

GENERAL SPECIFICATION

SURVEYS

GS EP GEO 401

GIS requirements for engineering site surveys and studies

08	11/2019	Integration of Satellite Derived Bathymetry (SDB) GIS requirements
07	11/2017	SSDM v2 compliant for geophysical and geotechnical data
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1. Scope

The following specifications shall be construed as the minimum standards required by Company, applicable to Geographic Information System (GIS) data delivery for engineering site survey and studies, for onshore and/or offshore facilities.

This particularly applies to spatial data provided as part of the following investigations or studies:

- Site surveys: geophysical engineering surveys, debris surveys, bathymetric surveys, geotechnical surveys, topographical surveys, metocean surveys and geochemical surveys
- Desktop studies: all synthesis or integrated studies dealing with geology, geophysics, geotechnics, remote sensing, meteorology and oceanography, seismicity, geohazards and natural risks assessment, etc.

Contractor may propose to provide slightly modified or more detailed data, in which case this shall be approved by Company before the final data delivery.

For other investigations and studies or for specific cases where data requirements are not covered in this document, Contractor shall provide a detailed proposition and/or a data delivery sample to Company for approval before the delivery of the final dataset.

This specification is compliant with the SSDM V2, with additional company-specific elements. The datamodel provided by Company prevails over the SSDM V2.

Hereafter, "SSDM" refers to the SSDM V2.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and addendums, is the latest revision published at the effective date of this document.

Reference	Title
ISO 19115 (All parts)	Geographic information - MetaData - All Parts
IOGP Report No. 462-02	Guideline for the delivery of the Seabed Survey Data Model

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Reference	Title
GS EP ENV 501	GIS deliverables for HSE

3. Glossary

List of abbreviations

CAD	Computer Assisted Design
CPT	Cone Penetration Test
CTD	Conductivity Temperature Density
CRS	Coordinate Reference System
DSM	Digital Surface Model
DTM	Digital Terrain Model
EBS	Environmental Baseline Study
GDB	GeoDataBase
GIS	Geographic Information System
GNSS	Global Navigation Satellite System
LIDAR	Light Detection And Ranging
QA/QC	Quality Assessment / Quality Control
SDB	Satellite Derived Bathymetry
SSDM	Seabed Survey Data Model
SSS	Side Scan Sonar

4. Deliverables

4.1 Resources provided by Company to Contractor

A GIS template data package consisting of all of the following documents and material shall be transmitted by Company to Contractor:

1. A directory structure
2. The official Project Coordinate Reference System (CRS) in .prj format and associated geodetic parameters in .pdf format
3. An empty GIS database in ESRI File Geodatabase (.gdb) file format

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4. A master GIS project file in ESRI .mxd file format
5. A GIS symbology file in ESRI .style file format and ESRI .lyr file format
6. A CAD file template for geophysical and topographic surveys.
7. A XLS GIS content file
8. A XLS SIGEO content file. Refer to 6.7- SIGEO content Excel file
9. A DOCX check-list validation sheet
10. Existing company data, if applicable.

The directory structure is a standard Windows directory structure that Company uses to store and organise all Project GIS materials, source data and associated resources.

The ESRI File Geodatabase is pre-projected to the Project CRS and is aimed to store Project GIS vector data. The master GIS project file is ready-to-use. Layers are structured in the table of content and symbolized with the Company standard symbology (SSDM compliant with additional company-specific elements).

The XLS GIS content file is a Microsoft Excel .xlsx spreadsheet for Contractor to record and describe GIS content submitted to Company. Contractor will also use this file to highlight any questions or issues. Company will use the spreadsheet to provide comments/feedback to Contractor.

The DOCX check-list validation sheet is designed to help the Contractor perform its QC. Checking all the sheet items is a strong indicator that the final GIS delivery will meet Company requirements.

4.2 Deliverables to be provided by Contractor to Company

Every GIS delivery shall be prepared by populating the GIS template data package provided by Company.

4.2.1 Draft delivery for report and GIS template validation

Between the draft interpretation report delivery and the final report delivery, a draft GIS shall be submitted to Company.

The draft GIS will be used for the final approval of the report.

Contractor may highlight any questions or issues in the XLS GIS Content file.

Contractor may propose additional information (such as new domains, feature class, symbology etc.).

