SECTION 02100

SURVEYING

PART 1 GENERAL

1.01 SCOPE

A. This section describes the requirements for surveying, including, but not limited to:
   1. establishing temporary survey and control points;
   2. establishing a horizontal and vertical project control system based on existing benchmarks;
   3. performing verification of the existing conditions;
   4. setting limits and boundaries of construction activities;
   5. performing topographic surveys as required to determine measurement of quantities for periodic progress payments and final payment; and
   6. preparing and furnishing as-built drawings.

1.02 RELATED SECTIONS AND PLANS

A. Section 02110 - Clearing, Grubbing, and Stripping

B. Section 02270 - Erosion and Sediment Control

C. Section 13000 - Borrow Area Management

D. Section 13010 - Impacted Material Placement

E. Impacted Material Placement Plan, Rev. 1, October 1997

F. Part 6 - Statement of Work

G. Part 8 - Environmental Health and Safety, and Training Requirements

1.03 REFERENCES

A. National Geodetic Survey Standards.

1.04 QUALIFICATIONS

A. Oversight for the survey work shall be provided and certified by a Land Surveyor licensed in the State of Ohio.

B. Surveying work shall be performed under the direct supervision of a person who has a least 5 years of experience in construction surveying.

C. Work performed in referencing or re-establishment of land or United States survey monuments shall be stamped/certified by a Ohio-licensed land surveyor.

1.05 SUBMITTALS

A. Submit a copy of surveyor's license to the Construction Manager within 15 calendar days from Notice to Proceed.

B. Submit two copies of the survey notes, sketches and drawings for the following surveys to the Construction Manager on a weekly basis:
1. preliminary surveys;
2. intermediate surveys;
3. surveys before the winter break and at completion of the Contract;
4. surveys at completion;
5. measurement and payment surveys; and
6. final surveys.

C. On request by the Construction Manager, submit documentation verifying accuracy of survey work.

D. Upon completion of the survey work, provide the Construction Manger the original field note books, layout, computations, certified sketches and drawings in Integraph Microstation (version 5.0 or later) ".dgn" files in DXF format.

E. One complete set of final "as-built" drawings certified and stamped by a Surveyor licensed in the State of Ohio shall be submitted to the Construction Manager within 15 days of completion of the project.

1.06 PROJECT RECORD DOCUMENTS

A. Maintain on site, a complete, accurate log documenting survey work as it progresses.

B. Maintain on-site, a plan clearly showing survey control points and benchmarks.

C. Maintain on-site, an accurate and current set of marked-up drawings showing "as-built" conditions. Data shall be incorporated within one week of completion of the respective construction activity.

1.07 HEALTH AND SAFETY REQUIREMENTS

A. Environmental, health and safety, and other training requirements shall be as specified in Part 8 of the Contract Documents.

PART 2 PRODUCTS

2.01 MATERIALS AND SURVEY INSTRUMENTS

A. Provide materials as required to properly perform the surveys, including, but not limited to, instruments, tapes, rods, measures, mounts and tripods, stakes and hubs, nails, ribbons, other reference markers, and all else as required.

B. The survey instruments used for this work shall be precise and accurate to meet the needs of the project. Survey instruments should be capable of reading to a precision of 0.001 feet and with a setting accuracy of ± 8 seconds.

PART 3 EXECUTION

3.01 GENERAL

A. Maintain accurate and complete notes of surveys:
   1. Handwritten survey notes and information shall be documented in survey fieldbooks. A copy of the numbered, dated, and signed fieldbook pages shall be given to the Construction Manager weekly or upon request by the Construction Manager. Survey notes shall be legibly recorded. Notation shall be consistently applied to survey

work; the stake marking format and the fieldbook notation shall be compatible. Identify survey benchmarks on the field notes, sketches, and drawings.

2. Electronically collected field survey information shall be permanently stored and backup equipment shall be available in the event of equipment malfunction.
   a. Electronic format for printed output of data collector field survey notes shall be compatible with the approved fieldbook notation format.
   b. Electronic format for printed output of data collector survey work shall be compatible with the Contractor's and computer equipment and software specified in this Section for verifying and checking the work. A copy of the data disk shall be submitted to the Construction Manager monthly.

