

THRASHER

2019 Tucker County Aerial Triangulation And Ground Control Report

Prepared by:

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The Thrasher Group (TTG) has successfully completed the aerial triangulation (AT) for the countywide spring flight.

Using semi-automatic analytical aerial triangulation procedures, TTG determined the exterior orientation parameters for each exposure in the photography that covers the project area.

The results of the final adjustments are sufficient to enable TTG to photogrammetrically produce orthophotos from the photography. The AT solution ensures that the project data will meet or exceed the accuracy expectation as outlined in the contract.

Ground Control

The ground control network was designed to provide a geometrically strong horizontal and vertical control system within the project area.

Sufficiently identified ground control points (GCPS) were surveyed within the block to provide horizontal and vertical control.

Aerial Photography

Aerial photography for the project was captured between March 20, 2019 and March 28, 2019.

The photography was acquired with an approximate 60 percent overlap and an approximate 30 percent side lap. The flight altitude of the photography was approximately 7,700 feet above mean terrain.

Airborne GPS

Airborne-GPS (ABGPS) data was captured during the acquisition of the aerial photography. An appropriate GPS antenna was mounted on each aircraft used on the project, and the relationship between the antenna phase centers and the camera perspective centers was then determined through close-range survey techniques. Dual frequency, geodetic quality receivers were utilized for the data collection.

The GPS data was post-processed, and the appropriate interpolations, transformations and reductions were applied to derive the camera's spatial position referenced to the World Geodetic System of 1984 (WGS84) at each instant of exposure.

Flight

The flight plan was comprised of 29 flight lines. The designed ground sample distance per pixel was 10 centimeters.

The block consisted of a total of 1,310 images.

A fully equipped aircraft was employed for the photographic mission. In the aircraft, the instrumentation utilized in the acquisition of aerial photography and ABGPS data comprised of a Zeiss DMC III aerial camera featuring forward motion compensation, and a GPS Novatel Span Receiver with a collection rate of one half-second.

During each flight, every exposure triggered by each camera was recorded in the associated GPS data file as an external event. A time stamp for each event later allowed the interpolation of the camera position at each instant or exposure.

Aerial Triangulation

Aerial triangulation is the simultaneous space resection of image rays projected and recorded at one source, the perspective center of the aerial camera. These image rays projected from two or more overlapping images (stereo-models) intersect at the corresponding ground location to determine the three-dimensional coordinates of each point measured. This collection of image rays is fit to known ground survey control in a simultaneous three-dimensional least squares adjustment. After the completion of this adjustment, coordinates of the 'unknown' ground points are derived by the intersection of the adjusted image points.

The aerial triangulation was performed utilizing the ground control and the airborne GPS-assisted techniques. These data are then introduced along with the reduced image coordinates, as observations, into a combined three-dimensional simultaneous least squares adjustment by bundles. This approach allows a substantial reduction in the amount of ground control required for the AT solutions.

The purpose of aerial triangulation is to densify horizontal and vertical control from relatively few ground control points (GCPs). Since obtaining GCPs is a relatively significant expense in any mapping project, AT procedures are used to reduce the amount of field survey required by extending control to all stereo-models.

Internal software checks were performed to detect gross errors in the photo measurements.

