TRANSNET FREIGHT RAIL

RAIL NETWORK – DESIGN OFFICE

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THORNWOOD SCOPE OF WORK – SURVEYING

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SERVICE INFORMATION

The following abbreviations may be used in this document, and have the meaning as indicated:

- DTM = Digital Terrain Model
- MSL = Mean Sea Level
- SRJ = Stock Rail Joint (of turnouts)
- ETO = End of Turnout
- ES = End of Set (or turnout)
- OHTE = Overhead Track Equipment
- C/M = Clearance marker
- WGS = World Geodetic System
- CAD = Computer Aided Design

1 DESCRIPTION OF THE SERVICES

The Services will complete a detailed topographical survey to design the diversion of stormwater away from nearby houses near Thornwood Train Station on KM74.053. The area to be surveyed is between the railway line (a 100m length from MP73/30 to MP74/4) and Thornwood Road in Thornwood. The Services covers the general survey of the site and any other work arising out of or incidental from the Services or required of the Contractor for proper completion of the work following the true meaning and intent of the contract document and includes the following:

a) Surveying of the structures, gabions, services, buildings, roads, natural ground levels, embankment top to bottom, cutting top to bottom, ballast top, & bottom, boundary fence, mast poles, railway lines, electrical cables, manholes and markers, storm water drains inlet to outlet, rock outcrops, culverts, signal equipment's etc.
b) Establish permanent and temporary benchmark positions.
c) All survey information should be provided on a CVS and text format.
d) Cadastral layout
e) Survey work could be expected of a qualified surveyor that is professionally registered.

2 DRAWINGS

The area to be surveyed in Thornwood is shown below, which will include surrounding areas.

Figure 1: Thornwood area

3 SPECIFICATIONS

a) Applicable Standard Specifications - There are no technical specifications applicable.
b) Applicable Generic Specifications - Transnet E7/1 (July 1998): Specification for works on, over, under or adjacent to railway lines and near high voltage equipment.
c) The Contractor must make sure that he/she obtains an access certificate and together with his personnel comply to any safety requirements imposed by Transnet Freight Rail and as arranged by the Employer's Agent.

4 CONSTRAINTS ON HOW THE CONTRACTOR PROVIDES THE SERVICES

4.1 Requirements for Equipment (Refer to SANS 1921-1 clause 4.13)

a) The requirements for equipment to be used near high voltage equipment are provided in the Generic specification, E7/1.
b) The Contractor shall use a non-conductive (wood or plastic) mechanism, to accurately determine the centre line and level of railway track survey points.
c) The design of such a mechanism shall be submitted to the Employers Agent for approval before the Contractor first establishes on site.

4.2 Format of information to be provided

a) The survey information shall be supplied in a digital format (assessable on MicroStation and AutoCAD).
b) The DTM data shall be in an ASCII and TOT format, supplied on a virus free compact disc and readable by the software programme CIVIL 3D.
c) All annotations on the plan shall be in English.
d) The plan shall be orientated with north at the top of the drawing.
e) **Levels** shall be displayed with a point as the **decimal point** and this point shall be placed at the centre of the level and must **correspond with the survey shot**.
f) **Levels** shall be indicated with **2 digits before the decimal point and 2 digits** after the decimal point, with lettering not less than 2.5mm high, in Arial font. The level shall be one text line.
g) To prevent cluttering of the as-is drawings, when plotting these levels, the *Contractor* shall ensure that they are spaced not closer than **1mm apart (at a 1:500 scale)**, and that the numerals indicating the levels do not **overlap**.

h) Levels and descriptions of the level shall be on separate CAD layers.

i) Contours generated from the survey must accurately reflect the ground levels. The height intervals shall depend on site conditions and on the scale of the drawing. Where practical 0,5m contours shall be shown, but the space between plotted contours on the plan shall not be less than 5mm. Rail levels must be not be considered when generating ground contours.

j) When defining the various points surveyed, the standard symbols to be used on the as-is drawings.

k) Co-ordinates system and datum level

- All co-ordinates shall be based upon the WGS system.
- The datum for levels shall be MSL.

l) Information to be recorded

- The Contractor shall record all local topography on a grid of not more than 20m x 20m.
- Spot heights shall indicate the crests of hills and bottom of valleys and depressions. Sufficient spot heights need to be provided to indicate ground variations, which cannot be adequately expressed by contour lines. Storm water trenches, streams and berms need to be located and shown clearly.
- Rail survey shots to be recorded on a separate layer and to be positioned on the centre line of the track at the exact position the shot was taken.
- Control points must be recorded on a separate layer on the drawing.
- Levels of control points shall be indicated with 4 digits before the decimal point and 2 digits after the decimal point, with lettering not less than 2.5mm high, in Arial font. The level shall be one text line.

m) In addition to the above, the following features shall also be surveyed, if encountered:

- **Railway Related Infrastructure**
  - Track centreline positions at 20m intervals.
  - Turnouts (centre line of track) at SRJ, ETO, and ES, as well as the centreline of the C/M. (The Contractor will be furnished with a drawing indicating the method to determine these points on site, if they are not clearly visible.)
  - All grade posts adjacent to the track, also recording the markings on it reflecting the grade in both directions.
  - All kilometre posts, also recording the markings on it reflecting the distances.

