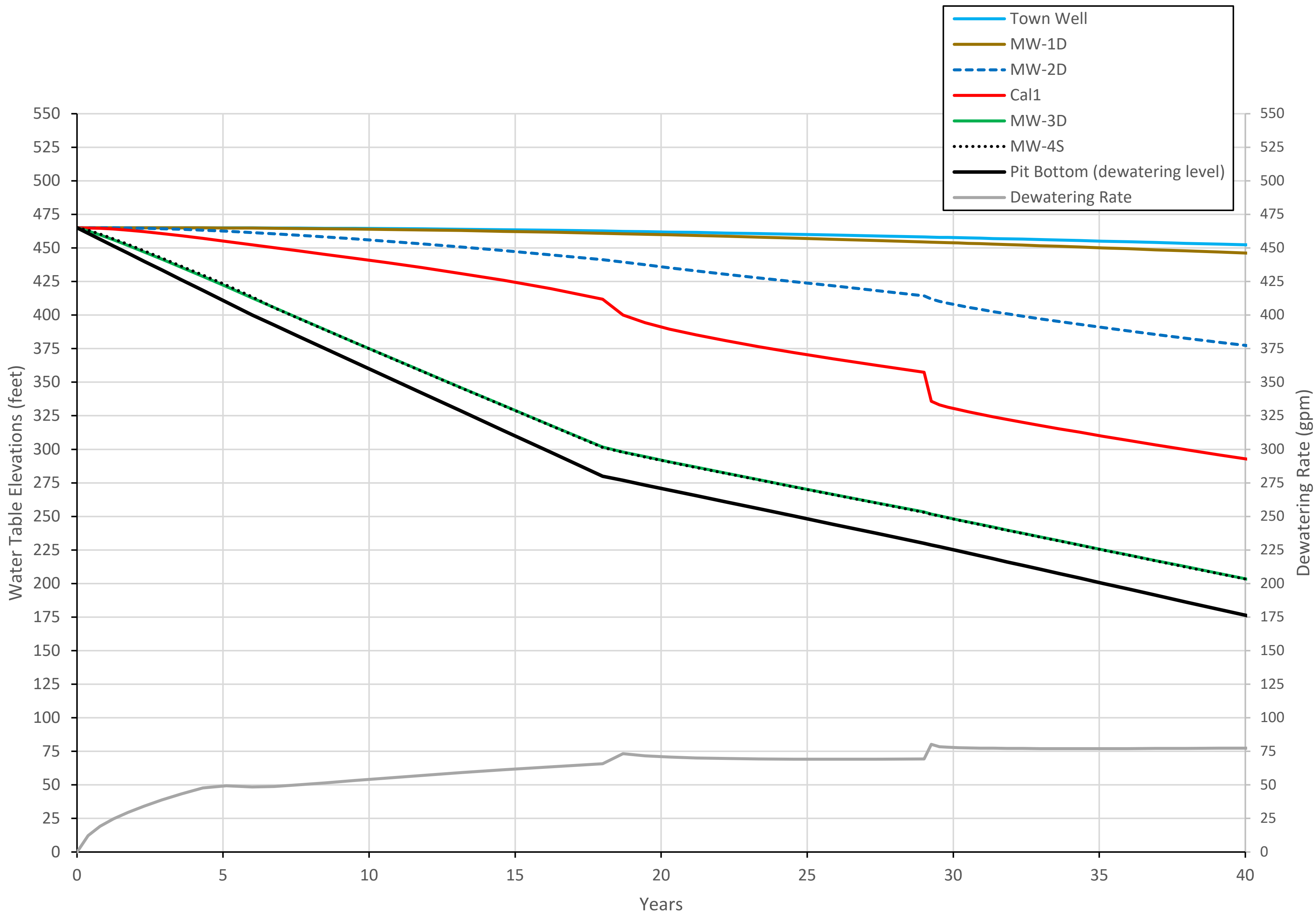
DATE: 7-15-21

PROJECT NUMBER: 210730B

FIGURE NO. **5-1**

Drawing Path: T:\ENV\Projects\2021\210730B Luck Stone_Fairfield I-77_Hydrogeologic Services\GIS\5-1-regionalmodeldomain.mxd plotted by DHomans 07-15-2021

Figure 5-2. Fairfield - Groundwater model simulation for scenario "an25". (Elevations & Rate)