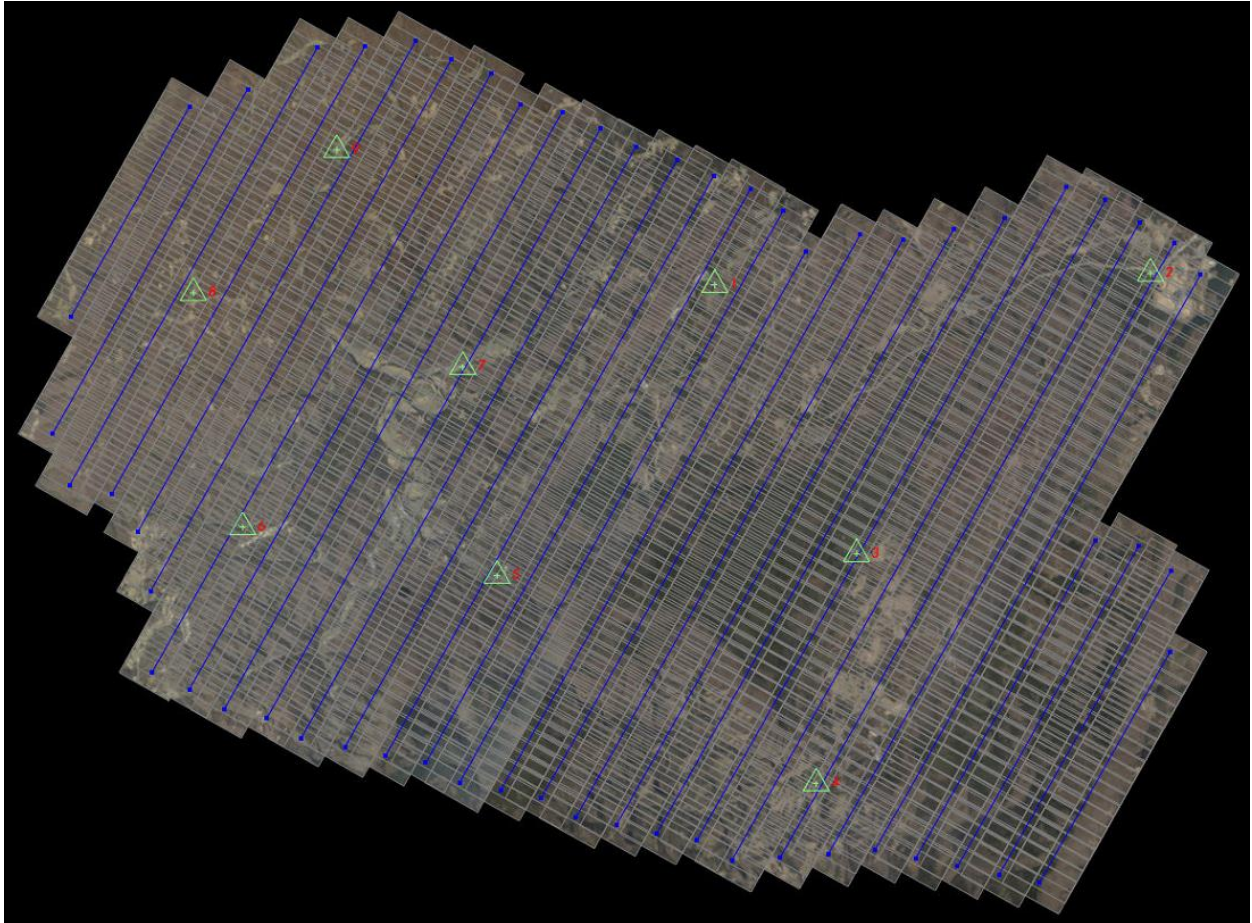
Bundle Adjustment

The surveyed control, along with the reduced image coordinates, served as input into the 'combined' block adjustment. Three-dimensional, simultaneous least squares adjustments by bundles, were undertaken using Match-AT bundle adjustment software. This bundle block adjustment software has proven to be a very rigorous and stable platform.

Nine control points were used to constrain the AT solution. The sigma naught is a significant indicator of the quality of the adjustment. The sigma value derived by the block adjustment is the root mean square of all photo measurement residuals for the entire block. The lower the sigma naught, the less tension within the AT solution. The sigma naught for this adjustment was 0.4 microns. The residuals of the control points from measured position to surveyed position are as follows:

Residual point x y z (ft.)

1	-0.020	0.055	-0.007
2	-0.011	0.021	-0.003
3	-0.054	0.037	0.000
4	0.052	0.105	0.011
5	0.159	0.052	0.046
6	0.322	-0.083	0.064
7	0.065	0.089	0.023
8	0.335	0.026	0.109
9	0.251	0.139	0.075



CONTROL POINT LOCATION SHEET

VERTICAL DATUM: GEOID 12B COORDINATE DATUM: NAD 83 (FT), WV NORTH ZONE

ORDER OF ACCURACY: RTK GPS 1/100,000

YEAR: 2019

ADDRESS: TUCKER COUNTY, WEST VIRGINIA – ST. GEORGE DIST. (RT. 219)

ESTABLISHED BY: THE THRASHER GROUP

CHIEF OF PARTY: MARK GALLAGHER

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NORTHING (Y) = 251449.088

EASTING (X) = 1963335.615

ELEVATION (Z) = 3188.166

DETAILED DESCRIPTION:

SW CORNER OF CONCRETE
SIDEWALK; HOUSE #24841



CONTROL POINT LOCATION SHEET

VERTICAL DATUM: GEOID 12B COORDINATE DATUM: NAD 83 (FT), WV NORTH ZONE

ORDER OF ACCURACY: RTK GPS 1/100,000

YEAR: 2019

ADDRESS: TUCKER COUNTY, WEST VIRGINIA – DRY FORK DIST. (NORTH RIDGE ROAD)