In case the Contractor propose additional information, this shall be approved by Company before the final data delivery.

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4.2.2 Final deliverables

Contractor shall transmit to Company the final version of the GIS data package.

Final version content shall integrate all the modifications required by Company at the draft delivery stage.

The final GIS delivery shall only occur once the technical final report is validated by Company.

5. General requirements

5.1 Software compatibility

Contractor's deliverable shall be compliant with GIS software **ESRI ArcGIS Desktop 10.5.1**.

CAD file (Computer Assisted Drawing) shall be compliant with **Autodesk AutoCAD 2010**, in DWG format.

5.2 Language

Unless otherwise specified by Company, the English language shall be used for reporting, mapping and GIS deliverables.

5.3 Data Quality Assessment / Quality Control (QA/QC)

It is the responsibility of Contractor to apply QA/QC procedures when producing the GIS datasets.

Any anomaly or discrepancies between the datasets detected by Contractor shall be brought to the attention of Company.

In particular, all of the following items shall be QC'ed:

- Georeferencing
- Valid feature geometry
- Feature attribution: all relevant attribute table fields are fully and accurately populated.

Any difficulties Contractor faces populating attribute fields shall be reported to Company so that Company may provide guidance.

Topology shall be QC'ed as per paragraph 4.5.3 in [IOGP Report No. 462-02](#).

5.4 Units

Unless otherwise specified, the International System shall be used.

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5.5 Geodetic system applicable

As part of the GIS template data package, the CRS for the project will be supplied by Company to Contractor and the CRS will be applied to the GIS template supplied to Contractor by Company.

All GIS data supplied to Company by Contractor shall be geo-referenced in the CRS.

The CRS description of the data shall be included in the ASCII file header of raw data in ASCII file format.

6. Data general specifications

6.1 Naming convention of the files

The name of the Contractor data delivery shall be compliant with the following nomenclature **YYYY_CT_CT-Ref_SurveyName** with:

- YYYY: Year of survey / study
- CT: Name of the Contractor in 2-Digits provided by Company
- CT-Ref: Contractor project reference with non space, no special character
- SurveyName: Name of the survey (maximum of 30 digits).

Example: Debris survey of the Seine by DEV/TEC/GEO in 2017, reference contractor FR-IDF-75-GEO002 becomes 2017_TG_FR-IDF-75-GEO002_Seine-Debris-Survey

The GIS template sent to Contractor by Company follows this naming convention.

Names of feature classes, attribute fields and tables within the GIS data package provided to Contractor are pre-defined by Company and shall not be modified by Contractor.

6.2 Metadata

The use of metadata ensures the traceability of data imported into the GIS template.

Metadata shall be compliant with [ISO 19115 \(All Parts\)](#).

The GIS template provided by Company defines a minimum set of feature level metadata.

Contractor shall provide feature level metadata for each feature class part of the GIS delivery.

Survey keysheet, survey equipment limits and survey tracklines feature classes provide important feature level metadata.

In addition, all feature classes utilized as part of the survey deliverable shall be accompanied by a metadata statement embedded into the ESRI Geodatabase.

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As a minimum Contractor shall provide metadata covering the following information:

- Data source (Contractor name, project name, creation date, report, conversion type, etc.)
- File ID (name, revision, date, type, etc.)
- Geodetic system (official coordinate reference system, GNSS datum, datum shift, vertical datum, etc.).

An example of a metadata statement for a seabed survey is provided in [IOGP Report No. 462-02](#) (Figure 11 of IOGP Report).

6.3 Symbology

Contractor shall use the symbologies provided by Company as a Style file and a layer file.

The symbologies are also pre-defined in the MXD.

Contractor may use the .style file to apply Company standard symbology to feature classes; alternatively Contractor may use the ESRI .lyr file to reload pre-symbolised feature classes and tables from the accompanying GIS database.

The symbology of each unique object is defined by an IOGP symbol code, or by a TOT symbol code for codes defined by Company. Each feature class contains the symbology code value in the SYMBOLOGY CODE field, which is constrained by domains.

