Executive Summary

THG Geophysics, Ltd. (THG) completed a utility clearance survey for the proposed Swift Current Energy meteorological tower site in McKean County, Pennsylvania on September 29–30, 2025. The survey covered a 300-foot buffer around the tower location using magnetic, electromagnetic, ground penetrating radar (GPR), and conventional utility locating methods.

The results identified a single shallow metallic anomaly interpreted as an abandoned pipe segment at approximately 1 foot below grade. The anomaly trends northeast–southwest, matches the extent located with passive and induction line locators, and terminates before crossing the access road. This feature was marked in the field with pink survey flags. No vertical well casings, active utilities, or other conflicting infrastructure were detected within the survey area.

The staked tower location is considered clear of active or conflicting utilities.

October 3, 2025

Joey Shannon
Senior Director, Development
Swift Current Energy
510 Bering Drive, Suite 300
Houston, TX 77057
(832) 985-3288

Re: Geophysical Investigation
Met Tower Installation
McKean County, Pennsylvania
THG Project No. 1541-12350

Dear Mr. Shannon:

THG Geophysics, Ltd. (THG) conducted a geophysical investigation at the proposed Swift Current Energy meteorological (met) tower site in McKean County, Pennsylvania on September 29-30, 2025 (**Figure 1**). The objective of this survey was to provide utility clearance within a 300-foot buffer around the proposed tower location and to evaluate the area for the presence of abandoned infrastructure. The scope of work included the use of magnetometer gradiometry, frequency-domain electromagnetic terrain conductivity mapping (TCM), ground penetrating radar (GPR), and traditional active and passive line locators. These complementary methods are capable of detecting buried metallic utilities, abandoned pipe segments, and other cultural features that may pose conflicts with proposed tower installation.

The met tower site is located on a wooded ridge accessed by existing oil and gas/logging roads, adjacent to a small clearing where unrelated excavation activities were observed. Surficial geology is mapped as the Pottsville Formation of Pennsylvanian age, consisting predominantly of gray sandstone and conglomerate with incidental shale, claystone, limestone, and coal beds (Miles, 2001). These materials form a generally resistive background for geophysical surveys, with low natural conductivity and favorable conditions for locating shallow metallic infrastructure.

Geophysical Methods

Traditional Utility Locating Equipment

Passive radio and 60 Hz line locating was conducted across the survey area to identify grounded metallic conductors carrying stray radio or electrical signals. Intermittent responses were noted along the anomaly corridor when operating in passive radio mode. To confirm the extent of this response, an induction transmitter was deployed, producing the same traceable extent as observed in passive radio.

Active frequency locating methods were also available, where a transmitter can be directly connected to metallic utilities, tracer wires, or a traceable rodder inserted into a conduit or drain line. Once connected, the induced frequency can be traced with a receiver. These complementary methods allow buried metallic utilities and other conductors to be identified and marked in the field in real time (**Figure 2**).

Magnetic Gradiometer Survey

A GEM Systems GSM-19GW v.7.0 Overhauser gradiometer was used to detect subsurface ferrous metal that affects the Earth's magnetic field (**Figure 3**). The instrument measures the difference in total magnetic field between two identical sensors separated by one (1) meter, producing results in nanoteslas per meter (nT/m). This differential setup emphasizes anomalies from shallow metallic objects while reducing background noise from long-wavelength regional variations (Reynolds, 1997).

An advantage of the gradiometer configuration is that both sensors operate simultaneously, eliminating the need for diurnal correction and improving sensitivity to small, near-surface features such as buried pipes or utilities. Magnetic gradient mapping is therefore well suited for utility clearance surveys where shallow targets are the primary concern.

Terrain Conductivity Mapping

Terrain conductivity mapping (TCM) measures the electrical conductivity of subsurface soils, rock, and groundwater. Conductivity (or its inverse, resistivity) is influenced by porosity, permeability, and fluid content in the pore spaces (McNeill, 1980). Although absolute conductivity values are not necessarily diagnostic, variations in conductivity and the companion in-phase response are effective for identifying buried anomalies such as utilities or metallic infrastructure (Benson et al., 1988).

For this survey, THG used a GF Instruments CMD-Explorer in high-mode configuration to map terrain conductivity (**Figure 4**). The system consists of a transmitter coil that radiates an electromagnetic field, which induces eddy currents in the ground. These currents generate a secondary field that is recorded by the receiver and separated into two outputs: the quadrature (conductivity) component measured in milliSiemens per meter (mS/m), and the in-phase component measured in parts per thousand (ppt). The conductivity channel provides a measure of bulk soil properties, while the in-phase channel is highly responsive to shallow buried metallic objects (McQuown et al., 1991).

The effective depth of investigation depends on the coil spacing, with penetration extending to roughly 1.5 times the distance between transmitter and receiver. The CMD-Explorer provides three coil spacings with effective depths of approximately 7, 14, and 22 feet below grade. Each measurement represents an average across its respective “skin depth,” but collectively these depths provide qualitative insight into how conductivity varies with depth across the site.

Ground Penetrating Radar

GPR uses high-frequency radio waves to image subsurface features (Annan and Cosway, 1992). A transmitting antenna emits short radar pulses into the ground, and reflected signals are recorded by a receiving antenna and displayed as radargrams. Subsurface contrasts in dielectric properties, such as changes between soil and rock, or between native materials and buried metallic objects, produce visible reflections.

The frequency of the GPR antenna determines both resolution and penetration depth. High-frequency antennas provide finer detail but shallower penetration, while lower-frequency antennas penetrate deeper at lower resolution. Signal penetration is also reduced in electrically conductive soils such as clays, which can attenuate radar energy.

Depth estimates on radargrams are based on the two-way travel time of the radar pulse and the assumed velocity of radar waves in the ground. Velocity is influenced by the dielectric properties and moisture content of the soils. Unless direct ground-truth information is available, velocity values are assumed from published ranges appropriate for the local geologic conditions.

For this survey, THG collected GPR data across accessible portions of the site and over areas of interest identified in the magnetic and conductivity results (**Figure 5**). A Sensors & Software Noggin system equipped with a 250 MHz antenna was used. Penetration depth varied with ground conditions, but generally ranged from about 7 to 10 feet below grade.

