LUFACILITIES
681 Taylor Street
Bethlehem, PA 18015-1755
Tel: 610.758.3970

SITE/CIVIL LAND SURVEYING AND RELATED DRAWING REQUIREMENTS

These requirements pertain to survey work and associated plan preparation for:

- Property Boundary Surveys
- Existing Conditions Surveys
- Construction and As-Built Surveys

GENERAL SURVEY REQUIREMENTS

1. All services shall be performed by qualified personnel under the supervision of a professional licensed by the Commonwealth of Pennsylvania to practice land surveying, and the document(s) submitted shall bear the Surveyor's signature, seal and statement to that effect.

2. All services shall be performed in accordance with the current edition of the Manual of Practice for Professional Land Surveyors in the Commonwealth of Pennsylvania.

3. Lehigh University has title to this property and the right of entry for this survey.

4. Access to available record documents and GIS data will be provided to the Surveyor by Lehigh University prior to the Start of Work. After reviewing this information, the Surveyor shall notify Lehigh University of any information gaps or discrepancies that should be resolved in order to complete the Scope of Services.

5. The survey work to be performed may serve as the basis for design of a future land development project requiring zoning and subdivision and land development approval from the local municipality and other county, state and federal agencies. As a result, any survey plans prepared for this project must also meet the drawing requirements of the local municipality's Zoning and Subdivision and Land Development Ordinances and any other related regulations.

6. It is understood that Lehigh University, or an Agent on Lehigh's behalf, may reproduce the Surveyor's drawings without modification and distribute the prints in connection with the use or disposition of the property without incurring obligation for additional compensation to the Surveyor. The original drawings shall remain the property of the Surveyor. Ownership of the Surveyor's work products provided by this contract shall be in accordance with the Surveyor's signed Master Services Agreement or contract.

7. All work and drawings shall be tied to the North American Datum of 1983 (NAD 83), Pennsylvania State Plane Coordinate System, South Zone and North American Vertical Datum of 1988 (NAVD 88) in US feet.

8. All work and drawings shall be tied to two (2) of Lehigh University's permanent control monuments as described in the Control Survey Report for Lehigh University as prepared by Herbert, Rowland & Grubic, Inc. and dated September 29, 2016.

9. All drawings containing a building footprint shall be drawn so that at least two points of the building's footprint (preferably corners at opposite ends of a building) are referenced to the Pennsylvania State Plane Coordinate System, South Zone.

10. All drawings containing above ground and/or underground utilities shall be drawn so that at least two points of a permanent structure (one that will remain after construction, preferably a building footprint) are referenced to the Pennsylvania State Plane Coordinate System, South Zone.

11. Unless otherwise stated elsewhere, the precision of the survey shall be based on the positional accuracy concept. The Surveyor shall recommend in the proposal positional accuracy limits and error of closure limits for the property being surveyed.

12. Above ground and underground utilities are to be shown based on record information and on surface evidence. The Surveyor must place a Pennsylvania One Call prior to locating utilities and coordinate a field meeting with the offices of Lehigh University Facilities and Planning, Design and Construction staff as part of the survey procedure. Discrepancies between record information and survey findings shall be brought to the attention of Lehigh University and resolved prior to the submission of final drawings. If a discrepancy cannot be resolved prior to final drawing submission, a note shall be placed on the plan recommending a course of action for additional investigation.

13. The Surveyor shall provide Lehigh University with copies of any records used to complete the survey work that were obtained from sources other than Lehigh University.

14. The Surveyor shall submit a request to have Lehigh University provide access to and remove debris from all utility structures to be surveyed in order to obtain complete and accurate location and elevation information. The request shall be submitted at least two weeks prior to surveying the utilities identified in the request.

15. Note that Lehigh University is currently developing standards for the integration of property and topographic survey information with our Geographic Information System. Although these standards have not been finalized, we would appreciate your cooperation in how features are represented on drawings, drawing layers are managed and data is transferred to Lehigh University. Additional guidance in this regard will be provided as soon as it is available.

