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Geospatial Integrity of Geoscience Software (GIGS) User Guide

Acknowledgements

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About

GIGS is an open-source digital testing framework designed to evaluate the capability of software in establishing and maintaining the integrity of geospatial data. It is primarily aimed at geoscience applications, but elements can be readily applied to any software that handles spatial data. The testing framework comprises a series of qualitative evaluations that assess software functionality and configuration, coupled with data-driven tests that quantify the accuracy and robustness of geodetic engines and libraries, in executing coordinate operations. The test package is supported by two documents, a general Guidance Note on the theory of geospatial integrity and GIGS testing (IOGP Report 430-1) and a comprehensive User Guide providing technical procedures for executing the GIGS tests (IOGP Report 430-2, this document).

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Geospatial Integrity of Geoscience Software (GIGS) User Guide

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2.0	November 2021	Major revision
1.0	September 2011	First release

Contents

Introduction

Background

The energy industry makes extensive use of geoscience software that handles spatial data, in support of safely and efficiently exploring for, producing, and storing sources of energy. The number of applications that handle spatial data has grown exponentially in the past decade as widespread digitalization has resulted in a significant increase in the volume, variety and veracity of spatial data being generated and exchanged.

A diverse range of geophysical, wellbore and cultural data are brought into such applications, where they are visualised, processed and exported to other software, shared with other users, and interpreted to form the basis of major operational and business decisions. Such datasets, referred to hereafter as 'geoscience data', are referenced to location in the real world by means of geospatial data. Typically, the geospatial data are in the form of coordinates, together with the coordinate reference system being used and other essential geospatial metadata.

There are thousands of different software packages available for use in the energy industry, as well as dozens of different geodetic engines and libraries. It has been estimated that a typical project will involve over a hundred transactions where data is moved or manipulated. The users of these applications require them to be interoperable, exchanging data as needed and without introducing errors.

If all the geospatial data is complete, consistent, correct, and verifiable, and remains so during any manipulations, then geospatial integrity has been maintained. If geospatial integrity and data quality are compromised, the validity of any decisions made with the geoscience datasets may be compromised.

Failure of the geospatial integrity of geoscience data sometimes can be attributed to a lack of understanding or knowledge of the user managing the data, but in other cases it can be traced to deficiencies or failings in the implementation, configuration or operation of the software.

In 2009 a joint industry project (JIP) sponsored by IOGP was formed in response to significant concern and documented evidence of safety-critical geospatial data integrity failures in geoscience applications. In 2011 the first version of the Geospatial Integrity of Geoscience Software (GIGS) framework was released comprising technical recommendations, a series of software evaluation tests and a supporting set of standard test data. The entire testing package was subsequently revised, updated, and re-released as open source in 2021, with enhancements intended to make the GIGS testing process simpler, more flexible and easier to integrate programmatically.

The GIGS evaluation process is grouped into numbered themes[1], referred to as Series:

- 0000 – Coordinate Reference Systems
- 1000 – General User Documentation
- 2000 – Predefined Geodetic Entities
    - 2100 - Predefined Geodetic Parameter Library
    - 2200 - Predefined Geodetic Data Objects

[1] Note that previous versions of GIGS had a standalone series, 8000, for Error Trapping. In recent released these tests have been embedded in the respective series to which they refer.

- 3000 – User-defined Geodetic Entities
  - 3100 - User-defined Geodetic Parameter Library
  - 3200 - User-defined Geodetic Data Objects
- 4000 – User Interface
- 5000 – Data Operations
  - 5100 – Conversions
  - 5200 – Coordinate Transformations
  - 5300 – 2D Seismic Position Data
  - 5400 – 3D Seismic Position Data
  - 5500 – Surface and Wellbore Deviation Data
- 6000 – Audit Trail
- 7000 – Deprecation

The evaluation process is guided by structured checklists which describe what should be tested within the software (see Section 2 of this document for more detail). For many tests, Test Procedures are required to be undertaken using data from the GIGS Test Dataset (see Section 2 of this document for more detail).

The GIGS Test Dataset consists of a series of files provided in a variety of formats, including industry data exchange formats and ASCII. Each file is designed for a specific GIGS test. The Test Data is in one of three categories:

- Geodetic data definitions, used for Series 2000, Series 3000 and 7000 tests.
- Coordinate operation data, used for Series 5100 and 5200 tests.
- Seismic and wellbore data, used for Series 5300, 5400 and 5500 tests.

There are no Test Data files for the Coordinate Reference Systems (Series 0000) or Documentation (Series 1000). Some User Interface (Series 4000) and Audit Trail (Series 6000) tests utilise Test Data used in the Series 5000 tests. At this time, boundary and cultural data have not been developed for inclusion in the GIGS Test Dataset.

Purpose

This document specifically provides technical guidance on executing a GIGS evaluation with detailed information on undertaking the GIGS Test Series and utilizing the GIGS Test Dataset.

Evaluators undertaking GIGS Test Procedures using the GIGS Test Dataset should refer to Section 2.11, Test Procedures Specific Guidelines, of this document for individual procedural guidance.

The purpose of this User Guide is to provide software developers and users with recommended industry best practice to evaluate the capabilities of a software package with respect to establishing and maintaining geospatial data integrity. The User Guide aims to support the identification of geospatial integrity failures, via execution of the GIGS process, thereby reducing or eliminating incorrect data and results, inconsistent understanding, and misleading information in the user community.

To fulfil this purpose, GIGS comprises several elements, which can be accessed via the GIGS main site (https://gigs.iogp.org):

- GIGS Guidance Note (IOGP Report 430-1), describing the GIGS process
- GIGS User Guide (IOGP Report 430-2, this document), providing specific procedural information on the GIGS Test Series and GIGS Test Dataset[2]
- GIGS Test Series package[3], containing the framework of tests in checklist structure to undertake the evaluation, delivered by online platform or spreadsheet format
- GIGS Test Dataset package[4], comprising a compiled set of data files used for testing algorithms and data exchange capabilities
- GIGS Media Pack, made up of presentation material and engagement content

Scope

This User Guide is intended for wide use by anyone involved with geospatial data, with a focus on the energy industry. It specifically addresses the developers, vendors, and users of geoscience software.

In this User Guide the term 'software' includes any executable code and underlying database (either cloud based or 'on-premise') used in spatial data manipulation, including applications, processing packages and their user interfaces. It also includes software components, such as geodetic computation engines, extensions and libraries.

This User Guide applies especially to the software functions that address spatial data import, creation, manipulation, merging, processing, coordinate operations (including transformations and conversions), visualization, mapping, and export. It is, however, also relevant for existing product maintenance and to new product design, testing and production support.

It does not address raw data processing methods (e.g., wellbore curve calculation methods) though the general principles are still valid; nor does it address the quality of the geoscience datasets themselves. The focus of this User Guide is on the preservation of reference integrity and maintaining the geospatial quality inherent in the original data set.

This document's scope is split into two main sections, with Section 1 pertaining to guidelines on the GIGS Test Series and Section 2 providing guidelines on the GIGS Test Dataset. Ideally, the User Guide content should be taken in totality, but specific sections can also be used for quick reference. It is recommended that the scope and content of IOGP Report 430-1 – *Geospatial Integrity of Geoscience Software (GIGS) – Guidance Note* (companion to this document) is understood before considering this document.

[2] Previously GIGS comprised 3 Guidance Notes (430-1, 430-2 and 430-3), however due to the creation of the online platform, 430-2 and 430-3 have been consolidated and merged.

[3] Previously this was released as "430-2a", but due to the now web-based delivery the numbering has been dropped

[4] Previously this was released as "430-3a", but due to the now web-based delivery the numbering has been dropped

1. GIGS Test Series User Guide

1.1 Overview

The GIGS Test Series is grouped into themes that pertain to different aspects of software functionality and capability, as defined below. IOGP Guidance Note 430-1 covers the background of the themes in more detail.

GIGS Test Series #	GIGS Test Series Name	This series examines
0000	Coordinate Reference Systems	The association of geodetic metadata to coordinates, and general aspects of geodetic integrity of the application
1000	General User Documentation	Overview documentation, release notes and knowledge bases relating to the geospatial aspect of the application
2100	Predefined Geodetic Parameter Library	The configuration and functionality of the reference library within the geodetic engine of the application
2200	Predefined Geodetic Data Objects	The range and accuracy of the reference geodetic data objects supported within the geodetic engine of the application
3100	User-defined Geodetic Parameter Library	The configuration and functionality of the user-defined library within the geodetic engine of the application
3200	User-defined Geodetic Data Objects	The range and accuracy of the user-defined geodetic data objects supported within the geodetic engine of the application
4000	User Interface	The nomenclature, user-oriented nature and accuracy of information of the UI for geospatial aspects of the application
5100	Data Operations (Conversions)	The range and accuracy of coordinate operations, specifically map projections, supported within the application
5200	Data Operations (Coordinate Transformations)	The range and accuracy of coordinate operations, specifically coordinate transformations, supported within the application
5300	Data Operations (2D Seismic Position Data)	The range and accuracy of coordinate operations and data manipulations pertaining to 2D seismic position data supported within the application
5400	Data Operations (3D Seismic Position Data)	The range and accuracy of coordinate operations and data manipulations pertaining to 3D seismic position data supported within the application
5500	Data Operations (Surface and Wellbore Deviation Data)	The range and accuracy of coordinate operations and data manipulations pertaining to wellbore data supported within the application
6000	Audit Trail	The audit trail for coordinate and data operations carried out within the geodetic engine of the application
7000	Deprecation	The deprecation of algorithms and files within the geodetic engine of the application

Figure 1: GIGS Test Series, at time of publication

Within each Test Series several tests are presented - typically between 10 and 20 individual tests per series. These tests refer to a specific element of functionality or capability being evaluated.

Associated with every test are several response criteria that correspond with a GIGS Level (see Section 1.2). For each relevant test, the Evaluator should select the criterion that describes the conditions most closely aligned with the application being tested.

In some cases, a test may be associated with a Test Procedure utilising the Test Dataset (see Section 2.11).

Tests are numbered sequentially and, where relevant, sub-numbered if multiple tests pertain to one particular piece of functionality (i.e., 1.1, 1.2, 1.3).

Each test has a "banner" indicating the test subject as well as, where relevant, a tooltip containing notes, applicable to that Test Series. The tooltip help can be opened by the "i" icon in the online platform or by opening the cell comment pop-up in the offline spreadsheet.

The GIGS Test Series is provided in both online and offline formats, as an online platform and spreadsheet respectively. The online platform offers enhanced functionality for storing and calculating results and managing evaluation details, however the Test Series content is identical in both the online and offline versions. Hence, the same result is derived using either system. Nonetheless, it is strongly recommended that the online platform is used where possible, and this document refers primarily to operation of the online platform.

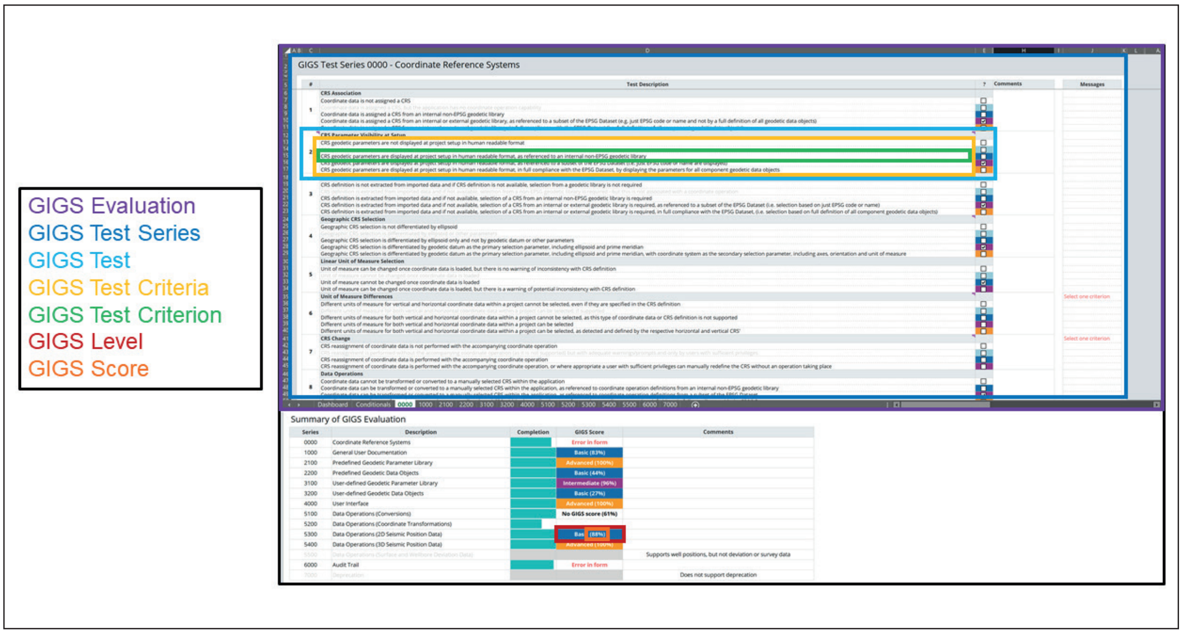


Figure 2: GIGS 'offline' spreadsheet term definitions

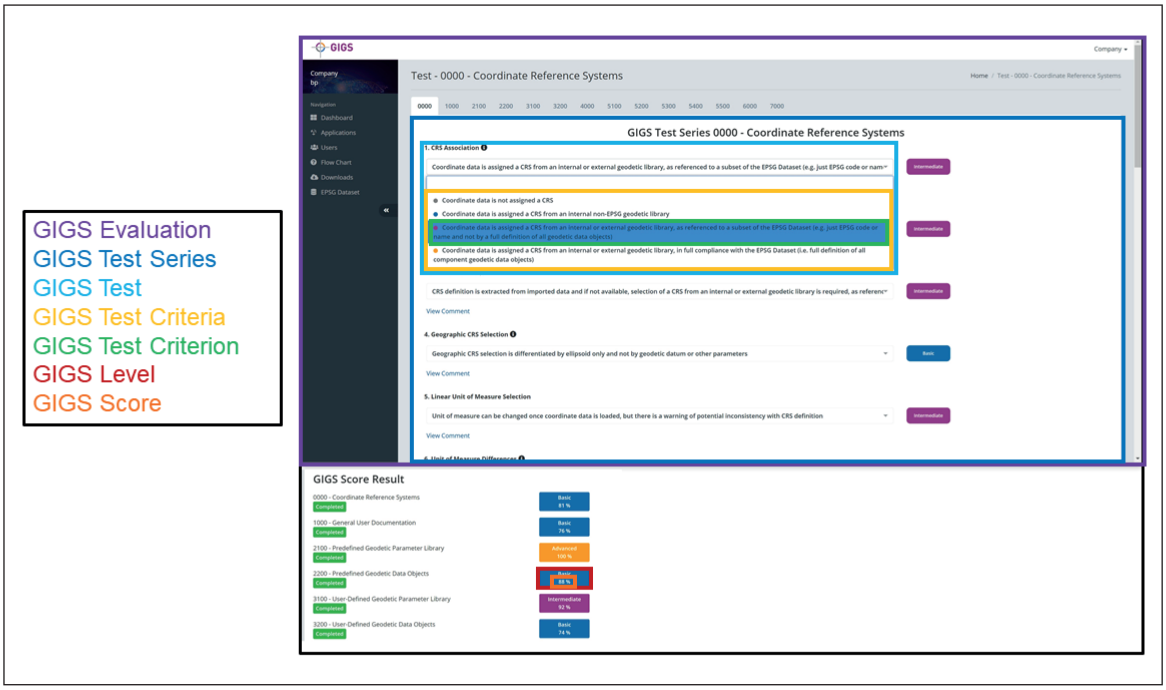


Figure 3: GIGS 'online' web portal term definitions

1.2 Scoring

The outcome of a GIGS evaluation is the identification of functionality and capability within an application that either enables or compromises geospatial data integrity. To facilitate systematic evaluation and comparison, the GIGS Test Series results are presented as GIGS Scores (alongside contextual evidence and findings). The GIGS Score comprises a GIGS Level and a percentage score within each level.

See 430-1 for a full description of scoring and associated definitions of geospatial integrity, however the basic principles are outlined below.

The GIGS Levels (and associated colour indicators) are:

Table 1: GIGS Level definitions

No GIGS Score	directly compromises geospatial integrity
Elementary	no capability to perform coordinate operations, but maintains geospatial integrity
Basic	limited capability to perform coordinate operations, establishes and maintains geospatial integrity
Intermediate	extensive capability to perform coordinate operations and establishes and maintains geospatial integrity to a fully satisfactory degree
Advanced	complete capability to perform coordinate operations with additional features to reduce possibility of compromising geospatial integrity

Each criterion in the Test Series is associated with a particular GIGS Level, depending on how it aligns with the definitions of geospatial data integrity. For example, it can be said that a certain software function is deemed to be of "Intermediate level" (see IOGP Report 430-1 for further detail).

For the GIGS Level, a percentage score is assigned, to give further indication of the software functionality, indicating how the application performs for that level. The GIGS Score assigned to each Series is the lowest level that has been identified in all the tests. A GIGS Score is assigned for each Series rather than calculating a single total score for the entire application, however a sum of all scores can be derived if required.

In the online platform, GIGS Scores can be found in the Application Details for each Test Series. In the offline spreadsheet these can be found at the footer of each Test Series tab, and in the Dashboard Tab (once the Series is marked as "complete"). The scoring calculation algorithm is embedded in source code of the online and offline Test Series; and can be made available on request.

1.2.1 Elementary Level

Elementary level tests do not follow the process described above, as they apply to software without coordinate operation capability, which therefore cannot be assessed against the geospatial data integrity definitions associated with Basic, Intermediate and Advanced capability levels.

Nonetheless, geospatial integrity is still relevant for software that has no functionality to perform coordinate operations. For example, an application may not have a geodetic engine in order to perform transformations or conversions, but it may still include functionality to load, visualize, manipulate and export geospatial data in different CRSs referenced to an internal/external library of geodetic parameters, and therefore would need to be assessed.

Therefore, provision is made in the GIGS framework for such software to be evaluated using a different set of criteria than those for "standard" applications.

Such software can only attain the Elementary level of geospatial integrity (or 'No GIGS Score'). Evaluators assessing this type of software should ensure that the Condition Test A (see Section 1.5.1) is set to "No". Thereafter, all Basic, Intermediate and Advanced tests will be disabled.

In the offline spreadsheet, if Elementary tests are disabled then they are greyed out and should be ignored (note that the text may still be visible but should not be considered in any tests).

1.3 GIGS Test Series Process

It is recommended that Evaluators should use the online platform version of the GIGS Test Series due to its numerous advantages in tracking and recording evaluation progress, as well as enhanced functionality for report generation and user management. The following guidelines focus mainly on the online platform, although the same principles apply to the offline spreadsheet version. Note that this section does not advise on the strategy of planning and executing a GIGS review - see IOGP Report 430-1 for further detail. It is assumed at this stage that all software and hardware elements/licenses/source code are in place and suitable resources have been provisioned.

The following workflow is recommended for completing the Test Series:

1) Collate application details including organization, version number, testing date.
2) Assign evaluation personnel including product administrator and Evaluators.
3) Complete application Conditional tests to identify relevant tests.
4) Identify application geographic area of use/applicability to further refine relevant test elements.
5) Complete relevant Test Series in sequential order, beginning at 0000, alongside undertaking GIGS Test Procedures (see Section 2.11).
6) Collate and record supporting evidence.
7) Generate GIGS scores and identify any tests for immediate re-evaluation.
8) Generate summary report.
9) Write full report and issue conclusions/recommendations.

1.3.1 Populating Test Series Checklists

The general principle in populating the Test Series checklists is that the Evaluator should select the test criterion that corresponds most closely with the application being tested, considering the subject of the test.

Criteria for each test are structured to allow for methodical and logical assessment of the responses. Generally, the criteria are structured as:

{data/object} is/is not supported and/or {application} does/does not do {function}

The assignment of a criterion to a particular GIGS Level corresponds with the associated definitions of geospatial integrity for that particular subject and classification (see Section 1.2), and further indicates how the functionality has been implemented:

- No GIGS Score – functionality is supported but implemented in a way that causes failure of geospatial data integrity.
- Elementary – functionality supported and accurate but does not correspond with a coordinate operation.
- Basic – functionality is part-supported or not supported.
- Intermediate – functionality is supported and is accurate.
- Advanced – functionality is supported and is accurate, with additional functionality.

Note that every test may not have the full range of criteria levels (Basic, Intermediate, Advanced), for example some tests may refer only to Intermediate or Advanced functionality. However, all tests will have the possibility of No GIGS Score, to account for any identified failures in geospatial integrity.

In the offline spreadsheet, criteria selection is made by tick box. In the online platform selection is made by selecting the criterion from a drop-down menu. Criteria are colour-coded based on the respective level colour, as outlined in Section 1.2.

Only one criterion may be selected for each test. If there is not a criterion that directly matches the software functionality, then the closest should be selected and a comment made.

An exception to the above is the 2200 (Predefined Geodetic Data Objects) and 3200 (User-Defined Geodetic Data Objects) Test Series (see Section 1.5.5 and 1.5.7). These tests require the completion of matrix style criteria, in which multiple Boolean Yes/No selections should be made per test.

Compliance with lower-level classification levels is required in any of the levels. For example, if an Intermediate criterion is appropriate for a particular test, then fulfilment of the requirements for the Basic level is implied. If that is not the case, the Evaluator should qualify the response in the comments.

It is highly recommended that supporting comments and evidence are attached to each test, relating to the subject matter being evaluated. This could be clarifying notes, screenshots or even calculation results. In the online platform there is a "WSIWYG" editor embedded alongside each test where rich media or text can be entered and stored. In the offline spreadsheet a comment field is provided alongside each row.

Depending on the response to the Conditional tests (see Section 1.5.1), a number of Test Series may be disabled as they will not pertain to the particular application being tested. For example, if the Evaluator responds "No" to the Conditional test "Does the application support surface and wellbore deviation data?", then Test Series 5500 will be disabled. For Elementary applications, all Basic, Intermediate and Advanced tests will be disabled. In the online platform any disabled tests will not be visible to the user, however in the offline spreadsheet a grey hash will be applied to disabled tests and an error presented if one is selected.

All applicable tests should be completed in order to mark the evaluation as complete and to generate the final GIGS score for each test. Error messages will be displayed alongside any tests that have been missed or answered in error.

1.4 Flowchart and Test Correlations

A small proportion of tests are highly correlated with other tests either in the same series, or sometimes in other series. In the online portal these correlations are referred to in the tooltip, and in the offline spreadsheet they are indicated by comment callouts on the test number cell. The correlation indicators denote which tests are highly correlated, and it is strongly recommended that the selected criteria for all correlated tests should be assessed in unison to ensure agreement between respective tests.

Additionally, a comprehensive flowchart of the Test Series architecture is provided as an offline graphML file or via the Flowchart page on the online portal.

1.5 Test Series General Guidelines

The following sections contain general guidelines and key points to note for each Test Series.

1.5.1 Conditionals

The Conditional Tests are the first element of the Test Series addressed. In the online portal they are presented to the Evaluator once an application to be evaluated has been set up. In the offline spreadsheet these tests are contained within the Conditionals tab.

The Conditionals determine which tests are to be undertaken for a particular evaluation. Depending on the response, certain Test Series or individual tests may be disabled and removed from the evaluation scoring calculations.

The primary, and first Conditional to address is whether the application has "capability to perform coordinate operations?". If "No" is selected then the application is deemed to be Elementary in nature and all Basic/Intermediate/Advanced tests are disabled, along with certain entire Test Series.

The other Conditionals address specific aspects of functionality, such as whether the application supports seismic data or whether it has a user interface.

Adjacent to each Conditional test is a message displaying which Test Series are enabled/disabled according to how the Conditionals are answered.

The Conditionals selection can be changed at any point in an evaluation if application functionality changes; however any entries made to tests that are subsequently disabled will be locked. They can be unlocked by reversing the Conditional response.

It is important to answer the Conditional tests as accurately as possible early in the testing process, to ensure a relevant and complete consideration of applicable tests is made.

1.5.2 0000 Coordinate Reference Systems

This Test Series addresses general aspects of geospatial integrity, specifically behaviour of the software with respect to the association of a valid CRS to coordinates. The spatial data concerned primarily includes seismic and wellbore data but could be applied to any geospatial data type.

In some tests the terms 'unspecified CRSs', '<null CRS>' or 'invalid CRSs' may be presented. The first two terms refer to situations where no CRS information is associated with a spatial data file, and the latter to instances where incomplete or (partially) incorrect information is provided on the CRS.

1.5.3 1000 General User Documentation

This Test Series refers to the consistency and coverage of the overview documentation and release notes of the software that are related to geospatial/geodetic functionality. Tests referring to specific subjects are embedded in the respective Test Series relating to that subject.

1.5.4 2100 Predefined Geodetic Parameter Library

This Test Series evaluates the functionality and configuration of the geodetic parameter library that comes with the software. Tests concern the source and reference of the library, how it is accessed, and version controlled.

1.5.5 2200 Predefined Geodetic Data Objects

This Test Series assesses the geodetic data objects within the predefined geodetic parameter library, in respect of completeness, correctness, and consistency. The structure of these tests is such that the criteria responses are presented in matrix form, indicating that for each test a response for every geodetic data object should be selected.

Test Procedures are required as part of this Test Series, referencing the 22XX GIGS Test Dataset files (see Section 2.11.1)

1.5.6 3100 User-defined Geodetic Parameter Library

This Test Series evaluates the functionality and configuration of the user-defined geodetic parameter library that allows users to define and utilise entities that are not part of the predefined library. Tests concern the source and reference of the library and how it is created, updated, managed and accessed.

