Topographic Survey Specification for Urban Projects

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APEX SURVEYS
geomatics realized
CHARTERED LAND SURVEYORS

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Specification Introduction

Executive Summary

This document contains a detailed topographic survey specification and supporting quality assurance (QA) procedures for 1:250 urban works as implemented by the Quality Bus Network (QBN) Project Office and Dublin City Council. It has been developed over a period of years by a working group including members representing the interests of the city council, private land survey firms, local government, civil engineering consultants, professional survey organisations, and survey software developers. In addition to the specification itself, the document provides a checklist of QA activities to be carried out to ensure that any given survey fully meets the specification in terms of accuracy and content.

The specification has been applied and refined over a number of large projects such that it has been shown to fully meet the demanding requirements of dense urban topographic surveys while being readily achievable by the survey contractor in a cost effective manner. Specifically the specification has been shown to deliver consistent results in terms of high quality cartographic and 3d model output to AutoCAD / MX / Microstation and SCC with well defined relative and absolute accuracies.

The specification is based in the ITM grid, while still fully supporting the older IG75 grid. As such the specification has proven a good mechanism for transitioning between the two grid systems. The specification currently requires that all outputs be provided in both grid systems, with the intention that the requirement to provide outputs in the older grid can be dropped once it becomes redundant.

This is the first full public release of the specification, and as such there is a bias towards the specific needs of the QBN Project Office in terms of content, accuracy, and desired output formats. It is intended that the specification will be updated based on feedback to this document to meet broader requirements.

Background to the Specification

This specification is based on a previous specification developed by QBN Project Office and Atlas Computers Ltd for the QBN Project Office, and is designed to address a number of perceived shortcomings in that specification. These are as follows:

- To provide a documented set of QA procedures against all specification elements to enable both the surveyor and client to verify the correctness of the survey work. This includes allowing for independent check surveys to check accuracy and completeness, procedures to verify the 2d and 3d digital data supplied, provision of sufficient redundant measurements to quickly identify common survey errors, and provision of a complete set of all observed data such that any positions can be verified and recomputed as required.
- To move from IG75 to ITM as the primary grid, while still fully supporting IG75 as and when required, and thus enable broader use of the GPS active network by survey contractors.
- To document all cartographic, naming, and DTM requirements explicitly rather than depending on them being met by processing through specific software.
- To provide a user guide and sample reports for the survey contractor, illustrating how to meet the specification.

In addition to QBN Project Office and Atlas Computers Ltd, the working group that has developed the specification include members representing the interests of engineering survey clients, survey contractors, local government, and professional survey bodies in Ireland. They are

Peter Muller, QBN Project Office

Tom Curran, Dublin City Council, Survey and Mapping Department

Shane MacLaughlin (Chair) and Áine Martin, Atlas Computers Ltd

Dr Paddy Prendergast, Irish Institute of Surveyors

Tom Mulreid, Apex Surveys and Society of Chartered Surveyors

Vincent Molloy, Local Government Computer Services Board

Ray Murphy and Stan Schoene, Murphy Surveys Ltd

Gerry Healy, RPS Consulting Engineers

The combined depth and breadth of expertise held within the group is such that it has enabled us to meet the objectives setout in a manner workable for both the end user of the survey, and the surveyor on the ground. The group has been refining the specification over the last two years based on feedback from the specification use on major survey projects. Contact details for all members are available at the end of this section.

Objectives

- To provide the consumer of the data i.e. public and private bodies, with a standardised quality assured output using best practice standards and survey techniques. This will lead to efficiencies, less double handling of data and less time delays at construction phase.
- To ensure that the survey client (e.g. the QBN Project Office) receives consistent results in terms of reports, cartographic content, 3d content, and accuracy, independently of the survey contractor used. Hence to allow the survey client to effectively use multiple survey contractors without compromising the overall quality of the combined work.
- To provide the documented processes and tools to the survey contractors such that they can meet the specification in an efficient manner.
- To allow the survey client to move from the older IG75 grid to ITM on new projects while maintaining IG75 compatibility on existing projects.
- To ensure that the survey drawings and models appear identical across all processing software used, e.g. AutoCAD, MX, Microstation and SCC
- To enable the survey client, or their agent, to independently verify that all aspects of the specification have been met, in terms of content, accuracy and completeness.
- To have all cartographic, 3d modelling and digital content requirements explicitly stated with illustrative examples, independently of processing software used.
- To create an environment where topographic survey data can be easily reused, shared, combined and transformed into multiple formats. Hence to increase the value of such surveys as a long-term digital asset.
- To provide an extensible platform to create a broader specification, or series of similar specifications, to deal with different client requirements (e.g. rivers, rural works), scales, technologies (e.g. LIDAR, scanners) and data formats (e.g. LandXML, GML).

Intended Audience

This specification is designed to be of benefit to anyone who procures, specifies, or carries out topographic surveys. This includes senior local authority engineers and planners, engineering consultants, owners and managers of survey companies, and professional institutes involved in surveying and civil engineering.

The first publication of this document will be one thousand copies, seven hundred of which will be sent out at time of publication. Additional copies will be available for download in pdf format through Dublin City Council website at:
www.dublincity.ie/ROADSANDTRAFFIC/QBNPROJECTOFFICE/Pages/QBNProjectOffice.aspx

Scope and Recommended Usage

The current version of the specification is suitable for use 'as is' for urban works that demand a high level of accuracy and rich content. The specification can also be readily adapted to similar work by reviewing the scale, accuracies, feature library and digital output against any given set of requirements.

To use this specification on any given survey project, the group would recommend the user to go through the following stages:

- Familiarise yourself with the document in its entirety.
- Clearly identify and document all of your survey requirements. Specifically, the features which need to be identified on the ground, the accuracies required, and the output formats and reports required.
- Where additional features are required, you should state how they should be represented in plan and in each of the supported output formats (e.g. AutoCAD, MX). Additionally, each new feature should be assigned a group corresponding to either the type of survey or organisation carrying out the survey (e.g. roads, rail, QBN) and category indicating the general class of feature (e.g. street furniture, vegetation, underground services). Where the feature has additional dimensions, you should show how they should be annotated in drawings and represented in digital output. Where the feature is surveyed using more than one point, you should provide an illustration depicting the number and order of survey points relative to the feature. See appendix E for examples of the above.
- Avoid using feature names already in use in the specification for other purposes or with different surveying conventions.
- Remove all features from the specification that are not consistent with your requirements.
- Remove any output formats from the specification that are not consistent with your requirements.
- On smaller jobs you may wish to specify a local grid and scale factor of one rather than ITM. The advantage of this is that it can simplify design and make setting out with a total station easier. The disadvantages are that it can complicate use of GPS, make it difficult to overlay background mapping, and reduce the potential re-usability of the survey. Moving forward, the group would suggest using ITM where possible.

The group will be running training courses covering this specification, both for survey clients and survey contractors, over the coming months. For further details, please contact support@atlascomputers.ie.

Future Additions to the Specification

One of the important design objectives with this specification is that it can be enhanced to support a broader range of survey activities in future revisions. This will be based to a very large degree on the feedback received for this revision. Some of the anticipated enhancements are as follows:

- Additional domain specific updates and feature libraries, e.g. river surveys, building façade surveys, rural surveys, etc…
- Enhance the specification and associated documentation through feedback from users, professional bodies, public and private organisations, and other interested parties on standardising the approach through use of common techniques, QA procedures, common feature libraries and standardised outputs.
- Encourage inclusion of automated features/outputs in relevant software to contribute to national approach to preparation of survey specifications.
- Support for emerging broadly adopted open survey data exchange standards, such as

LandXML and GML, with a view to making one of these formats the defacto standard for such work in Ireland. LandXML is the standard in use with many international public bodies in the USA, Australia and further a field. It is also broadly supported by many civil engineering packages including most Bentley and AutoDesk solutions, survey instrumentation manufacturers such as Leica and Trimble, and survey software packages such as SCC. See http://www.landxml.org/ for further details. GML is a widely used standard for exchange of geospatial data, and is likely to be included as an appendix to the UK highway agencies upcoming 1:500 survey specification. Both LandXML and GML are extensible formats, such that their schemas can be extended to include additional data not present in the base specification, which is typically the case for most large scale implementations.

- Support for emerging and changing measurement technologies such as scanners, LIDAR,

Please send any comments, questions, or other feedback you may have in relation to this document to support@atlascomputers.ie

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Project Information

1 Project Information

1.1 Project Information

The information given in the following clauses provides essential information needed for the Project.

1.2 Project Designation

Name: _____

Reference No.: T-QBN-_____

1.2.1 Purpose of Project

The Project Objective is to provide information to enable the following work to be carried out by the Employer:

The design of _____

1.2.2 End Product

Under this Project the following is to be produced by the Contractor:

Accurate ground survey of _____

Processing of the survey data as specified producing the specified survey report and survey data, SCC files, and 3D CAD Drawings of the ground model plan, long sections and cross sections of the roads in the survey area.

1.2.3 Project Scale

The nominal survey scale for information provided under this Project will be 1: 250

1.2.4 Employer Provisions

The following items will be supplied by the Employer to the Contractor:

Customized SCC Feature Library as given in Appendix E

Tutorial on use of SCC Feature Library

User guide providing explanatory text relating to the specification preferred processing and checking methods, and samples as appropriate

1.2.5 Project Constraints

The following specific constraints will apply to the work carried out under this Project:

_____

_____

_____

_____

1.3 Survey Summary

1.3.1 Area/Extent of Survey

The area and extent of the survey is shown on Drawing No.

T-QBN-_____

1.3.2 Scale of Plans Required

Where hard copy plans are specified for this Project then the following scales will be required:

1:250 for the ground model plan

1:200 horizontal, 1:50 vertical for the longitudinal sections

1:200 horizontal, 1:50 vertical for the cross sections

1.3.3 Digital Data Required

Digital data is specified for this Project as per clauses 4.4 and 4.5.

1.3.4 Agreed Entry to Site

The Surveyor will be required to inform the site owners/occupiers of the specific access dates required and a list and plan will be supplied by the Employer when requested by the Surveyor.

1.4 Summary of Specification

The following Sections of the Standard Specification have been completed:

1. Project Information
2. Land Surveys
3. Survey data content
4. Presentation of Results
5. Compliance with Specification
6. Check Survey

Appendix A: Permanent Ground Markers

Appendix B: Planimetric Features

Appendix C: Additional Spot Levels

Appendix D: Bill Of Quantities

Appendix E: Feature Library

Appendix F: Sample of Cartography & Sections

Annexe

Annexe A: User Guide

Annexe B: Survey Report

1.5 Survey Records

The Surveyor shall make available to the Employer for inspection, on request, all survey data including that obtained from other sources.

The Surveyor shall retain the same for a period of 5 years.

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Land Survey

2 Land Survey

2.1 Metric Measurements

All linear dimensions and measurements shall be metric. Angular measurements and geodetic coordinates shall be degrees minutes and seconds. All Cartesian coordinates shall be reported to the nearest millimetre. All geodetic coordinates shall be reported to the nearest one thousandth of a second.

2.2 Control Network : Planimetric Control

The Contractor shall advise on appropriate control arrangements and submit details to the Employer for approval.

2.2.1 Permanent Ground Markers

The main survey stations shall be of stable construction. Standard forms of markers are shown in Appendix A and, unless otherwise specified within the accompanying documents, the Contractor should choose the most appropriate marker for each location from this selection.

The maximum distance between adjacent permanent survey stations shall be 150m.

All stations internal to the survey shall have unobstructed visibility to at least two adjacent stations (i.e. foresight and backsight stations) within 150 meters. Stations at the external boundary of the survey shall have unobstructed visibility to at least one adjacent station.

Where permanent stations are determined using a total station traverse method, they must be surveyed from GPS baselines such that there are no more than ten traverse stations connecting the same (loop traverse) or successive (link traverse) baselines. Where the survey contains more than one GPS baseline, the baselines are to be separated by no more than 1500 metres.

2.2.2 Survey Grid / Coordinate Reference System

The survey shall use the ITM (Irish Transverse Mercator) coordinate reference system. A description of the grid system shall be quoted on each survey plan.

For an initial transition period two sets of each survey shall be supplied - one on ITM and one on IG75.

No reference shall be made to Ordnance Survey Ireland Trig Stations and Bench Marks

2.2.3 Accuracy

The relative accuracy between permanent survey control stations shall, when checked, not exceed 1 part in 30,000 for distances exceeding 150 metres. For shorter distances the relative accuracy should be not exceed ± 5 mm.

The absolute accuracy of any permanent survey control station shall, when checked, not exceed ± 25mm.

2.2.4 Documentation / Survey Report

The following documentation shall be included in the Survey Report outlined in clause 2.5.

2.2.4.1 Schedule of Permanent Control Stations

A schedule shall be prepared giving the following information:

- Station designation
- ETRS89 coordinates
- ITM coordinates
- IG75 coordinates (during transition period)
- Height value related to Malin Head Datum (Orthometric)
- Description

2.2.4.2 Location Diagrams of Permanent Control Stations

Diagram to include the following information:

- Station designation
- Station coordinates
- Location diagram indicating location of the station with dimensions to a minimum of three easily recognisable and durable points.
- Photograph
- Type of marker used for the station.

2.2.4.3 Diagram of Permanent Control Network

When the number of permanent control stations exceeds three stations, a network diagram shall be supplied. The network diagram shall show the connections, together with the adjusted distances and adjusted bearings of each observed line in the network. Where possible, error ellipses for each permanent control station should also be supplied.

2.2.4.4 Observation and adjustment details

Where total stations have been used, the adjustment of plan positions shall be by a least squares variation of coordinates method. The adjustment report shall include the following:

- Details of any corrections applied, such as map scale factor, mean sea level, refraction and atmospherics, curvature, etc…
- All total station observations, i.e. horizontal directions, slope distances, vertical angles, instrument heights and target heights.
- Reduced observations, i.e. forward measured angles, bearings and horizontal distances
- Standard errors applied to each observation
- Adjustment residuals and standardised residuals
- Chi-squared goodness of fit test to verify the observations are in broad agreement with the stated standard errors.
- Coordinate corrections applied
- Error ellipse semi-major and semi-minor axes, and axis bearing, for a confidence level of 95%

2.2.4.5 Use of static GPS for control

Where static GPS is used to establish plan control, the following criteria must be met:

- All survey control stations to be co-ordinated by Static GPS observations with a minimum of twenty minutes continuous observations per station.
- Special attention to GDOP value (<3.5) in the field at time of observation.
- Static control observations should be by leap-frog method.
- Processing of GPS Control should be post processed by downloading relevant RINEX data from Ordnance Survey Ireland website or from another properly validated RINEX data supplier.
- Independent checks should be carried out at time of processing e.g. using two independent OS base stations to calculate co-ordinates.
- All raw observation data and correction data used must be supplied to the client in RINEX format along with all grid, correction, and adjustment parameters used such that the stations can be re-coordinated by a third party.

2.2.4.6 Instrument set-up report

An instrument set-up report shall be produced for each detail survey that includes the following:

- Survey file name
- Station setup observation at the start and end of each setup. This will ensure no orientation errors have occurred and the station setup was stable over the period of the observation. The reduced horizontal distance will verify the correctness of the scale factor in use
- Details of any corrections applied, such as map scale factor, mean sea level, refraction and atmospherics, curvature, etc.
- Occupied and back-sighted station names
- Backsight observation horizontal angle, vertical angle and slope distance
- Computed X,Y and Z mis-closure to back-sight station
- Computed horizontal distance mis-closure to back-sight station

2.3 Control Network : Vertical Control

2.3.1 Levelling Network

The Contractor shall advise on appropriate control arrangements and submit details to the Employer for approval.

2.3.2 Height Datum

All levels shall be related to Ordnance Datum at Malin Head. Ellipsoidal heights of the permanent control stations shall be converted to orthometric heights (Malin Head datum) using the OSGM02 geoid model using a Dublin City Council approved software package for transformation. See section 5.3 for a list of approved packages.

Relative heights between permanent control stations will be determined using a double run of levels in preference to using the relative heights acquired from GPS. One permanent control station, normally in the centre of the project, shall be held fixed, and the rest of the station

heights will be adjusted using the relative heights acquired from the double levelling.

No reference shall be made to Ordnance Survey Ireland Bench Marks.

2.3.3 Site Bench Marks

All permanent control stations will act as site bench marks. Additional bench marks may be nominated in consultation with the Employer.

2.3.4 Accuracy

The relative accuracy of heights between any two site bench marks shall, when checked, not exceed ± 10mm x k, where k is the square root of the distance in kilometres between the points being considered, or ± 5mm, whichever is the greater.

The absolute accuracy of the one permanent control station held fixed, when checked shall not exceed 20mm.

2.3.5 Documentation / Survey Report

The following documentation shall be included in the Survey Report outlined in clause 2.8.

2.3.5.1 Schedule of Site Bench Marks

The schedule supplied shall contain the following information:

- Designation of site bench mark
- Level value (orthometric) Above Ordnance Datum at Malin Head
- Level value (ellipsoidal) and its tolerance (accuracy range)
- Description

2.3.5.2 Location Diagrams of Site Bench Marks

Diagram to include the following information:

- Station designation
- Height Value (AOD - Malin Head)
- Location diagram indicating location of the site bench mark with dimensions to a minimum of three easily recognisable and durable points.
- Photograph
- Type of marker used for the site bench mark.

2.3.5.3 Network Diagram of Height Control

When benchmarks are located on other than permanent control stations a network diagram of the vertical control network shall be prepared. The network diagram shall show:

- Connections between the site bench marks and the permanent control stations
- Height values of all site bench marks
- Relative height differences between site bench marks (adjusted)
- Identification of the permanent control station held fixed in the adjustment.

2.3.5.4 Schedule of Observations and Adjustment Details

The report shall include the following:

- All reduced level observations
- Adjustment details to include height mis-closures and observation residuals

2.4 Detail Survey : Topographic Detail

A comprehensive list of the standard planimetric features to be surveyed is supplied in Appendix B. The Contractor shall visit the site before submitting his tender to identify what categories and features are applicable to the survey area.

The following categories of topographic detail shall be surveyed:

✓	Permanent buildings/structures
✓	Temporary/mobile buildings
✓	Visible boundary features: walls, fences, hedges
✓	Roads, tracks, footways, paths
✓	Street furniture
✓	Statutory Authorities' plant and service covers where visible
✓	Changes of surface
✓	Isolated trees/wooded areas/limits of vegetation
✓	Pitches/recreation
	Private gardens or grounds (off-site areas)
✓	Water features
✓	Earth works
✓	Industrial features
✓	Railway features with arranged access
	Other (specify)

2.4.1 Accuracy

The relative accuracy of the plan position of critical detail and well defined features shall, when checked, not exceed ± 25mm.

The relative accuracy of the plan position of soft, less well defined features and vegetation shall, when checked, not exceed ± 50mm.

A tolerance of 95% will be used as the acceptance criteria for the relative accuracy of plan position. All co-ordinates shall fall within 3 times the above values.

2.4.2 Obscured Ground

Detail which cannot be surveyed to the specified accuracy without extensive clearing of vegetation shall be surveyed approximately and annotated accordingly on the survey plan. The Survey Report (outlined in clause 2.8) will also make reference to any obscured ground so surveyed.

2.4.3 Level Detail

Height information shall be supplied as spot heights for the height detail specified in Appendix C, and also for relevant topographic detail specified in Appendix B.

2.4.4 Longitudinal and Cross Sections

The road centreline (or road crown) shall form the chainage line on which the survey is based. The position of (the chainage line and of) Chainage 0.000m for each survey area shall be agreed in advance with the Employer.

The Contractor shall clearly mark out on site the Chainage Point 0.000m and chainage points at intervals of 10m parallel to the road centreline or road crown, on the channel line, subject to the approval of the Employer.

The Contractor shall use these chainage points to establish cross section lines (perpendicular to the chainage line) commencing at Chainage 0.000m and at intervals of 10m for the full length of each survey section as detailed on drawings. The end points of these cross sections shall be clearly marked out on site for checking purposes.

Cross sections shall indicate any abrupt change in height and spot levels shall be taken at the following positions for each cross section:

1. On top of the first step of thresholds and building entrances
2. Base of boundary and building walls
3. Back of path
4. Footpath edge or change in surface
5. Top of kerb (on edge facing road)
6. Bottom of kerb (channel level)
7. Channel (mastic or concrete) edge
8. Road marking lines on carriageway
9. Crown of carriageway

Sufficient levels shall be surveyed such that the ground configuration, including all discontinuities, is represented on the survey drawing. In open areas, spot levels should be taken on a 10m regular grid (paced - where distances between levels should not exceed 10m).

The Contractor is to ensure that all points required to create a 3 dimensional (3D) ground model that represents the surveyed area surface fully are surveyed. Extra points that are required to represent the 3D surface fully e.g. steps, walls, traffic ramps, kerbs with small radii, traffic islands etc shall be included in the survey. The Contractor shall curve fit small radii on kerbs, traffic islands, and walls etc.

2.4.5 Spot Heights

The maximum distance between adjacent spot levels shall be 10 metres.

2.4.6 Accuracy

A tolerance of 95% will be used as the acceptance criteria for the relative accuracy of elevations. All elevations shall fall within 3 times the above values.

The relative accuracy of levels on hard surfaces shall, when checked, not exceed ± 10mm and elsewhere not exceed ± 25mm, except on ploughed or otherwise broken surfaces.

2.4.7 Corrections to Levels

All levels, when checked, which do not comply with the requirements of clauses 2.4.1 and 2.4.6 shall be corrected by the Contractor at their own expense.

2.4.8 Land Use

The Contractor shall record land-use details of ground floor land use for all properties fronting onto the route, according to the following categories:

1. Residential
2. Amenity
3. Retail
4. Industrial
5. Public Buildings
6. Agricultural

2.5 Survey Report

In addition to the survey drawings the Contractor shall supply a survey report that shall include the following information:

- A statement on the use of software name and version number for coordinate transformations:
- A statement certified by the chief surveyor that the accuracy specifications for the survey were attained, and the results achieved:
- A description of the survey and computation methodology used for Planimetric Control including the information specified in clause 2.2:
- A description of the survey and computation methodology used for Vertical Control including the information specified in clause 2.3:
- A description of the surveying methodology used for topographic detail:
- A description of the surveying methodology used for level detail:
- A description of the Standard Operational Surveying Procedures (SOSPs) and their results:
- Instrument set-up details for each detail survey as per clause 2.2.4.6
- A digitally signed schedule of all files provided as per 4.5.8

A sample survey report is provided in Annexe B.

2.5.1 Static GPS details

Where plan control has been carried out using static GPS, the survey report shall also include the following:

- Details of the observational plan, equipment used and observations recorded.
- Summary of the data processing performed, the software used, version number and the techniques employed.
- Summary and detailed analysis of adjustments performed.
- Diagram for the project stations including base lines and error ellipses

3

Survey Data Content

3 Survey Data Content

3.1 Feature Library And Naming Conventions

3.1.1 Feature naming conventions

Digital data shall be presented using naming conventions consistent with the feature library given in Appendix E, which comprise of the feature code given for each feature on the ground, the corresponding layer name used in DWG, DXF and Bentley Microstation based output, and label name used within the Bentley MX model. There shall be no modification or deviation from the naming conventions given in the feature library. All string and point information shall be surveyed to facilitate the use of the feature library. The Contractor shall carry out the survey of each feature as per the requirements of the feature library.

3.1.2 Feature types and data collection implications

Discrete survey objects will be collected as single points, two points, or three points in a manner consistent with the feature library given in Appendix E. Where the object is surveyed using more than one point, the position and order of the survey points is indicated in red in the feature library. Linear features must contain at least two survey points.

The Contractor shall survey all square or rectangular covers, manholes, street furniture exceeding 0.5m width dimensions using 3 points, or two points and a measured width. These are to be reduced to true rectangles as part of the survey processing, and presented as closed four point polygons in the ground model.

All small covers, manholes, gullies and street furniture shall be surveyed using 1 point. All covers must be oriented correctly.

Other polygonal survey features must contain at least three survey points.

3.2 Ground model standards presentation and Quality Assurance

The survey data is to be triangulated to from a constrained Delaunay TIN (triangulated irregular network) surface model, which in turn will be used to interpolate contours. For the purposes of this specification, the constraints on the triangulation will be made up of breaklines, and inclusive and exclusive boundary polygons.

3.2.1 Use of features in the triangulated surface

Whether or not a feature is included in the TIN surface, whether it is a 2D or 3D feature, and whether it forms an internal or external polygonal boundary, is determined by the feature library given in Appendix E. An external boundary is a polygonal line outside which triangulation and contour data is not created. An internal boundary is a polygonal line inside which triangulation and contour data is not created. All linear features that are included in the TIN surface are assumed to be breaklines. Not all 3D features will be included in the TIN surface. No 2D features will be included in the TIN surface.

3.2.2 Ground model quality control

All significant grade changes in the terrain should be surveyed using three-dimensional strings / break-lines.

There are no crossing break-lines in the model. Where two breaklines intersect on the ground, a point must be included in the ground model to resolve the elevation at the position of the intersection.

All non-surface data, such as overhead and underground features, are not included in the TIN either as points or break-lines

Strings representing single continuous features on the ground must consist of a single continuous string or polyline in the model.

Strings representing polygonal features such as boundaries, buildings, and ponds should be represented as closed strings or closed polylines.

There is no other three-dimensional data included in the TIN model that has not been directly surveyed on the ground surface.

Strings must not contain duplicate points or double back on themselves.

Gaps should not be used to break up separate strings.

The TIN surface should be verified, by the surveyor, as being in good agreement with the ground.

All strings associated with a given road or similar linear feature must be oriented in the same direction.

Data should not be duplicated in the model.

Strings denoting linear features should contain at least two points.

Where two strings denoting 3D features meet at a common junction point they should share a common elevation at that point.

3.2.3 Model boundaries

The ground model must include at least one closed 3d boundary string, made up from survey points in the TIN model, that is used to indicate the external limits of the TIN model and contours.

Where any internal boundaries exist within the model, that is areas which are not valid for contouring or other TIN based interpolation, closed 3d internal boundary strings must surround them.

3.3 Digital data formats

Drawing and ground model data will be provided in AutoCAD DWG, Bentley MX, Bentley Microstation, and Atlas SCC formats. The cartographic rendering and TIN surface for the survey must be identical within the formats given.

3.3.1 AutoCAD DWG

AutoCAD files must be provided in 3d AutoCAD 2000 compatible DWG format using a layering system in accordance with the feature library given in Appendix E. All symbols will be represented as block INSERT entities. All surveyed lines will be represented as POLYLINE entities. All triangles from the TIN surface will be represented as 3DFACE entities with a clockwise winding. All annotation will be represented using TEXT entities. No data other than directly surveyed data should appear in the drawing in accordance with the feature library given in Appendix E. Any other drawing enhancements will be placed on layer 0. All two-dimensional data should have an elevation of zero. All data, other than drawing enhancements on layer 0, should have colours and line-styles set to BYLAYER. Points and strings will be described with a single entity only. There will be no duplicate entities for the same survey point, other than for text annotation. All layers in the drawing will be turned on and visible.

3.3.2 Microstation DGN

Microstation files must be provided in 3d Microstation V8 compatible DGN format in accordance with the feature library given in Appendix E. All symbols will be represented as shared cells. All surveyed lines will be represented as line strings. All triangles from the TIN

surface will be represented as 3DFACE entities with a clockwise winding. All annotation will be represented using text entities. No data other than directly surveyed data should appear in the drawing in accordance with the feature library given in Appendix E. Any other drawing enhancements will be placed on level 0. All two-dimensional data should be represented using 2d elements. All data, other than drawing enhancements on level 0, should have colours and line-styles set by level. Points and strings will be described with a single entity only. There will be no duplicate entities for the same survey point, other than for text annotation. Logical colours used in the DGN will be in accordance with the colour table provided in A-4.5.1 of Annexe A.

3.3.3 SCC Model

The SCC ground model will be compatible with SCC 9.0.1 or later and will be created using the Dublin City Council _____ feature library. All annotation in the model will be created as ' Macro Text' such that it can be readily transformed between grid systems.

3.3.4 Bentley MX GENIO

The MX GENIO file will be labelled in accordance with the feature library given in Appendix E, such that it is suitable for drawing with the MX feature naming set Dublin City Council _____.FNS and plan style set Dublin City Council _____.PSS, as given in appendix E. The file will be formatted such that it can be input directly into MX ROADS and drawn directly using the feature name and plan style sets given, with no additional editing, such that the result given complies with clauses 3.1 to 3.2.3 above. All survey data in the GENIO file will be provided in four dimensions corresponding to X, Y, Z and survey point number. 2D points will be given an elevation of –999. 3D strings that are not included in the TIN model will be given a string sub-reference of NULL. All string labels in the GENIO file will be unique four character alphanumeric string labels. All point strings will start with the letter 'P'. All text strings will start with the character '*'. All line strings will contain at least two points.

4

Presentation of Results

4 Presentation of Results

4.1 Style of Drawing

Drawings produced shall be in colour and to a consistent style and all the features specified shall be presented on the final plan or data set to a neat and legible standard.

Style of presentation of the specified work, feature colours, conventional symbols and feature name abbreviations shall be consistent with the feature library given in Appendix E.

The proposed sheet border and title block shall be agreed between the Employer and the Contractor.

4.1.1 Sheet Size and Layout

The final plans shall be produced on standard A1 size sheets at the following scales:

1:250 for the plan layout of the survey

1:200 horizontal, 1:50 vertical for the longitudinal sections

1:200 horizontal, 1:50 vertical for the cross sections

Adjoining sheets shall be overlapped. The sheet layouts shall be submitted by the Contractor for approval.

4.2 Drawing Content

4.2.1 Detail

All specified features shall be represented on the final drawings in accordance with the style specified in clause 4.1.

4.2.2 Annotation of points

Survey points and features will be annotated with text in accordance with the feature library given in Appendix E. This annotation may include feature name, elevation, plan position, point number, survey notes, and ancillary dimensions. The Contractor will edit annotation such that no text in the drawing overlaps. Where any given annotator has been moved by the Contractor for this reason, such that it is no closer to the annotated survey point than any other point in the model, an arrow will be added to connect the annotator to the survey point.

4.2.3 Reference Information

Location plans and diagrams may be located within the information margins of the main drawings or may be placed on a separate drawing of the same style.

The Contractor will provide as part of the final product the following items:

- location plan
- sheet layout diagram with cross references to overlays
- Survey Report

4.3 Final Drawings

4.3.1 Proof Copies

Two sets of hard copies of the final drawings shall be submitted to the Employer for approval before delivery of the final copies.

The Employer shall return one set within 10 working days with any amendments to be incorporated in the final copies.

4.3.2 Final Copies

One copy of each sheet shall be submitted to the Employer after approval of the proof copies.

4.4 Supply of Digital Data

4.4.1 Standards of Accuracy

All digital data supplied shall conform to the same standards of accuracy specified in clause 2 for each type of data.

4.4.2 Proof and Final Digital Data and Files

The Contractor shall submit one set of all digital data and files in this specification as a proof copy on compact disc to the Employer for approval before delivery of the final digital data and files on compact disc. The Employer shall request any amendments that are not to specification within 10 working days of submission.

After approval of the proof digital data and files, the Contractor shall submit 2 sets of all digital data as final copies on compact disc to the Employer.

4.4.3 Computer Compact Discs

It is the responsibility of the Contractor to ensure that any compact discs associated with the contract are supplied in good working order. If discs have to be resubmitted, they shall be resubmitted at the Contractor's expense.

4.4.4 Level Records

The Contractor shall submit records of all points levelled under the contract. The records shall detail the derivation of the levels using the **"height of collimation"** format. This data shall be submitted in the form of a Microsoft Excel file on compact disc.

4.4.5 ASCII File

The Contractor shall supply the survey data in the form of a comma delineated ASCII data file. Each record shall consist of a minimum of four fields - easting, northing, reduced level and record description. A fifth field - dimensions - shall be added where appropriate for surface features such as covers, gratings, etc.

Two ASCII files should be provided. One ASCII file should contain easting and northing coordinates in the ITM grid system and the second ASCII should contain easting and northing coordinates in IG75 grid system as per clauses 2.2.2 and 3.3.3.

It is a requirement that the data file shall be capable of inputting directly to Microsoft Excel.

4.4.6 SCC Files

The Contractor shall submit the following SCC Files on a compact disc to the Employer on completion of the project:

SCC Project File (*.Project)

SCC Traverse File (s) (*.Traverse)

SCC Traverse Report

Traverse Diagram (*Model)

SCC Transformation File (*.Transformation)

SCC Transformation Report

SCC Dataset File (s) (*.Survey)

SCC Drawing File (s) (*.Model)

SCC Section File (s) (*.Section)

Microstation v8 (*dxf) and Autocad 2000 (*dxf) files produced from SCC with required settings and using specified Colour Map Settings

MX file (*inp) using required settings for importation into the roads design program MX Roads.

All files should be submitted in accordance with clause 2.2.2.

4.5 Digital data

The Contractor shall supply SCC Model, MX GENIO, 2D and 3D Microstation v8, and AutoCAD 2000 files of the ground model of the surveyed area to a scale of 1:250. Where more than one sheet is required to cover the street or road, a map shall be provided showing the extent of each sheet, its overlap and orientation. The cartographic rendering and TIN surface for the survey must be identical within the formats given.

The Contractor shall supply SCC Section, 2D Microstation v8 and AutoCAD 2000 files, showing the reduced levels along the longitudinal sections of each road crown or centreline. The chainage location of all spot levels and the numerical value of all spot levels shall be clearly identifiable on the print. The longitudinal sections shall be plotted to a scale of 1:200 horizontally and 1:50 vertically.

The Contractor shall supply SCC Section, 2D Microstation v8 and AutoCAD 2000 files, showing the reduced levels along cross sections at 10m intervals extending across the full width of survey area. The chainage location of each cross section and the numerical values of all spot levels shall be clearly identifiable on the print. Levels on long sections should be reported to 3 decimal places. Offsets and level values on cross sections should be reported ot 3 decimal places. The cross sections shall be plotted to a scale of 1:200 horizontally and 1:50 vertically. Appendix F proves a sample cross and long section file.

4.5.1 AutoCAD DWG files

AutoCAD DWG files shall be supplied for all models, long sections and cross sections in accordance with clause 3.3.1

4.5.2 Microstation DGN files

Microstation DGN files shall be supplied for all models, long sections and cross sections in accordance with clause 3.3.1

4.5.3 SCC files

SCC model files shall be supplied in accordance with clauses 2.2.2 and 3.3.3. SCC long sections will be presented using the 'Dublin City Council -Long section' section style. SCC cross sections will be presented using the 'Dublin City Council -Cross section' section style. SCC survey files shall be supplied to include all topographic observations, instrument set-ups and reduced coordinates. SCC traverse files shall be supplied to include all total station control observations. An SCC project file shall be supplied to include all station coordinates and feature library used for processing.

4.5.4 Bentley MX GENIO files

MX GENIO files shall be supplied in accordance with clause 3.3.4.

4.5.5 Dublin City Council Corporate Policy for supply of CAD data.

All CAD data resulting from this contract, which is being supplied to Dublin City Council shall comply with the following:

The required vector file format is Bentley's Microstation, etc., .dgn format.

Data must conform to the current Corporate and Departmental CAD standards – details of which are available on request.

Procedures for the exchange of data to be agreed with Dublin City Council prior to the commencement of the contract.

It is the responsibility of the Contractor to organise vector data coherently and to maintain a reasonable file size.

All data supplied must be free of copyrighted material.

All spatial data will be required to be geo-referenced to Grid as referred to in clause 2.2.2 as defined by Ordnance Survey Ireland at a scale and level of accuracy set by Dublin City Council.

Responsibility for compliance with these requirements, including any costs, lies with the Contractor or his nominees

4.5.6 Survey reports

A survey report as outlined in clause 2.5 shall be supplied in PDF format digitally and additionally two bound paper copies.

4.5.7 GPS observation data

Where static GPS has been used to establish control, all GPS observation and correction data used must be supplied digitally in RINEX format in such a manner that the stations can be readily recomputed using any industry standard GPS post processing software.

4.5.8 Digital signing

The Contractor must supply a printed report listing the names, revision number, size, and CRC of all digital files provided. The CRC (cyclic redundancy check) may be created using the CRCFile program available at http://www.createwindow.com/programming/crc32/crcfile.htm

5

Compliance with Specification

5 Compliance with Specification

5.1 Compliance with Specification Introduction

The Employer will verify that the Work complies with the Specification at submission, by carrying out an independent check survey and an audit of the digital data provided. The Contractor shall be fully responsible at no extra charge for making corrections and supplying missing survey information to comply with the Specification.

Where the Work fails to comply with the Specification, the Contractor will incur a penalty cost corresponding to the cost incurred by the Employer in rechecking the work. Repeated failure to comply will result in the Contractor being removed from the list of approved survey Contractors.

5.2 Check survey

The Employer shall instruct an independent survey Contractor to carry out a check survey of the Work to verify that it complies with accuracies and content outlined in clauses 2 and 3 of this specification. The check survey will comprise re-surveying of a representative random sample of the Work to test accuracy and content. The check survey will be carried out to a higher order of accuracy than the Work, and include a larger number of redundant measurement, such that if there is a disagreement between the check survey and the Work, the error can be proven to lie with the Work.

5.3 Audit of digital data

The Employer shall audit the content of SCC, CAD and MX files at submission before final acceptance of the Work and the Contractor shall be fully responsible at no extra charge for making corrections and supplying missing survey information to comply with this specification.

This audit will verify that the data provided meets all of the criteria described in clauses 3 and 4 of this document. A list of checks that will be carried out, along with sample procedural descriptions of how they may be accomplished, are presented in the user manual accompanying this specification. In order to minimise potential delay in accepting the Work, the Contractor shall carry out these checks prior to submitting the data.

5.4 Coordinate transformations

The Employer will use a Dublin City Council approved software package for transformation to verify the correctness of coordinate transformations between ITM (Irish Transverse Mercator) and IG75 (Irish Grid - 1975 realisation), and all conversions of GPS heights (ellipsoidal) to heights related to the Malin Head datum (orthometric).

Where transformed values for a given position fail to meet the checked values, the failing items will be returned to the Contractor for correction. In order to minimise potential delay in accepting the Work, the Contractor shall carry out similar checks with a Dublin City Council approved software package for transformation, prior to submitting the data.

Currently, the Dublin City Council approved software packages for transformation are

- Ordnance Survey ‘GridinQuest’ software (version 6.6.0)
- SCC 9.0.1 later with embedded ‘GridinQuest’ software (version 6.6.0)

5.5 Survey Data Processing

The Employer will use a Dublin City Council approved software package for reduction, processing and modelling of survey data.

Currently, the Dublin City Council approved software packages for transformation are

- SCC 9.0.1 later with embedded ‘GridinQuest’ software (version 6.6.0)

6

Check survey

6 Check survey

6.1 Check Survey Introduction

Check surveys are being included as part of this specification as a quality control technique to meet the following requirements:

- To independently verify the correctness on the main survey, that is that it meets stated acceptance criteria in terms of accuracy and completeness.
- To include the necessary controls such that where this verification fails it clearly proves the failure lies with the main survey.
- To be cost effective, that is the check survey should typically cost less than 10% of the price of the main survey.
- To be free of any influence from the measurements or results of the main survey

In order to achieve the above goals the check survey must include the following:

- Higher order of accuracy than the original survey
- Sufficient redundancy to eliminate any possible errors due to equipment calibration, pointing, reduction methods and measurement method.
- Resurvey of a maximum of 3% of main survey in key areas, such as pinch points.
- No sight of adjusted station coordinates or topography by the checking surveyor prior to completion of check survey, comparison between check survey and main survey to carried out after submission of check survey.

6.2 Selection of check area

The Employer will select one or more check areas, typically around fifty meters in length for checking. The areas selected will typically be those considered critical to the success of the design, such as junctions and pinch points where the intended design is most constrained by the existing ground. The number of check areas will be based on the overall length of the job, and the number of areas deemed critical by the Employer.

The Employer will provide the checking surveyor with a list of features that are considered to be critical hard detail, and soft detail, for the purposes of this survey.

The Employer will provide the checking surveyor with location diagrams to all of the permanent control in view of the check areas, and boundary polygons delineating the area of topography to be checked. Typically this will involve a minimum of the station most central to the area being checked along with a forward and backward station.

6.3 Control

The checking surveyor will establish coordinates for the stations required by the Employer by observing them simultaneously using static GPS with an observation period of not less than one hour. Normal computational procedures will be used such as eliminating bad satellites to ensure the grid coordinates computed easily meet the original survey specification.

The checking surveyor will then traverse through all check stations, taking a minimum of three rounds of angles and distances to each station. The purpose of this exercise is to verify the correctness of the GPS, the calibration of the instrument and prisms, and the reduction options selected. This traverse will be adjusted by least squares with all GPS stations held as fixed, in order to produce observation residuals.

Heights for the check stations should be established by double run levelling, as per the main

survey, holding the central station fixed.

6.4 Topography

The checking surveyor will survey all linear features nominated by the employer, typically top and bottom of kerb, at the contract survey interval. The checking surveyor will additionally survey at least ten discrete features of hard detail, typically square manhole covers or street furniture.

All checked points are to be unambiguous, in that they lie on readily located positions such as the intersection or corners of features, or clearly marked points on the ground. They should also be selected to be less than 50 metres from the set-up station.

All points shall be observed using a single angle and distance observation from two separate stations. The elevations of these points should be observed using a level, again from two stations, using the same staff used for any other levelling in the check survey. These observations will be used to determine the typical pointing error present when checking topography and elevations, such that this error can be eliminated when computing relative accuracies in the main survey.

At the start and end of each instrument set-up the checking surveyor will observe a minimum of two other stations. The two observations taken at the start of the set-up will be used to compute a mean orientation for the set-up, and station mis-closures will be reported.

Where rectangular features such as inspection covers are present in the survey, they are to be observed using three total station points, with a check spot elevation taken on the fourth point.

6.5 Determination of errors within the check survey

To determine the coordinate errors in the check survey for any given station, re-adjust the traverse with all stations fixed except for that station, and compute the join distance between the adjusted value and the GPS value.

To verify the angular calibration of the total station, compare the computed included angles between survey stations, and the surveyed forward measured angles between the same stations taken during the traverse. These will correspond with the angle residuals in the least squares adjustment.

To verify the distance calibration of the total station, compare the computed join distances between survey stations, and the surveyed horizontal distances between the same stations taken during the traverse. These will correspond with the distance residuals in the least squares adjustment.

To verify the calibration of the level, compute the misclosure generated as a result of the double run levelling.

The typical accuracy for absolute topographic positions and levels has been covered under the clause 6.3.

6.6 Analysis of accuracies

Once the checking surveyor has submitted the check survey to the Employer, the Employer will furnish the checking surveyor with a schedule of stations coordinates and topography for the areas being checked for the purposes of analysis of accuracy.

The checking surveyor will compute the relative accuracies of the Work in accordance with clauses 2.2.3, 2.3.4, 2.4.1 and 2.4.6 of the specifications and provide a report listing the following:

- Checking method used
- Errors present in check survey
- Values present for the sample in the Work

- Values observed for sample in the check survey
- Worked analysis of comparison between the work and the check survey, detailing absolute and relative differences, and relative accuracies in the Work corrected for known errors in the check survey
- Conclusions as to whether survey passes or fails, and if it fails, whether the failure relates to a systematic error that can be corrected and re-checked.

Please refer to user notes accompanying this specification for details and a worked example of this analysis.

6.7 Analysis of topography

The checking surveyor should visually compare the topography in the Work with the corresponding topography in the check survey, and report the following:

- Any missing plan detail in the work
- Any significant disagreement in the plan line work
- Any significant discrepancies in position, dimensions and orientation of scaled objects and symbols such as inspection covers, street furniture, and road markings
- Any noticeable difference in contours between the two models when contoured at intervals of 0.1 and 0.01 metres.
- Any additional detail present in the Work but not present in the check survey
- Conclusions as to whether the topography in the Work is in good agreement with the topography in the check survey.