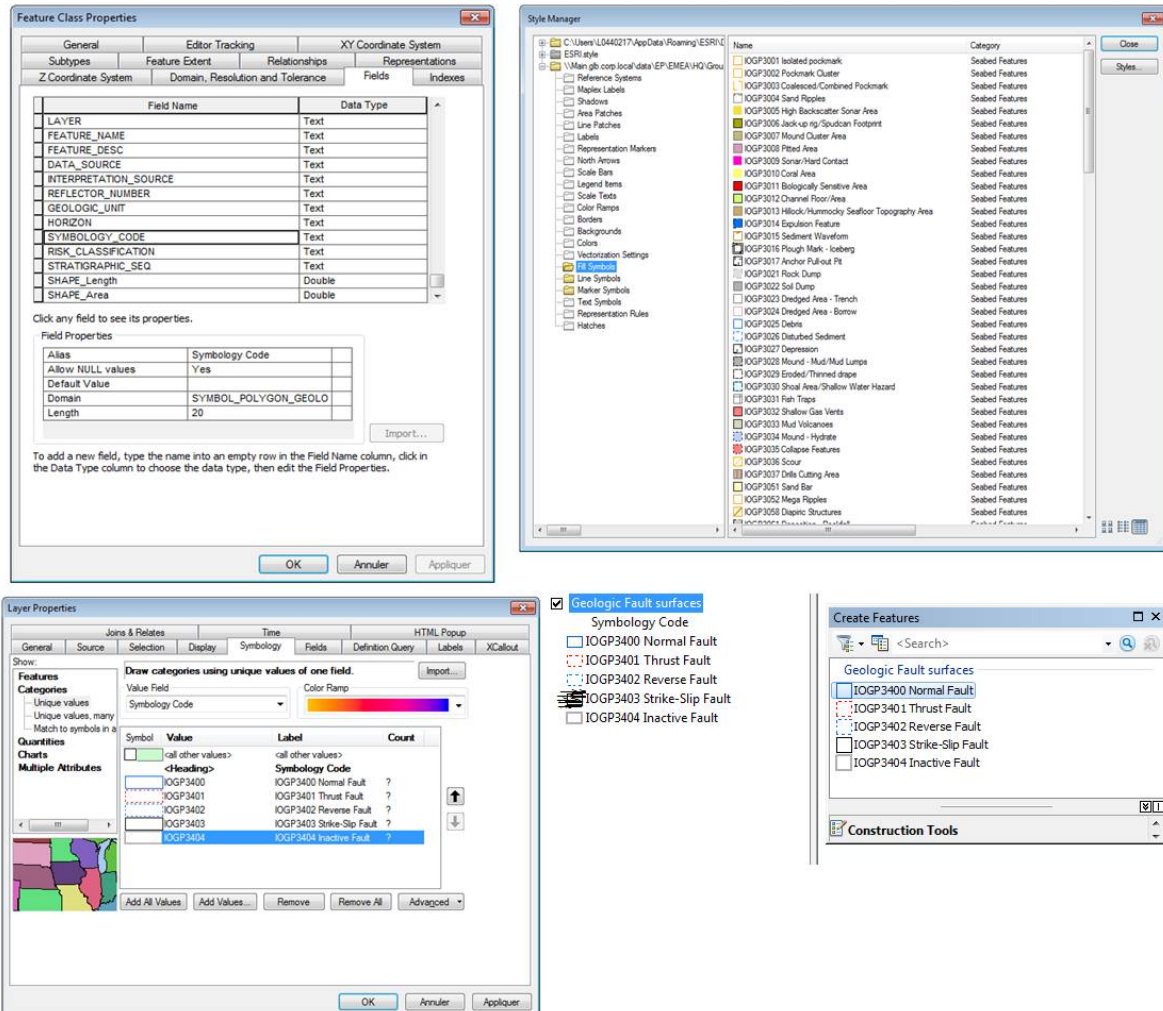
The symbology code value in the SYMBOLOGY_CODE field is in the following format:
IOPGXXXX e.g. IOGP1007 = Boulder or TOTXXX e.g. TOT1117 = Seabed TBAR

Contractor may propose new symbology.

For any new symbology, Contractor shall perform all the following steps:

- Request approval by Company before the final data delivery
- Request to Company a TOT symbol code
- Update the Symbology Code domain in order to add the new TOT symbol code provided by Company
- Update the Style, Layer and MXD files accordingly.