1.5.7 3200 User-defined Geodetic Data Objects

This Test Series assesses the geodetic data objects within the user-defined geodetic parameter library, in respect of completeness, correctness and consistency. The structure of these tests is such that the criteria responses are presented in matrix form, indicating that for each test a response for every geodetic data object should be selected.

Test Procedures are required as part of this Test Series, referencing the 32XX GIGS Test Dataset files (see Section 2.11.2)

1.5.8 4000 User Interface

This Test Series contains several general tests regarding the user interface, including the display and representation of geospatial information and geodetic parameters. Most other User Interface aspects are embedded in the other Test Series, as they specifically apply to the subject matter of that Test Series.

1.5.9 5100 Data Operations (Conversions)

This Test Series deals with software capability for coordinate operations, specifically conversions, including support and implementation of a range of different map projection algorithms/formulae, as well as how conversions are integrated in data workflows.

Conversions of particular interest to the energy industry are included in the test series, however if additional conversions are supported in the application, then it is up to the Evaluator to define and execute additional tests and Test Data (can potentially be sourced from other geodetic testing packages). Evaluator discretion should be used as to how many additional tests are implemented.

Test Procedures are required as part of this Test Series, referencing the 51XX GIGS Test Dataset files (see Section 2.11.3).

1.5.10 5200 Data Operations (Coordinate Transformations)

This Test Series deals with software capability for coordinate operations, specifically, coordinate transformations, including support and implementation of a range of different transformation methods, as well as how transformations are integrated in data workflows.

Coordinate transformation methods of particular interest to the energy industry are included in the Test Series, however if additional transformations are supported in the application, then it is up to the Evaluator to define and execute additional Test Data and tests (which potentially can be sourced from other geodetic testing packages). Evaluator discretion should be used as to how many additional tests are implemented.

Test Procedures are required as part of this Test Series, referencing the 52XX GIGS Test Dataset files (see Section 2.11.4)

1.5.11 5300 Data Operations (2D Seismic Position Data)

This Test Series assesses how software handles 2D seismic position data in terms of project configurations and coordinate operations on data import, transfer, and export. Due to the length of the tests in this series, the tests are grouped under subject-related headings, but this should not change the order of test completion.

Test Procedures are required as part of this Test Series, referencing the 53XX GIGS Test Dataset files (see Section 2.11.5)

The series is intended to be undertaken utilising industry standard data exchange formats (P1/XX, SEG-Y), however if none of these formats is supported, then the ASCII equivalent can be used. If multiple formats are supported in the software, then each test should be repeated for all format types and any discrepancies in behaviour between the different formats should be noted in the test comments.

Note that there are several Conditional tests (see Section 1.5.1) that determine which specific 2D seismic position data formats require tests.

1.5.12 5400 Data Operations (3D Seismic Position Data)

This Test Series assesses how software handles 3D seismic position data in terms of project configurations and coordinate operations on data import, transfer and export. Due to the length of the tests in this series, the tests are grouped under subject-related headings, but this should not change the order of test completion.

Test Procedures are required as part of this Test Series, referencing the 54XX GIGS Test Dataset files (see Section 2.11.6).

The series is intended to be undertaken utilising industry standard data exchange formats (P1/XX, P6/XX, SEG-Y), however if none of these formats is supported then the ASCII equivalent can be used. If multiple formats are supported in the software, then each test should be repeated for all format types and any discrepancies in behaviour between the different formats should be noted in the test comments.

Note that there are several Conditional tests (see Section 1.5.1) that determine which specific 3D seismic position data formats require tests.

1.5.13 5500 Data Operations (Surface and Wellbore Deviation Data)

This Test Series assesses how software handles wellbore deviation data in terms of project configurations and coordinate operations on data import, transfer and export. Due to the length of the tests in this series, the tests are grouped under subject-related headings, but this should not change the order of test completion.

Test Procedures are required as part of this Test Series, referencing the 55XX GIGS Test Dataset files (see Section 2.11.7).

The series is intended to be undertaken utilising industry standard data exchange formats (P7/XX), however if none of these formats is supported then the ASCII equivalent can be used. If multiple formats are supported in the software, then each test should be repeated for all format types and any discrepancies in behaviour between the different formats should be noted in the test comments.

Note that there are several Conditional tests (see Section 1.5.1) that determine which formats require tests.

In this Test Series a distinction is made between a well path and a wellbore survey. Various alternative terms are in use in the industry, but no standard exists, and the terms proposed in these Guidelines do not constitute a proposal for such standardization. The IOGP Report 483-7u – *P7/17 Wellbore Positioning Data Exchange User Guide* provides further clarification on surface and wellbore deviation terms.

In the context of GIGS, the term wellbore survey data refers to the raw measurement data of Measured Depth (MD), azimuth (AZ) and inclination (INC), that have been gathered in a wellbore survey. The term 'well path' refers to the collection of coordinates of identified points along the wellbore, calculated from the wellbore survey data, using one of the algorithms in use in the industry, such as the minimum curvature method[5] or the LMP method[6]. The GIGS Test Dataset is derived using LMP, if an application does not support this curve calculation method then it is acceptable to modify the Test Data so it can be sufficiently imported and processed.

[5] Sawaryn, S.J. and Tulceanu, M.A. "A Compendium for Directional Calculations Based on the Minimum Curvature Method: Part 2." SPE-110014-MS *Society of Petroleum Engineers Annual Technical Conference and Exhibition,* Anaheim, USA, 11-14 November 2007.

[6] Zinn, "N.D. Accounting for Earth Curvature in Directional Drilling." SPE-96813-MS. *Society of Petroleum Engineers Annual Technical Conference and Exhibition*, Dallas, USA, 9-12 November 2005.

1.5.14 6000 Audit Trail

This Test Series deals with software capability for audit trail generation, configuration and access. The term "auxiliary metadata" is used to refer to metadata that is populated in respect of each data operation executed (i.e., create, import, merge, and data processing through to transfer and export). Some software may capture auxiliary metadata but not capture that in an audit trail. Several tests specifically address this scenario.

1.5.15 7000 Deprecation

This Test Series deals with software capability for the deprecation of geodetic data objects, both for predefined and user-defined entities. Deprecation is not a widely supported function in most software so this series may be omitted in those cases.

Test Procedures are required as part of this Test Series, referencing the 7XXX GIGS Test Dataset file (see Section 2.11.8).

1.5.16 Error Trapping

In previous versions of GIGS, a dedicated Test Series 8000 was defined for Error Trapping functionality. As it is expected that all software will include some error trapping mechanisms, and they will be specific to a particular data theme, the error trapping tests are now embedded in the relevant Test Series to which they are related (for example, Error Trapping tests pertaining to wellbore data are included in Series 5500).

The error trapping tests described in the Test Series aim to capture software behaviour regarding geospatial integrity. In the tests, distinction is made between the following software responses:

- Warning flag (or message) - a message to the User indicating that geospatial integrity may fail unless preventive actions are taken.
- Error flag (or message) - a message to the User indicating that geospatial integrity will fail; the software allows the User to proceed.
- Strong error flag (or message) - a message to the User indicating an imminent serious failure of geospatial integrity; the software blocks the intended action.

2. GIGS Test Dataset User Guide

2.1 Overview

The GIGS Test Dataset provides source data for geodetic DDT (data-driven testing) in order to quantitatively evaluate software capability with respect to maintaining geospatial data integrity. In addition to the qualitative unit and integration tests that the GIGS Test Series provides, the GIGS Test Dataset provides a robust method of numerically validating the architecture, implementation and accuracy of an application's geodetic computation engine and library, thereby identifying potential causes of any failures in geospatial data integrity.

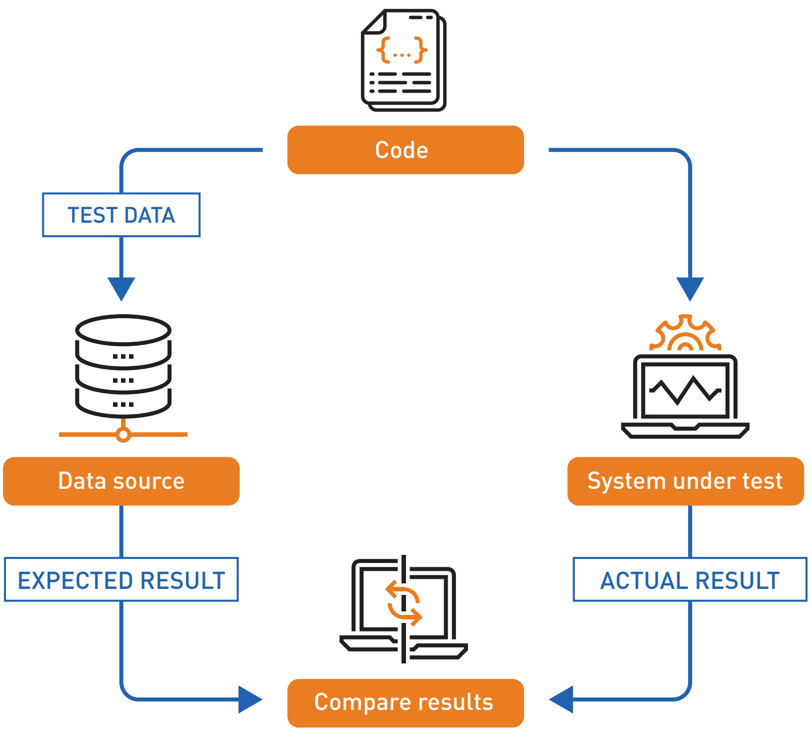


Figure 4: Test driven development testing cycles

The GIGS Test Dataset is associated with certain tests within the Test Series and is only provisioned for some of the Series, including:

- 2200 – Predefined Geodetic Data Objects Test Data
- 3200 – User-defined Geodetic Data Objects Test Data
- 5100 – Conversion Test Data
- 5200 – Coordinate transformation Test Data
- 5300 – 2D seismic Test Data
- 5400 – 3D seismic Test Data
- 5500 – Wells Test Data
- 7000 – Deprecation Test Data

The GIGS Test Dataset comprises different data, depending on the nature of the associated tests:

- Geodetic data definitions (Series 2200, 3200, 7000) – contains lists of entities and parameters that either should be created or checked.
- Coordinate operation data (Series 5100, 5200) – contains coordinate data to be converted or transformed, both forward and reverse.
- Seismic and wellbore data (Series 5300, 5400, 5500) – contains coordinate data and seismic/well attributes to be converted or transformed.

The GIGS Test Dataset Test Procedures (hereafter referred to as "Test Procedures") correspond with the groupings in the GIGS Test Series (see Section 1.5) and are numbered accordingly. Each Test Procedure has a unique number that corresponds with the relevant Test Series (for example *Test Procedure 5101* is in the *5100 Test Series, Test 1.1*).

GIGS Test Procedures have a defined set of results and tolerances that should be achieved and are therefore deemed to deliver a Boolean pass or fail outcome. If a Test Procedure result is 'Pass' then the respective Test (in the Test Series) is passed, and vice versa for 'Fail'. For example, if the output of Test Procedure 5101 matches the expected results, then Test 5100_1.1 would be passed, achieving an Intermediate level (see Section 1.2.). The failure of a Test Procedure results in a No GIGS Score level being assigned to the test in the Test Series, as it indicates a failure in geodetic data integrity has occurred.

The majority of ASCII Test Data files are separated into input and output files per Test Procedure (indicated by an "_input" or "_output" suffix). Therefore, in most cases there is a one-to-one file relationship for each Test Procedure, whereby the Evaluator loads data into the application from the input file, then compares the results with the data in the output file. Where multiple similar routines are to be run for a particular Test Procedure, but different parameters are required (e.g., for a different CRS), the Test Dataset files are split further into separate parts, indicated by a "_part{n}" suffix. It is also possible in most cases to only use the "_output" file if desired which contains the minimum amount of information to undertake a Test Procedure (see Section 2.4). Associated P-format files are not split into separate inputs and outputs.

In the input files, the values that are to be loaded into the application will be populated, and the attributes expected to be calculated will typically be marked as NULL (with the exception of where a geodetic parameter field is unpopulated). In the output files, all attributes will be populated including the input values (for reference) and expected output values. In this regard, it is possible that only the output file could be used in most Test Procedures (as it is a single file containing both the input and output values, with some exceptions). In some evaluation routines, however, it may be undesirable to "reveal the answers" prior to the calculations/operations being undertaken. This is down to Evaluator preference.

The GIGS Test Dataset is referenced to a combination of EPSG authority geodetic data objects (such as CRS) and synthetic entities that have been generated for GIGS testing purposes. This means that the Test Dataset corresponds with the EPSG Dataset version valid at the time of publication (indicated in the Test Data headers). A new GIGS Test Dataset version is not released every time a new EPSG Dataset version is, hence, Evaluators are recommended always to consult the latest EPSG Dataset (https://www.epsg.org) if any discrepancies arise in the Test Procedures.

2.2 Test Dataset Access

The GIGS Test Dataset is open source and issued under the GIGS and EPSG terms of use (see https://gigs.iogp.org).

The GIGS Test Dataset is available for download from the IOGP GIGS website as a zipped package or individual files, containing various nested folders grouped for each Test Series. The Test Data files are indexed in Appendix A.

2.3 Test Dataset Formats

The Test Dataset files are offered in a number of formats:

- ASCII base class[7] (.txt) – All series
- P1/11 subclass[8] (.p111) – Series 5100, 5200, 5300, 5400
- P1/90 subtype[9] (.p190) –Series 5300, 5400
- P6/98 subtype (.p698) – Series 5400
- P6/11 subtype (.p611) – Series 5400
- P7/2000 subtype (.p700) – Series 5500
- P7/17 subtype (.p717) – Series 5500

The Evaluator may choose to generate a different format from the ASCII base class for use in a particular application, this may include one of the following file types, but these are not supplied by IOGP and are therefore not controlled:

- WKT2 subclass (.wkt)
- Excel subclass[10] (.xlsx)
- XML subclass (.xml)

The ASCII base class contains all Test Data content in its simplest form. The intention is that these files provide the reference source code for all other Test Dataset files. These are the files primarily maintained by the GIGS authors. All other subclasses and subtypes are derived from the ASCII base class.

The tab-delimited ASCII format is offered as a base class as it is simple, universally consumable and platform agnostic. This data format can be integrated into whichever language/workflow is required for the application being tested. The file contents can be converted easily and programmatically to XML, JSON, Python or any other machine language format as required.

The P-format subtypes are generated in the format according to the respective standard (see associated IOGP reports on Format and User Guide). Generally, where tests involve the use of PX/XX industry standard exchange formats, the strong preference is to utilise the P files where supported (as opposed to defaulting to ASCII), however in terms of GIGS Test

[7] Base class refers to file in which all other classes are derived

[8] Subclass refers to secondary file type inherited from the base class. Note there are a small number of Test Data files that cannot be supplied in P1/11 format due to structure/content restrictions. See specific notes in Section 2.11.

[9] Subtype refers to a limited subordinate file type, i.e., this format only applies to a small number of Test Data files

[10] See Appendix F for advice on generating Excel Test Dataset files

Dataset derivation, the ASCII files remain the "master copy". The P-format files contain more explicit definitions of geodetic parameters due to the Common Header and are superior to other classes where Test Data is to be imported, transferred, or exported using an industry standard data exchange format.

Previous versions of P-formats are offered as it is recognized that some applications may not support newer formats, and it is important to be able to test legacy data workflows. However, it is strongly recommended that primary testing should be undertaken using the latest versions of the P-format files (see https://www.iogp.org/geomatics/). If the software supports P-formats, there is no requirement to repeat Test Procedures using the ASCII data, unless so desired. Due to the legacy nature of the older P-format files and inconsistencies in how the format has been subsequently adapted and adopted, the construct of the Test Dataset legacy files may not be exactly conformant with what an application is expecting. Therefore, modifications may need to be made by the Evaluator to ensure the legacy files can be correctly exchanged.

The P1/11 subclass is offered as an alternative format for ingesting most Test Data, not just those Test Procedures that explicitly involve seismic position data. The P1-format is suited well to the GIGS Test Procedures in that it explicitly defines geodetic parameters in the header and is flexible in storing point data. There is no requirement however for the Evaluator to use the P1/11 subclass files if not desired. Note that for most Test Procedures the P1/11 files are provided as single files (i.e., there are no input/output P1/11 files) due to the structure of the P-Format and the fact that the output file contains all necessary information to complete each Test Procedure (see Section 2.4 for further detail) – the exception being the 5400 Test Procedures, due to the nature of these Tests. If using the P1/11 subclass then note that the information on Test Dataset files in Section 2.11 will be invalid where "_input" files are referred to – instead use only the single file.

Note that for the P-format files, the file extension suffix is set to the vintage of P-format version (e.g., .p717). If the software being tested only accepts the shortened P-format file extension (e.g., .p7) then it is admissible to change all suffixes to ensure the files can be read.

2.4 Test Dataset Construct

The following description details the construction of the ASCII base class. See the respective IOGP format documentation for detailed information on how the P-format files are constructed (see https://www.iogp.org/geomatics/).

The ASCII files comprise a 1D vertical array header (outlined in Section 2.4.1) followed by a 2D array of data (i.e., a single column header above a multi column/row data table). The 2D data array consists of the data that is required for the particular test subject and typically contains either a list of geodetic parameters, or a list of coordinates and associated attributes.

The data array usually comprises a mixture of integer, float and string values, however (within the ASCII files) there is no associated schema that defines field types. At the base class level it is preferable to treat all values as strings (text), in order to ensure that numeric representations are preserved as they are stored (see Section 2.5.1). This is particularly important for those values derived from the EPSG Dataset. If required, the ASCII values can be cast to float, but ensuring the correct base is used.

Additionally, within the data array there may be attributes that are purposefully not populated (for example, in an input file where part of a row of data is to be calculated). For numeric fields these would typically appear as NULL, whereas for text fields these would appear as empty strings (""). Note that there are many instances in the data array where "0" is a valid value and does not pertain to either NULL or an empty string.

For coordinate operation Test Data (transformation and conversion), each coordinate tuple is assigned a test point ID (field: "Point") in the form: *GIGS-{test number}-{n}*, in order to make it easier to identify and load the point data. Additionally, a transect ID (field: "Transect") is assigned a letter (A, B, C, etc.) that identifies groups of points into linear transects that corresponds with the different latitudinal/longitudinal transects on which the Test Data have been defined. Finally, a coordinate operation direction field is provided (either field: "Conversion Direction" or "Transformation Direction") in the form: FORWARD or REVERSE, to indicate in which direction the calculation operation is expected to be undertaken for each data point. There are other auxiliary fields that sometimes appear in Test Data (for example, identifying points that are out of bounds and should therefore fail). These are typically represented by Boolean (TRUE, FALSE) values. These fields are not included in the P-Format files, instead Conversion/Transformation Direction is indicated in the record identifier (e.g., HC,1,8,2 – see respective IOGP P-Format definitions for further information).

Note that for coordinate operation Test Data, it is entirely feasible to only use the "_output" files in undertaking testing, particularly where Test Procedures are being implemented automatically/programmatically. This is because the output files contain the complete set of results, as well as input data, and operation information such as conversion direction and test result tolerance. Using only the output files does provide the "answers" up front, hence Evaluators may wish to still separate out the files, however the output files should provide all required information for scripting the Test Procedures (primarily for Series 5100 and 5200 – 5300, 5400 and 5500 may still require the usage of input and output files depending on the software configuration).

The seismic and wellbore test coordinate data are supplemented with additional identifying attributes to assist in loading and categorizing test points. For 2D seismic Test Data, line ID (field: "Line") is provided in the form: GIGS-{test number}-{n} as well as a shotpoint ID (field: "SP") in the form {n}, and usually increasing in intervals of 10.

For wellbore data, a vertical point ID (field: "Point") is added to appropriate data points to assist in the identification of key references along the wellbore. IDs include RT (Rotary Table), KB (Kelly Bushing), WRP (Well Reference Point), VRD (Vertical Reference Datum), Ground Level, MSL (Mean Sea Level), Horizons, TD (Total Depth) and others (see P7 User Guide).

2.4.1 ASCII File Header Definition

The ASCII data files have a header that was developed natively for the GIGS Test Dataset in order to present the Evaluator with the minimum amount of required information in the simplest format possible. See the respective P-format documentation for Common Header definitions of the P-format files.

The ASCII header comprises hashed[11] non-executable "metadata" that describes data content, in the format defined below:

 # File: {file name}
 # GIGS Test Procedure: {test number}
 # GIGS Test Dataset Version: {gigs version number}
 # EPSG Dataset Version: {epsg dataset version number}
 # GIGS Test Dataset Issue Date: {gigs version issue date}
 # Note[12]: {text}
 # Cartesian Tolerance[13]: {text}
 # Geographic Tolerance[13]: {text}
 # Round Trip Cartesian Tolerance[14]: {text}
 # Round Trip Geographic Tolerance[14]: {text}
#
 # Fields:
 # [0]: {field 0 name}
 # [1]: {field 1 name}
 # [2]: {field 2 name}
 # [n]: {field n name}
#
 # [0]   # [1]   # [2]   # [n]
{field 0 data}   {field 1 data}   {field 2 data}   {field n data}

The first vertical 1D block of attributes provide identifying details about the file including, its name and associated test number, followed by the version of GIGS that the file was released under, and the version of the EPSG Dataset from which the data was derived.

The second vertical 1D block of attributes contains the field descriptors that define the field name and associated parameters, where appropriate. When a field contains coordinates, the field descriptor contains information about the CRS of the coordinate data, typically in format: *{field name} ({gigs crs code}; {gigs crs name}; {epsg crs name}; {crs unit}; {epsg crs code})*

The third block of attributes is a horizontal 1D field header that "maps" the column numbers in the data array to the respective field definitions in the second block. These column numbers have an additional function of casting all data array values as strings when the ASCII data is ingested in a spreadsheet program (see Section 2.4.2).

Note that although the header is a standard format it does not necessarily rely on a defined number of byte locations per line, hence any interpretation program should use tags/string identifiers, rather than byte counters.

[11] A.k.a octothorpe, number sign, pound sign

[12] Not all Test Dataset files contain a Note in the header, hence caution is advised when reading the header based solely on the line number, as these could differ. There may also be multiple Note records

[13] Not all Test Dataset files contain a Cartesian or Geographic Tolerance, mainly those in the 5000 Test Series'. These values state the pass/fail tolerance from the input Test Data and results from the application being tested

[14] Not all Test Dataset files contain a Round Trip Tolerances, mainly those in the 5100/5200 Test Series. These values state the pass/fail tolerance from the input Test Data and results from the application being tested

2.4.2 CAUTION: Reading Test Dataset in Excel

Extreme caution should be exercised when opening the ASCII Test Dataset files in Microsoft Excel or other spreadsheet applications, due to the risk of truncating values with 16 (or more) significant figures. Excel can store numbers to 15 digits of precision, as per the IEE 754 specification[15], which means that very small or very large floating point numbers may be rounded or truncated. A small portion of the GIGS Test Dataset parameters (such as ellipsoid axes values) exceed this number of digits and hence are not correctly represented when read in Excel.

Many of the GIGS Test Dataset parameters are referenced directly to the EPSG Dataset which stores floating points numbers at full precision. In order to ensure full storage precision is maintained, it is recommended that the ASCII data array is interpreted as a string value, and automatic number interpretation is not applied.

Excel has a further idiosyncrasy when loading text files in that numbers and strings are presented as fixed column widths in a workbook, which if the file is then saved, only the data that is visible will be preserved.

Therefore, if the Evaluator wishes to use the Test Dataset in Excel format, it is recommended that a controlled method of loading the data is followed (see Appendix F). This circumvents some of the Excel ingestion issues that are encountered when the ASCII files are either 'drag-and-dropped' into a workbook, or opened in Excel using "Open with" function.

Note it may be required to manipulate the header slightly for ease of use in Excel. The horizontal field header numbers can also be supplemented with the Field names to allow for easy identification of columns. The hash header may also be filtered out for ease of sorting, however this can be restabilised by adjusting the filter. See Appendix F for complete instruction on the Excel process.

2.5 Test Dataset Numeric Precision and Representation

2.5.1 Precision of Geodetic Parameters

The precision of the geodetic parameters for defining all coordinate operations (coordinate transformations, conversions) in the GIGS Test Dataset is identical to that in the same defining parameters within the EPSG Dataset (i.e., equivalent number of significant figures).

Key portions of the GIGS Test Procedures require that Evaluators verify that the precision of the above parameters, as stored and utilised in the software, are at least as high as that for the corresponding parameters stored within the EPSG Dataset. This is tested in two scenarios:

- For the software's predefined geodetic library, the parameter precision for those coordinate operations are examined against the EPSG Dataset for conformance and/or non-conformance – as covered in the 2200 Test Series.
- For the software's ability to allow entry of user-defined geodetic objects, the precision allowed for the user-defined coordinate operations and other allowable geodetic objects are sufficient to allow for storage of equivalent precision to that provided in the EPSG Dataset – as covered in the 3200 Test Series.

[15] https://docs.microsoft.com/en-us/office/troubleshoot/excel/floating-point-arithmetic-inaccurate-result

2.5.2 Precision of GIGS Test Dataset Coordinates

All input coordinate elements in metres or feet (easting, northing, ellipsoidal heights, gravity related heights, depths, geocentric Cartesian X,Y,Z, etc.) are given to a minimum precision of at least 1 centimetre or 1 hundredth of a foot, respectively, i.e., to 2 decimal places. Some coordinates for certain tests may be stored and presented to 3 decimal places (at least 1 millimetre) to account for common rounding errors encountered in applications, however test tolerances are always at the centimetric level, so the additional significant figure is required only for further investigation.

Latitude and longitude in decimal degrees or grads are input to a minimum precision of 0.0000001 degree, i.e., 7 decimal places (that is DDD.ddddddd). For certain tests some coordinates may be stored and presented to 8 or 9 decimal places (millimetric) to account for common rounding errors encountered in applications, however test tolerances are always at the equivalent of centimetric level, so the additional significant figure is required only for further investigation.