- All curve data markers placed along the track, also recording the markings on it showing the beginning and end of transition and circular curves.
- All curve radii are to be represented as curves and not cords. Note the beginning of the curve, end of curve and radii of curves needs to be indicated on the survey.
- Centreline of All OHTE masts (when there are such masts) with the level on the ground, as well as any other equipment on the ground, also recording the markings / numbering on it.
- Ditto for all signal masts and electrical boxes, also recording the markings/numbering on it.
- Top and bottom of the ballast on main line.

n) Telephones, Power Lines and Electrification

- Telephone poles and routes
- Power poles and routes
- Transmission lines
- Surface cables and cable markers, also recording the markings / numbering on it

o) Structures and Buildings

- Culverts, also recording the size of opening, length, and invert levels– where applicable
- Bridge structures and retaining walls– where applicable
- Buildings, derelict buildings and quarters– where applicable
- Manholes – both cover and invert levels and recording the type of manhole. Invert levels shall clearly be marked as either pipe invert levels or manhole invert levels
- Fire hydrants and water taps
- Miscellaneous features
- Markers for pipes / cables also recording the markings / numbering on it

p) Roads, Fences, and other Features

- Footpaths and roads, showing kerbs, gutters, catch pits, type of road surface, width of premix and concrete surfaces with the relevant invert levels clearly marked as for Structures and buildings above.

4.3 Control points

a) The Contractor shall make use of new control points and pick up all existing control points if any.
b) The Contractor shall provide a list showing the co-ordinates and elevation of each control point and survey station.
c) The new control points shall be inter-visible and not more than 200m apart.
d) As a rule, control points shall be placed on the periphery of the area to be surveyed, within the Railway reserve and so spaced that a network of further control points can be established if required.
e) Control points shall be in such a position as to minimise the likelihood of disturbance or damage.
f) The Contractor and the Employees Agent shall agree on the minimum envisaged number of control points required for the survey.
g) The control points shall be 600 mm long Y-standard driven into the ground leaving at least 20mm protruding, which must be encased in concrete of at least Φ200mm and 100mm deep, or any other method which will protect these points permanently, as agreed between the Contractor and the Employers Agent.
h) Each control point shall be provided with a rust proof metal tag set into the concrete indicating its number.
i) Each control point shall have its own photograph accompanied with the survey.

4.4 Accurate Measurements Tolerances

a) The accuracy of the contours generated from Civil 3D (software program to be used) must be such that upon comparison with the results of a selective check survey, the surveyed elevations of at least 90% of the points checked do not differ from their elevation as interpolated from the contours by more than half of the contour interval, and not more than 1% differ by more than the contour interval. The check shots shall be placed at random and shall be sufficient in number for the size of the area being surveyed.
b) Spot heights shall be accurate to ± 20mm.
c) Centre line of track position shall be accurate to ± 50 mm and rail levels to ± 10mm.
d) Invert levels of culverts and manholes shall be accurate to ± 10mm.

4.5 Integrity of Results

a) Testing
b) The Contractor shall ensure, by means of field checks or other independent confirmations, that the task complies with the specified standards and shall furnish proof, if required by the Employers Agent, that drawings depict details correctly.
c) The Employers Agent will scrutinise and check the fieldwork, calculations, drawings, and records to such an extent as he may deem necessary to satisfy himself that the terms of the contract and specification are met and complied with.

4.6 Deliverables

a) Digital Terrain Model file

   Survey data shall be submitted on as a "Civil 3D" or equivalent file that can be used in "Civil 3D" and must include, all break lines, survey points, triangles, and contours at 1m interval. The centre of both left and right rails must be represented on the DTM with its superelevation on a separate surface. Triangulation of break lines must create the actual representation of the topography of the land when longitudinal sections and cross sections are extracted.

b) Survey layout plan on DWG

   Survey layout plan on DWG indicating all the surveyed features with legend on the side.

c) Tabulation of survey data in CSV and text fie
d) Locate at least 8 bench marks on the section. This list must also be indicated on the Drawing.
e) Few cross-section at random sections (at least 5 areas).
f) Cadastral layout plan with the information showing all the existing service on the section
g) List of Codes: A list showing all descriptions of survey codes used.
h) Photographs of the site in general must be provided in a digital format.
i) A detailed report.

4.7 Clarification Meeting

a) The appointed Contractor must be available for a clarification meeting either at the office or on site after the contract is awarded. The surveyor and the draft person must be available for this meeting.

5 REQUIREMENTS FOR THE PROGRAM

a) Services Start Date:

b) Services End Date:

6 SERVICES AND OTHER THINGS PROVIDED BY THE EMPLOYER

a) The Employer will not provide any plant, equipment, or material.

b) There will be no other activities on site that will interfere with the execution of the requirements of this task other than train operational activities. In this regard the Contractor shall acquaint himself of and abide by the requirements of specification: Transnet E7/1 (July 1998) Specification for works on, over, under or adjacent to railway lines and near high voltage equipment.