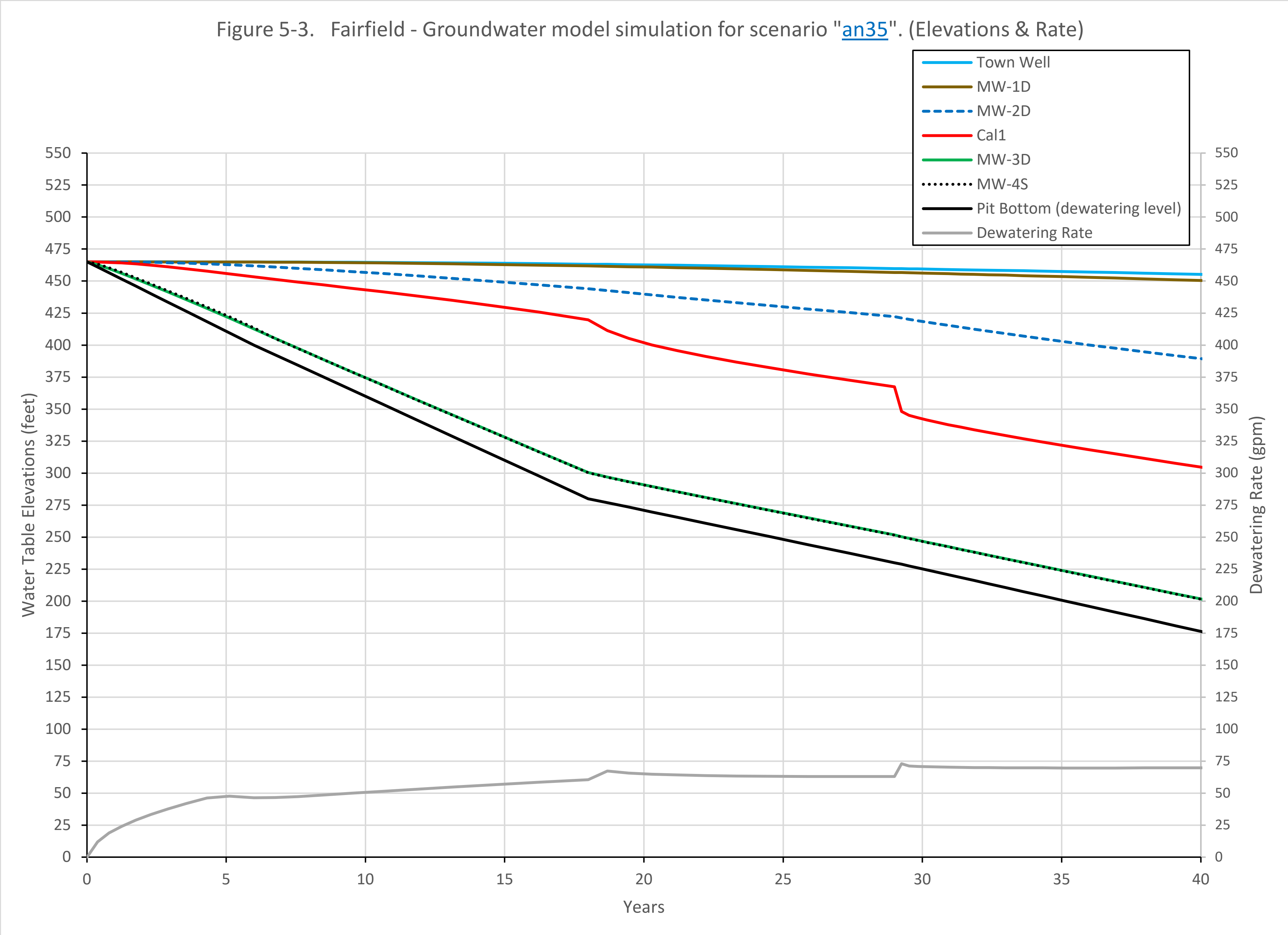


Figure 5-3. Fairfield - Groundwater model simulation for scenario "an35". (Elevations & Rate)
Town Well
MW-1D
MW-2D
Cal1
MW-3D
MW-4S
Pit Bottom (dewatering level)
Dewatering Rate
Water Table Elevations (feet)
Dewatering Rate (gpm)
Years
0
5
10
15
20
25
30
35
40
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
375
400
425
450
475
500
525
550