6.8 Stations

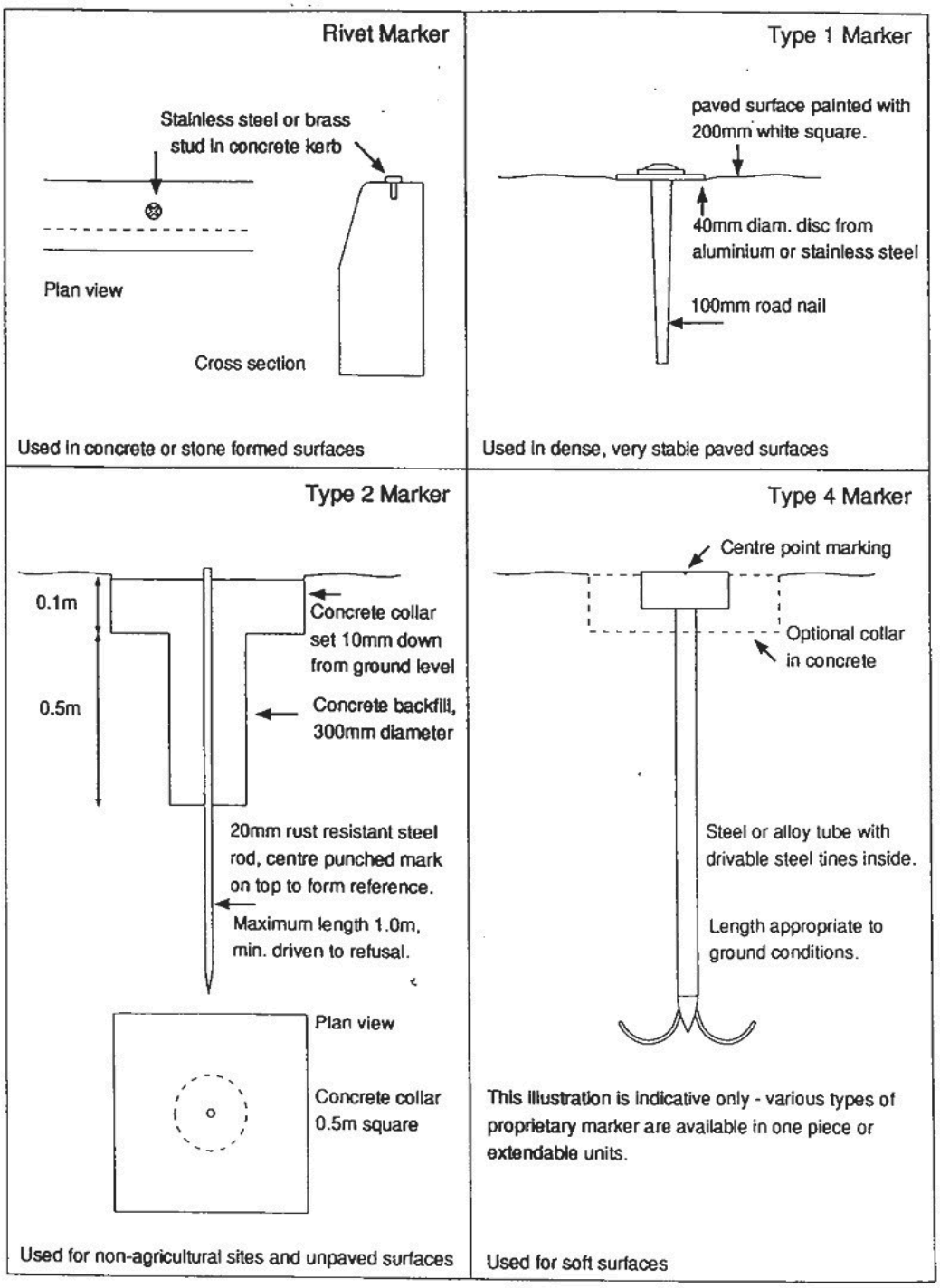
The check survey analysis should also comment on the following:

- Ease of location of the stations using the information provided
- Suitability and condition of ground anchors used

The check survey report will be signed by the checking surveyor and their manager, and returned to the Employer.

A sample check survey report is provided in the user guide accompanying this specification.

Appendix A: Permanent Ground Markers


Rivet Marker
Stainless steel or brass stud in concrete kerb
Plan view
Cross section
Used in concrete or stone formed surfaces
Type 1 Marker
paved surface painted with 200mm white square.
40mm diam. disc from aluminium or stainless steel
100mm road nail
Used in dense, very stable paved surfaces
Type 2 Marker
0.1m
0.5m
Concrete collar set 10mm down from ground level
Concrete backfill, 300mm diameter
20mm rust resistant steel rod, centre punched mark on top to form reference.
Maximum length 1.0m, min. driven to refusal.
Plan view
Concrete collar 0.5m square
Used for non-agricultural sites and unpaved surfaces
Type 4 Marker
Centre point marking
Optional collar in concrete
Steel or alloy tube with drivable steel tines inside.
Length appropriate to ground conditions.
This illustration is indicative only - various types of proprietary marker are available in one piece or extendable units.
Used for soft surfaces

Appendix B: Planimetric Features

At each increase in scale more details can be shown and more detail can be plotted to true scale instead of conventionally. As a general rule those features whose plotted size is less than 1mm on the plan will be shown conventionally, if at all.

ONLY THE ITEMS INDICATED WITH A TICK WILL BE SURVEYED
(†) Features usually shown only at 1:250 scale and above.
(‡) Features usually shown only at 1:100 scale and above.

1. Permanent buildings/structures

✓	Archways, underpasses, culverts
✓	Bridge over, bridge under
✓	Buildings detailed at plinth line
✓	Foundations
✓	Overhead features, canopies, porches, etc.
✓	Ramps, loading bays
✓	Ruins
✓	Steps: steps generalised, (‡) Steps individual
✓	Structures detailed at plinth line
✓	Threshold levels
	(‡) Boot scraper
✓	(†) Gullies
✓	(†) Rain water down pipes
✓	(†) Rodding eyes
✓	(‡) Waste pipes
	Other (specify)

2. *Temporary/mobile buildings*

✓	Garden sheds, greenhouses
✓	Mobile buildings
✓	Overhead features, canopies, porches, etc.
✓	Temporary buildings or structures

3. *Visible boundary features walls, fences, hedges*

✓	Fences: with type, with height
✓	Gate: (†) direction of opening shown
✓	Hedges, conventionalised below 0.5m width, (‡) to scale
	Walls: with type, with height, piers generalised, wall single line below 0.25m width
	(†) Walls, piers surveyed, wall single line below 0.11m width
✓	(‡) Walls, piers and widths fully surveyed

4. *Roads, tracks, footways, paths*

✓	Channel line road
✓	Centre line road
✓	Camber line on roundabouts
✓	Carriageway edge
✓	Channel edge
✓	Drop kerbs
✓	Top of kerb (On edge facing road)
✓	Crash barriers
✓	Gullies, kerb outlets
✓	Pedestrian barriers

✓	Pedestrian crossings
✓	Road markings, e.g. all road markings as specified in "The Department of Environment Traffic Signs Manual (1996)"
✓	Traffic ramps
✓	Traffic islands, (†) details
✓	Other road features, e.g. vehicle sensors
✓	Back edge of footway
✓	Paving pattern details
✓	Unmade tracks and paths, centre only, (†) sides

5. Street furniture

	Belisha Beacons
✓	Barriers
✓	Bollards
✓	Bus stops, bus shelters
✓	Control boxes
✓	Hoardings
✓	Lamp posts
✓	Anpost post boxes
✓	Mile posts
✓	Notice boards
✓	Posts
✓	Road signs
✓	Street name plates, (‡) wall mounted
✓	Ticket machines

✓	Traffic signals
✓	Troughs
✓	Vent pipes
✓	(†) Drainage channels
✓	(†) Cellar hatches and pavement lights
✓	(†) Coal holes
✓	(†) Cycle racks
✓	(†) Litter bins
✓	(†) Reflector posts
✓	(†) Salt/grit bins
✓	(†) Seats
	Other (specify)

6. Statutory Authorities' plant and service covers where visible

✓	Air valves
✓	(‡) Cable TV house points
✓	Cable TV inspection covers
✓	Cabinets (identified)
✓	Electric covers
✓	Electric poles
✓	Fire hydrants, (†) shown to scale
✓	Gas/water stop valves and stop cocks (cover)
✓	Inspection covers with level

✓	Lamp holes
✓	Marker posts
✓	Over head wires, (†) building connections to be shown
✓	(†) Pole stay wires
✓	Surveillance cameras
✓	Telecommunications inspection covers
✓	Telegraph poles
✓	Telephone call boxes
✓	(†) Water meter or gas meter covers (distinguished from valve)

7. Changes of surface

	HARD SURFACES		**SOFT SURFACES**
✓	Brick	✓	Cultivated
✓	Concrete	✓	Grassed
✓	Metalled		(†) Grass, maintained area
✓	Paving	✓	Planted
✓	Setts	✓	Rough ground
✓	Bituminous Material		Other (specify)
✓	Tactile Paving		
✓	Other (specify)		

8. Changes of surface Isolated trees, wooded areas, limits of vegetation

✓	Bushes/shrubs above 2m diameter
✓	Isolated trees above 0.15m trunk diameter, (‡) above 0.1m
✓	Ornamental/road side trees, (‡) planting box shown
✓	(‡) Staked saplings (individual)
✓	Areas of saplings/young trees
✓	Edge of vegetation
✓	Woodlands perimeter trees/tree canopy only
✓	Tree/bush details required on the drawing or on schedule
✓	Height ... estimated
✓	Height ... measured
✓	Spread ... (canopy diameter)
✓	Trunk diameter/circumference/(girth) at 1.2m above ground
✓	Species
	Other special requirements

9. Pitches/recreation

✓	Pitch/playground limits only
✓	(†) Pitch markings, goal posts
✓	(†) Play ground apparatus

10. Private gardens or grounds (off-site areas)

This section relates to areas outside the main site.

	Buildings, surveyed in detail
	Buildings, generalised
	Inspection covers in domestic property
	(†) Door openings
	(†) Garden paths, patios, retaining walls
	Other (specify)

11. Water features

Water features surveyed in outline only, (†) surveyed in detail.

✓	Fountain
	Groynes/sea defences
	Harbour wall, breakwater
✓	High water mark
	Landing stage
✓	Lock, perimeter and gates
	Low water mark
	Mooring posts
	Navigation beacons
✓	Outfall pipes
	Pier, jetty
✓	Pond/lake
✓	Pond/lake, top of bank

✓	Pond/lake, bottom of bank
✓	Pond/lake, water level
✓	Pond/lake, bed level
✓	Pumps
✓	River, top of bank
✓	River, bottom of bank
✓	River, water level
✓	River, direction of flow
✓	River, bed level
	Shore line detail exposed at low tide
✓	Streams and ditches, top of bank
✓	Streams and ditches, bottom of bank
✓	Streams and ditches, water level
✓	Streams and ditches, direction of flow
✓	Streams and ditches, bed level
✓	Weirs/waterfalls, indicative features surveyed from the bank

12. Earth works

✓	Bank bottom
✓	Bank top
✓	Mounds, spoil heaps
✓	Quarries, pits and mineral workings (limit only)

	Quarries, pits and mineral workings, detailed survey
✓	Retaining wall, base
✓	Retaining wall, top
✓	Sloping masonry, bottom
✓	Sloping masonry, top
✓	Terraces
	Other (specify)

13. Industrial features

	Aerial
	Cable ducts (specify detail required)
	Chimneys
	Chimneys, (with height) (specify)
✓	Electric sub stations or transformers (perimeter fence only)
	Filter beds, limits only
	Flagstaffs
✓	Inspection pits
✓	Overhead pipes/cables, (†) height required
	Pipe work or ducts (specify detail required)
	Overhead line tower/freestanding mast or pylon
✓	(‡) Overhead line tower/freestanding mast or pylon, bases shown
	Tanks/storage chambers individually surveyed
✓	Tanks by bund walls or perimeter only
✓	(†) Flood lights

✓	(†) Water taps/Stand pipes/Troughs
✓	(‡) Earth rods
	Other (specify)

14. Railway features (with arranged access)

✓	Ballast shoulder
✓	Buffers/stop blocks
✓	Cabinets, switch boxes
	Cable ducts
✓	Catchpits
	Cess limits
✓	Electrified rails (indicative only)
✓	Gantries
	Height gauges
✓	Huts
✓	Mile posts
✓	Platform furniture
✓	Platforms
✓	Points and crossovers
✓	Power masts
✓	Rails (gauge faces)
	Refuges
✓	Signals
✓	Signal boxes
✓	Signs

✓	Telephones
✓	TV monitors/cameras
	(†) Gradient posts
	(†) Grease points
	(†) Grit bin
	(†) Point rods (symbolised)
	(†) Track (distance) markers
	(‡) Check rail (on curves or bridges)
	(‡) Non ducted cables
	(‡) Points box/lever
	Other (specify)

15. Other

Special requirements or special areas ...

Spot levels are required at the following locations, in addition to general spot levels, or to supplement information given by contours. Spot levels are also required for all the items indicated with a tick in Appendix B.

ONLY THE ITEMS INDICATED WITH A TICK WILL BE SURVEYED

✓	Banks, top and bottom at 10 m intervals
✓	Building/structure corners
✓	Ditches, streams, drains sections at 10 m intervals
✓	Floor/threshold levels
✓	Hilltops, depressions and saddles
✓	Inspection covers, gullies, ducts and conduits
✓	Railway lines, both rails/low rail/high rail at 10 m intervals
	Railways, centre of tracks at sleeper level, at ..... m intervals
✓	Road centreline, channel, kerb, pavement at 10 m intervals
✓	Steps and ramps, top and bottom
✓	Water levels (with date of survey) to rivers, streams, ponds, etc.
✓	Weirs, outfalls
✓	Other locations (Extra points on curves of small radii of channels, kerbs, traffic islands etc., and all points on steps, walls, traffic ramps etc.)

Appendix D: Bill Of Quantities

PREAMBLE TO THE BILL OF QUANTITIES

1. Documents mutually compatible

The Conditions of Contract, the Specification and the Drawings shall be read in conjunction with the Bill of Quantities. The work or material covered by items in the Bill of Quantities are as detailed in the Specification.

2. Stated quantities

The quantities set out in the Bill of Quantities are the estimated quantities of the work.

The quantities of work actually carried out shall be re-measured on completion of the Contract. For payment purposes the re-measured values shall be taken.

3. Errors in the bill

Any error in description in the Bill of Quantities or omission there from shall not release the Contractor from the execution of the whole or any part of the Works according to the Specification or from any of his obligations or liabilities under the Contract. Any such error or omission shall be corrected by the Engineer and the value of the work actually carried out shall be ascertained in accordance with the Contract, provided that there shall be no rectification of any errors, omissions or wrong estimates in the descriptions, rates and prices inserted by the Contractor in the Bill of Quantities. In the event of a discrepancy between the quantity, the Bill rate and the extended amount, the Bill rate as written shall be taken as correct.

4. Rates to include

Bill rates shall be deemed to include all travelling and subsistence allowances which are payable to the operatives employed during the course of the Survey.

Rates shall be deemed to include the costs of provision and operation of all necessary equipment and compliance with the Contract.

ITEM	DESCRIPTION	QUANT.	UNIT	RATE	AMOUNT (€)
	ADDRESS? **PAGE 1**				
1.	Provide for all necessary insurances.		Item		
2.	Provide for all safety precautions necessary to carry out the works.		Item		
3.	Provide for Traffic Management, including the provision of a traffic management plan complying with the requirements of the Office of the Director of Traffic, Dublin City Council and the Roads (Traffic and Transportation) Department of xxxx County Council.		Item		
4.	Install and establish Permanent Ground Markers to ITM and IG75 Grids as per Clause 2.2.2 and provide location diagrams and photographs with control network diagram and survey report as per Clauses 2.2 and 2.5 of Survey Specification.	?	No.		
5.	Install and establish Site Bench Marks to Malin Head Datum with location diagrams and photographs and prepare control network diagram with survey report as per Clauses 2.3 and 2.5 of Survey Specification.	?	No.		
6.	Survey Works Area and obtain all planimetric and height information as specified in Clause 2.4 of Survey Specification. Include for establishing chainage and cross section lines as per Clause 2.4.4.	Approx. ?	Sq.m.		
7.	Use of Customized SCC Dublin City Council Feature Library to process and check survey data and produce SCC ground models in both ITM and IG75 Grids, files and reports as per Clauses 3 and 4 of the Survey Specification		Item		
Total for Page 1 Carry forward to General Summary at end of bill					€

ITEM	DESCRIPTION	QUANT.	UNIT	RATE	AMOUNT (€)
	ADDRESS? **PAGE 2**				
8.	Provide proof A1 hard copy sets of ground model plan, long sections and cross sections for approval as per Clause 4.3.1 of the Survey Specification	2	No		
9.	Provide proof digital data sets of level records, drawings of ground model plan, long sections and cross sections, SCC files and survey data on computer compact discs for approval as per Clause 4.4.2 of the Survey Specification.	1	No		
10.	Provide final A1 hard copy sets of ground model plan, long sections and cross sections as per Clause 4.3.2 of the Survey Specification	1	No		
11.	Provide final digital data sets of level records, drawings of ground model plan, long sections and cross sections, SCC files and survey data on computer compact discs as per Clauses 4.4 and 4.5 of the Survey Specification.	1	No		
12.	Provide for keeping all survey records and data for 5 years as per Clause 1.5 of the Survey Specification.		Item		
Total for Page 2 Carry forward to General Summary at end of bill					**€**

Note : Reference to a Clause in Survey Specification includes all Sub-Clauses e.g. Clause 2.2 includes Sub-Clauses 2.2.1.to 2.2.4.6

BILL OF QUANTITIES

GENERAL SUMMARY

BROUGHT FORWARD	**AMOUNT (€)**
Address? **TOTAL PAGE 1**	
Address? **TOTAL PAGE 2**	
Address? **TENDER TOTAL**	

V.A.T. will be additional to the above price and will be charged at _____ %

Signed: _____

Company: _____
_____
_____
_____
_____

Date: _____

SCHEDULE OF RATES

The Contractor shall list hereunder the all-in rates for the various categories of survey staff on which the Bill of Quantities is based.

Survey Staff	**Rate per Hour (€)**
Production Manager	
Senior Land Surveyor	
Land Surveyor	
Assistant Surveyor	

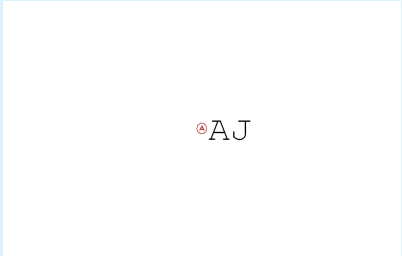
Appendix E: Feature Library

1

Feature: AJ1

Description: Armstrong Junction

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: SERV_AJ **MX Label:** PSAJ
This feature is 3D and is included in the TIN surface.
This feature is represented by the AV symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer SERV_AJ_FTR

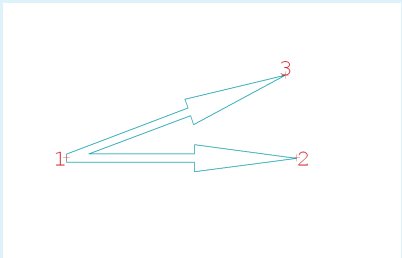


2

Feature: ARAHL

Description: Arrow Ahead Left (3 pt)

Linestyle: CONTINUOUS
Symbology: 3 Point Symbol
Colour: 3 (CYAN)
Layer: ROAD_MARKING **MX Label:** A1
This feature is 2D and is not included in the TIN surface.
This feature is represented by the AR_AH_L symbol

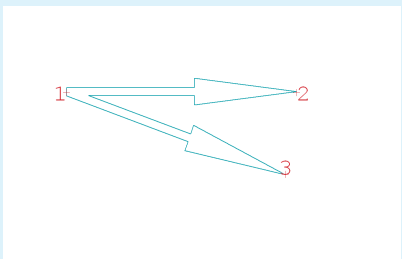


3

Feature: ARAHR

Description: Arrow Ahead Right (3 pt)

Linestyle: CONTINUOUS
Symbology: 3 Point Symbol
Colour: 3 (CYAN)
Layer: ROAD_MARKING **MX Label:** A2
This feature is 2D and is not included in the TIN surface.
This feature is represented by the AR_AH_R symbol

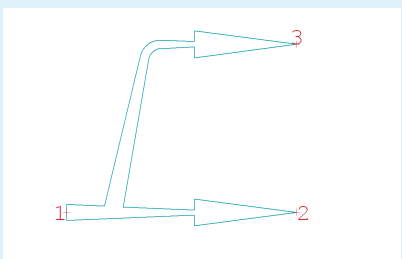


4

Feature: ARBE

Description: Arrow Bus Lane End (3 pt)

Linestyle: CONTINUOUS
Symbology: 3 Point Symbol
Colour: 3 (CYAN)
Layer: ROAD_MARKING **MX Label:** A3
This feature is 2D and is not included in the TIN surface.
This feature is represented by the AR_BUS_E symbol

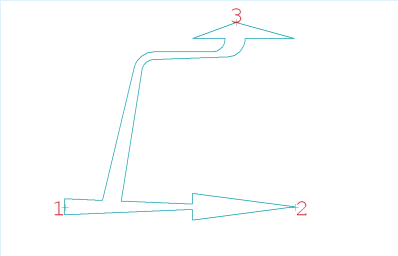


5

Feature: ARBL

Description: Arrow Bus Lane Str Left (3 pt)

Linestyle: CONTINUOUS
Symbology: 3 Point Symbol
Colour: 3 (CYAN)
Layer: ROAD_MARKING **MX Label:** A4
This feature is 2D and is not included in the TIN surface.
This feature is represented by the AR_BUS_L symbol

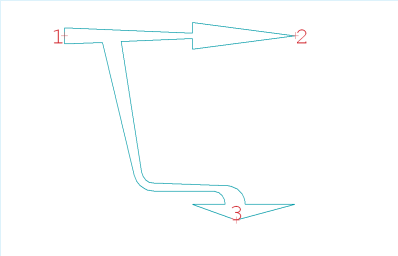


6

Feature: ARBR

Description: Arrow Bus Lane Str Right (3 pt

Linestyle: CONTINUOUS
Symbology: 3 Point Symbol
Colour: 3 (CYAN)
Layer: ROAD_MARKING **MX Label:** A5
This feature is 2D and is not included in the TIN surface.
This feature is represented by the AR_BUS_R symbol

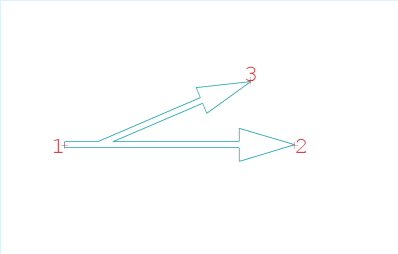


7

Feature: ARDL

Description: Arrow Left Diverge Lane (3 pt)

Linestyle: CONTINUOUS
Symbology: 3 Point Symbol
Colour: 3 (CYAN)
Layer: ROAD_MARKING **MX Label:** A6
This feature is 2D and is not included in the TIN surface.
This feature is represented by the AR_DIV_L symbol

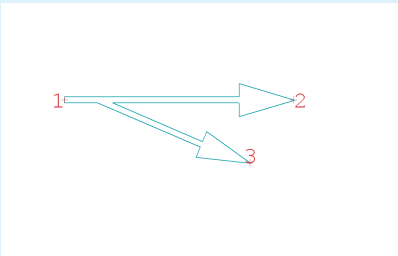


8

Feature: ARDR

Description: Arrow Right Diverge Lane (3 pt

Linestyle: CONTINUOUS
Symbology: 3 Point Symbol
Colour: 3 (CYAN)
Layer: ROAD_MARKING **MX Label:** A7
This feature is 2D and is not included in the TIN surface.
This feature is represented by the AR_DIV_R symbol

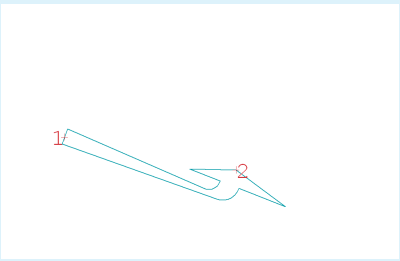


9

Feature: ARL

Description: Arrow Left Turn (2 pt)

Linestyle: CONTINUOUS
Symbology: 2 Point Symbol (Centre)
Colour: 3 (CYAN)
Layer: ROAD_MARKING **MX Label:** A8
This feature is 2D and is not included in the TIN surface.
This feature is represented by the AR_L symbol

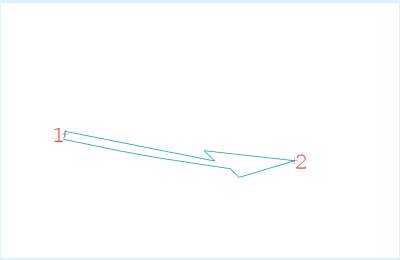


10

Feature: ARML

Description: Arrow Lane Merge Left (2 pt)

Linestyle: CONTINUOUS
Symbology: 2 Point Symbol (Centre)
Colour: 3 (CYAN)
Layer: ROAD_MARKING **MX Label:** A9
This feature is 2D and is not included in the TIN surface.
This feature is represented by the AR_MER_L symbol

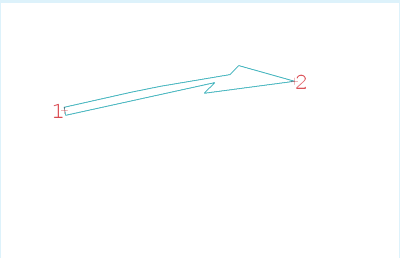


11

Feature: ARMR

Description: Arrow Lane Merge Right (2 pt)

Linestyle: CONTINUOUS
Symbology: 2 Point Symbol (Centre)
Colour: 3 (CYAN)
Layer: ROAD_MARKING **MX Label:** AA
This feature is 2D and is not included in the TIN surface.
This feature is represented by the AR_MER_R symbol

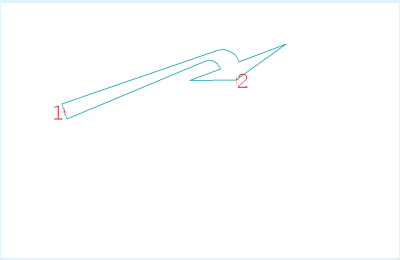


12

Feature: ARR

Description: Arrow Right Turn (2 pt)

Linestyle: CONTINUOUS
Symbology: 2 Point Symbol (Centre)
Colour: 3 (CYAN)
Layer: ROAD_MARKING **MX Label:** AB
This feature is 2D and is not included in the TIN surface.
This feature is represented by the AR_R symbol

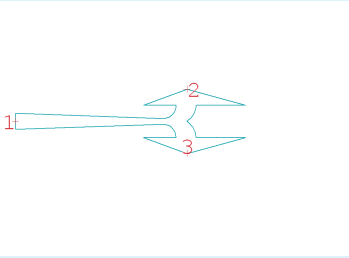


13

Feature: ARSD

Description: Arrow Left and Right (3 pt)

Linestyle: CONTINUOUS
Symbology: 3 Point Symbol
Colour: 3 (CYAN)
Layer: ROAD_MARKING **MX Label:** AC
This feature is 2D and is not included in the TIN surface.
This feature is represented by the AR_STR_D symbol

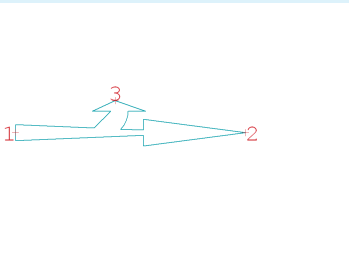


14

Feature: ARSL

Description: Arrow Straight Left (3 pt)

Linestyle: CONTINUOUS
Symbology: 3 Point Symbol
Colour: 3 (CYAN)
Layer: ROAD_MARKING **MX Label:** AD
This feature is 2D and is not included in the TIN surface.
This feature is represented by the AR_STR_L symbol

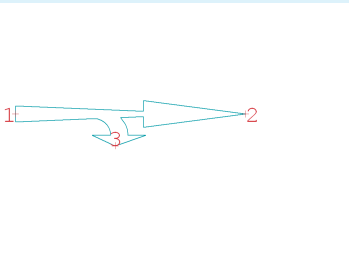


15

Feature: ARSR

Description: Arrow Straight Right (3 pt)

Linestyle: CONTINUOUS
Symbology: 3 Point Symbol
Colour: 3 (CYAN)
Layer: ROAD_MARKING **MX Label:** AE
This feature is 2D and is not included in the TIN surface.
This feature is represented by the AR_STR_R symbol

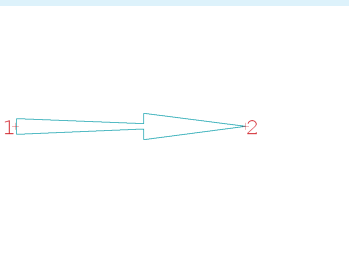


16

Feature: ARSTR

Description: Arrow Straight Ahead (2 pt)

Linestyle: CONTINUOUS
Symbology: 2 Point Symbol (Centre)
Colour: 3 (CYAN)
Layer: ROAD_MARKING **MX Label:** AF
This feature is 2D and is not included in the TIN surface.
This feature is represented by the AR_STR symbol



17

Feature: ARTX

Description: Text Arrow (2 pt)

Linestyle: CONTINUOUS
Symbology: 2 Point Symbol (Centre)
Colour: 0 (BLACK)
Layer: TEXT_ARROW **MX Label:** AT
This feature is 2D and is not included in the TIN surface.
This feature is represented by the ARRTEXT symbol which has a variable diameter defaulting to 1.000M

18

Feature: BB

Description: Bottom of Bank

Linestyle: DASHED
Symbology: None
Colour: 2 (GREEN)
Layer: BANK **MX Label:** BB
This feature is 3D and is included in the TIN surface.

19

Feature: BDA

Description: Bridge Abutment

Linestyle: CONTINUOUS
Symbology: None
Colour: 1 (BLUE)
Layer: BRIDGE_ABUTMENT **MX Label:** BA
This feature is 3D and is included in the TIN surface.

20

Feature: BDD

Description: Bridge Deck

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: BRIDGE_DECK **MX Label:** BD
This feature is 3D and is included in the TIN surface.

21

Feature: BDP

Description: Bridge Parapet

Linestyle: CONTINUOUS
Symbology: None
Colour: 1 (BLUE)
Layer: BRIDGE_PARAPET **MX Label:** BP
This feature is 3D and is included in the TIN surface.

22

Feature: BDR

Description: Bridge Railing

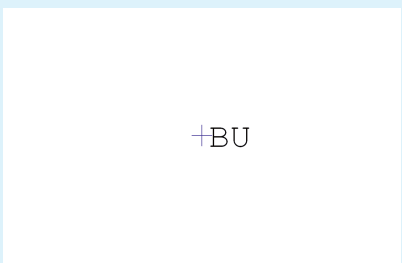
Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: BRIDGE_RAILING **MX Label:** BR
This feature is 3D and is included in the TIN surface.

23

Feature: BDS1

Description: Bridge Soffit (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 1 (BLUE)
Layer: BRIDGE_SOFFIT **MX Label:** PBFT
This feature is 3D and is included in the TIN surface.
This feature is represented by the SPOT symbol which has a variable size defaulting to 1.5mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer BRIDGE_SOFFIT_FTR



24

Feature: BDW

Description: Bridge Wall

Linestyle: CONTINUOUS
Symbology: None
Colour: 1 (BLUE)
Layer: BRIDGE_WALL **MX Label:** BW
This feature is 3D and is included in the TIN surface.

25

Feature: BDY

Description: Boundary Line

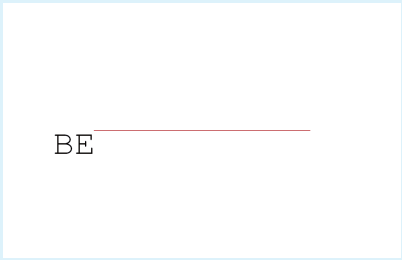
Linestyle: DASHED
Symbology: None
Colour: 4 (RED)
Layer: BOUNDARY_LINE **MX Label:** BL
This feature is 3D and is included in the TIN surface.

26

Feature: BE

Description: Bench

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: FURN_BENCH **MX Label:** BE
This feature is 3D and is included in the TIN surface.



Feature text is displayed at the Right Top of the survey point aligned along the string. This text is only placed on the first point of the string. Text layer FURN_BENCH_FTR

27

Feature: BG

Description: Building

Linestyle: CONTINUOUS
Symbology: None
Colour: 1 (BLUE)
Layer: BUILDING **MX Label:** BG
This feature is 3D and is included in the TIN surface.

28

Feature: BGC

Description: Building Canopy

Linestyle: DASHED
Symbology: None
Colour: 1 (BLUE)
Layer: BUILDING_CANOPY **MX Label:** BC
This feature is 3D and is included in the TIN surface.

29

Feature: BH1

Description: Borehole (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: BOREHOLE **MX Label:** PBOH
This feature is 3D and is included in the TIN surface.
This feature is represented by the BOREHOLE symbol which has a variable size defaulting to 1.5mm

30

Feature: BIN1

Description: Bin (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_BIN **MX Label:** PBIN
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_CIR1 symbol which has a variable size defaulting to 1.5mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_BIN_FTR

31

Feature: BLD1

Description: Boulder (1pt)

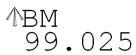
Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_BOULDER **MX Label:** PBDR
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_CIR2 symbol which has a fixed size of 0.8mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_BOULDER_FTR

32

Feature: BM1

Description: Survey Bench Mark (1pt)

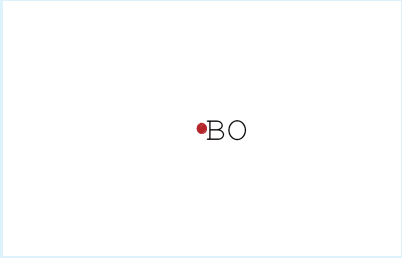
Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 0 (BLACK)
Layer: SURVEY_BM **MX Label:** PBMK
This feature is 3D and is included in the TIN surface.
This feature is represented by the B_MARK symbol which has a variable size defaulting to 1.5mm
Level text is displayed 1.0mm left of2.0mm below the Left Centre of the survey point aligned along the sheet. Text layer SURVEY_BM_LVL
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer SURVEY_BM_FTR



33

Feature: BOC1

Description: Bollard Circle (1pt)

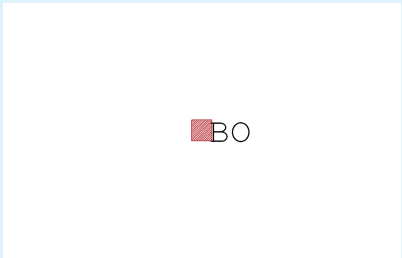


Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_BOLLARD **MX Label:** PBOC
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_CIR2 symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 0.5mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_BOLLARD_FTR

34

Feature: BOS1

Description: Bollard Square (1pt)

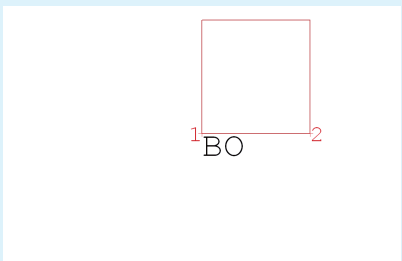


Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_BOLLARD **MX Label:** PBOS
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_SQR2 symbol which has a variable size defaulting to 1.5mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_BOLLARD_FTR

35

Feature: BOS2

Description: Bollard Square (2pt+w)



Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: FURN_BOLLARD **MX Label:** BO
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the grid. This text is only placed on the first point of the string. Text layer FURN_BOLLARD_FTR

36

Feature: BOX1

Description: Box (1pt)

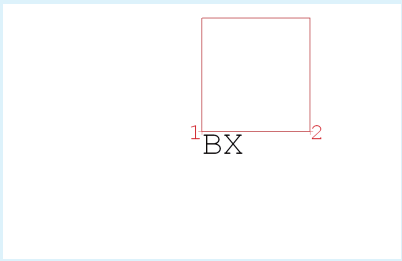
Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_BOX **MX Label:** PBOX
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_SQR1 symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_BOX_FTR

37

Feature: BOX2

Description: Box (2pt+w)

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: FURN_BOX **MX Label:** BX
This feature is 3D and is included in the TIN surface.



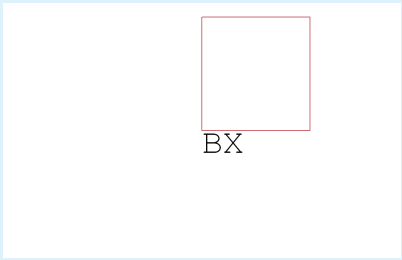
Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the grid. This text is only placed on the first point of the string. Text layer FURN_BOX_FTR

38

Feature: BOX3

Description: Box (3pt)

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: FURN_BOX **MX Label:** BX
This feature is 3D and is included in the TIN surface.



Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer FURN_BOX_FTR

39

Feature: BP

Description: Back of Path

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: BACK_OF_PATH **MX Label:** BF
This feature is 3D and is included in the TIN surface.

40

Feature: BS1

Description: Bus Stop (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_BUS_STOP **MX Label:** PBUS
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_CIR1 symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_BUS_STOP_FTR

41

Feature: BSL

Description: Bus Lane

Linestyle: CONTINUOUS
Symbology: None
Colour: 3 (CYAN)
Layer: LANA_BUS **MX Label:** LB
This feature is 3D and is included in the TIN surface.

42

Feature: BSLD

Description: Bus Lane Dashed

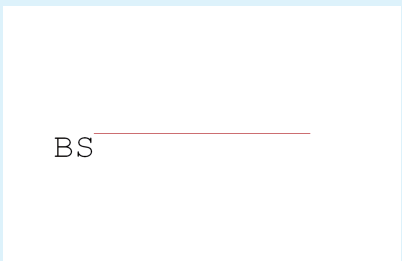
Linestyle: DASHED
Symbology: None
Colour: 3 (CYAN)
Layer: LANA_BUS **MX Label:** LN
This feature is 3D and is included in the TIN surface.

43

Feature: BSS

Description: Bus Shelter

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: FURN_BUS_STOP **MX Label:** BS
This feature is 3D and is included in the TIN surface.



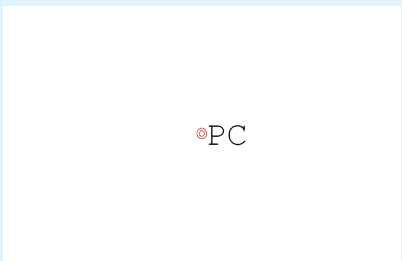
Feature text is displayed at the Right Top of the survey point aligned along the string. This text is only placed on the first point of the string. Text layer FURN_BUS_STOP_FTR

44

Feature: CAM1

Description: Camera (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_POLE_CAMERA **MX Label:** PCAM
This feature is 3D and is included in the TIN surface.
This feature is represented by the BUS_STOP symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 0.5mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_POLE_CAMERA_FTR



45

Feature: CC

Description: Channel Concrete Line

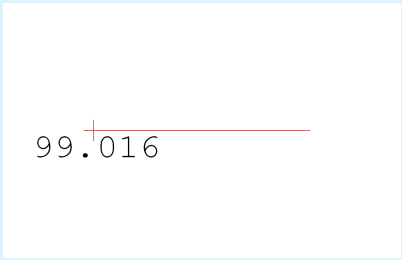
Linestyle: DASHED2
Symbology: None
Colour: 1 (BLUE)
Layer: CHANNEL_CONCRETE **MX Label:** CC
This feature is 3D and is included in the TIN surface.

46

Feature: CE

Description: Cellar (Basement)

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: CELLAR **MX Label:** CE
This feature is 3D and is included in the TIN surface.



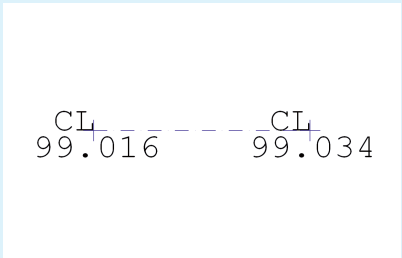
Level text is displayed 0.5mm below the Centre Top of the survey point aligned along the string. This text is only placed on the first point of the string. Text layer CELLAR_LVL

47

Feature: CL

Description: Road Centreline

Linestyle: DASHDOT
Symbology: None
Colour: 1 (BLUE)
Layer: ROAD_CL **MX Label:** CL
This feature is 3D and is included in the TIN surface.



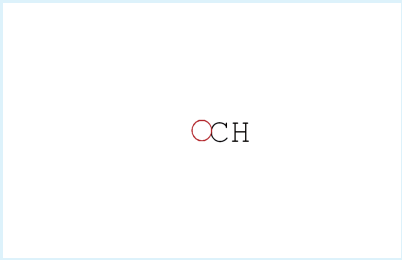
Level text is displayed 0.5mm below the Centre Top of the survey point aligned along the string. Text layer ROAD_CL_LVL
Feature text is displayed at the Right Bottom of the survey point aligned along the string. This text is placed on the first and last points of the string. Text layer ROAD_CL_FTR

48

Feature: CLH1

Description: Coal Hole (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_COAL_HOLE **MX Label:** PCOH
This feature is 3D and is included in the TIN surface.



This feature is represented by the MH_CIR1 symbol which has a variable size defaulting to 1.5mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_COAL_HOLE_FTR

49

Feature: CM

Description: Channel Mastic Line

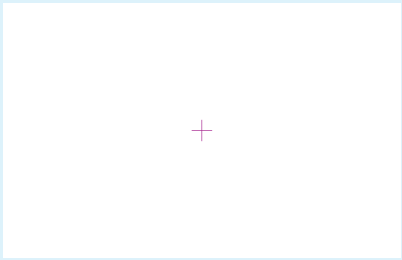
Linestyle: DASHED2
Symbology: None
Colour: 1 (BLUE)
Layer: CHANNEL_MASTIC **MX Label:** CM
This feature is 3D and is included in the TIN surface.

50

Feature: CUI1

Description: Culvert Invert (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 5 (MAGENTA)
Layer: CULVERT_INVERT **MX Label:** PCIV
This feature is 3D and is included in the TIN surface.
This feature is represented by the SPOT symbol which has a variable size defaulting to 1.5mm

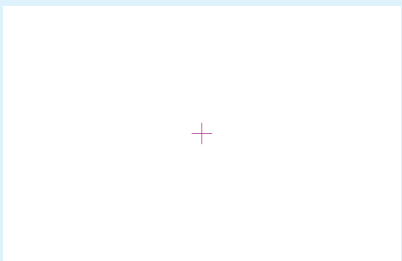


51

Feature: CUS1

Description: Culvert Soffit (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 5 (MAGENTA)
Layer: CULVERT_SOFFIT **MX Label:** PCSF
This feature is 3D and is included in the TIN surface.
This feature is represented by the SPOT symbol which has a variable size defaulting to 1.5mm



52

Feature: CUW

Description: Culvert Wall

Linestyle: CONTINUOUS
Symbology: None
Colour: 5 (MAGENTA)
Layer: CULVERT_WALL **MX Label:** CW
This feature is 3D and is included in the TIN surface.

53

Feature: CYC

Description: Cycleway Edge

Linestyle: CONTINUOUS
Symbology: None
Colour: 3 (CYAN)
Layer: CYCLEWAY **MX Label:** CY
This feature is 3D and is included in the TIN surface.

54

Feature: CYC11

Description: Cycle Logo 1.1m wide (2 pt)

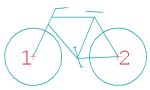
Linestyle: CONTINUOUS
Symbology: 2 Point Symbol (Centre)
Colour: 3 (CYAN)
Layer: ROAD_MARKING **MX Label:** CS
This feature is 3D and is included in the TIN surface.
This feature is represented by the CYC symbol which has a variable diameter defaulting to 1.776M

55

Feature: CYC17

Description: Cycle Logo 1.7m wide (2 pt)

Linestyle: CONTINUOUS
Symbology: 2 Point Symbol (Centre)
Colour: 3 (CYAN)
Layer: ROAD_MARKING **MX Label:** CB
This feature is 3D and is included in the TIN surface.
This feature is represented by the CYC symbol which has a variable diameter defaulting to 2.750M



56

Feature: CYCD

Description: Cycleway Edge Dashed

Linestyle: DASHED
Symbology: None
Colour: 3 (CYAN)
Layer: CYCLEWAY **MX Label:** CD
This feature is 3D and is included in the TIN surface.

57

Feature: DH

Description: Ditch Bed Level

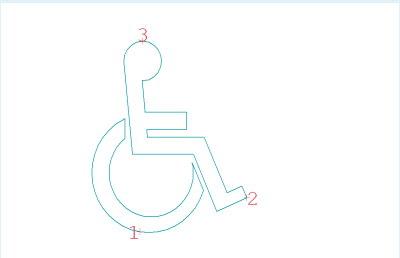
Linestyle: DASHED
Symbology: None
Colour: 2 (GREEN)
Layer: DITCH **MX Label:** DI
This feature is 3D and is included in the TIN surface.

58

Feature: DIS

Description: Disabled Parking Symbol (3 pt)

Linestyle: CONTINUOUS
Symbology: 3 Point Symbol
Colour: 3 (CYAN)
Layer: ROAD_MARKING **MX Label:** DS
This feature is 2D and is not included in the TIN surface.
This feature is represented by the WCHAIR symbol



59

Feature: DP1

Description: Down Pipe (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_DOWN_PIPE **MX Label:** PDWN
This feature is 3D and is included in the TIN surface.
This feature is represented by the TP symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 0.5mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_DOWN_PIPE_FTR

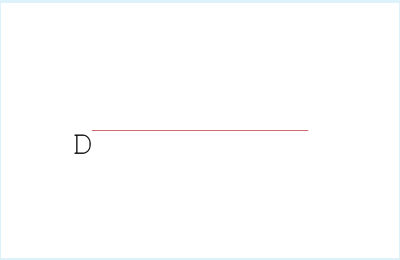
60

Feature: DR

Description: Door

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: DOOR **MX Label:** D
This feature is 3D and is included in the TIN surface.