Geographic coordinate data are not provided in other representations (degrees minutes seconds, radians, packed DMS, decimal minutes). If the application does not support import or export of decimal degrees then the coordinates will need to be converted prior to ingestion, using standard conversion algorithms. See IOGP Report 373-07-01 - *Surveying and Positioning Guidance Note Number 7, part 1 - Using the EPSG Geodetic Parameter Dataset* for further information.

2.5.3 Precision of Legacy P-format Data

Seismic 2D position data in the P1/90 data exchange format coordinates are limited in precision, simply because the P1/90 format itself has limited coordinate resolution.

Geographic coordinates (latitude and longitude) in degrees in P1/90 are in a packed sexagesimal DDMMSS.ss format with arc second storage defined using Fortran format F5.2, which means it only allows a resolution of 0.01 arc second. This is a pseudo-unit used in the EPSG Dataset for storing CRS definition parameter values given in sexagesimal degrees (degrees, minutes, and seconds) as a floating point number in a single numeric field.

Similarly, P1/90 map grid coordinates (easting and northing) are limited to a resolution of 0.1 metres. P1/90 allows a resolution of 0.1 metre for height/depth data, which is the same resolution as easting and northing coordinates when given in metres. In all cases, the P1/90 coordinate storage is an order of magnitude less precise than that which modern software should allow.

To gain increased precision, users of the format may have used implied decimals, which generally are not recognised by geospatial software. Users may have implemented workarounds to generate their own P1 Reader software to manage these limitations. When used out of context, these "workarounds" can create their own geospatial data problems.

2.6 Test Dataset Naming Convention

2.6.1 Test Procedure Naming/Numbering

The GIGS Test Dataset files follow a standard naming convention as follows:

GIGS_{series name abbrev.}_{Test Procedure number}_{Test Procedure name abbrev.}[16]

Depending on the specific Test Procedure, usually there will also be a *_input, _output, _part{n}*, or special identifying suffix (see Appendix A).

The Test Procedure numbers are four digits long, with the first two digits corresponding to the Test Series number to which the test is related. For example, Test Data file "GIGS_seis2D_5307_input" is associated with test series 5300 (2D seismic position data).

The Test Procedure number increases incrementally (by 1) for each Test Procedure (i.e., 5306, 5307, 5308), however although the numbers are sequential, they do not always indicate the order of the tests, as testing for various Series are not always done in isolation (depending on the specific functionality of the application).

The Test Dataset occasionally may be modified, supplemented or potentially have elements removed. When this occurs, the GIGS Test Dataset Version and GIGS Test Dataset Issue Date values are updated in the file headers. Some legacy Test Procedures have been removed because they are outdated or irrelevant, but in order to preserve the Test Dataset structure (and ensure backwards compatibility), number assignments for such Test Procedures are not re-used. In preliminary drafts of the GIGS documentation, there was an exact correlation between Test number and Test Procedure number. However, this correlation was lost as the Test Dataset was updated over various iterations. This is why, in the current release it may appear that certain numbers are skipped, or in the wrong order.

Additionally, the GIGS Test Dataset is designed to be extensible, so additional Test Procedures (and therefore numbers) may be introduced in the future.

2.6.2 Test Dataset Geodetic Data Object Naming/Numbering

All user-defined geodetic entities within the Test Dataset are named and numbered (assigned a GIGS code) to assist with referencing and constructing objects while executing Test Procedures. GIGS codes are integer numbers in the range 60000 to 69999. The entity name is prefixed with "GIGS" and describes its type and includes a letter or number which is unique within that type.

- For geodetic CRSs the EPSG subtypes geocentric and geographic 3D are embedded in the name, but in the names of geographic 2D CRSs, the '2D' is omitted. For example, "GIGS geog3DCRS A" and "GIGS geogCRS A"
- Datum names include a letter, for example "GIGS geodetic datum A" or "GIGS vertical datum U". CRSs using that datum take the same letter, for example "GIGS geogCRS B" is a geographic 2D CRS which uses geodetic datum B.

[16] In previous GIGS versions test file names also contained the version date, however this was removed to ease file compilation. The version of the Test Dataset to which the file corresponds now found in the file header.

- Conversion (map projection) names include a number, for example "GIGS conversion 3".
- Projected CRS names include the letter for the base geographic CRS and the number for the conversion, for example "GIGS projCRS B3" is based on CRS and geodetic datum B and conversion 3.
- Vertical CRS names include the letter for the datum, a number to indicate axis unit, and the words 'height' or 'depth' to indicate positive axis direction, for example "GIGS vertCRS U1 height"
- For coordinate transformations, the name is not given explicitly but if needed it can be built implicitly by following the EPSG Dataset convention of *{Source CRS name} to {Target CRS name} {variant number}.*

The relationship between GIGS CRSs and "real world systems", as documented in the EPSG Dataset, is shown in Appendix C, on the basis that the EPSG CRSs are limited to their specified "usage extent" as defined in the EPSG Dataset. Conversely, the corresponding GIGS CRSs have unlimited area of use (i.e., they may be used for any geographic area of the Earth).

The EPSG names and codes are equivalent to the GIGS names and codes for "late binding"[17] systems only (i.e., for CRS and datums not requiring coordinate transformations as part of the datum definition).

For some real-world geodetic datums and geographic CRS entities, multiple GIGS entities are created. The duplicate entities, indicated by the prime sign ('), are necessary only for software that requires a transformation to WGS 84 as part of the datum or CRS definition (so called "early binding"). Note that 'Early binding' is adopted in some software as a means of implementing coordinate transformations. In the real world, datums and CRSs are stand-alone entities capable of existing without defining their relationship to WGS 84.

As per Section 2.6.1, the original GIGS Test Dataset had a complete and sequential Geodetic Data Object naming/numbering system. However, as the Test Dataset was updated and modified, some Objects may have been removed or renamed (for example, if their equivalent EPSG Code changed and was inferred in the GIGS Code). To ensure backwards-compatibility in the Test Dataset, such names and codes are not re-used. Hence there may be instances where it appears that codes or names are missing in the order.

2.7 User-Defined Geodetic Data Object Definitions

As described above, each of the geodetic objects used in the Test Series 3000 Test Procedures is given a GIGS code and name. These geodetic objects are also used in tests in other Series. Most of these objects correspond to a "real world" geodetic object, which is already in the EPSG Dataset.

The creation of custom GIGS geodetic objects is deliberate, for the following reasons. Firstly, these GIGS definitions mitigate geodetic objects that may exist in predefined libraries within software that have a correct name but incorrect parameters (e.g., the British National Grid has been defined erroneously in some predefined libraries with a scale factor 0.9996 rather than the correct value of 0.9996012717). Thus, it allows data operations tests to be conducted using the correct definitions, controlled by the Evaluator.

[17] Transformation does not form explicitly part of coordinate reference system definition

Secondly, EPSG CRS, transformation, and conversion data are associated with an area of applicability. Thus, they should be limited in usage to a specific geographic area. In principle, this "extent" data should be used by the software to limit use of the CRS or operation (e.g., to prevent the use of the British National Grid outside of the area covered by Britain). However, for some GIGS Test Procedures, the Test Data deliberately exceeds the normal area of use for that data. For example, conversions (map projections) are tested beyond the projection method extents. Similarly, software is tested to establish which of the overlapping Canadian and US transformation data options is being referenced. For this reason, the GIGS geodetic Test Data is deliberately not constrained to the limits of the equivalent real-world data, as documented in the EPSG Dataset.

The GIGS geodetic Test Data are given names specifically for the GIGS project, for example GIGS projCRS F7. This is equivalent to the GDA94/MGA zone 54 CRS, except that F7 is not bounded by "extent" data. Similarly, the GIGS geogCRS J is equivalent to the NAD27 Geographic 2D CRS, but without the associated "extent" data. This process allows fictitious areas of use to be associated with the GIGS systems in software that does recognise the EPSG area of use "extent" data.

Thirdly, the CRS 'WGS 84 / British National Grid'[18] is used in the Test Dataset as a common CRS in which to present the Test Data. This was chosen deliberately to allow full testing of the coordinate operations in Series 5100 and 5200, and to minimize the number of projects that need to be created for the Series 5300 through Series 5500 tests. This GIGS CRS has no real-world equivalent.

The precision of the defining parameters for all GIGS geodetic entities is identical to that in the equivalent data within the EPSG Dataset. To simplify usage and minimise confusion, clear descriptions and definitions of all custom GIGS datums, geographic CRSs and projected CRSs have been tabulated and cross-referenced against their corresponding EPSG entities (that include the EPSG-defined "area of use" Usage Extent). This has been done within each of the GIGS Test Data files, and these relationships are tabulated separately in Appendix F of this document. Testing for geographic applicability is not included in the tests to date, other than for NADCON and NTv2 gridded transformations across the US-Canadian border, but the Test Data allow for such testing in the future, should this be required.

2.8 Predefined Geodetic Data Object Applicability

Each of the geodetic objects used in the Test Series 2000 Test Procedures is given its respective EPSG Usage Extent alongside other defining parameters[19]. The 'Extent' field can be utilised to exclude certain objects from testing, if an application is specifically and legitimately designed not to work with data pertaining to that geographic area. This provides flexibility in the evaluation, in that not all software needs to support the wide range of geodetic data objects that are included in the predefined library tests.

[18] The British National Grid was defined by Great Britain's national mapping agency, to be referenced to the Ordnance Survey of Great Britain 1936 datum. Although it can be linked to the WGS 84 datum mathematically, it is never used in that way, nor is it defined in the EPSG Geodetic Parameter Registry in that way. Hence, WGS 84 / British National Grid does not exist in the real world and should not be used outside these Test Procedures.

[19] Replaces "Particularly important to E&P industry" field as used in legacy GIGS versions

When executing Tests and Test Procedures for the 2000 Series, therefore it is justifiable to record the results that are specific only to the geodetic data objects relevant to the software's general area of use.

Note that the geographic applicability of the objects does not necessarily apply to the Test Dataset in the 3000 Series, as the custom GIGS objects are designed to be used outside of the typical area of use. Therefore, a Test Procedure may require the creation and execution of a coordinate operation, or CRS, outside of the design area of use of the software. However, in these cases it is the geodetic data object itself (e.g., transformation or conversion method) that should be noted as 'not supported' by the software, rather than the usage extent associated with the object. For example, an application may be designed explicitly not for use in the USA. In the 2000 Series, therefore, all geodetic data objects with a 'Usage Extent' of CONUS ('CONtinental US') could be excluded from testing; whereas in the 3000 Series the NADCON tests ('N American Datum CONversion') should be reported as 'not supported'.

In addition to Usage Extent, where appropriate, each geodetic data object is also assigned its respective aliases, as recorded in the EPSG Dataset. In some applications, the defining parameters of the object may match those in the GIGS Test Dataset (and EPSG Dataset), but the name may be different. Provided that the name is included in the list of aliases, then the individual test can be deemed a Pass, however, use of any other names should be reported.

2.9 Test Procedure Project Naming

For the Test Series 5000 Data Operations tests, Test Data must be loaded into the software. This normally will require the creation of a project within the software. To comply with the test scenarios, these projects need to be referenced to specified CRSs. To identify the project to which data is to be loaded, GIGS project names have been constructed such that project names comprise the required horizontal and vertical GIGS CRS names. For example, "GIGS project A9V1depth" references horizontal CRS "A9" and vertical CRS "V1 depth". The project CRSs are further detailed in Appendix D.

2.10 Round Trip Calculations

Many of the Test Series 5000 Data Operations Test Procedures require the execution of round trip calculations, where iterations of forward and reverse computations are performed, using the output of computation *n* as input into computation *n+1*, for a specific test point (usually the first or last in a set). The coordinate value from each iteration is compared to the tolerance value specified for each Test Procedure, and the number of iterations it takes to exceed the tolerance is reported. Realistically, no more than 1000 iterations are necessary to adequately test the function.

The round-trip calculation threshold (e.g., 0.0000006° or 0.006m (6mm)) is the acceptable change from the original calculated coordinates, not the expected Test Data coordinate. For example, a single calculation could give a coordinate that differs by 0.03m (30mm) from the expected result (which is within the 0.05m (50mm) single calculation tolerance), but after 1000 iterations, if the coordinate has changed from the initial calculated value by more than 0.006m (6mm), that is considered out of the expected tolerance. This is a valid and important test because software operability is not expected to deteriorate the calculation result or propagate error after the round trips.

Such calculations are an important test for functionality in software where coordinate data may be exchanged many times back and forth in a particular module/algorithm, for example where a conversion or transformation is taking place. A failure in geospatial data integrity may occur if an error is introduced during each operation, and that error then propagates and increases through the entire calculation chain. This can cause coordinates to "walk" from their correct values as the number of iterations increases, resulting in reduced results accuracy.

It is recognised that the round-trip calculation procedures can be cumbersome to implement, and so they should only be executed where the routine can be run programmatically. If this is not possible in the software, manual input/output for round trip calculations should be avoided and the iteration results should be generated by other means, or the number of iterations reduced to an attainable level.

The test point to be used for round trip calculations is indicated by a comment in the "GIGS Remarks" field of each input file.

2.11 Test Procedures Specific Guidelines

The following sections contain instructions for executing each Test Procedure. Note that details of the input and output Test Data files are for guidance only and refer to the ASCII base class, depending on the chosen, or derived, Test Dataset Format, the actual file names and structure may be different (see Sections 2.3 and 2.4).

2.11.1 2200 Predefined Geodetic Data Object Test Procedures

The Test Procedures for this series are designed to verify the correctness of geodetic parameters that are delivered with the software. The latest version of the EPSG Dataset should be used for these tests and is taken as 'truth'.

Records in the EPSG Dataset which have been deprecated should be ignored in Series 2000 testing (Deprecation is examined in Series 7000).

The Test Data files for Series 2000 describe a subset of EPSG records which is of particular interest to the energy industry. It constitutes the minimum set of definitions to be checked. Evaluators are encouraged to go beyond this minimum set and verify the software's complete predefined geodetic parameter library against the EPSG Dataset, but this is not a requirement.

As per Section 2.8, an EPSG Usage Extent is assigned to each data object; if the application being tested is unequivocally designed not to operate in certain areas, then objects associated with such geographies can be excluded from testing.

The Series 2000 tests are structured to follow the ISO 19111 and EPSG data models for spatial referencing by coordinates. This may be envisaged as a hierarchical series of entities, with higher-level entities being dependent upon lower-level entities. For example, a geodetic datum (higher-level) includes an ellipsoid (lower level) with the datum dependent upon that ellipsoid definition. The higher-level entity in this pairing may then be a lower level in a later pairing, for example a geodetic CRS (higher level) includes a geodetic datum (lower-level). Lower-level entities may be used in one or many higher-level entities. The tests begin at the bottom of the hierarchy.

See Appendix B for tips on conducting these tests in software in which the storage of geodetic parameters does not conform to the EPSG model and/or EPSG nomenclature.

Test Procedure:	**2201 - Predefined units of measure**
Test Purpose:	To verify reference units of measure bundled with the application.
Test Process:	Compare unit definitions included in the application against the EPSG Dataset.
Test Data:	EPSG Dataset and file *GIGS_lib_2201_Unit*. As a minimum those units relevant to the application's area of use should be tested. This file contains three separate blocks of data for linear units, angular units and scaling units. It gives the EPSG code and name for the unit of measure, together with the ratio of the unit to the ISO base unit for that unit type.
Expected Results:	• Unit of measure definitions bundled with the application should have the same name and ratio as the appropriate base unit in the EPSG Dataset. The values of the base unit per unit should be correct to at least 10 significant figures. • Units should be reported if they are: – missing from the application – additional to those in the EPSG Dataset – objectively different from those in the EPSG Dataset
Note:	• Some applications may not recognise the diversity of units of measure encountered in geodetic definitions and coordinates. Particular attention should be given to whether the application distinguishes between different types of feet and supports different representations of degrees. • The ratio to base unit may be embedded in application code and not readily available to Users. If this is the case, it may be possible to convert a coordinate set in base unit to the desired unit in order to compute the effective ratio to base unit. Otherwise, report that the conversion ratio cannot be determined.

Test Procedure:	**2202 - Predefined ellipsoids**
Test Purpose:	To verify reference ellipsoid parameters bundled with the application.
Test Process:	Compare ellipsoid definitions included in the application against the EPSG Dataset.
Test Data:	EPSG Dataset and file *GIGS_lib_2202_Ellipsoid*. As a minimum those ellipsoids relevant to the application's area of use should be tested This file gives the EPSG code and name for the ellipsoid, commonly encountered alternative name(s) for the same object, the value and units for the semi-major axis, the conversion ratio to metres for these units, and then a second parameter which will be either the value of the inverse flattening (unitless) or the value of the semi-minor axis (in the same units as the semi-major axis). It may additionally contain a flag to indicate that the figure is a sphere: without this flag the figure is an oblate ellipsoid.
Expected Results:	• Ellipsoid definitions bundled with application, if any, should have same name and defining parameters as in the EPSG Dataset. Equivalent alternative parameters are acceptable but should be reported. The values of the parameters should be correct to at least 10 significant figures. • For ellipsoids defined by Clarke and Everest, as well as those adopted by IUGG as International, several variants exist. These must be clearly distinguished. • Ellipsoids should be reported if they are: – missing from the application – additional to those in the EPSG Dataset – objectively different from those in the EPSG Dataset

Note:	• The term 'spheroid' may be used in application documentation. 'Ellipsoid' is the preferred term • Some applications require or use different defining parameters to 'a' and '1/f', for example 'e', 'e2' or 'n'. If necessary, the values of these alternative parameters should be calculated from those given in the EPSG Dataset using standard formulae available in EPSG Guidance Note 7 part 2 or in geodetic texts. Where the second parameter is the semi-minor axis 'b' and the figure is an ellipsoid, the derived value of inverse flattening is given in the EPSG Dataset ellipsoid forms and reports. • If the figure is a sphere, '1/f' is indeterminate and is not used. • Some applications require that all ellipsoid axes are defined using (international) metres. The metric equivalent of those given in the EPSG Dataset in other units may be derived using the appropriate conversion factor taken from the EPSG units definitions. The equivalent metric semi-major axes are given in file *GIGS_lib_2202_Ellipsoid*.

Test Procedure:	**2203 - Predefined prime meridians**
Test Purpose:	To verify reference prime meridians bundled with the application.
Test Process:	Compare prime meridian definitions included in the application against the EPSG Dataset.
Test Data:	EPSG Dataset and file *GIGS_lib_2203_PrimeMeridian*. As a minimum those prime meridians relevant to the application's area of use should be tested.
Expected Results:	• Prime meridian definitions bundled with the application should have the same name and Greenwich Longitude as in the EPSG Dataset. Equivalent alternative units are acceptable but should be reported. • The values of the Greenwich Longitude should be correct to at least 7 decimal places (of degrees or grads). • Prime meridians should be reported if they are: – missing from the application – additional to those in the EPSG Dataset – objectively different from those in the EPSG Dataset
Note:	• Some applications may not identify prime meridians. In this case it should be assumed that they are Greenwich. • Offsets are positive when the subject prime meridian is east of the Greenwich meridian and negative when west of the Greenwich meridian. • Some applications may require that all offsets from Greenwich are defined using (decimal) degrees. The decimal degree equivalents of the sexagesimal format are also included within the test file.

Test Procedure:	**2204 - Predefined geodetic datums**
Test Purpose:	To verify reference geodetic datums bundled with the application.
Test Process:	Compare geodetic definitions included in the application against the EPSG Dataset.
Test Data:	EPSG Dataset and file *GIGS_lib_2204_GeodeticDatum*. As a minimum those geodetic datums relevant to the application's area of use should be tested. Tests for component logical consistency should be included: for example, if a higher-level library-defined component such as ED50 datum is selected, it should not be possible to change any of its lower-level components such as the ellipsoid from the predefined value (in this example International 1924).
Expected Results:	• Definitions bundled with the application should have the same name and associated ellipsoid and prime meridian as in the EPSG Dataset. • Geodetic datums should be reported if they are: – missing from the application – additional to those in the EPSG Dataset – objectively different from those in the EPSG Dataset
Note:	• Critical data are correct: geodetic datum name, ellipsoid name and parameter values, and prime meridian name and Greenwich Longitude value. • Some applications may associate a transformation (to WGS 84) with a datum definition. This is not part of an EPSG datum or CRS definition and if present should be reported. See also Test Procedure 2207.

Test Procedure:	2205 - Predefined geodetic CRSs
Test Purpose:	To verify reference geodetic CRSs bundled with the application.
Test Process:	Compare geocentric, geographic 3D and geographic 2D CRS definitions included in the application against the EPSG Dataset.
Test Data:	EPSG Dataset and file *GIGS_lib_2205_GeodeticCRS*. As a minimum those geodetic CRS relevant to the application's area of use should be tested. Tests for logical consistency of components should be included.
Expected Results:	• Definitions bundled with the application should have the same name and associated geodetic datum as in the EPSG Dataset. • CRS should be reported if they are: – missing from the application – additional to those in the EPSG Dataset – objectively different from those in the EPSG Dataset
Note:	• Critical data are correct: CRS and geodetic datum name etc. • EPSG Dataset geodetic CRS entries should have Cartesian axes in order X, Y, Z and ellipsoidal axes in order latitude, longitude, [ellipsoidal height]. The CRS axis order should agree with that in the EPSG dataset. • CRSs with the same datum but differing coordinate system attributes (in particular axes order) are considered to be different CRSs. Occurrences should be reported. • Some applications may associate a transformation (to WGS 84) with a CRS definition. This is not part of an EPSG CRS definition and if present should be reported. See also Test Procedure 2208.

Test Procedure:	2206 - Predefined conversions
Test Purpose:	To verify reference conversions (map projections) bundled with the application.
Test Process:	Compare conversion definitions included in the application against the EPSG Dataset.
Test Data:	EPSG Dataset and file *GIGS_lib_2206_Conversion*. As a minimum those conversions relevant to the application's area of use should be tested.
Expected Results:	• Conversion definitions bundled with the application should have the same name, method name, defining parameters and parameter values as in the EPSG Dataset. The values of the parameters should be correct to at least 10 significant figures. • Conversions should be reported if they are: – missing from the application – additional to those in the EPSG Dataset – objectively different from those in the EPSG Dataset
Note:	• Critical data are correct name, method name, parameters and their values. • Some applications require that all map projection parameters are defined using specific units. The equivalent of those given in the EPSG Dataset in other units may be derived using the appropriate conversion factor taken from the EPSG units definitions.

Test Procedure:	**2207 - Predefined projected CRSs**
Test Purpose:	To verify reference projected CRSs bundled with the application.
Test Process:	Compare projected CRS definitions included in the application against the EPSG Dataset.
Test Data:	EPSG Dataset and file *GIGS_lib_2207_ProjectedCRS*. As a minimum those projected CRS relevant to the application's area of use should be tested
Expected Results:	• Projected CRS definitions bundled with the application should have the same name, coordinate system (including units, axes abbreviations and axes order) and conversion as in the EPSG Dataset. • CRSs should be reported if they are: – missing from the application – additional to those in the EPSG Dataset – objectively different from those in the EPSG Dataset
Note:	• Critical data are correct name and associated datum, coordinate system and map projection. • The EPSG Dataset projected CRS entries are specific regarding axes order, axes name/abbreviation and axes units. CRSs with the same datum and map projection but differing coordinate system attributes (particularly axes order and units) are considered to be different CRSs. Variances from EPSG should be reported. • Some applications may associate a transformation (to WGS 84) with a datum definition. This is not part of an EPSG datum or CRS definition and if present should be reported.

Test Procedure:	**2208 - Predefined coordinate transformations**
Test Purpose:	To verify reference coordinate transformations bundled with the application.
Test Process:	Compare transformation definitions included in the application against the EPSG Dataset.
Test Data:	EPSG Dataset and file *GIGS_lib_2208_CoordTfm*. As a minimum those coordinate transformations relevant to the application's area of use should be tested.
Expected Results:	• Transformation definitions bundled with the application should have the same name, method name, defining parameters and parameter values as in EPSG Dataset. The values of the parameters should be correct to at least 10 significant figures. • Transformations should be reported if they are: – missing from the application – additional to those in the EPSG Dataset – objectively different from those in the EPSG Dataset
Note:	• Critical data are correct name, method name, parameters and their values. • Some applications require that all transformation parameters are defined using specific units. The equivalent of those given in the EPSG Dataset in other units may be derived using the appropriate conversion factor taken from the EPSG units definitions.

Test Procedure:	**2209 - Predefined vertical datums**
Test Purpose:	To verify reference vertical datums bundled with the application.
Test Process:	Compare vertical datum definitions included in the application against the EPSG Dataset.
Test Data:	EPSG Dataset and file *GIGS_lib_2209_VerticalDatum*. As a minimum those datums relevant to the application's area of use should be tested.
Expected Results:	• Definitions bundled with the application should have the same name and defining parameters as in EPSG Dataset. • Datums should be reported if they are: – missing from the application – additional to those in the EPSG Dataset – objectively different from those in the EPSG Dataset
Note:	• Critical data is correct datum name.

Test Procedure:	**2210 - Predefined vertical CRSs**
Test Purpose:	To verify reference vertical CRSs bundled with the application.
Test Process:	Compare vertical CRS definitions included in the application against the EPSG Dataset.
Test Data:	EPSG Dataset and file *GIGS_lib_2210_VerticalCRS*. As a minimum those CRS relevant to the application's area of use should be tested.
Expected Results:	• Definitions bundled with the application should have the same name and coordinate system (including axes direction and units) as in EPSG Dataset. • CRS should be reported if they are: – missing from the application – additional to those in the EPSG Dataset – objectively different from those in the EPSG Dataset
Note:	• Critical data are correct CRS and datum name, axes directions, units and abbreviation. • The EPSG Dataset vertical CRS entries are specific regarding axes name/abbreviation and axes units. CRSs with the same datum but differing coordinate system attributes are considered to be different CRSs.