ESTABLISHED BY: THE THRASHER GROUP

CHIEF OF PARTY: CHRIS DEFINO

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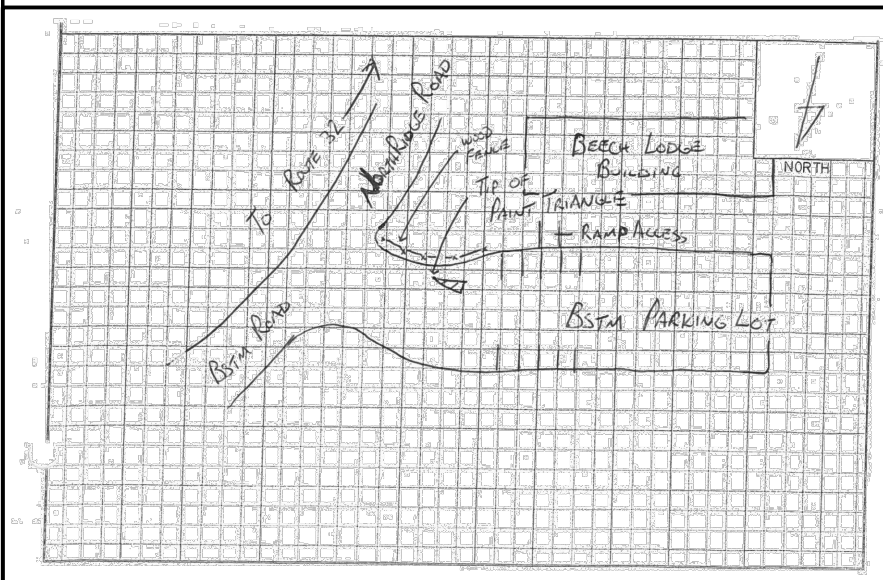
NORTHING (Y) = 212494.999

EASTING (X) = 1983869.046

ELEVATION (Z) = 3330.972

DETAILED DESCRIPTION:

EASTERN TIP OF TRIANGULAR
YELLOW CROSS HATCH; BEECH
LODGE PARKING LOT OFF OF
NORTH RIDGE ROAD



CONTROL POINT LOCATION SHEET

VERTICAL DATUM: GEOID 12B COORDINATE DATUM: NAD 83 (FT), WV NORTH ZONE

ORDER OF ACCURACY: RTK GPS 1/100,000

YEAR: 2019

ADDRESS: TUCKER COUNTY, WEST VIRGINIA – DRY FORK DIST. (RT. 32)

ESTABLISHED BY: THE THRASHER GROUP

CHIEF OF PARTY: CHRIS DEFINO

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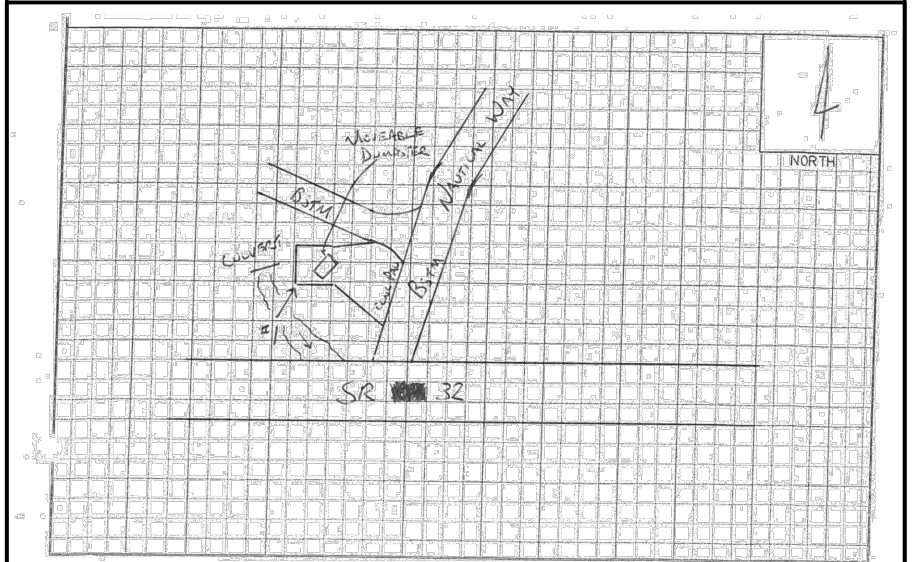
NORTHING (Y) = 179335.368