PROPERTY BOUNDARY SURVEY REQUIREMENTS

1. If requested by Lehigh University, the survey work shall be performed in accordance with the Minimum Standard Detail Requirements for ALTA/NSPS Land Title Surveys effective February 16, 2021, or more current edition, including the additional tasks described in the attached Table A.

2. Prior to making this survey and insofar as is possible, the Surveyor shall acquire data including, but not limited to, deeds, maps, and other boundary line locations in the vicinity. Lehigh University will provide title and other information, as available.

3. Reconcile any discrepancies between the survey and the recorded legal description.

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4. Show boundary lines, giving length and bearing (including reference or basis) on each straight line and the radius, arc length, chord bearing, chord length and central angle of curved lines.

5. Show individual lot lines, deed book volume and page, and parcel identification (map book page, lot and block or parcel number). Show street numbers of buildings if available.

6. Give area of the property in square feet if less than one acre; in acres (to .001 acre) if over one acre.

7. Give names of record owners of adjacent property.

8. Note identity, jurisdiction and right-of-way width of existing adjoining alleys, streets and highways, including width and type of pavement and edging. Identify street monuments and show distance to the nearest street intersection.

9. Note federal, state and municipal planned rights-of-way and the nature of each.

10. Note federal, state and municipal planned street widenings.

11. Show recorded or otherwise known easements and rights-of-way and identify owners (holders).

12. Show the following zoning information available from the municipality or design team:

    a. Zoning classification of property. If more than one zone, show the extent of each.

    b. Show zoning of adjacent property and property across the street(s) or highway(s).

    c. Show building line and setback requirements.

13. Plot location of structures on the property. Label structures with names. Dimension to property lines and other buildings. Describe building materials and note number of stories, as provided by Lehigh University. Dimension the perimeters of structures in feet and inches to nearest 1/2 inch.

14. Locate structures on adjacent property within 50 feet of Lehigh University's property and across road rights-of-way adjacent to Lehigh University's property, with adjoining landowner permission.

15. Note vacant parcels as VACANT.

16. Show encroachments, including cornices, belt courses, etc., either way across property lines.

17. Describe driveways, sidewalks, fences and walls and locate them with respect to property lines.

18. Include identification of party walls from tax parcel or other records.

19. Furnish a legal description of the property based upon the survey results.

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20. Unless otherwise prohibited by law, where no monument exists, set permanent iron pin (monument) or other suitable permanent monument at property corners in accordance with local municipal ordinances and regulations; drive pin adequately into ground to prevent movement and mark with wood stake; state on the drawing(s) whether corners were found or set and describe each. Lehigh University shall be notified at least two (2) days prior to the installation of any monumentation.

21. The Surveyor shall include as an option in the proposal the recording of survey documents in the county courthouse, if requested by Lehigh University.

22. The Surveyor shall include as an option in the proposal the preparation of a Lot Consolidation Plan, if requested by Lehigh University.

EXISTING CONDITIONS SURVEY REQUIREMENTS

1. All lines of levels shall be checked by separate check level lines, or on previous turning points or benchmarks.

2. Contours shall be shown at 1-foot intervals where existing slopes are equal to or less than 5 percent, at 2-foot intervals where existing slopes are greater than 5 percent and equal to or less than 20 percent, and at 5-foot intervals where existing slopes are greater than 20 percent; error shall not exceed one-half contour interval.

3. Spot elevations shall be shown at:

    a. Each intersection of a 50-foot square grid covering the property;
    b. Street intersections;
    c. 50-foot intervals along the centerline of streets and at the edges of paving not otherwise edged with curbing;
    d. The top and bottom of all exterior stairs;
    e. 50-foot intervals and at changes in direction at the top and bottom of curbing, along both edges of sidewalks, and at the top and the upper and lower finished grades along walls.

4. Spot elevations on paving or other hard surfaces shall be to the nearest .01 foot; on other surfaces, to the nearest 0.10 foot.

5. The name, address, phone number and contact person of the company providing any photogrammetry to the Surveyor, including the date on which any photogrammetry products were created.