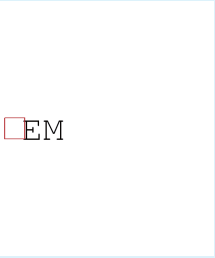
Feature text is displayed at the Right Top of the survey point aligned along the string. This text is only placed on the first point of the string. Text layer DOOR_FTR



61

Feature: EIR1

Description: Eircom Cover (1pt)

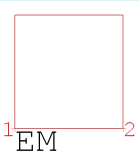


Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: SERV_COVER_EIRCOM **MX Label:** PEIM
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_SQR1 symbol which has a variable size defaulting to 1.5mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer SERV_COVER_EIRCOM_FTR

62

Feature: EIR2

Description: Eircom Cover (2pt+w)



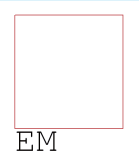
Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_COVER_EIRCOM **MX Label:** EM
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the grid. This text is only placed on the first point of the string. Text layer SERV_COVER_EIRCOM_FTR

63

Feature: EIR3

Description: Eircom Cover (3pt)



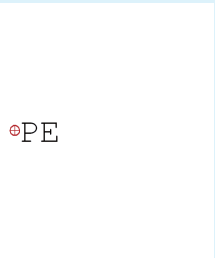
Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_COVER_EIRCOM **MX Label:** EM
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer SERV_COVER_EIRCOM_FTR

64

Feature: EP1

Description: ESB Pole (1pt)



Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_POLE_ESB **MX Label:** PEPL
This feature is 3D and is included in the TIN surface.
This feature is represented by the EP symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 0.5mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_POLE_ESB_FTR

65

Feature: EPL1

Description: ESB Pole Large (1pt)

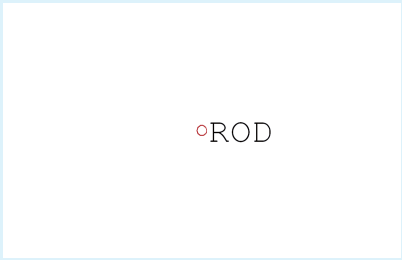
Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_POLE_ESB **MX Label:** PESL
This feature is 3D and is included in the TIN surface.
This feature is represented by the EP symbol which has a fixed diameter of 0.600M
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_POLE_ESB_FTR

66

Feature: ER1

Description: Earthing Rod

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: SERV_ROD **MX Label:** PROD
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_CIR1 symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer SERV_ROD_FTR

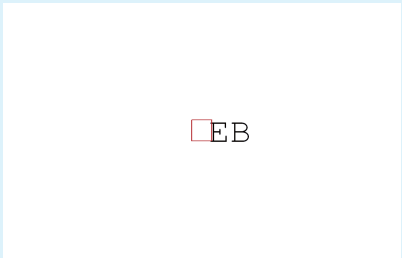


67

Feature: ESB1

Description: ESB Cover (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: SERV_COVER_ESB **MX Label:** PESB
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_SQR1 symbol which has a variable size defaulting to 1.5mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer SERV_COVER_ESB_FTR



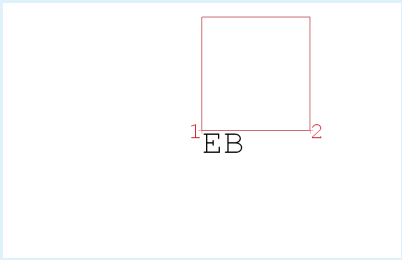
68

Feature: ESB2

Description: ESB Cover (2pt+w)

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_COVER_ESB **MX Label:** EB
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the grid. This text is only placed on the first point of the string. Text layer SERV_COVER_ESB_FTR

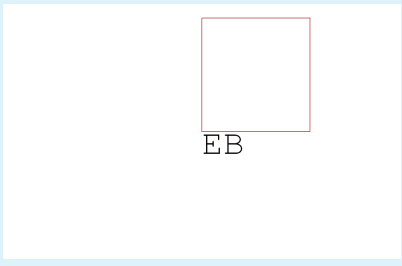


69

Feature: ESB3

Description: ESB Cover (3 point)

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_COVER_ESB **MX Label:** EB
This feature is 3D and is included in the TIN surface.



Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer SERV_COVER_ESB_FTR

70

Feature: EST1

Description: ESAT Cover (1pt)

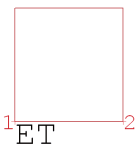
Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: SERV_COVER_ESAT **MX Label:** PEST
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_SQR1 symbol which has a variable size defaulting to 1.5mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer SERV_COVER_ESAT_FTR

71

Feature: EST2

Description: ESAT Cover (2pt+w)

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_COVER_ESAT **MX Label:** ET
This feature is 3D and is included in the TIN surface.



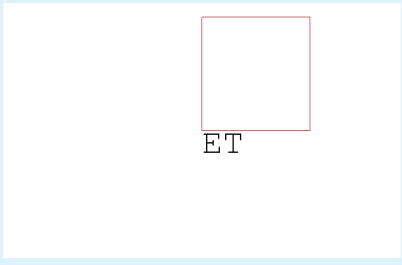
Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the grid. This text is only placed on the first point of the string. Text layer SERV_COVER_ESAT_FTR

72

Feature: EST3

Description: ESAT Cover (3 point)

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_COVER_ESAT **MX Label:** ET
This feature is 3D and is included in the TIN surface.



Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer SERV_COVER_ESAT_FTR

73

Feature: F

Description: Fence

Linestyle: DASHDOT
Symbology: None
Colour: 4 (RED)
Layer: FENCE **MX Label:** FE
This feature is 3D and is included in the TIN surface.

74

Feature: FB1

Description: Flower Box (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_FLOWER **MX Label:** PFWB
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_SQR1 symbol which has a variable size defaulting to 1.0mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_FLOWER_FTR

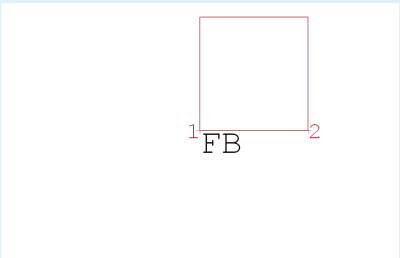
75

Feature: FB2

Description: Flower Box (2pt+w)

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: FURN_FLOWER **MX Label:** FB
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer FURN_FLOWER_FTR



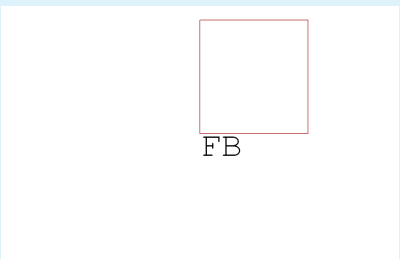
76

Feature: FB3

Description: Flower Box (3pt)

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: FURN_FLOWER **MX Label:** FB
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer FURN_FLOWER_FTR

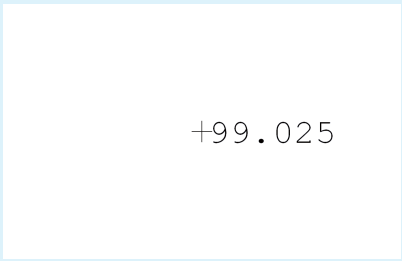


77

Feature: FFL1

Description: Floor Level (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 0 (BLACK)
Layer: LEVEL_FLOOR **MX Label:** PFLL
This feature is 3D and is included in the TIN surface.
This feature is represented by the SPOT symbol which has a variable size defaulting to 1.5mm
Level text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet. Text layer LEVEL_FLOOR_LVL



78

Feature: FL

Description: Form Line

Linestyle: DASHED2
Symbology: None
Colour: 3 (CYAN)
Layer: FORM_LINE **MX Label:** FL
This feature is 3D and is included in the TIN surface.

79

Feature: FM

Description: Climbing Frame

Linestyle: DASHED
Symbology: None
Colour: 4 (RED)
Layer: FURN_CFRAME **MX Label:** FM
This feature is 3D and is included in the TIN surface.

Feature text is displayed at the Right Top of the survey point aligned along the string. This text is placed on the first and last points of the string. Text layer FURN_CFRAME_FTR

80

Feature: FP

Description: Footpath

Linestyle: DASHED
Symbology: None
Colour: 4 (RED)
Layer: FOOTPATH **MX Label:** FP
This feature is 3D and is included in the TIN surface.

81

Feature: GA

Description: Gate

Linestyle: CONTINUOUS
Symbology: 2 Point Symbol (Centre)
Colour: 4 (RED)
Layer: GATE **MX Label:** GA
This feature is 3D and is included in the TIN surface.
This feature is represented by the GATE symbol which has a fixed size of 5.0mm

82

Feature: GAS1

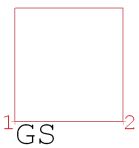
Description: Gas Cover (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: SERV_COVER_GAS **MX Label:** PGAS
This feature is 3D and is included in the TIN surface.
This feature is represented by the GAS_SQ symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 0.5mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer SERV_COVER_GAS_FTR

83

Feature: GAS2

Description: Gas Cover (2pt+w)



Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_COVER_GAS **MX Label:** GS
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer SERV_COVER_GAS_FTR

84

Feature: GAS3

Description: Gas Cover (3pt)

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_COVER_GAS **MX Label:** GS
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer SERV_COVER_GAS_FTR

85

Feature: GLASS

Description: Glasshouse

Linestyle: CONTINUOUS
Symbology: None
Colour: 0 (BLACK)
Layer: GLASSHOUSE **MX Label:** PGHS
This feature is 3D and is included in the TIN surface.

Feature text is displayed at the Right Top of the survey point aligned along the string. This text is placed on the first and last points of the string. Text layer GLASSHOUSE_FTR

86

Feature: GP

Description: Gate Post

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: GATE **MX Label:** PGAT
This feature is 3D and is included in the TIN surface.
This feature is represented by the EP symbol which has a variable size defaulting to 1.5mm

87

Feature: GV1

Description: Gas Valve (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: SERV_COVER_GAS **MX Label:** PGSV
This feature is 3D and is included in the TIN surface.
This feature is represented by the GAS_V symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 0.5mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer SERV_COVER_GAS_FTR

88

Feature: GY

Description: Gully String

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_GULLY **MX Label:** G
This feature is 3D and is included in the TIN surface.

Feature text is displayed at the Right Bottom of the survey point aligned along the string. This text is only placed on the first point of the string. Text layer SERV_GULLY_FTR

89

Feature: GY1

Description: Gully (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: SERV_GULLY **MX Label:** PGLY
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_SQR1 symbol which has a variable size defaulting to 1.5mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer SERV_GULLY_FTR

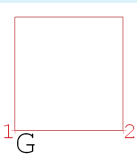
90

Feature: GY2

Description: Gully (2pt+w)

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_GULLY **MX Label:** G
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer SERV_GULLY_FTR



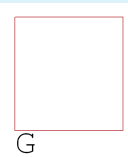
91

Feature: GY3

Description: Gully (3 pt)

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_GULLY **MX Label:** G
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer SERV_GULLY_FTR



92

Feature: H

Description: Hedge

Linestyle: CONTINUOUS
Symbology: None
Colour: 2 (GREEN)
Layer: HEDGE **MX Label:** HE
This feature is 3D and is included in the TIN surface.

93

Feature: HC

Description: Hedge C/L

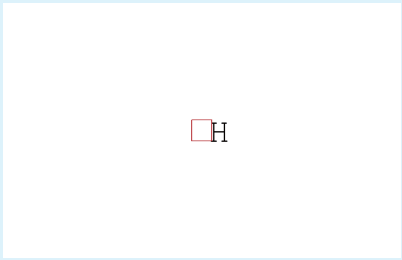
Linestyle: DASHED
Symbology: None
Colour: 2 (GREEN)
Layer: HEDGE **MX Label:** HC
This feature is 3D and is included in the TIN surface.

94

Feature: HYD1

Description: Fire Hydrant Cover (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: SERV_FH **MX Label:** PHYD
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_SQR1 symbol which has a variable size defaulting to 1.5mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer SERV_FH_FTR



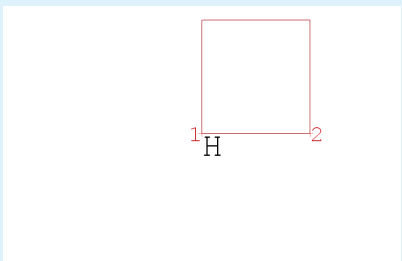
95

Feature: HYD2

Description: Fire Hydrant Cover (2pt+w)

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_FH **MX Label:** HY
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer SERV_FH_FTR



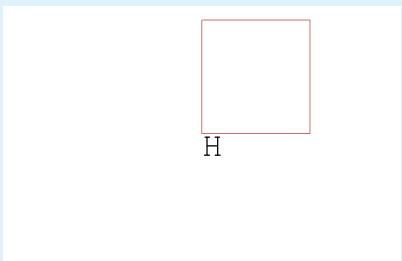
96

Feature: HYD3

Description: Fire Hydrant Cover (3pt)

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_FH **MX Label:** HY
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer SERV_FH_FTR



97

Feature: IC1

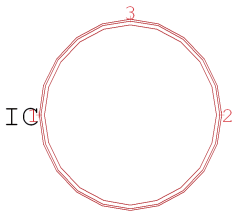
Description: Inspection Cover Circle (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: SERV_IC **MX Label:** PICC
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_CIR1 symbol which has a variable size defaulting to 1.5mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer SERV_IC_FTR

98

Feature: IC3

Description: Inspection Cover Circle (3pt)

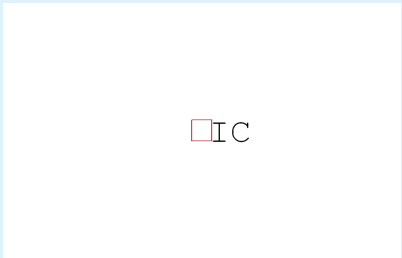


Linestyle: CONTINUOUS
Symbology: 3 Point Symbol
Colour: 4 (RED)
Layer: SERV_IC **MX Label:** IC
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_CIR1 symbol
Feature text is displayed at the Right Centre of the survey point aligned along the sheet. This text is only placed on the first point of the string. Text layer SERV_IC_FTR

99

Feature: ICR1

Description: Inspection Cover Rectangle (1p)

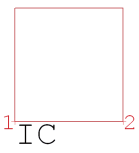


Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: SERV_IC **MX Label:** PICR
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_SQR1 symbol which has a variable size defaulting to 1.5mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer SERV_IC_FTR

100

Feature: ICR2

Description: Inspection CoverRectangle (2pt



Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_IC **MX Label:** IR
This feature is 3D and is included in the TIN surface.

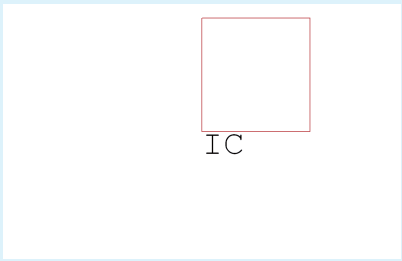
Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer SERV_IC_FTR

101

Feature: ICR3

Description: Inspection CoverRectangle (3pt

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_IC **MX Label:** IR
This feature is 3D and is included in the TIN surface.



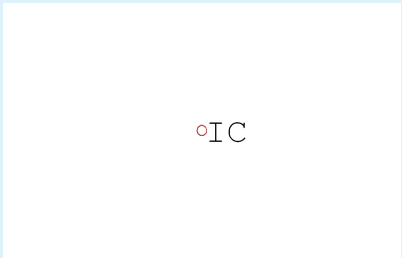
Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer SERV_IC_FTR

102

Feature: ICS1

Description: InspectionCoverCircleSmall(1pt

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: SERV_IC **MX Label:** PICS
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_CIR1 symbol which has a variable size defaulting to 0.8mm



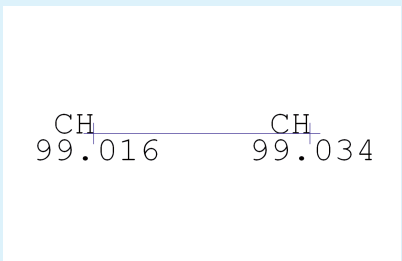
Feature text is displayed 0.5mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer SERV_IC_FTR

103

Feature: KC

Description: Kerb Channel Line

Linestyle: CONTINUOUS
Symbology: None
Colour: 1 (BLUE)
Layer: KERB_CHANNEL **MX Label:** CH
This feature is 3D and is included in the TIN surface.



Level text is displayed 0.5mm below the Centre Top of the survey point aligned along the string. Text layer KERB_CHANNEL_LVL
Feature text is displayed at the Right Bottom of the survey point aligned along the string. This text is placed on the first and last points of the string. Text layer KERB_CHANNEL_FTR

104

Feature: KT

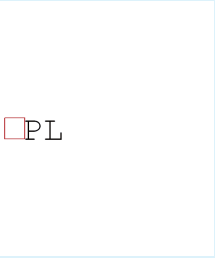
Description: Kerb Top

Linestyle: DASHED
Symbology: None
Colour: 14 (YELLOW)
Layer: KERB_TOP **MX Label:** KT
This feature is 3D and is included in the TIN surface.

105

Feature: LC1

Description: Public Lighting Cover (1pt)

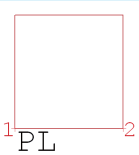


Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: SERV_COVER_PL **MX Label:** PPLC
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_SQR1 symbol which has a variable size defaulting to 1.5mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer SERV_COVER_PL_FTR

106

Feature: LC2

Description: Public Lighting Cover (2pt+w)



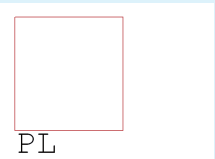
Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_COVER_PL **MX Label:** LC
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer SERV_COVER_PL_FTR

107

Feature: LC3

Description: Public Lighting Cover (3pt)



Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_COVER_PL **MX Label:** LC
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer SERV_COVER_PL_FTR

108

Feature: LND

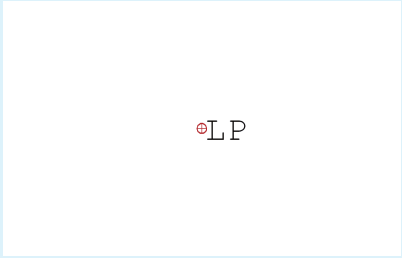
Description: Landing

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: LANDING **MX Label:** LD
This feature is 3D and is included in the TIN surface.

109

Feature: LP1

Description: Lamp Post (1pt)



Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_LAMP_POST **MX Label:** PLMP
This feature is 3D and is included in the TIN surface.
This feature is represented by the EP symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 0.5mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_LAMP_POST_FTR

110

Feature: LPL1

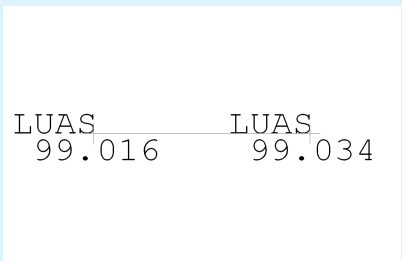
Description: Lamp Post Large (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_LAMP_POST **MX Label:** PLPL
This feature is 3D and is included in the TIN surface.
This feature is represented by the EP symbol which has a fixed diameter of 0.750M
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_LAMP_POST_FTR

111

Feature: LU

Description: LUAS Track



Linestyle: CONTINUOUS
Symbology: None
Colour: 7 (LIGHT GRAY)
Layer: LUAS **MX Label:** LU
This feature is 3D and is included in the TIN surface.

Level text is displayed 0.5mm below the Centre Top of the survey point aligned along the string. Text layer LUAS_LVL
Feature text is displayed at the Right Bottom of the survey point aligned along the string. This text is placed on the first and last points of the string. Text layer LUAS_FTR

112

Feature: LUS

Description: LUAS Shelter

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: FURN_LUAS_STOP **MX Label:** LUS
This feature is 3D and is included in the TIN surface.

Feature text is displayed at the Right Top of the survey point aligned along the string. This text is only placed on the first point of the string. Text layer FURN_LUAS_STOP_FTR

113

Feature: MHC1

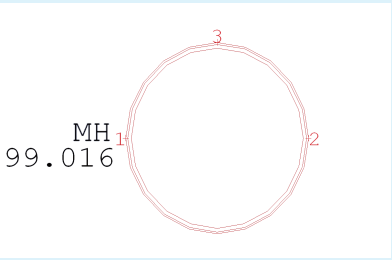
Description: Manhole Circle (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: SERV_MH **MX Label:** PMHC
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_CIR2 symbol which has a fixed diameter of 0.600M
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer SERV_MH_FTR

114

Feature: MHC3

Description: Manhole Circle (3pt)



Linestyle: CONTINUOUS
Symbology: 3 Point Symbol
Colour: 4 (RED)
Layer: SERV_MH **MX Label:** MC
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_CIR1 symbol
Level text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet. This text is only placed on the first point of the string. Text layer SERV_MH_LVL
Feature text is displayed at the Left Centre of the survey point aligned along the sheet. This text is only placed on the first point of the string. Text layer SERV_MH_FTR

115

Feature: MHR1

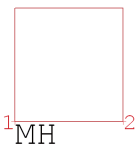
Description: Manhole Rectangle (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: SERV_MH **MX Label:** PMHR
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_SQR2 symbol which has a fixed diameter of 0.600M
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer SERV_MH_FTR

116

Feature: MHR2

Description: Manhole Rectangle (2pt+w)



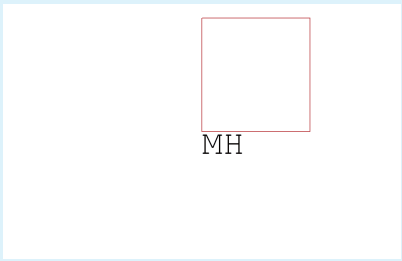
Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_MH **MX Label:** MR
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer SERV_MH_FTR

117

Feature: MHR3

Description: Manhole Rectangle (3pt)



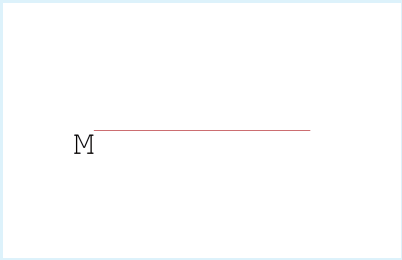
Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_MH **MX Label:** MR
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer SERV_MH_FTR

118

Feature: MON

Description: Monument



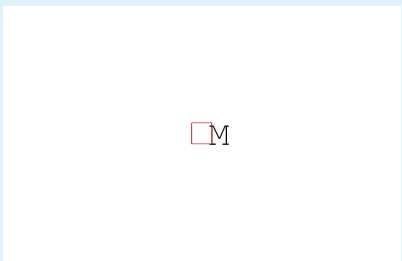
Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: FURN_MONUMENT **MX Label:** MN
This feature is 3D and is included in the TIN surface.

Feature text is displayed at the Right Top of the survey point aligned along the string. This text is only placed on the first point of the string. Text layer FURN_MONUMENT_FTR

119

Feature: MON1

Description: Monument (1pt)

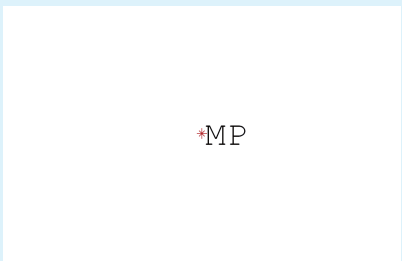


Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_MONUMENT **MX Label:** PMNT
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_SQR1 symbol which has a variable size defaulting to 1.5mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_MONUMENT_FTR

120

Feature: MP1

Description: Marker Post (1pt)

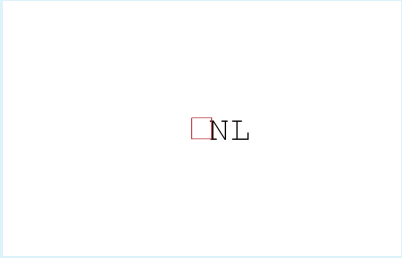


Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_MARKER_POST **MX Label:** PMKP
This feature is 3D and is included in the TIN surface.
This feature is represented by the MARKER symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 0.5mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_MARKER_POST_FTR

121

Feature: NTL1

Description: NTL Cover (1pt)

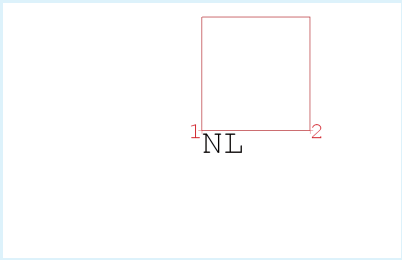


Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: SERV_COVER_NTL **MX Label:** PNTL
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_SQR1 symbol which has a variable size defaulting to 1.5mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer SERV_COVER_NTL_FTR

122

Feature: NTL2

Description: NTL Cover (2pt+w)



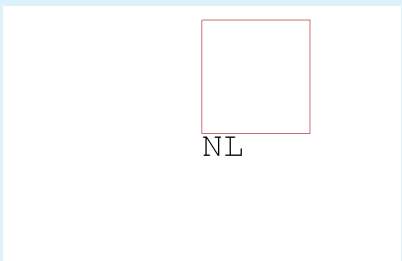
Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_COVER_NTL **MX Label:** NT
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer SERV_COVER_NTL_FTR

123

Feature: NTL3

Description: NTL Cover (3pt)



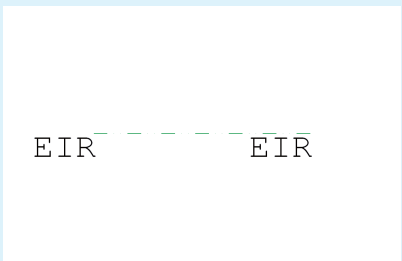
Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_COVER_NTL **MX Label:** NT
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer SERV_COVER_NTL_FTR

124

Feature: OE

Description: Line Eircom Overhead



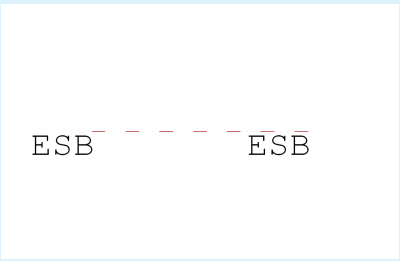
Linestyle: DIVIDE
Symbology: None
Colour: 2 (GREEN)
Layer: LINE_EIRCOM **MX Label:** OE
This feature is 2D and is not included in the TIN surface.

Feature text is displayed at the Right Top of the survey point aligned along the string. This text is placed on the first and last points of the string. Text layer LINE_EIRCOM_FTR

125

Feature: OESB

Description: Line ESB Overhead



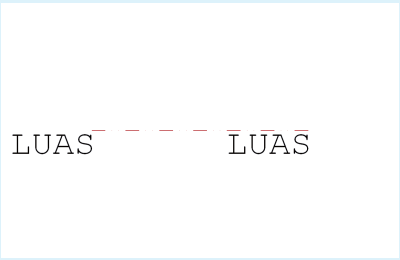
Linestyle: DIVIDE
Symbology: None
Colour: 4 (RED)
Layer: LINE_ESB **MX Label:** OS
This feature is 2D and is not included in the TIN surface.

Feature text is displayed at the Right Top of the survey point aligned along the string. This text is placed on the first and last points of the string. Text layer LINE_ESB_FTR

126

Feature: OLU

Description: Line LUAS Overhead



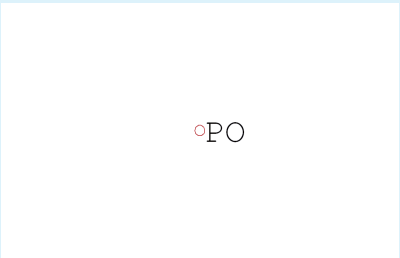
Linestyle: DIVIDE
Symbology: None
Colour: 4 (RED)
Layer: LINE_LUAS **MX Label:** OL
This feature is 2D and is not included in the TIN surface.

Feature text is displayed at the Right Top of the survey point aligned along the string. This text is placed on the first and last points of the string. Text layer LINE_LUAS_FTR

127

Feature: P1

Description: Post (1pt)



Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_POST **MX Label:** POST
This feature is 3D and is included in the TIN surface.
This feature is represented by the CIRCL symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 0.5mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_POST_FTR

128

Feature: PBX1

Description: Phone Box (1pt)

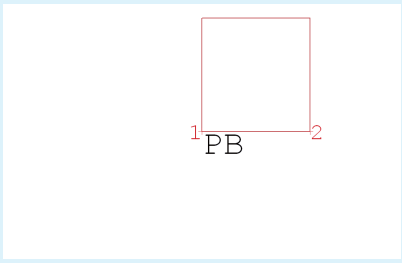
Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_PHONE **MX Label:** PPBX
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_SQR1 symbol which has a variable size defaulting to 1.5mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_PHONE_FTR

129

Feature: PBX2

Description: Phone Box (2pt+w)

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: FURN_PHONE **MX Label:** B3
This feature is 3D and is included in the TIN surface.



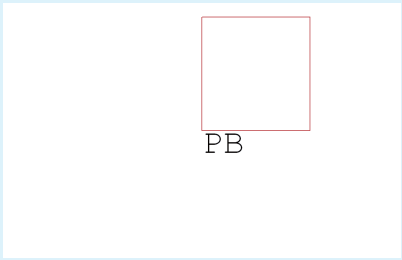
Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer FURN_PHONE_FTR

130

Feature: PBX3

Description: Phone Box (3pt)

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: FURN_PHONE **MX Label:** B3
This feature is 3D and is included in the TIN surface.



Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer FURN_PHONE_FTR

131

Feature: PCR

Description: Pedestrian Crossing

Linestyle: CONTINUOUS
Symbology: None
Colour: 3 (CYAN)
Layer: ROAD_MARKING **MX Label:** CR
This feature is 2D and is not included in the TIN surface.

132

Feature: PIP1

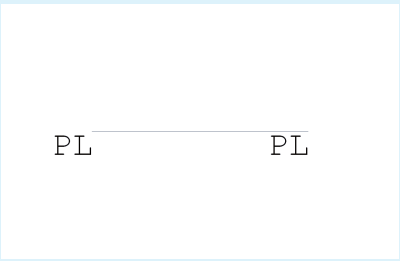
Description: Pipe (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: SERV_PIPE **MX Label:** PIPE
This feature is 3D and is included in the TIN surface.
This feature is represented by the CIRCL symbol which has a fixed diameter of 0.750M
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer SERV_PIPE_FTR

133

Feature: PL

Description: Public Lighting



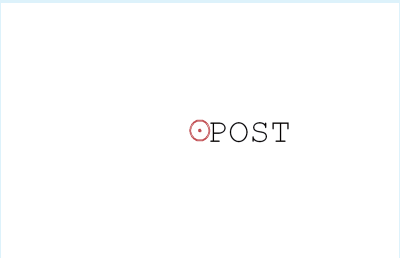
Linestyle: CONTINUOUS
Symbology: None
Colour: 7 (LIGHT GRAY)
Layer: LINE_PL **MX Label:** OP
This feature is 2D and is not included in the TIN surface.

Feature text is displayed at the Right Top of the survey point aligned along the string. This text is placed on the first and last points of the string. Text layer LINE_PL_FTR

134

Feature: PST1

Description: Post Box (1pt)

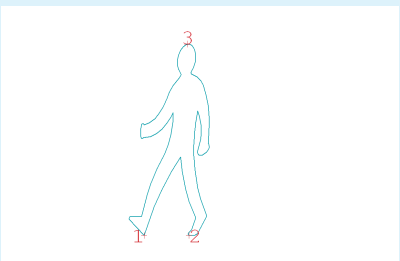


Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_POST_BOX **MX Label:** PSTX
This feature is 3D and is included in the TIN surface.
This feature is represented by the FLAG_2 symbol which has a variable size defaulting to 1.5mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_POST_BOX_FTR

135

Feature: PSY

Description: Pedestrian Symbol (3pt)

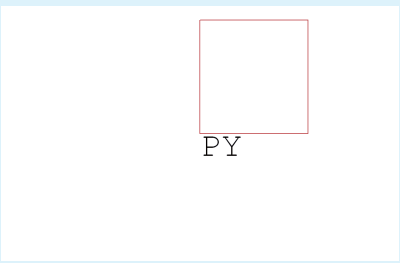


Linestyle: CONTINUOUS
Symbology: 3 Point Symbol
Colour: 3 (CYAN)
Layer: ROAD_PED **MX Label:** SY
This feature is 2D and is not included in the TIN surface.
This feature is represented by the PED_DCC symbol

136

Feature: PYL

Description: Pylon



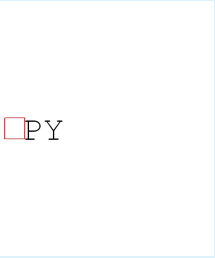
Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: FURN_PYLON_ESB **MX Label:** YL
This feature is 2D and is not included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer FURN_PYLON_ESB_FTR

137

Feature: PYL1

Description: Pylon (1pt)

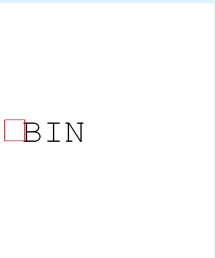


Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_PYLON_ESB **MX Label:** PYLN
This feature is 2D and is not included in the TIN surface.
This feature is represented by the MH_SQR1 symbol which has a variable size defaulting to 1.5mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_PYLON_ESB_FTR

138

Feature: RB1

Description: Recycle Bin (1pt)

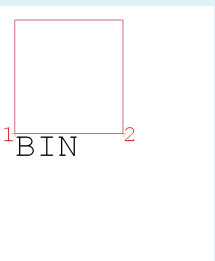


Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_BIN **MX Label:** PRBI
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_SQR1 symbol which has a variable size defaulting to 1.5mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_BIN_FTR

139

Feature: RB2

Description: Recycle Bin (2pt+w)



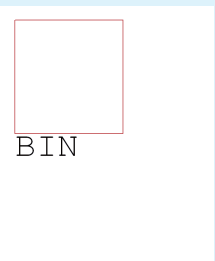
Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: FURN_BIN **MX Label:** RB
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer FURN_BIN_FTR

140

Feature: RB3

Description: Recycle Bin (3pt)



Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: FURN_BIN **MX Label:** RB
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer FURN_BIN_FTR

141

Feature: RC

Description: Road Crown

Linestyle: DASHED2
Symbology: None
Colour: 3 (CYAN)
Layer: ROAD_CROWN **MX Label:** RC
This feature is 3D and is included in the TIN surface.

142

Feature: RDE1

Description: Rodding Eye (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: SERV_RODDING **MX Label:** PRDE
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_CIR1 symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 0.5mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer SERV_RODDING_FTR

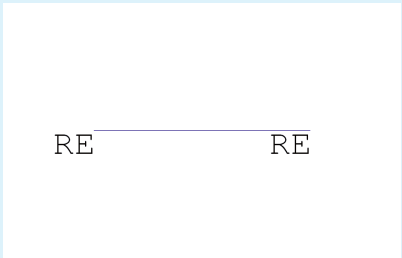
143

Feature: RE

Description: Road Edge

Linestyle: CONTINUOUS
Symbology: None
Colour: 1 (BLUE)
Layer: ROAD_EDGE **MX Label:** RE
This feature is 3D and is included in the TIN surface.

Feature text is displayed at the Right Top of the survey point aligned along the string. This text is placed on the first and last points of the string. Text layer ROAD_EDGE_FTR



144

Feature: RL

Description: Railing

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: RAILING **MX Label:** RL
This feature is 3D and is included in the TIN surface.

145

Feature: RMDD

Description: Road Marking Yellow Double

Linestyle: CONTINUOUS
Symbology: None
Colour: 3 (CYAN)
Layer: ROAD_MARKING **MX Label:** R5
This feature is 3D and is included in the TIN surface.

146

Feature: RMWD

Description: Road Marking White Line Dashed

Linestyle: DASHED
Symbology: None
Colour: 3 (CYAN)
Layer: ROAD_DASH **MX Label:** R2
This feature is 3D and is included in the TIN surface.

147

Feature: RMWL

Description: Road Marking White Line

Linestyle: CONTINUOUS
Symbology: None
Colour: 3 (CYAN)
Layer: ROAD_MARKING **MX Label:** R1
This feature is 3D and is included in the TIN surface.

148

Feature: RMYD

Description: Road Marking Yellow LineDashed

Linestyle: DASHED
Symbology: None
Colour: 3 (CYAN)
Layer: ROAD_DASH **MX Label:** R4
This feature is 3D and is included in the TIN surface.

149

Feature: RMYL

Description: Road Marking Yellow Line

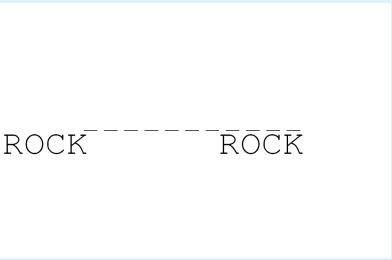
Linestyle: CONTINUOUS
Symbology: None
Colour: 3 (CYAN)
Layer: ROAD_MARKING **MX Label:** R3
This feature is 3D and is included in the TIN surface.

150

Feature: ROCK

Description: Rock Outcrop

Linestyle: DASHED
Symbology: None
Colour: 0 (BLACK)
Layer: ROCK **MX Label:** RK
This feature is 3D and is included in the TIN surface.



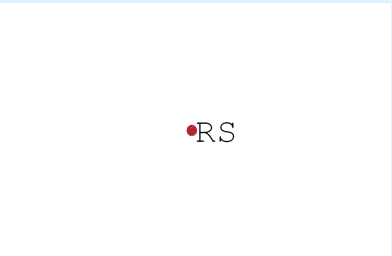
Feature text is displayed at the Right Top of the survey point aligned along the string. This text is placed on the first and last points of the string. Text layer ROCK_FTR

151

Feature: RSC1

Description: Road Sign Circle (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_ROAD_SIGN **MX Label:** PRSC
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_CIR2 symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 0.5mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_ROAD_SIGN_FTR



152

Feature: RSG

Description: Road Sign

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: FURN_ROAD_SIGN **MX Label:** RS
This feature is 3D and is included in the TIN surface.

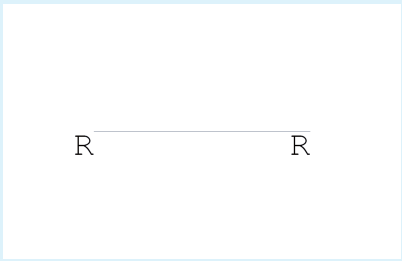
Feature text is displayed at the Right Top of the survey point aligned along the string. This text is only placed on the first point of the string. Text layer FURN_ROAD_SIGN_FTR

153

Feature: RT

Description: Railway Track

Linestyle: CONTINUOUS
Symbology: None
Colour: 7 (LIGHT GRAY)
Layer: RAIL **MX Label:** RT
This feature is 3D and is included in the TIN surface.



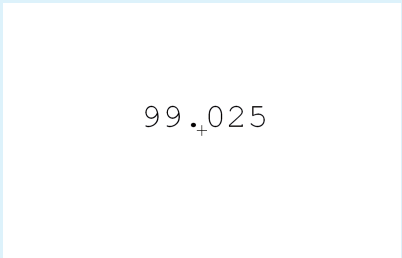
Feature text is displayed at the Right Top of the survey point aligned along the string. This text is placed on the first and last points of the string. Text layer RAIL_FTR

154

Feature: S1

Description: Spot Level (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 0 (BLACK)
Layer: LEVEL_SPOT **MX Label:** PSLV
This feature is 3D and is included in the TIN surface.
This feature is represented by the SPOT symbol which has a variable size defaulting to 0.8mm
Level text is displayed 0.5mm above the Centre Bottom of the survey point aligned along the sheet.
Text layer LEVEL_SPOT_LVL

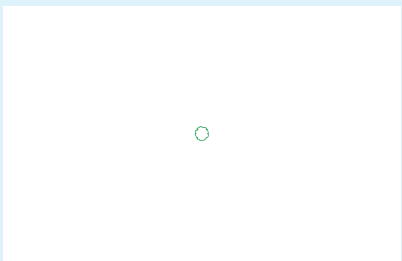


155

Feature: SAP1

Description: Sapling (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 2 (GREEN)
Layer: TREE_SAPLING **MX Label:** PSAP
This feature is 3D and is included in the TIN surface.
This feature is represented by the TREE_1 symbol which has a fixed diameter of 0.500M

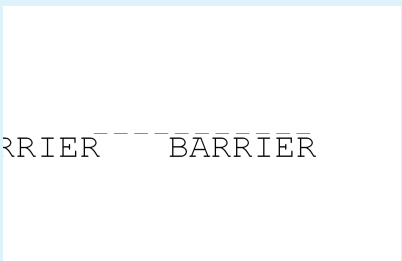


156

Feature: SBAR

Description: Safety Barrier

Linestyle: DASHED
Symbology: None
Colour: 4 (RED)
Layer: FURN_BARRIER **MX Label:** BI
This feature is 3D and is included in the TIN surface.



Feature text is displayed at the Right Top of the survey point aligned along the string. This text is placed on the first and last points of the string. Text layer FURN_BARRIER_FTR

157

Feature: SC1

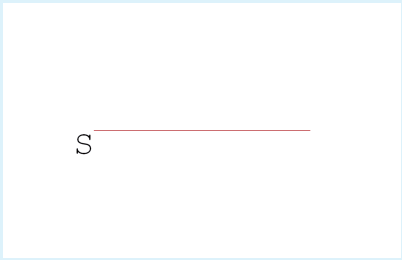
Description: Stop Cock (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: SERV_STOP_COCK **MX Label:** PSTC
This feature is 3D and is included in the TIN surface.
This feature is represented by the SV symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 0.5mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer SERV_STOP_COCK_FTR

158

Feature: SG

Description: Sign



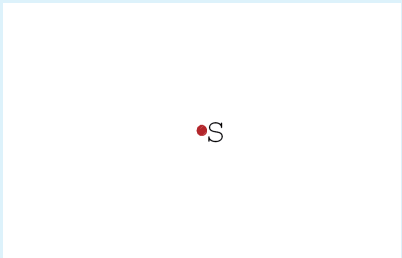
Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: FURN_SIGN **MX Label:** SG
This feature is 3D and is included in the TIN surface.

Feature text is displayed at the Right Top of the survey point aligned along the string. This text is only placed on the first point of the string. Text layer FURN_SIGN_FTR

159

Feature: SG1

Description: Sign (1pt)



Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_SIGN **MX Label:** PSGN
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_CIR2 symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 0.5mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_SIGN_FTR

160

Feature: SL

Description: Change of Surface Line

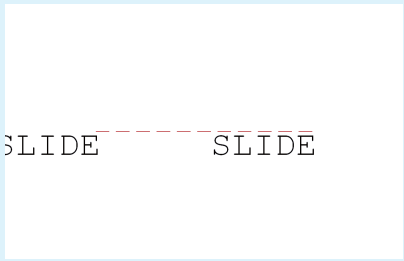
Linestyle: DASHED
Symbology: None
Colour: 4 (RED)
Layer: SURFACE_LINE **MX Label:** SL
This feature is 3D and is included in the TIN surface.

161

Feature: SLIDE

Description: Slide

Linestyle: DASHED
Symbology: None
Colour: 4 (RED)
Layer: FURN_SLIDE **MX Label:** DE
This feature is 3D and is included in the TIN surface.



Feature text is displayed at the Right Top of the survey point aligned along the string. This text is placed on the first and last points of the string. Text layer FURN_SLIDE_FTR

162

Feature: STN

Description: Survey Station

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 5 (MAGENTA)
Layer: SURVEY_SS **MX Label:** PSTN
This feature is 3D and is included in the TIN surface.
This feature is represented by the STN symbol which has a variable diameter defaulting to 1.500M

163

Feature: STP

Description: Steps

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: STEPS **MX Label:** SP
This feature is 3D and is included in the TIN surface.

Feature text is displayed at the Right Top of the survey point aligned along the string. This text is only placed on the first point of the string. Text layer STEPS_FTR

164

Feature: SUB1

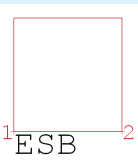
Description: ESB Sub station (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: SERV_ESB_SUB **MX Label:** PSUB
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_SQR1 symbol which has a variable size defaulting to 1.5mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer SERV_ESB_SUB_FTR

165

Feature: SUB2

Description: ESB Sub station (2pt+w)



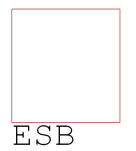
Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_ESB_SUB **MX Label:** SB
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the grid. This text is only placed on the first point of the string. Text layer SERV_ESB_SUB_FTR

166

Feature: SUB3

Description: ESB Sub station (3 point)



Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_ESB_SUB **MX Label:** SB
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer SERV_ESB_SUB_FTR

167

Feature: SV1

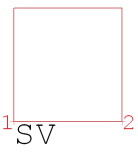
Description: Stop Valve (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: SERV_STOP_VALVE **MX Label:** PSTV
This feature is 3D and is included in the TIN surface.
This feature is represented by the STP_V symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 0.5mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer SERV_STOP_VALVE_FTR

168

Feature: SV2

Description: Stop Valve (2pt+w)



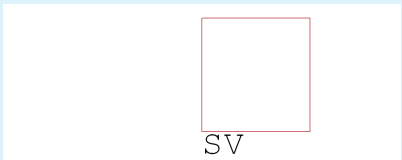
Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_STOP_VALVE **MX Label:** SV
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer SERV_STOP_VALVE_FTR

169

Feature: SV3

Description: Stop Valve (3pt)



Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_STOP_VALVE **MX Label:** SV
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer SERV_STOP_VALVE_FTR

170

Feature: SW1

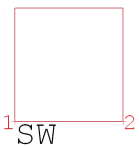
Description: Sewer Cover (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: SERV_COVER_SEWER **MX Label:** PSWC
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_SQR1 symbol which has a variable size defaulting to 1.5mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer SERV_COVER_SEWER_FTR

171

Feature: SW2

Description: Sewer Cover (2pt+w)



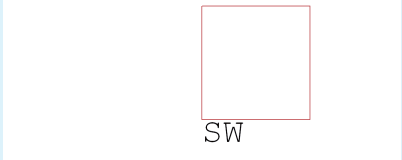
Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_COVER_SEWER **MX Label:** SW
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer SERV_COVER_SEWER_FTR

172

Feature: SW3

Description: Sewer Cover (3pt)



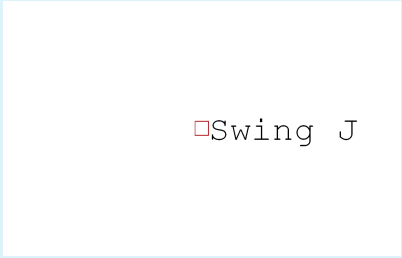
Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_COVER_SEWER **MX Label:** SW
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer SERV_COVER_SEWER_FTR

173

Feature: SWINGJ

Description: Swing - Junior (1pt)

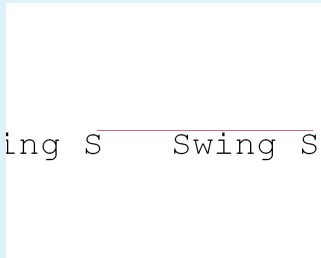


Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_SWING_J **MX Label:** PSWJ
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_SQR1 symbol which has a variable size defaulting to 1.0mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_SWING_J_FTR

174

Feature: SWINGS

Description: Swing - Senior



Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: FURN_SWING **MX Label:** SS
This feature is 3D and is included in the TIN surface.