EASTING (X) = 1978031.655

ELEVATION (Z) = 2914.196

DETAILED DESCRIPTION:

SE TOP OUTSIDE CORNER OF
CONCRETE DUMPSTER PAD; OFF
OF RT 32 AT ENTRANCE OF
NAUTICAL WAY



CONTROL POINT LOCATION SHEET

VERTICAL DATUM: GEOID 12B COORDINATE DATUM: NAD 83 (FT), WV NORTH ZONE

ORDER OF ACCURACY: RTK GPS 1/100,000

YEAR: 2019

ADDRESS: TUCKER COUNTY, WEST VIRGINIA – HENDRICKS CORP. DIST. (RT. 72)

ESTABLISHED BY: THE THRASHER GROUP

CHIEF OF PARTY: MARK GALLAGHER

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NORTHING (Y) = 209375.203

EASTING (X) = 1931780.900

ELEVATION (Z) = 1710.020

DETAILED DESCRIPTION:

MID SE CORNER OF CONCRETE

DRIVE ALONG MULCH BED;

ALONG RT 72 AT HOUSE #667



CONTROL POINT LOCATION SHEET

VERTICAL DATUM: GEOID 12B COORDINATE DATUM: NAD 83 (FT), WV NORTH ZONE

ORDER OF ACCURACY: RTK GPS 1/100,000

YEAR: 2019

ADDRESS: TUCKER COUNTY, WEST VIRGINIA – BLACK FORK DIST. (RT. 219)

ESTABLISHED BY: THE THRASHER GROUP

CHIEF OF PARTY: MARK GALLAGHER

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NORTHING (Y) = 216381.053

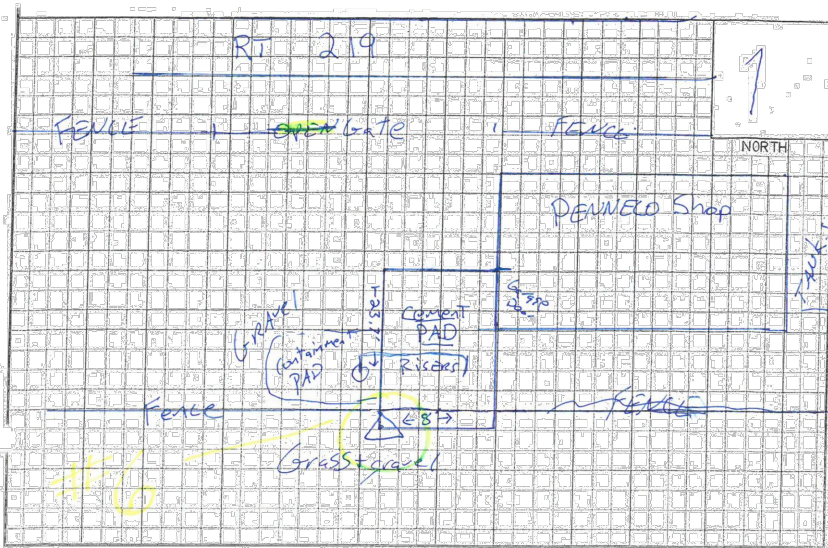
EASTING (X) = 1894965.167

ELEVATION (Z) = 1970.232

DETAILED DESCRIPTION:

SW CORNER OF CONCRETE

PAD; ALONG RT 219 AT PENNECO
SHOP



CONTROL POINT LOCATION SHEET

VERTICAL DATUM: GEOID 12B COORDINATE DATUM: NAD 83 (FT), WV NORTH ZONE

ORDER OF ACCURACY: RTK GPS 1/100,000

YEAR: 2019

ADDRESS: TUCKER COUNTY, WEST VIRGINIA -ST. GEORGE DIST. (HORSESHOE RUN RD)