Discussion

The integrated utility clearance survey at the Swift Current Energy met tower site combined traditional line locating, magnetic gradiometry, TCM, and GPR to evaluate a 300-foot buffer around the proposed tower location (**Figure 2**). Background conditions were generally favorable: the Pottsville Formation at shallow depth is dominated by sandstone and conglomerate, which provide a resistive, low-conductivity matrix that reduces background noise in both the magnetic and electromagnetic methods. Traditional passive radio and 60 Hz line locating was completed across the site, with intermittent passive radio hits recorded along a corridor crossing the survey area. Deployment of an induction transmitter at this location produced the same traceable extent, confirming a localized linear response (magenta line, **Figure 2**).

The magnetic gradiometer survey identified a well-defined linear anomaly trending northeast–southwest across the central portion of the buffer, matching with the feature located with passive locators (**Figure 3**). The anomaly is expressed as a paired positive/negative gradient typical of shallow ferrous metallic pipe at a depth of approximately 1 foot. A semi-circular ring pattern east of the anomaly was noted in the interpolated grid; this is an artifact of the broad line spacing and interpolation, not a circular magnetic anomaly of the type normally associated with vertical well casings. The gradiometer data show the anomaly terminating toward the southwest, with no evidence of extension across the full grid.

TCM data provides further support for the presence of the shallow metallic feature (**Figure 4**). Conductivity data for an effective depth of 7 feet shows a pronounced negative corridor aligned with the magnetic anomaly, consistent with electromagnetic coupling to a metallic pipe. Occasional small negative responses elsewhere were attributed to instrument tilt while navigating dense brush and to air coupling, but these are isolated and not linear. Conductivity data for effective depths of 14 feet below grade and deeper show low and uniform conductivity values, consistent with the dry, resistive soils expected in this geologic setting. These deeper data confirm that the anomaly in shallower data is not a soil-related lithologic effect but a response to a cultural metallic feature.

GPR was collected along three profiles across the anomaly corridor (**Figure 5**). Line 1, oriented along the access road, includes a shallow point hyperbola interpreted as a boulder off alignment, while the expected corridor area did not display strong hyperbolas in the sample portion shown (green box, **Figure 5**). Line 2 provided the clearest radar image of the anomaly, showing a shallow hyperbola at approximately 1 foot below grade consistent with the metallic pipe mapped in the magnetic and TCM data. Line 3 also imaged a shallow target at a similar depth directly along the alignment, indicating that the pipe continues through this location. These results support interpretation of a short, shallow metallic pipe segment trending northeast–southwest across the survey area, with a distinct termination before crossing the access road.

Conclusion

The utility clearance survey at the Swift Current Energy met tower site integrated line locating, magnetic gradiometry, terrain conductivity mapping, and GPR to evaluate a 300-foot buffer around the proposed tower location. The combined results identified a single shallow metallic anomaly interpreted as an abandoned pipe segment at approximately 1 foot below grade. The anomaly trends northeast–southwest, matches the traceable extent identified with passive and induction locators, and terminates before crossing the access road. No evidence of vertical well casings, additional utilities, or other subsurface infrastructure was identified within the surveyed buffer. The following locations were marked in the field with pink survey flagging:

East Longitude (°)	North Latitude (°)	Field Note/Interpretation
–78.31468195	41.71626289	Radio Hit
–78.31468968	41.71625307	GPR hyperbola, ~1 ft depth
–78.31467112	41.71627836	Radio Hit
–78.31464445	41.71631415	Radio Hit
–78.31461893	41.71633992	Radio Hit
–78.31456331	41.71639699	Radio Hit
–78.31470750	41.71621762	Radio Hit

Should you have any questions or require additional information, please contact our office at (724) 325-3996 or via e-mail axb@thggeophysics.com.

Respectfully,
THG Geophysics, Ltd.

Alex Balog
Lead Geophysicist

Enclosures

Geophysical investigations are a non-invasive method of interpreting physical properties of the shallow earth using electrical, electromagnetic, or mechanical energy. This document contains geophysical interpretations of responses to induced or real-world phenomena. As such, the measured phenomenon may be impacted by variables not readily identified in the field that can result in a false-positive and/or false-negative interpretation. THG makes no representations or warranties as to the accuracy of the interpretations.

References

Annan, A. P. & W. Cosway (1992), Ground Penetrating Radar Survey Design, Symposium on the Application of Geophysics to Engineering and Environmental Problems. January, 1992. Pp. 329-351.

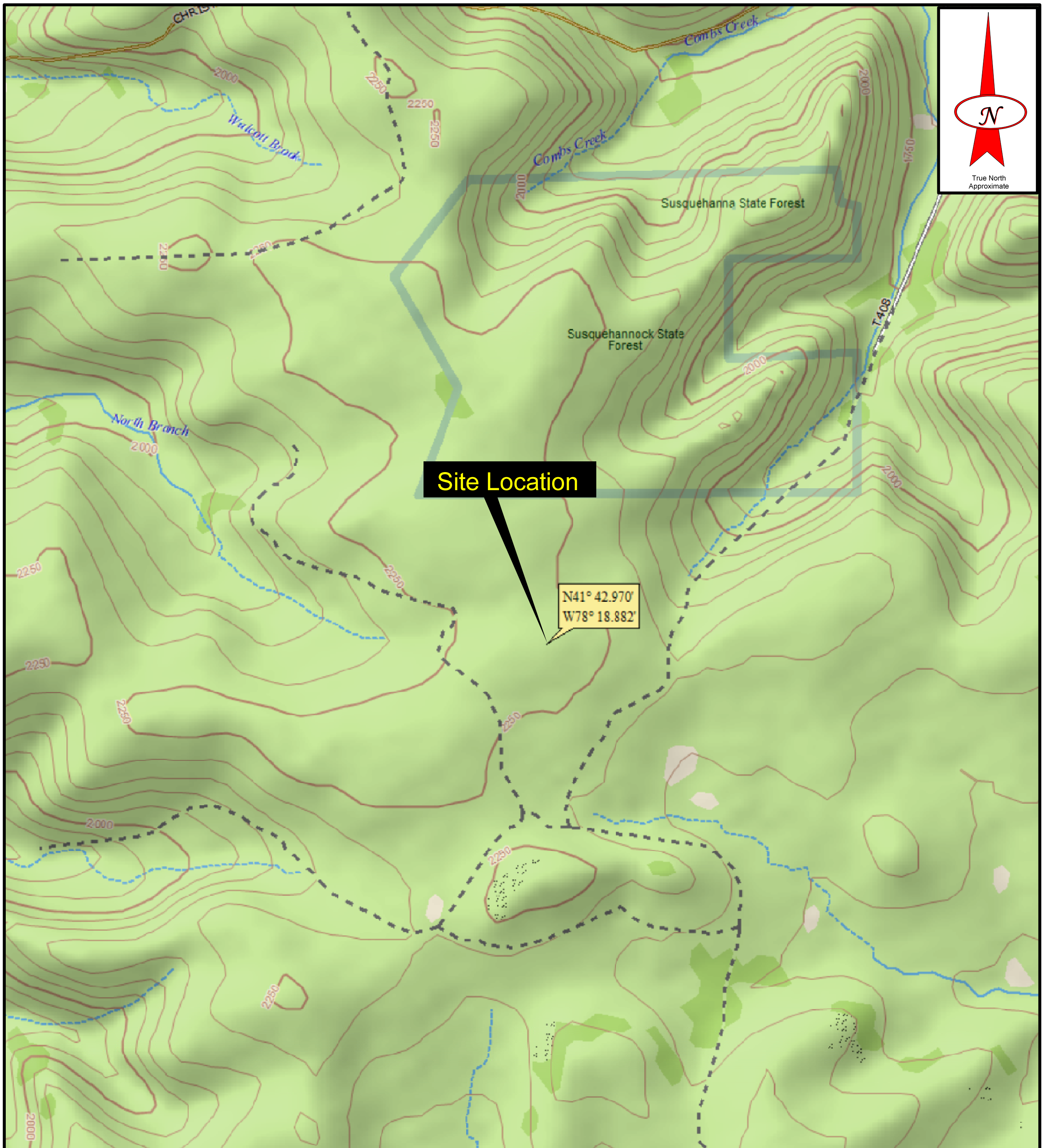
Benson, R., R. A. Glaccum and M. R. Noel. (1988). Geophysical Techniques for Sensing Buried Wastes and Waste Migration. National Water Well Association Dublin, OH, 236 pp.