Test Procedure:	**2211 - Predefined vertical transformations**
Test Purpose:	To verify reference vertical transformations bundled with the application.
Test Process:	Compare transformation definitions included in the application against the EPSG Dataset.
Test Data:	EPSG Dataset and file *GIGS_lib_2211_VertTfm*. As a minimum those transformations relevant to the application's area of use should be tested.
Expected Results:	• Transformation definitions bundled with the application should have same name, method name, defining parameters and parameter values as in EPSG Dataset. The values of the parameters should be correct to at least 10 significant figures. • Transformations should be reported if they are: – missing from the application – additional to those in the EPSG Dataset – objectively different from those in the EPSG Dataset
Note:	• Critical data are correct name, method name, parameters and their values. • Some applications require that all transformation parameters are defined using specific units. The equivalent of those given in the EPSG Dataset in other units may be derived using the appropriate conversion factor taken from the EPSG units definitions. • Other vertical transformation method, at this time these tests are not covered in the GIGS Test Dataset or associated Test Procedures, although they may be added at a later date.

End of 2200 Test Procedures

2.11.2 3200 User-defined Geodetic Data Object Test Procedures

The Test Procedures in this series are designed to evaluate the software's capabilities for adding user-defined CRS and transformation definitions to its geodetic parameter library. The Test Procedures assume that the software follows the ISO 19111 and EPSG geodetic data model. See Appendix B for tips for conducting these tests in software in which the storage of geodetic parameters does not conform with the EPSG model and/or EPSG nomenclature.

The Test Procedures in this section should be conducted sequentially as some data loaded in early tests is required in later tests. The data may be envisaged as a hierarchical series of entities, with higher-level entities being dependent upon lower-level entities. For example, a geodetic datum (higher level) includes an ellipsoid (lower level), and the datum is dependent upon that ellipsoid definition. Lower level entities may be used in one or many higher level entities. The tests begin at the bottom of the entity hierarchy. The fully built-up CRSs and transformations are used for later tests, particularly those in Series 5000, Data Operations.

See Section 2.6 for comments on the names of geodetic entities created during these Test Procedures and Appendix C for their relationship to real world entities documented in the EPSG Dataset.

If the software requires an area of use to be assigned to user-created geodetic entities, use the range +90 to -90 degrees latitude and +180 to -180 degrees longitude.

To cater for software using so-called "early binding" and requiring a transformation as part of the geodetic datum definition, the Test Data for each geodetic datum includes a default transformation to WGS 84. These default transformations deliberately use the geocentric translation method to ensure broadest applicability. Similarly, vertical datums are, in general, associated with mean sea level.

An equivalent EPSG name and code is assigned to each object (see Appendix C), if there is no respective EPSG entity (i.e., if the object is a custom entity defined specifically for GIGS) then the value "*No direct EPSG equivalent*" is populated.

Test Procedure:	**3201 - User-defined units of measure**
Test Purpose:	To verify that the application allows correct definition of a user-defined unit of measure.
Test Process:	• Create user-defined unit of measure for each of several different units, using parameters in fields 0-2 • The values of the base unit per unit should be correct to at least 9 decimal places.
Test Data:	*GIGS_user_3201_Unit*
Expected Results:	The application should accept the Test Data. The order in which the name and the unit factor are entered is not critical, although that given in the Test Dataset is recommended. Test result will be pass or fail. If fail, details of failure should be reported.
Note:	Units are defined relative to an ISO base unit: metre for length, radian for angle, unity for scale. These are included in the dataset for reference only. The expected input is the number of base units per unit. It may be described as a fraction formed from two values which EPSG refers to as factor B and factor C (numerator and denominator respectively). If necessary, use the Test Data ratio as the numerator and unity as the denominator.

Test Procedure:	**3202 - User-defined ellipsoids**
Test Purpose:	To verify that the application allows correct definition of a user-defined ellipsoid.
Test Process:	• Create user-defined ellipsoid for each of several different ellipsoids, using parameters in fields 0-3 and additional factors in fields 4-6. • Parameters in fields 7-9 provided for information only.
Test Data:	*GIGS_user_3202_Ellipsoid*
Expected Results:	The application should accept the Test Data. The order in which the name and the ellipsoid parameters are entered is not critical, although that given in the Test Dataset is recommended. Test result will be pass or fail. If fail, details of failure should be reported.

Note:	• The term 'spheroid' may be used in application documentation. 'Ellipsoid' is the preferred term. • Some applications require or uses different defining parameters from '1/f' or 'b', for example 'e', 'e2' or 'n'. If necessary, the values of these alternative parameters should be calculated from those given in the EPSG Dataset using standard formulae available in EPSG Guidance Note 7, part 2 or geodetic texts. • Some applications require that all ellipsoid axes are defined using (international) metres. The metric equivalent of Test Data non-metric values can be obtained using the unit conversion factor included in the Test Data. • Applications that use only 'a' and '1/f' will be unable to define a sphere. • Applications that use only 'a' and 'b' will be able to define a sphere by inputting the Test Data value of 'a' for both 'a' and 'b'.

Test Procedure:	**3203 - User-defined prime meridians**
Test Purpose:	To verify that the application allows correct definition of a user-defined prime meridian.
Test Process:	• Create user-defined prime meridian for each of several different meridians, using parameters in fields 0-3 • Parameters in field 4-5 provided for information only.
Test Data:	*GIGS_user_3203_PrimeMeridian*
Expected Results:	The application should accept the Test Data. The order in which the name and the meridian parameters are entered is not critical, although that given in the Test Dataset is recommended. Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• Offsets are positive when the subject prime meridian is east of the Greenwich meridian and negative when west of the Greenwich meridian. • Some applications may require that parameters are entered in sexagesimal degrees (which should be reported), if this is the case then undertake a suitable conversion on the decimal degree values before entering.

Test Procedure:	**3204 - User-defined geodetic datums**
Test Purpose:	To verify that the application allows correct definition of a user-defined geodetic datum, using both user-defined data and predefined components.
Test Process:	• Create user-defined geodetic datum for each of several different datums, using parameters in fields 0-5 • Source of parameters is both user-defined and predefined (library), see field 1 • If the application uses early-binding then refer to early binding tfm code in field 6 and see test 3208 for details.
Test Data:	*GIGS_user_3204_GeodeticDatum*
Expected Results:	The application should accept the Test Data. The order in which the name and the meridian parameters are entered is not critical, although that given in the Test Dataset is recommended. Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• A geodetic datum comprises its name, and the ellipsoid and prime meridian it uses. The detailed geodetic definition of origin and orientation is not required. • As most datums use the Greenwich prime meridian it is acceptable for this to be the default. • Some applications may require that the datum definition includes a transformation to a standard CRS, normally WGS 84. See Test Procedure 3208. • Although the GIGS Test Dataset is static in nature (i.e., does not consider dynamic CRSs), due to the alignment with the EPSG Dataset, GIGS datum A WGS 84 (6326) is defined as the World Geodetic System 1984 ensemble which groups together successive realizations of the datum as one. Depending on the specific configuration of an application it is recommended that the latest realization is defined (G1762 at time of writing), but it is acceptable to construct either the full ensemble or another specific realisation. The same applies to GIGS datum G, the European Terrestrial Reference System 1989 ensemble.

Test Procedure:	**3205 - User-defined geodetic CRSs**
Test Purpose:	To verify that the application allows correct definition of a user-defined geodetic CRS.
Test Process:	• Create user-defined geodetic CRS for each of several different CRSs, using parameters in fields 0-5 • Source of parameters is both user-defined and predefined (library), see field 1 • If the application uses early-binding then refer to early binding tfm code in field 8 and see test 3208 for details. Early-bound entities will be used in 5000 series tests.
Test Data:	*GIGS_user_3205_GeodeticCRS*
Expected Results:	The application should accept the Test Data. Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• A geodetic CRS comprises its name, a geodetic datum and a coordinate system giving axes names, order and units. EPSG characterizes subtypes of geodetic CRS – geographic and geocentric (based on the coordinate system). • Some applications may require that the datum definition includes a transformation to a standard CRS, normally WGS 84. See Test Procedure 3007.

Test Procedure:	**3206 - User-defined conversions**
Test Purpose:	To verify that the application allows correct definition of a user-defined conversion (map projection).
Test Process:	• Create user-defined map projection for each of several different conversions, using parameters in fields 0-27 • If the application can satisfactorily define projection code 65002, there is no requirement to define 65021 or 65022. However if the application cannot create 65002 because it has a latitude of origin not on the equator, report the fact and create both 65021 and 65022 instead. These are needed for later tests. • Note: The codes 65003 and 65020 and names GIGS conversion '3', '20', '21' and '22' are deliberately missing from the sequence.
Test Data:	*GIGS_user_3206_Conversion*
Expected Results:	The application should accept the Test Data. The order in which the name and the conversion parameters are entered is not critical, although that given in the Test Dataset is recommended. Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• Each conversion method requires specific parameters (see EPSG Dataset for details). All parameters should be variables. Some applications hardwire the values of (some of) these variables, e.g., scale factor must be 1.0, scale factor must be 0.9996, latitude of origin must be 0 degrees, etc. The data for this test have no "standard" values. Latitudes are positive north, negative south; longitudes positive east, negative west. Several different map projections are to be tested. • Some applications may require that parameters are entered in sexagesimal degrees (which should be reported), if this is the case then undertake a suitable conversion on the decimal degree values before entering.

Test Procedure:	**3207 - User-defined projected CRSs**
Test Purpose:	To verify that the application allows correct definition of a user-defined projected CRS.
Test Process:	• Create user-defined projected CRS for each of several different CRS, using parameters in fields 0-15. • Source of parameters is both user-defined and predefined (library), see field 1
Test Data:	*GIGS_user_3207_ProjectedCRS.*
Expected Results:	The application should accept the Test Data. The order in which the name and the projection parameters are entered is not critical, although that given in the Test Dataset is recommended. Test result will be pass or fail. If fail, details of failure should be reported.

Note:	• A projected CRS comprises its name, a geodetic datum, a conversion (map projection) and a coordinate system giving axes names, order and units. • The coordinate system is defined within the projected CRS Test Data file; in the ISO/EPSG model it is a separate entity. • The projected CRS units may not be the same as those of its components. • Some applications may require that the datum definition includes a transformation to a standard CRS, normally WGS 84. This requirement may be inherited by projected CRSs. See Test Procedures 3204 and 3208.

Test Procedure:	**3208 - User-defined coordinate transformations**
Test Purpose:	To verify that the application allows correct definition of a user-defined coordinate transformation.
Test Process:	• Create user-defined coordinate transformation for each of several different coordinate transformation method, using parameters in fields 0-38
Test Data:	*GIGS_user_3208_CoordTfm.* • Additional files for grid-based transformations: *GIGS_user_3208_CoordTfm_61004_N_SLOPE.LAS, GIGS_user_3208_CoordTfm_61004_N_SLOPE.LOS, GIGS_user_3208_CoordTfm_61844_QUE27-98.gsb*
Expected Results:	The application should accept the Test Data. The order in which the name and the coordinate transformation parameters are entered is not critical, although that given in the Test Dataset is recommended. Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• Each coordinate transformation method requires specific parameters (see EPSG Dataset for details). All parameters should be variables. Their units may vary. Several different coordinate transformations are to be tested. • Some applications may require that a datum definition includes a transformation to a standard CRS, normally WGS 84. If this is the case treat this test as part of Test Procedure 3204 and report the fact. • Some applications may require that parameters are entered in sexagesimal degrees (which should be reported), if this is the case then undertake a suitable conversion on the decimal degree values before entering. • Although every effort has been made to assign user-defined coordinate transformations with a respective GIGS code (with a '6' prefix), unfortunately due to restrictions of the 5 digits in the 6XXXX code range, where a coordinate transformation has an equivalent EPSG code of 5 digits, it is not possible to assign an additional GIGS code. Therefore, some transformations (including 15929, 15788, 15934) have their respective EPSG code also as the GIGS code. In these cases, if the software already has the EPSG version of the transformation loaded, then this can be used in place of manually adding the transformation; otherwise, manually add the transformation with the EPSG code specified. Report this event if it occurs. • The 3200 series is designed to test the addition of user-defined geodetic data to an application. To emulate user-defined data for the tests for NADCON and NTv2 methods which both use parameter files the small test files (n_slope.las for NADCON, QUE27-98.gsb for NTv2), the expectation is that they may not already be bundled with an application and therefore could be used as Test Data. The data within the grid files are not used in any functionality calculations and tests. This test is designed to evaluate whether user data may be inserted into the application. • The data in the n_slope.las/n_slope.los files to be used for this test is a small subset of the data in the alaska.las/alaska.los files to be used for Test Procedure 5206, and are mutually exclusive. There is no relationship between the data in the QUE27-98.gsb file (covers Quebec) to be used for this test and the data in the NTv2.gsb file for Canada to be used for Test Procedure 5207.

Test Procedure:	3209 - User-defined vertical datums
Test Purpose:	To verify that the application allows correct definition of a user-defined vertical datum.
Test Process:	• Create user-defined geodetic datum for each of several different datums, using parameters in fields 0-2 • For datum origin refer to the EPSG Dataset (using Equivalent EPSG code)
Test Data:	*GIGS_user_3209_VerticalDatum*
Expected Results:	The application should accept the Test Data. The order in which the name and the components are entered is not critical, although that given in the Test Dataset is recommended. Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• Some applications may require that the vertical datum definition includes a transformation to a standard CRS, normally non-specified mean sea level. This requirement may be inherited by vertical CRSs. See Test Procedure 3211.

Test Procedure:	3210 - User-defined vertical CRSs
Test Purpose:	To verify that the application allows correct definition of a user-defined vertical CRS.
Test Process:	• Create user-defined geodetic CRS for each of several different CRSs, using parameters in fields 0-7 • If application uses early-binding then refer to early binding tfm code in field 10 and see test 3208 for details.
Test Data:	*GIGS_user_3210_VerticalCRS.*
Expected Results:	The application should accept the Test Data. The order in which the name and the components are entered is not critical, although that given in the Test Dataset is recommended. Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• A vertical CRS comprises its name, a vertical datum, a conversion (map projection) and a coordinate system giving axes names, order and units. • The vertical CRS units may not be the same as those of its components.

Test Procedure:	3211 - User-defined vertical coordinate transformations
Test Purpose:	To verify that the application allows correct definition of a user-defined vertical coordinate transformation.
Test Process:	• Create user-defined coordinate transformation for each of several different transformation methods, using parameters in fields 0-21
Test Data:	*GIGS_user_3211_VertTfm*
Expected Results:	The application should accept the Test Data. The order in which the name and the coordinate transformation parameters are entered is not critical, although that given in the Test Dataset is recommended. Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• Each coordinate transformation method requires specific parameters (see EPSG Dataset for details). All parameters should be variables. Their units may vary. Several different coordinate transformations are to be tested. • Some applications may require that a datum definition includes a transformation to a standard vertical datum, normally (non-specific) mean sea level. If this is the case treat this test as part of Test Procedure 3209 and report the fact. • Some applications may require that parameters are entered in sexagesimal degrees (which should be reported), if this is the case then undertake a suitable conversion on the decimal degree values before entering.

Test Procedure:	3212 - User-defined concatenated coordinate transformation
Test Purpose:	To verify that the application allows correct definition of a user-defined concatenated coordinate transformation.
Test Process:	• Create user-defined concatenated coordinate transformation for each of several different transformations, using parameters in fields 0-9
Test Data:	*GIGS_user_3212_ConcatTfm*
Expected Results:	The application should accept the Test Data. The order in which the steps of the concatenated coordinate transformation are entered is not critical as long as the step number is correct, although that given in the Test Dataset is recommended. Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• The concatenated coordinate transformations in the Test Procedure use steps constructed during Test Procedure 3208. • The reversing of source and target CRSs in individual steps is not tested

End of 3200 Test Procedures

2.11.3 5100 Conversion Test Procedures

The Test Procedures in this series are designed to evaluate the software's accuracy in performing conversions (map projections). A number of conversion methods commonly used in the energy industry are tested using realistic coordinate values (see Appendix E).

The conversion method names follow those in the EPSG Dataset. If the software does not follow this recommended method naming, see the individual Test Procedure descriptions that follow for tips for some common alternative names for the same method. Test Procedures for which the method is not supported by the software should be reported as such in the Test, and the Test Data excluded from the testing process.

Software is not required to use the formulae published by EPSG, but its algorithms are expected to give results which are not significantly different (see individual test tolerances) to those using the EPSG formulae.

The Test Data for this series comprises input and output files with each test point on a separate row in the data array. Points to be input for the forward and reverse calculations are generally interleaved in adjacent rows. The general process is to load the input file; convert the latitude/longitude referenced to a geogCRS to a projCRS; convert easting/northing referenced to a projCRS to a geogCRS; compare the results with the values in the output file data array. All points in the input file should be tested in the direction dictated by the input fields. Round trip calculations from the converted coordinates back to the original should also be tested for the point or points indicated in the input file, with the final coordinates compared with the starting values.

The CRS to which input and output coordinates are referenced is given in the file headers (see series 3000 data for associated parameters). The use of special GIGS geodetic entities created in the Series 3000 tests is deliberate. Should software fail the Series 3000 tests and have passed the Series 2000 tests it should still be possible to run this series of tests.

In some cases there may be multiple CRSs to be tested for one Test Procedure (or subtly different algorithms), in these cases the files are split into multiple parts.

Coordinates of test points are given in the order and units that are described in the CRS definition. Latitude and longitude are given in decimal degree (or grads) representation, Decimal degree values for latitude are positive for the northern hemisphere, negative for the southern hemisphere, and values for longitude are positive for the eastern hemisphere, negative for the western hemisphere.

Each set of Test Data comprises a small number of points, mostly laid out in two perpendicular transects. These transects avoid the system origin. When considered appropriate, additional points or transects have been added. The test points are divided into multiple subsets and data for testing both forward and reverse cases have been generated. The tests investigate computational behaviour of the method within and slightly beyond the reasonable area of use. In general, possible failure points at "difficult" locations, such as a geographic pole, have not been included. Test points have not been extended well away from a practical and reasonable "area of use".

The Test Datasets are not exhaustive. Developers are expected to augment the data to test frequently encountered failure conditions (boundary conditions, etc). Precision of Test Data is further described in Section 2.5.

The Test Procedures in the 5100 series are designed for the conversion of individual points. If the software does not have the functionality to allow this it may be necessary to first create a project for each Test Procedure and to load the test points as if they were the locations of geoscience data. In this case, the project CRS should be that of the projected CRS defined in the Test Procedure.

Test Procedure:	**5101 - Transverse Mercator conversions**
Test Purpose:	To verify that conversions for the Transverse Mercator map projection method are consistent with EPSG.
Test Process:	• Invoke coordinate conversions in both directions and inspect results, for all parts • For the first test point in part 1, perform iterations of forward and reverse computations using the output of computation *n* as input into computation *n+1*, until the output coordinate values exceed more than 0.006m (6mm) or 0.00000006° from the original calculated values (but no more than 1000 iterations).
Test Data:	*GIGS_conv_5101_TM_input_part[x]*. This data includes forward and reverse calculations. The Test Data is in four parts, one for each hemisphere quadrant, as well as separate files for JHS/USGS calculation formulae. Because of the importance of the Transverse Mercator projection method, this test is more extensive than for other methods.
Expected Results:	• Results for the forward and reverse calculations should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. See file *GIGS_conv_5101_TM_output_part[x]*. • For the round trip calculation the initial calculated coordinates of the point should change by less than 0.006m (6mm) or 0.00000006° (before 1000 iterations). • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	EPSG considers this method includes Gauss-Boaga and Gauss-Kruger (with all five TM parameters as variables and suitable parameter values). If the application allows these methods they should be included in this Test Procedure. EPSG publishes two sets of formulae for the TM method. USGS formulae are known to break down for points more than 4° from the central meridian (longitude of origin). The JHS formulae are robust to at least 30° and although use of the projection is not recommended this far from the central meridian, the JHS formulae are preferred. Results from both formulae are included in the Test Data.

Test Procedure:	**5102 - Lambert Conic Conformal (1SP[20]) conversions**
Test Purpose:	To verify that conversions for the Lambert Conic Conformal (1SP) map projection method are consistent with EPSG.
Test Process:	• Invoke coordinate conversions in both directions and inspect results, for all parts • For the first test point in part 1, perform iterations of forward and reverse computations using the output of computation *n* as input into computation *n+1*, until the output coordinate values exceed more than 0.006m (6mm) or 0.00000006 grad from the original calculated values (but no more than 1000 iterations).
Test Data:	*GIGS_conv_5102_LCC1_input_part[x]*. This data includes forward and reverse calculations. The Test Data is in two parts.
Expected Results:	• Results for the forward and reverse calculations should agree to within 0.03m (30mm) or 0.0000003 grad of the Test Data. See file *GIGS_conv_5102_LCC1_output_part[x].* • For the round trip calculation the initial calculated coordinates of the point should change by less than 0.006m (6mm) or 0.00000006 grad (before 1000 iterations). • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	

Test Procedure:	**5103 - Lambert Conic Conformal (2SP[21]) conversions**
Test Purpose:	To verify that conversions for the Lambert Conic Conformal (2SP) map projection method are consistent with EPSG.
Test Process:	• Invoke coordinate conversions in both directions and inspect results, for all parts • For the first test point in part 1, perform iterations of forward and reverse computations using the output of computation *n* as input into computation *n+1*, until the output coordinate values exceed more than 0.02 ftUS/ft (0.24in) or 0.00000006° from the original calculated values (but no more than 1000 iterations).
Test Data:	*GIGS_conv_5103_LCC2_input_part[x]*. This data includes forward and reverse calculations. The Test Data is in three parts, in which the grid coordinates are in different units.
Expected Results:	• Results should agree to within 0.1 ftUS/ft (1.2in) or 0.0000003° of the Test Data. See file *GIGS_conv_5103_LCC2_output_part[x],* worksheet 5103 LCC2. • For the round trip calculation the initial calculated coordinates of the point should change by less than 0.02 ftUS/ft (or 0.24in) 0.00000006° (before 1000 iterations). • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	

Test Procedure:	**5104 - Oblique Stereographic conversions**
Test Purpose:	To verify that conversions for the Oblique Stereographic map projection method are consistent with EPSG.
Test Process:	• Invoke coordinate conversions in both directions and inspect results. • For the last test point, perform iterations of forward and reverse computations using the output of computation *n* as input into computation *n+1*, until the output coordinate values exceed more than 0.006m (6mm) or 0.00000006° from the original calculated values (but no more than 1000 iterations).
Test Data:	*GIGS_conv_5104_OblStereo_input.* This data includes forward and reverse calculations.

[20] 1SP means one standard parallel is used in the conversion definition.
[21] 2SP means two standard parallels are used in the conversion definition.

Expected Results:	• Results should agree to within 0.05m (50mm) or 0.0000006° of the Test Data. See file *GIGS_conv_5104_OblStereo_output*. • For the round trip calculation the initial calculated coordinates of the point should change by less than 0.006m (6mm) or 0.00000006° (before 1000 iterations). • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	There are two significantly different approaches to the handling of the ellipsoidal development of this map projection method. These are often not clearly distinguished through the method name. These give significantly different results at locations away from the projection origin and should be considered to be different methods. In some applications the method is called 'Double Stereographic' equates to the EPSG Oblique Stereographic method.

Test Procedure:	**5105 - Hotine Oblique Mercator (variant B) conversions**
Test Purpose:	To verify that conversions for the Hotine Oblique Mercator (variant B) map projection method are consistent with EPSG.
Test Process:	• Invoke coordinate conversions in both directions and inspect results, for all parts • For the first test point in part 1, perform iterations of forward and reverse computations using the output of computation *n* as input into computation *n+1*, until the output coordinate values exceed more than 0.006m (6mm) or 0.00000006° from the original calculated values (but no more than 1000 iterations).
Test Data:	*GIGS_conv_5105_HOM-B_input_part[x]*. This data includes forward and reverse calculations. This test is in two parts, testing oblique and 90° scenarios for the azimuth of the projection initial line. (The latter is a known problem area in some applications).
Expected Results:	• Results should agree to within 0.05m (50mm) or 0.0000006° of the Test Data. See file *GIGS_conv_5105_HOM-B_output_part[x]*. • For the round trip calculation the initial calculated coordinates of the point should change by less than 0.006m (6mm) or 0.00000006° (before 1000 iterations). • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	Applications may define the map projection in different ways. One variation is in the location at which false grid coordinates are applied. EPSG caters for two alternatives and considers these to be different methods – see Test Procedure 5106 below. Another variation involves how the initial line is defined. EPSG requires an azimuth value. An alternative approach is to define this azimuth through the coordinates of two points; this approach is not catered for by EPSG.

Test Procedure:	**5106 - Hotine Oblique Mercator (variant A) conversions**
Test Purpose:	To verify that conversions for the Hotine Oblique Mercator (variant A) map projection method are consistent with EPSG.
Test Process:	• Invoke coordinate conversions in both directions and inspect results • For the last test point, perform iterations of forward and reverse computations using the output of computation *n* as input into computation *n+1*, until the output coordinate values exceed more than 0.006m (6mm) or 0.00000006° from the original calculated values (but no more than 1000 iterations).
Test Data:	*GIGS_conv_5106_HOM-A_input*. This data includes forward and reverse calculations.
Expected Results:	• Results should agree to within 0.05m (50mm) or 0.0000006° of the Test Data. See file *GIGS_conv_5106_HOM-A_output*. • For the round trip calculation the initial calculated coordinates of the point should change by less than 0.006m (6mm) or 0.00000006° (before 1000 iterations). • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	Applications may define the map projection in different ways. One variation is in the location at which false grid coordinates are applied. EPSG caters for two alternatives and considers these to be different methods – see Test Procedure 5105 above. Another variation involves the means by which the initial line is defined. EPSG requires an azimuth value. An alternative approach is to define this azimuth through the coordinates of two points; this approach is not catered for by EPSG.