ESTABLISHED BY: THE THRASHER GROUP

CHIEF OF PARTY: KELLIE KINSINGER

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NORTHING (Y) = 239594.494

EASTING (X) = 1926842.171

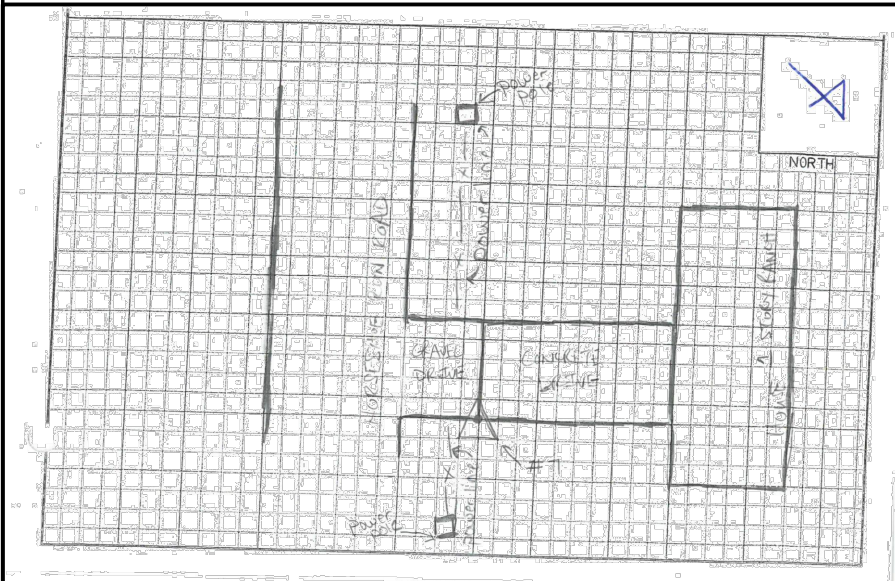
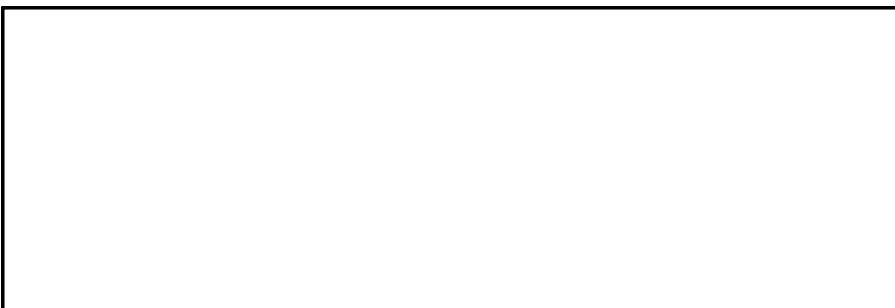
ELEVATION (Z) = 1619.528

DETAILED DESCRIPTION:

SE CORNER OF CONCRETE

DRIVE ALONG HORSESHOE RUN

RD



CONTROL POINT LOCATION SHEET

VERTICAL DATUM: GEOID 12B COORDINATE DATUM: NAD 83 (FT), WV NORTH ZONE

ORDER OF ACCURACY: RTK GPS 1/100,000

YEAR: 2019

ADDRESS: TUCKER COUNTY, WEST VIRGINIA – CLOVER DIST. (HICKORY ORCHARD RD)