6. Floor elevations and elevations at each entrance of buildings on the property. Finished floor elevations for all structures/buildings shall be measured at a point centered on and immediately inside the threshold of the main entrance to the building. Access to buildings is to be coordinated in advance with Lehigh University.

7. Plotted location of structures, paving and improvements above and below ground.

8. The topographic survey work shall include the location of above ground and underground utilities in accordance with Quality Level C, as described in the current edition of the American Society of Civil Engineers (ASCE) Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data CI/ASCE 38-02.

9. Incomplete or unknown information requiring the surveyor to employ techniques of subsurface exploration to locate features or utilities will be an additional service subject to Lehigh University approval.

10. At a minimum, the following information is to be included in the completed survey based on record information and surface evidence.

    - **Domestic Water:** piping location, record depth and size; valve boxes, meter pits;

    - **Fire Protection:** piping location and size including water main connection size; post indicator valves, fire hydrants and valves; record size of the main serving each fire hydrant;

    - **Sanitary Sewer:** piping location, depth, record pressure and size, direction of flow; manhole location, size, depth and inverts and sizes of pipes at each. Note if piping is combined sanitary and stormwater sewer. Sanitary lift stations, buried tanks and septic fields are to be identified;

    - **Stormwater Sewer:** piping location, depth and size, direction of flow; manholes, catch basins, culverts, inlets and outlets, and overflow structures including location, depth and size and inverts of pipe at each; rain gardens, retention and detention structures including underground tanks. Note if piping is combined sanitary and stormwater sewer. Stormwater lift stations are to be identified;

    - **Electric:** location, elevation, configuration, size and characteristics of underground cable and duct banks, overhead power poles and cable; configuration and size of manholes and vaults, transformers, traffic control facilities, street and area lighting poles;

    - **Natural Gas:** piping location, record depth and size, record pressure; main valves and lateral shutoff valves, meter locations; above-ground or buried tanks;

    - **Telecommunications:** location, elevation, configuration, size and characteristics of fiber optic, telephone, cable TV and any other communications systems; underground cable and duct banks; overhead cable and poles; junction boxes and handholds;

    - **Central Steam and Condensate Distribution:** underground piping location, record depth and size; record system pressure, manhole size and depth. Include location and size of meters, traps and tunnels;

    - **Central Chilled Water Distribution:** piping location, record depth, record pressure and size, valves, vents and drains.

- **Use of Lettering, Numbering or Cardinal Directions at Structures:** For manholes, inlets and other similar structures, letters of the alphabet, whole numbers or cardinal directions (N, NE, E, SE, S, SW, W, NW, etc.) shall be used to label invert elevations associated with pipe connections.

11. Show the name of the owner and operating authority, including contact person and phone number, for each utility indicated above.

12. Location and type of signage and fixed site furnishings including, but not limited to, bus stops, parking meters, picnic tables, recreation equipment, etc.

13. Show and describe the following natural features:

    a. Soil types as identified in county soil surveys.

    b. Observed elevation of water in any excavation, well or nearby body of water.

    c. Location of flood plains and the flood levels of streams or adjacent bodies of water.

    d. Delineated wetlands, if flagged in advance in the field by a wetland scientist.

    e. Test borings, if flagged in advance in the field by a geotechnical specialist.

    f. Sinkholes, if flagged in advance in the field by a geotechnical specialist.

    g. Extent of the watershed(s) within the property.

    h. Location of trees with a diameter at breast height of 2” or more. Locate the center of these trees within a tolerance of 6 inches. Note those specimen trees flagged by Lehigh University.

    i. Location of hedges, landscaped beds or other planting areas.

    j. Perimeter outline only of thickly wooded areas unless otherwise directed.

CONSTRUCTION AND AS-BUILT SURVEY REQUIREMENTS

1. Prior to digging, the General Contractor and/or Construction Manager shall determine if a soft dig or similar investigation is deemed necessary. If so, a recommendation for such work shall be presented to Lehigh University for review and approval. Findings from the soft dig or similar investigation are to be submitted to Lehigh within 10 business days of the work being completed. Onsite presence from Lehigh is strongly encouraged during this work.