McNeill, J. D. (1980). Electromagnetic terrain conductivity measurement at low induction numbers. Geonics Limited. Technical Note. TN-6. 1-15 pp.

McQuown, M. S., S. R. Becker and P. T. Miller. (1991). Subsurface characterization of a landfill using integrated geophysical techniques. In, Proceedings of the Fifth National Outdoor Action Conference on Aquifer Restoration, Ground Water Monitoring and Geophysical Methods, May 13-16, 1991. ed. Pp. 933-946. Water Well Journal Publishing Co. Las Vegas.

Miles, C.E., and Whitfield, T.G., compilers, 2001, Pennsylvania Bureau of Topographic and Geologic Survey, Department of Conservation and Natural Resources, Bedrock Geology of Pennsylvania, edition: 1.0, digital map, scale 1:250,000

Reynolds, J. M. (1997). An Introduction to Applied and Environmental Geophysics. Chichester: John Wiley and Sons Ltd. 796p.



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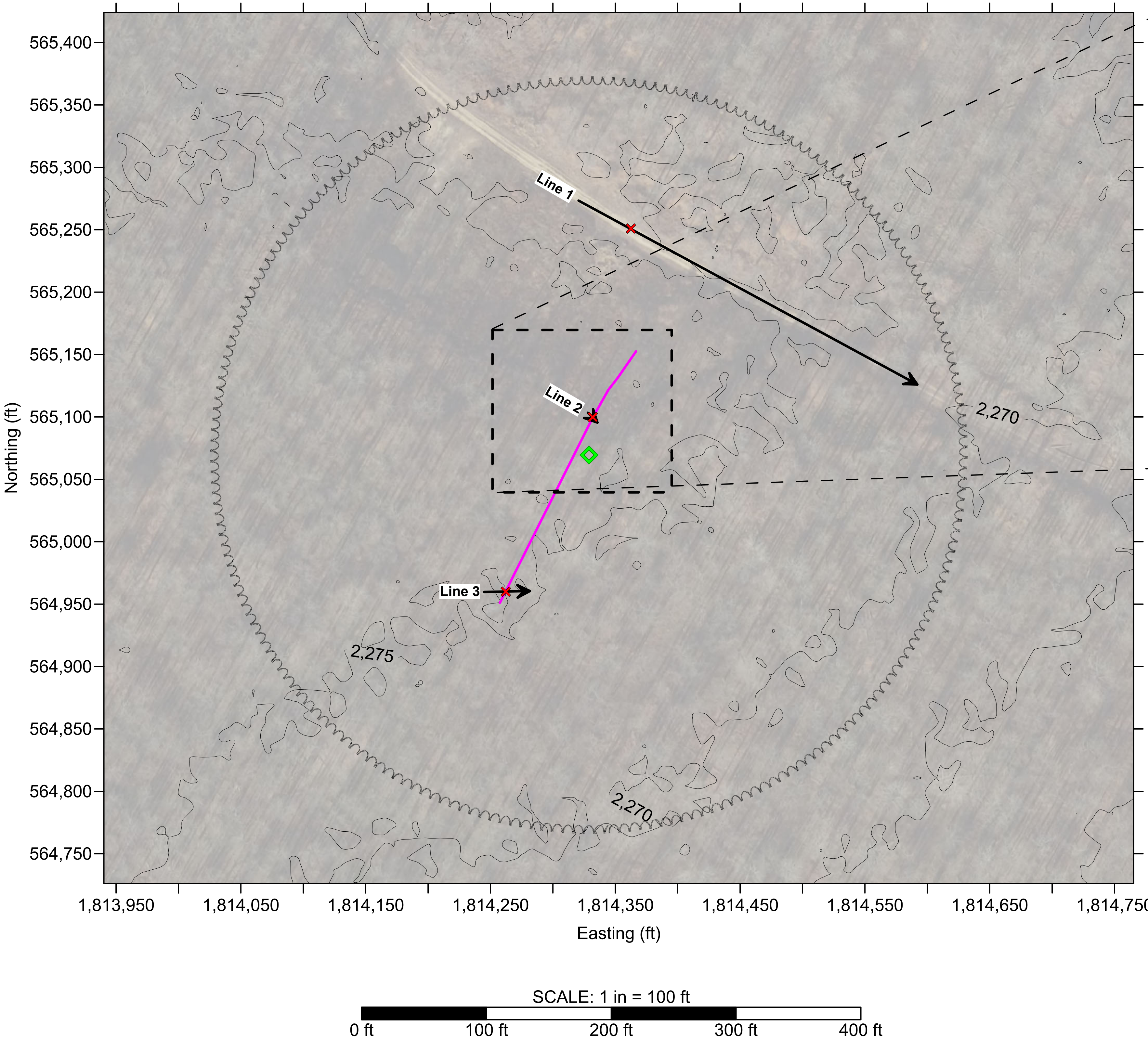
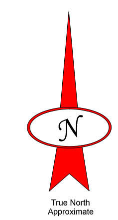
0 ft 1000 ft 2000 ft 3000 ft 4000 ft 5000 ft