Test Procedure:	5107 - American Polyconic conversions
Test Purpose:	To verify that conversions for the American Polyconic map projection method are consistent with EPSG.
Test Process:	• Invoke coordinate conversions in both directions and inspect results • For the last test point, perform iterations of forward and reverse computations using the output of computation *n* as input into computation *n+1*, until the output coordinate values exceed more than 0.006m (6mm) or 0.00000006° from the original calculated values (but no more than 1000 iterations).
Test Data:	*GIGS_conv_5107_AmPolyC_input*. This data includes forward and reverse calculations.
Expected Results:	• Results should agree to within 0.05m (50mm) or 0.0000006° of the Test Data. See file *GIGS_conv_5107_AmPolyC_output.* • For the round trip calculation the initial calculated coordinates of the point should change by less than 0.006m (6mm) or 0.00000006° (before 1000 iterations). • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	There are numerous polyconic methods available in the literature giving significantly different results. The method name "polyconic" therefore is ambiguous.

Test Procedure:	5108 - Cassini-Soldner conversions
Test Purpose:	To verify that conversions for the Cassini-Soldner map projection method are consistent with EPSG.
Test Process:	• Invoke coordinate conversions in both directions and inspect results • For the last test point, perform iterations of forward and reverse computations using the output of computation *n* as input into computation *n+1*, until the output coordinate values exceed more than 0.006m (6mm) or 0.00000006° from the original calculated values (but no more than 1000 iterations).
Test Data:	*GIGS_conv_5108_Cass_input*. This data includes forward and reverse calculations.
Expected Results:	• Results should agree to within 0.05m (50mm) or 0.0000006° of the Test Data. See file *GIGS_conv_5108_Cass_output.* • For the round trip calculation the initial calculated coordinates of the point should change by less than 0.006m (6mm) or 0.00000006° (before 1000 iterations). • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	Method may be called "Cassini".

Test Procedure:	5109 - Albers Equal Area conversions
Test Purpose:	To verify that conversions for the Albers Equal Area map projection method are consistent with EPSG.
Test Process:	• Invoke coordinate conversions in both directions and inspect results • For the last test point, perform iterations of forward and reverse computations using the output of computation *n* as input into computation *n+1*, until the output coordinate values exceed more than 0.006m (6mm) or 0.00000006° from the original calculated values (but no more than 1000 iterations).
Test Data:	*GIGS_conv_5109_Albers_input*. This data includes forward and reverse calculations.
Expected Results:	• Results should agree to within 0.05m (50mm) or 0.0000006° of the Test Data. See file *GIGS_conv_5109_Albers_output.* • For the round trip calculation the initial calculated coordinates of the point should change by less than 0.006m (6mm) or 0.00000006° (before 1000 iterations). • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	Method may be called "Albers".

Test Procedure:	5110 - Lambert Azimuthal Equal Area conversions
Test Purpose:	To verify that conversions for the Lambert Azimuthal Equal Area map projection method are consistent with EPSG.
Test Process:	• Invoke coordinate conversions in both directions and inspect results • For the last test point, perform iterations of forward and reverse computations using the output of computation *n* as input into computation *n+1*, until the output coordinate values exceed more than 0.006m (6mm) or 0.00000006° from the original calculated values (but no more than 1000 iterations).
Test Data:	*GIGS_conv_5110_LAEA_input*. This data includes forward and reverse calculations.
Expected Results:	• Results should agree to within 0.05m (50mm) or 0.0000006° of the Test Data. See file *GIGS_conv_5110_LAEA_output*. • For the round trip calculation the initial calculated coordinates of the point should change by less than 0.006m (6mm) or 0.00000006° (before 1000 iterations). • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	Method may be called "LAEA".

Test Procedure:	5111 - Mercator (variant A) conversions
Test Purpose:	To verify that conversions for the Mercator (variant A) map projection method are consistent with EPSG.
Test Process:	• Invoke coordinate conversions in both directions and inspect results, for all parts • For the first test point in part 1, perform iterations of forward and reverse computations using the output of computation *n* as input into computation *n+1*, until the output coordinate values exceed more than 0.006m (6mm) or 0.00000006° from the original calculated values (but no more than 1000 iterations).
Test Data:	*GIGS_conv_5111_MercA_input_part[x]*. This data includes forward and reverse calculations. The test is in two parts, one using a geographic CRS based on the Greenwich meridian, the other using a non-Greenwich CRS.
Expected Results:	• Results should agree to within 0.05m (50mm) or 0.0000006° of the Test Data. See file *GIGS_conv_5111_MercA_output_part[x].* • For the round trip calculation the initial calculated coordinates of the point should change by less than 0.006m (6mm) or 0.00000006° (before 1000 iterations). • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• Method may be called Mercator (1SP). • Part 2 uses a non-Greenwich prime meridian. Applications may not handle CRSs using a prime meridian other than (by default) Greenwich. Should this be the case, this failure should be documented.

Test Procedure:	5112 - Mercator (variant B) conversions
Test Purpose:	To verify that conversions for the Mercator (variant B) map projection method are consistent with EPSG.
Test Process:	• Invoke coordinate conversions in both directions and inspect results • For the last test point, perform iterations of forward and reverse computations using the output of computation *n* as input into computation *n+1*, until the output coordinate values exceed more than 0.006m (6mm) or 0.00000006° from the original calculated values (but no more than 1000 iterations).
Test Data:	*GIGS_conv_5112_MercB_input*. This data includes forward and reverse calculations

Expected Results:	• Results should agree to within 0.05m (50mm) or 0.0000006° of the Test Data. See file *GIGS_conv_5112_MercB_output.* • For the round trip calculation the initial calculated coordinates of the point should change by less than 0.006m (6mm) or 0.00000006° (before 1000 iterations). • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• In EPSG literature prior to 2010 this method was previously called "Mercator (2SP)". However this name is ambiguous. See EPSG Guidance Note 7 part 2 October 2010 or later revision for further information on the variants of the Mercator method. • Applications may support variant C rather than this variant B. Should that be the case the test may be run using a value of 0.0 for the "latitude of origin" defining parameter.

Test Procedure:	**5113 - Transverse Mercator (South Orientated) conversions**
Test Purpose:	To verify that conversions for the Transverse Mercator (South Orientated) map projection method are consistent with EPSG.
Test Process:	• Invoke coordinate conversions in both directions and inspect results • For the last test point, perform iterations of forward and reverse computations using the output of computation *n* as input into computation *n+1*, until the output coordinate values exceed more than 0.006m (6mm) or 0.00000006° from the original calculated values (but no more than 1000 iterations).
Test Data:	*GIGS_conv_5113_TMSO_input*. This data includes forward and reverse calculations.
Expected Results:	• Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. See file *GIGS_conv_5113_TMSO_output.* • For the round trip calculation the initial calculated coordinates of the point should change by less than 0.006m (6mm) or 0.00000006° (before 1000 iterations). • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	

End of 5100 Test Procedures

2.11.4 5200 Coordinate Transformation Test Procedures

The Test Procedures in this series are designed to evaluate the software's accuracy in performing coordinate transformations. Several transformation methods commonly used in the energy industry are tested, using realistic coordinate values (see Appendix E).

The transformation method names follow those in the EPSG Dataset. If the software does not follow this recommended method naming, see the individual Test Procedure descriptions that follow for tips for some common alternative names for the same method. Test Procedures for which the method is not supported by the software should be reported as such in the Test, and the Test Data excluded from the testing process.

Software is not required to use the formulae published by EPSG, but its algorithms are expected to give results which are not significantly different (see individual test tolerances) to those using the EPSG formulae.

The Test Data for this series comprises input and output files with each test point on a separate row in the data array. Points to be input for the forward and reverse calculations are generally interleaved in adjacent rows. The general process is to load the input file; transform coordinates from geogCRS 1 to geogCRS 2; transform the coordinates referenced to geogCRS 2 to geogCRS 1; compare the results with the values in the output file data array. All points in the input file should be tested in the direction dictated by the input fields. Round trip calculations from the transformed coordinates back to the original should also be tested for the point or points indicated in the input file, with final coordinates compared with the starting values.

The CRSs to which input and output coordinates are referenced are given in the file headers (see series 3000 data for associated parameters). The use of special GIGS geodetic entities created in the Series 3000 tests is deliberate. Should software fail the Series 3000 tests and have passed the Series 2000 tests it should still be possible to run this series of tests.

In some cases there may be multiple CRSs (usually 2D and 3D versions) to be tested for one Test Procedure (or subtly different algorithms). In this case the files are split into multiple parts.

Coordinates of test points are given in the order and units that are described in the CRS definition. Latitude and longitude are given in decimal degree (or grads) representation, Decimal degree values for latitude are positive for the northern hemisphere, negative for the southern hemisphere, and values for longitude are positive for the eastern hemisphere, negative for the western hemisphere. Note: So-called "early binding" software will require the transformation to be defined as part of a CRS definition. The necessary transformations are given in Series 3000 Test Procedures 3007 (horizontal) and 3009 (vertical).

Each set of Test Data comprises a small number of points, mostly laid out in two perpendicular transects. These transects avoid the system origin. When considered appropriate, additional points or transects have been added. The test points are divided into multiple subsets and data for testing both forward and reverse cases have been generated. The tests investigate computational behaviour of the method within and slightly beyond the reasonable area of use. In general, possible failure points at "difficult" locations such as a geographic pole, have not been included. The test points have been extended well away from a practical and reasonable "area of use".

The Test Datasets are not exhaustive. Developers are expected to augment the data to test frequently encountered failure conditions (boundary conditions, etc). Precision of Test Data is further described in Section 2.5.

The Test Procedures in the 5200 series are designed for the transformation of individual points. If the software does not have the functionality to allow this, it may be necessary to first create a project for each Test Procedure and to load the test points as if they were the locations of geoscience data. In this case, the project CRS could be either the source CRS or the target CRS defined in the Test Procedure.

Furthermore, the Test Datasets are designed to test methods individually. This configuration does not test software behaviour for the selection of coordinate transformation method when several methods are available, for example in Australia where low, medium and high accuracy variants are promoted using 3-parameter geocentric translation, 7-parameter coordinate frame and NTv2 methods respectively. Software might not allow a User to override the use of a higher accuracy method with a coordinate transformation using a lower accuracy method. This should be investigated without a specific Test Data set.

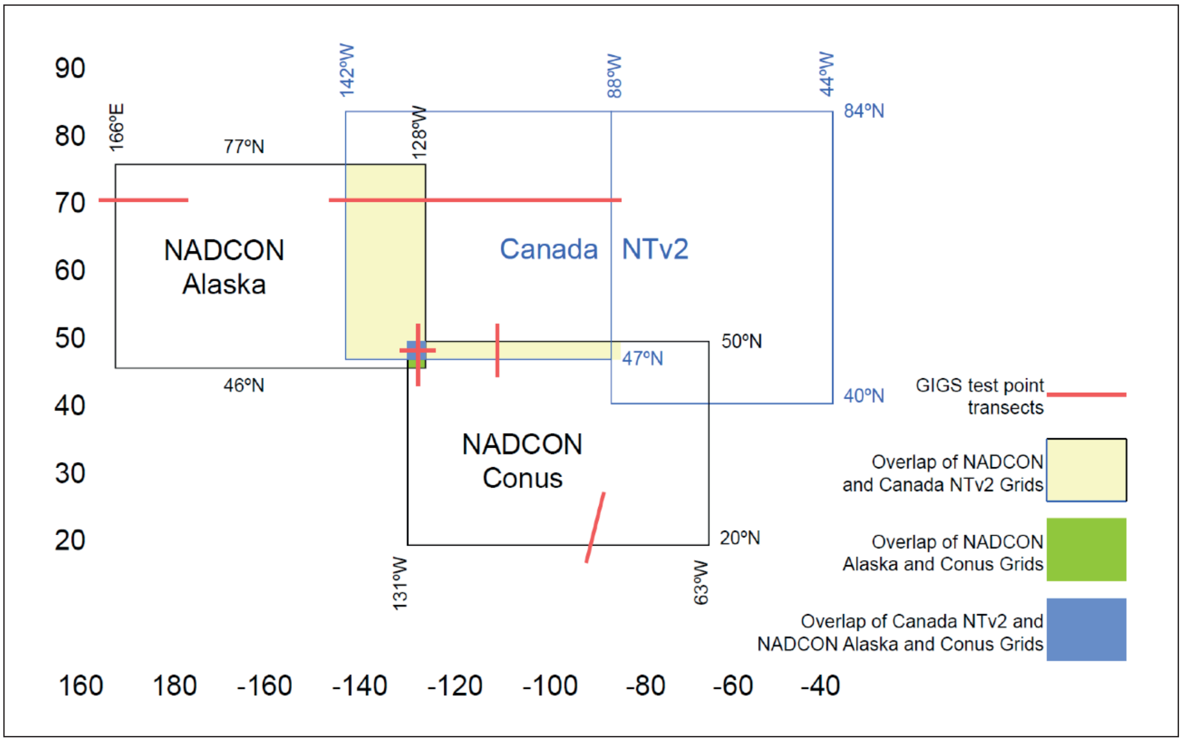


Figure 5: GIGS tests for NTv2 and NADCON methods in relation to grid coverage.

Test Procedure:	**5201 - Geographic/geocentric conversions**
Test Purpose:	To verify that conversions for the geographic/geocentric method are consistent with EPSG method 9602 (Geographic/geocentric conversions).
Test Process:	• Invoke coordinate conversions in both directions and inspect results. • For the first and last test point, perform iterations of forward and reverse computations using the output of computation *n* as input into computation *n+1*, until the output coordinate values exceed more than 0.006m (6mm) or 0.00000006° from the original calculated values (but no more than 1000 iterations).
Test Data:	*GIGS_tfm_5201_GeogGeocen_input*. This data includes forward and reverse calculations.
Expected Results:	• Results should agree to within 0.01m (10mm) or 0.00000009° of the Test Data. See file *GIGS_tfm_5201_GeogGeocen_output*. • For the round trip calculation the initial calculated coordinates of the point should change by less than 0.006m (6mm) or 0.00000006° (before 1000 iterations). • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• Although technically a conversion, this method is most likely to be applicable only in applications which can handle transformations and is therefore treated in this section. • Applications may not handle geocentric Cartesian coordinates. Should this be the case, then this test cannot be conducted. The reason for failure should be stated. • The same test point input coordinates are used as input in Test Procedures 5201, 5203-5205 and 5211-5213. Output coordinates differ due to the different CRSs and transformations used in these tests.

Test Procedure:	5203 - Position Vector (geographic domain) transformations
Test Purpose:	To verify that transformations for the Position Vector 7-parameter transformation method (which operate both 'from' and 'to' geographic coordinates) are consistent with EPSG methods. Either the Position Vector transformation (geog2D domain), method 9606 or Position Vector transformation (geog3D domain) method 1037 is acceptable.
Test Process:	• Invoke GIGS transformation "GIGS geogCRS B to GIGS geogCRS A (2)", GIGS code 61314 in both directions and inspect results, for all parts. • For the first test point in part 1 and part 2, perform iterations of forward and reverse computations using the output of computation *n* as input into computation *n+1*, until the output coordinate values exceed more than 0.006m (6mm) or 0.00000006° from the original calculated values (but no more than 1000 iterations).
Test Data:	*GIGS_tfm_5203_PosVec_input_part[x]*. This data includes forward and reverse calculations. The Test Data is in two parts.
Expected Results:	• Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. See file *GIGS_tfm_5203_PosVec_output_part[x].* • For the round trip calculation the initial calculated coordinates of the point should change by less than 0.006m (6mm) or 0.00000006° (before 1000 iterations). • Test result will be pass or fail. If fail, details of failure should be reported. • Some applications ignore ellipsoidal heights during these transformations (or set the input ellipsoidal heights to zero). If that is the case, results will match the results as shown for the geog2D case, EPSG method 9606. Horizontal coordinates obtained for those points with ellipsoidal heights significantly different from zero will be incorrect, whereas correct results may be generated for points with zero (or near zero) ellipsoidal heights. For large ellipsoidal heights (either positive or negative), the correct results are given by the geog3D EPSG method 1037. Results that are a match should be clearly documented in the report on the test results.
Note:	• If the application does not appear to support this method but has one called "Helmert 7-parameter" or "Bursa Wolf", this may be an equivalent method. • In practice coordinate transformation parameters are defined using a variety of units. The Test Data includes coordinate transformations of interest to the industry using different units of measure. • The same test point input coordinates are used as input in Test Procedures 5201, 5203-5205 and 5211-5213. Output coordinates differ due to the different CRSs and coordinate transformations in these tests.

Test Procedure:	5204 - Coordinate Frame Rotation (geographic 2D domain) transformations
Test Purpose:	To verify that transformations for the Coordinate Frame Rotation method (which operate both 'from' and 'to' geographic 2D coordinates) are consistent with EPSG methods. Either the Coordinate Frame Rotation (geog2D domain), method 9607 or Coordinate Frame Rotation (geog3D domain) method 1038 is acceptable.
Test Process:	• Invoke GIGS transformation "GIGS geogCRS E to GIGS geogCRS A (2)", GIGS code 15929 in both directions and inspect results, for all parts. • For the first test point in part 1 and part 2, perform iterations of forward and reverse computations using the output of computation *n* as input into computation *n+1*, until the output coordinate values exceed more than 0.006m (6mm) or 0.00000006° from the original calculated values (but no more than 1000 iterations).
Test Data:	*GIGS_tfm_5204_CoordFrame_input_part[x]*. This data includes forward and reverse calculations. The Test Data is in two parts.

Expected Results:	• Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. See file *GIGS_tfm_5204_CoordFrame_output_part[x].* • For the round trip calculation the initial calculated coordinates of the point should change by less than 0.006m (6mm) or 0.00000006° (before 1000 iterations). • Test result will be pass or fail. If fail, details of failure should be reported. • Some applications ignore ellipsoidal heights during these transformations (or set the input ellipsoidal heights to zero). If that is the case, results will match the results as shown for the geog2D case, EPSG method 9607. Horizontal coordinates obtained for those points with ellipsoidal heights significantly different from zero will be incorrect, whereas correct results may be generated for points with zero (or near zero) ellipsoidal heights. For large ellipsoidal heights (either positive or negative), the correct results are given by the geog3D EPSG method 1037. Results that are a match should be clearly documented in the report on the test results.
Note:	• There are two opposing sign conventions for the rotations in 7-parameter geocentric transformations. EPSG distinguishes these as two discrete methods; see also Test Procedure 5203 above. Applications may use only one of these conventions within its coordinate transformation engine, but it is expected that it will accept coordinate transformation definitions for both methods and make the necessary adjustments internally. Should the application fail to make these adjustments the output will be incorrect. • If the application does not appear to support this method but has one called "Helmert 7-parameter" or "Bursa Wolf", this may an equivalent method. • The same test point input coordinates are used as input in Test Procedures 5201, 5203-5205 and 5211-5213. Output coordinates differ due to the different CRSs and coordinate transformations in these tests.

Test Procedure:	**5205 - Molodensky-Badekas (geographic 2D domain) transformations**
Test Purpose:	To verify whether transformations for the Molodensky-Badekas method (which operate f both 'from' and 'to' geographic 2D coordinates) are consistent with EPSG methods. Either the Molodensky-Badekas (geog2D domain), method 9636 or Molodensky-Badekas (geog3D domain) method 1039 is acceptable.
Test Process:	• Invoke GIGS transformation "GIGS geogCRS C to GIGS geogCRS A (3)", GIGS code 61003 in both directions and inspect results, for all parts. • For the first test point in part 1 and part 2, perform iterations of forward and reverse computations using the output of computation *n* as input into computation *n+1*, until the output coordinate values exceed more than 0.00000006° from the original calculated values (but no more than 1000 iterations).
Test Data:	*GIGS_tfm_5205_MolBad_input_part[x].* This data includes forward and reverse calculations. The Test Data is in two parts.
Expected Results:	• Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. See file *GIGS_tfm_5205_MolBad_output_part[x].* • For the round trip calculation the initial calculated coordinates of the point should change by less than 0.006m (6mm) or 0.00000006° (before 1000 iterations). • Test result will be pass or fail. If fail, details of failure should be reported. • Some applications ignore ellipsoidal heights during these transformations (or set the input ellipsoidal heights to zero). If that is the case, results will match the results as shown for the geog2D case, EPSG method 9606. Horizontal coordinates obtained for those points with ellipsoidal heights significantly different from zero will be incorrect, whereas correct results may be generated for points with zero (or near zero) ellipsoidal heights. For large ellipsoidal heights (either positive or negative), the correct results are given by the geog3D EPSG method 1037. Results that are a match should be clearly documented in the report on the test results.
Note:	• See Test Procedure 5212 for a similar test operating between geocentric coordinates. • The same test point input coordinates are used as input in Test Procedures 5201, 5203-5205 and 5211-5213. Output coordinates differ due to the different CRSs and coordinate transformations in these tests.

Test Procedure:	5206 - NADCON transformations
Test Purpose:	To verify that coordinate transformations for the NADCON method are consistent with EPSG method 9613.
Test Process:	• Invoke respective grid-based transformations in both directions and inspect results, for either part 1 or part 2 and part 3. • This test uses two pairs of binary gridded data files [Alaska.las Alaska.los; Conus.las Conus.los]. It is assumed that these files are included in the application being tested. If necessary, the gridded data files may be downloaded from NGS. The equivalent EPSG transformation names are: NAD27 to NAD83 (2) (code 1243) and NAD27 to NAD83 (1) (code 1241). • For the first test point perform iterations of forward and reverse computations using the output of computation *n* as input into computation *n+1*, until the output coordinate values exceed more than 0.00000006° from the original calculated values (but no more than 1000 iterations).
Test Data:	*GIGS_tfm_5206_Nadcon_input_part[x].* This data includes forward and reverse calculations. The Test Data is in either one or two parts, if application requires early-binding use parts 2 and 3 only, part 1 is for all other applications.
Expected Results:	• Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. See file *GIGS_tfm_5206_Nadcon_output.* • For the round trip calculation the initial calculated coordinates of the point should change by less than 0.006m (6mm) or 0.00000006° (before 1000 iterations). • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• This method uses a 'longitude positive to the west' convention. This should be handled internally within the application, as the EPSG and ISO convention of longitudes positive east should be presented to Users. • In North America there is an overlap in NADCON and NTv2 grid coverage. For applications incorporating both methods, the results in the area of overlap should be checked. Some of the test points are in the overlap areas and are common with those in Test Procedure 5207. See Figure 5 above. The expectation is that NADCON grids are used within the USA and NTv2 grids are used within Canada. • The 5200 series is designed to test the transformation functionality of an application. Any similarities in the grid-based transformations required by those defined in Test Procedure 3208 is coincidental, and not related. As it happens, the source and target CRSs for the NADCON tests are the same, but Test Procedures 5206 (and 5207) are not dependent upon the results of other tests, they stand on their own. Test Procedure 5206 requires two pairs of NADCON files, conus.las/conus.los and alaska.las/alaska.los. The file to be used is determined by the latitude and longitude of each test point. If the application being tested does not have these grids bundled within it, they will need to be obtained from the National Geodetic Survey.

Test Procedure:	5207 - NTv2 transformations
Test Purpose:	To verify that coordinate transformations for the NTv2 method are consistent with EPSG method 9615.
Test Process:	• Invoke respective grid-based transformations in both directions and inspect results, for both parts • This test uses gridded data files [A66 National (13.09.01).gsb for Australia and NTv2.gsb for Canada]. It is assumed that these files are included in the application being tested. If necessary, the gridded data file for Australia may be downloaded from ICSM and for Canada from NRCAN. Equivalent EPSG transformation names and codes: AGD66 to GDA94 (11) (code 1803); NAD27 to NAD83 (4) (code 1313). • For the first test point in part 1 and part 2 perform iterations of forward and reverse computations using the output of computation *n* as input into computation *n+1*, until the output coordinate values exceed more than 0.00000006° from the original calculated values (but no more than 1000 iterations).
Test Data:	*GIGS_tfm_5207_NTv2_input_part[x].* This data includes forward and reverse calculations. The Test Data is in two parts.

Expected Results:	• Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. See file *GIGS_tfm_5207_NTv2_output_part[x].* • For the round trip calculation the initial calculated coordinates of the point should change by less than 0.006m (6mm) or 0.00000006° (before 1000 iterations). • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• This method uses a 'longitude positive to the west' convention. This should be handled internally within the application, as the EPSG and ISO convention of longitudes positive east should be presented to users. • In North America there is an overlap in NADCON and NTv2 grid coverage. For applications incorporating both methods the results in the area of overlap should be checked. Some of the test points are in the overlap areas and common with those in Test Procedure 5206. See figure 1 above. Results should be compared. The expectation is that NADCON grids are used within the USA and NTv2 grids are used within Canada. • Some applications support this method only for Canada. However, the NTv2 transformation method is actively used in many countries outside of Canada (where it originated). For example, official NTv2 coordinate transformations exist for Australia, New Zealand, France, Spain and Germany. • An issue has been reported with the implementation of NTv2 grids in Australia in some applications. The problem points appear to fall on certain parallels and meridians, such as 8.55°S and 138.05°E, which match edge points or corner points of the Australian NTv2 sub grids. Points to test the 138.05°E meridian have been included. The parallel of 8.55°S, however, fell outside the Australian online converter used for generating the Test Dataset. The included task should suffice since failure at the selected meridian 138.05°E test points will also imply failure at the other problematic sub grid junction points.