Feature text is displayed at the Right Top of the survey point aligned along the string. This text is placed on the first and last points of the string. Text layer FURN_SWING_FTR

175

Feature: SY

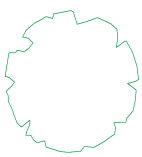
Description: Stay

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_STAY **MX Label:** PSTY
This feature is 3D and is included in the TIN surface.
This feature is represented by the MARKER symbol which has a variable size defaulting to 1.5mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_STAY_FTR

176

Feature: T1

Description: Tree (1pt)



Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 2 (GREEN)
Layer: TREE **MX Label:** PTRE
This feature is 3D and is included in the TIN surface.
This feature is represented by the TREE_1 symbol which has a fixed diameter of 5.000M

177

Feature: TB

Description: Top of Bank

Linestyle: DASHED
Symbology: None
Colour: 2 (GREEN)
Layer: BANK **MX Label:** TB
This feature is 3D and is included in the TIN surface.

178

Feature: TC1

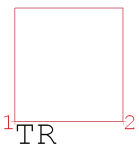
Description: Traffic Cover (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: SERV_COVER_TRAFFIC **MX Label:** PTRC
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_SQR1 symbol which has a variable size defaulting to 1.5mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer SERV_COVER_TRAFFIC_FTR

179

Feature: TC2

Description: Traffic Cover (2pt+w)



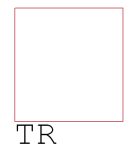
Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_COVER_TRAFFIC **MX Label:** TC
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer SERV_COVER_TRAFFIC_FTR

180

Feature: TC3

Description: Traffic Cover (3pt)



Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_COVER_TRAFFIC **MX Label:** TC
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer SERV_COVER_TRAFFIC_FTR

181

Feature: TCR

Description: Traffic Ramp

Linestyle: DASHED2
Symbology: None
Colour: 3 (CYAN)
Layer: TRAFFIC_RAMP **MX Label:** RM
This feature is 3D and is included in the TIN surface.

182

Feature: TD

Description: Traffic Detector

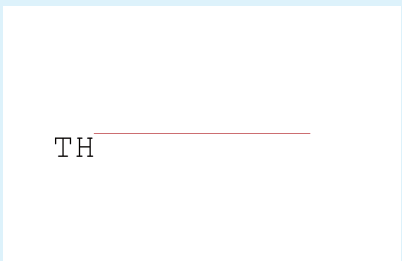
Linestyle: DASHED2
Symbology: None
Colour: 3 (CYAN)
Layer: TRAFFIC_DETECTOR **MX Label:** TD
This feature is 2D and is not included in the TIN surface.

183

Feature: TH

Description: Threshold

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: THRESHOLD **MX Label:** TH
This feature is 3D and is included in the TIN surface.



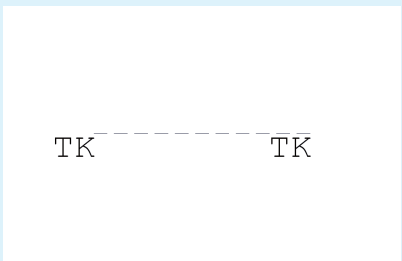
Feature text is displayed at the Right Top of the survey point aligned along the string. This text is only placed on the first point of the string. Text layer THRESHOLD_FTR

184

Feature: TK

Description: Track

Linestyle: DASHED
Symbology: None
Colour: 8 (DARK GRAY)
Layer: TRACK **MX Label:** TK
This feature is 3D and is included in the TIN surface.



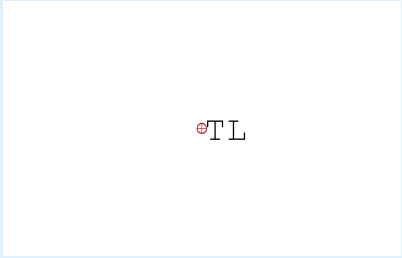
Feature text is displayed at the Right Top of the survey point aligned along the string. This text is placed on the first and last points of the string. Text layer TRACK_FTR

185

Feature: TL1

Description: Traffic Light (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_TRAFFIC_LIGHT **MX Label:** PTLG
This feature is 3D and is included in the TIN surface.
This feature is represented by the EP symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 0.5mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_TRAFFIC_LIGHT_FTR

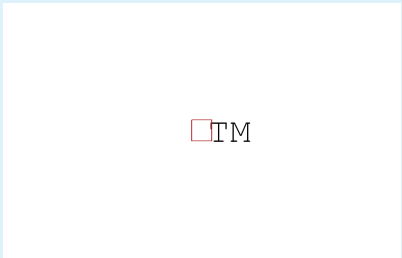


186

Feature: TM1

Description: Ticket Machine (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_TICKET **MX Label:** PTKM
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_SQR1 symbol which has a variable size defaulting to 1.5mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_TICKET_FTR

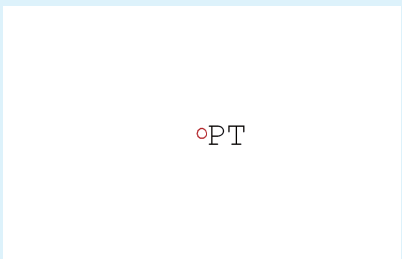


187

Feature: TP1

Description: Eircom (Telephone) Pole (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: FURN_POLE_EIRCOM **MX Label:** PTPL
This feature is 3D and is included in the TIN surface.
This feature is represented by the POLE symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 0.5mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer FURN_POLE_EIRCOM_FTR



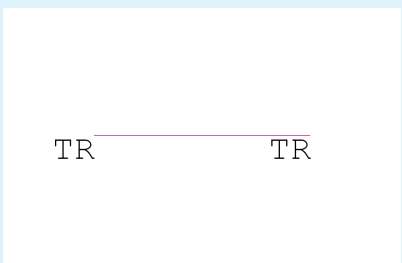
188

Feature: TR

Description: Traffic

Linestyle: CONTINUOUS
Symbology: None
Colour: 5 (MAGENTA)
Layer: LINE_TRAFFIC **MX Label:** TR
This feature is 3D and is included in the TIN surface.

Feature text is displayed at the Right Top of the survey point aligned along the string. This text is placed on the first and last points of the string. Text layer LINE_TRAFFIC_FTR



189

Feature: TX

Description: Information Text

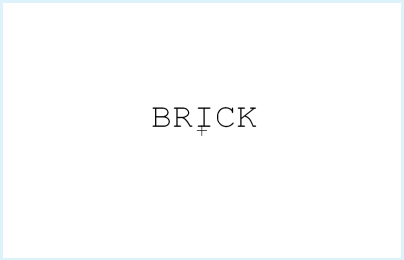
Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 0 (BLACK)
Layer: TEXT_INFORMATION **MX Label:** PTX1
This feature is 2D and is not included in the TIN surface.
This feature is represented by the SPOT symbol which has a variable size defaulting to 0.8mm

190

Feature: TXB

Description: Brick Surface Text

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 0 (BLACK)
Layer: TEXT_INFORMATION **MX Label:** PTX2
This feature is 2D and is not included in the TIN surface.
This feature is represented by the SPOT symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 0.5mm above the Centre Bottom of the survey point aligned along the string.
This text is placed on the first and last points of the string. Text layer TEXT_INFORMATION_FTR

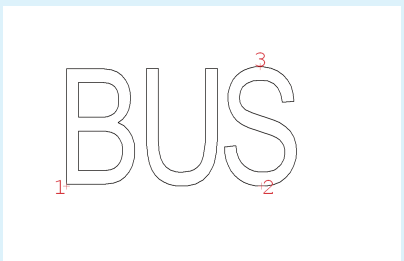


191

Feature: TXBS3

Description: Road Marking Bus Text (3pt)

Linestyle: CONTINUOUS
Symbology: 3 Point Symbol
Colour: 0 (BLACK)
Layer: TEXT_INFORMATION **MX Label:** PTX3
This feature is 2D and is not included in the TIN surface.
This feature is represented by the BUS_TXT symbol

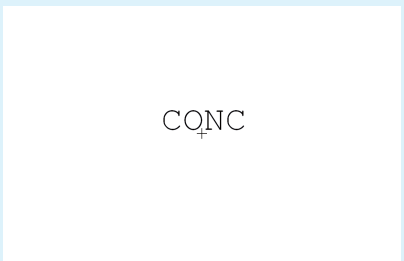


192

Feature: TXC

Description: Concrete Surface Text

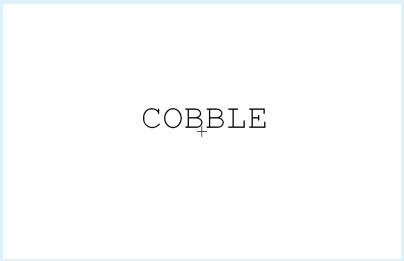
Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 0 (BLACK)
Layer: TEXT_INFORMATION **MX Label:** PTX4
This feature is 2D and is not included in the TIN surface.
This feature is represented by the SPOT symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 0.5mm above the Centre Bottom of the survey point aligned along the string.
This text is placed on the first and last points of the string. Text layer TEXT_INFORMATION_FTR



193

Feature: TXCB

Description: Cobble Surface Text



Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 0 (BLACK)
Layer: TEXT_INFORMATION **MX Label:** PTX5
This feature is 2D and is not included in the TIN surface.
This feature is represented by the SPOT symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 0.5mm above the Centre Bottom of the survey point aligned along the string.
This text is placed on the first and last points of the string. Text layer TEXT_INFORMATION_FTR

194

Feature: TXCP

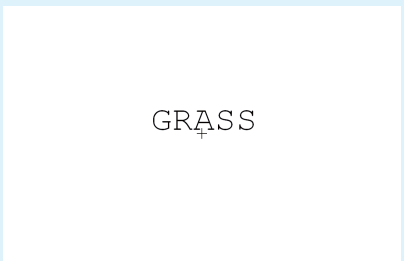
Description: Concrete Paving Surface Text

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 0 (BLACK)
Layer: TEXT_INFORMATION **MX Label:** PTX6
This feature is 2D and is not included in the TIN surface.
This feature is represented by the SPOT symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 0.5mm above the Centre Bottom of the survey point aligned along the string.
This text is placed on the first and last points of the string. Text layer TEXT_INFORMATION_FTR

195

Feature: TXG

Description: Grass Surface Text



Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 0 (BLACK)
Layer: TEXT_INFORMATION **MX Label:** PTX7
This feature is 2D and is not included in the TIN surface.
This feature is represented by the SPOT symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 0.5mm above the Centre Bottom of the survey point aligned along the string.
This text is placed on the first and last points of the string. Text layer TEXT_INFORMATION_FTR

196

Feature: TXGR

Description: Granite Paving Text

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 0 (BLACK)
Layer: TEXT_INFORMATION **MX Label:** PTX8
This feature is 2D and is not included in the TIN surface.
This feature is represented by the SPOT symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 0.5mm above the Centre Bottom of the survey point aligned along the string.
This text is placed on the first and last points of the string. Text layer TEXT_INFORMATION_FTR

197

Feature: TXLD3

Description: Road Marking Loading Text (3pt

Linestyle: CONTINUOUS
Symbology: 3 Point Symbol
Colour: 0 (BLACK)
Layer: TEXT_INFORMATION **MX Label:** PTXC
This feature is 2D and is not included in the TIN surface.
This feature is represented by the LOAD_TXT symbol

198

Feature: TXLL3

Description: RoadMarkingLookLeftText (3pt)

Linestyle: CONTINUOUS
Symbology: 3 Point Symbol
Colour: 0 (BLACK)
Layer: TEXT_INFORMATION **MX Label:** PTX9
This feature is 2D and is not included in the TIN surface.
This feature is represented by the LLFT_TXT symbol

199

Feature: TXLN3

Description: Road Marking Lana Text (3pt)

Linestyle: CONTINUOUS
Symbology: 3 Point Symbol
Colour: 0 (BLACK)
Layer: TEXT_INFORMATION **MX Label:** PTXA
This feature is 2D and is not included in the TIN surface.
This feature is represented by the LANA_TXT symbol

200

Feature: TXLR3

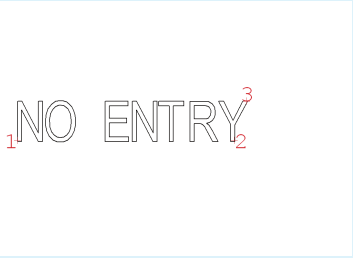
Description: RoadMarkingLookRightText (3pt)

Linestyle: CONTINUOUS
Symbology: 3 Point Symbol
Colour: 0 (BLACK)
Layer: TEXT_INFORMATION **MX Label:** PTXB
This feature is 2D and is not included in the TIN surface.
This feature is represented by the LRGT_TXT symbol

201

Feature: TXNE3

Description: Road Marking No Entry Text(3p)



Linestyle: CONTINUOUS
Symbology: 3 Point Symbol
Colour: 0 (BLACK)
Layer: TEXT_INFORMATION **MX Label:** PTXD
This feature is 2D and is not included in the TIN surface.
This feature is represented by the NENT_TXT symbol

202

Feature: TXO

Description: Road Marking Text Outline Stri

Linestyle: DASHED2
Symbology: None
Colour: 14 (YELLOW)
Layer: ROAD_MARKING_TEXT **MX Label:** TX
This feature is 2D and is not included in the TIN surface.

203

Feature: TXRM

Description: Road Marking Text

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 0 (BLACK)
Layer: ROAD_MARKING_TEXT **MX Label:** PTXE
This feature is 2D and is not included in the TIN surface.
This feature is represented by the SPOT symbol which has a variable size defaulting to 0.8mm

204

Feature: TXS

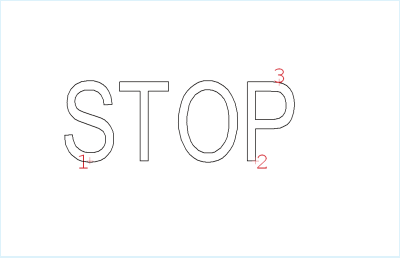
Description: Surface Text

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 0 (BLACK)
Layer: SURFACE_TEXT **MX Label:** PTXF
This feature is 2D and is not included in the TIN surface.
This feature is represented by the SPOT symbol which has a variable size defaulting to 0.8mm

205

Feature: TXST3

Description: Road Marking Stop Text (3pt)

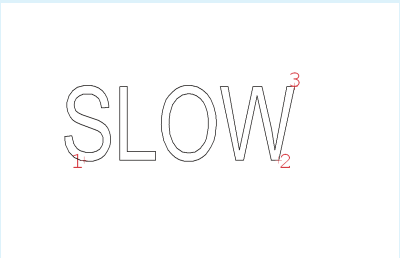


Linestyle: CONTINUOUS
Symbology: 3 Point Symbol
Colour: 0 (BLACK)
Layer: TEXT_INFORMATION **MX Label:** PTXG
This feature is 2D and is not included in the TIN surface.
This feature is represented by the STOP_TXT symbol

206

Feature: TXSW3

Description: Road Marking Slow Text (3pt)



Linestyle: CONTINUOUS
Symbology: 3 Point Symbol
Colour: 0 (BLACK)
Layer: TEXT_INFORMATION **MX Label:** PTXH
This feature is 2D and is not included in the TIN surface.
This feature is represented by the SLOW_TXT symbol

207

Feature: TXTM

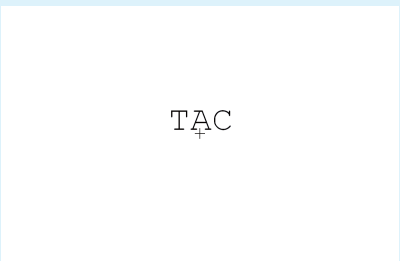
Description: Tarmac Surface Text

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 0 (BLACK)
Layer: TEXT_INFORMATION **MX Label:** PTXI
This feature is 2D and is not included in the TIN surface.
This feature is represented by the SPOT symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 0.5mm above the Centre Bottom of the survey point aligned along the string.
This text is placed on the first and last points of the string. Text layer TEXT_INFORMATION_FTR

208

Feature: TXTP

Description: Tactile Paving Surface Text



Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 0 (BLACK)
Layer: TEXT_INFORMATION **MX Label:** PTXJ
This feature is 2D and is not included in the TIN surface.
This feature is represented by the SPOT symbol which has a variable size defaulting to 0.8mm
Feature text is displayed 0.5mm above the Centre Bottom of the survey point aligned along the string.
This text is placed on the first and last points of the string. Text layer TEXT_INFORMATION_FTR

209

Feature: TXX3

Description: Road Marking Taxi Text (3pt)

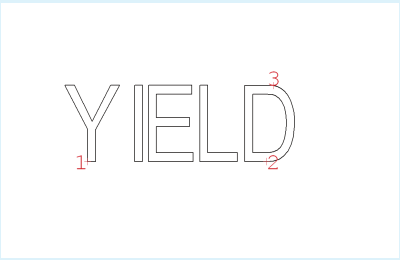
Linestyle: CONTINUOUS
Symbology: 3 Point Symbol
Colour: 0 (BLACK)
Layer: TEXT_INFORMATION **MX Label:** PTXK
This feature is 2D and is not included in the TIN surface.
This feature is represented by the TX_TXT symbol

210

Feature: TXYD3

Description: Road Marking Yield Text (3pt)

Linestyle: CONTINUOUS
Symbology: 3 Point Symbol
Colour: 0 (BLACK)
Layer: TEXT_INFORMATION **MX Label:** PTXL
This feature is 2D and is not included in the TIN surface.
This feature is represented by the YLD_TXT symbol



211

Feature: UCSW

Description: U/G Line Sewer Combined

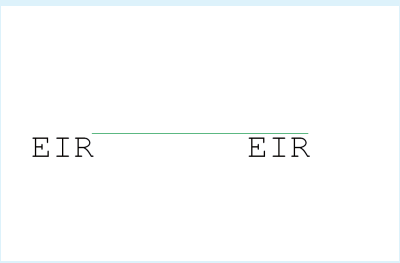
Linestyle: CONTINUOUS
Symbology: None
Colour: 5 (MAGENTA)
Layer: LINE_SEWER **MX Label:** USC
This feature is 2D and is not included in the TIN surface.

212

Feature: UE

Description: U/G Line Eircom

Linestyle: CONTINUOUS
Symbology: None
Colour: 2 (GREEN)
Layer: LINE_EIRCOM **MX Label:** UC
This feature is 2D and is not included in the TIN surface.



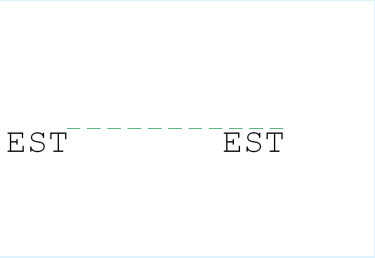
Feature text is displayed at the Right Top of the survey point aligned along the string. This text is placed on the first and last points of the string. Text layer LINE_EIRCOM_FTR

213

Feature: UES

Description: U/G Line ESAT

Linestyle: DASHED
Symbology: None
Colour: 2 (GREEN)
Layer: LINE_ESAT **MX Label:** UET
This feature is 2D and is not included in the TIN surface.



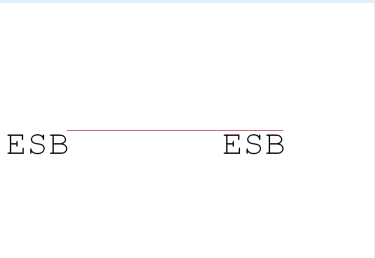
Feature text is displayed at the Right Top of the survey point aligned along the string. This text is placed on the first and last points of the string. Text layer LINE_ESAT_FTR

214

Feature: UESB

Description: U/G Line ESB

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: LINE_ESB **MX Label:** USB
This feature is 2D and is not included in the TIN surface.



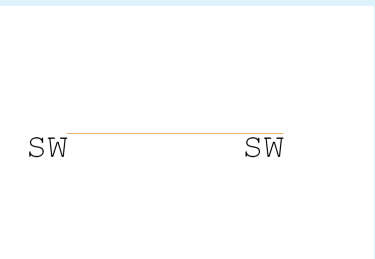
Feature text is displayed at the Right Top of the survey point aligned along the string. This text is placed on the first and last points of the string. Text layer LINE_ESB_FTR

215

Feature: UFSW

Description: U/G Line Sewer Foul

Linestyle: CONTINUOUS
Symbology: None
Colour: 6 (BROWN)
Layer: LINE_SEWER **MX Label:** UF
This feature is 2D and is not included in the TIN surface.



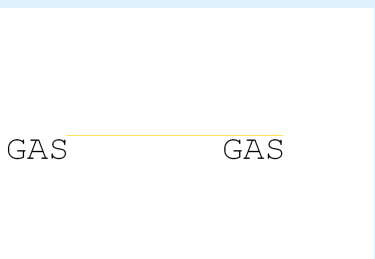
Feature text is displayed at the Right Top of the survey point aligned along the string. This text is placed on the first and last points of the string. Text layer LINE_SEWER_FTR

216

Feature: UGAS

Description: U/G Line Gas

Linestyle: CONTINUOUS
Symbology: None
Colour: 14 (YELLOW)
Layer: LINE_GAS **MX Label:** UG
This feature is 2D and is not included in the TIN surface.



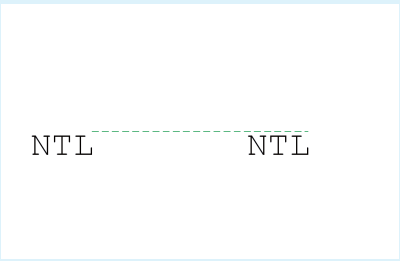
Feature text is displayed at the Right Top of the survey point aligned along the string. This text is placed on the first and last points of the string. Text layer LINE_GAS_FTR

217

Feature: UNTL

Description: U/G Line NTL

Linestyle: HIDDEN
Symbology: None
Colour: 2 (GREEN)
Layer: LINE_NTL **MX Label:** UNT
This feature is 2D and is not included in the TIN surface.



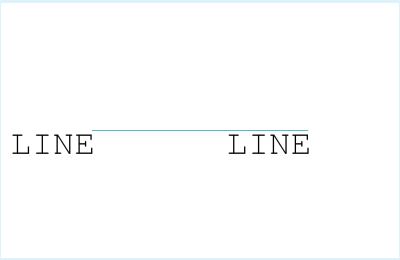
Feature text is displayed at the Right Top of the survey point aligned along the string. This text is placed on the first and last points of the string. Text layer LINE_NTL_FTR

218

Feature: UO

Description: U/G Line Others

Linestyle: CONTINUOUS
Symbology: None
Colour: 3 (CYAN)
Layer: LINE_OTHER **MX Label:** UO
This feature is 2D and is not included in the TIN surface.



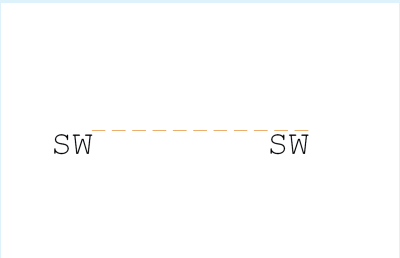
Feature text is displayed at the Right Top of the survey point aligned along the string. This text is placed on the first and last points of the string. Text layer LINE_OTHER_FTR

219

Feature: USSW

Description: U/G Line Sewer Surface Water

Linestyle: DASHED
Symbology: None
Colour: 6 (BROWN)
Layer: LINE_SEWER **MX Label:** UW
This feature is 2D and is not included in the TIN surface.



Feature text is displayed at the Right Top of the survey point aligned along the string. This text is placed on the first and last points of the string. Text layer LINE_SEWER_FTR

220

Feature: VL

Description: Vegetation Line Left

Linestyle: CONTINUOUS
Symbology: None
Colour: 2 (GREEN)
Layer: VEGETATION **MX Label:** VG
This feature is 3D and is included in the TIN surface.

221

Feature: VR

Description: Vegetation Line Right

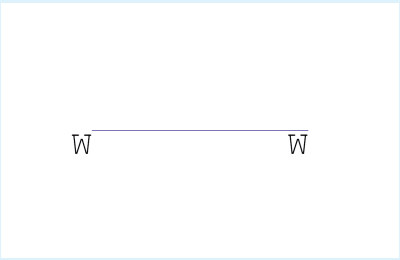
Linestyle: CONTINUOUS
Symbology: None
Colour: 2 (GREEN)
Layer: VEGETATION **MX Label:** VG
This feature is 3D and is included in the TIN surface.

222

Feature: WA

Description: Line Water

Linestyle: CONTINUOUS
Symbology: None
Colour: 1 (BLUE)
Layer: LINE_WATER **MX Label:** WA
This feature is 3D and is included in the TIN surface.



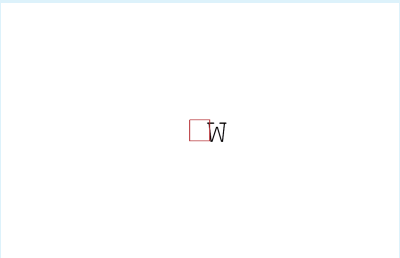
Feature text is displayed at the Right Top of the survey point aligned along the string. This text is placed on the first and last points of the string. Text layer LINE_WATER_FTR

223

Feature: WA1

Description: Water Cover Square (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 4 (RED)
Layer: SERV_COVER_WATER **MX Label:** PWAC
This feature is 3D and is included in the TIN surface.
This feature is represented by the MH_SQR1 symbol which has a variable size defaulting to 1.5mm
Feature text is displayed 1.0mm left of the Left Centre of the survey point aligned along the sheet.
This text is placed on the first and last points of the string. Text layer SERV_COVER_WATER_FTR

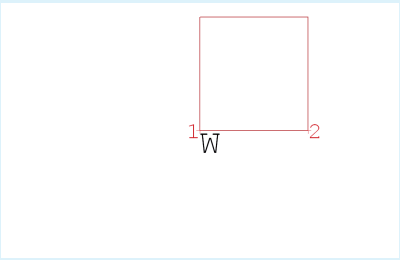


224

Feature: WA2

Description: Water Cover (2pt+w)

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_COVER_WATER **MX Label:** WC
This feature is 3D and is included in the TIN surface.

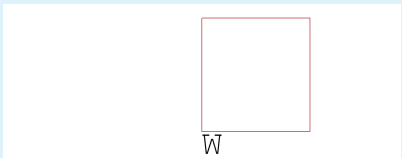


Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer SERV_COVER_WATER_FTR

225

Feature: WA3

Description: Water Cover (3pt)



Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: SERV_COVER_WATER **MX Label:** WC
This feature is 3D and is included in the TIN surface.

Feature text is displayed 1.5mm below the Left Centre of the survey point aligned along the sheet.
This text is only placed on the first point of the string. Text layer SERV_COVER_WATER_FTR

226

Feature: WAE

Description: Water Edge

Linestyle: CONTINUOUS
Symbology: None
Colour: 1 (BLUE)
Layer: WATER_EDGE **MX Label:** WH
This feature is 3D and is included in the TIN surface.

227

Feature: WAE1

Description: Water Edge (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 1 (BLUE)
Layer: WATER_EDGE **MX Label:** PWAE
This feature is 3D and is included in the TIN surface.
This feature is represented by the SPOT symbol which has a variable size defaulting to 1.5mm

228

Feature: WAL1

Description: Water High Level (1pt)

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 1 (BLUE)
Layer: WATER_HWL **MX Label:** PWAL
This feature is 3D and is included in the TIN surface.
This feature is represented by the SPOT symbol which has a variable size defaulting to 1.5mm

229

Feature: WB

Description: Wall Bottom

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: WALL **MX Label:** W1
This feature is 3D and is included in the TIN surface.

230

Feature: WBB

Description: Wall Boundary Bottom

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: WALL_BOUNDARY **MX Label:** WB
This feature is 3D and is included in the TIN surface.

231

Feature: WBT

Description: Wall Boundary Top

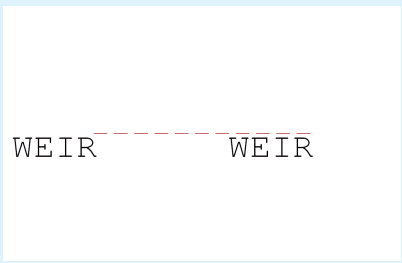
Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: WALL_BOUNDARY **MX Label:** WT
This feature is 3D and is included in the TIN surface.

232

Feature: WEIR

Description: Weir

Linestyle: DASHED
Symbology: None
Colour: 4 (RED)
Layer: WATER_WEIR **MX Label:** WE
This feature is 3D and is included in the TIN surface.



Feature text is displayed at the Right Top of the survey point aligned along the string. This text is placed on the first and last points of the string. Text layer WATER_WEIR_FTR

233

Feature: WRB

Description: Wall Retaining Bottom

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: WALL_RETAINING **MX Label:** WR
This feature is 3D and is included in the TIN surface.

234

Feature: WRT

Description: Wall Retaining Top

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: WALL_RETAINING **MX Label:** W3
This feature is 3D and is included in the TIN surface.

235

Feature: WT

Description: Wall Top

Linestyle: CONTINUOUS
Symbology: None
Colour: 4 (RED)
Layer: WALL **MX Label:** W2
This feature is 3D and is included in the TIN surface.

236

Feature: YLBOX

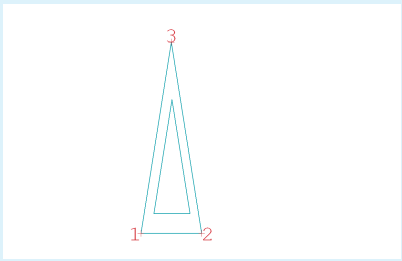
Description: Yellow Box

Linestyle: CONTINUOUS
Symbology: None
Colour: 3 (CYAN)
Layer: ROAD_MARKING **MX Label:** Y
This feature is 3D and is included in the TIN surface.

237

Feature: YLD

Description: Yield Sign (3 pt)



Linestyle: CONTINUOUS
Symbology: 3 Point Symbol
Colour: 3 (CYAN)
Layer: ROAD_MARKING **MX Label:** YD
This feature is 3D and is included in the TIN surface.
This feature is represented by the YIELD symbol which has a fixed diameter of 1.700M

238

Feature: ~BORDER

Description: Sheet Border

Linestyle: CONTINUOUS
Symbology: None
Colour: 8 (DARK GRAY)
Layer: _BORDER **MX Label:** 0
This feature is 3D and is included in the TIN surface.

239

Feature: ~BRKLINE

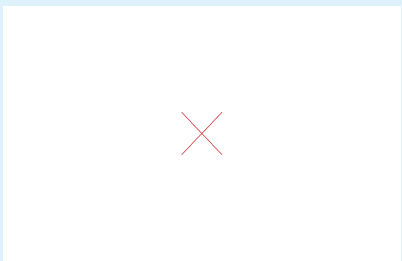
Description: Breakline

Linestyle: CONTINUOUS
Symbology: None
Colour: 5 (MAGENTA)
Layer: _BRKLINE **MX Label:** 0
This feature is 3D and is included in the TIN surface.

240

Feature: ~BRK_INT

Description: Breakline Intersetion Point



Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 12 (LIGHT RED)
Layer: _BRK_INT **MX Label:** 0
This feature is 3D and is included in the TIN surface.
This feature is represented by the CROSS_1 symbol which has a variable size defaulting to 3.0mm.
This feature represents generated model data rather than directly surveyed ground data

241

Feature: ~CTR 0

Description: Zero Contour

Linestyle: CONTINUOUS
Symbology: None
Colour: 2 (GREEN)
Layer: _CTR_0 **MX Label:** 0
This feature is 3D and is included in the TIN surface.

242

Feature: ~CTR IN

Description: Negative Index Contour

Linestyle: CONTINUOUS
Symbology: None
Colour: 12 (LIGHT RED)
Layer: _CTR_IN **MX Label:** 0
This feature is 3D and is included in the TIN surface.

243

Feature: ~CTR IP

Description: Positive Index Contour

Linestyle: CONTINUOUS
Symbology: None
Colour: 11 (LIGHT CYAN)
Layer: _CTR_IP **MX Label:** 0
This feature is 3D and is included in the TIN surface.

244

Feature: ~CTR RN

Description: Negative Normal Contour

Linestyle: DASHED
Symbology: None
Colour: 4 (RED)
Layer: _CTR_RN **MX Label:** 0
This feature is 3D and is included in the TIN surface.

245

Feature: ~CTR_RP

Description: Positive Normal Contour

Linestyle: DASHED
Symbology: None
Colour: 3 (CYAN)
Layer: _CTR_RP **MX Label:** 0
This feature is 3D and is included in the TIN surface.

246

Feature: ~CTR_SOL

Description: Solid Relief Contours

Linestyle: CONTINUOUS
Symbology: None
Colour: 12 (LIGHT RED)
Layer: _CTR_SOL **MX Label:** 0
This feature is 3D and is included in the TIN surface.

247

Feature: ~DUP_PNT

Description: Duplicate Points

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 13 (LIGHT MAGENTA)
Layer: _DUP_PNT **MX Label:** 0
This feature is 3D and is included in the TIN surface.
This feature is represented by the CROSS_1 symbol which has a variable size defaulting to 2.0mm.
This feature represents generated model data rather than directly surveyed ground data

248

Feature: ~GRID

Description: Title Grid

Linestyle: CONTINUOUS
Symbology: None
Colour: 1 (BLUE)
Layer: _GRID **MX Label:** 0
This feature is 3D and is included in the TIN surface.

Feature: ~GRID2

Description: Title Grid2

Linestyle: CONTINUOUS
Symbology: None
Colour: 1 (BLUE)
Layer: _GRID2 **MX Label:** 0
This feature is 3D and is included in the TIN surface.

249

Feature: ~MESH

Description: Grid Mesh

Linestyle: CONTINUOUS
Symbology: None
Colour: 2 (GREEN)
Layer: _MESH **MX Label:** 0
This feature is 3D and is included in the TIN surface.

250

Feature: ~SECT_T

Description: Section Template

Linestyle: CONTINUOUS
Symbology: None
Colour: 9 (LIGHT BLUE)
Layer: _SECT_T **MX Label:** 0
This feature is 3D and is included in the TIN surface.

251

Feature: ~SHTEDGE

Description: Sheet edge

Linestyle: CONTINUOUS
Symbology: None
Colour: 8 (DARK GRAY)
Layer: _SHTEDGE **MX Label:** 0
This feature is 3D and is included in the TIN surface.

252

253

Feature: ~SHVOID

Description: Sheet annotation box

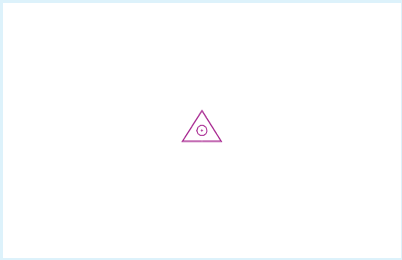
Linestyle: CONTINUOUS
Symbology: None
Colour: 8 (DARK GRAY)
Layer: _SHVOID **MX Label:** 0
This feature is 2D and is not included in the TIN surface.

254

Feature: ~STATION

Description: Survey Station

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 5 (MAGENTA)
Layer: SURVEY_SS **MX Label:** PSTN
This feature is 3D and is included in the TIN surface.
This feature is represented by the STN symbol which has a variable diameter defaulting to 1.500M.
This feature represents generated model data rather than directly surveyed ground data



255

Feature: ~SURVOBS

Description: Survey Obs

Linestyle: CONTINUOUS
Symbology: Point Symbol
Colour: 7 (LIGHT GRAY)
Layer: _SUR_OBS **MX Label:** PSOB
This feature is 3D and is included in the TIN surface.
This feature is represented by the BOREHOLE symbol which has a variable size defaulting to 2.0mm.
This feature represents generated model data rather than directly surveyed ground data
Point text is displayed 1.0mm left of the Left Centre of the survey point aligned along the string. Text layer _SUR_OBS_PNT

256

Feature: ~TRAVLIN

Description: Traverse

Linestyle: CONTINUOUS
Symbology: None
Colour: 1 (BLUE)
Layer: _TRAVLIN **MX Label:** 0
This feature is 3D and is included in the TIN surface.

Feature: ~TRI_OFF 257

Description: Invalid Triangle

Linestyle: CONTINUOUS
Symbology: None
Colour: 1 (BLUE)
Layer: _TRI_OFF **MX Label:** 0
This feature is 3D and is included in the TIN surface.

Feature: ~TRI_ON 258

Description: Valid Triangle

Linestyle: CONTINUOUS
Symbology: None
Colour: 2 (GREEN)
Layer: _TRI_ON **MX Label:** 0
This feature is 3D and is included in the TIN surface.

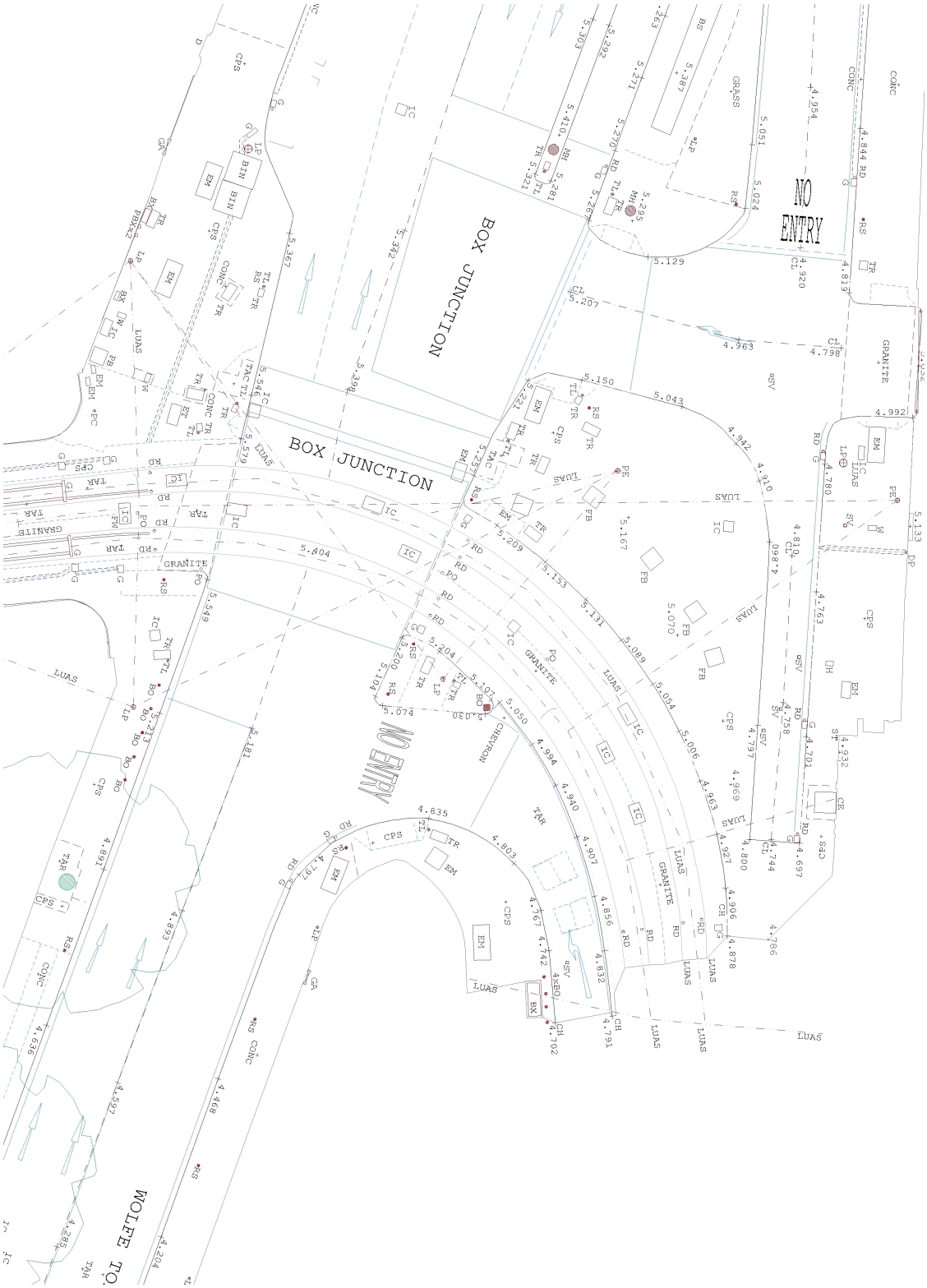
Feature: ~TRI_SOL 259

Description: Solid Triangles

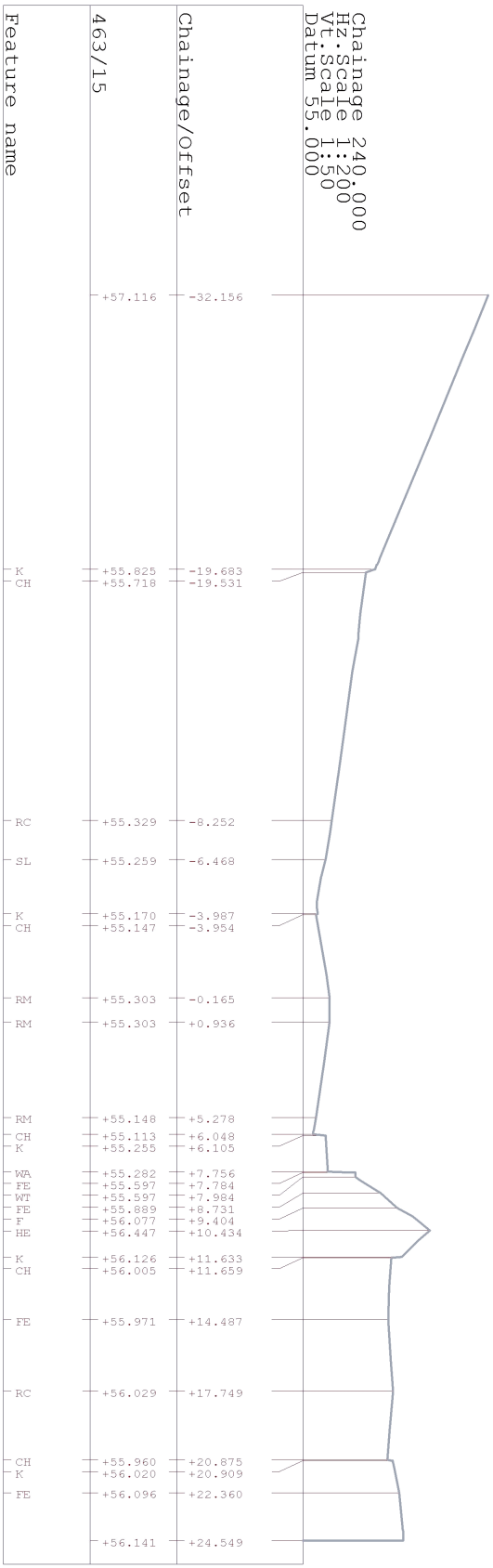
Linestyle: CONTINUOUS
Symbology: None
Colour: 2 (GREEN)
Layer: _TRI_SOL **MX Label:** 0
This feature is 3D and is included in the TIN surface.

Appendix F: Sample of Cartography & Sections

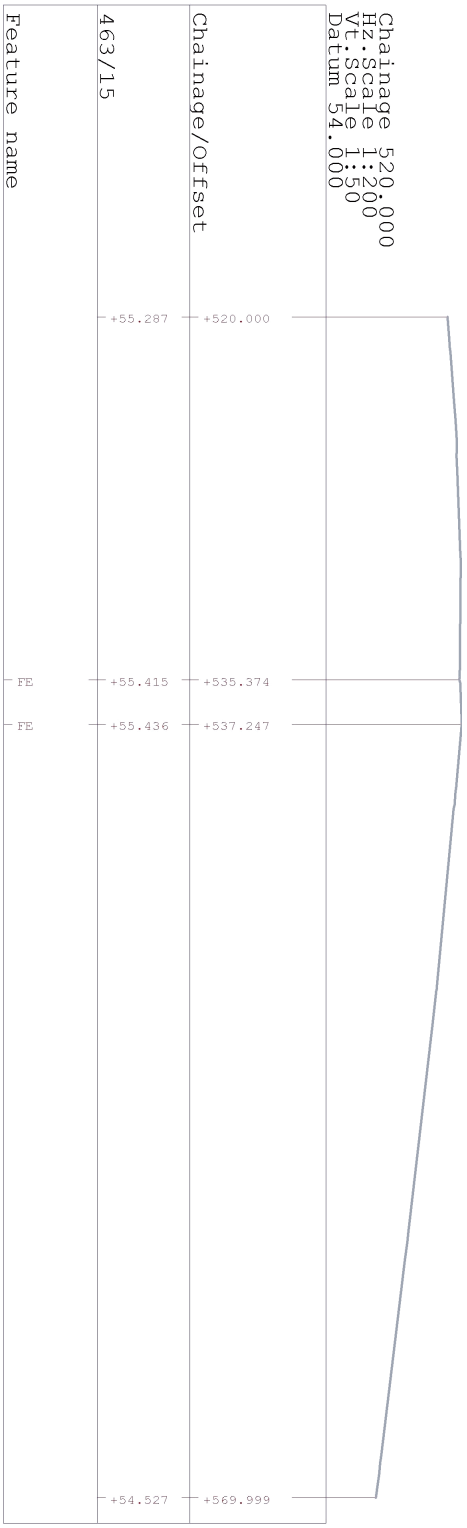
Sample of Cartography and Survey Detail: Extract of QBN Model



Sample of Cross Section



Sample of Long Section (Subdivided)



Annexe A: User Guide

The user guide is an adjunct to the specification that provides explanation on the text of the specification, and illustrative examples as to how the specification may be efficiently achieved, as appropriate. The guide also includes checks that will be used by the Employer to determine if the items delivered properly meet the specification, such that the Contractor may perform those checks prior to delivery to the Employer.