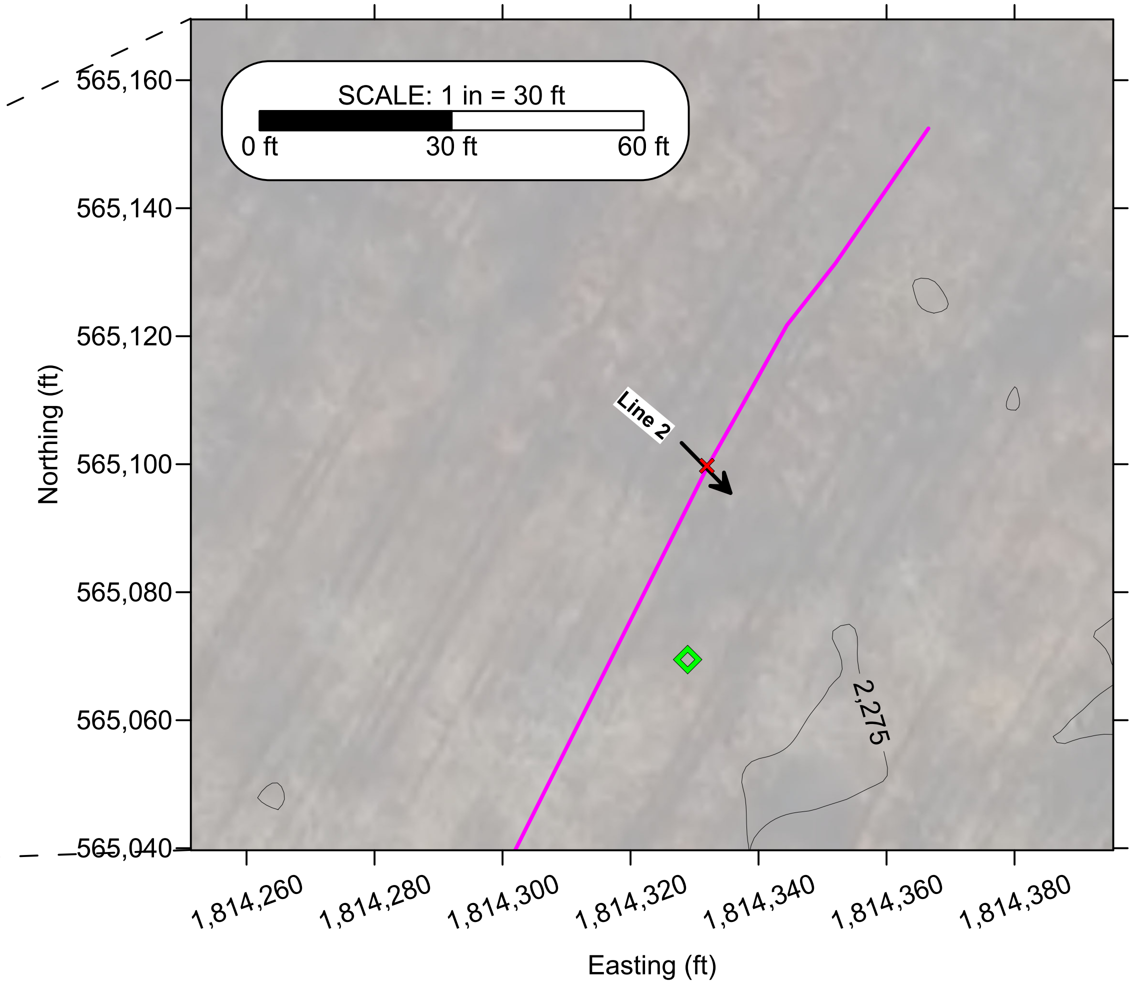
Figure 1
Site Location Map

Geophysical Investigation
Met Tower Installation
McKean County, Pennsylvania

SCALE: 1:24,000	PROJECT NO.: 1541-12350	DRAWING NO.: DWG12350F1
DATE : 10-3-25		
DRAWN BY: AXB	SOURCE: 1971 Norwich (PA) USGS 7.5 Minute Topographic Quadrangle	
CHECKED BY: PJH		







Map Legend

- Proposed Met Tower Location
- Unknown Anomaly - Potential Utility
- Line 1 → GPR Profile
- GPR Point Target Anomaly
- Survey Area - 300' Buffer

Notes

Geophysical investigation conducted September 29–30, 2025 using a GEM Systems GSM-19GW gradiometer, a GF Instruments CMD-Explorer terrain conductivity meter, Sensors & Software Noggin GPR, and conventional utility locating equipment.

Data positioned with a Juniper Geode GPS equipped with ATLAS RTK corrections and referenced to NAD 1983 State Plane Pennsylvania North (FIPS 3701) coordinate system, U.S. Survey feet.

Locations are approximate.

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DRN	AXB	10-3-25
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CHK	KSM	10-3-25
REV		
PROJ. MGR.	AXB	10-3-25

PROJECT:
Geophysical Investigation
Met Tower Installation
McKean County, Pennsylvania