Test Procedure:	5208 - Longitude rotation
Test Purpose:	To verify that transformations for the Longitude Rotation method are consistent with EPSG method 9601.
Test Process:	• Invoke GIGS transformation "GIGS geogCRS H to GIGS geogCRS T (1)", GIGS code 61763 in both directions and inspect results • For the first test point perform iterations of forward and reverse computations using the output of computation *n* as input into computation *n+1*, until the output coordinate values exceed more than 0.00000006° from the original calculated values (but no more than 1000 iterations).
Test Data:	*GIGS_tfm_5208_LonRot_input*. This data includes forward and reverse calculations.
Expected Results:	• Results should agree to within 0.03m (30mm) or 0.0000003 grad (dependent on latitude) of the Test Data. See file *GIGS_tfm_5208_LonRot_output.* • For the round trip calculation the initial calculated coordinates of the point should change by less than 0.006m (6mm) or 0.00000006 grad (before 1000 iterations). • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	Applications may not handle CRSs using a prime meridian other than Greenwich (by default). This should be considered a failure for this method.

Test Procedure:	**5209 - Bin grid transformation**
Test Purpose:	To verify that transformations for the P6 seismic bin grid affine method are consistent with EPSG method 9666
Test Process:	• Define bin grid in application using parameters in ASCII file, or P6 file used in Test Procedure 5403 • Invoke coordinate operation in both directions and inspect results • For the first test point perform iterations of forward and reverse computations using the output of computation *n* as input into computation *n+1*, until the output coordinate values exceed more than 0.006m (6mm) from the original calculated values (before 1000 iterations). • This test uses the following Bin Grid definition: – Projected CRS name: GIGS projCRS A1 (WGS 84 / UTM zone 31N) – CRS code: GIGS:62001 (EPSG:32631) – Orientation (deg) = 20 – Bin width I (map grid units) = 25.00 – Bin width J (map grid units) = 12.50 – Increment I = 2.00 – Increment J = 2.00 – Scale factor = 1 – Origin - E = 414188.460 – Origin - N = 5761775.889 – Origin - I = 1 – Origin - J = 10000
Test Data:	*GIGS_tfm_5209_BinGrid_input*. This data includes forward and reverse calculations.
Expected Results:	• Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. See file *GIGS_tfm_5209_BinGrid_output*. • For the round trip calculation the initial calculated coordinates of the point should change by less than 0.006m (6mm) or 0.00000006° (before 1000 iterations). • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• If the application does not handle P6 bin grid data, this Test Procedure should be documented as non-applicable. • This Test Procedure is referenced in 5400 (3D Seismic Data) although it has a 52XX code. This is because the original Test Data was being developed specifically for manual bin grid transformations, but was then supplemented in later GIGS revisions to incorporate the P6 file.

Test Procedure:	**5210 - Vertical offset**
Test Purpose:	To verify that transformations for the vertical offset method are consistent with EPSG method 9616.
Test Process:	• Invoke GIGS vertical transformations "GIGS vertCRS W1 height/depth to GIGS vertCRS V1 height/depth", GIGS codes 65400, 65438, 65440 and 65441, in both directions • For the first test point perform iterations of forward and reverse computations using the output of computation *n* as input into computation *n+1*, until the output coordinate values exceed more than 0.006m (6mm) from the original calculated values (before 1000 iterations). • The order of transformations is discretionary, but the following is recommended: – transform height referenced to "GIGS vertCRS W1" into depth referenced to "GIGS vertCRS W1". – transform height referenced to "GIGS vertCRS W1" into height referenced to "GIGS vertCRS V1". – transform height referenced to "GIGS vertCRS W1" into depth referenced to "GIGS vertCRS V1". – transform depth referenced to "GIGS vertCRS W1" into height referenced to "GIGS vertCRS W1". – transform depth referenced to "GIGS vertCRS W1" into height referenced to "GIGS vertCRS V1". – transform depth referenced to "GIGS vertCRS W1" into depth referenced to "GIGS vertCRS V1". – transform height referenced to "GIGS vertCRS V1" into height referenced to "GIGS vertCRS W1". – transform height referenced to "GIGS vertCRS V1" into depth referenced to "GIGS vertCRS W1". – transform height referenced to "GIGS vertCRS V1" into depth referenced to "GIGS vertCRS V1". – transform depth referenced to "GIGS vertCRS V1" into height referenced to "GIGS vertCRS W1". – transform depth referenced to "GIGS vertCRS V1" into depth referenced to "GIGS vertCRS W1". – transform depth referenced to "GIGS vertCRS V1" into height referenced to "GIGS vertCRS V1".

Test Data:	*GIGS_tfm_5210_VertOff_input.* This data includes forward and reverse calculations using GIGS vertical datums V and W, that is, vertCRSs V1 height, V1 depth, W1 height and W1 depth.
Expected Results:	• Results should agree to within 0.01m (10mm) or 0.00000009° of the Test Data. See file *GIGS_tfm_5210_VertOff_output.* • For the round trip calculation the initial calculated coordinates of the point should change by less than 0.006m (6mm) or 0.00000006° (before 1000 iterations). • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• Applications may not handle both heights and depths simultaneously with correct signage (which should be reported). • Due to file format structure, this Test Data cannot be consumed in P1/11 subclass format, only use the ASCII files for this Test Procedure

Test Procedure:	**5211 - Geocentric translations (geocentric domain) transformations**
Test Purpose:	To verify whether coordinate transformations for the geocentric translation method, which operate 'from' and 'to' geocentric Cartesian coordinates, are consistent with EPSG transformation method 1031.
Test Process:	• Invoke GIGS transformation "GIGS geogCRS B to GIGS geogCRS A (1)", GIGS code 61196 in both directions and inspect results. • For the first test point perform iterations of forward and reverse computations using the output of computation *n* as input into computation *n+1*, until the output coordinate values exceed more than 0.006m (6mm) from the original calculated values (before 1000 iterations).
Test Data:	*GIGS_tfm_5211_3trnslt_Geocen_input.* This data includes forward and reverse calculations.
Expected Results:	• Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. See file *GIGS_tfm_5211_3trnslt_Geocen_output.* • For the round trip calculation the initial calculated coordinates of the point should change by less than 0.006m (6mm) or 0.00000006° (before 1000 iterations). • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• Applications may not handle geocentric Cartesian coordinates. Should this be the case, then this test cannot be conducted. The reason for failure should be stated. • See Test Procedures 5212 and 5213 for similar tests operating between geographic 2D CRSs and geographic 3D CRSs respectively. • The same test point input coordinates are used as input in Test Procedures 5201, 5203-5205 and 5211-5213.

Test Procedure:	**5212 - Geocentric translations (geographic 3D domain) transformations.**
Test Purpose:	To verify whether coordinate transformations for the Geocentric Translation method which operate 'from' and 'to' geographic 3D coordinate reference systems are consistent with EPSG method 1035.
Test Process:	• Invoke GIGS transformation "GIGS geogCRS B to GIGS geogCRS A (1)", GIGS code 61196 in both directions and inspect results. • For the first test point perform iterations of forward and reverse computations using the output of computation *n* as input into computation *n+1*, until the output coordinate values exceed more than 0.006m (6mm) or 0.00000006° in horizontal and vertical from the original calculated values (before 1000 iterations).
Test Data:	*GIGS_tfm_5212_3trnslt_Geog3D_input.* This data includes forward and reverse calculations.

Expected Results:	• Results should agree to within 0.03m (30mm) or 0.0000003° horizontal and 0.01m (10mm) 0.00000009° vertical of the Test Data. See files *GIGS_tfm_5212_3trnslt_Geog3D_output_AbrMol* or *GIGS_tfm_5212_3trnslt_Geog3D_output_EPSGconcat*. These two sets use alternative methods, both of which are valid for the transformation of geographic 3D CRSs. Report which of the coordinate transformation methods the application is using. • For the round trip calculation the initial calculated coordinates of the point should change by less than 0.006m (6mm) or 0.00000006° in horizontal and vertical (before 1000 iterations). • Test result will be pass or fail. If fail, details of failure should be reported. • Some applications ignore the ellipsoidal heights during these transformations (or set the input ellipsoidal heights to zero). If that is the case, horizontal coordinates obtained for those points with ellipsoidal heights significantly different from zero will be incorrect, whereas correct results may be generated for points with zero (or near zero) ellipsoidal heights. For large ellipsoidal heights (either positive or negative), the correct results are given by the geog3D EPSG method 1035. Results that match should be clearly documented in the report on the test results. To assist this evaluation, the results file includes data generated using the Abridged Molodensky method.
Note:	• See Test Procedures 5211 and 5213 for similar tests operating between geocentric CRSs and geographic 2D CRSs respectively. • The same test point input coordinates are used as input in Test Procedures 5201, 5203-5205 and 5211-5213. In general output coordinates differ due to the different CRSs and transformations in these tests. The intermediate geocentric coordinates obtained performing this method, however, are used as both input and output coordinates for Test Procedure 5211 above.

Test Procedure:	**5213 - Geocentric translations (geographic 2D domain) transformations.**
Test Purpose:	To verify whether coordinate transformations for the geocentric translation method which operate 'from' and 'to' geographic 2D coordinate reference systems are consistent with EPSG methods. Either EPSG method 9603 geocentric translation (geog2D domain), or method 9605 Abridged Molodensky, is acceptable.
Test Process:	• Invoke GIGS transformation "GIGS geogCRS B to GIGS geogCRS A (1)", GIGS code 61196 in both directions and inspect results. • For the first test point perform iterations of forward and reverse computations using the output of computation *n* as input into computation *n+1*, until the output coordinate values exceed more than 0.00000006° from the original calculated values (but no more than 1000 iterations).
Test Data:	*GIGS_tfm_5213_3trnslt_Geog2D_input*. This data includes forward and reverse calculations.
Expected Results:	• One of two possible sets of results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. See file *GIGS_tfm_5213_3trnslt_Geog2D_output_AbrMol* or *GIGS_tfm_5213_3trnslt_Geog2D_output_EPSGconcat*. These two sets use alternative methods, both of which are valid for the transformation of geographic 2D CRSs. Report which of the coordinate transformation methods the application is using. • For the round trip calculation the initial calculated coordinates of the point should change by less than 0.006m (6mm) or 0.00000006° (before 1000 iterations). • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• See Test Procedures 5211 and 5213 for similar tests operating between geocentric CRSs and geographic 3D CRSs respectively. • This test uses a subset of the points used as input into Test Procedures 5201, 5203-5205 and 5212.

End of 5200 Test Procedures

2.11.5 5300 2D Seismic Test Procedures

The Test Procedures for seismic position data in Series 5300 (2D seismic) require loading and unloading of Test Data to a software 'project'. Projects are required to be referenced to specific coordinate reference systems as defined in the Test Procedures below. See Appendix D for an explanation of the project naming and see the user-defined library Series 3000 for the definitions of the CRSs. The projects are also used for the Series 5400 3D Seismic and Series 5500 wells tests.

The majority of tests use a project area in the southwestern part of the North Sea. This area was chosen because it is within the extended reach of surrounding countries in which CRSs using several important conversion and transformation methods are found. However, to use the Test Data agnostically in software that may have predefined implementations of "real world" CRS which happen to be applicable to the project area, a fictitious CRS (WGS 84 / British National Grid) was chosen as the target CRS for data, ensuring that all software are using the same objective CRS. To test geodetic data from elsewhere in the world, other fictitious systems such as one using US Survey Feet are applied to this setting.

The tests in this section use hypothetical seismic line position data. The input Test Dataset files for these tests are synthetic P1/11 or P1/90 format text files, for which an equivalent ASCII file is also provided for software that cannot handle the P1-format. The output files are either in ASCII format or both P1 and ASCII, depending on the nature of the test. The entire Test Series should be repeated for each data exchange format supported, and the results reported for any differences between the different formats.

The Test Data for this series comprises input and output files with each test point (representing a shotpoint) on a separate row in the data array. The general process is to load the input file and transform/convert coordinates referenced from geogCRS 1/projCRS 1 to geogCRS 2/projCRS 2, then compare the results with the values in the output file data array. The seismic 2D position data have been designed so that if converted or transformed correctly the seismic lines will intersect.

The CRS to which input and output coordinates are referenced are given file headers (see series 3000 data for associated parameters). The use of special GIGS geodetic entities created in the Series 3000 Test Procedures is deliberate. Should software fail the Series 3000 tests, but have passed the Series 2000 tests it should still be possible to run this series of Test Procedures.

In some cases, multiple CRSs are tested for one Test Procedure (or subtly different algorithms). In this case the files are split into multiple parts.

The GIGS Test Dataset currently provides both P1/11 and P1/90 format options, but Evaluators may wish to repeat the following Test Procedures using other 2D seismic position data exchange formats that they consider important. SEG-Y files are not provided, and if required should be generated by Evaluators, based on ASCII files. If the application supports more than one exchange format (including different P1 vintages), then each Test Procedure should be repeated for all supported formats and the results individually reported for each test.

Test Procedure:	5306 - Import 2D seismic position data with conversion (map projection) change (1)
Test Purpose:	To verify that the application correctly loads horizontal locations from a P1-format file (or ASCII equivalent) with traditional "full definition" CRS records when a change of map projection is required.
Test Process:	• Load data from test input file to project GIGS_project_A2V1depth. • Verify coordinates in project GIGS_project_A2V1depth against expected results.
Test Data:	*GIGS_seis2D_5306_input_part[x].* The Test Data is in two parts, one for onshore, the other for offshore. The onshore data includes height rather than depth.
Expected Results:	• The application recognises P1 (or ASCII) file CRS definition, converts P1 (or ASCII) file horizontal coordinates and stores correct horizontal locations. Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. See file *GIGS_seis2D_5306_output.* • The application stores an audit trail of CRS actions.
Note:	• This test involves a change of horizontal CRS from the input CRS defined in the input file to the project CRS. The test output file assumes that the application applies a coordinate change and then stores coordinates in the output CRS to which the project is referenced. • The application should retain an audit trail of coordinate change actions. See Series 6000 tests. • The P1-format file requires both geographic and grid coordinates. To verify that the application is handling grid coordinates, the geographic coordinates in the test file have been set to zero and therefore if used by the Evaluator, should cause the seismic position data to appear outside of the project area. • The input file part 1 includes vertical coordinates referenced to a different vertical CRS to that of the project. This is evaluated in Test Procedure 5314. • The same input data is used for Series 6000 audit trail tests. • If the application cannot import P-format data but has a generic ASCII loader, this should be reported and the equivalent ASCII file used.

Test Procedure:	5307 - Import 2D seismic position data with conversion (map projection) change (2)
Test Purpose:	To verify that the application correctly loads horizontal locations from a P1-format file (or ASCII equivalent) with EPSG CRS identification, when a change of map projection is required.
Test Process:	• Load data from test input file to project *GIGS_project_A2V1depth.* • Verify coordinates in project *GIGS_project_A2V1depth* against expected results.
Test Data:	*GIGS_seis2D_5307_input*
Expected Results:	The application recognises P1 (or ASCII) file CRS definition, converts P1 (or ASCII) file horizontal coordinates and stores correct horizontal locations. Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. See file *GIGS_seis2D_5307_output.*
Note:	• See Test Procedure 5306. • The same input data is used for Series 6000 audit trail tests. • If the application cannot import P-format data but has a generic ASCII loader, this should be reported and the equivalent ASCII file used.

Test Procedure:	5308 - Import 2D seismic position data with geodetic datum change (1)
Test Purpose:	To verify that the application correctly loads horizontal locations from a P1-format file (or ASCII equivalent) with traditional CRS definition records when a change of geodetic datum is involved.
Test Process:	• Load data from test input file to project *GIGS_project_A2V1depth*. • Verify coordinates in project *GIGS_project_A2V1depth* against expected results.
Test Data:	*GIGS_seis2D_5308_input_part[x]*. The Test Data is in two parts, one for onshore, the other for offshore.
Expected Results:	• The application recognizes P1 (or ASCII) file CRS definition, converts P1 (or ASCII) file horizontal coordinates and stores correct horizontal locations. Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. See file *GIGS_seis2D_5308_output*. • The application stores an audit trail of CRS actions.
Note:	• This test involves a change of horizontal CRS from input CRS to project CRS. The test output file assumes that the application applies a coordinate transformation and then stores coordinates in the CRS to which the project is referenced. • The application should retain an audit trail of coordinate change actions. See Series 6000 tests. • The P1-format file requires both geographic and grid coordinates. To verify that the application is handling geographic coordinates, the grid coordinates in the test file have been set to zero and therefore if used by the Evaluator, should cause the seismic position data to appear outside the project area. • If the application cannot import P-format data but has a generic ASCII loader, this should be reported and the equivalent ASCII file used.

Test Procedure:	5309 - Import 2D seismic position data with geodetic datum change (2)
Test Purpose:	To verify that the application correctly loads horizontal locations from a P1-format file (or ASCII equivalent) with EPSG CRS identification when a change of geodetic datum is required.
Test Process:	• Load data from test input file to project *GIGS_project_A2V1depth*. • Verify coordinates in project *GIGS_project_A2V1depth* against expected results.
Test Data:	*GIGS_seis2D_5309_input*
Expected Results:	The application recognises P1 (or ASCII) file CRS definition, converts P1 (or ASCII) file horizontal coordinates and stores correct horizontal locations. Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. See file *GIGS_seis2D_5309_output*
Note:	See test 5308.

Test Procedure:	5310 - Import 2D seismic position data with change of horizontal units
Test Purpose:	To verify that the application correctly loads horizontal locations from a P1-format file (or ASCII equivalent) when a change in projected CRS coordinate units (m/ft) is applied.
Test Process:	• Load data from test input file to project *GIGS_project_A2V1depth*. • Verify coordinates in project *GIGS_project_A2V1depth* against expected results.
Test Data:	*GIGS_seis2D_5310_input*
Expected Results:	• The application recognises P1 (or ASCII) file CRS definition, converts P1 (or ASCII) file horizontal coordinates and stores correct horizontal locations. Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. See file *GIGS_seis2D_5310_output*. • The vertical CRS units should not be converted.
Note:	• The P1-format file requires both geographic and grid coordinates. To verify that the application is handling grid coordinates, the geographic coordinates in the test file have been set to zero and therefore if used by the Evaluator, should cause the seismic position data to appear outside the project area. • If the application cannot import P-format data but has a generic ASCII loader, this should be reported and the equivalent ASCII file used.

Test Procedure:	**5311 - Import 2D seismic position data with coordinates in grads**
Test Purpose:	To verify that the application correctly loads coordinates given in grads.
Test Process:	• Load data from test input file to project *GIGS_project_A2V1depth*. • Verify coordinates in project *GIGS_project_A2V1depth* against expected results.
Test Data:	*GIGS_seis2D_5311_input*
Expected Results:	The application recognises P1 (or ASCII) file CRS definition, converts P1 (or ASCII) file horizontal coordinates in grads and stores correct horizontal locations. Results should agree to within 0.03m (30mm) or 0.0000003 grad of the Test Data. See file *GIGS_seis2D_5311_output*
Note:	Gradians is not supported in the P1/11 file format S1 position record, so cannot be supplied.

Test Procedure:	**5312 - Import 2D seismic position data with vertical datum change**
Test Purpose:	To verify that the application correctly loads vertical locations from a P1-format file (or ASCII equivalent) when a change of vertical datum is required.
Test Process:	• Load data from test input file to project *GIGS_project_A2V1depth*. • Verify coordinates in project *GIGS_project_A2V1depth* against expected results.
Test Data:	*GIGS_seis2D_5312_input_part[x]*. The Test Data is in two parts, one for onshore, the other for offshore. The onshore data includes height rather than depth.
Expected Results:	The application recognises P1 (or ASCII) file CRS definition, transforms P1 (or ASCII) file vertical coordinates and stores correct vertical locations. Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. See file *GIGS_seis2D_5312_output*
Note:	• This test involves a change of CRS from input CRS to project CRS. The test output file assumes that the application applies a coordinate transformation and then stores coordinates in the CRS to which the project is referenced. • The application should retain an audit trail of coordinate change actions. See Series 6000 tests. • If the application cannot import P-format data but has a generic ASCII loader, this should be reported and the equivalent ASCII file used.

Test Procedure:	**5313 - Import 2D location seismic data with ellipsoidal height**
Test Purpose:	To verify that the application correctly loads vertical locations when ellipsoidal height is used.
Test Process:	• Load data from test input file to project *GIGS_project_A2V1depth*. • Verify coordinates in project *GIGS_project_A2V1depth* against expected results.
Test Data:	*GIGS_seis2D_5313_input*
Expected Results:	The application recognises P1 (or ASCII) file CRS definition, transforms P1 (or ASCII) file ellipsoidal 3D coordinates and stores correct vertical locations. Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. See file *GIGS_seis2D_5313_output*
Note:	• This test involves a change from ellipsoidal height given in the input file to the gravity-related height which the project uses. The test assumes that the application applies a geoid model coordinate transformation and then stores coordinates in the CRS to which the project is referenced. Use of the EGM08 geoid model is assumed. • The P1-format file requires both geographic and grid coordinates. To verify that the application is handling geographic 3D coordinates, the grid coordinates in the test file have been set to zero and therefore if used by the Evaluator, should cause the seismic position data to appear outside the project area. • The application should retain an audit trail of coordinate change actions. See Series 6000 tests. • If the application cannot import P-format data but has a generic ASCII loader, this should be reported and the equivalent ASCII file used.

Test Procedure:	5314 - Import 2D location seismic data with change of vertical units
Test Purpose:	To verify that the application correctly loads vertical locations from a P1-format file (or ASCII equivalent) when a change in vertical coordinate units (ft/m) is applied.
Test Process:	• Load data from test input file to project *GIGS_project_A2V1depth*. • Verify coordinates in project *GIGS_project_A2V1depth* against expected results.
Test Data:	*GIGS_seis2D_5314_input*
Expected Results:	The application recognises P1 file CRS definition, converts P1 file vertical coordinates and stores correct vertical values. Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. See file *GIGS_seis2D_5314_output*
Note:	If the application cannot import P-format data but has a generic ASCII loader, this should be reported and the equivalent ASCII file used.

Test Procedure:	5315 - Import and decimate or reduce 2D seismic position data
Test Purpose:	*To verify that the application correctly loads and "decimates" locations from a P1-format file (or ASCII equivalent). The test is designed to reduce the number of locations stored to the minimum required to honour line geometry, that is, to store only line end points and, if present, intermediate points at which the line orientation changes (bends). The test is only in the horizontal domain.* *Sometimes called "decimation" because some application stores every tenth location. No coordinate conversions or transformations are required for this test.*
Test Process:	• Load data from test input file to project *GIGS_project_A2V1depth*. • Verify coordinates in project *GIGS_project_A2V1depth* against expected results.
Test Data:	*GIGS_seis2D_5315_input*
Expected Results:	The application stores correct horizontal locations. Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. See file *GIGS_seis2D_5315_output*
Note:	• Line GIGS-5315-16 includes two curves: application may vary in how it treats these. The output file includes every shotpoint around these curves. • Line GIGS-5315-17 has a location (shotpoint 302) with anomalous input coordinates. It should be filtered out. • If the application cannot import P-format data but has a generic ASCII loader, this should be reported and the equivalent ASCII file used.

Test Procedure:	5316 - Export 2D seismic position data with conversion (map projection) change
Test Purpose:	To verify that the application correctly exports to a P1-format file (or ASCII equivalent) when a change of map projection is required, but the same base geographic CRS is maintained.
Test Process:	• Export the Test Data from project *GIGS_project_A2V1depth.* Exported data should be in P1-format (or ASCII) referenced horizontally to CRS GIGS projCRS A1 (WGS 84/UTM zone 31N, EPSG CRS code 32631). • Verify coordinates in the exported data file against expected results.
Test Data:	Seismic line GIGS-5315-17 from GIGS_project_A2V1depth.
Expected Results:	• The application exports locations correctly. See file *GIGS_seis2D_5316_output* • The application exports CRS definition correctly. • Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• This test assumes that seismic line GIGS-5315-17 has been correctly loaded to the project (see Test Procedure 5315). • The same Test Data is used for Test Procedures 5316, 5319, 5320 and 5323. Output for 5316 and 5320 should have same coordinate values, only the medium differs.

Test Procedure:	5317 - Export 2D seismic position data with geodetic datum change
Test Purpose:	To verify that the application correctly exports to a P1-format file (or ASCII equivalent) when a change of geodetic datum is required.
Test Process:	• Export the Test Data from project *GIGS_project_A2V1depth*, the exported data to be in P1-format (or ASCII) referenced horizontally to CRS GIGS projCRS B2 (Ordnance Survey Great Britain 1936/ British National Grid, EPSG CRS code 27700. • Verify coordinates in exported data file against expected results.
Test Data:	Seismic lines GIGS-5306-05 and GIGS-5306-11 from project *GIGS_project_A2V1depth*.
Expected Results:	• The application exports locations correctly. See file *GIGS_seis2D_5317_output* • The application exports CRS definition correctly. • Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• This test assumes that seismic lines GIGS-5306-05 and GIGS-5306-11 have been correctly loaded to the project (see Test Procedure 5306). • The same input Test Data is used for Test Procedures 5317 and 5321. Output should have same coordinate values, only the medium differs.

Test Procedure:	5318 - Export 2D seismic position data with change of horizontal units
Test Purpose:	To verify that the application correctly exports to a P1-format file (or ASCII equivalent) when a change of horizontal CRS unit (m/ft) is required.
Test Process:	• Export the Test Data from project *GIGS_project_A2V1depth*, the exported data to be in P1-format (or ASCII) referenced horizontally to CRS GIGS projCRS A23 (WGS 84/BLM 31N (ftUS)). • Verify coordinates in exported data file against expected results.
Test Data:	Seismic lines GIGS-5306-05 and GIGS-5306-11 from project *GIGS_project_A2V1depth*.
Expected Results:	• The application exports locations correctly. See file *GIGS_seis2D_5318_output* • The application exports CRS definition correctly. • Results should agree to within 0.1 ftUS/ft (1.2in) or 0.0000003° of the Test Data. • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• This test assumes that seismic lines GIGS-5306-05 and GIGS-5306-11 have been correctly loaded to the project (see Test Procedure 5306). • The same input Test Data is used for Test Procedures 5317 and 5321. Output should have same coordinate values, only the medium differs.