2. A minimum of one permanent benchmark shall be set on the property for each four acres of area. The benchmark shall be set at an elevation to nearest .01 foot and a description of the benchmark shall be noted.

3. Greenlee Marker Mate devices shall be used to mark utilities that may be hard to locate after construction. An example would be a manhole lid buried below grade on a storm line. The storm line may be plastic and the cast iron lid may be too deep to be able to find with a metal detector. Greenlee Marker Mate devices, provided by Lehigh University, shall be placed directly above a buried utility, but no deeper than 5' below finished grade (accounting for any possible ground settlement). See attached catalog cut at the end of this document. These devices are to be used for utility features that are almost impossible to find after they are buried. Not every construction project will require these devices. The proposed use of Greenlee Marker Mate devices shall be recommended by the installing contractor or surveyors and presented to Lehigh University for review and approval.

4. As-built dimensions of site civil and associated exterior utility improvements shall be taken as construction occurs to an accuracy as stated in the proposal submitted by the Surveyor and approved by Lehigh University prior to the start of any work.

5. For exterior utilities, as-built drawings shall include, at a minimum, elevation and plan view dimensions at intervals of 50 feet or less and wherever there is a junction, crossing and/or change in direction or elevation. Plan view dimensions shall be referenced to building walls, edges of sidewalks, back of curbs, existing survey monuments, and/or other approved structures. Plan view dimensions of utilities situated within roadways shall be recorded using road stationing. Elevations shall be made from finished grade to the top of the utility. Underground pipes, tunnels, and direct buried cables shall be measured vertically from the top of the utility and the centerline in the horizontal direction. Items exposed or above grade such as valve boxes, cast iron lids, flush access doors, and hydrants shall be measured from the centerline.

6. Any changes in site civil and exterior utility conditions and construction methods or materials from the original design plan shall be fully documented on the as-built plan. Features not installed as per the original design plan shall be crossed off on the as-built drawing or removed from the as-built drawing and noted as such.

7. Any obstacles or abandoned features discovered during construction shall be documented on the as-built plan along with any features removed or abandoned during construction.

8. If a surveying, engineering or architectural drawing for a project is used as a background for an as-built plan, the drawing must be the most current version, as confirmed by Lehigh University.

9. As-built drawings should be clearly identified as such in the title block. To avoid confusion, an as-built plan intended to show only one utility or one aspect of site conditions should NOT imply that information pertaining to other utilities or other site conditions is also being depicted. Therefore, the title block and/or notes should indicate what facilities are being shown in an as-built condition.

10. The name of the entity submitting the plan should be clearly marked on the drawing in addition to the source of the information shown. For example, an as-built plan submitted by a contractor containing information from a subcontractor should specifically state the name of the contractor as the submitter and subcontractor as the information source.

11. If changes are made to the as-built, revision dates shall be included to identify different submissions of the plan to Lehigh University.

12. A draft copy of the as-built drawings for exterior utility improvements shall be submitted to Lehigh University within two weeks after the utilities are in the ground and covered, which may be considerably before the building is complete. Lehigh University will review and respond back to the General Contractor and/or Construction Manager with comments within two weeks of receipt of the draft as-builts.

13. Under no circumstances will Lehigh University accept as-built plans from multiple sources that show conflicting or inconsistent information for the same feature. The construction manager or general contractor is responsible for verifying the content of as-built plans from multiple sources prior to submission to avoid conflicting or inconsistent information.

14. Final as-builts shall be submitted to Lehigh University within 2 months of the work being completed.

15. Photos of the utility installation work shall be taken during construction and submitted along with the as-built drawings. Photos shall be labeled as to the primary feature being photographed and the date of the photo. The background of a photo should include objects that can be used to help orient the viewer to the location of the feature being photographed. Close-up photos of a feature are encouraged to explain site conditions in more detail. If possible, link the photos to the as-built drawing.

16. As-built drawing submissions will be reviewed for compliance and accuracy by Lehigh University and consultants as appropriate based on the criteria described above. Drawings found to be unsatisfactory shall be returned to the contractor for correction. If after multiple submittals, the contractor cannot produce acceptable As-Built Documents, Lehigh University reserves the right to hire a Utility Locating Firm to produce the required results at the contractor's sole expense.