ESTABLISHED BY: THE THRASHER GROUP

CHIEF OF PARTY: KELLIE KINSINGER

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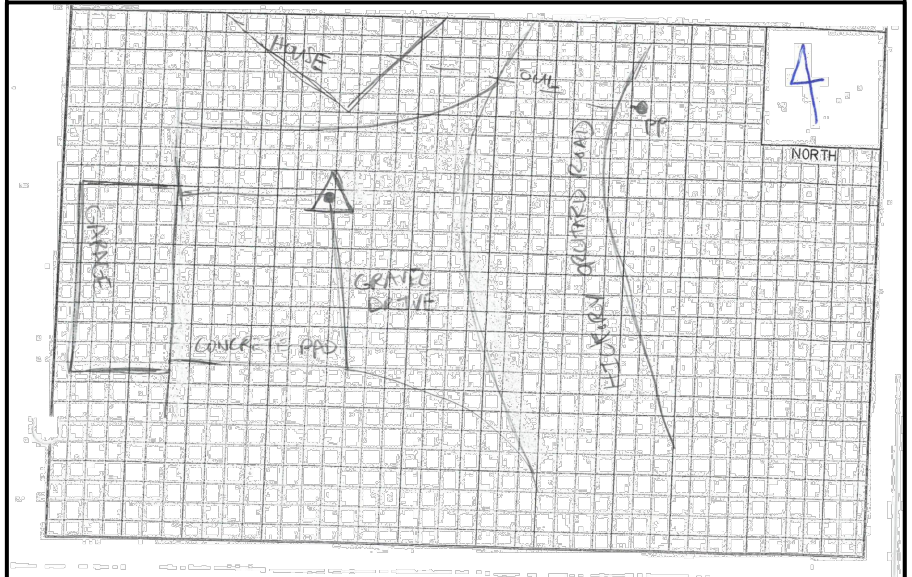
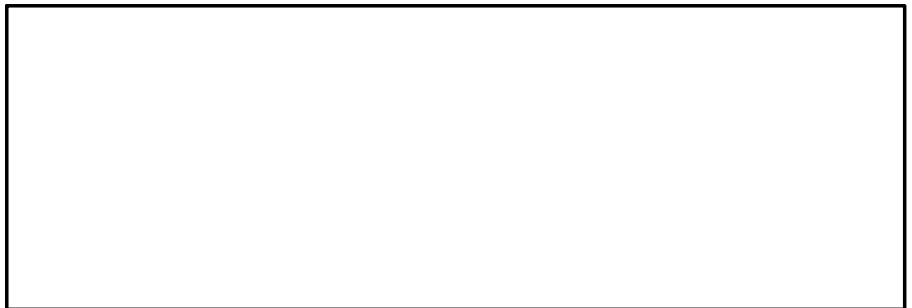
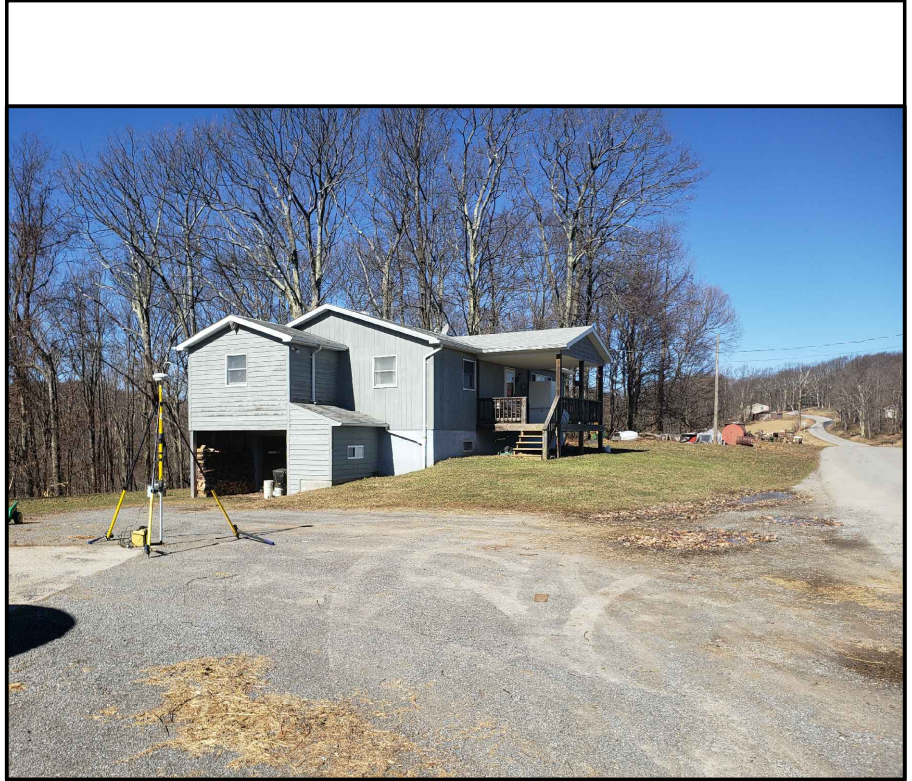
NORTHING (Y) = 250284.487

EASTING (X) = 1887819.757

ELEVATION (Z) = 2669.434

DETAILED DESCRIPTION:

NE CORNER OF CONCRETE PAD
ALONG HICKORY ORCHARD RD



CONTROL POINT LOCATION SHEET

VERTICAL DATUM: GEOID 12B COORDINATE DATUM: NAD 83 (FT), WV NORTH ZONE

ORDER OF ACCURACY: RTK GPS 1/100,000

YEAR: 2019

ADDRESS: TUCKER COUNTY, WEST VIRGINIA – LICKING DIST. (RT. 72)

ESTABLISHED BY: THE THRASHER GROUP

CHIEF OF PARTY: KELLIE KINSINGER

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NORTHING (Y) = 270975.797

EASTING (X) = 1908576.497

ELEVATION (Z) = 1520.936

DETAILED DESCRIPTION:

NE CORNER OF CONCRETE
DRIVE ALONG RT. 72