B. During construction of the OSDF, survey notes shall be retained by the Contractor and Surveyor.

C. Prior to the placement of successive soil or geosynthetic layers the Contractor shall submit a written statement and surveys certifying compliance of the preceding layer thickness and grades to the Construction Manager.

D. The precision of horizontal and vertical controls shall meet or exceed Third-Order Class I and Third-Order accuracies, respectively, as defined by National Geodetic Survey Standards.

E. Conformance check surveys for elevation and for horizontal coordinates shall be recorded to the nearest 0.01 ft and for angles shall be to the nearest 20 seconds.

F. Measurement and payment surveys for elevation and for horizontal distances shall be recorded to the nearest 0.1 ft ± 0.05 ft.

G. Final "as-built" drawings shall be certified for method and accuracy of work and sealed by the Land Surveyor.

H. Perform construction layout surveys in advance of scheduled construction activities. At completion of a survey, provide a copy of the field notes, drawings, or sketches to the Construction Manager for review. The Contractor shall allow the CQC Consultant and/or Construction Manager three calendar days for review of conformance surveys. The Contractor is responsible for rework and/or construction delays caused by survey or staking errors.

I. Set grade and slope stakes required for construction activities as the work progresses. Staking shall be in accordance with accepted surveying practices, provisions herein, and subject to Construction Manager review. Set fine grade stakes on all surfaces for which the plans show a definite grade line. Grade stakes shall not be permitted on soil layers overlying any geosynthetic material within 12 inches of the geosynthetic material.

J. Upon completion of the work, the Contractor shall provide the Construction Manager with original survey notes, layouts, computations, and electronic files, binders containing electronic file information and one copy each of electronic files specified in this Section.

K. Protect survey control points. Replace disturbed survey control points and benchmarks at no additional cost to Fluor Daniel Fernald.

L. Establish temporary survey control points, as necessary, to support construction work activities.

M. Survey control points, accuracy, and documentation:
   1. Record the following information in survey notebooks for each control point established:
      a. designation of control point;
      b. coordinates based on state Planar North American Datum (NAD) 1983 Ohio south;
      c. elevations based on National Geodatic Vertical Datum (NGVD);
      d. date of establishment;
      e. description and sketch of the control point location; and
      f. control points referenced to a minimum of three features that can be seen from the control point.
   2. Document survey work in the fieldbooks using the format and procedures described below:
      a. title and consecutive fieldbook number on the front cover;
      b. consecutively numbered pages;
      c. table of contents, indicated by survey task, on the first numbered page;
      d. legend indicating symbols used in survey notes;
      e. names of survey team for each task;
      f. notes on weather, equipment, etc.;
      g. date and time on each page to indicate when work was recorded;

h. notes in a uniform character such that they can be interpreted and used by anyone with survey knowledge; and
i. description and/or sketches of the existing survey control used.

3.02 SUPPORT SURVEYS

A. Preliminary Surveys:
1. Verification of the Existing Conditions:
   a. Prior to the start of clearing and earthwork activities, verify the accuracy of the existing conditions shown on the Construction Drawings. Immediately notify the Construction Manager in writing of deviations from the existing conditions indicated on the Construction Drawings which affect construction cost or schedule.
   b. Verify the existing benchmarks, structures, utilities, wells, topography, erosion and sediment control measures, construction and radiological control fences, sedimentation basins and appurtenances, and drainage features shown on the Construction Drawings. Notify the Construction Manager of any differences or conflicts with proposed work.
2. Establish construction limits required for installation of the construction fence and radiological control fence as shown on the Construction Drawings.
3. Establish location for the installation of the erosion and sediment control measures specified in Section 02270.
4. Clearing Limit Staking: Stake clearing limits according to Section 02110.
5. Alignment and Existing Ground Staking: Following clearing operations and before stripping operations begin, preliminary locations of alignments and/or baseline of project features shall be established. Perform topographic surveys to describe original ground features before stripping or excavation begins. The distance between grid points shall not exceed 50 feet, and all breaks shall be noted.
6. Earthwork Staking: Staking for cut and fill limits shall establish the exterior limits of excavations and embankments. The maximum staking interval shall be 50 feet. Stakes shall be prominently noted with description of point, vertical distance to design elevation, and offset distance as applicable.
7. Perform survey for conformance checks as specified in this Section.