DRAWING REQUIREMENTS

Requirements for land survey drawings are as follows.

1. Drawings shall note all dimensions and elevations in imperial units at 1" = 20', 1" = 40' or 1" = 50' scale reviewed with and approved by Lehigh University. Include both a graphic and written scale on all drawings.

2. Drawing sheets shall be trim size 24" x 36" or 30" x 42" with 1.5" left and 0.5" top, bottom and right borders.

3. Show NORTH arrow and locate magnetic North directed to the top of the sheet.

4. Include legend of symbols and abbreviations used on the drawing(s).

5. Record all plan revisions in a revision block, including a date and description of the revision.

6. The source of all information provided by the Surveyor shall be noted, especially when this information is obtained from third parties. Symbology shall be used to differentiate between features documented by the survey and those obtained from other sources.

7. Features shall be represented as follows:

    a. Represent surveyed features as points (i.e., coordinate geometry [COGO] points), lines (i.e., 2D polylines), or polygons (i.e., 2D closed polylines). Always represent feature types consistently.

    b. Depict infrastructure junctions as COGO points located at the centroid of the feature. Infrastructure junctions (e.g., manholes) are surface-accessible features that connect and/or provide access to subsurface features.

    c. Depict linear features (e.g., pipes, cables, etc.) as 2D polylines. All linear features shall be drawn as a single line (not as a double line or other graphic).

    d. Depict stormwater management facilities or other major utility structures as 2D closed polylines.

    e. Draw any feature that connects to a junction feature (e.g., a pipe connecting to a manhole) such that a single 2D polyline is snapped to the centroid of the junction feature.

    f. Draw linear features such that polyline segments are broken by junctions, horizontal bends, or changes in attribute (i.e., material, dimension, etc.)

    g. Assign a unique feature ID to each feature and label that feature on a corresponding CAD text layer.

    h. Utility feature polylines shall be drawn to depict the direction of flow, with the beginning point of the line being the upstream terminus and the ending point of the line being the downstream terminus of the polyline.

    i. Utility feature polylines shall be continuous and may only be broken at utility junctions or fittings.

    j. No duplication of features. No overlapping features. No gaps between or voids within features.

8. Management of layers shall be as follows:

    a. Organize CAD file layers to facilitate accurate migration of CAD data into GIS.
    b. Prepare CAD drawings according to the following layer management requirements:

    • Limit CAD object types to COGO points, 2D polylines and 2D closed polylines.
    • Include a single CAD object type on any individual CAD layer.
    • Label unique feature IDs on a CAD text layer corresponding to the CAD object layers.
    • Include a 2D closed polyline layer defining the survey extent.

c. Features should be grouped on CAD layers by infrastructure type (i.e., sanitary sewer, telecommunications, etc.) and by CAD object type (point, 2D polyline, etc.). For example, sanitary sewer mains and sanitary sewer laterals are within the same infrastructure category (e.g., sanitary sewer) and would be represented with 2D polylines; therefore, these features types would be included on the same sanitary sewer polyline layer. Similarly, sanitary sewer manholes and vents are within the same infrastructure category, but would be represented with COGO points; therefore, manholes and vents would be drawn on a separate sanitary sewer CAD layer than the pipes. The following CAD layers represent this example:

   • Sanitary sewer polyline layers: “SS_Main” and “SS_Lateral”;
   • Sanitary sewer COGO layers: “SS_Manhole” and “SS_Vent”; and
   • Sanitary sewer text layer: “SS_Txt”.

d. Perform quality control inspections of the data including, but not limited to, removal of duplicate features and elimination of overlaps and gaps between features and voids within features.

9. Annotation and any associated leader lines shall be recorded in a text layer specific to that feature class and not placed in the feature layer. Annotation shall be aligned for legibility and shall not overlap a feature or other annotation.

10. Boundary and existing conditions information, where both are required, shall be on the same drawing unless otherwise requested by Lehigh University.