While following the processes illustrated using the examples given provides a proven method for efficiently meeting specification, they are intended to be implemented by suitably qualified and experienced staff.

Most of the examples in this document utilise SCC, as it has been specifically enhanced to streamline the execution of these procedures. Alternative solutions may be used where they can provide the necessary functionality to completely meet the specification in its entirety.

For purposes of readability, direct extracts from the main specification text are coloured in blue. The section numbering scheme used in this guide also corresponds to the numbers used in the specification prefix with the letter A-.

Similarly, procedural steps within any given example use a bold font.

Other explanatory text remains in a normal font.

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LIST OF FIGURES

LIST OF TABLES

A-1

Project Information

A-1 Project Information

A-1.1 Project Information

The information given in the following clauses provides essential information needed for the Project.

A-1.2 Project Designation

Name: _____

Reference No.: T-QBN-_____

A-1.2.1 Purpose of Project

The Project Objective is to provide information to enable the following work to be carried out by the Employer:

The design of _____

A-1.2.2 End Product

Under this Project the following is to be produced by the Contractor:

Accurate ground survey of _____

Processing of the survey data as specified producing the specified survey report and survey data, SCC files, and 3D CAD Drawings of the ground model plan, long sections and cross sections of the roads in the survey area.

A-1.2.3 Project Scale

The nominal survey scale for information provided under this Project will be 1: 250

A-1.2.4 Employer Provisions

The following items will be supplied by the Employer to the Contractor:

Customized SCC Feature Library as given in Appendix E

Tutorial on use of SCC Feature Library

User guide providing explanatory text relating to the specification preferred processing and checking methods, and samples as appropriate.

A-1.2.5 Project Constraints

The following specific constraints will apply to the work carried out under this Project:

_____

_____

_____

_____

A-1.3 Survey Summary

A-1.3.1 Area/Extent of Survey

The area and extent of the survey is shown on Drawing No.

T-QBN-_____

A-1.3.2 Scale of Plans Required

Where hard copy plans are specified for this Project then the following scales will be required:

1:250 for the ground model plan

1:200 horizontal, 1:50 vertical for the longitudinal sections

1:200 horizontal, 1:50 vertical for the cross sections

A-1.3.3 Digital Data Required

Digital data is specified for this Project as per clauses 4.4 and 4.5.

A-1.3.4 Agreed Entry to Site

The Surveyor will be required to inform the site owners/occupiers of the specific access dates required and a list and plan will be supplied by the Employer when requested by the Surveyor.

A-1.4 Summary of Specification

The following Sections of the Standard Specification have been completed:

1. Project Information
2. Land Surveys
3. Survey data content
4. Presentation of Results
5. Compliance with Specification
6. Check Survey

Appendix A: Permanent Ground Markers

Appendix B: Planimetric Features

Appendix C: Additional Spot Levels

Appendix D: Bill Of Quantities

Appendix E: Feature Library

Appendix F: Sample of Cartography & Sections

Annexe

Annexe A: User Guide

Annexe B: Survey Report

A-1.5 Survey Records

The Surveyor shall make available to the Employer for inspection, on request, all survey data including that obtained from other sources.

The Surveyor shall retain the same for a period of 5 years.

A-2

Land Survey

A-2 Land Survey

A-2.1 Metric Measurements

All linear dimensions and measurements shall be metric. Angular measurements and geodetic coordinates shall be degrees minutes and seconds. All Cartesian coordinates shall be reported to the nearest millimetre. All geodetic coordinates shall be reported to the nearest one thousandth of a second.

A-2.2 Control Network : Planimetric Control

The Contractor shall advise on appropriate control arrangements and submit details to the Employer for approval.

A-2.2.1 Permanent Ground Markers

The main survey stations shall be of stable construction. Standard forms of markers are shown in Appendix A and, unless otherwise specified within the accompanying documents, the Contractor should choose the most appropriate marker for each location from this selection.

The maximum distance between adjacent permanent survey stations shall be 150m.

All stations internal to the survey shall have unobstructed visibility to at least two adjacent stations (i.e. foresight and backsight stations) within 150 meters. Stations at the external boundary of the survey shall have unobstructed visibility to at least one adjacent station.

Where permanent stations are determined using a total station traverse method, they must be surveyed from GPS baselines such that there are no more than ten traverse stations connecting the same (loop traverse) or successive (link traverse) baselines. Where the survey contains more than one GPS baseline, the baselines are to be separated by no more than 1500 metres.

A-2.2.2 Survey Grid / Coordinate Reference System

The survey shall use the ITM (Irish Transverse Mercator) coordinate reference system. A description of the grid system shall be quoted on each survey plan.

For an initial transition period two sets of each survey shall be supplied - one on ITM and one on IG75.

No reference shall be made to Ordnance Survey Ireland Trig Stations and Bench Marks.

This specification is based around the use of ITM for reasons of accuracy when collecting GPS data. It also provides for transformation of all reduced data into IG75 Irish Grid system for legacy applications.

National grid transformations may be carried out using Grid Inquest provided by Quest Geo Solutions. This software may be used directly and is also embedded into SCC for easy transformation of SCC models, survey data sets and control, as shown below:

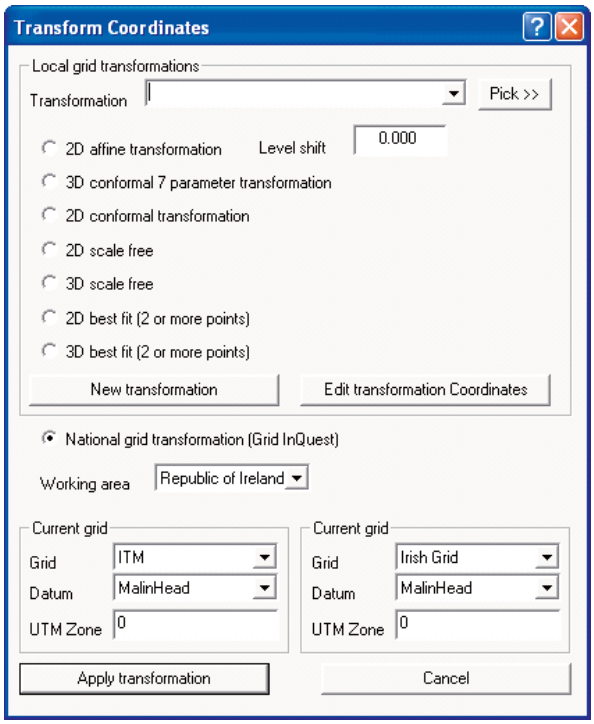


Figure 2.1: SCC Transform Coordinates Dialog

The user can transform data within an SCC dataset or SCC model by selecting current grid and datum and also setting new grid and datum:

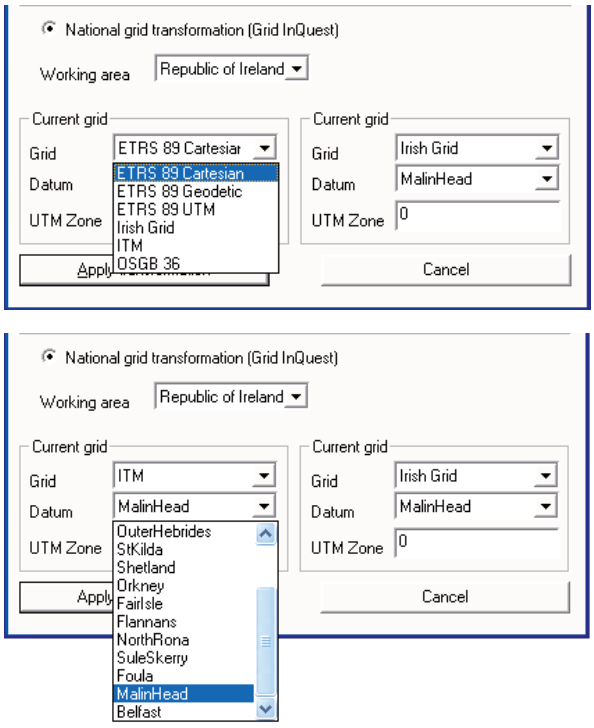


Figure 2.2: SCC Transform Coordinates Dialog: National Grid Transformation

Within the SCC dataset Detail Observation Sheet, select 'TOOLS > Transform Coordinates'

Set up the necessary parameters using the drop down menus

Within the SCC Model, select 'TOOLS > Transform Coordinates'

Set up the necessary parameters using the drop down menus

A-2.2.3 Accuracy

The relative accuracy between permanent survey control stations shall, when checked, not exceed 1 part in 30,000 for distances exceeding 150 metres. For shorter distances the relative accuracy should be not exceed ± 5 mm.

The absolute accuracy of any permanent survey control station shall, when checked, not exceed ± 25mm.

A-2.2.4 Documentation / Survey Report

The following documentation shall be included in the Survey Report outlined in clause 2.5.

A-2.2.4.1Schedule of Permanent Control Stations

A schedule shall be prepared giving the following information:

- Station designation
- ETRS89 coordinates
- ITM coordinates
- IG75 coordinates (during transition period)
- Height value related to Malin Head Datum (Orthometric)
- Description

A-2.2.4.2Location Diagrams of Permanent Control Stations

Diagram to include the following information:

- Station designation
- Station coordinates
- Location diagram indicating location of the station with dimensions to a minimum of three easily recognisable and durable points.
- Photograph
- Type of marker used for the station.

A-2.2.4.3Diagram of Permanent Control Network

When the number of permanent control stations exceeds three stations, a network diagram shall be supplied. The network diagram shall show the connections, together with the adjusted distances and adjusted bearings of each observed line in the network. Where possible, error ellipses for each permanent control station should also be supplied.

A-2.2.4.4Observation and adjustment details

Where total stations have been used, the adjustment of plan positions shall be by a least squares variation of coordinates method. The adjustment report shall include the following:

- Details of any corrections applied, such as map scale factor, mean sea level, refraction and atmospherics, curvature, etc…

- All total station observations, i.e. horizontal directions, slope distances, vertical angles, instrument heights and target heights.
- Reduced observations, i.e. forward measured angles, bearings and horizontal distances
- Standard errors applied to each observation
- Adjustment residuals and standardised residuals
- Chi-squared goodness of fit test to verify the observations are in broad agreement with the stated standard errors.
- Coordinate corrections applied
- Error ellipse semi-major and semi-minor axes, and axis bearing, for a confidence level of 95%

A-2.2.4.5Use of static GPS for control

Where static GPS is used to establish plan control, the following criteria must be met:

- All survey control stations to be co-ordinated by Static GPS observations with a minimum of twenty minutes continuous observations per station.
- Special attention to GDOP value (<3.5) in the field at time of observation.
- Static control observations should be by leap-frog method.
- Processing of GPS Control should be post processed by downloading relevant RINEX data from Ordnance Survey Ireland website or from another properly validated RINEX data supplier.
- Independent checks should be carried out at time of processing e.g. using two independent OS base stations to calculate co-ordinates.
- All raw observation data and correction data used must be supplied to the client in RINEX format along with all grid, correction, and adjustment parameters used such that the stations can be re-coordinated by a third party.

A-2.2.4.6Instrument set-up report

An instrument set-up report shall be produced for each detail survey that includes the following:

- Survey file name
- Station setup observation at the start and end of each setup. This will ensure no orientation errors have occurred and the station setup was stable over the period of the observation. The reduced horizontal distance will verify the correctness of the scale factor in use
- Details of any corrections applied, such as map scale factor, mean sea level, refraction and atmospherics, curvature, etc.
- Occupied and back-sighted station names
- Backsight observation horizontal angle, vertical angle and slope distance
- Computed X,Y and Z mis-closure to back-sight station
- Computed horizontal distance mis-closure to back-sight station

A-2.3 Control Network : Vertical Control

A-2.3.1 Levelling Network

The Contractor shall advise on appropriate control arrangements and submit details to the Employer for approval.

A-2.3.2 Height Datum

All levels shall be related to Ordnance Datum at Malin Head. Ellipsoidal heights of the permanent control stations shall be converted to orthometric heights (Malin Head datum) using the OSGM02 geoid model using a Dublin City Council approved software package for transformation. See section specification 5.3 for a list of approved packages.

Relative heights between permanent control stations will be determined using a double run of levels in preference to using the relative heights acquired from GPS. One permanent control station, normally in the centre of the project, shall be held fixed, and the rest of the station heights will be adjusted using the relative heights acquired from the double levelling.

No reference shall be made to Ordnance Survey Ireland Bench Marks.

A-2.3.3 Site Bench Marks

All permanent control stations will act as site bench marks. Additional bench marks may be nominated in consultation with the Employer.

A-2.3.4 Accuracy

The relative accuracy of heights between any two site bench marks shall, when checked, not exceed ± 10mm x k, where k is the square root of the distance in kilometres between the points being considered, or ± 5mm, whichever is the greater.

The absolute accuracy of the one permanent control station held fixed, when checked shall not exceed 20mm.

Why?: These have been shown to be readily achievable accuracies using well-calibrated modern equipment in the hands of an experienced surveyor and meets Employer engineering requirements. Please see section A-6 (check survey) for a description of relative and absolute accuracies in the context of this specification, and how they can be independently verified using a check survey.

A-2.3.5 Documentation / Survey Report

The following documentation shall be included in the Survey Report outlined in clause 2.5.

A-2.3.5.1Schedule of Site Bench Marks

The schedule supplied shall contain the following information:

- Designation of site bench mark
- Level value (orthometric) Above Ordnance Datum at Malin Head
- Level value (ellipsoidal) and its tolerance (accuracy range)
- Description

A-2.3.5.2Location Diagrams of Site Bench Marks

Diagram to include the following information:

- Station designation

- Height Value (AOD - Malin Head)
- Location diagram indicating location of the site bench mark with dimensions to a minimum of three easily recognisable and durable points.
- Photograph
- Type of marker used for the site bench mark.

A-2.3.5.3Network Diagram of Height Control

When benchmarks are located on other than permanent control stations a network diagram of the vertical control network shall be prepared. The network diagram shall show:

- Connections between the site bench marks and the permanent control stations
- Height values of all site bench marks
- Relative height differences between site bench marks (adjusted)
- Identification of the permanent control station held fixed in the adjustment.

A-2.3.5.4Schedule of Observations and Adjustment Details

The report shall include the following:

- All reduced level observations
- Adjustment details to include height mis-closures and observation residuals

A-2.4 Detail Survey : Topographic Detail

A comprehensive list of the standard planimetric features to be surveyed is supplied in Appendix B. The Contractor shall visit the site before submitting his tender to identify what categories and features are applicable to the survey area.

The following categories of topographic detail shall be surveyed:

✓	Permanent buildings/structures
✓	Temporary/mobile buildings
✓	Visible boundary features: walls, fences, hedges
✓	Roads, tracks, footways, paths
✓	Street furniture
✓	Statutory Authorities' plant and service covers where visible
✓	Changes of surface
✓	Isolated trees/wooded areas/limits of vegetation
✓	Pitches/recreation
	Private gardens or grounds (off-site areas)
✓	Water features
✓	Earth works

✓	Industrial features
✓	Railway features with arranged access
	Other (specify)

The full list of features used along with how they should be interpreted is provided in printed format in Appendix E, and in electronic format as a Dublin City Council supplied SCC feature library. The feature library is also available electronically in the field for compatible Leica 1200 series and Trimble TSC equipment. Additionally, a PocketDTM version of the Dublin City Council supplied feature library is also available which will display all of the required cartography during the survey process. PocketDTM is available on-board on the Leica RX1250 series, and will work with most Windows CE and Windows mobile devices to ensure that the specification may be efficiently met with most modern survey measurement equipment.

A-2.4.1 Accuracy

The relative accuracy of the plan position of critical detail and well defined features shall, when checked, not exceed ± 25mm.

The relative accuracy of the plan position of soft, less well defined features and vegetation shall, when checked, not exceed ± 50mm.

A tolerance of 95% will be used as the acceptance criteria for the relative accuracy of plan position. All co-ordinates shall fall within 3 times the above values.

A-2.4.2 Obscured Ground

Detail which cannot be surveyed to the specified accuracy without extensive clearing of vegetation shall be surveyed approximately and annotated accordingly on the survey plan. The Survey Report (outlined in clause 2.5) will also make reference to any obscured ground so surveyed.

A-2.4.3 Level Detail

Height information shall be supplied as spot heights for the height detail specified in Appendix C, and also for relevant topographic detail specified in Appendix B.

A-2.4.4 Longitudinal and Cross Sections

The road centreline (or road crown) shall form the chainage line on which the survey is based. The position of (the chainage line and of) Chainage 0.000m for each survey area shall be agreed in advance with the Employer.

The Contractor shall clearly mark out on site the Chainage Point 0.000m and chainage points at intervals of 10m parallel to the road centreline or road crown, on the channel line, subject to the approval of the Employer.

The Contractor shall use these chainage points to establish cross section lines (perpendicular to the chainage line) commencing at Chainage 0.000m and at intervals of 10m for the full length of each survey section as detailed on drawings. The end points of these cross sections shall be clearly marked out on site for checking purposes.

Cross sections shall indicate any abrupt change in height and spot levels shall be taken at the following positions for each cross section:

1. On top of the first step of thresholds and building entrances
2. Base of boundary and building walls

3. Back of path
4. Footpath edge or change in surface
5. Top of kerb (on edge facing road)
6. Bottom of kerb (channel level)
7. Channel (mastic or concrete) edge
8. Road marking lines on carriageway
9. Crown of carriageway

Sufficient levels shall be surveyed such that the ground configuration, including all discontinuities, is represented on the survey drawing. In open areas, spot levels should be taken on a 10m regular grid (paced - where distances between levels should not exceed 10m).

The Contractor is to ensure that all points required to create a 3 dimensional (3D) ground model that represents the surveyed area surface fully are surveyed. Extra points that are required to represent the 3D surface fully e.g. steps, walls, traffic ramps, kerbs with small radii, traffic islands etc shall be included in the survey. The Contractor shall curve fit small radii on kerbs, traffic islands, and walls etc.

A-2.4.5 Spot Heights

The maximum distance between adjacent spot levels shall be 10 metres.

A-2.4.6 Accuracy

A tolerance of 95% will be used as the acceptance criteria for the relative accuracy of elevations. All elevations shall fall within 3 times the above values.

The relative accuracy of levels on hard surfaces shall, when checked, not exceed ± 10mm and elsewhere not exceed ± 25mm, except on ploughed or otherwise broken surfaces.

A-2.4.7 Corrections to Levels

All levels, when checked, which do not comply with the requirements of clauses 2.4.1 and 2.4.6 shall be corrected by the Contractor at their own expense.

A-2.4.8 Land Use

The Contractor shall record land-use details of ground floor land use for all properties fronting onto the route, according to the following categories:

1. Residential
2. Amenity
3. Retail
4. Industrial
5. Public Buildings
6. Agricultural

A-2.5 Survey Report

In addition to the survey drawings the Contractor shall supply a survey report that shall include the following information:

- A statement on the use of software name and version number for coordinate transformations:

- A statement certified by the chief surveyor that the accuracy specifications for the survey were attained, and the results achieved:
- A description of the survey and computation methodology used for Planimetric Control including the information specified in clause 2.2:
- A description of the survey and computation methodology used for Vertical Control including the information specified in clause 2.3:
- A description of the surveying methodology used for topographic detail:
- A description of the surveying methodology used for level detail:
- A description of the Standard Operational Surveying Procedures (SOSPs) and their results:
- Instrument set-up details for each detail survey as per clause 2.2.4.6
- A digitally signed schedule of all files provided as per 4.5.8

A sample survey report is provided in Annexe B.

In order to simplify the production of the survey reports, the sample report provided as a Word document may be used as a template and modified by survey contractors. A set of Crystal Reports has also been prepared for use with SCC to automate the generation of the following: Station location and description, Traverse observation and adjustment details, Instrument set-up and mis-closure details, digitally signed file schedule and check survey analysis.

A-2.5.1 Static GPS details

Where plan control has been carried out using static GPS, the survey report shall also include the following:

- Details of the observational plan, equipment used and observations recorded.
- Summary of the data processing performed, the software used, version number and the techniques employed.
- Summary and detailed analysis of adjustments performed.
- Diagram for the project stations including base lines and error ellipses

A-3

Survey Data Content

A-3 Survey Data Content

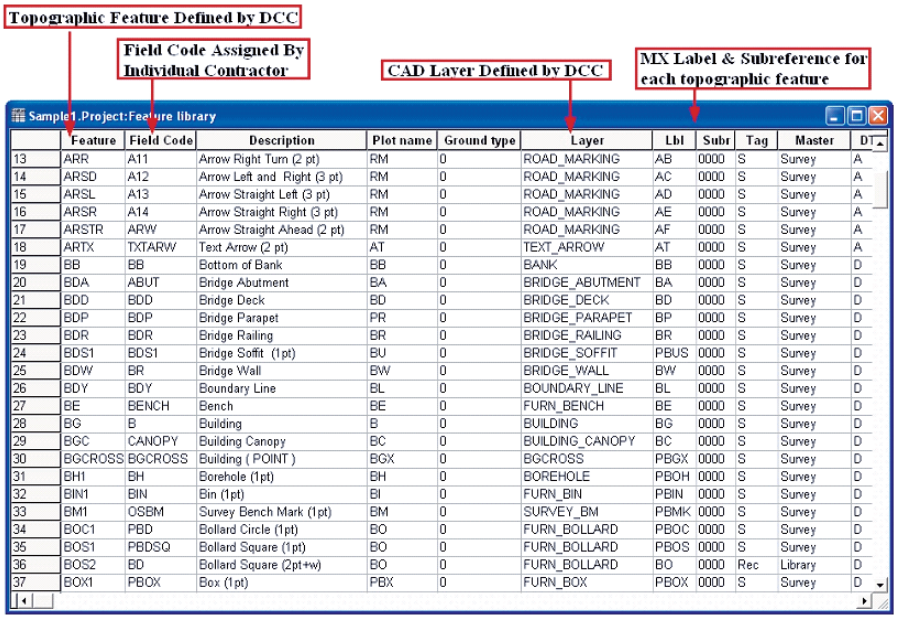
The primary tool used to illustrate the survey processing and QA aspects of the specification is SCC. Alternative processing packages that provide similar capability may be used as required, once the final product fully meets the specification for delivered digital data.

A-3.1 Feature Library And Naming Conventions

A-3.1.1 Feature naming conventions

Digital data shall be presented using naming conventions consistent with the feature library given in Appendix E, which comprise of the feature code given for each feature on the ground, the corresponding layer name used in DWG, DXF and Bentley Microstation based output, and label name used within the Bentley MX model. There shall be no modification or deviation from the naming conventions given in the feature library. All string and point information shall be surveyed to facilitate the use of the feature library. The Contractor shall carry out the survey of each feature as per the requirements of the feature library.

Why?: The primary advantage of providing a detailed feature library is to enforce strict drawing and model consistency across a range of different survey contractors. This allows drawings and models to be merged and greatly increases their longevity.



	Feature	Field Code	Description	Plot name	Ground type	Layer	Lbl	Subr	Tag	Master	DT
13	ARR	A11	Arrow Right Turn (2 pt)	RM	0	ROAD_MARKING	AB	0000	S	Survey	A
14	ARSD	A12	Arrow Left and Right (3 pt)	RM	0	ROAD_MARKING	AC	0000	S	Survey	A
15	ARSL	A13	Arrow Straight Left (3 pt)	RM	0	ROAD_MARKING	AD	0000	S	Survey	A
16	ARSR	A14	Arrow Straight Right (3 pt)	RM	0	ROAD_MARKING	AE	0000	S	Survey	A
17	ARSTR	ARW	Arrow Straight Ahead (2 pt)	RM	0	ROAD_MARKING	AF	0000	S	Survey	A
18	ARTX	TXTARW	Text Arrow (2 pt)	AT	0	TEXT_ARROW	AT	0000	S	Survey	A
19	BB	BB	Bottom of Bank	BB	0	BANK	BB	0000	S	Survey	D
20	BDA	ABUT	Bridge Abutment	BA	0	BRIDGE_ABUTMENT	BA	0000	S	Survey	D
21	BDD	BDD	Bridge Deck	BD	0	BRIDGE_DECK	BD	0000	S	Survey	D
22	BDP	BDP	Bridge Parapet	PR	0	BRIDGE_PARAPET	BP	0000	S	Survey	D
23	BDR	BDR	Bridge Railing	BR	0	BRIDGE_RAILING	BR	0000	S	Survey	D
24	BDS1	BDS1	Bridge Soffit (1pt)	BU	0	BRIDGE_SOFFIT	PBUS	0000	S	Survey	D
25	BDW	BR	Bridge Wall	BW	0	BRIDGE_WALL	BW	0000	S	Survey	D
26	BDY	BDY	Boundary Line	BL	0	BOUNDARY_LINE	BL	0000	S	Survey	D
27	BE	BENCH	Bench	BE	0	FURN_BENCH	BE	0000	S	Survey	D
28	BG	B	Building	B	0	BUILDING	BG	0000	S	Survey	D
29	BGC	CANOPY	Building Canopy	BC	0	BUILDING_CANOPY	BC	0000	S	Survey	D
30	BGCROSS	BGCROSS	Building (POINT)	BGX	0	BGCROSS	PBGX	0000	S	Survey	D
31	BH1	BH	Borehole (1pt)	BH	0	BOREHOLE	PBOH	0000	S	Survey	D
32	BIN1	BIN	Bin (1pt)	BI	0	FURN_BIN	PBIN	0000	S	Survey	D
33	BM1	OSBM	Survey Bench Mark (1pt)	BM	0	SURVEY_BM	PBMK	0000	S	Survey	D
34	BOC1	PBD	Bollard Circle (1pt)	BO	0	FURN_BOLLARD	PBOC	0000	S	Survey	D
35	BOS1	PBDSQ	Bollard Square (1pt)	BO	0	FURN_BOLLARD	PBOS	0000	S	Survey	D
36	BOS2	BD	Bollard Square (2pt+w)	BO	0	FURN_BOLLARD	BO	0000	Rec	Library	D
37	BOX1	PBOX	Box (1pt)	PBX	0	FURN_BOX	PBOX	0000	S	Survey	D

Figure 3.0: SCC Feature Library outlining specific columns

The feature library in this case also manages the consistent transformation of survey data to all of the computers packages in use, and determines the number and relative position of survey points for each feature type.

A-3.1.2 Feature types and data collection implications

Discrete survey objects will be collected as single points, two points, or three points in a manner consistent with the feature library given in Appendix E. Where the object is surveyed using more than one point, the position and order of the survey points is indicated in red in the feature library. Linear features must contain at least two survey points.

The Contractor shall survey all square or rectangular covers, manholes, street furniture exceeding 0.5m width dimensions using 3 points, or two points and a measured width. These

are to be reduced to true rectangles as part of the survey processing, and presented as closed four point polygons in the ground model.

All small covers, manholes, gullies and street furniture shall be surveyed using 1 point. All covers must be oriented correctly.

Other polygonal survey features must contain at least three survey points.

Features within the Dublin City Council library provided have been set up as either:

- a ‘String’
- a ‘Single Point’
- a ‘2 Point + Width’
- a ‘2 Point Symbol’,
- a ‘3 Point Symbol’,
- a ‘3 Point Circle’
- or a ‘3 Point Rectangle’

It is important that each feature is surveyed to suit the settings within the Feature Library.

Feature settings are easily identified within the Feature Wizard (figure 3.1) and often further symbol investigation is needed to identify the insertion points of the symbols.

Example 1: Arrow Symbols set up as 3 Point Symbols

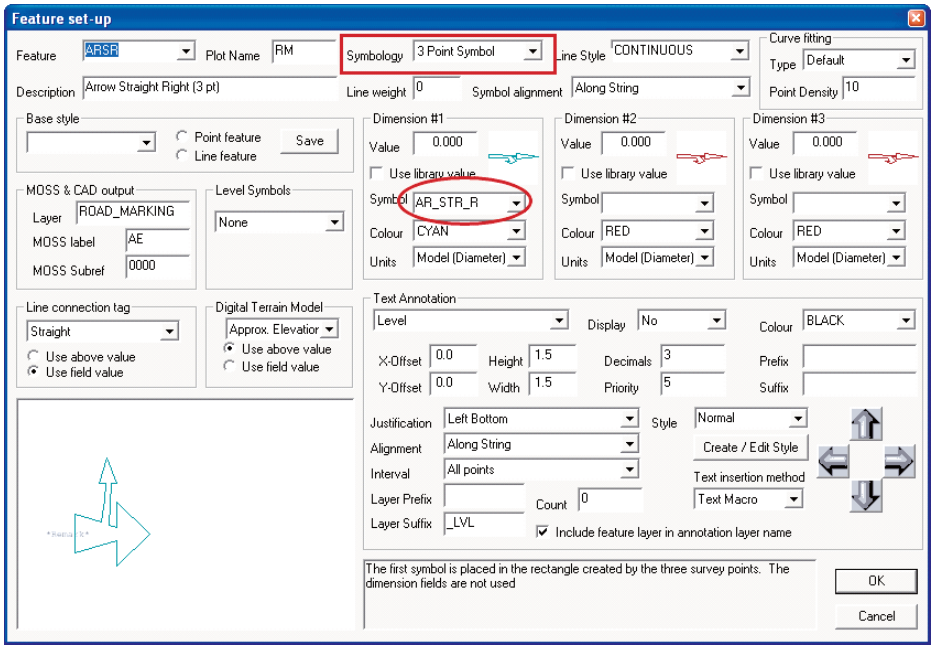


Figure 3.1: Feature Wizard

A 3-point Arrow ‘ARSR’ denoted in the Feature Wizard below (VIEW > Feature Wizard) requires the surveyor to pick up 3 points on the arrow itself. Further evaluation can be carried out within ‘EDIT > Symbol > Edit symbol insertion points’ or referring to Appendix E to determine where the 3 points lie.

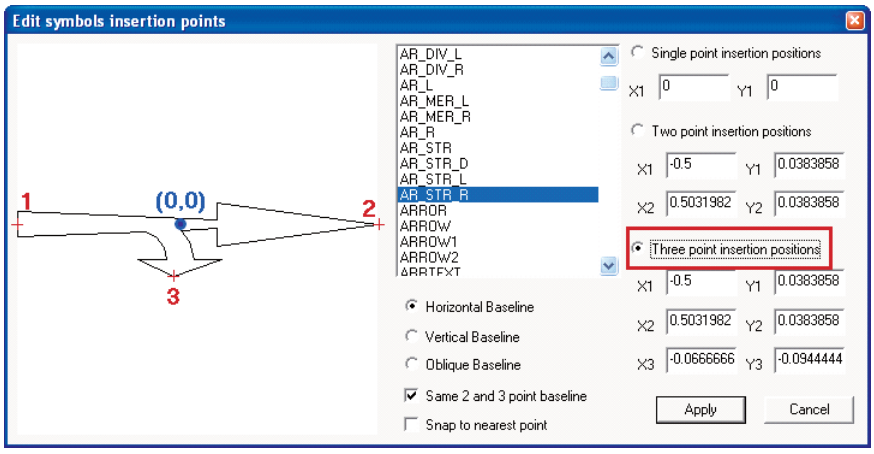


Figure 3.2: Edit Symbol Insertion Points

Example 2: Road Marking Text set up as 3 Point Symbols

The road marking text features (sample denoted in Table 3.0 below) have been set up as ' 3 point symbol features' also.

SCC Feature Code	Description	Symbology
TXBS3	Road Marking Bus Text (3pt)	3 Point Symbol
TXLD3	Road Marking Loading Text (3pt)	3 Point Symbol
TXLL3	RoadMarkingLookLeftText (3pt)	3 Point Symbol
TXLN3	Road Marking Lana Text (3pt)	3 Point Symbol
TXLR3	RoadMarkingLookRightText (3pt)	3 Point Symbol
TXNE3	Road Marking No Entry Text (3pt	3 Point Symbol
TXST3	Road Marking Stop Text (3pt)	3 Point Symbol
TXSW3	Road Marking Slow Text (3pt)	3 Point Symbol
TXX3	Road Marking Taxi Text (3pt)	3 Point Symbol
TXYD3	Road Marking Yield Text (3pt)	3 Point Symbol

Table 3.0: Road Marking Text set up as 3 point symbols

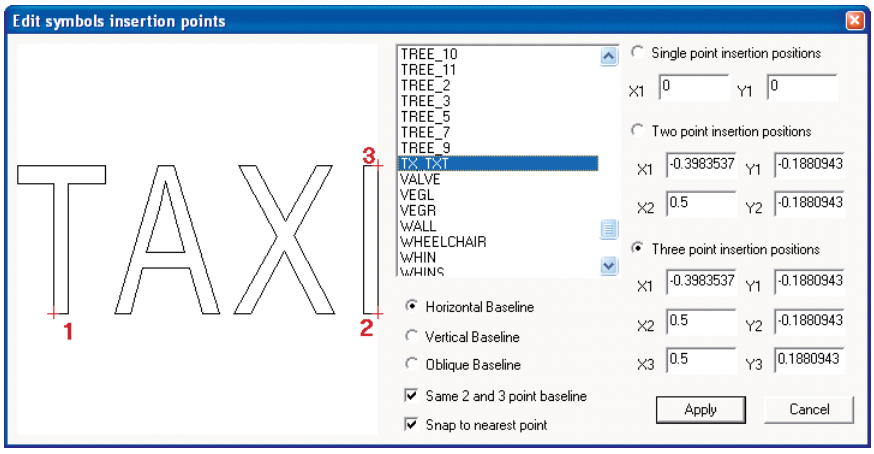


Figure 3.3: Edit Symbol Insertion Points

Linear features must contain at least two survey points

Care must be taken to describe all linear features by at least two survey points. For example, if the linear features 'KT' set up in the library as a string with a specific MX code ' KT' and a single 'KT' point 'orphaned point' exists perhaps due to editing, on what otherwise should be a line sting, the MX export will create 'PKT1, PKT2 etc.' points. Such MX labels do not exist in the MX style set and will not get interpreted correctly.

To check the model for spurious **'Orphan Points':**

Within the model, select 'TOOLS > Search for orphan points

Overlapping, cluttered and skew level text and feature text shall be edited in SCC only, so that all text is shown neatly and aligned to strings and at the correct spacing where applicable and to cartographic standards.

All editing should be carried out in SCC only. Thus no further editing is required in CAD or MX. No cluttered text on frozen CAD layers

Although the library automatically dictates what text is automatically turned on or off the user should further edit the text to resolve overlapping and cluttered text. Text should be aligned to strings or grid and closely match the plotted sheet so to allow the text to be easily read.

The following SCC tools can be used for text editing:

Delete Text allows the user to delete existing text.

Select 'EDIT > Text > Delete Text'

Left click the mouse on individual pieces of text to delete

Use the data selection dialog prior to selecting this option to delete a large amount of text at the same time.

Move Text allows the user to move existing text.

Select 'EDIT > Text > Move Text'

Left click on individual pieces of text

As the user moves the cursor the text will also move

Left click the mouse to place text

Rotate Text allows the user to rotate existing text graphically about the insertion point of the text. The insertion point of text is to the bottom left of the text. Use the data selection dialog prior to selecting this option to rotate a large amount of text at the same time. This will give the user an option to either set a fixed angle for all the selected text or add a relative rotation to that text.

Select 'EDIT > Text > Rotate Text'

Left click on individual pieces of text

As the user moves the cursor the text will rotate

Left click the mouse to place text

Copy Text allows the user to copy text and paste the text multiply.

Edit Existing String allows the user to edit existing text in the Create / Edit text dialog box. In this dialog the selected text may be edited, the height, width, rotation and justification of text may also be changed. Select existing text by clicking on it. Font information for the edited text will be determined by the current text style.

Toggle Text On/Off option turns on or off all the text associated with a given point and is provided as an alternative to manually deleting text, or using the delete overlapping text

option

Align Text To A String option aligns text to a given reference string, either interactively or by pre-selecting a number of text nodes.

Redraw String Annotation option allows the user to apply three options to pre-selected text or if globally if text is not pre-selected:

- Redraw all string annotation for all selected points using the feature library.

  This option re-applies settings in the feature Library to text.

- Check for, and automatically correct, any annotation errors in existing macro text.

  This option corrects errors such as position in text.

- Check for any errors in existing text and highlight the errors, but do not change the model:

  Errors are highlighted with blue outline

The Contractor shall survey all square or rectangular covers, manholes, street furniture exceeding 0.5m width dimensions using 3 points, or two points and a measured width. These are to be reduced to true rectangles as part of the survey processing, and presented as closed four point polygons in the ground model.

All small covers, manholes, gullies and street furniture shall be surveyed using 1 point. All covers must be oriented correctly.

Other polygonal survey features must contain at least three survey points.

Further editing such as reorienting of 1 point symbols can be carried out within the model itself by firstly unlocking the symbol and then reorienting the symbol.

Unlock Symbol converts a symbol associated with a survey point into a symbol that may be edited with the edit symbol command.

Within the SCC model, left click mouse to bring up the 'Data Selection Dialog'

Select 'Individual Points' and 'Ok'

Left click on symbol such as a Gully

Select 'EDIT > Symbol > Unlock Symbol'

Select 'Yes' to 'Convert all symbol associated with selected points to editable symbols'

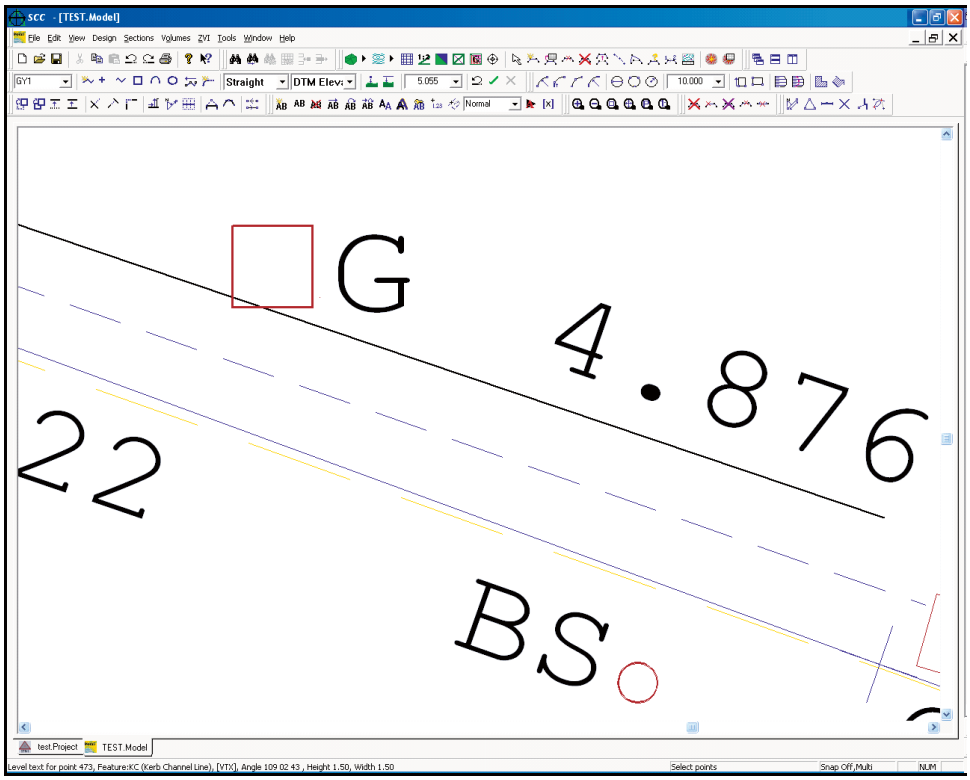


Figure 3.4: SCC Model with 1 point Gully symbol overlapping string

Rotate Inserted Symbol option allows the user to rotate an inserted symbol with the mouse.

Select 'EDIT > Symbol > Rotate Inserted Symbol'

Left click on symbol, as the user moves the cursor the symbol begins to reorientate

Left click to fix orientation

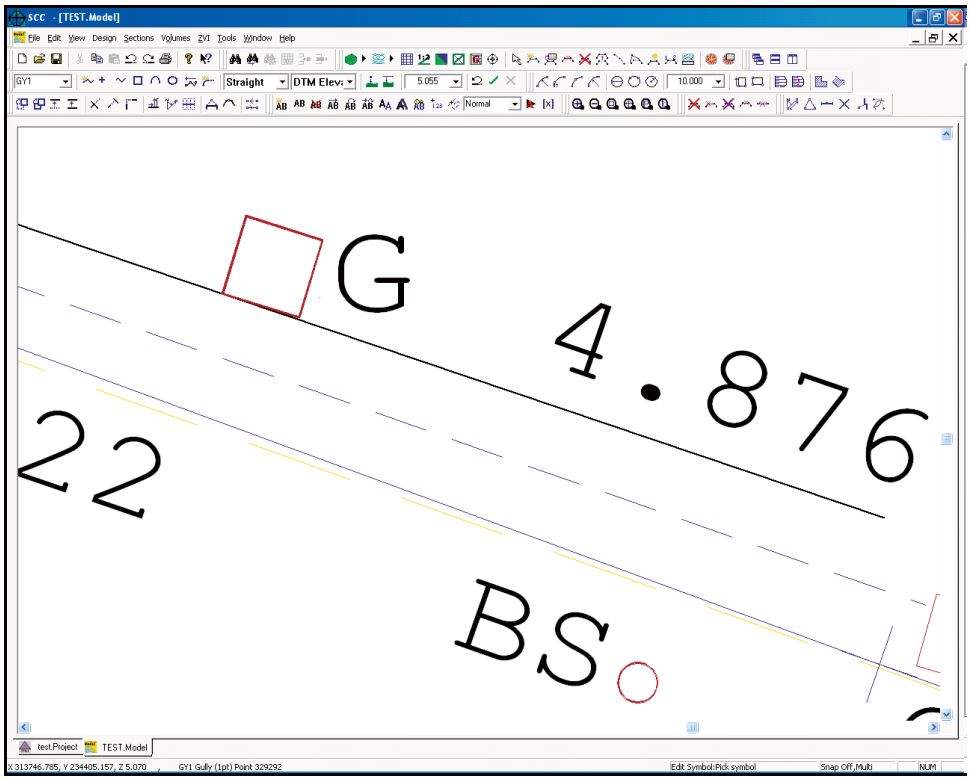


Figure 3.5: SCC Model with 1 point Gully symbol reoriented

Other polygonal survey features must contain at least three survey points.

A selection of features, have been given specific Line Connection Tags codes, which are forced within the library. This ensures that regardless of values within the input (raw survey) file the library values are held.

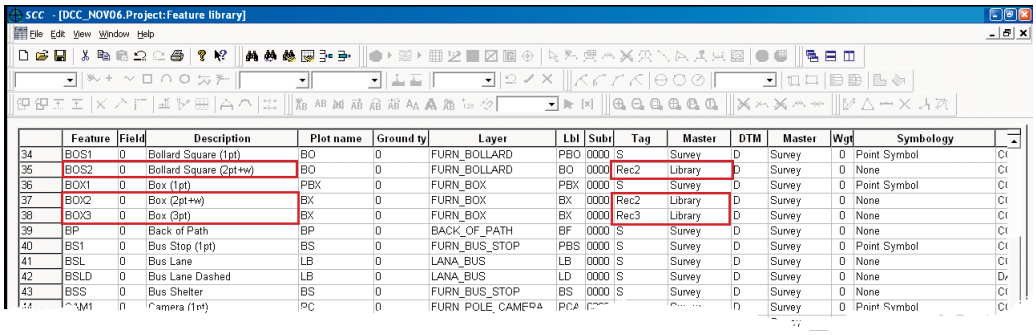
For example, 'EIR3' has a forced line connection tag of 'Rec3', therefore SCC expects 3 survey points to define the eircom cover.