SCALE: 1 in = 100 ft

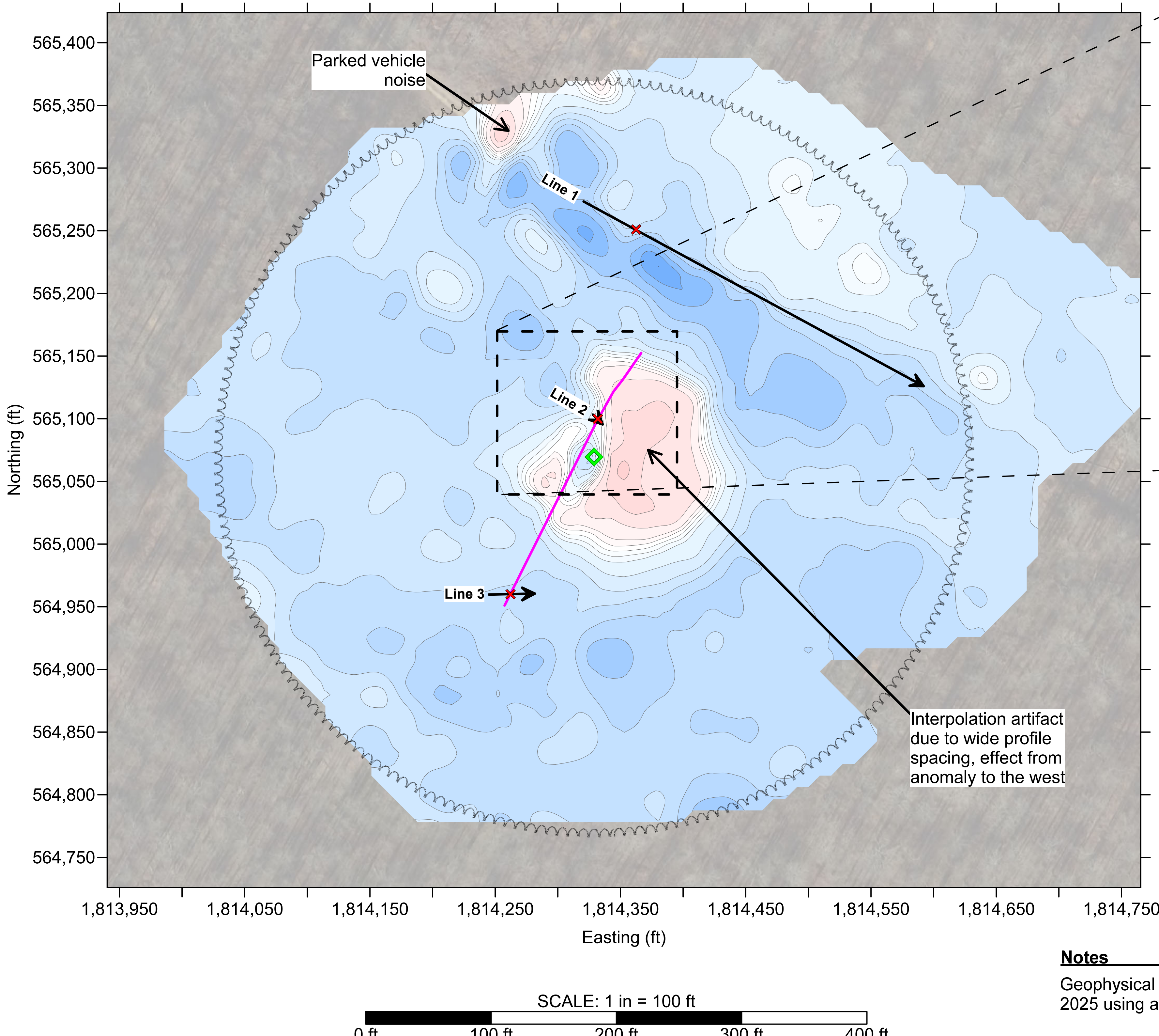
SOURCE: MAXAR Technologies, 2025

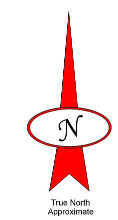
DRAWING NO.:
Figure 2
Site Layout Map

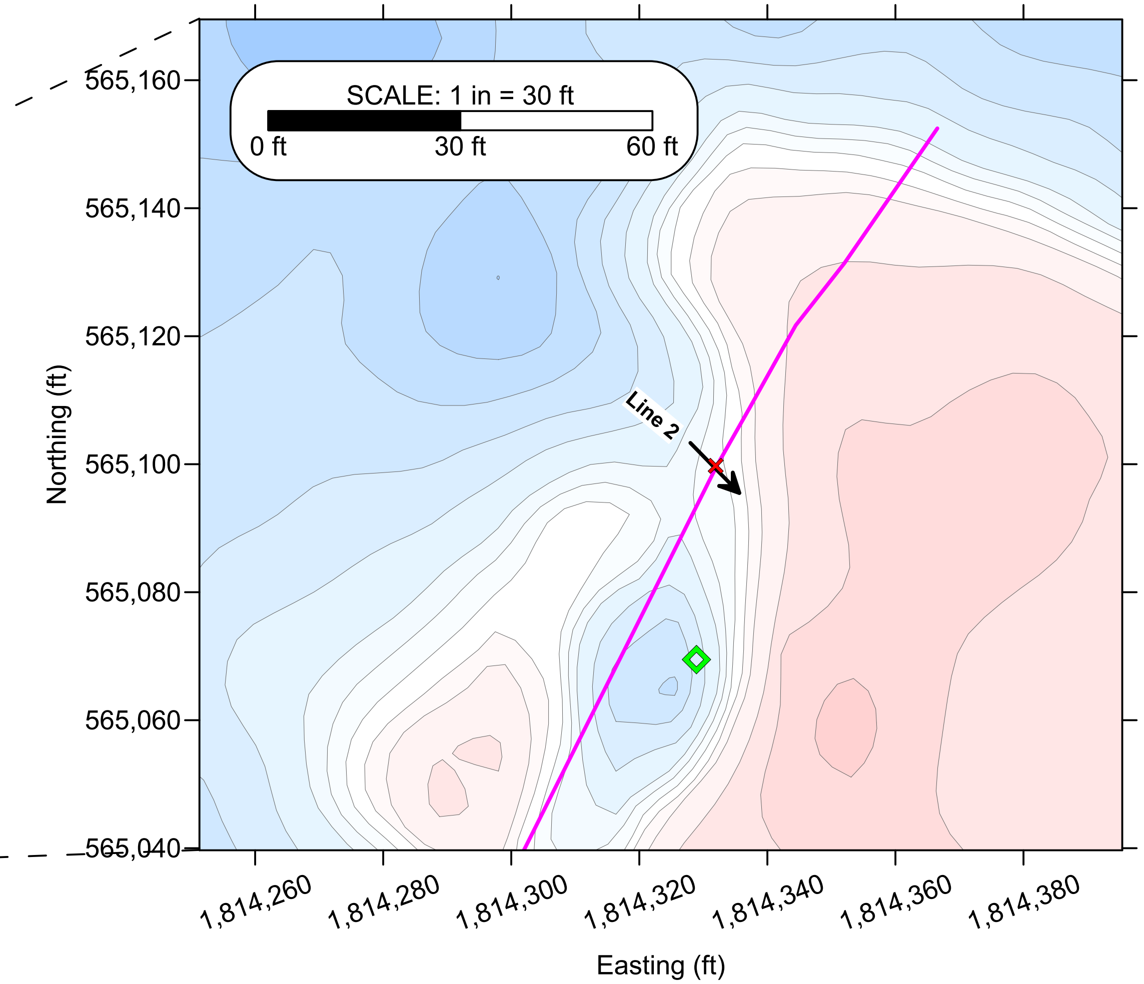
PREPARED FOR: SWIFT CURRENT

PROJECT NO.: 1541-12350

SHEET TITLE: DWG12350F2







Map Legend

Proposed Met Tower Location

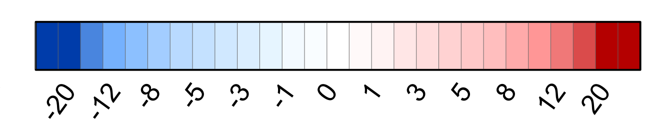
Unknown Anomaly - Potential Utility

Line 1 GPR Profile

GPR Point Target Anomaly

Survey Area - 300' Buffer

Magnetic Gradient Anomaly (nT/m)



Notes