Figure 1 - Feature class symbology codes and ArcGIS layer file symbology settings



6.4 Rasters

Raster files shall:

- Be provided in Geotiff format
- Stored in the dedicated "Raster" folder
- Not be stored in the ESRI File Geodatabase
- Named with the naming convention as follows:
 - CT_CT-Ref_DataType
 - Where:
 - . CT: Name of the Contractor in 2-Digits provided by Company
 - . CT-Ref: Contractor project reference with no space and no special character

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. DataType:

- (a) BAT: Bathymetry in meters (negative values)
- (b) LAS: Bathymetry processed from LiDAR/Laser data
- (c) BAK: Backscatter
- (d) SSS: Side scan sonar
- (e) ISOC: Isochrones
- (f) ISOP: Isopachs (in meters)
- (g) CAM: (Seabed) photographs mosaic
- (h) DTM: Digital Terrain Model
- (i) DSM: Digital Surface Model
- (j) HIL: Hillshade
- (k) SLO: (Seabed) slopes in degrees.

For the naming convention of remote sensing imagery, refer to section 7.4 Remote sensing.

For the naming convention of rasters associated to topographic survey refer to section 13, Appendix 5.

The symbology pre-loaded in the MXD table of content and LYR file provided by Company (section 12, Appendix 4) shall be applied to the different types of rasters.

MXD and LYR shall be updated by Contractor to reflect the rasters delivered with the GIS data template.

Satellite imagery shall be provided with TFW file and spatial index.

For areas included in the tiles but outside the survey limits, the pixels shall be tagged as "NoData".

For isopachs, the velocity model used for time-depth conversion shall be specified and whether the raster refers to absolute depth, depth below seabed or thickness between layers.

Rasters, even georeferenced, which are not part of the datatype list above (for instance, marine charts extracts, profiles etc.) are not destined to be displayed in the MXD and shall be stored in the "Hyperlink_Documents" folder.

For each raster Contractor shall:

- Calculate statistics
- Build pyramids.

Rasters shall be delivered as per formats described (see section 6.4, Table 1).

Table 1 - Expected raster formats

Raster delivery	Raster Type	Number of bands/bits	Cell value
Topographic DEM/DSM/DTM	Elevation raster	1 band / 32 bits	Elevation (>0)
Bathymetric DEM	Elevation raster	1 band / 32 bits	Elevation (<0)
Side Scan Sonar imagery	Grey level raster	1 band / 8 bits	Grey level (0 to 255)
Hillshade raster	Grey level raster	1 band / 8 bits	Grey level (0 to 255)
Backscatter raster	Grey level raster	1 band / 8 bits	Grey level (0 to 255)
DEM slope raster	Elevation raster	1 band / 32 bits	Slope value in degree (°)
Satellite imagery	RGB raster	Minimum of 3 bands / 8 bits	Red, Green, Blue, (optional CIR, PAN, ...)

6.5 Associated documents (hyperlinks)

The survey deliverable contains a number of datasets in addition to the GIS deliverable itself (report, charts, figure, log, seismic profiles, Excel spreadsheets etc.).

The survey deliverables shall be stored in the Hyperlink_Documents directory (Figure 2).

Any document stored in "Hyperlink_Documents" shall be hyperlinked to the corresponding feature class.

These hyperlinks enable users of the GIS data to directly open and visualize associated materials.

"Hyperlink" fields in attribute tables shall be populated as with the relative file path linking the feature class to the document starting at the level of the "Hyperlink_Documents" repertory.

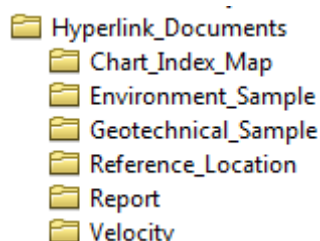
E.g. "Hyperlink_Documents\Geotechnical_Sample\Sample1.pdf"

Please make sure to use "\" and not "/" in the path name.

Hyperlink field attributes exist for the following feature classes: survey keysheet, chart index map, survey tracklines, geotechnical sample and line of profile profile (as per paragraph 4.1.4 in [IOGP Report No. 462-02](#)).

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Figure 2 - Hyperlink_Documents file organization for geophysical, geochemical and geotechnical surveys



Documents shall be stored as follows:

- Maps in Chart_Index_Map
- AUV pictures and/or videos in Environmental Sample
- Borehole logs and pictures in Geotechnical_Sample
- Calibration report in Reference_Location
- Results and Operations reports in Report
- SVP in Velocity.