Test Procedure:	5319 - Export 2D seismic position data with vertical datum change
Test Purpose:	To verify that the application correctly exports to a P1-format file (or ASCII equivalent) when a change of vertical datum is required.
Test Process:	• Export the Test Data from project *GIGS_project_A2V1depth*, the exported data to be in P1-format (or ASCII) referenced vertically to CRS GIGS vertCRS W1 depth (Caspian depth, EPSG CRS code 5706). • Verify coordinates in exported data file against expected results.
Test Data:	Seismic line GIGS-5315-17 from project GIGS_project_A2V1depth.
Expected Results:	• The application exports locations correctly. See file *GIGS_seis2D_5319_output*. • The application exports CRS definition correctly. • Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• This test assumes that seismic line GIGS-5315-17 has been correctly loaded to the project (see Test Procedure 5315). • The same input Test Data is used for Test Procedures 5316, 5319, 5320 and 5323. Output for 5319 and 5323 should have same coordinate values, only the medium differs.

Test Procedure:	5320 - Transfer 2D seismic position data with conversion (map projection) change
Test Purpose:	To verify that the application correctly transfers 2D seismic position data to a different project when a change of map projection is required.
Test Process:	• In project *GIGS_project_A2V1depth*, select Test Data described below. • Transfer to project *GIGS_project_A1W_A1W1depth*. • Verify data in project *GIGS_project_A1W_A1W1depth* against expected results.
Test Data:	Seismic line GIGS-5315-17 from project *GIGS_project_A2V1depth*.
Expected Results:	• The application transfers horizontal and vertical locations correctly. See file *GIGS_seis2D_5320_output*. • Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• This test involves a change of CRS from source project CRS to target project CRS. The test assumes that the application applies a coordinate change and then stores coordinates in the CRS to which the target project is referenced. • The test assumes that seismic line GIGS-5315-17 has been correctly loaded to the source project (see Test Procedure 5315). • The same input Test Data is used for Test Procedures 5316, 5319, 5320 and 5323. Output for 5316 and 5320 should have same coordinate values, only the medium differs. • The application should retain an audit trail of coordinate change actions. See Series 6000 tests.

Test Procedure:	5321 - Transfer 2D seismic position data with geodetic datum change
Test Purpose:	To verify that the application correctly transfers 2D seismic position data to a different project when a change of geodetic datum is required.
Test Process:	• In project *GIGS_project_A2V1depth*, select Test Data described below. • Transfer to project *GIGS_project_B2V1depth*. • Verify data in project *GIGS_project_B2V1depth* against expected results.
Test Data:	Seismic lines GIGS-5306-05 and GIGS-5306-11 from project *GIGS_project_A2V1depth*.
Expected Results:	• The application transfers horizontal locations correctly. See file *GIGS_seis2D_5321_output*. • Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• This test involves a change of CRS from source project CRS to target project CRS. The test assumes that the application applies a coordinate change and then stores coordinates in the CRS to which the target project is referenced. • The test assumes that seismic lines GIGS-5306-05 and GIGS-5306-11 have been correctly loaded to the source project (see Test Procedure 5306). • The same input Test Data is used for Test Procedures 5317 and 5321. Output should have same coordinate values, only the medium differs. • The application should retain an audit trail of coordinate change actions. See Series 6000 tests.

Test Procedure:	5322 - Transfer 2D seismic position data with horizontal unit change
Test Purpose:	To verify that the application correctly transfers 2D seismic position data to a different project when a change of horizontal CRS unit (m/ft) is required.
Test Process:	• In project *GIGS_project_A2V1depth,* select Test Data as described below. • Transfer to project *GIGS_project_A23V1depth*. • Verify data in project *GIGS_project_A23V1depth* against Test Data.
Test Data:	Seismic lines GIGS-5306-04 and GIGS-5306-12 from project *GIGS_project_A2V1depth*.

Expected Results:	• The application transfers locations correctly. See file *GIGS_seis2D_5322_output*. • Results should agree to within 0.1 ftUS/ft (1.2in) or 0.0000003° of the Test Data. • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• This test involves a change of CRS from source project CRS to target project CRS. The test assumes that the application applies a coordinate change and then stores coordinates in the CRS to which the target project is referenced. • The test assumes that seismic lines GIGS-5308-04 and GIGS-5308-12 have been correctly loaded to the source project (see Test Procedure 5308). • The same input Test Data is used for Test Procedures 5318 and 5322. Output should have same coordinate values, only the medium differs. • The application should retain an audit trail of coordinate change actions. See Series 6000 tests.

Test Procedure:	**5323 - Transfer 2D seismic position data with vertical datum change**
Test Purpose:	To verify that the application correctly transfers 2D seismic position data to a different project when a change of vertical datum is involved.
Test Process:	• In project *GIGS_project_A2V1depth*, select Test Data described below. • Transfer to project *GIGS_project_A1W1depth*. • Verify data in project *GIGS_project_A1W1depth* against Test Data.
Test Data:	Seismic line GIGS-5315-17 from project *GIGS_project_A2V1depth*.
Expected Results:	• The application transfers locations correctly. See file *GIGS_seis2D_5323_output*. • Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• This test involves a change of CRS from source project CRS to target project CRS. The test assumes that the application applies a coordinate change and then stores coordinates in the CRS to which the target project is referenced. • The test assumes that seismic line GIGS-5315-17 has been correctly loaded to the source project (see Test Procedure 5315). • The same input Test Data is used for Test Procedures 5316, 5319, 5320 and 5323. Output for 5319 and 5323 should have same coordinate values, only the medium differs. • The application should retain an audit trail of coordinate change actions. See Series 6000 tests.

Test Procedure:	**5324 - Import 2D seismic position data with NADCON transformation**
Test Purpose:	To verify that the application correctly loads horizontal locations from a P1-format file (or ASCII equivalent) when a transformation using the NADCON method must be applied.
Test Process:	• Load data from test input file to project *GIGS_project_Z28V1depth*. • Verify coordinates in project *GIGS_project_Z28V1depth* against expected results.
Test Data:	*GIGS_seis2D_5324_input*
Expected Results:	• The application recognises P1 (or ASCII) file CRS definition, converts P1 (or ASCII) file horizontal coordinates using the NADCON method, and stores correct horizontal locations. See file *GIGS_seis2D_5324_output*. • The input data includes some points also used for Test Procedure 5325, with common input points having identical coordinates. After transformation the coordinates of output points will not be the same as those output in Test Procedure 5325. • Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• It may be necessary to force the application to utilise the NADCON method. • In North America the NADCON grids for Conus and Alaska overlap with the NTv2 grid for Canada. Application should use NADCON for locations in the US and NTv2 for locations in Canada. The Test Data includes lines which cross the national boundary. See also Test Procedure 5325. Note: the GIGS Test Data is not an authority on international boundaries. In the test results the indication of which points fall inside and outside of US is indicative only.

Test Procedure:	**5325 - Import 2D seismic position data with NTv2 transformation**
Test Purpose:	To verify that the application correctly loads horizontal locations from a P1-format file (or ASCII equivalent) when a transformation using the NTv2 method is applied.
Test Process:	• Load data from test input file to project *GIGS_project_Z28V1depth*. • Verify coordinates in project *GIGS_project_Z28V1depth* against expected results.
Test Data:	*GIGS_seis2D_5325_input*
Expected Results:	• The application recognises P1 (or ASCII) file CRS definition, converts P1 (or ASCII) file horizontal coordinates using the NTv2 method, and stores correct horizontal locations. See file *GIGS_seis2D_5325_output*. • The input data includes some points also used for Test Procedure 5324, with common input points having identical coordinates. After transformation the coordinates of output points will not be the same as those output in Test Procedure 5324. • Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• It may be necessary to force the application to utilise the NTv2 method. • In North America the NADCON grids for Conus and Alaska overlap with the NTv2 grid for Canada. Applications should use NADCON for locations in the US and NTv2 for locations in Canada. The Test Data includes lines which cross the national boundary. See also Test Procedure 5324. Note: the GIGS Test Data is not an authority on international boundaries. In the test results the indication of which points fall inside and outside of Canada is indicative only.

End of 5300 Test Procedures

2.11.6 5400 3D Seismic Test Procedures

The Test Procedures for seismic position data in Series 5400 (3D seismic) require loading and unloading of Test Data to a software 'project'. Projects are required to be referenced to specific CRS as defined in the Test Procedures below. See Appendix D for an explanation of the project naming and see the user-defined library Series 3000 for the definitions of these CRSs. The projects are also used for the Series 5300 2D Seismic and Series 5500 wells tests.

The majority of tests use a project area in the southwestern part of the North Sea. This area was chosen because it is within the extended reach of surrounding countries in which CRSs using several important conversion and transformation methods are found. As before, a fictitious CRS (WGS 84 / British National Grid) was chosen as the target CRS for data, ensuring that all software are using the same objective CRS. To test geodetic data from elsewhere in the world, other fictitious systems such as one using US Survey Feet were applied to this setting.

The tests in this section use hypothetical seismic line position data. The input Test Dataset files for these tests are synthetic P6/11 or P6/98 format text files, as well as P1 file for a specific test - an equivalent ASCII file is also provided for software that cannot handle P-format files. The output files are all in ASCII format. The entire Test Series should be repeated for each data exchange format supported, and the results reported for any differences between the different formats.

The Test Data for this series comprises input and output files with each test point (representing a bin grid inline/crossline) on a separate row in the data array. The general process is to load the input file and transform/convert coordinates referenced from geogCRS 1/projCRS 1 to geogCRS 2/projCRS 2 - then compare the results with the values in the output file data array. The seismic 3D position data have been designed so that if converted or transformed correctly the seismic bin grids will intersect.

Five overlapping synthetic surveys are used. Surveys A, B and C fall over part of the extensive Survey D. Survey E is a small site survey around platform Y. These are shown schematically in Figure 6, along with the horizontal locations of the synthetic wells that will be examined in Series 5500 tests. The map grid is at 10km intervals.

The CRS to which input and output coordinates are referenced are given in file headers (see series 3000 data for associated parameters). The use of special GIGS geodetic entities created in the Series 3000 tests is deliberate. Should software fail the Series 3000 tests and have passed the Series 2000 tests it should still be possible to run this series of tests.

The GIGS Test Dataset currently provides both P6/11 and P6/98 format options, but Evaluators may wish to repeat the following Test Procedures using other 3D seismic position data exchange formats that they consider important. SPS files are not provided and, if required, should be generated by Evaluators based on the ASCII files. If the application supports more than one exchange format (including different P1 vintages) then each test should be repeated for all supported formats and the results individually reported for each test.

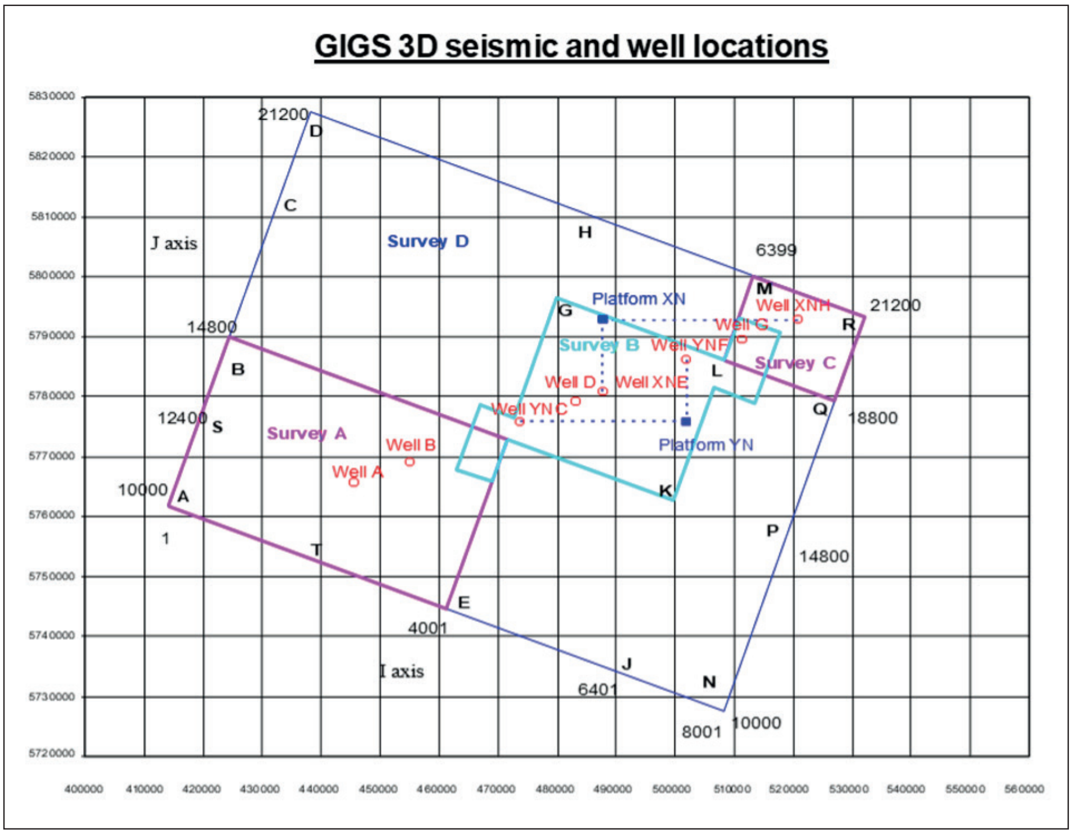


Figure 6: GIGS 3D seismic and well locations schematic, southern North Sea (WGS 84 / UTM zone 31N) (see Appendix A for plan map).

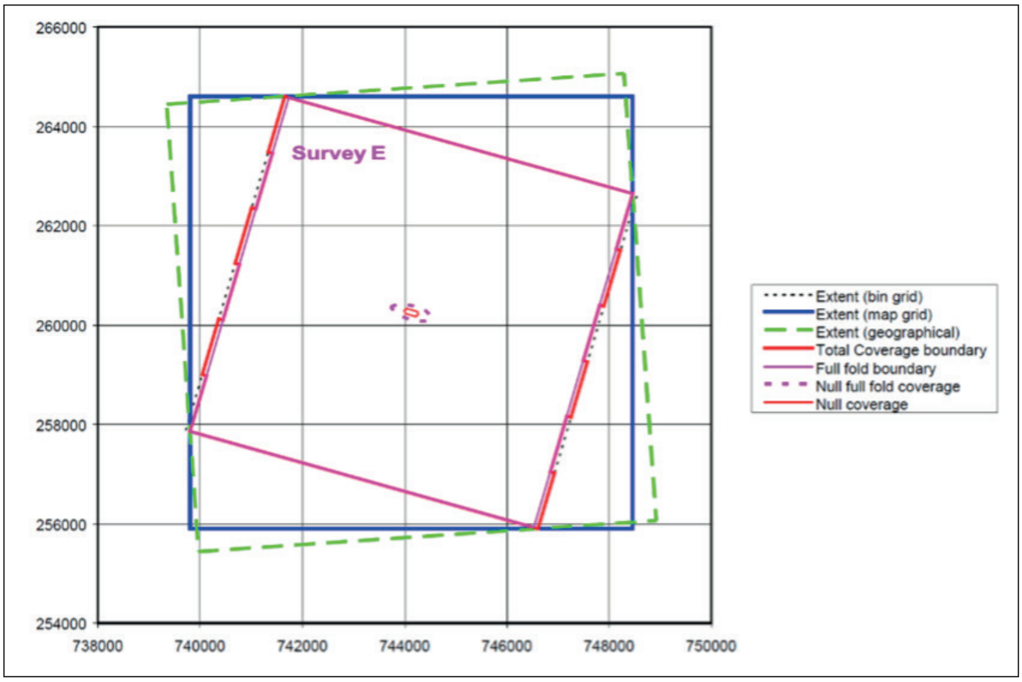


Figure 7: GIGS 3D seismic Survey E extent and coverage schematic, southern North Sea (WGS 84 / British National Grid) (see Appendix A for plan map).

Test Procedure:	5403 - Import 3D seismic position data with CRS change
Test Purpose:	To evaluate the position of 3D seismic position data when a change of CRS is required on import.
Test Process:	• Load Test Data to project *GIGS_project_A2V1depth* (P1 and P6, or ASCII) • Measure coordinates of locations described in output data file. • Compare measured coordinates with output file coordinates. In particular, report differences in the area of overlap between survey A and survey B and survey D (inline 3501 through 4001, crossline 13600 through 14800) and in the area of overlap between survey B and survey C and survey D (inline 6401 through 7001, crossline 18800 through 20000)
Test Data:	• *GIGS_seis3D_5403_surveyA_input* • *GIGS_seis3D_5403_surveyB_input* • *GIGS_seis3D_5403_surveyC_input* • *GIGS_seis3D_5403_surveyD_input*
Expected Results:	• Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. See files: – *GIGS_seis3D_5403_surveyA_output* – *GIGS_seis3D_5403_surveyB_output* – *GIGS_seis3D_5403_surveyC_output* – *GIGS_seis3D_5403_surveyD_output* • Additional checks should be made on the axes of the bin grid derived from the input data, by measuring the distance and bearing of each – *GIGS_seis3D_5403_surveyA_output_axes* – *GIGS_seis3D_5403_surveyB_output_axes* – *GIGS_seis3D_5403_surveyC_output_axes* – *GIGS_seis3D_5403_surveyD_output_axes* • Test result will be pass or fail. If fail, details of failure should be reported. • The application stores an audit trail of CRS actions

Note:	• The orthogonal properties of a seismic bin grid cannot be maintained if a change of coordinate reference system is introduced. The way that a seismic bin grid is defined within a project influences the effect of this phenomenon. • When reading coordinate values, care needs to be taken to ensure that it is the bin position rather than cursor position that is being measured. If application shows cursor position without notifying user, report this. • The input data is used for Test Procedures 5404 and 5405. • If the application cannot import P-format data but has a generic ASCII loader, this should be reported and the equivalent ASCII file used

Test Procedure:	**5404 - Export 3D seismic position data with CRS change**
Test Purpose:	To identify how the application exports 3D seismic position data when a change of CRS is required.
Test Process:	• In *GIGS_project_A2V1depth*, select all Survey B Test Data (including generated inlines and crosslines. • Export. • Describe results.
Test Data:	See Test Procedure 5403
Expected Results:	Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. See file *GIGS_seis3D_5404_output*. Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• The test assumes that the Test Data has been correctly loaded to the project. See Test Procedure 5403. • The same Test Data is used for Test Procedure 5405.

Test Procedure:	**5405 - Transfer 3D seismic position data with CRS change**
Test Purpose:	To identify how the application transfers 3D seismic position data when a change of CRS is required.
Test Process:	• In *GIGS_project_A2V1depth*, select all Survey B Test Data (including generated inlines and crosslines). • Transfer to project *GIGS_project_A1W1depth*. • Describe results.
Test Data:	See Test Procedure 5403
Expected Results:	Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. See file *GIGS_seis3D_5405_output*. Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• The test assumes that the Test Data has been correctly loaded to the project. See Test Procedure 5403. • The same Test Data is used for Test Procedure 5404.

Test Procedure:	**5406 - Import P6 extent and coverage data (without CRS change)**
Test Purpose:	To identify that the application imports 3D coverage polygons based on bin grid extent, map grid extent, geographic extent, total coverage, full fold coverage, null full fold coverage island and null coverage island from P6/98 extent and coverage records.
Test Process:	• Load Test Data to project *GIGS_project_A2V1depth*. • Examine whether polygons for bin grid extent, map grid extent, geographic extent, total coverage, full fold coverage, null full fold coverage island and null coverage island are present. Coordinates should correspond to the input file.
Test Data:	*GIGS_seis3D_5406_surveyE_input*.

Expected Results:	• Extent rectangles and coverage polygons are present – see Figure 7. • Coordinates should correspond to those in the input file (also given in file *GIGS_seis3D_5406_surveyE_output*, see below). • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• If the application cannot read a P6 format file this test cannot be run. • The P6/98 format allows for extent records to be in bin grid and/or map grid and/or geographic coordinates. The test file provides all three. • The P6/98 format allows for coverage records to be in either bin grid and/or map grid coordinates. The test file provides both options. • The same Test Data is used for Test Procedure 5407.

Test Procedure:	**5407 - Import P6 extent data with CRS change**
Test Purpose:	To identify how the application imports different polygons based on bin grid extent, map grid extent, geographic extent, total coverage, full fold coverage, null full fold coverage island and null coverage island from P6/98 extent records when a change of CRS is required.
Test Process:	• Load Test Data to project *GIGS_project_A1W1depth*. • Determine whether the coordinates of the polygon representing the survey extent match those of the test output file.
Test Data:	*GIGS_seis3D_5407_surveyE_input*
Expected Results:	Results should agree to within 0.03m (30mm) or 0.0000003° of the Test Data. See file *GIGS_seis3D_5407_surveyE_output*. Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• If the application cannot read a P6 format file, this test cannot be run. • Extent map grid and geographic records are in the CRS to which the survey is referenced. If the data are loaded to a different CRS then the map grid and geographic bounding boxes need to be recalculated from the bin grid extent – a simple conversion of the map grid or geographic corner coordinates in the source CRS is not correct. • The three input files describe the survey extent by one each of bin grid, map grid and geographic coordinates. In this Test Data set there is no datum change involved and the description of the geographic grid is not rigorously tested. • The same Test Data is used for Test Procedure 5406.

End of 5400 Test Procedures

2.11.7 5500 Wells Test Procedures

The Test Procedures for wellbore data in Series 5500 require loading and unloading of Test Data to a software project. For these tests, projects require to be referenced to specific CRS as defined in the Test Procedures below. See Appendix D for an explanation of the project naming and see the User-defined library Series 3000 for the definitions of the CRSs used. The projects are also used for the Series 5300 (2D seismic) and 5400 (3D seismic) Test Procedures.

The majority of tests use a project area in the south-western part of the North Sea. This area was chosen because it is within extended reach of surrounding countries in which CRSs using several important conversion and transformation methods are found. As before, a fictitious CRS (WGS 84 / British National Grid) was chosen as the target CRS for data, ensuring that all software are using the same objective CRS.

To test geodetic data from elsewhere in the world, other fictitious systems such as one using US Survey Feet were applied to this setting. To test the proper treatment of grid convergence thoroughly, the four deviated wells have been recomputed for an Australian scenario.

The tests in this section use hypothetical wellbore position data. The well surface positions given in the input files are referenced to a variety of horizontal and vertical CRSs, with each test point (representing an observable/station) on a separate row in the data array. The input Test Dataset files for these tests are synthetic P7/17 or P7/00 format text files, an equivalent ASCII file is also provided for software that cannot handle P-format files. The output files are all in ASCII format. The entire Test Series should be repeated for each data exchange format supported, and the results reported for differences between the different formats.

The CRS to which input and output coordinates are referenced are given in file headers (see series 3000 data for associated parameters). The use of special GIGS geodetic entities created in the Series 3000 tests is deliberate. Should software fail the Series 3000 tests and have passed the Series 2000 tests it should still be possible to run this series of tests.

The Test Procedures require the wellbores to be loaded to a project. The general process is to load the input file and transform/convert coordinates referenced from geogCRS 1/projCRS 1 to geogCRS 2/projCRS 2, then compare the results with the values in the output file data array.

Eight wells A through H are used. Four (A, B, D and G) are vertical. The other four wells (C, E, F and H) are deviated wellbores from two hypothetical platforms XN and YN. The horizontal positions of the wells are shown schematically in Figure 6. The platform and wells general layouts and schematic cross sections are shown in the Figures 8-14.

Each of the eight input well files are used in two tests (one testing horizontal geospatial integrity, the other testing vertical geospatial integrity):

Table 2: GIGS well and platform ID for northern hemisphere tests.

Well	Platform	Input to Test Procedures
A		5506, 5526
B		5507, 5517
YNC	YN	5511, 5515
D		5508, 5515
XNE	XN	5510, 5514
YNF	YN	5511, 5515
G		5509, 5516
XNH	XN	5510, 5514

Because the definition of the sign of grid convergence in the southern hemisphere has been the source of some confusion, the horizontal tests are repeated in an Australian setting using the four deviated wellbores recalculated as wells J, K, L and M from platforms XS and YS:

Table 3: GIGS well and platform ID for southern hemisphere tests.

Well	Platform	Input to Test Procedures
XSJ	XS	5512
XSK	XS	5512
YSL	YS	5513
YSM	YS	5513

If tests 5506 through to 5517 and 5526 have been successful and if the application has the functionality to display well cross sections, then in project GIGS_project_A2V1depth, a cross-section through the bottom hole locations of wells A, B, YNC, D, XNE, YNF, G and YNH should fall in a straight line in the horizontal plane and another straight line in the vertical plane. The intersection of wellbores A, B, YNC, D and XNE with horizon 1 should lie on a straight line in the vertical plane. The intersection of the wellbores YNF, G and XNH with horizon 1 should lie on another straight line in the vertical plane, between XNE and YNF there should be a 20m vertical fault. See the cross-section in Figure 8.

The GIGS Test Dataset provides both P7/2000 and P7/17 format, but Evaluators may wish to repeat the following Test Procedures using other wellbore position data exchange formats they consider important. If the application supports more than one exchange format (including different P7 vintages) then each test should be repeated for all supported formats and the results individually reported for each test.