Geophysical investigation conducted September 29–30, 2025 using a GEM Systems GSM-19GW gradiometer.

Data positioned with a Juniper Geode GPS equipped with ATLAS RTK corrections and referenced to NAD 1983 State Plane Pennsylvania North (FIPS 3701) coordinate system, U.S. Survey feet. Locations are approximate.

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McKean County, Pennsylvania

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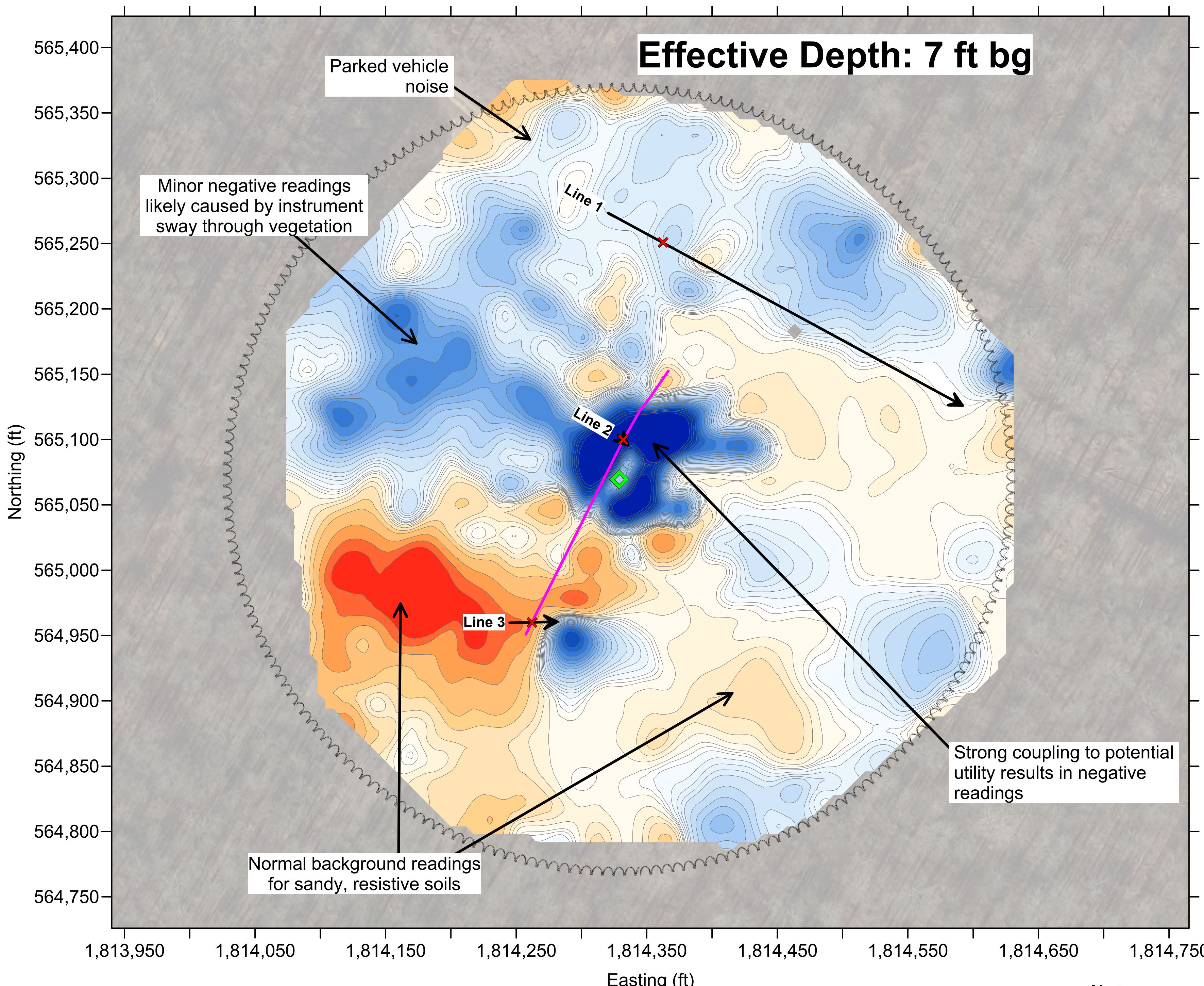
SOURCE: MAXAR Technologies, 2025

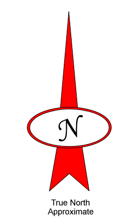
DRAWING NO.:
Figure 3
Magnetic Gradient Anomaly Map