Line Connection Tag:

Table below shows a sample of 'Line Connection Tags' which have been forced by the Dublin City Council supplied feature library:

SCC Feature Code	Description	Tag	Master
BOS2	Bollard Square (2pt+w)	Rec2	Library
BOX2	Box (2pt+w)	Rec2	Library
BOX3	Box (3pt)	Rec3	Library
EIR2	Eircom Cover (2pt+w)	Rec2	Library
EIR3	Eircom Cover (3pt)	Rec3	Library
ESB2	ESB Cover (2pt+w)	Rec2	Library
ESB3	ESB Cover (3 point)	Rec3	Library
EST2	ESAT Cover (2pt+w)	Rec2	Library
EST3	ESAT Cover (3 point)	Rec3	Library

Table 3.1: Line Connection Tags within the Feature Library



	Feature	Field	Description	Plot name	Ground ty	Layer	Lbl	Subt	Tag	Master	DTM	Master	Wgt	Symbology
34	BOS1	0	Bollard Square (1pt)	BO	0	FURN_BOLLARD	PBO	0000	S	Survey	D	Survey	0	Point Symbol
35	BOS2	0	Bollard Square (2pt+w)	BO	0	FURN_BOLLARD	BO	0000	Rec2	Library	D	Survey	0	None
36	BOX1	0	Box (1pt)	PBX	0	FURN_BOX	PBX	0000	S	Survey	D	Survey	0	Point Symbol
37	BOX2	0	Box (2pt+w)	BX	0	FURN_BOX	BX	0000	Rec2	Library	D	Survey	0	None
38	BOX3	0	Box (3pt)	BX	0	FURN_BOX	BX	0000	Rec3	Library	D	Survey	0	None
39	BP	0	Back of Path	BP	0	BACK_OF_PATH	BF	0000	S	Survey	D	Survey	0	None
40	BS1	0	Bus Stop (1pt)	BS	0	FURN_BUS_STOP	PBS	0000	S	Survey	D	Survey	0	Point Symbol
41	BSL	0	Bus Lane	LB	0	LANA_BUS	LB	0000	S	Survey	D	Survey	0	None
42	BSLD	0	Bus Lane Dashed	LB	0	LANA_BUS	LD	0000	S	Survey	D	Survey	0	None
43	BSS	0	Bus Shelter	BS	0	FURN_BUS_STOP	BS	0000	S	Survey	D	Survey	0	None

Figure 3.6: Extract of Feature Library highlighting Line Connection Tags forced in the library

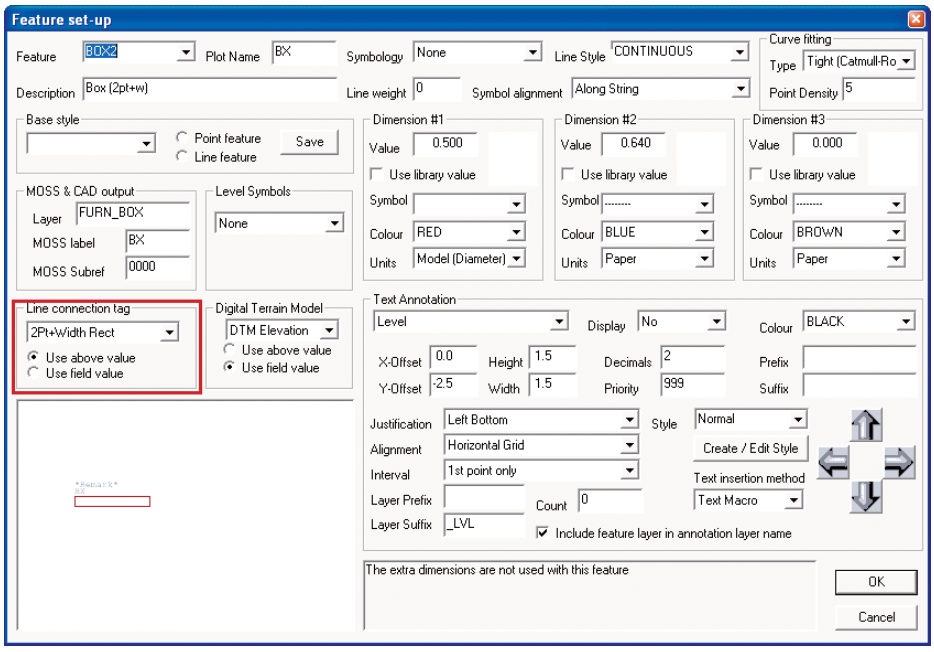


Figure 3.7: Feature Wizard denoting 'BOX2' feature with forced Line Connection Tag

A-3.2 Ground model standards presentation and Quality Assurance

The survey data is to be triangulated to from a constrained Delaunay TIN (triangulated irregular network) surface model, which in turn will be used to interpolate contours. For the purposes of this specification, the constraints on the triangulation will be made up of breaklines, and inclusive and exclusive boundary polygons.

A-3.2.1 Use of features in the triangulated surface

Whether or not a feature is included in the TIN surface, whether it is a 2D or 3D feature, and whether it forms an internal or external polygonal boundary, is determined by the feature library given in Appendix E. An external boundary is a polygonal line outside which triangulation and contour data is not created. An internal boundary is a polygonal line inside which triangulation and contour data is not created. All linear features that are included in the TIN surface are assumed to be breaklines. Not all 3D features will be included in the TIN surface. No 2D features will be included in the TIN surface.

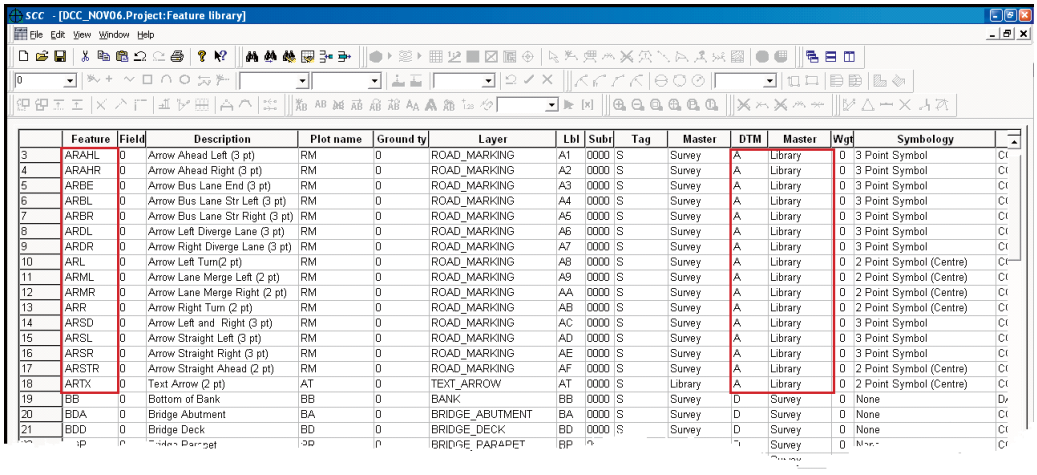
For the most part all features in the field are 3D defined within SCC as 'D' DTM. However, specific features (sample listed below) such as an overhead wire are set up as 2D points with a forced DTM status of 'Approx Elevation' that is, they do not form part of the TIN.

DTM code:

Table below shows a sample of 'DTM codes'which have been forced by the Dublin City Council supplied feature library:

SCC Feature Code	Description	Tag	Master
ARAHL	Arrow Ahead Left (3 pt)	A	Library
ARAHR	Arrow Ahead Right (3 pt)	A	Library
ARBE	Arrow Bus Lane End (3 pt)	A	Library
DIS	Disabled Parking Symbol (3 pt)	A	Library
OE	Line Eircom Overhead	A	Library
OESB	Line ESB Overhead	A	Library
PCR	Pedestrian Crossing	A	Library
PL	Public Lighting	A	Library
PYL	Pylon	A	Library
TD	Traffic Detector	A	Library
TX	Information Text	A	Library
UE	U/G Line Eircom	A	Library
UES	U/G Line ESAT	A	Library
YLBOX	Yellow Box	D	Library

Table 3.2: DTM codes forced within the Feature Library



	Feature	Field	Description	Plot name	Ground ty	Layer	Lbl	Subt	Tag	Master	DTM	Master	Wgt	Symbology
3	ARAHL	0	Arrow Ahead Left (3 pt)	RM	0	ROAD_MARKING	A1	0000	S	Survey	A	Library	0	3 Point Symbol
4	ARAHR	0	Arrow Ahead Right (3 pt)	RM	0	ROAD_MARKING	A2	0000	S	Survey	A	Library	0	3 Point Symbol
5	ARBE	0	Arrow Bus Lane End (3 pt)	RM	0	ROAD_MARKING	A3	0000	S	Survey	A	Library	0	3 Point Symbol
6	ARBL	0	Arrow Bus Lane Str Left (3 pt)	RM	0	ROAD_MARKING	A4	0000	S	Survey	A	Library	0	3 Point Symbol
7	ARBR	0	Arrow Bus Lane Str Right (3 pt)	RM	0	ROAD_MARKING	A5	0000	S	Survey	A	Library	0	3 Point Symbol
8	ARDL	0	Arrow Left Diverge Lane (3 pt)	RM	0	ROAD_MARKING	A6	0000	S	Survey	A	Library	0	3 Point Symbol
9	ARDR	0	Arrow Right Diverge Lane (3 pt)	RM	0	ROAD_MARKING	A7	0000	S	Survey	A	Library	0	3 Point Symbol
10	ARL	0	Arrow Left Turn(2 pt)	RM	0	ROAD_MARKING	A8	0000	S	Survey	A	Library	0	2 Point Symbol (Centre)
11	ARML	0	Arrow Lane Merge Left (2 pt)	RM	0	ROAD_MARKING	A9	0000	S	Survey	A	Library	0	2 Point Symbol (Centre)
12	ARMR	0	Arrow Lane Merge Right (2 pt)	RM	0	ROAD_MARKING	AA	0000	S	Survey	A	Library	0	2 Point Symbol (Centre)
13	ARR	0	Arrow Right Turn (2 pt)	RM	0	ROAD_MARKING	AB	0000	S	Survey	A	Library	0	2 Point Symbol (Centre)
14	ARSD	0	Arrow Left and Right (3 pt)	RM	0	ROAD_MARKING	AC	0000	S	Survey	A	Library	0	3 Point Symbol
15	ARSL	0	Arrow Straight Left (3 pt)	RM	0	ROAD_MARKING	AD	0000	S	Survey	A	Library	0	3 Point Symbol
16	ARSR	0	Arrow Straight Right (3 pt)	RM	0	ROAD_MARKING	AE	0000	S	Survey	A	Library	0	3 Point Symbol
17	ARSTR	0	Arrow Straight Ahead (2 pt)	RM	0	ROAD_MARKING	AF	0000	S	Survey	A	Library	0	2 Point Symbol (Centre)
18	ARTX	0	Text Arrow (2 pt)	AT	0	TEXT_ARROW	AT	0000	S	Library	A	Library	0	2 Point Symbol (Centre)
19	BB	0	Bottom of Bank	BB	0	BANK	BB	0000	S	Survey	D	Survey	0	None
20	BDA	0	Bridge Abutment	BA	0	BRIDGE_ABUTMENT	BA	0000	S	Survey	D	Survey	0	None
21	BDD	0	Bridge Deck	BD	0	BRIDGE_DECK	BD	0000	S	Survey	D	Survey	0	None
						BRIDGE_PARAPET	BP					Survey	0	

Figure 3.8: SCC Feature Library denoting Road Arrows with forced DTM codes in the Feature Library

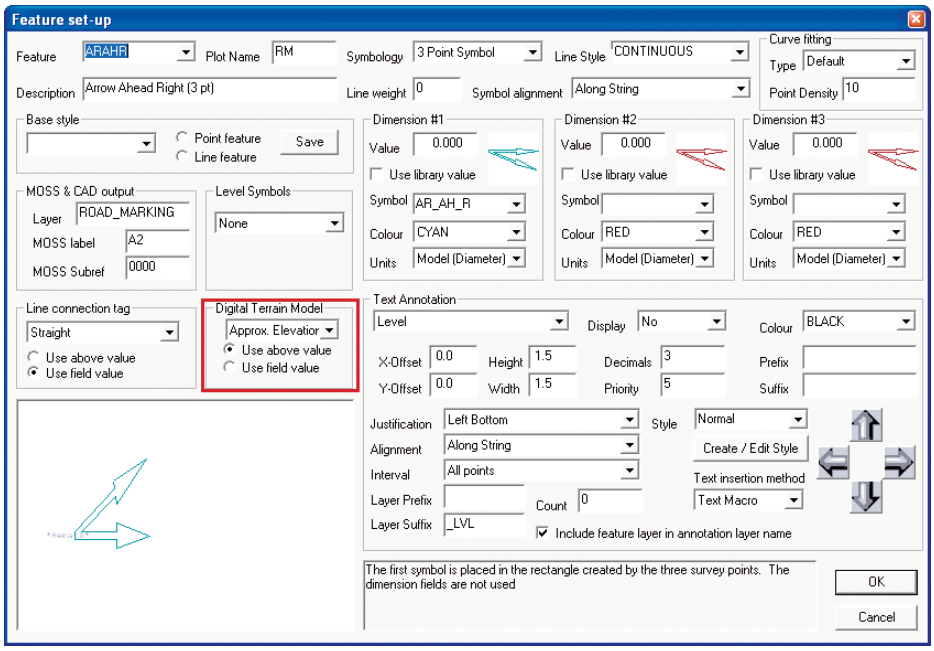


Figure 3.9: SCC Feature Wizard denoting 'ARAHR' feature with forced DTM code

A-3.2.2 Ground model quality control

All significant grade changes in the terrain should be surveyed using three-dimensional strings / break-lines.

There are no crossing break-lines in the model. Where two breaklines intersect on the ground, a point must be included in the ground model to resolve the elevation at the position of the intersection.

While discrete points can be used to adequately describe smooth and reasonably flat surfaces, they are unsuitable for describing irregular surfaces containing significant grade changes such as embankments, spoil heaps, pits & hollows, etc. Strings are used as break-lines and as such constrain the triangulation around irregular areas, the net effect of not using strings where they are required is that embankments, pit edges, etc. may appear to spill as illustrated in the diagram below:

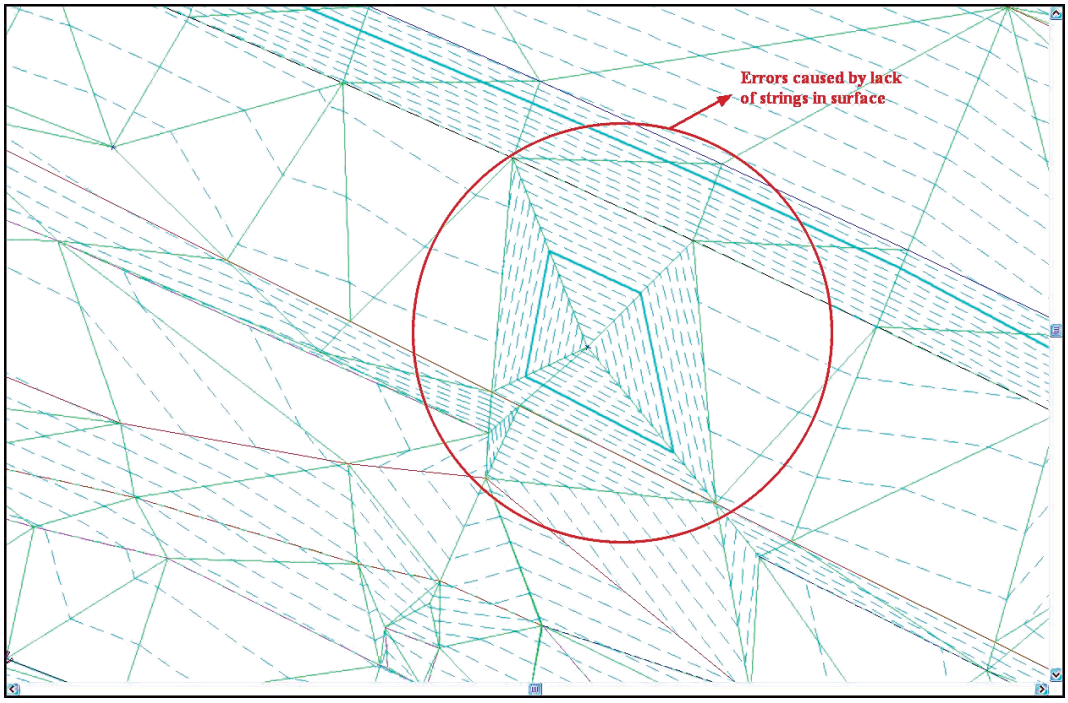


Figure 3.10: Model with contours turned on highlighting the error caused by lack of strings in the surface

The error shown above is corrected by connecting the discrete points defining the embankment / grade change with a string to produce the results shown in the following picture.

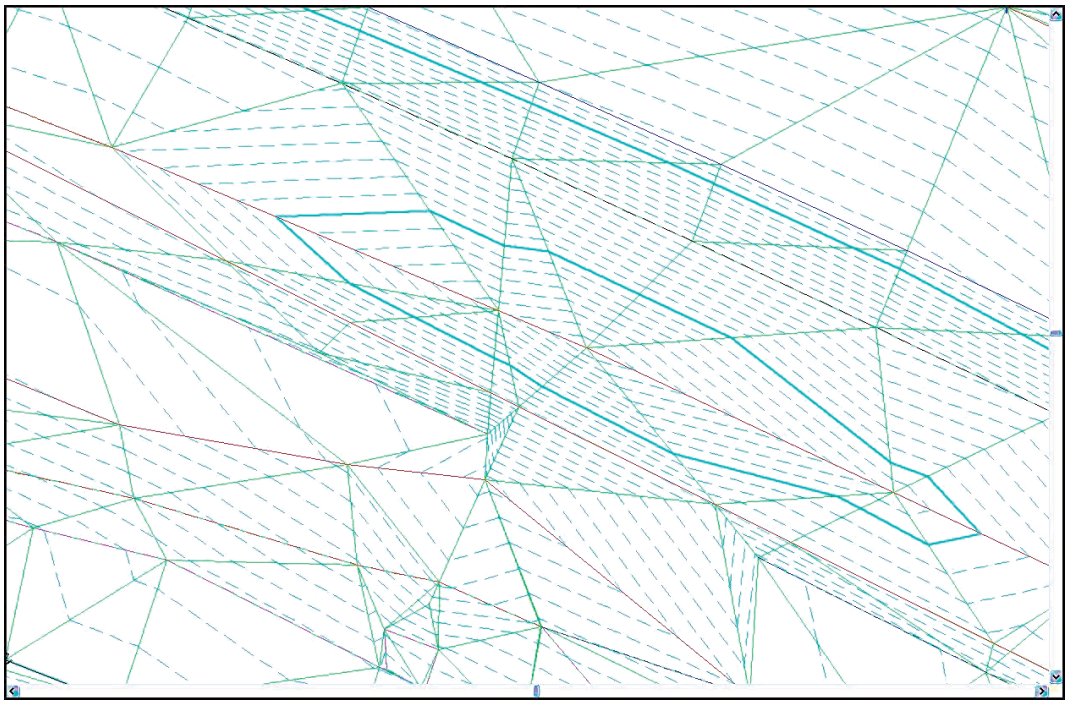


Figure 3.11: Model with contours turned on highlighting the effects of strings in the surface in comparison to Figure 3.10

To easily identify such errors in the terrain model, the surveyor can simply lower the contour interval, for example to 0.250m or perhaps turn on a High/Low colour relief contour scheme.

There are no crossing break-lines in the model.

A crossing break-line represents a point in the model with an ambiguous elevation, and is always indicative of a shortcoming or error in the survey. If the two strings in question do actually cross, a point should be surveyed or generated at the junction between the two strings to resolve the elevation ambiguity.

Crossing breaklines are liable to be flagged as model errors when moving the data between different modelling packages, and may cause the data to either be interpreted differently or rejected entirely.

Within SCC, crossing breaklines can be corrected using the 'Resolve crossing breaklines' tool.

Resolve Crossing Breaklines Tool allows the user to quickly resolve breaklines such as a Gully with a Road Marking on top. That is, if the Contractor has surveyed a gully with an elevation of 10m and subsequently a Double Yellow line with elevation of 10.5m, which crosses over the gully, a 'red cross' highlights the 3D error where both intersect. With this tool, the user has the option to create an intersection point at the correct level on either string.

Within the SCC model, zoom in as shown below

Select 'TOOLS > Resolve crossing breaklines'

SCC will isolate crossing strings (String 1 and String 2)

The user has the option to insert an additional point which is an 'Interpolate point based on level of string 1', 'Interpolate point based on level of string 2' or an'Interpolate point based on mean observation'

With the use of '<<Last' and 'Next>>' commands the user can quickly view crossing breaklines

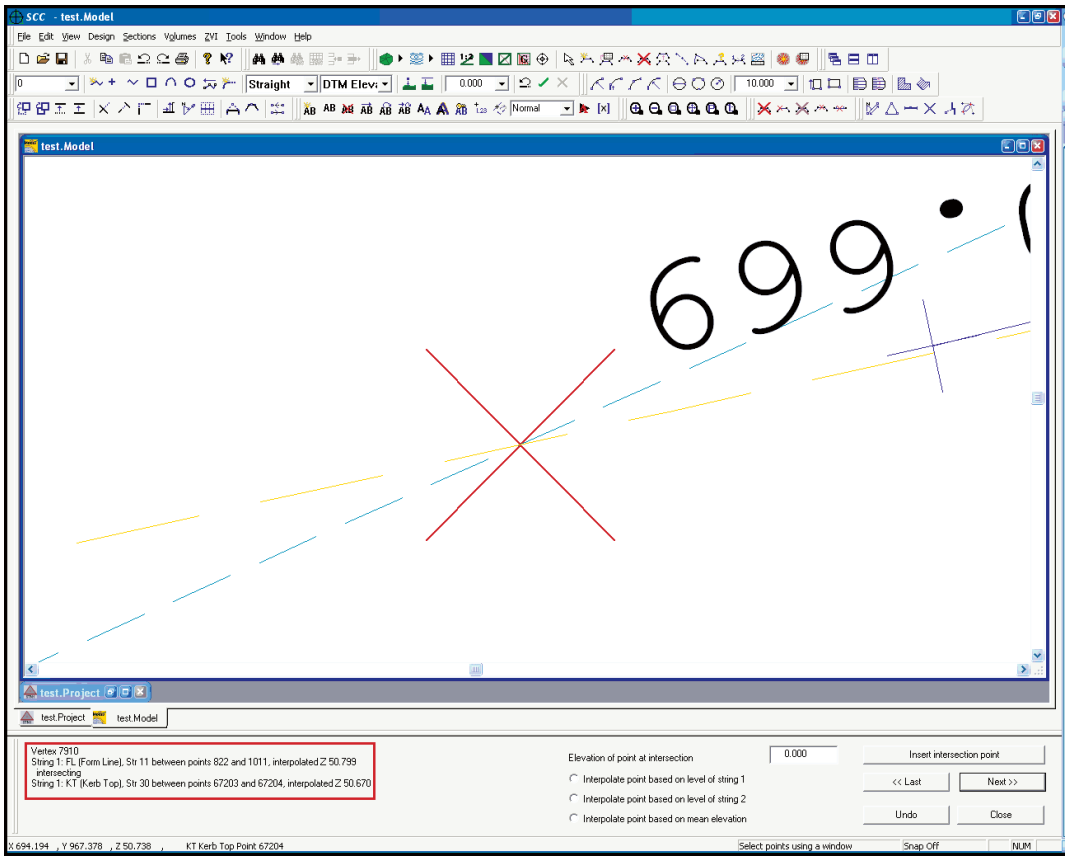


Figure 3.12: SCC Screen shot of Breakline Intersection Tool within SCC, highlighting

3D error

Where two breaklines intersect on the ground, a point must be included in the ground model to resolve the elevation at the position of the intersection.

All non-surface data, such as overhead and underground features, are not included in the TIN either as points or break-lines

All overhead and underground features are not included in the TIN either as points or break-lines.

Including such features in the TIN would distort the surface, and hence the contours and any sections, volumes or other analyses carried out on the surface.

Strings representing single continuous features on the ground must consist of a single continuous string or polyline in the model.

If data is represented as discrete line segments, or multiple polylines where a single polyline would be more correct, the following problems may occur:

It is not possible to use the string as a single entity for the purpose of trimming beyond the first or last point, moving or deleting mid-points, length and distance measurement, generating long or cross sections, creating offset strings, and many other similar operations.

There are a large number of duplicate, redundant points in the model making the model larger, slower and more prone to error.

All redundant points which are not part of a line feature when imported into MX are joined together to form spurious line strings which can distort the TIN.

Note that it is quite common to receive data with this type of problem from CAD and DXF files where editing of three-dimensional polylines has necessitated exploding the polyline into separate lines. It is also a problem associated with DXF generated by some older survey and design packages.

Specific tools within SCC such as 'Join Adjacent Strings' should be utilised to ensure that strings representing single continuous features on the ground consist of a single continuous string or polylines in the model:

Join Adjacent Strings (Same Feature) is used to join all strings together in the model, within a specified tolerance, that have the same feature name. This is particularly useful when processing polylines from CAD that were exploded into lines for editing purposes.

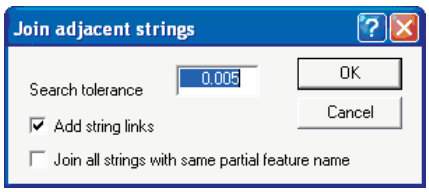


Figure 3.13: Join Adjacent Strings same feature Dialog box from SCC

Within the SCC model, select 'TOOLS > Join Adjacent Strings (Same Feature)

Enter Search tolerance

Add string links option will convert strings into closed polygons if the start and end points lie within the stated tolerance

Joining strings with the same partial feature name option ignores the numeric part of the feature name when performing the comparison

Join Adjacent Strings (Any Feature) option is used to search for groups of proximate points that are within a given horizontal and vertical distance from one another, and edit them such that they are all snapped to the same point.

Within the SCC model, select 'TOOLS > Join Adjacent Strings (Any Feature)

Set the horizontal and vertical search tolerances.

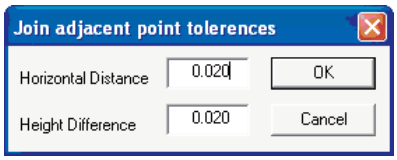


Figure 3.14: Join Adjacent Strings different features Dialog box from SCC

On entering your tolerances, SCC searches for all groups of proximate points, and displays the dialog shown below. To continue, you should ideally be zoomed in close enough that millimetre distances are visible on screen. The screen will be centred on the first group of proximate points, and these points will be highlighted in plan. The next and last buttons may be used to pan between all the groups of proximate points, and other editing buttons are available to resolve those points. The position to which points will be snapped may also either be selected or entered directly. The various editing options are appropriate to the different model conditions shown below:

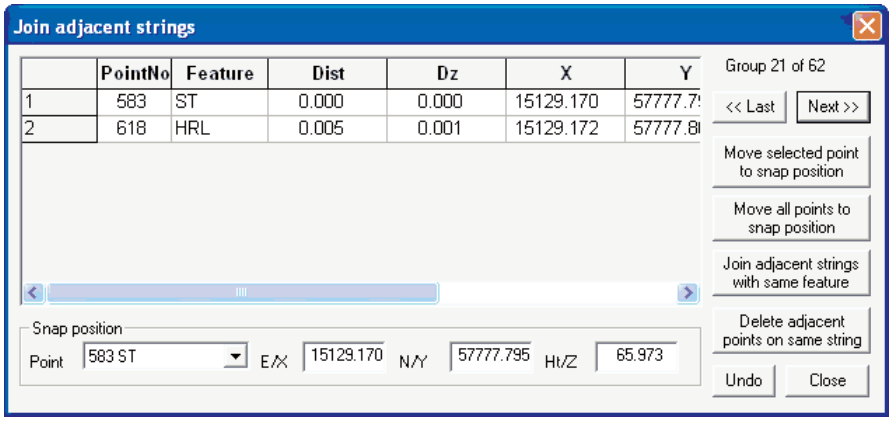


Figure 3.15: Example of Join Adjacent Strings (different features) Dialog box from SCC

If the group is made up of string end points that have the same feature name, select the ' Join adjacent strings with same feature' option.

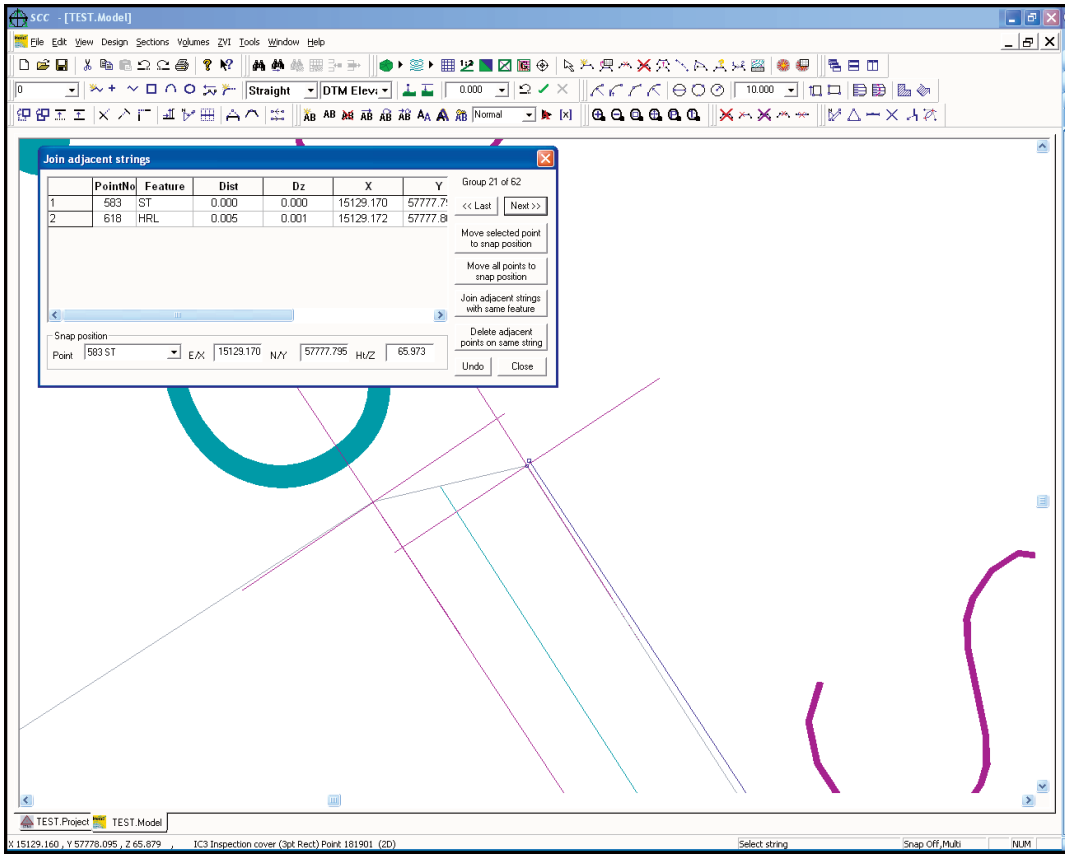


Figure 3.16: Example of Join Adjacent Strings (different features) Dialog box from SCC pin pointing difference within the model

This will also close polygons with links where appropriate.

Strings representing polygonal features such as boundaries, buildings, and ponds should be represented as closed strings or closed polylines.

If this is not done the string may not be used as a boundary in SCC and other packages such as MOSS / MX. It will also not be possible to measure the area enclosed by the polygon in SCC or CAD.

There is no other three-dimensional data included in the TIN model that has not been directly surveyed on the ground surface.

Any spurious three-dimensional data in the TIN model will distort the surface and any analyses carried out on it.

Such data can be very common in DXF where extra entities such as text nodes, title blocks, and other such information can be stored in three dimensions. This is particularly true of DXF produced by other survey and design packages, where the DXF file will often contain many more points than those surveyed. A problem associated with files coming from some such packages is that the surveyed point will include multiple entities with different plan position yet the same elevation in order to represent both the point and the text annotation associated with it.

Another common problem when dealing with DXF generated from digitally processed ground survey is that the contours will be included as three-dimensional polylines, even though they have not been surveyed, and will cause the model to greatly increase in size and have many crossing break-lines if re-triangulated. These contours will normally be on separate layers and should be excluded from the file to be modelled.

Strings must not contain duplicate points or double back on themselves.

Strings, particularly significant linear strings such as road centre lines, should not contain

duplicate points or double back on themselves.

If a profile is taken from a string, such as a road centre line, the profile will be longer than the road.

If the string is used to generate cross sections and cross sectional volumes, there may be extra sections and the volume will be too large.

If the string is used to generate offset strings the error will become magnified.

Isolation of Duplicate Points

Visual Identification of Duplicate Points

Within the Model, go to 'Triangulation Options 

Select to 'Display' Duplicate Points

Note on the model the Duplicate points are visible with a Magenta Cross

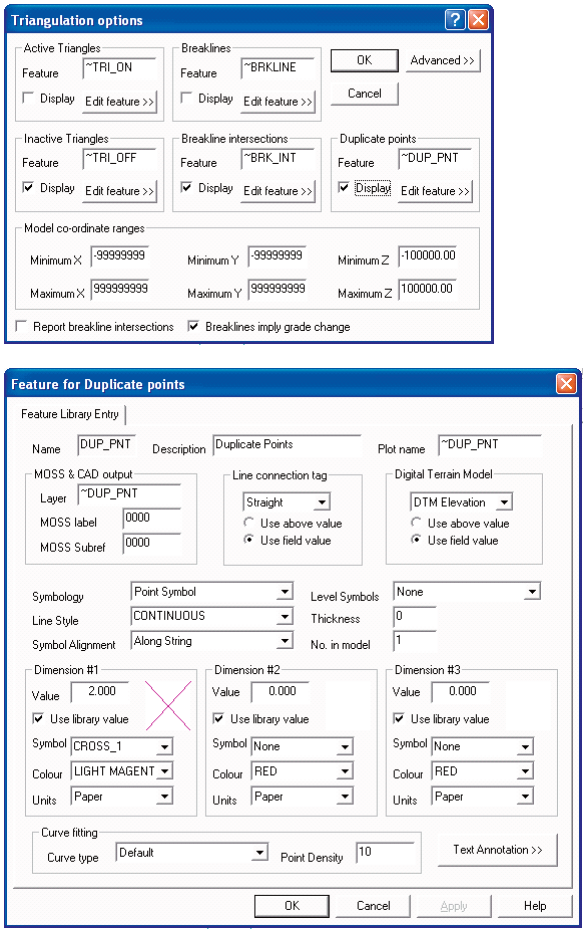


Figure 3.17: Triangulation Options with Duplicate Feature Entry Dialog

Report Duplicate Points

Within the Model, go to 'TOOLS > Report String Intersections'

Select 'Report Duplicate Points'

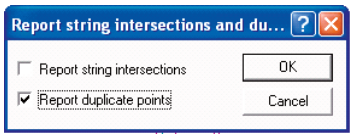


Figure 3.18: Report Duplicate Points Dialog from SCC

Select 'OK'

Select 'Yes' to edit report

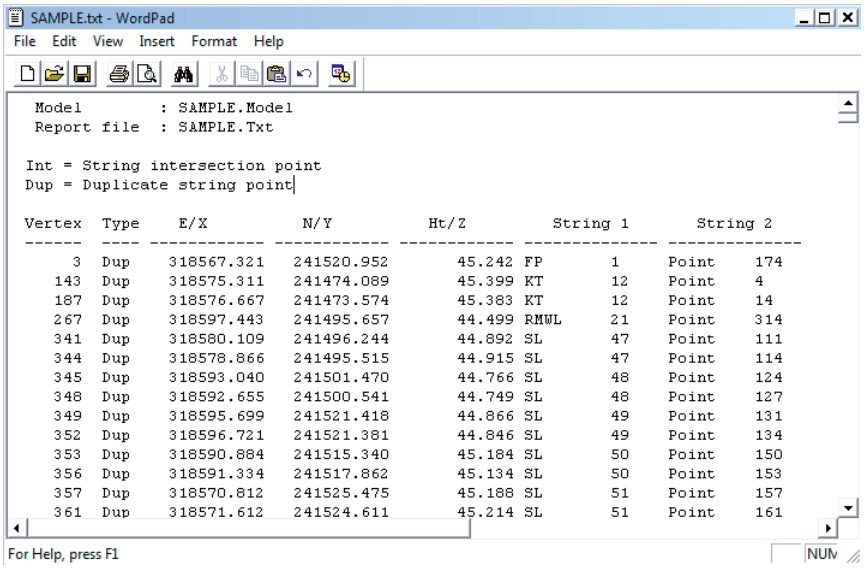


Figure 3.19: Extract of Duplicate Points Report from SCC

Investigation of duplicate points is essential and utilising SCC functions such as **'Delete duplicate points from model'** is important before exporting to MX

Delete duplicate points

Within model, go to 'TOOLS > Delete Duplicate points'

Select the relevant options

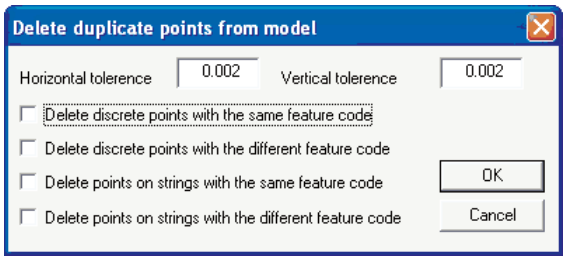


Figure 3.20: Delete Duplicate Points Dialog from SCC

Gaps should not be used to break up separate strings.

A gap, referred to as a discontinuity in MOSS / MX, is a break in a string.

A common survey error is to use gaps to end strings. While the resultant model looks correct in plan, it becomes difficult to edit as seemingly unrelated data belongs to the same string. SCC provides an 'End' tag code for this purpose.

The TIN surface should be verified, by the surveyor, as being in good agreement with the ground.

Editing the triangulation allows further control over the final model surface and its

boundaries.

Weeding Model Triangles

The simplest way of triangle editing is to 'Weed the Triangulation'.

From the Main Menu Bar, select 'EDIT > Weed the Triangulation'

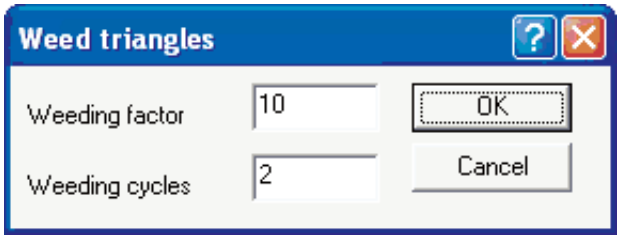


Figure 3.21: SCC Weed Triangulation Dialog

Select OK to accept the defaults

The weeding factor determines how many standard deviations from the normal will be required to eliminate the triangle. A higher number will eliminate fewer triangles.

Weeding cycles determine how many times the system will run through this process.

Adding And Removing Triangles

The weeding defaults work reasonably well on most models but it is possible that some triangles may be eliminated from the interior of the model that you wish to keep. The ' Add/Remove' option will allow you to replace any of those triangles.

Additionally, there may be triangles the weeding did not remove, that are invalid. These may be close to equilateral triangles crossing a concave area, or triangles interior to a building or other flat surface. The above option also allows you to remove any of these unwanted triangles.

By selecting 'EDIT' and then 'Add/Remove Triangles', you will activate the triangle editor. You know when this editor is active because the color of the triangles in your model will be filled in either green or blue. Triangles may be interactively selected or by using previously selected points. The invalid or removed triangles are shown in blue and the valid triangles are shown in green.

When you select this option a dialog will be displayed. This dialog allows you to control how the triangles are selected and the action you wish to apply to them.

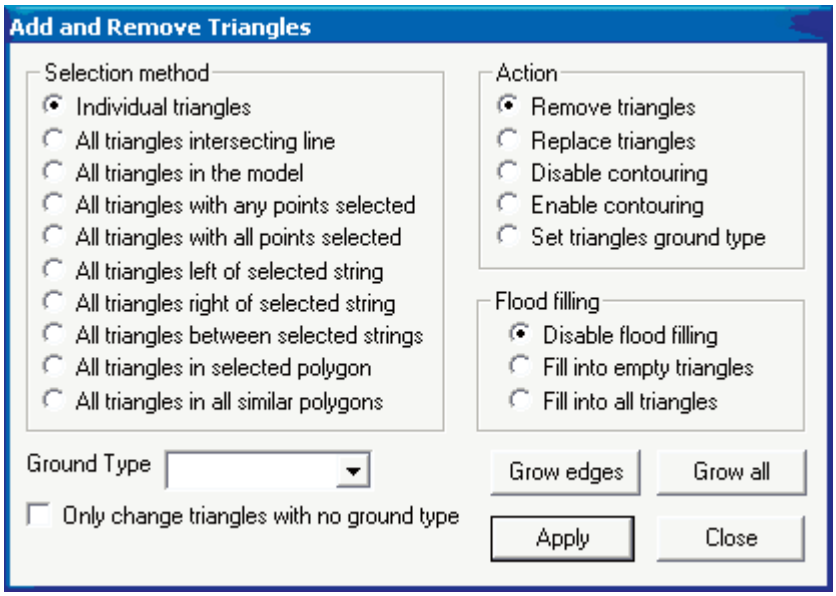


Figure 3.22: SCC Add/Remove Triangles Dialog

By selecting points in advance, for example all points on a road centre line, it is very easy to set triangles by feature or string. In this case, selecting 'All triangles with any points selected' will usually refer to any triangle in contact with a road centre line. This will be much quicker than selecting triangles manually.

Triangle Editing

From the Main Menu Bar, select 'EDIT > Add and Remove triangles'

Highlight 'All triangles intersecting line'

Highlight 'Remove triangles'

Click OK

Select the triangles shown in blue in the image below by left click mouse to start the intersecting line, move the cursor across triangle you wish to remove and then left click mouse to end intersecting line.

Select Close (or press ESC) when finished

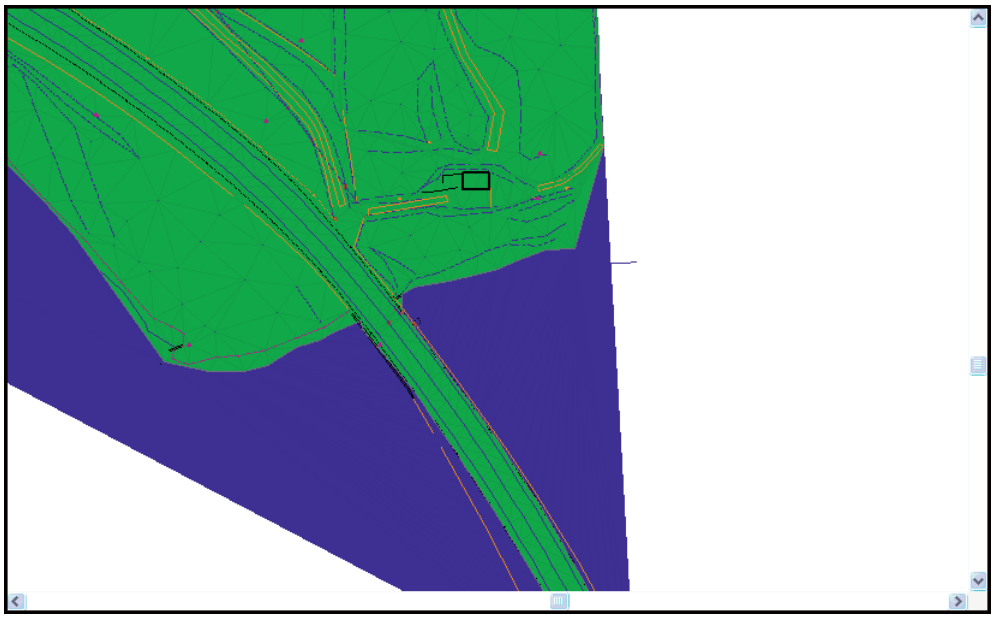


Figure 3.23: SCC Model Extract with Active Triangles highlighted in green and Inactive triangles highlighted in blue

SCC then gives you the option of storing the boundary you have created using the ‘ Add/Remove Triangles’ option, as a boundary string. If you say ‘Yes’ to this, a boundary string called '~BNDRY' is created and stored in your model. This is very useful especially when volume calculations may be needed.

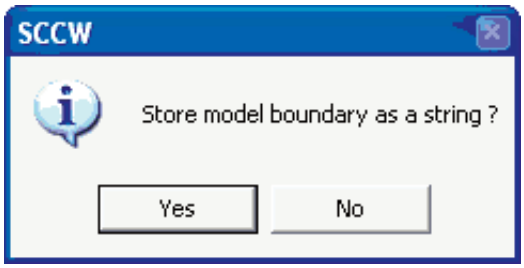


Figure 3.24: SCC dialog prompting to store boundary after Triangulation editing

Click 'Yes' to 'Store model boundary as a string'

The ‘Add/Remove Triangles’ option also allows you to disable contours in a given area, but keeping the triangles active. For example, on a road, you may not want to display contours across the hard surface but will wish to generate profiles and cross sections of the road at a later stage. Removing the triangles from this area will mean that no sections can be generated at all so therefore you would use the ‘Disable contours’ option instead.

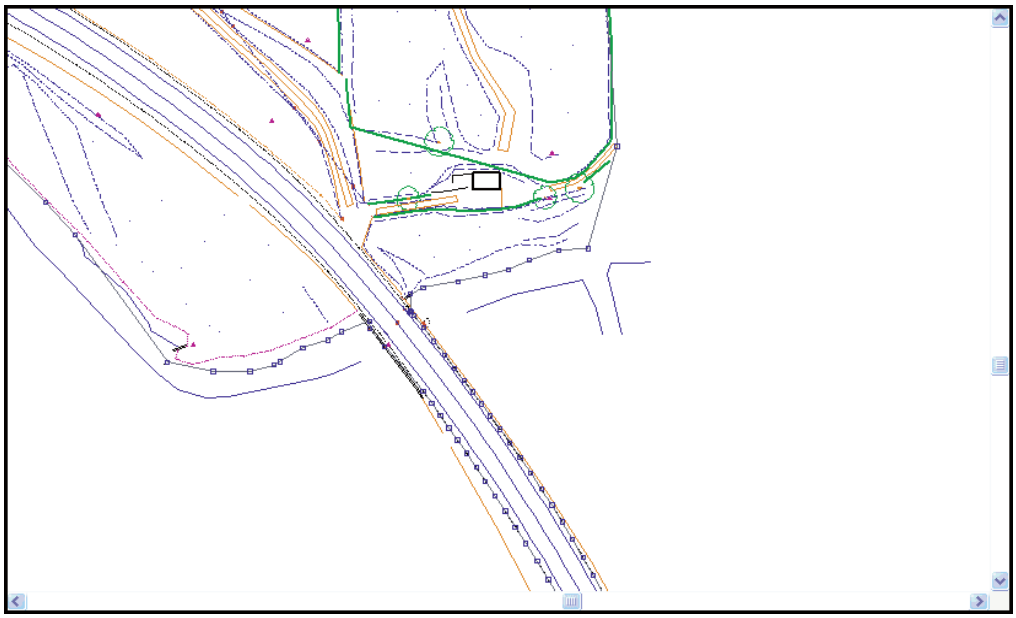


Figure 3.25: SCC Model Extract with Boundary highlighted

Regardless of the survey method, the surveyor should visually inspect the model to ensure that there is no missing data, and no extra spurious data. The surface can be checked by inspecting the contours with a small (e,g, 0.2M) contour interval set, and by taking a number of sample profiles around suspect areas.