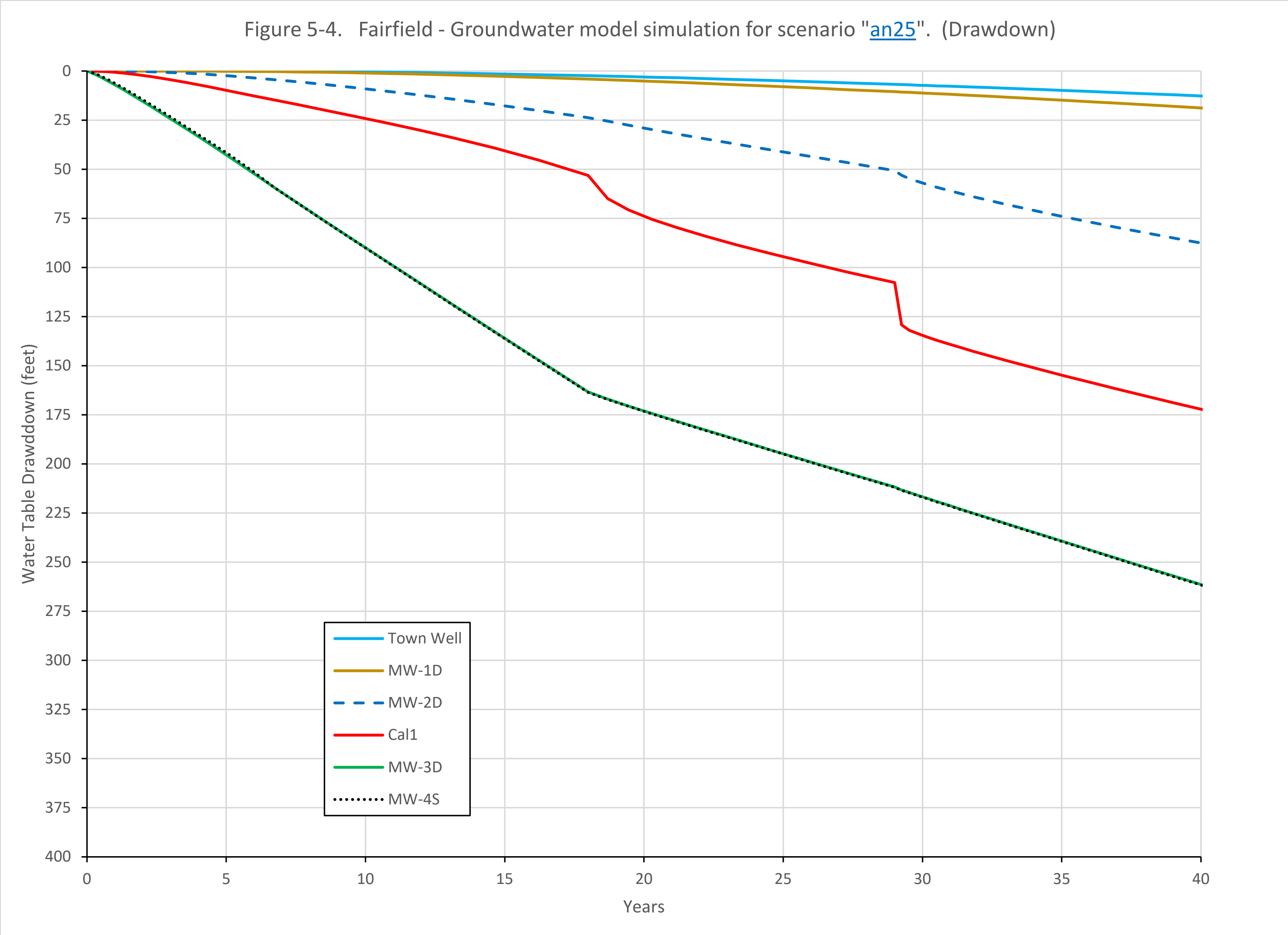


Figure 5-4. Fairfield - Groundwater model simulation for scenario "an25". (Drawdown)
Water Table Drawddown (feet)
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
375
400
0
5
10
15
20
25
30
35
40
Years
Town Well
MW-1D
MW-2D
Cal1
MW-3D
MW-4S

Figure 5-5. Fairfield - Groundwater model simulation for scenario "an35". (Drawdown)