11. State the horizontal and vertical elevation datum used to perform the survey on each drawing. Also state the control points to which the survey is tied.

12. The Surveyor shall sign and seal each drawing and shall state that to the best of the Surveyor's knowledge, information and belief, all information thereon is true and accurately shown.

13. Submit both AutoCAD and PDF copies of the drawings to Lehigh University.

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92kHz Fiber OmniMarker™ can be placed in any orientation. Fiber enhanced Marker Mate's scan mode can locate all 9 electric utilities simultaneously.

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BENEFITS

Fiber Omni-Marker

- **Easy to use:** Does not require any particular orientation when buried and fits into standard 4 inch trench with NO EXTRA DIGGING.
- **Reliable:** No floating parts or liquids to contaminate the environment.

Marker-Mate

- **The Right Tool:** The scan mode and pinpoint accuracy within the EML-100 reduces time locating OmniMarker™, UniMarker™ and other markers made to industry standard frequencies.
- **Accurate:** User-Adjustable detection threshold is shown in bar graph, numerica and audible signal strength options and is equipped with battery warnings within its rugged design.

GENERAL	
Housing Material	High density welded polyethylene
Identification	Solid moulded colour and moulded text
Detection Range	1.5 m typical (5 ft) for all models (using Greenlee EML-100 or RD8000MRX)
US Patents	5,699,048 and 6,097,293
ELECTRICAL	
Detection Field	Dipole (Uni Marker model), Spherical (Omni Marker model)
Frequency tolerance	± 0.35 %
Detection Offset	15 cm (6") maximum at 1.5 m (5 ft)
MECHANICAL	
Overall Diameter	115 mm (4½") max
Minimum Trench Width	100 mm (4") Omni Marker case is dimpled to allow this 115 mm (4½") for UniMarker devices
Anchoring	Two "tie down" loops along flange. UniMarker devices are supplied with a mounting clip
Detection Offset (for OmniMarker or horizontally mounted UniMarker)	15 cm (6") maximum at 1.5 m (5 ft)

Weight	136 g (0.3 lb) OmniMarker models 70 g (2½ oz) UniMarker models
Interior Foam (OmniMarker models only)	Ensures precise mechanical alignment of the coils and structural strength.
ENVIRONMENTAL	
Water Penetration	Housing welded leak tight. Pressure tested at production.
Crush strength	35 pounds (155 N) applied with 0.187" (4.75 mm) radius point causes less than 0.25" (6 mm) deflection. 400 pounds (1780 N) uniformly distributed load with 1.5" (40 mm) aggregate.
Puncture resistance	22 pounds (100 N) applied with a point that has a 1/64 inch (0.4 mm) radius.
Chemical Resistance	High density polyethylene has good resistance to non-oxidising acids, alkalis and solvents (tested with diesel fuel, gasoline, alcohol, acetone and motor oil).
Drop and Shock Resistance	20 foot (6 m) drop on concrete
Interior Foam (OmniMarkers only)	Provides mechanical alignment of the coils and structural strength.
Temperature	-30 C to +65 C (operation), -40 C to +75 C (storage)
UV Resistance	1 year direct sunlight (simulating storage)

ORDERING INFORMATION

CAT NO.	DESCRIPTION
EML100	Marker Mate Locator

MARKER BALLS

	COLOUR(S)	FREQ. (kHz)	COMMON USE	UNIMARKER	UPC #	OMNIMARKER	UPC #
NEW	Yellow / Black	92.0	Fiber Optic	Model 183	07167	Model 180	05160
	Purple	66.35	Non-potable water	Model 178	11059	Model 168	11050
	Orange / Black	77.0	Cable TV	Model 175	60776	Model 165	60770
	Yellow	83.0	Gas	Model 174	60775	Model 164	60769
	Orange	101.4	Telephone	Model 173	60774	Model 163	60768
	Green	121.6	Sanitary	Model 172	60773	Model 162	60767
	Red / Blue	134.0	European Power	Model 182	07161	Model 181	05160
	Blue	145.7	Water	Model 171	60772	Model 161	60766
	Red	169.8	Power	Model 170	60771	Model 160	60765

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