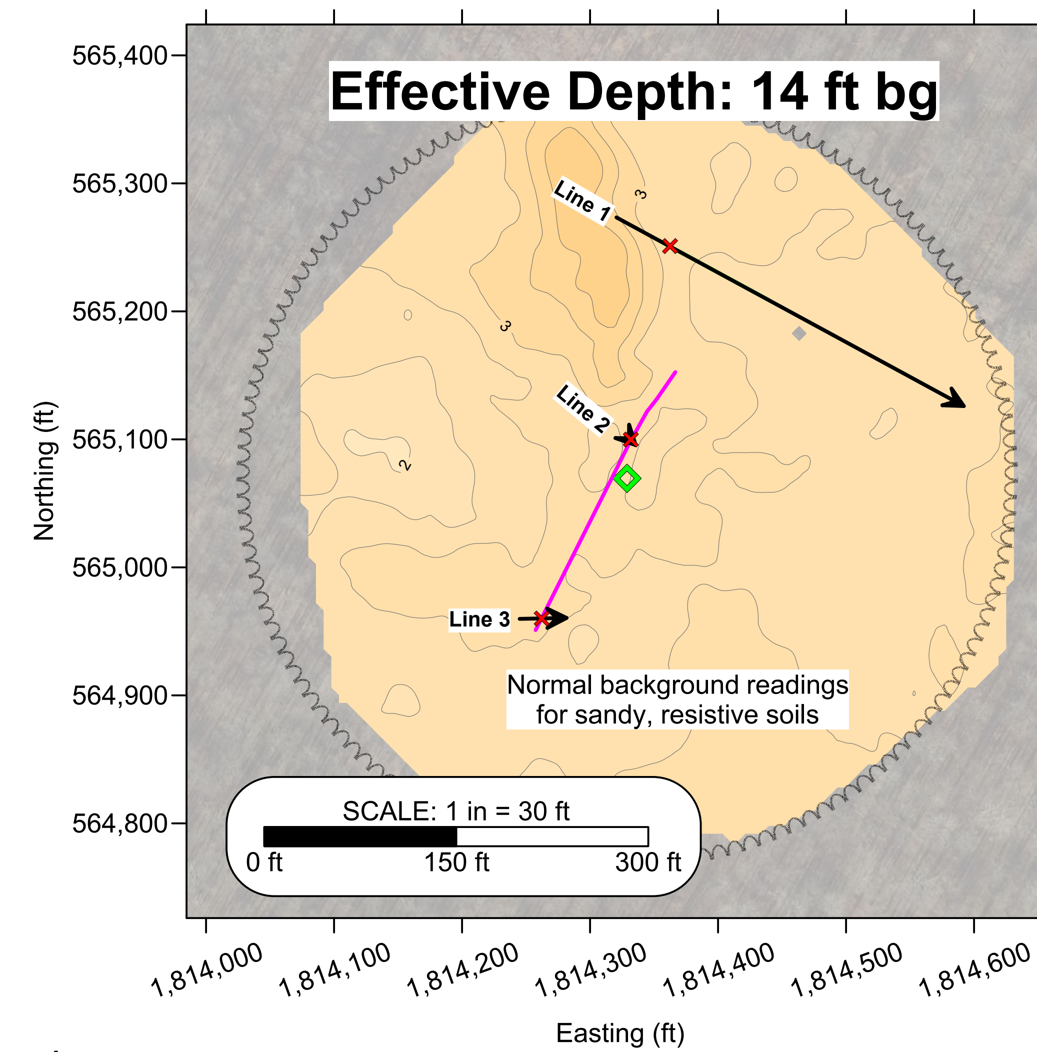
PREPARED FOR: SWIFT CURRENT

PROJECT NO.: 1541-12350

SHEET TITLE: DWG12350F3



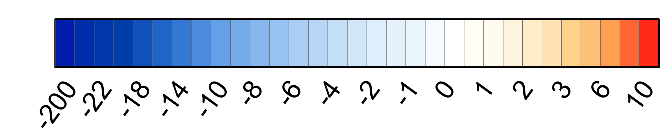




Map Legend

- Proposed Met Tower Location
- Unknown Anomaly - Potential Utility
- Line 1 — GPR Profile
- GPR Point Target Anomaly
- Survey Area - 300' Buffer

Bulk Terrain Conductivity (mS/m)



Notes

Geophysical investigation conducted September 29–30, 2025 using a GF Instruments CMD-Explorer terrain conductivity meter.

Data positioned with a Juniper Geode GPS equipped with ATLAS RTK corrections and referenced to NAD 1983 State Plane Pennsylvania North (FIPS 3701) coordinate system, U.S. Survey feet. Locations are approximate.

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REV		
PROJ. MGR.	AXB	10-3-25

PROJECT: **Geophysical Investigation Met Tower Installation McKean County, Pennsylvania**