Within the model, select 'Contouring Options' from the edit toolbar

Set the Regular Contour Interval to 0.2

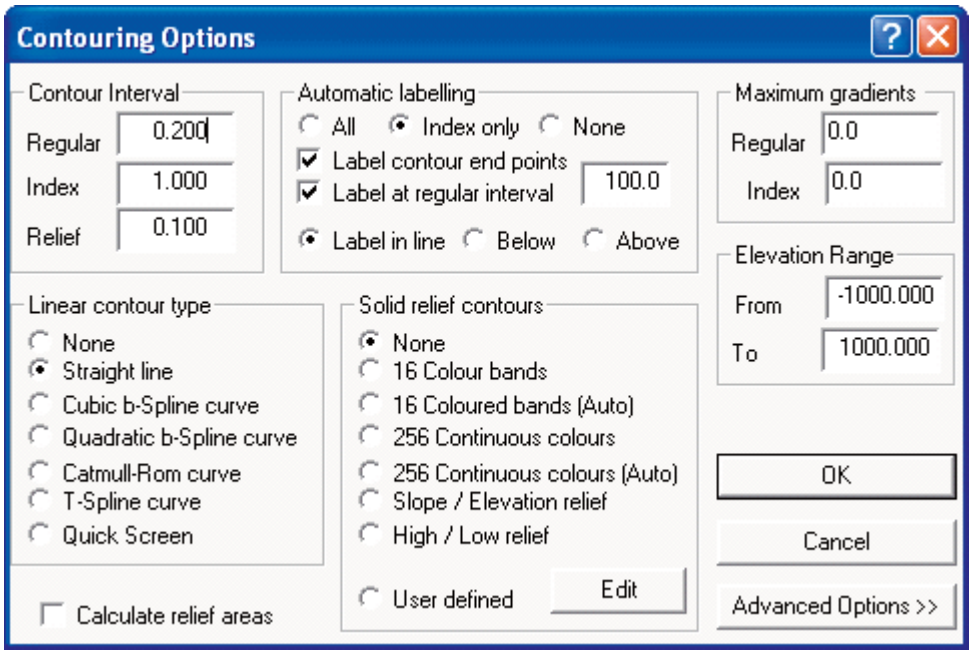


Figure 3.26: SCC Contour Options Dialog

All strings associated with a given road or similar linear feature must be oriented in the same direction.

In a road, rail, canal or similar linear survey all major linear strings should have the same basic orientation, and operations such as offsetting that use left and right measurements make logical sense.

When strings are used to generate profiles in the absence of an alignment, the first point on the string is generally taken as chainage 0. If two strings, say the left and right edge of a road, have different orientations, and they are used to generate profiles one will have chainage 0 at the beginning of the road and the other at the end of the road.

This option allows you to globally re-orient either selected strings, or all strings in the model, such that they all have the same general orientation. This is particularly useful for annotation purposes, and when creating long sections or profiles from existing survey strings. When run, this option reverses any strings, over the specified length, whose average orientation is away from the selected orientation. Polygonal strings will be given an clockwise orientation.

Within model, go to 'TOOLS > Set preferred string direction'

Select the relevant options

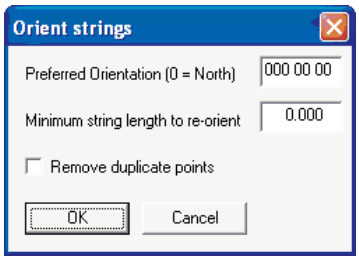


Figure 3.27: Set preferred string direction Dialog

Data should not be duplicated in the model.

Duplicate data leads to increased model size and can make it confusing or difficult to edit individual points.

Large amounts of duplicate data can also result in errors in the triangulation, particularly where duplicate points in plan have different elevations.

An error sometimes encountered is where the surveyor has taken the three-dimensional points representing the line work into CAD and subsequently joined the points together with either two-dimensional or three-dimensional polylines. If three-dimensional polylines are used the original points should be deleted afterwards to avoid duplication. If two-dimensional lines are used the model will not have any break-lines, leading to the errors detailed earlier.

As a final check of data before export, the surveyor should generate a QA report ensuring that no duplicate points exist. Such reports can also identify intersection points.

Strings denoting linear features should contain at least two points.

Where two strings denoting 3D features meet at a common junction point they should share a common elevation at that point.

A-3.2.3 Model boundaries

The ground model must include at least one closed 3d boundary string, made up from survey points in the TIN model, that is used to indicate the external limits of the TIN model and contours.

Where any internal boundaries exist within the model, that is areas which are not valid for contouring or other TIN based interpolation, closed 3d internal boundary strings must surround them.

The inclusion of explicit boundary strings allows the triangulation to be readily recreated in other systems and explicitly defines the limits over which elevations may be interpolated.

A-3.3 Digital data formats

Drawing and ground model data will be provided in AutoCAD DWG, Bentley MX, Bentley Microstation, and Atlas SCC formats. The cartographic rendering and TIN surface for the survey must be identical within the formats given.

A-3.3.1 AutoCAD DWG

AutoCAD files must be provided in 3d AutoCAD 2000 compatible DWG format using a layering system in accordance with the feature library given in Appendix E. All symbols will be represented as block INSERT entities. All surveyed lines will be represented as POLYLINE entities. All triangles from the TIN surface will be represented as 3DFACE entities with a clockwise winding. All annotation will be represented using TEXT entities. No data other than directly surveyed data should appear in the drawing in accordance with the feature library given in Appendix E. Any other drawing enhancements will be placed on layer 0. All two-dimensional data should have an elevation of zero. All data, other than drawing enhancements on layer 0, should have colours and line-styles set to BYLAYER. Points and strings will be described with a single entity only. There will be no duplicate entities for the same survey point, other than for text annotation. All layers in the drawing will be turned on and visible.

A-3.3.2 Microstation DGN

Microstation files must be provided in 3d Microstation V8 compatible DGN format in accordance with the feature library given in Appendix E. All symbols will be represented as shared cells. All surveyed lines will be represented as line strings. All triangles from the TIN surface will be represented as 3DFACE entities with a clockwise winding. All annotation will be represented using text entities. No data other than directly surveyed data should appear in the drawing in accordance with the feature library given in Appendix E. Any other drawing enhancements will be placed on level 0. All two-dimensional data should be represented using 2d elements. All data, other than drawing enhancements on level 0, should have colours and line-styles set by level. Points and strings will be described with a single entity only. There will be no duplicate entities for the same survey point, other than for text annotation. Logical colours used in the DGN will be in accordance with the colour table provided in A-4.5.1 of Annexe A.

A-3.3.3 SCC Model

The SCC ground model will be compatible with SCC 9.0.1 or later and will be created using the Dublin City Council _____ feature library. All annotation in the model will be created as ‘ Macro Text’ such that it can be readily transformed between grid systems.

A-3.3.4 Bentley MX GENIO

The MX GENIO file will be labelled in accordance with the feature library given in Appendix E, such that it is suitable for drawing with the MX feature naming set Dublin City Council _____.FNS and plan style set Dublin City Council _____.PSS, as given in appendix E. The file will be formatted such that it can be input directly into MX ROADS and drawn directly using the feature name and plan style sets given, with no additional editing, such that the result given complies with clauses 3.1 to 3.2.3 above. All survey data in the GENIO file will be provided in four dimensions corresponding to X, Y, Z and survey point number. 2D points will be given an elevation of –999. 3D strings that are not included in the TIN model will be given a string sub-reference of NULL. All string labels in the GENIO file will be unique four character alphanumeric string labels. All point strings will start with the letter ‘P’. All text strings will start with the character ‘*’. All line strings will contain at least two points.

A-4

Presentation of Results

A-4 Presentation of Results

A-4.1 Style of Drawing

Drawings produced shall be in colour and to a consistent style and all the features specified shall be presented on the final plan or data set to a neat and legible standard.

Style of presentation of the specified work, feature colours, conventional symbols and feature name abbreviations shall be consistent with the feature library given in Appendix E.

The proposed sheet border and title block shall be agreed between the Employer and the Contractor.

A-4.1.1 Sheet Size and Layout

The final plans shall be produced on standard A1 size sheets at the following scales:

1:250 for the plan layout of the survey

1:200 horizontal, 1:50 vertical for the longitudinal sections

1:200 horizontal, 1:50 vertical for the cross sections

Adjoining sheets shall be overlapped. The sheet layouts shall be submitted by the Contractor for approval.

A-4.2 Drawing Content

A-4.2.1 Detail

All specified features shall be represented on the final drawings in accordance with the style specified in clause 4.1.

A-4.2.2 Annotation of points

Survey points and features will be annotated with text in accordance with the feature library given in Appendix E. This annotation may include feature name, elevation, plan position, point number, survey notes, and ancillary dimensions. The Contractor will edit annotation such that no text in the drawing overlaps. Where any given annotator has been moved by the Contractor for this reason, such that it is no closer to the annotated survey point than any other point in the model, an arrow will be added to connect the annotator to the survey point.

A-4.2.3 Reference Information

Location plans and diagrams may be located within the information margins of the main drawings or may be placed on a separate drawing of the same style.

The Contractor will provide as part of the final product the following items:

- location plan
- sheet layout diagram with cross references to overlays
- Survey Report

These items can be checked initially by verifying that no modifications have been made to the Dublin City Council feature library provided. This can be done by exporting any given SCC model feature library to a CSV file and comparing it to the file created by exporting

the Dublin City Council library supplied. The only column that the survey contractor should have changed is the Field code column.

Models and sections should also be visually inspected to ensure they are legible and have not had any content systematically removed or added. This can be done by comparing the annotation for any given feature with the feature library report entry for the same feature. It is also recommended that the TIN model be displayed and checked to ensure that no features have been systematically added or removed from the TIN during processing.

A-4.3 Final Drawings

A-4.3.1 Proof Copies

Two sets of hard copies of the final drawings shall be submitted to the Employer for approval before delivery of the final copies.

The Employer shall return one set within 10 working days with any amendments to be incorporated in the final copies.

A-4.3.2 Final Copies

One copy of each sheet shall be submitted to the Employer after approval of the proof copies.

A-4.4 Supply of Digital Data

A-4.4.1 Standards of Accuracy

All digital data supplied shall conform to the same standards of accuracy specified in Clause 2 for each type of data.

A-4.4.2 Proof and Final Digital Data and Files

The Contractor shall submit one set of all digital data and files in this specification as a proof copy on compact disc to the Employer for approval before delivery of the final digital data and files on compact disc. The Employer shall request any amendments that are not to specification within 10 working days of submission.

After approval of the proof digital data and files, the Contractor shall submit 2 sets of all digital data as final copies on compact disc to the Employer.

A-4.4.3 Computer Compact Discs

It is the responsibility of the Contractor to ensure that any compact discs associated with the contract are supplied in good working order. If discs have to be resubmitted, they shall be resubmitted at the Contractor's expense.

A-4.4.4 Level Records

The Contractor shall submit records of all points levelled under the contract. The records shall detail the derivation of the levels using the **"height of collimation"** format. This data shall be submitted in the form of a Microsoft Excel file on compact disc.

A-4.4.5 ASCII File

The Contractor shall supply the survey data in the form of a comma delineated ASCII data file. Each record shall consist of a minimum of four fields - easting, northing, reduced level and record description. A fifth field - dimensions - shall be added where appropriate for surface features such as covers, gratings, etc.

Two ASCII files should be provided. One ASCII file should contain easting and northing coordinates in the ITM grid system and the second ASCII should contain easting and northing coordinates in IG75 grid system as per clauses 2.2.2 and 3.3.3.

It is a requirement that the data file shall be capable of inputting directly to Microsoft Excel.

A-4.4.6 SCC Files

The Contractor shall submit the following SCC Files on a compact disc to the Employer on completion of the project:

SCC Project File (*.Project)

SCC Traverse File (s) (*.Traverse)

SCC Traverse Report

Traverse Diagram (*Model)

SCC Transformation File (*.Transformation)

SCC Transformation Report

SCC Dataset File (s) (*.Survey)

SCC Drawing File (s) (*.Model)

SCC Section File (s) (*.Section)

Microstation v8 (*dxf) and Autocad 2000 (*dxf) files produced from SCC with required settings and using specified Colour Map Settings

MX file (*inp) using required settings for importation into the roads design program MX Roads.

All files should be submitted in accordance with clause 2.2.2.

A-4.5 Digital data

The Contractor shall supply SCC Model, MX GENIO, 2D and 3D Microstation v8, and AutoCAD 2000 files of the ground model of the surveyed area to a scale of 1:250. Where more than one sheet is required to cover the street or road, a map shall be provided showing the extent of each sheet, its overlap and orientation. The cartographic rendering and TIN surface for the survey must be identical within the formats given.

The Contractor shall supply SCC Section, 2D Microstation v8 and AutoCAD 2000 files, showing the reduced levels along the longitudinal sections of each road crown or centreline. The chainage location of all spot levels and the numerical value of all spot levels shall be clearly identifiable on the print. The longitudinal sections shall be plotted to a scale of 1:200 horizontally and 1:50 vertically.

The Contractor shall supply SCC Section, 2D Microstation v8 and AutoCAD 2000 files, showing the reduced levels along cross sections at 10m intervals extending across the full width of survey area. The chainage location of each cross section and the numerical values of all spot levels shall be clearly identifiable on the print. Levels on long sections should be reported to 3 decimal places. Offsets and level values on cross sections should be reported ot 3 decimal places. The cross sections shall be plotted to a scale of 1:200 horizontally and 1:50 vertically. Appendix F proves a sample cross and long section file.

Drawing and ground model data will be provided in AutoCAD DWG, Bentley MX, Bentley

Microstation, and Atlas SCC formats. The cartographic rendering and TIN surface for the survey must be identical within the formats given. This should be visually inspected to determine that it is the case.

The explicit content within the different digital file formats has been included to further enforce consistency and to maximise data portability.

A-4.5.1 AutoCAD DWG files

AutoCAD DWG files shall be supplied for all models, long sections and cross sections in accordance with clause 3.3.1

The following settings should be used when exporting an AutoCAD DXF file from SCC:

Within the Model, go to 'FILE > Export Model > CAD Drawing'

Select Host CAD System 'Text DXF'

Select Drawing Type '3D Model'

Select 'Do not colour entities BYLAYER',

'Export Approx Elevation with an elevation of 0,0',

'Export text styles using 'True Type' fonts' and

'Export in-line text as complex line styles'

Select 'Colour Map>>'

Set up the CAD Colour mapping fields as follows:

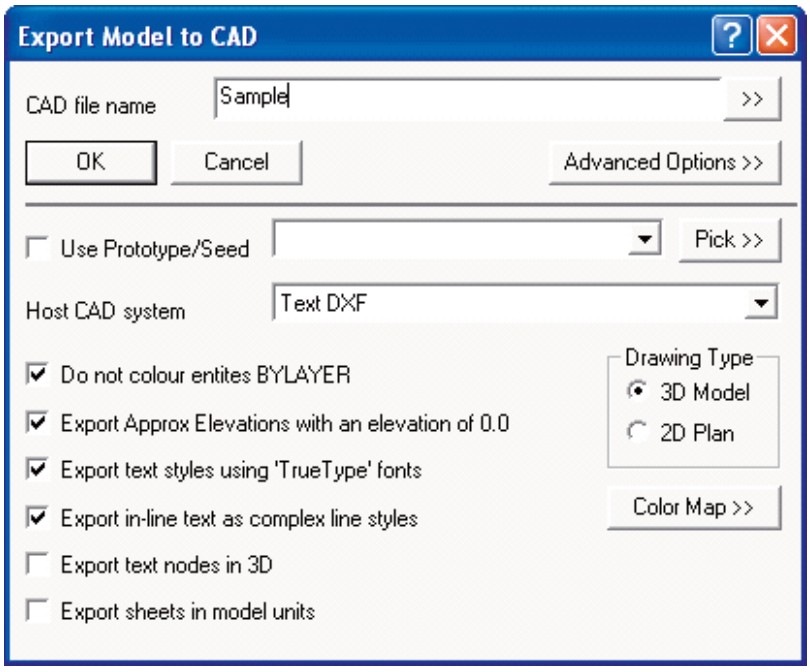


Figure 4.0: SCC Export Model To CAD Dialog

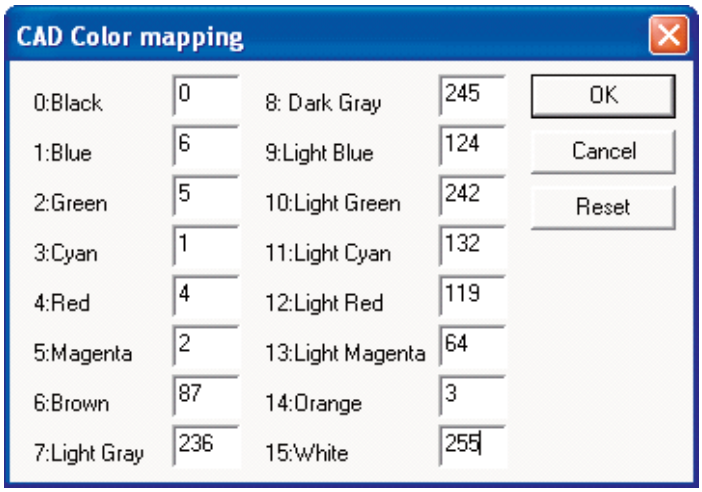


Figure 4.1: SCC CAD Colour Mapping Dialog depicting Dublin City Council 256 Colour Table

Note: QBN Project Office use the standard AutoCAD colour table

Select 'OK' to exist CAD Color mapping

Select 'OK' within the Export Model to CAD

A-4.5.2 Microstation DGN files

Microstation DGN files shall be supplied for all models, long sections and cross sections in accordance with clause 3.3.2

A-4.5.3 SCC files

SCC model files shall be supplied in accordance with clauses 2.2.2 and 3.3.3. SCC long sections will be presented using the 'Dublin City Council -Long section' section style. SCC cross sections will be presented using the 'Dublin City Council -Cross section' section style. SCC survey files shall be supplied to include all topographic observations, instrument set-ups and reduced coordinates. SCC traverse files shall be supplied to include all total station control observations. An SCC project file shall be supplied to include all station coordinates and feature library used for processing.

A-4.5.4 Bentley MX GENIO files

MX GENIO files shall be supplied in accordance with clause 3.3.4.

The following settings should be used when exporting a MX GENIO file from SCC:

Within the Model, go to 'FILE > Export Model > MX (MOSS) Model'

Set up the following:

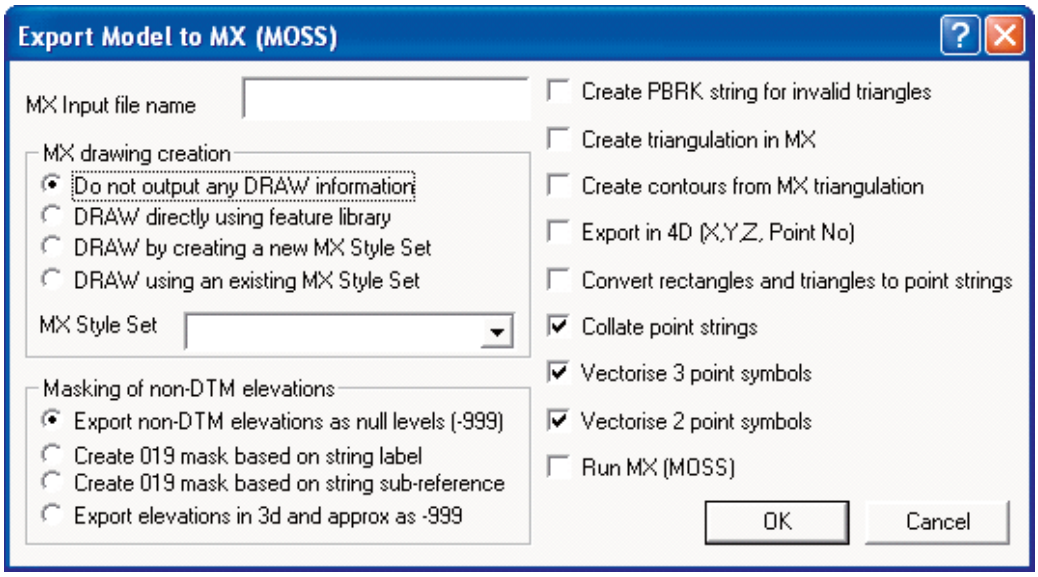


Figure 4.2: SCC MX Export Dialog

A-4.5.5 Dublin City Council Corporate Policy for supply of CAD data.

All CAD data resulting from this contract, which is being supplied to Dublin City Council shall comply with the following:

The required vector file format is Bentley's Microstation, etc., .dgn format.

Data must conform to the current Corporate and Departmental CAD standards – details of which are available on request.

Procedures for the exchange of data to be agreed with Dublin City Council prior to the commencement of the contract.

It is the responsibility of the Contractor to organise vector data coherently and to maintain a reasonable file size.

All data supplied must be free of copyrighted material.

All spatial data will be required to be geo-referenced to Grid as referred to in clause 2.2.2 as defined by Ordnance Survey Ireland at a scale and level of accuracy set by Dublin City Council.

Responsibility for compliance with these requirements, including any costs, lies with the Contractor or his nominees

A-4.5.6 Survey reports

A survey report as outlined in clause 2.5 shall be supplied in PDF format digitally and additionally two bound paper copies.

A-4.5.7 GPS observation data

Where static GPS has been used to establish control, all GPS observation and correction data used must be supplied digitally in RINEX format in such a manner that the stations can be readily recomputed using any industry standard GPS post processing software.

A-4.5.8 Digital signing

The Contractor must supply a printed report listing the names, revision number, size, and CRC of all digital files provided. The CRC (cyclic redundancy check) may be created using the CRCFile program available at http://www.createwindow.com/programming/crc32/crcfile.htm

Providing a printed signed document that includes a CRC and revision number against each digital file provided is a mechanism that can be used to verify that a given file has not been modified in any way since being delivered.

SCC also provides an explicit tool to generate a CRC report for a selection of files using **'FILE > Export >Create file CRC report'.**

A-5

Compliance with Specification

A-5 Compliance with Specification

A-5.1 Compliance with Specification Introduction

The Employer will verify that the Work complies with the Specification at submission, by carrying out an independent check survey and an audit of the digital data provided. The Contractor shall be fully responsible at no extra charge for making corrections and supplying missing survey information to comply with the Specification.

Where the Work fails to comply with the Specification, the Contractor will incur a penalty cost corresponding to the cost incurred by the Employer in rechecking the work. Repeated failure to comply will result in the Contractor being removed from the list of approved survey Contractors.

If the check survey highlights systematic errors in the Work that are corrected and the Work re-submitted, a new check survey is required. This is because using the check survey to correct the Work invalidates the value of the check survey as a random check. The cost of the re-check lies with the Contractor as the onus was on the Contractor to provide compliant work in the first instance.

A-5.2 Check survey

The Employer shall instruct an independent survey Contractor to carry out a check survey of the Work to verify that it complies with accuracies and content outlined in clauses 2 and 3 of this specification. The check survey will comprise re-surveying of a representative random sample of the Work to test accuracy and content. The check survey will be carried out to a higher order of accuracy than the Work, and include a larger number of redundant measurement, such that if there is a disagreement between the check survey and the Work, the error can be proven to lie with the Work.

A-5.3 Audit of digital data

The Employer shall audit the content of SCC, CAD and MX files at submission before final acceptance of the Work and the Contractor shall be fully responsible at no extra charge for making corrections and supplying missing survey information to comply with this specification.

This audit will verify that the data provided meets all of the criteria described in clauses 3 and 4 of this document. A list of checks that will be carried out, along with sample procedural descriptions of how they may be accomplished, are presented in the user manual accompanying this specification. In order to minimise potential delay in accepting the Work, the Contractor shall carry out these checks prior to submitting the data.

The steps for checking that various stages of the specification have been adhered to in terms of accuracy and content have been covered in previous sections in this document. To ensure that nothing has been missed, it is advisable to tabulate them into a QA check list as shown below, where each QA task is ticked off as it is completed and the results signed off by the checker. This check list should also be included in the contract survey report.

✓	Angle and distance residuals for of all traverse observations were less than at most twice the anticipated standard error.
✓	The value of the semi-major axis for all error ellipses was less than the relative plan station accuracy required.
✓	The height difference residuals for all the level observations were less than at most twice the anticipated standard error.

✓	The equivalent linear accuracy of the traverse was within the specified range
✓	The equivalent linear accuracy of the levelling was within the specified range

In accordance with sections 3 and 4 of the specification, the following quality control checks were applied to the survey model prior to submission.

✓	All significant grade changes in the terrain were surveyed using three-dimensional strings / break-lines.
✓	There are no crossing break-lines in the model. Where two breaklines intersect on the ground, a point was included in the ground model to resolve the elevation at the position of the intersection.
✓	All non-surface data, such as overhead and underground features, were not included in the TIN either as points or break-lines
✓	Strings representing single continuous features on the ground consist of a single continuous string or polyline in the model.
✓	Strings representing polygonal features such as boundaries, buildings, and ponds are represented as closed strings or closed polylines.
✓	There is no other three-dimensional data included in the TIN model that has not been directly surveyed on the ground surface.
✓	Strings do not contain duplicate points or double back on themselves. (Duplicate points may exist at the common junction point between two or more strings)
✓	Gaps have not been be used to break up separate strings.
✓	The TIN surface and contours have been verified, by the surveyor, as being in good agreement with the ground.
✓	All strings associated with a given road or similar linear feature are oriented in the same direction.
✓	The model does not contain any unnecessary duplicate data, such as more than one copy of a given discrete point, string, or piece of text.
✓	Strings denoting linear features contain at least two points.
✓	Where two strings denoting 3D features meet at a common junction point they share a common elevation at that point
✓	The ground model includes a single closed 3d boundary string, made up from survey points in the TIN model, that is used to indicate the external limits of the TIN model and contours
✓	All internal boundaries within the model, that is areas which are not valid for contouring or other TIN based interpolation, are surrounded by closed 3d internal boundary strings.
✓	The model does not contain references to any features not present in the feature library provided with the specification, nor does it make any alterations

	to how those features are interpreted or represented.
✓	The model has been annotated in accordance with the feature library provided in Appendix E of the specification.
✓	Section files provided include all information as outlined in clause 2.4.4 of the specification.

A-5.4 Coordinate transformations

The Employer will use a Dublin City Council approved software package for transformation to verify the correctness of coordinate transformations between ITM (Irish Transverse Mercator) and IG75 (Irish Grid - 1975 realisation), and all conversions of GPS heights (ellipsoidal) to heights related to the Malin Head datum (orthometric).

Where transformed values for a given position fail to meet the checked values, the failing items will be returned to the Contractor for correction. In order to minimise potential delay in accepting the Work, the Contractor shall carry out similar checks with a Dublin City Council approved software package for transformation, prior to submitting the data.

Currently, the Dublin City Council approved software packages for transformation are

- Ordnance Survey 'GridinQuest' software (version 6.6.0)
- SCC 9.0.1 later with embedded 'GridinQuest' software (version 6.6.0)

A-5.5 Survey Data Processing

The Employer will use a Dublin City Council approved software package for reduction, processing and modelling of survey data.

Currently, the Dublin City Council approved software packages for transformation are

- SCC 9.0.1 later with embedded 'GridinQuest' software (version 6.6.0)

A-6

Check survey

A-6 Check survey

A-6.1 Check Survey Introduction

Check surveys are being included as part of this specification as a quality control technique to meet the following requirements:

- To independently verify the correctness on the main survey, that is that it meets stated acceptance criteria in terms of accuracy and completeness.
- To include the necessary controls such that where this verification fails it clearly proves the failure lies with the main survey.
- To be cost effective, that is the check survey should typically cost less than 10% of the price of the main survey.
- To be free of any influence from the measurements or results of the main survey

In order to achieve the above goals the check survey must include the following:

- Higher order of accuracy than the original survey
- Sufficient redundancy to eliminate any possible errors due to equipment calibration, pointing, reduction methods and measurement method.
- Resurvey of a maximum of 3% of main survey in key areas, such as pinch points.
- No sight of adjusted station coordinates or topography by the checking surveyor prior to completion of check survey, comparison between check survey and main survey to carried out after submission of check survey.

A-6.2 Selection of check area

The Employer will select one or more check areas, typically around fifty meters in length for checking. The areas selected will typically be those considered critical to the success of the design, such as junctions and pinch points where the intended design is most constrained by the existing ground. The number of check areas will be based on the overall length of the job, and the number of areas deemed critical by the Employer.

The Employer will provide the checking surveyor with a list of features that are considered to be critical hard detail, and soft detail, for the purposes of this survey.

The Employer will provide the checking surveyor with location diagrams to all of the permanent control in view of the check areas, and boundary polygons delineating the area of topography to be checked. Typically this will involve a minimum of the station most central to the area being checked along with a forward and backward station.

A-6.3 Control

The checking surveyor will establish coordinates for the stations required by the Employer by observing them simultaneously using static GPS with an observation period of not less than one hour. Normal computational procedures will be used such as eliminating bad satellites to ensure the grid coordinates computed easily meet the original survey specification.

The checking surveyor will then traverse through all check stations, taking a minimum of three rounds of angles and distances to each station. The purpose of this exercise is to verify the correctness of the GPS, the calibration of the instrument and prisms, and the reduction options selected. This traverse will be adjusted by least squares with all GPS stations held as fixed, in order to produce observation residuals.

Heights for the check stations should be established by double run levelling, as per the main

survey, holding the central station fixed.

A-6.4 Topography

The checking surveyor will survey all linear features nominated by the employer, typically top and bottom of kerb, at the contract survey interval. The checking surveyor will additionally survey at least ten discrete features of hard detail, typically square manhole covers or street furniture.

All checked points are to be unambiguous, in that they lie on readily located positions such as the intersection or corners of features, or clearly marked points on the ground. They should also be selected to be less than 50 metres from the set-up station.

All points shall be observed using a single angle and distance observation from two separate stations. The elevations of these points should be observed using a level, again from two stations, using the same staff used for any other levelling in the check survey. These observations will be used to determine the typical pointing error present when checking topography and elevations, such that this error can be eliminated when computing relative accuracies in the main survey.

At the start and end of each instrument set-up the checking surveyor will observe a minimum of two other stations. The two observations taken at the start of the set-up will be used to compute a mean orientation for the set-up, and station mis-closures will be reported.

Where rectangular features such as inspection covers are present in the survey, they are to be observed using three total station points, with a check spot elevation taken on the fourth point.

A-6.5 Determination of errors within the check survey

To determine the coordinate errors in the check survey for any given station, re-adjust the traverse with all stations fixed except for that station, and compute the join distance between the adjusted value and the GPS value.

To verify the angular calibration of the total station, compare the computed included angles between survey stations, and the surveyed forward measured angles between the same stations taken during the traverse. These will correspond with the angle residuals in the least squares adjustment.

To verify the distance calibration of the total station, compare the computed join distances between survey stations, and the surveyed horizontal distances between the same stations taken during the traverse. These will correspond with the distance residuals in the least squares adjustment.

To verify the calibration of the level, compute the misclosure generated as a result of the double run levelling.

The typical accuracy for absolute topographic positions and levels has been covered under the clause 6.3.

A-6.6 Analysis of accuracies

Once the checking surveyor has submitted the check survey to the Employer, the Employer will furnish the checking surveyor with a schedule of stations coordinates and topography for the areas being checked for the purposes of analysis of accuracy.

The checking surveyor will compute the relative accuracies of the Work in accordance with clauses 2.2.3, 2.3.4, 2.4.1 and 2.4.6 of the specifications and provide a report listing the following:

- Checking method used
- Errors present in check survey
- Values present for the sample in the Work

- Values observed for sample in the check survey
- Worked analysis of comparison between the work and the check survey, detailing absolute and relative differences, and relative accuracies in the Work corrected for known errors in the check survey
- Conclusions as to whether survey passes or fails, and if it fails, whether the failure relates to a systematic error that can be corrected and re-checked.

Please refer to user notes accompanying this specification for details and a worked example of this analysis.

A-6.7 Analysis of topography

The checking surveyor should visually compare the topography in the Work with the corresponding topography in the check survey, and report the following:

- Any missing plan detail in the work
- Any significant disagreement in the plan line work
- Any significant discrepancies in position, dimensions and orientation of scaled objects and symbols such as inspection covers, street furniture, and road markings
- Any noticeable difference in contours between the two models when contoured at intervals of 0.1 and 0.01 metres.
- Any additional detail present in the Work but not present in the check survey
- Conclusions as to whether the topography in the Work is in good agreement with the topography in the check survey.

A-6.8 Stations

The check survey analysis should also comment on the following:

- Ease of location of the stations using the information provided
- Suitability and condition of ground anchors used

The check survey report will be signed by the checking surveyor and their manager, and returned to the Employer.

A sample check survey report is provided in the user guide accompanying this specification.

Notes on processing check surveys

From the specification, we have to check the absolute accuracy and relative accuracy of plan position and elevation as part of the check survey. For the purposes of this specification, absolute elevation accuracy is difference in elevation between the contract survey and the corrected check survey. Similarly, absolute elevation accuracy is difference in grid position between the contract survey and the corrected check survey.

For the purposes of this specification, relative accuracy is the same as absolute accuracy with any systematic errors due shifts removed. The following paragraphs discuss how it can be computed.

Relative accuracy of elevations

Relative accuracies are specified as they are more readily achieved using GPS without compromising engineering requirements. Accuracies are tested by comparing a representative sample of measured values in the main survey with similar higher order values from the check survey.

Method: Given absolute elevations for common points such as stations in main and check

survey, compute and compare relative elevations to determine relative accuracy.

- Given a sample of n elevations for common points from the main survey ZS(n), and the check survey ZC(n)
- Calculate the mean elevation for the main survey mZS
- Calculate the mean elevation for the check survey mZC
- For each absolution elevation in ZS(n) subtract mZS to get a set of relative elevations for the main survey RZS(n)
- For each absolution elevation in ZC(n) subtract mZC to get a set of relative elevations for the check survey RZC(n)
- For each main survey relative elevation, subtract the check survey relative elevation to obtain the set of relative accuracies RAZ(n)
- Subtract any known errors in the check survey, CE(n), from the relative height accuracies to get the relative accuracies in the main survey.

Absolute accuracy of elevation is given as the difference in main survey value and check survey value.

Where required relative accuracy of elevations is not met, it should be determined whether the errors are random or systematic in nature, as this will dictate whether the errors can be corrected without a complete resurvey. If the application of a single scale factor to the relative elevations of the main survey improve the relative accuracies to the extent that they comply with the Specification, the error can be rectified without re-survey and the Work re-checked.

Example:

	Sample size (n)		**9**	**Required accuracy 0.005**					
	Main Survey			**Check Survey**			**Accuracies**		
Point	**ZS**	**mZS**	**RZS**	**ZC**	**mZC**	**RZC**	**RAZ**	**CE**	**Passes**
700	26.1270	23.8774	-2.2496	26.1610	23.9167	-2.2443	0.0052	0.0040	**TRUE**
701	24.8840		-1.0066	24.8960		-0.9793	0.0272	0.0040	**FALSE**
706	23.1240		0.7534	23.1630		0.7537	0.0002	0.0040	**TRUE**
709	24.9310		-1.0536	24.9680		-1.0513	0.0022	0.0040	**TRUE**
710	26.0140		-2.1366	26.0580		-2.1413	-0.0048	0.0040	**TRUE**
716	24.3920		-0.5146	24.4330		-0.5163	-0.0018	0.0040	**TRUE**
PC49	22.3160		1.5614	22.3720		1.5447	-0.0168	0.0040	**FALSE**
PC50	20.9610		2.9164	21.0010		2.9157	-0.0008	0.0040	**TRUE**
PC51	22.1480		1.7294	22.1980		1.7187	-0.0108	0.0040	**FALSE**

Table 6.0: Check Survey Analysis: Relative Accuracy of Elevations

From the above we can see that 33% of stations fail to meet the required elevation accuracy.

Relative accuracy of plan positions

Given absolute positions for common points such as stations in main and check survey, compute and compare relative positions to determine relative accuracy.

– Given a sample of n plan positions for common points from the main survey XYS(n), and the check survey XYC(n)

- Calculate the centroid (arithmetic mean position) for the main survey mXYS
- Calculate the centroid (arithmetic mean position) for the check survey mXYC
- For each absolution position in XYS(n) subtract mXYS to get a set of relative positions for the main survey RXYS(n)
- For each absolution position in XYC(n) subtract mXYC to get a set of relative positions for the check survey RXYS(n)
- For each main survey relative position, compute the join distance to the check survey relative positions to obtain the set of relative accuracies RAXY(n)
- Subtract the known standard errors in the check survey from the relative accuracies to get the relative accuracies in the main survey.

Note that this method assumes that the orientation of the grids in the main survey and the check survey is the same, due to use of GPS control. To perform a relative accuracy check based on different grid orientations would require computation of mean orientation shift on relative coordinates).

Absolute accuracy of position is given as the join distance between the main survey value and corrected check survey value.

Where required relative accuracy of plan positions is not met, it should be determined whether the errors are random or systematic in nature, as this will dictate whether the errors can be corrected without a complete resurvey. If the application of a 2D conformal transformation to the positions of the main survey improve the relative accuracies to the extent that they comply with the Specification, the error can be rectified without re-survey and the Work re-checked.

Example:

	Survey Absolute positions			Check		Absolute accuracy
Point	X	Y	ChkErr	X	Y	
700	311688.065	233209.236	0.005	311688.064	233209.228	0.0081
701	311731.512	233238.552	0.005	311731.512	233238.561	0.0090
706	312034.614	233679.326	0.005	312034.617	233679.340	0.0143
709	312145.631	233818.796	0.005	312145.615	233818.819	0.0280
710	312059.917	233794.137	0.005	312059.902	233794.158	0.0258
716	311916.029	233666.421	0.005	311916.027	233666.423	0.0028
PC49	311578.874	233718.392	0.005	311578.863	233718.365	0.0292
PC50	311657.055	233731.739	0.005	311657.042	233731.719	0.0239
PC51	311747.051	233754.426	0.005	311747.039	233754.413	0.0177
Centroid	311839.861	233623.447		311839.853	233623.447	
Point	Relative survey positions			Relative check positions		Distance
700	-151.7959	-414.2112		-151.7894	-414.2193	441.1496
701	-108.3489	-384.8952		-108.3414	-384.8863	399.8547
706	194.7531	55.8788		194.7636	55.8927	202.6110
709	305.7701	195.3488		305.7616	195.3717	362.8450
710	220.0561	170.6898		220.0486	170.7107	278.4954
716	76.1681	42.9738		76.1736	42.9757	87.4547
PC49	-260.9869	94.9448		-260.9904	94.9177	277.7205

PC50	-182.8059	108.2918		-182.8114	108.2717	212.4738
PC51	-92.8099	130.9788		-92.8144	130.9657	160.5276
	Relative differences					
Point	dX	dY	ChkErr	Rel.Acc.	Passes	1:30000
700	-0.0064	0.0081	0.0050	0.0054	TRUE	0.0147
701	-0.0074	-0.0089	0.0050	0.0066	TRUE	0.0133
706	-0.0104	-0.0139	0.0050	0.0124	FALSE	0.0068
709	0.0086	-0.0229	0.0050	0.0194	FALSE	0.0121
710	0.0076	-0.0209	0.0050	0.0172	FALSE	0.0093
716	-0.0054	-0.0019	0.0050	0.0008	TRUE	0.0029
PC49	0.0036	0.0271	0.0050	0.0223	FALSE	0.0093
PC50	0.0056	0.0201	0.0050	0.0159	FALSE	0.0071
PC51	0.0046	0.0131	0.0050	0.0089	FALSE	0.0054

Table 6.1: Check Survey Analysis: Relative Accuracy of Plan Position

From the above we see that 33% of stations fail the absolute accuracy requirement of ± 25mm and 66% of stations fail the relative requirement of ± 5mm for distances below 150M or 1:30000 for distances over 150M.

Using SCC to automate computation of check surveys

In order to simplify the processing of check surveys for QBN, we have added some additional functionality to SCC to effectively automate the task. The automated processing of the check survey is carried out in three phases, as follows:

– ***Comparison of contract survey stations with check survey stations***

This assumes that the check survey traverse has been adjusted, the final values of check stations are available in a given SCC project file, and the final values of the contract survey stations are available in a separate SCC project file. It also assumes that the nominal accuracy of the check survey stations is known as a result of the adjustment, coupled with redundant measurements taken. Given these prerequisites, SCC searches for stations matched by name, and computes relative and absolute differences between them, in plan and elevation, referred to in the report as raw errors. The raw errors are reduced by the nominal accuracy to give corrected errors, which are subsequently compared to acceptance criteria at 67%, 95% and 99% levels, to determine if the contract survey stations meet specification. For the survey to meet specification, 67% of the stations must fall within given absolute and relative error criteria, 95% must fall within a looser criteria, and 99% must fall within a loosest criteria.

– ***Comparison of discrete topographic detail from contract survey stations with similar detail in the check survey.***

A similar process is carried out for all discrete topographic detail features, which are identified by feature name. This assumes that the check model includes all final reduced check coordinates. In this case it is assumed that each point in the check survey has been surveyed twice from different stations, and the distance between the two positions is used in place of nominal accuracy. The contract survey is searched for points with the same feature name in a specified search radius, which are used as a basis for comparison. Acceptability computations are the same as used in the station analysis, with alternative acceptance parameters.

– ***Comparison of linear detail from contract survey stations with similar detail in the check survey.***

In the case of linear features we cannot be sure that the check survey points are coincident with the contract survey points, so the checking routine cuts a series of cross sections and uses the chainage, offset and level of the position where the section cuts the linear feature in place of the surveyed coordinate. In this scenario, for any given cut the chainages will always agree whereas the offsets and heights are used to determine error. This is significant, as with offset (e.g. width of carriageway) is of primary interest to the client. As with the discrete points, it is assumed that the check survey will include each string twice surveyed from separate stations, as a means of computing the accuracy of the check survey.

To process the check survey we do the following:

Process the check survey control and models as with any other survey.

Select the 'Check Survey' option that will display the following dialog:

Provide details for check survey project and models, contract survey project and models, linear and discrete feature names, and acceptance criteria.

This will create a detailed report as shown below which includes a summary and breakdown for stations and topographic detail. All out of specification items are highlighted in red.

In addition to the report, the delivery of the check survey should include check models, and all survey and traverse observations, as per the contract survey.

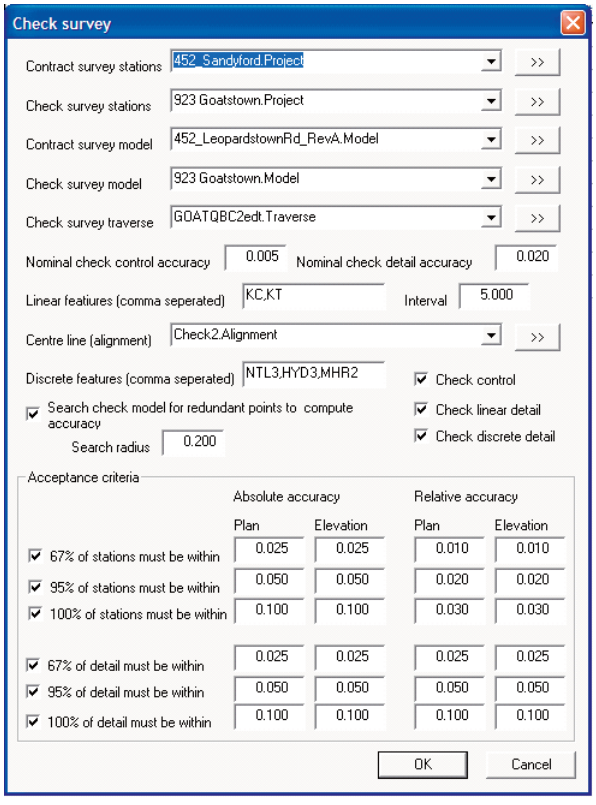
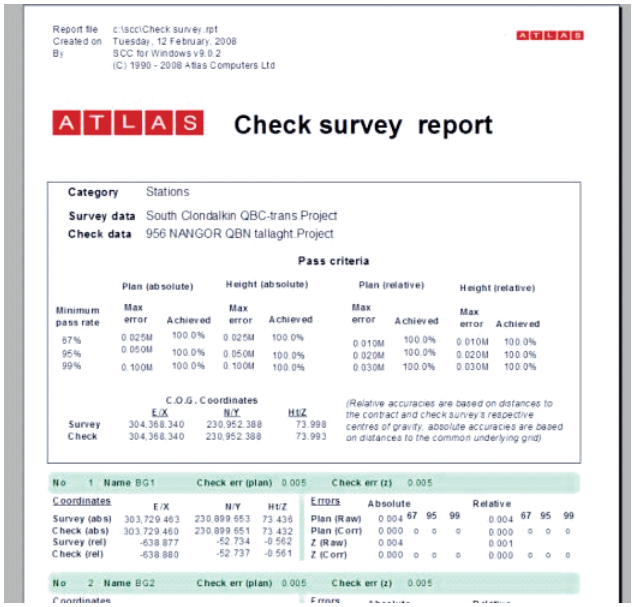


Figure 6.0: SCC Check Survey Dialog

If the check survey includes a visual inspection on sight for missing detail, the results of this inspection should also be included with the check report.