B. Intermediate Surveys:
1. Perform surveys during progress of the construction activities to verify the accuracy of work and as directed by the Construction Manager. These surveys include but are not limited to surveys at the completion of subgrade excavation, compacted clay liner

and cap, LDS, LCS, and cover drainage layers, protective layer, contouring layer, biointrusion barrier layer, granular filter, vegetative soil layer, topsoil, LDS and LCS piping, horizontal wells, select impacted material layer, impacted material layer, debris placement areas; and other surveys directed by the Construction Manager during the progress of construction activities.

2. Perform surveys as required by Section 13000 and Section 13010.
3. Perform surveys for measurement and periodic progress payment as specified in this Section.
4. Perform surveys for conformance check as specified in this Section.

C. Final Surveys:
1. Final topography shall be staked at nominal 50-foot intervals. Additionally, the following points shall be staked and noted as applicable.
   a. grade breaks;
   b. points of horizontal curvature and tangency; and
   c. points of stationing equation.
2. Structures: Stake structure centerlines or building lines so that the orientation, position, limits, and foundation elevation(s) are positively identified. Mark stakes to reflect the design elevation and offset distance as applicable.
3. Ditches and Channels: Stake ditches, channels and culverts such that the layout remains undisturbed during construction.
4. Perform survey for conformance checks as specified in this Section.

3.03 SURVEYS FOR MEASUREMENT AND PAYMENT

A. Perform surveys for periodic progress payments and final payment to determine quantities of work. Measurements for quantities shall be as specified in Part 6 of the Contract documents.

B. Calculate and certify quantities of work and submit survey notes and calculations to the Construction Manager for review, evaluation, and payment.

3.04 SURVEYS FOR CONFORMANCE CHECKS AND "AS-BUILT" DOCUMENTS

A. Survey the following surfaces to verify the lines and grades achieved during soil placement and compaction for conformance checks and "as built" documents:

1. for berms, ditches, roads, and other earthwork:
   a. original grade surface;
   b. compacted surface of cut slopes; and
   c. finished grade surface;
2. for culverts and other erosion and sedimentation control structures:
   a. original grade surface;
   b. pipe inverts; and
   c. finished grade surface;
3. for the compacted clay liner:
   a. prepared subgrade surface; and
   b. finished compacted clay liner surface;
4. for the LDS, LCS, and cover drainage layers:
   a. finished grade surface;
   b. horizontal monitoring wells; and
   c. leachate piping;
5. for the biointrusion barrier, granular filter, vegetative soil, and topsoil layers;
   a. top surface of preceding layer; and
   b. finished grade surface;
6. for the compacted clay cap:
   a. prepared contouring layer surface; and
   b. finished compacted clay cap surface;
7. for the geomembrane:
   a. anchor trench;
   b. top and bottom of all side slopes; and
   c. seam intersections; and
8. for the impacted material placement:
   a. surface of the impacted material placed in the OSDF every month or surface of every 15,000 cubic loads of impacted material placed in OSDF, whichever comes first; this survey shall be at 100-ft grid and at grade breaks; and
   b. special impacted material placement as required by the Impacted Material Placement Plan.

B. Perform conformance checks and "as-built" surveying immediately upon completion of a given installation to facilitate progress and avoid delaying commencement of the next installation. Provide the following minimum spacings and locations for survey points (Additional survey points may be required if field conditions warrant.):
   1. surfaces with gradients less than 10 percent, survey on a square grid spaced not wider than 50 ft;

2. on slopes greater than 10 percent, a square grid spaced not wider than 50 ft shall be used, but in any case, a line at the crest and toe of the slope shall be taken; if the slope distance is greater than 20 ft, a midpoint slope survey point is required;
3. a line of survey points spaced not more than 50 ft apart shall be taken along any slope break (this will include the inside edge and outside edge of any bench on a slope);
4. a line of survey points spaced not more than 50 ft apart shall be taken at the top of any pipes or other appurtenances to the liner; and
5. at the corners and midpoints of the top and bottom of all slope breaks for liner penetration areas in cells.

[END OF SECTION]