SCALE: 1 in = 100 ft

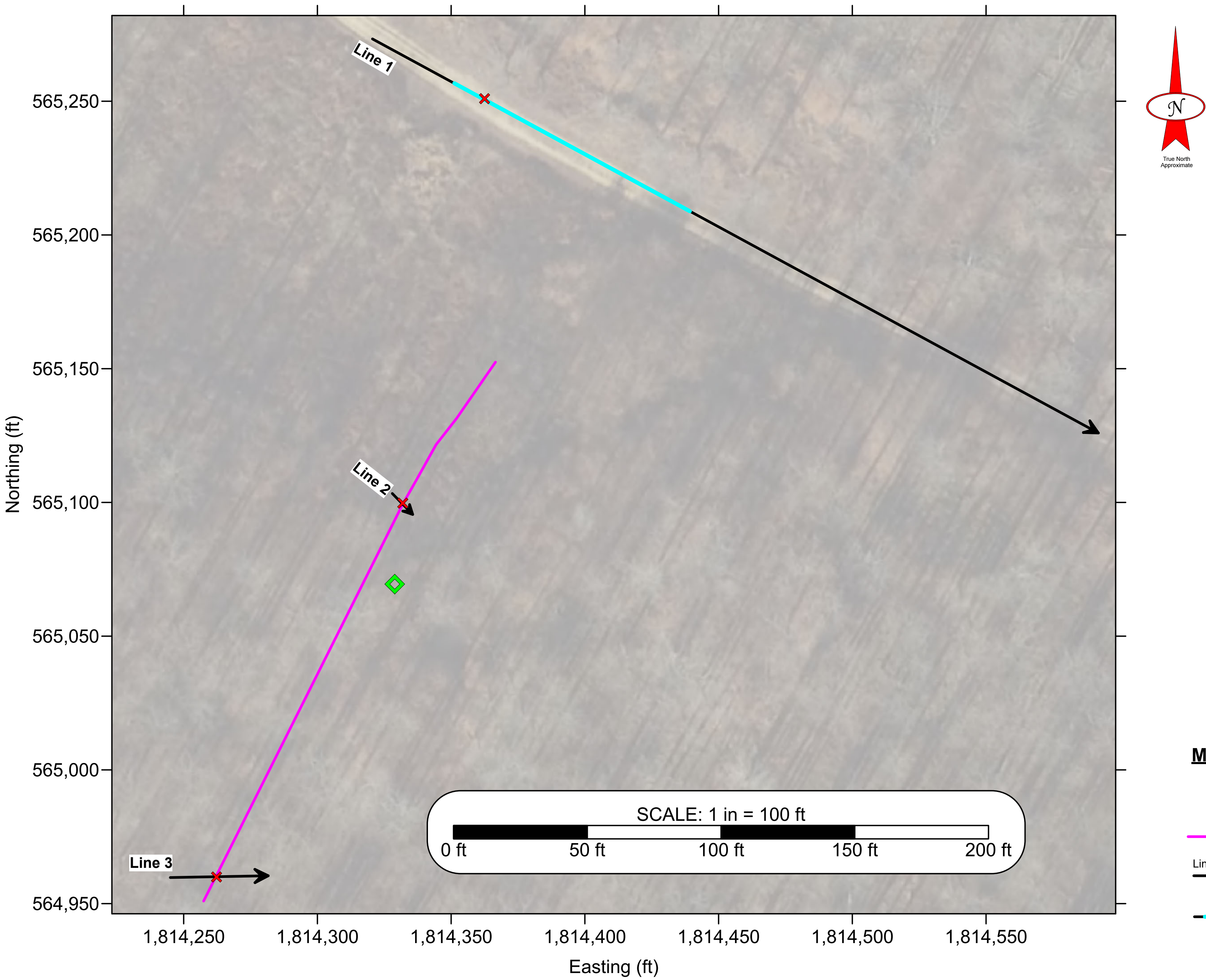
SOURCE: MAXAR Technologies, 2025

DRAWING NO.: **Figure 4** Bulk Terrain Conductivity Map

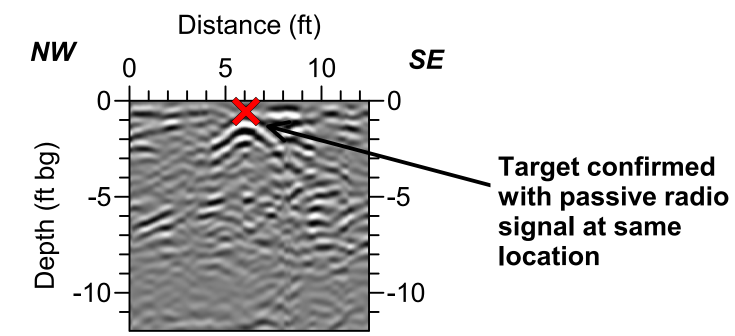
PREPARED FOR: SWIFT CURRENT

PROJECT NO.: 1541-12350

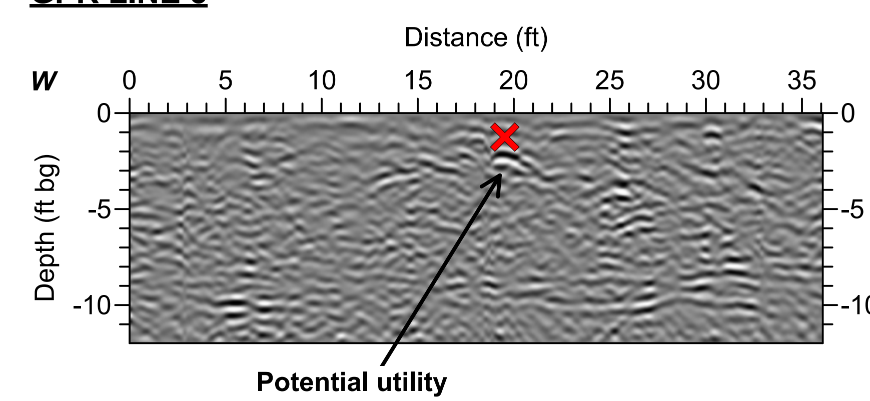
SHEET TITLE: DWG12350F4



GPR LINE 2



GPR LINE 3



Map Legend

Proposed Met Tower Location

Unknown Anomaly - Potential Utility

Line 1 GPR Profile

Sample Portion of GPR Profile

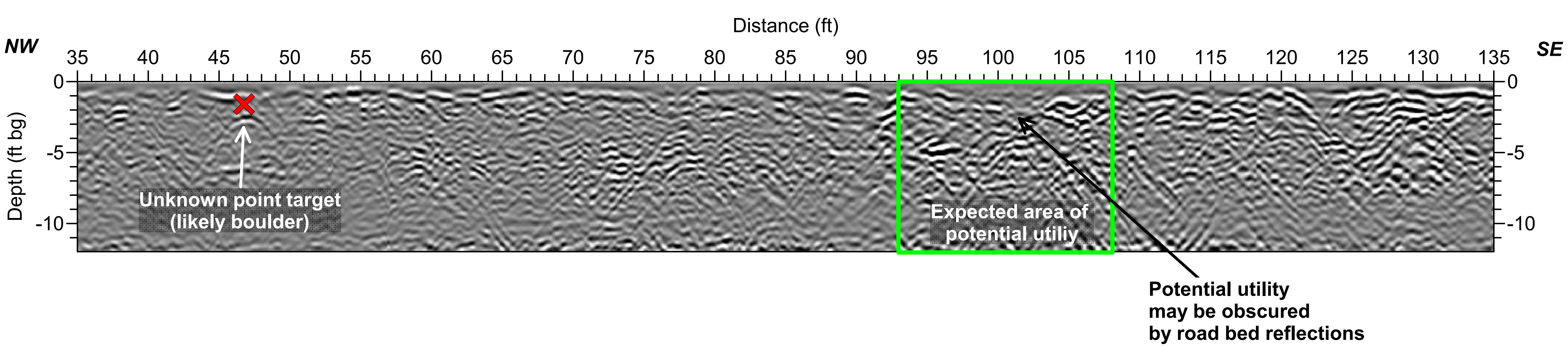
GPR Point Target Anomaly

Notes

Geophysical investigation conducted September 29–30, 2025 using a Sensors & Software Noggin GPR equipped with a 250 MHz antenna.

Data positioned with a Juniper Geode GPS equipped with ATLAS RTK corrections and referenced to NAD 1983 State Plane Pennsylvania North (FIPS 3701) coordinate system, U.S. Survey feet. Locations are approximate.

GPR LINE 1



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Met Tower Installation
McKean County, Pennsylvania

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DRAWING NO.:
Figure 5
Sample GPR Data

SOURCE: MAXAR Technologies, 2025

PREPARED FOR: SWIFT CURRENT

PROJECT NO.: 1541-12350

SHEET TITLE: DWG12350F5