The check survey report will be broken down into two sections for stations and detail respectively. Each section will start with a header showing whether pass criteria at each level were met or not, followed by a breakdown per checked item. This will include absolute and relative coordinates for each item, along with raw and corrected errors in plan and elevation, and whether or not that item passes or fails at each specified level (i.e.

67%, 95% and 99%)



Report file c:\scc\Check survey.rpt
Created on Tuesday, 12 February, 2008
By SCC for Windows v9.8.2
(C) 1990 - 2008 Atlas Computers Ltd

ATLAS

Check survey report

Category Stations
Survey data South Clondalkin QBC-trans Project
Check data 956 NANGOR QBN tallaght Project

Pass criteria

Minimum pass rate	Plan (absolute) Max error	Plan (absolute) Achieved	Height (absolute) Max error	Height (absolute) Achieved	Plan (relative) Max error	Plan (relative) Achieved	Height (relative) Max error	Height (relative) Achieved
67%	0.025M	100.0%	0.025M	100.0%	0.010M	100.0%	0.010M	100.0%
95%	0.050M	100.0%	0.050M	100.0%	0.020M	100.0%	0.020M	100.0%
99%	0.100M	100.0%	0.100M	100.0%	0.030M	100.0%	0.030M	100.0%

C.O.G. Coordinates

	E/X	N/Y	Ht/Z
Survey	304,368.340	230,952.388	73.998
Check	304,368.340	230,952.388	73.993

(Relative accuracies are based on distances to the contract and check survey's respective centres of gravity, absolute accuracies are based on distances to the common underlying grid)

No 1 Name BG1 Check err (plan) 0.005 Check err (z) 0.005

Coordinates	E/X	N/Y	Ht/Z
Survey (abs)	303,729.463	230,889.653	73.436
Check (abs)	303,729.460	230,889.651	73.432
Survey (rel)	-638.877	-52.734	-0.562
Check (rel)	-638.880	-52.737	-0.561

Errors	Absolute	67	95	99	Relative	67	95	99
Plan (Raw)	0.004				0.004			
Plan (Corr)	0.000	0	0	0	0.000	0	0	0
Z (Raw)	0.004				0.001			
Z (Corr)	0.000	0	0	0	0.000	0	0	0

No 2 Name BG2 Check err (plan) 0.005 Check err (z) 0.005

Figure 6.1: Sample Check Survey Report from SCC

Analysing a failed check survey

A survey can fail the above checks for a number of reasons, some of which are recoverable. As such, if a check survey indicates that a contract survey fails to meet specification, it is important to analyse why this is happened, and is it straightforward to correct the errors. Some of the reasons that a contract survey might fail which can be recovered from are:

– ***Mis-application of scale factor and / or grid.***
The specification states that data must be provided in ITM which has inherent scale factor. If the contractor chooses the wrong scale factor or grid, or simply does not enter a scale factor, this will be shown up by the check survey. This can be tested for by creating a transformation that transforms the contract stations onto the check stations, also applying that to the contract model, and repeating the check process with the transformed results. If the transformed data meets the specification standards, this typically indicates mis-application of grid or scale factor. If this is the case, the results should be verified through an additional check survey.

– ***Incorrect station labelling***
If a station provided by the contractor has been given the wrong name, or is difficult to locate on the ground with the location diagrams provided, this may also lead to the contract survey failing to meet specification. This can be readily identified on the check report where gross errors are visible on a given station. In this case, the faulty station should be excluded from the checking process, the checking process should be repeated, and the correct station details should be sought from the contractor.

Annexe B: Survey Report

The Survey Report is an adjunct to the specification that acts as a sample template to fulfil terms set out in clause 2.5.

Table of Contents

B-1

Introduction

B-1 Introduction

The scope of the works involved carrying out a topographical survey from A to B to facilitate the design of a proposed QBC along the route.

The project required establishment of 11 permanent control points along the main survey corridor prior to the topographical survey at distances less that 150m apart. These control points were also used as site bench marks for the project.

The project was carried out using the ITM coordinate reference system and all project deliverables have been supplied on both ITM and the IG75 coordinate reference systems. It was also required to check existing permanent control points along route in the vicinity of junction C and D

B-2

Provision Of Digital Data

B-2 Provision Of Digital Data

A schedule of digital data provided is given in appendix F. This includes

✓	Topographic models in Bentley MX GENIO format suitable for MX Roads 2004 or later
✓	Topographic models in SCC Model format suitable for SCC 9.0.1 or later
✓	Topographic models in Bentley Microstation DGN format suitable for Microstation R8 or later
✓	Topographic models in AutoCAD DWG format suitable for AutoCAD 2000 or later
✓	All traverse observations in SCC Traverse format suitable for SCC 9.0.1or later
✓	All detail observations in SCC Survey format suitable for SCC 9.0.1or later
✓	All station coordinates and feature library in SCC Project format suitable for SCC 9.0.1 or later
✓	Survey report in PDF format
✓	Traverse report in PDF format
✓	Levelling report in PDF format
✓	Longitudinal sections and cross sections in SCC Section format suitable for SCC 8.3.0 or later

B-3

Method Of Observation

B-3 Method Of Observation

Primary horizontal control has been established via static GPS with pairs of stations at 1 kilometre intervals along the route. A minimum of 600 static GPS observations were taken at 2 second intervals at permanent control stations GPS 1, GPS 2, GPS3, GPS4, GPS8 & GPS9. A minimum of two GPS receivers were used to observe baselines between the pairs of permanent control stations GPS 1, GPS 2, GPS3, GPS4, GPS8 & GPS9.

Secondary horizontal control has been established by traversing through the primary control using a total station with two rounds of angles per set-up and forced centring. Stations were selected such that the maximum distance between adjacent stations was no greater than 150m and that every station internal to the survey had unobstructed visibility of a forward and backsight station.

Tertiary horizontal control has been established where off route or ad hoc stations were required using a total station with two rounds of angles per set-up and forced centring.

Vertical control was established using double run levelling through all survey stations in conjunction with static GPS observations used in establishing horizontal control. No additional site bench marks were required or used in the project.

All topographic detail has been observed using a total station, with ancillary dimensional measurements taken using a steel tape.

A schedule of instruments used in the survey is given in appendix G.

B-4

Method Of Adjustment

B-4 Method Of Adjustment

B-4.1 Horizontal Control

The GPS observations were processed using RINEX files from the three closest OSi Active GPS stations at Fingal County Council (SWRD @ 23 kms), Tallaght College (TLLG @ 2.5 kms) and Kilkenny Hospital (KLKN @ 90 kms). The GPS Network was computed three times each time using one of the OSi Active GPS stations. Suspect observations and satellites were eliminated as per normal practice before computation of coordinates. This permitted the identification and elimination of gross errors by:

Comparing the three results to identify and eliminate gross error in the OSi stations:

The computation of baseline loops:

The comparison of GPS baseline distances with observed traverse distances (See table 2).

Coordinates (ETRF89) for the pairs of GPS points (Stations GPS 1, GPS 2, GPS3, GPS4, GPS8 & GPS9) were computed using a free float least squares adjustment in Leica software.

These ETRF89 coordinates were transformed to ITM and IG75 using the OSi Grid InQuest software.

Coordinates for all remaining stations were computed with a constrained network adjustment via least squares in SCC by:

Holding the best fix for a station from each of the GPS pairs of stations.

Using the observed forward measured angles and horizontal distances from the traverse.

The resulting coordinates were used for horizontal control when processing the topographic detail. The adjustment report is provided in appendix A

B-4.2 Vertical Control

Provisional ellipsoidal heights were computed for Stations GPS 1, GPS 2, GPS3, GPS4, GPS8 & GPS9 using RINEX files from the three closest OSi Active GPS stations at Fingal County Council (SWRD @ 23 kms), Tallaght College (TLLG @ 2.5 kms) and Kilkenny Hospital (KLKN @ 90 kms) using a free float least squares adjustment in Trimble Office software. Suspect observations and satellites were eliminated as per normal practice before computation of mean heights for each station and their standard deviations.

These heights were transformed into provisional orthometric heights using the ‘OSGM02’ geoid model via the OSi GridinQuest software.

The observations of the levelling loops were reduced to determine the difference in height between adjacent permanent control stations.

The height network was then readjusted using a constrained least squares adjustment by holding the GPS computed height for station GPS3 fixed. The final computed heights for stations GPS 1, GPS 2, GPS3, GPS4, GPS8 & GPS9were checked to make sure they fell within the error tolerances computed from the GPS observations.

The levelling report is provided in appendix B

B-5

QA Checks Applied In The Field

B-5 QA Checks Applied In The Field

The total station calibration was checked on site by observing an angle and distance between occupied and backsight and foresight station at the start of each day.

An additional check was taken for each instrument set-up to compute the misclosure to the backsight station. Where the misclosure fell outside of tolerance, the calibration check was repeated and the instrument set-up repeated.

A further check shot was taken to a common point of hard detail from each set-up to ensure accuracy requirements were being met.

A schedule of instrument set-ups and misclosures is given in appendix I

B-6

QA Checks Applied During Processing

B-6 QA Checks Applied During Processing

The outputs from the traverse adjustment, levelling and instrument set-up reports were reviewed to verify that required accuracy had been achieved, specifically:

✓	Angle and distance residuals of all traverse observations were less than at most twice the anticipated standard error.
✓	The value of the semi-major axis for all error ellipses was less than the relative plan station accuracy required.
✓	The height difference residuals for all the level observations were less than at most twice the anticipated standard error.
✓	The equivalent linear accuracy of the traverse was within the specified range
✓	The equivalent linear accuracy of the levelling was within the specified range

In accordance with clauses 3 and 4 of the specification, the following quality control checks were applied to the survey model prior to submission.

✓	All significant grade changes in the terrain were surveyed using three-dimensional strings / break-lines.
✓	There are no crossing break-lines in the model. Where two breaklines intersect on the ground, a point was included in the ground model to resolve the elevation at the position of the intersection.
✓	All non-surface data, such as overhead and underground features, were not included in the TIN either as points or break-lines
✓	Strings representing single continuous features on the ground consist of a single continuous string or polyline in the model.
✓	Strings representing polygonal features such as boundaries, buildings, and ponds are represented as closed strings or closed polylines.
✓	There is no other three-dimensional data included in the TIN model that has not been directly surveyed on the ground surface.
✓	Strings do not contain duplicate points or double back on themselves. (Duplicate points may exist at the common junction point between two or more strings)
✓	Gaps have not been be used to break up separate strings.
✓	The TIN surface and contours have been verified, by the surveyor, as being in good agreement with the ground.
✓	All strings associated with a given road or similar linear feature are oriented in the same direction.
✓	The model does not contain any unnecessary duplicate data, such as more than one copy of a given discrete point, string, or piece of text.
✓	Strings denoting linear features contain at least two points.

✓	Where two strings denoting 3D features meet at a common junction point they share a common elevation at that point
✓	The ground model includes a single closed 3d boundary string, made up from survey points in the TIN model, that is used to indicate the external limits of the TIN model and contours
✓	All internal boundaries within the model, that is areas which are not valid for contouring or other TIN based interpolation, are surrounded by closed 3d internal boundary strings.
✓	The model does not contain references to any features not present in the feature library provided with the specification, nor does it make any alterations to how those features are interpreted or represented.
✓	The model has been annotated in accordance with the feature library provided in Appendix E of the specification.
✓	Section files provided include all information as outlined in clause 2.4.4 of the specification.

B-7

Results

B-7 Results

Reviewing the survey reports produced and quality control checks applied herein, it can be concluded that the models and survey data provided meets all requirements laid out in the specification given.

B-8

Surveyors Certification

B-8 Surveyors Certification

I, _____ (surveyor's name in CAPITALS) hereby certify that all of the information contained in this report and its appendices is correct and has been verified as such.

Surveying services supplied by _____ (name of survey firm in CAPITALS) are covered by professional indemnity insurance.

Certified by: _____ (Signature)

Date: _____

Appendix A: Traverse Report

ABC Surveys
123 Penny Lane
Sometown
Somewhere

00 1234 56789
00 1234 56710
email: mwhite@abcsurveys.com
web: www.abcsurveys.com

Traverse Report

Project:

Client:

Ref. Number:

Date:

Traverse name: **EXAMPLE.Traverse**

Horizontal adjustment method: Least squares (2D, variation of coordinates)

Vertical adjustment method: Least squares (1D, distance weighted)

Default standard errors

Horizontal angles (secs)	3
Horizontal distances (mm)	5
Horizontal scale (ppm)	2

Corrections applied

Local scale factor : No local scale factor
Earth curvature and refraction : Curvature only (Earth Radius 6380000.000)
Temperature and pressure : No
Mean sea level correction : No

Statistical analysis of results

Number of observations : 60
Number of unknowns : 22
Reference variance : 0.12914
Reference standard deviation So : 0.41736

Failed Chi-Square test at 95% level; exceeded lower bound (0.00)

Survey Stations

Station: STN1 — Type: Fixed

Coordinates:	E/X	N/Y	Ht/Z	Error ellipse	
Adjusted	1,166.1950	1,100.00	54.31	Major Axis:	0.00000
Provisional	1,166.1950	1,100.00	54.31	Minor Axis:	0.00000
Correction	0.0000	0.0000	0.0000	Angle:	000 00 00

ETRF89 Coordinates:	Lat	Long	Height
	000 0.00000N	000 0.00000E	0.0000

Station description:

Station: STN2 — Type: Free

Coordinates:	E/X	N/Y	Ht/Z	Error ellipse	
Adjusted	1,099.9970	1,100.00	55.69	Major Axis:	0.00202
Provisional	1,099.9970	1,100.01	55.70	Minor Axis:	0.00000
Correction	0.0010	-0.0060	-0.0010	Angle:	090 00 00

ETRF89 Coordinates:	Lat	Long	Height
	000 0.00000N	000 0.00000E	0.0000

Station description:

Station: STN4 — Type: Free

Coordinates:	E/X	N/Y	Ht/Z	Error ellipse	
Adjusted	1,099.8840	1,125.34	53.02	Major Axis:	0.00203
Provisional	1,099.8850	1,125.35	53.02	Minor Axis:	0.00081
Correction	0.0000	-0.0050	-0.0010	Angle:	094 06 12

ETRF89 Coordinates:	Lat	Long	Height
	000 0.00000N	000 0.00000E	0.0000

Station description:

Station: STN5 — Type: Free

Coordinates:	E/X	N/Y	Ht/Z	Error ellipse	
Adjusted	1,141.2210	1,122.19	52.36	Major Axis:	0.00174
Provisional	1,141.2200	1,122.19	52.36	Minor Axis:	0.00078
Correction	0.0010	-0.0030	-0.0010	Angle:	096 06 38

ETRF89 Coordinates:	Lat	Long	Height
	000 0.00000N	000 0.00000E	0.0000

Station description:

Station: STN6 — Type: Free

Coordinates:	E/X	N/Y	Ht/Z	Error ellipse	
Adjusted	1,202.0830	1,098.42	51.48	Major Axis:	0.00145
Provisional	1,202.0830	1,098.42	51.48	Minor Axis:	0.00083
Correction	0.0000	-0.0010	-0.0005	Angle:	095 27 54

ETRF89 Coordinates:	Lat	Long	Height
	000 0.00000N	000 0.00000E	0.0000

Station description:

Station: STN7 — Type: Free

Coordinates:	E/X	N/Y	Ht/Z	Error ellipse	
Adjusted	1,225.1210	1,097.61	50.77	Major Axis:	0.00102
Provisional	1,225.1210	1,097.61	50.77	Minor Axis:	0.00084
Correction	0.0000	-0.0010	-0.0004	Angle:	113 01 18

ETRF89 Coordinates:	Lat	Long	Height
	000 0.00000N	000 0.00000E	0.0000

Station description:

Station: STN8 — Type: Free

Coordinates:	E/X	N/Y	Ht/Z	Error ellipse	
Adjusted	1,220.2990	1,075.02	58.80	Major Axis:	0.00103
Provisional	1,220.2980	1,075.02	58.80	Minor Axis:	0.00024
Correction	0.0010	0.0000	-0.0005	Angle:	114 45 58

ETRF89 Coordinates:	Lat	Long	Height
	000 0.00000N	000 0.00000E	0.0000

Station description:

Station: STN9A — Type: Free

Coordinates:	E/X	N/Y	Ht/Z	Error ellipse	
Adjusted	1,215.1580	1,142.77	40.62	Major Axis:	0.00176
Provisional	1,215.1580	1,142.77	40.62	Minor Axis:	0.00100
Correction	0.0000	0.0000	-0.0004	Angle:	161 34 57

ETRF89 Coordinates:	Lat	Long	Height
	000 0.00000N	000 0.00000E	0.0000

Station description:

Station: STN9B — Type: Free

Coordinates:	E/X	N/Y	Ht/Z	Error ellipse	
Adjusted	1,215.1570	1,142.77	40.62	Major Axis:	0.00175
Provisional	1,215.1570	1,142.77	40.62	Minor Axis:	0.00146
Correction	0.0000	-0.0010	-0.0006	Angle:	031 35 41

ETRF89 Coordinates:	Lat	Long	Height
	000 0.00000N	000 0.00000E	0.0000

Station description:

Station: STN9C — Type: Free

Coordinates:	E/X	N/Y	Ht/Z	Error ellipse	
Adjusted	1,215.1530	1,142.77	40.63	Major Axis:	0.00229
Provisional	1,215.1540	1,142.77	40.63	Minor Axis:	0.00100
Correction	0.0000	-0.0020	-0.0007	Angle:	087 36 25

ETRF89 Coordinates:	Lat	Long	Height
	000 0.00000N	000 0.00000E	0.0000

Station description:

Station: TEM1 — Type: Free

Coordinates:	E/X	N/Y	Ht/Z	Error ellipse	
Adjusted	1,101.1770	1,143.46	52.22	Major Axis:	0.00204
Provisional	1,101.1780	1,143.46	52.22	Minor Axis:	0.00169
Correction	-0.0010	-0.0050	-0.0010	Angle:	093 25 34

ETRF89 Coordinates:	Lat	Long	Height
	000 0.00000N	000 0.00000E	0.0000

Station description:

Station: TEM2 — Type: Free

Coordinates:	E/X	N/Y	Ht/Z	Error ellipse	
Adjusted	1,105.9590	1,132.62	52.25	Major Axis:	0.00229
Provisional	1,105.9590	1,132.62	52.25	Minor Axis:	0.00132
Correction	-0.0010	-0.0050	-0.0010	Angle:	075 47 49

ETRF89 Coordinates:	Lat	Long	Height
	000 0.00000N	000 0.00000E	0.0000

Station description:

Traverse Leg Statistics

From Station	To Station	Length	Misc Lth	Bearing	dZ	Type
STN4	STN2	25.340	0.0010	179 44 39	2.6710	Loose
STN4	TEM1	18.165	0.0000	004 04 46	0.8040	Loose
STN4	TEM2	9.480	0.0000	039 50 43	0.7740	Loose
STN5	STN4	41.457	0.0000	274 21 40	0.6660	Loose
STN5	STN9C	76.745	0.0000	074 26 30	11.7280	Loose
STN6	STN5	65.340	0.0000	291 20 04	0.8800	Loose
STN6	STN9B	46.242	0.0000	016 25 22	10.8580	Loose
STN7	STN6	23.053	0.0000	271 59 54	0.7110	Loose
STN7	STN9A	46.243	0.0000	347 33 27	10.1470	Loose
STN8	STN7	23.107	-0.0010	012 02 51	8.0300	Loose
STN8	STN1	59.594	0.0000	294 47 15	4.4860	Loose

Total traverse length	434.765	0.00	**Equivalent linear accuracy**	**1:** 289,050
Total length of constrained legs	0.000	0.0000		**1:** 0
Total length of free legs	434.765	0.00		
Total dZ	51.7546			

Observations

Setup 1 **At Stn#** STN1

From Stn	To Stn	Inst Ht	Rod Ht	Ha	Va	Sl. Dist	Hor.Dist	Ht Diff	FMA
STN2	STN8	1.50	1.50	179 04 27.00	085 41 42.00	59.7620	59.5930	4.4864	204 47 16.00
STN2	STN8	1.50	1.50	179 04 28.99	085 41 44.00	59.7630	59.5940	4.4859	204 47 17.99
STN2	STN2	1.50	1.50	334 17 13.00	090 00 00.00	0.0000	0.0000	0.0000	000 00 00.00
STN2	STN2	1.50	1.50	334 17 11.00	090 00 00.00	0.0000	0.0000	0.0000	000 00 00.00

Setup 2 **At Stn#** STN8

From Stn	To Stn	Inst Ht	Rod Ht	Ha	Va	Sl. Dist	Hor.Dist	Ht Diff	FMA
STN1	STN1	1.50	1.50	357 03 18.00	094 18 16.00	59.7620	59.5930	-4.4852	000 00 00.00
STN1	STN7	1.50	1.50	074 18 54.00	109 09 47.00	24.4630	23.1070	-8.0301	077 15 36.00
STN1	STN7	1.50	1.50	074 18 56.00	109 09 44.99	24.4620	23.1070	-8.0296	077 15 38.00
STN1	STN1	1.50	1.50	357 03 15.00	094 18 19.00	59.7630	59.5940	-4.4862	000 00 00.00

Setup 3 **At Stn#** STN7

From Stn	To Stn	Inst Ht	Rod Ht	Ha	Va	Sl. Dist	Hor.Dist	Ht Diff	FMA
STN8	STN8	1.50	1.50	007 28 14.00	070 50 11.00	24.4640	23.1080	8.0308	000 00 00.00
STN8	STN8	1.50	1.50	007 28 15.00	070 50 12.00	24.4620	23.1060	8.0300	000 00 00.00
STN8	STN9A	1.50	1.50	162 58 51.99	102 22 34.00	47.3430	46.2430	-10.1468	155 30 36.99
STN8	STN9A	1.50	1.50	162 58 50.00	102 22 32.99	47.3440	46.2440	-10.1468	155 30 35.00
STN8	STN6	1.50	1.50	087 25 20.00	088 13 58.00	23.0630	23.0520	0.7113	079 57 05.00
STN8	STN6	1.50	1.50	087 25 18.99	088 14 00.00	23.0630	23.0520	0.7111	079 57 03.99

Setup 4 **At Stn#** STN6

From Stn	To Stn	Inst Ht	Rod Ht	Ha	Va	Sl. Dist	Hor.Dist	Ht Diff	FMA
STN7	STN7	1.50	1.50	173 33 07.99	091 45 57.99	23.0630	23.0520	-0.7108	000 00 00.00
STN7	STN9B	1.50	1.50	097 58 34.99	103 12 52.00	47.4990	46.2410	-10.8579	284 25 27.00
STN7	STN9B	1.50	1.50	097 58 37.00	103 12 52.00	47.5000	46.2420	-10.8582	284 25 29.00
STN7	STN5	1.50	1.50	012 53 22.00	089 13 41.00	65.3470	65.3410	0.8807	199 20 14.00
STN7	STN5	1.50	1.50	012 53 18.00	089 13 40.00	65.3450	65.3390	0.8810	199 20 10.00
STN7	STN7	1.50	1.50	173 33 11.99	091 45 58.00	23.0650	23.0540	-0.7108	000 00 00.00

Setup 5 **At Stn#** STN5

From Stn	To Stn	Inst Ht	Rod Ht	Ha	Va	Sl. Dist	Hor.Dist	Ht Diff	FMA
STN6	STN6	1.50	1.50	031 08 16.00	090 46 19.00	65.3460	65.3400	-0.8800	000 00 00.00
STN6	STN6	1.50	1.50	031 08 15.00	090 46 17.00	65.3450	65.3390	-0.8794	000 00 00.00
STN6	STN9C	1.50	1.50	354 14 40.00	098 41 20.00	77.6360	76.7450	-11.7279	323 06 25.00
STN6	STN9C	1.50	1.50	354 14 41.00	098 41 19.00	77.6350	76.7440	-11.7274	323 06 26.00
STN6	STN4	1.50	1.50	194 09 53.00	089 04 48.00	41.4610	41.4560	0.6658	163 01 38.00
STN6	STN4	1.50	1.50	194 09 50.99	089 04 48.00	41.4630	41.4580	0.6659	163 01 35.99

Reduced Horizontal Angles & Residuals

ObsFrom		At	To	Angle	Residual	StdErr	StdRes
1	STN2	STN1	STN8	204 47 16	-000 00 01	3.0000	0.1737
2	STN2	STN1	STN8	204 47 18	-000 00 03	3.0000	0.8404
5	STN1	STN8	STN7	077 15 36	-000 00 01	3.0000	0.2059
6	STN1	STN8	STN7	077 15 38	-000 00 03	3.0000	0.8726
9	STN8	STN7	STN9A	155 30 37	-000 00 01	3.0000	0.3333
10	STN8	STN7	STN9A	155 30 35	000 00 01	3.0000	-0.3334
11	STN8	STN7	STN6	079 57 04	-000 00 01	3.0000	0.3754
12	STN8	STN7	STN6	079 57 05	-000 00 02	3.0000	0.7087
15	STN7	STN6	STN9B	284 25 27	000 00 01	3.0000	-0.3333
16	STN7	STN6	STN9B	284 25 29	-000 00 01	3.0000	0.3333
17	STN7	STN6	STN5	199 20 14	-000 00 04	3.0000	1.1951
18	STN7	STN6	STN5	199 20 10	000 00 00	3.0000	-0.1383
21	STN6	STN5	STN9C	323 06 25	000 00 01	3.0000	-0.1667
22	STN6	STN5	STN9C	323 06 26	-000 00 00	3.0000	0.1667
23	STN6	STN5	STN4	163 01 38	-000 00 02	3.0000	0.8257
24	STN6	STN5	STN4	163 01 36	-000 00 00	3.0000	0.1590
27	STN5	STN4	TEM2	305 29 03	000 00 00	3.0000	0.0000
28	STN5	STN4	TEM1	269 43 06	000 00 00	3.0000	0.0000
29	STN5	STN4	TEM1	269 43 06	-000 00 00	3.0000	0.0000
30	STN5	STN4	TEM2	305 29 03	-000 00 00	3.0000	0.0000
31	STN5	STN4	STN2	085 23 01	-000 00 01	3.0000	0.4679
32	STN5	STN4	STN2	085 23 01	-000 00 01	3.0000	0.4679
34	STN1	STN2	STN4	269 44 39	000 00 00	3.0000	-0.0897
35	STN4	STN2	STN1	090 15 21	-000 00 00	3.0000	0.0897
36	STN4	STN2	STN1	090 15 23	-000 00 02	3.0000	0.7564

Reduced Horizontal Distances & Residuals

Obs	At	To	Hor Dist	Residual	StdErr	StdRes
1	STN1	STN8	59.5934	0.0007	0.0051	-0.1443
2	STN1	STN8	59.5944	-0.0003	0.0051	0.0589
4	STN8	STN1	59.5934	0.0007	0.0051	-0.1358
5	STN8	STN7	23.1075	-0.0008	0.0050	0.1492
6	STN8	STN7	23.1066	0.0001	0.0050	-0.0224
7	STN8	STN1	59.5944	-0.0002	0.0051	0.0462
8	STN7	STN8	23.1065	0.0002	0.0050	-0.0456
9	STN7	STN9A	46.2428	0.0005	0.0051	-0.1007
10	STN7	STN9A	46.2439	-0.0005	0.0051	0.1007
11	STN7	STN6	23.0520	0.0005	0.0050	-0.0958
12	STN7	STN6	23.0520	0.0005	0.0050	-0.0972
13	STN7	STN8	23.1083	-0.0016	0.0050	0.3209
14	STN6	STN7	23.0520	0.0005	0.0050	-0.0945
15	STN6	STN9B	46.2413	0.0005	0.0051	-0.0956
16	STN6	STN9B	46.2423	-0.0005	0.0051	0.0955
17	STN6	STN5	65.3411	-0.0014	0.0051	0.2814
18	STN6	STN5	65.3391	0.0006	0.0051	-0.1092
19	STN6	STN7	23.0540	-0.0015	0.0050	0.3017
20	STN5	STN6	65.3391	0.0005	0.0051	-0.1067
21	STN5	STN9C	76.7450	-0.0005	0.0052	0.0903
22	STN5	STN9C	76.7441	0.0005	0.0052	-0.0904
23	STN5	STN4	41.4557	0.0010	0.0051	-0.1885
24	STN5	STN4	41.4577	-0.0010	0.0051	0.2049
25	STN5	STN6	65.3401	-0.0004	0.0051	0.0865
26	STN4	STN5	41.4567	0.0000	0.0051	0.0075
27	STN4	TEM2	9.4805	0.0000	0.0050	0.0000
28	STN4	TEM1	18.1652	0.0000	0.0050	0.0000
29	STN4	TEM1	18.1652	0.0000	0.0050	0.0000
30	STN4	TEM2	9.4805	0.0000	0.0050	0.0000
31	STN4	STN2	25.3396	0.0008	0.0051	-0.1514
32	STN4	STN2	25.3396	0.0008	0.0051	-0.1514
33	STN4	STN5	41.4567	0.0000	0.0051	0.0075
34	STN2	STN4	25.3386	0.0017	0.0051	-0.3458
37	STN2	STN4	25.3416	-0.0012	0.0051	0.2372

Reduced Height Differences & Residuals

Obs	At	To	Ht Diff	Residual	StdErr	StdRes
1	STN1	STN8	4.4864	0.0005	0.0168	0.0273
2	STN1	STN8	4.4859	0.0000	0.0168	-0.0027
4	STN8	STN1	-4.4852	0.0007	0.0168	0.0403
5	STN8	STN7	-8.0301	0.0000	0.0433	-0.0003
6	STN8	STN7	-8.0296	0.0005	0.0433	0.0125
7	STN8	STN1	-4.4862	-0.0003	0.0168	-0.0158
8	STN7	STN8	8.0300	-0.0001	0.0433	-0.0028
9	STN7	STN9A	-10.1468	0.0000	0.0216	-0.0002
10	STN7	STN9A	-10.1468	0.0000	0.0216	0.0002
11	STN7	STN6	0.7111	0.0001	0.0434	0.0019
12	STN7	STN6	0.7113	0.0003	0.0434	0.0070
13	STN7	STN8	8.0308	0.0006	0.0433	0.0150
14	STN6	STN7	-0.7108	0.0002	0.0434	0.0052
15	STN6	STN9B	-10.8579	0.0001	0.0216	0.0053
16	STN6	STN9B	-10.8582	-0.0001	0.0216	-0.0053
17	STN6	STN5	0.8807	0.0004	0.0153	0.0281
18	STN6	STN5	0.8810	0.0007	0.0153	0.0471
19	STN6	STN7	-0.7108	0.0002	0.0434	0.0038
20	STN5	STN6	-0.8794	0.0009	0.0153	0.0587
21	STN5	STN9C	-11.7279	-0.0003	0.0130	-0.0201
22	STN5	STN9C	-11.7274	0.0003	0.0130	0.0201
23	STN5	STN4	0.6658	0.0000	0.0241	0.0008
24	STN5	STN4	0.6659	0.0001	0.0241	0.0021
25	STN5	STN6	-0.8800	0.0003	0.0153	0.0165
26	STN4	STN5	-0.6658	0.0000	0.0241	0.0014
27	STN4	TEM2	-0.7740	0.0000	0.1055	0.0000
28	STN4	TEM1	-0.8039	0.0000	0.0551	0.0000
29	STN4	TEM1	-0.8039	0.0000	0.0551	0.0000
30	STN4	TEM2	-0.7740	0.0000	0.1055	0.0000
31	STN4	STN2	2.6711	0.0000	0.0395	-0.0002
32	STN4	STN2	2.6711	0.0000	0.0395	-0.0002
33	STN4	STN5	-0.6658	0.0000	0.0241	0.0014
34	STN2	STN4	-2.6707	0.0003	0.0395	0.0085
37	STN2	STN4	-2.6714	-0.0003	0.0395	-0.0088

End of report

Appendix B: Levelling Report

ABC Surveys
123 Penny Lane
Sometown
Somewhere

00 1234 56789
00 1234 56710
email: mwhite@abcsurveys.com
web: www.abcsurveys.com

Levelling Report

Project:

Client:

Ref. Number:

Date:

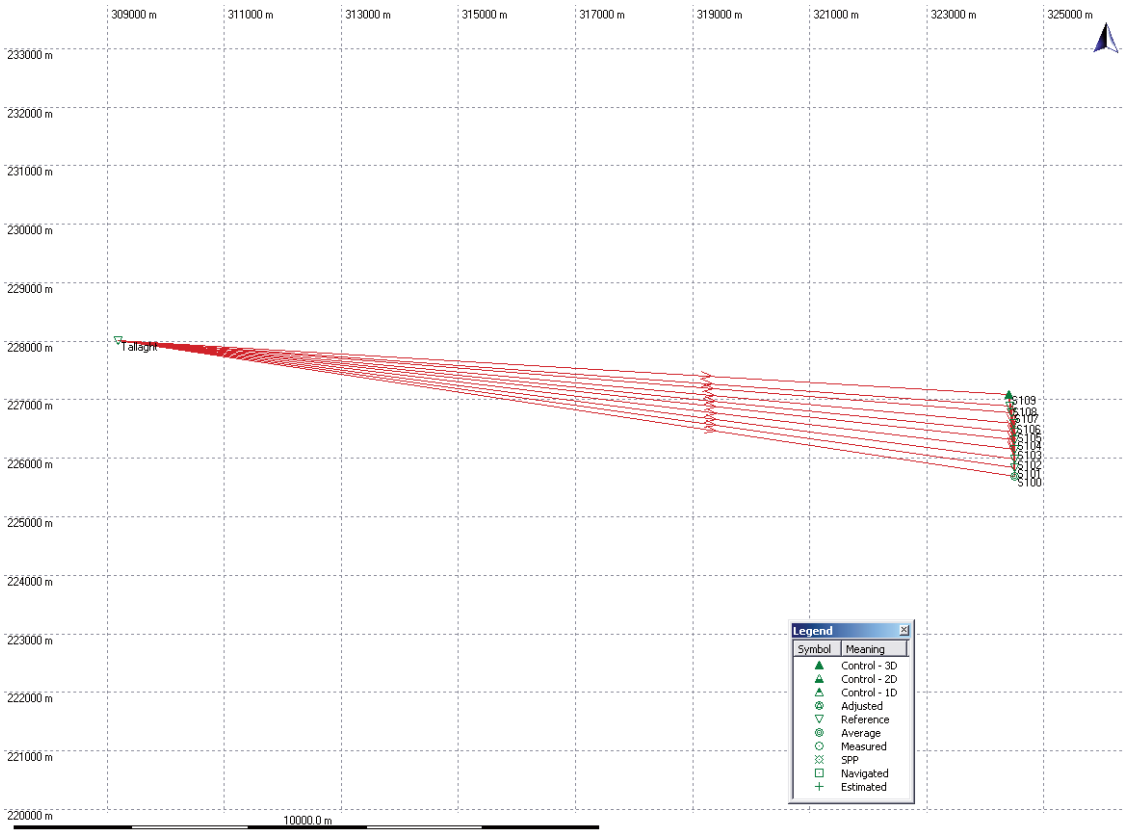
Back-Sight	Inter-Mediate Fore-Sight	dH	H	No.
2570			74.155	GPS2
1431	1198	1.372	75.527	STN1
2172	1414	0.017	75.544	STN2
0298	1444	0.728	76.272	STN3
0965	2669	-2.370	73.902	STN4
1457	1895	-0.930	72.972	STN5
2253	0979	0.478	73.450	STN6
1368	2424	-0.171	73.279	STN7
2382	1940	-0.572	72.707	STN8
1331	2424	1.021	73.278	STN9
1884	2352	-1.021	72.707	STN8
2433	1314	0.570	73.277	STN7
0884	2263	0.170	73.447	STN6
1946	1361	-0.477	72.970	STN5
2548	1016	0.931	73.901	STN4
1353	0176	2.372	76.273	STN3
1502	2081	-0.728	75.545	STN2
1189	1519	-0.017	75.528	STN1
	2562	-1.373	74.155	GPS2
29966	29969			

Average Values

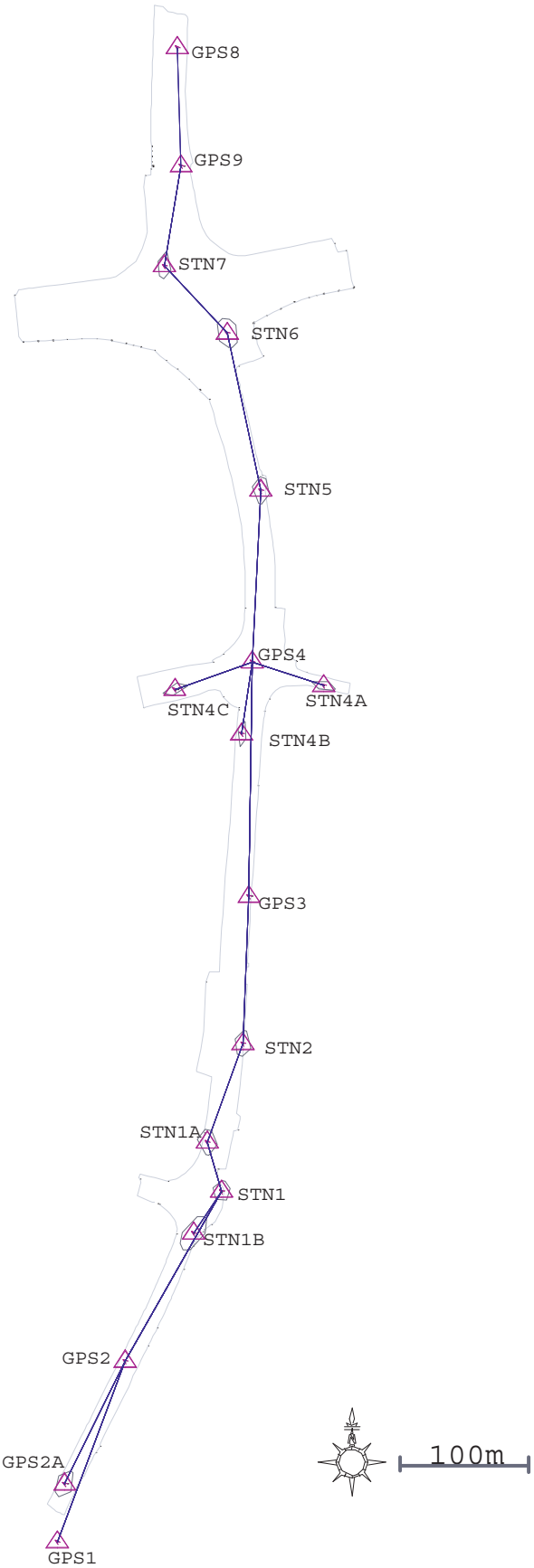
STN1	75.528
STN2	75.545
STN3	76.273
STN4	73.902
STN5	72.971
STN6	73.449
STN7	73.278
STN8	72.707
STN9	73.728

Appendix C: Diagram Of GPS Network

DIAGRAM OF GPS NETWORK



Appendix D: Diagram Of Traverse Report


GPS8
GPS9
STN7
STN6
STN5
GPS4
STN4C
STN4A
STN4B
GPS3
STN2
STN1A
STN1
STN1B
GPS2
GPS2A
GPS1
100m

Appendix E: PGM Diagram

ABC Surveys
123 Penny Lane
Sometown
Somewhere

00 1234 56789
00 1234 56710
email: mwhite@abcsurveys.com
web: www.abcsurveys.com

Station Description Sheet

Project:

Client:

Ref. Number:

Date:

Station Name: STN40

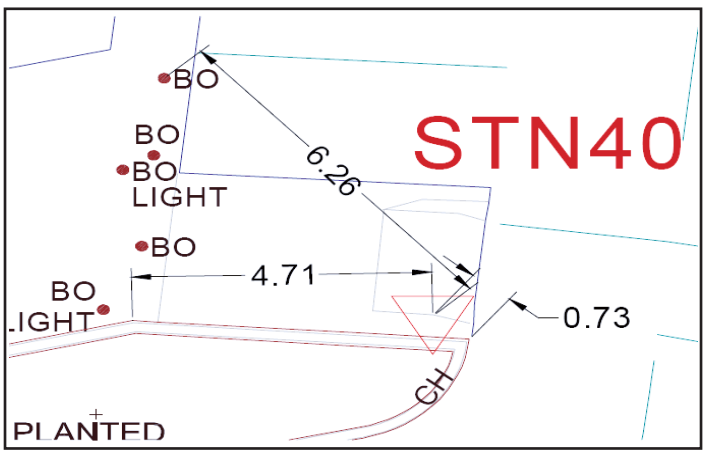
System: **ETRF89**
Latitude: 53 13 02.814 N
Longitude: 06 39 50.732 W
Ellipsoidal Height: 143.471

System: **ITM**
Easting (m): 689219.543
Northing (m): 719392.757
Orthometric Height (m): 92.223
(OSGM02) Malin Head
Scale Factor: 0.999690

System: **IG75**
Easting (m): 289288.301
Northing (m): 219363.116
Orthometric Height (m): 94.884
(OSGM02) Malin Head
Scale Factor: 1.000185

Description:

Earth Anchor



Appendix F: Schedule Of Computer Files Provided

Name	Size (bytes)		Last modified	CRC
QBN123456.Project	2,592,930		Tuesday March 04 2008	d976c68b
QBN123456.Traverse	130,754		Thursday February 14 2008	a71db207
QBN123456 Levelling Report.pdf	20,996		Thursday February 14 2008	43acdf49
QBN123456 PGM'S Diagrams.pdf	311,540		Monday February 18 2008	2455ac5f
QBN123456 Traverse report.pdf	41,575		Monday February 18 2008	80511049
QBN123456.Survey	5,539,768		Tuesday February 12 2008	701db642
QBN123456-IG75.Model	3,742,685		Tuesday March 04 2008	90f94d73
QBN123456-ITM.Model	6,537,216		Wednesday March 05 2008	d0c3e5b4
QBN123456-ITM.INP	1,537,216		Wednesday March 05 2008	20c345b45
QBN123456-ITM.DGN	4,567,278		Wednesday March 05 2008	76c345b45
QBN123456-ITM.DWG	5,355,567		Wednesday March 05 2008	777cc5b45

Appendix G: Schedule Of Surveying Equipment Used

Model and serial no	Last calibration date	Manufacturer
Leica 1200 series GPS Sn 100-200-300	12/12/2007	Leica Geosystems http://www.leica-geosystems.com
Leica 1200 series GPS Sn 120-230-330	12/12/2007	Leica Geosystems http://www.leica-geosystems.com
Leica 1200 series total station Sn 101-400-360	12/12/2007	Leica Geosystems http://www.leica-geosystems.com
Leica 1200 series total station Sn 101-434-960	12/12/2007	Leica Geosystems http://www.leica-geosystems.com
Trimble DINI digital level SN 1124-111	14/01/2008	Trimble www.trimble.com

Appendix H: Schedule Of Processing Software Used

Name	Version	Manufacturer
OSI Grid Inquest	6.0.6	Quest Geosolutions Ltd http://www.qgsl.com/
Survey Control Centre	9.0.1	Atlas Computers Ltd http://www.atlascomputers.ie
Leica Geo Office	V6.0	Leica Geosystems http://www.leica-geosystems.com

Appendix I: Instrument Set-up Report

ABC Surveys
123 Penny Lane
Sometown
Somewhere

00 1234 56789
00 1234 56710
email: mwhite@abcsurveys.com
web: www.abcsurveys.com

Instrument Setup QA Checks

Project:

Client:

Ref. Number:

Date:

At Stn	To Stn	Instr Hgt	Rod Hgt	HA	VA	Sl Dist	X Err	Y Err	Z Err	HDist Err
STN3A	STN3	1.666	1.800	187-41-40	090-04-58	49.600	0.0000	0.0030	(0.0010)	0.0040
STN3	STN2	1.705	1.800	185-28-56	090-32-00	189.130	0.0100	0.0150	(0.0040)	0.0210
STN3	STN2	1.695	1.800	185-28-56	090-31-49	189.130	0.0200	0.0160	(0.0040)	0.0220
STN3	STN2	1.650	1.800	185-28-56	090-30-59	189.130	0.0100	0.0150	(0.0050)	0.0210
STN2	STN1	1.675	1.850	180-00-00	089-59-35	183.530	0.0100	0.0090	0.0490	0.0110
STN2	STN1	1.676	1.800	180-00-00	089-59-38	183.530	0.0100	0.0100	0.0010	0.0130
STN2	STN1	1.732	1.800	180-00-00	090-00-40	183.530	0.0100	0.0070	0.0000	0.0090
STN1	STN2	1.690	1.800	000-00-00	089-55-44	183.530	0.0000	(0.0050)	(0.0190)	0.0060
STN1	STN2	1.738	1.800	000-00-00	089-56-21	183.530	(0.0100)	(0.0060)	(0.0340)	0.0080
STN1	STN2	1.698	1.800	000-00-00	089-56-17	183.530	(0.0100)	(0.0090)	0.0020	0.0110

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