The Reference_Location, Report and Velocity folders shall be filled in for each survey.

The remaining folders (Chart_Index_Map, Environmental Sample, Geotechnical_Sample) may be filled depending on the survey type.

6.6 GIS content Excel file

The GIS content excel file lists all the feature classes provided in the GIS template, per feature dataset.

Contractor shall:

- Indicate which features classes are filled in or unused ("Empty/Filled" column)
- Fill in the CAD layer name corresponding to each feature class (when relevant)
- Make sure that the "CAD Layer Name / (Detail)" column in the GIS content file matches the "CAD Layer Name" field in attribute tables
- Add any relevant comment as to why an element of this General Specification have been respected, or flag any question or problem encountered (in the "Contractor Comments" column)
- Indicate to Company the need for any addition or modification of domains, domain codes and/or symbologies - in the "Contractor Comments" column.

The GIS content excel file serves as a tracking spreadsheet for the QC process.

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The validation status of feature classes is indicated after each QC iteration, in conjunction with Company and Contractor comments and answers. Comments are synthesized in the “Synthesis” worksheet.

The revision of the GIS content Excel file is incremented after each iteration between Contractor and Company. Restrain from creating new worksheets in the document.

6.7 SIGEO content Excel file

As part of the delivery, an additional Excel is provided for Geophysical, Geotechnical and Topographic survey and shall be filled in.

This file is composed of two sheets describing the equipment used and the survey / study extent.

The coordinates of the area shall be in WGS 84 and there will be as many coordinates as there are vertices in the line / polygone of the survey extent.

The Excel files are specific to each specialty. Refer to the appendix of the speciality concerned.

6.8 Workflow

The GIS delivery workflow shall consist of the following steps:

1. Contractor loads all the vector data in the Geodatabase provided by Company.
2. Contractor organizes project resources in the *Hyperlink_Documents* directory.
3. Contractor populates all relevant attribute fields for the populated feature classes and tables, including hyperlinks to associated documents.
4. Contractor stores raster files in the dedicated folder.
5. Contractor deletes unused layers and symbologies in the MXD table of content. Contractor populates the MXD provided by Company and does not create other MXD documents.
6. Contractor repairs the links to the raster files.
7. Contractor updates the template ESRI® .lyr file to be consistent with the Project MXD.
8. Contractor fills in the XLS GIS Content file.
9. Contractor fills in the XLS SIGEO Content file (for Geophysical, Geotechnical Topographic and Metocean survey).

Following these steps is a strong indicator that the final GIS delivery will meet Company requirements.

Any change to this process shall be agreed upon with Company at the earliest stage.

7. Particular specifications

7.1 Geophysical, geochemical and geotechnical site surveys

A common template is used for geophysical, geochemical and geotechnical site surveys (Figure 4 and Figure 5).

7.1.1 Geophysical survey

The following layers shall be provided as a minimum:

- All survey information: Survey extent, tracklines, shot points, chart extent, equipment list and extent, bathymetry details (*Survey_Measurements* Feature dataset)
- Survey data: Bathymetry (MBES), SSS, SBP data (Raster and ASCII XYZ)
- Seabed interpretation *-if required in the scope of work-*: any feature that could be identified on the seabed, sediment classification (*Seabed_Features* feature dataset)
- Sub-seabed interpretation *-if required in the scope of work-*: Isopach, Isochron, Line of Profile, Acoustic and Geologic Features (*Shallow_Intermediate_Geology* feature dataset)
- The coring and reference points: Locations of velocity samplings, positioning reference points (*Environmental_Samples* feature dataset).

A master CAD shall be provided as follows:

- In addition to the GIS delivery
- Be based on the CAD template provided by Company.

CAD layer names and symbology shall match the names and symbology of the corresponding layers in the MXD table of content.

Figure 3 - Example of CAD layers list



7.1.2 Geotechnical survey

The following layers shall be provided as a minimum:

- All survey information: Location and information per borehole, or individual test location basis such as penetration, water depth, soil synopsis, borehole/ testing method (core penetration test, vane test or else) etc. (*Geotechnical_Survey* feature dataset)
- Laboratory test results for each borehole: giving detailed laboratory test results and geotechnical descriptions versus depth (*Geotechnical_Survey* feature dataset).