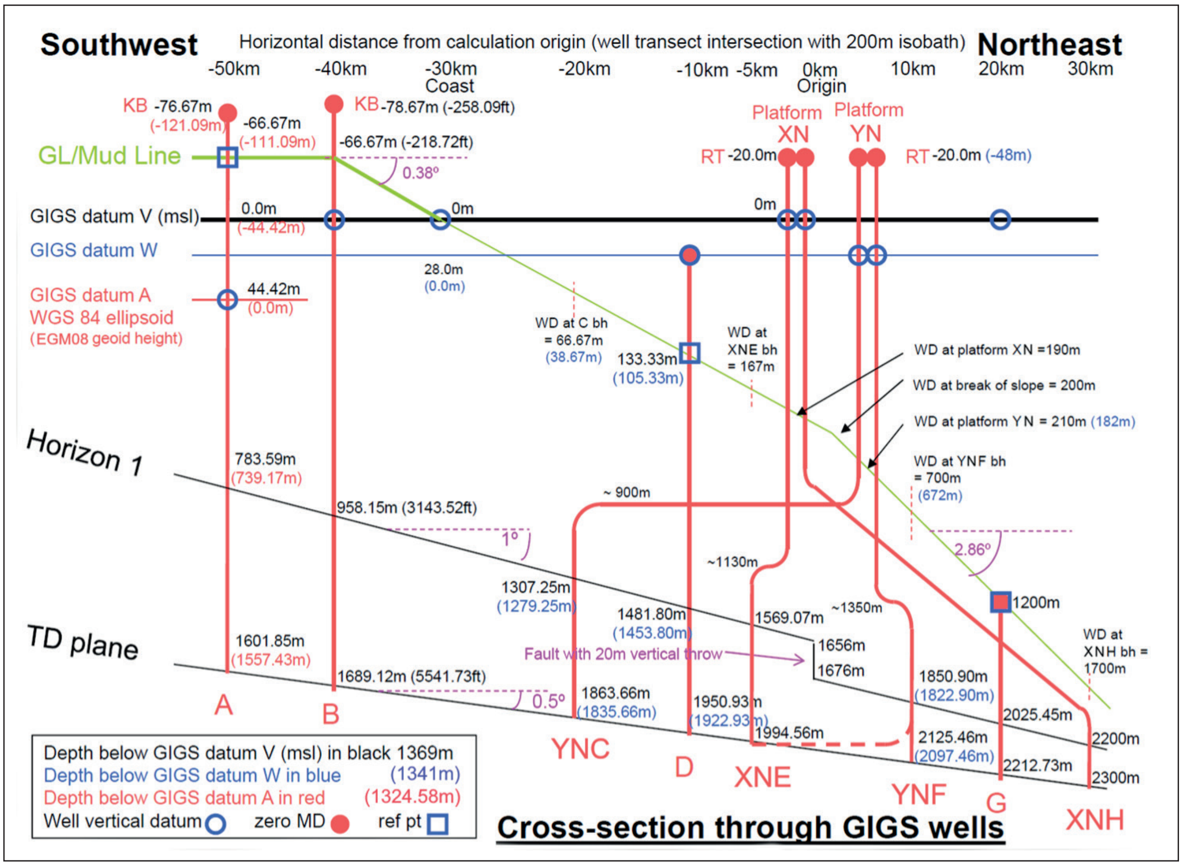


Figure 8: GIGS Northern Hemisphere Well cross section (see Appendix A for plan map).

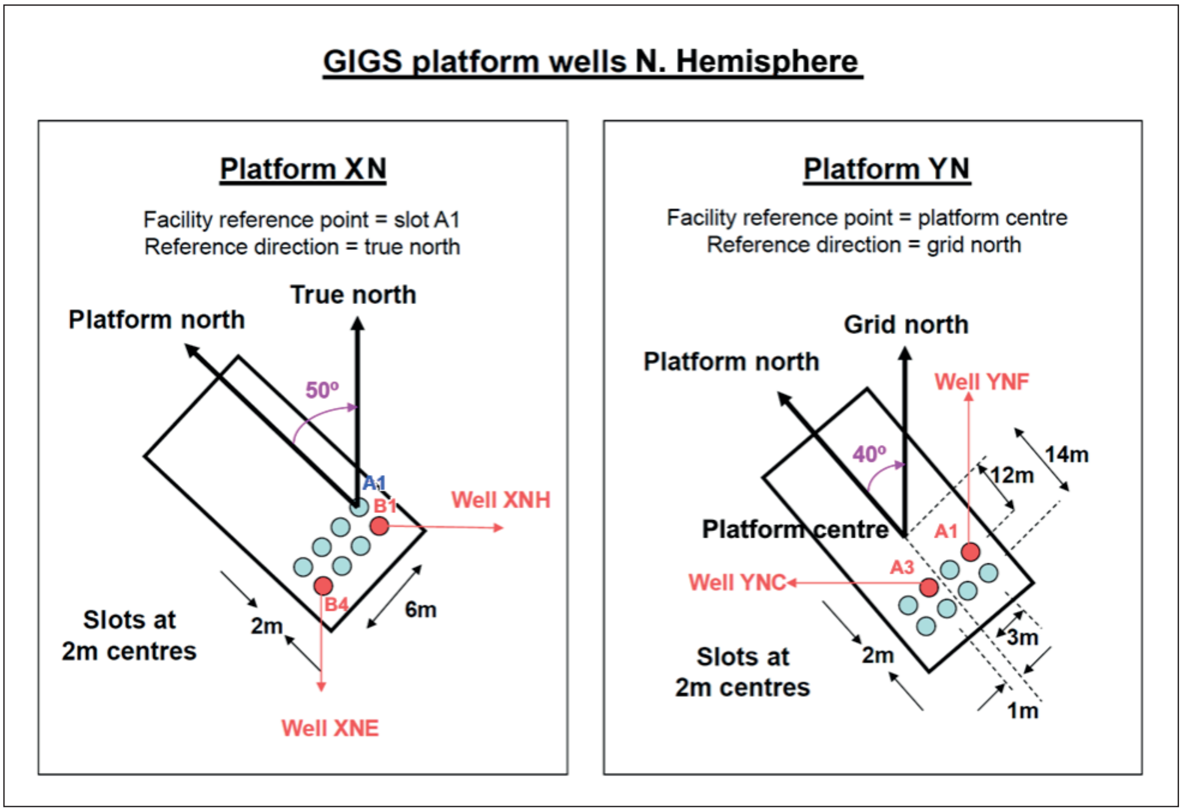


Figure 9: Platform wells for northern hemisphere well tests.

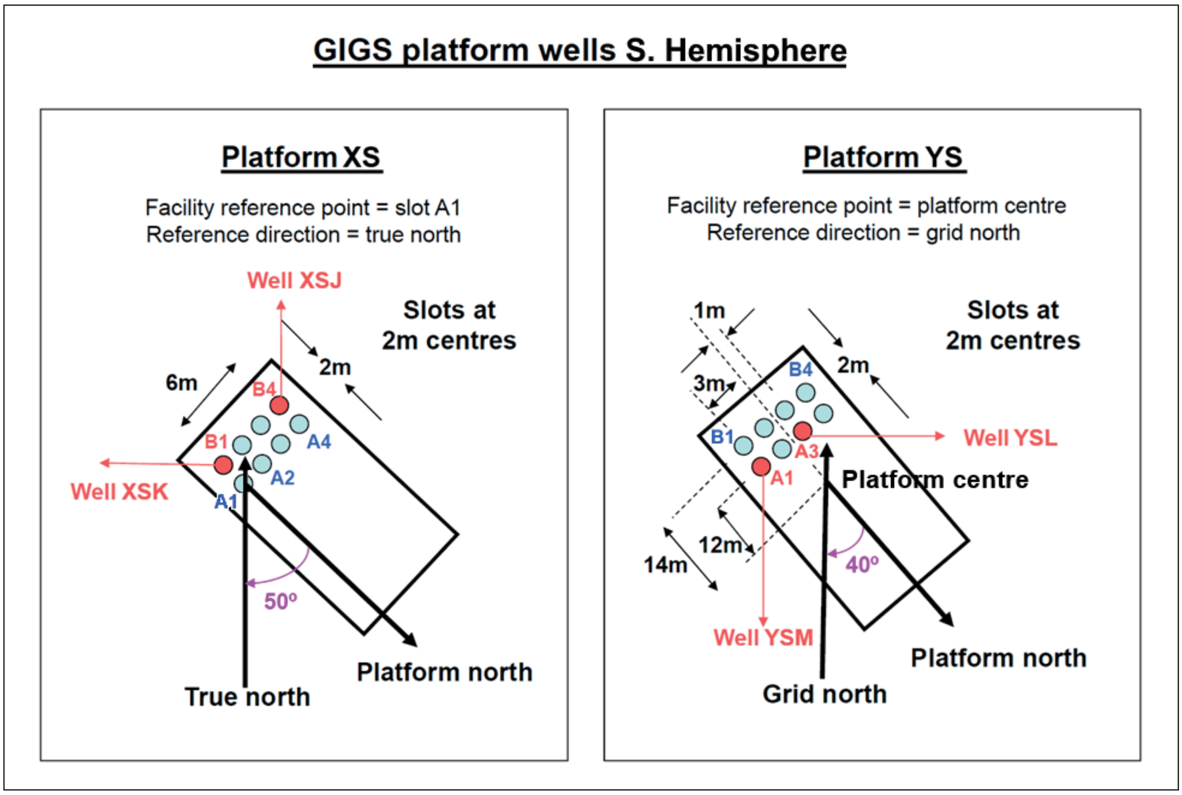


Figure 10: Platform wells for southern hemisphere well tests.

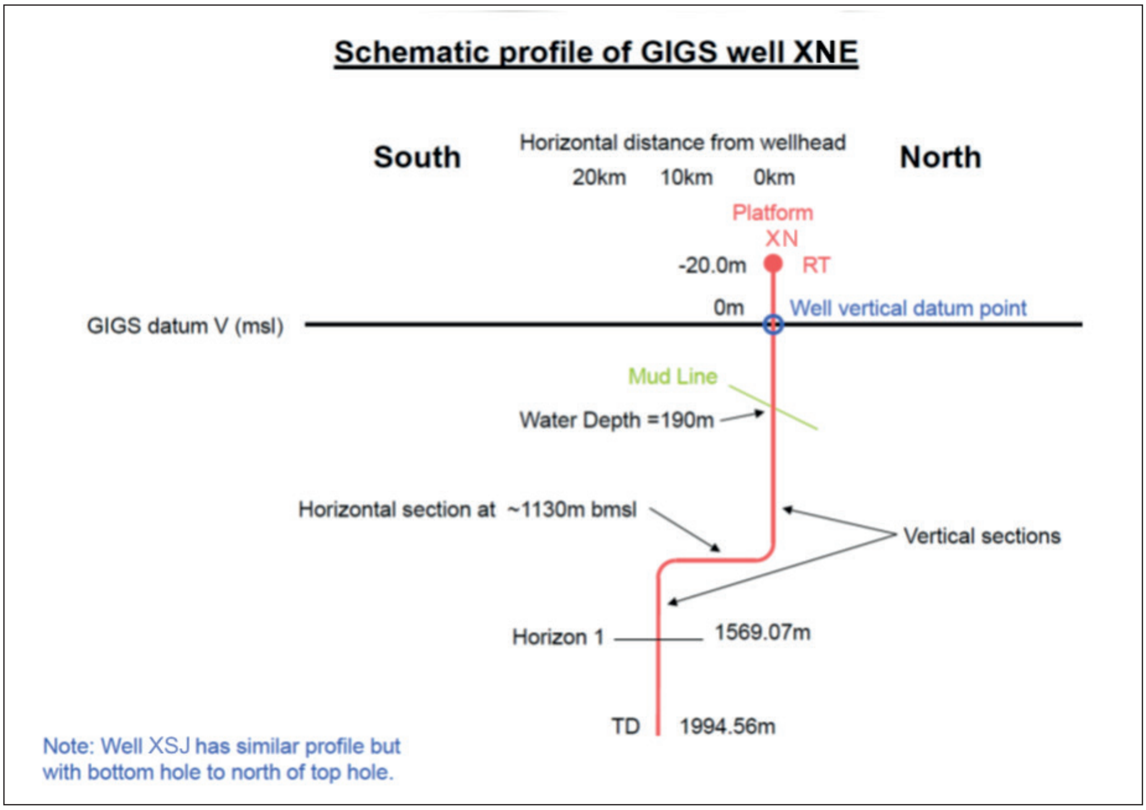


Figure 11: Schematic profile of GIGS well XNE

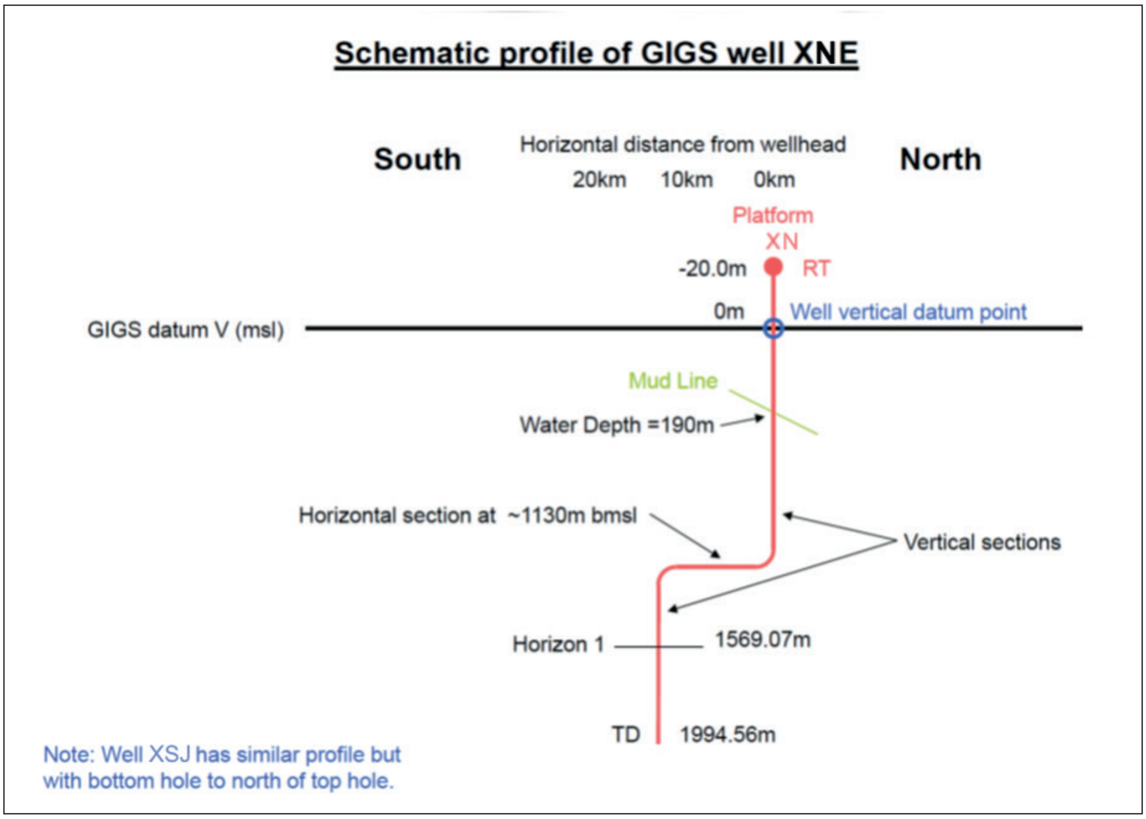


Figure 12: Schematic profile of GIGS well XNH.

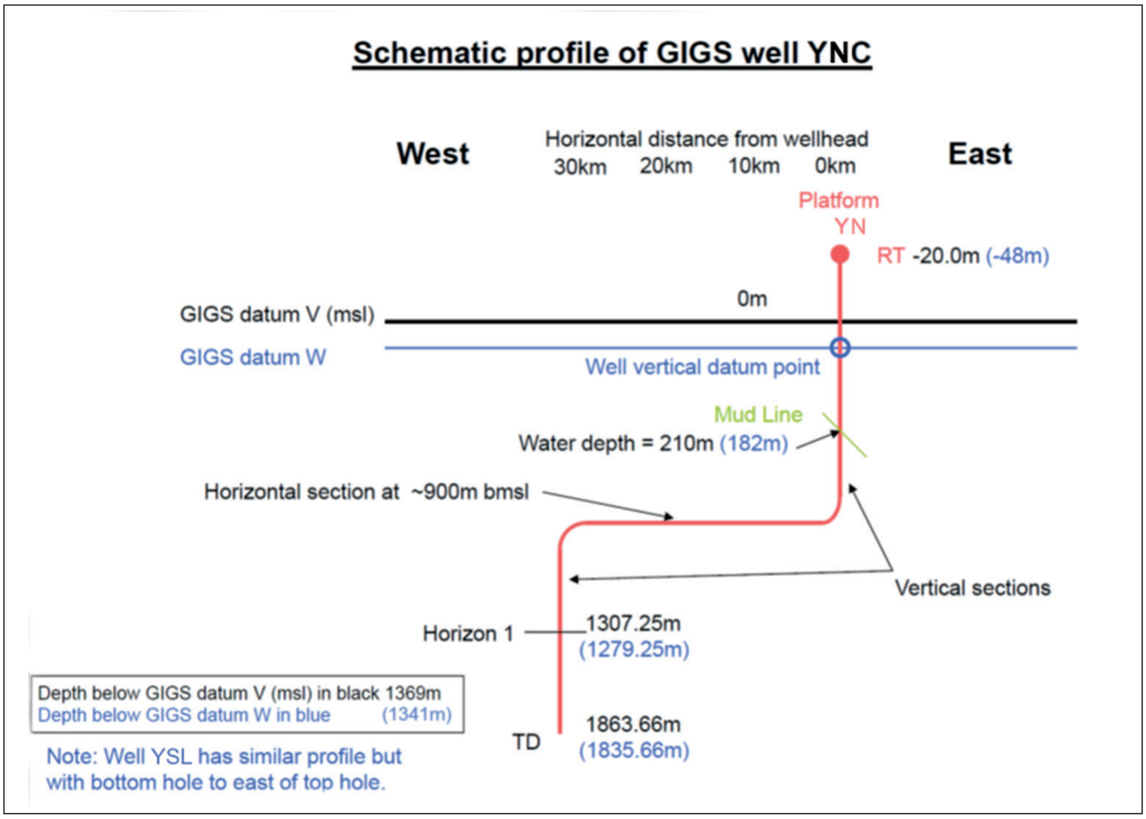


Figure 13: Schematic profile of GIGS well YC.

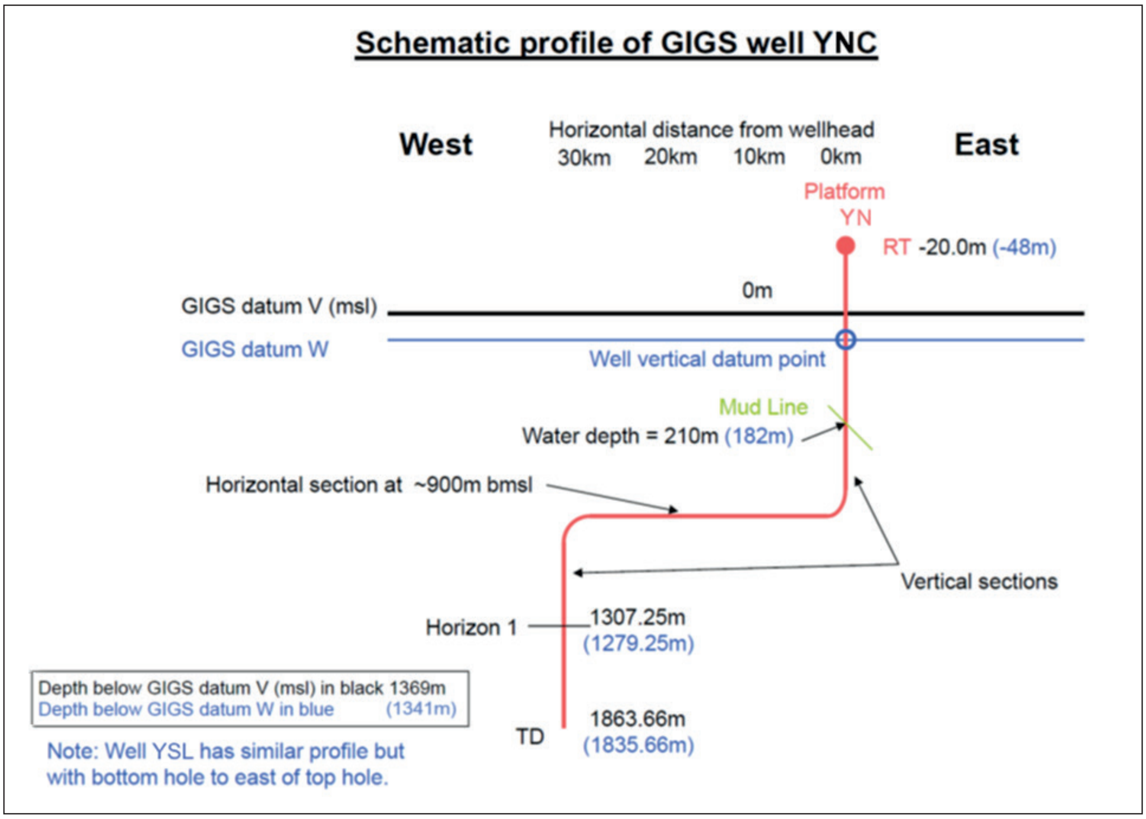


Figure 14: Schematic profile of GIGS well YF.

Test Procedure:	5506 - Import wellbore location from geographic CRS coordinates
Test Purpose:	To verify that the application can correctly load wellbore data when the horizontal position is given in geographic 2D (latitude/longitude) coordinates. This test complements that in Test Procedure 5526.
Test Process:	• Load data from test file to project *GIGS_project_A2V1depth.* • Import wellbore position data from φλ • Check horizontal locations in project *GIGS_project_A2V1depth* against Test Data.
Test Data:	*GIGS_wells_5506_wellA_input*
Expected Results:	• The conversion of geographical coordinates to grid coordinates is required. Results should agree to within 0.03m (30mm) of the Test Data. See file *GIGS_wells_5506_wellA_output.* • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• In the input file, the geodesy is defined through reference to EPSG rather than explicitly (as allowed in the P7/2000 format). The identified system is geographic 3D (see Test Procedure 5526 for of the vertical component). • The same input data is also used in Test Procedure 5526. • If the application cannot import a P7 format file, report this and instead use the ASCII file.

Test Procedure:	5507 - Import wellbore location from projected CRS coordinates
Test Purpose:	To verify that the application can correctly load vertical wellbore data when the horizontal position is given in map coordinates. No change of CRS is required.
Test Process:	• Load data from test file to project *GIGS_project_A2V1depth.* • Import wellbore position data from EN • Check horizontal locations in project *GIGS_project_A2V1depth* against Test Data.
Test Data:	*GIGS_wells_5507_wellB_input.*
Expected Results:	• Results should agree to within 0.03m (30mm) of the Test Data. See file *GIGS_wells_5507_wellB_output.* • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• The same input data is also used in Test Procedure 5517. • If the application cannot import a P7 format file, report this and instead use the ASCII file.

Test Procedure:	5508 - Import wellbore location with conversion (map projection) change
Test Purpose:	To verify that the application correctly imports vertical wellbore data when the horizontal position given in projected (map) coordinates requires converting to a different projected CRS (map projection change only).
Test Process:	• Load data from test file to project *GIGS_project_A2V1depth.* • Import wellbore position data from different EN • Check horizontal locations in project *GIGS_project_A2V1depth* against Test Data.
Test Data:	*GIGS_wells_5508_wellD_input*
Expected Results:	• Results should agree to within 0.1m (100mm) of the Test Data. See file *GIGS_wells_5508_wellD_output.* • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• The same input data is also used in Test Procedure 5515. • If the application cannot import a P7 format file, report this and instead use the ASCII file.

Test Procedure:	5509 - Import wellbore location with geodetic datum change
Test Purpose:	To verify that the application correctly imports vertical wellbore data when the horizontal position is given in geographic coordinates and requires converting to a CRS using a different geodetic datum
Test Process:	• Load data from test file to project *GIGS_project_A2V1depth.* • Import wellbore position data from different geodetic datum • Check horizontal locations in project *GIGS_project_A2V1depth* against Test Data.
Test Data:	*GIGS_wells_5509_wellG_input*
Expected Results:	• Results should agree to within 0.1m (100mm) of the Test Data. See file *GIGS_wells_5509_wellG_output.* • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• The same input data is also used in Test Procedure 5516. • If the application cannot import a P7 format file, report this and instead use the ASCII file.

Test Procedure:	5510 - Import wellbore horizontal location from measured data relative to true north (northern hemisphere)
Test Purpose:	To verify that the application can correctly load horizontal position from deviated wellbore survey data given as measured depth, inclination and azimuth with azimuth referenced to true north. Well located in northern hemisphere. This test complements that in Test Procedure 5514.
Test Process:	• Load data from test file to project *GIGS_project_A2V1depth.* • Import wellbore position data from MD/Inc/Az - TN, Northern hemisphere • Check horizontal locations in project *GIGS_project_A2V1depth* against Test Data.
Test Data:	• *GIGS_wells_5510_wellXNE_input* • *GIGS_wells_5510_wellXNH_input*
Expected Results:	• Results should agree to within 0.1m (100mm) of the Test Data. See file *GIGS_wells_5510_wellXNE_output* and *GIGS_wells_5510_wellXNH_output.* • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• The well reference point coordinates are referenced to a geographic CRS and should be converted to the project CRS in the application loading process. • Both input wells XNE and XNH should be tested: their wellbores are orthogonal to one another. • The same input data is also used in Test Procedure 5514. • If the application cannot import a P7 format file, report this and instead use the ASCII file.

Test Procedure:	5511 - Import wellbore horizontal location from measured data relative to grid north (northern hemisphere)
Test Purpose:	To verify that the application can correctly load horizontal position from deviated wellbore data given as measured depth, inclination and azimuth, with azimuth referenced to grid north and wellhead location requiring a change of map projection. Well located in northern hemisphere. This test complements that in Test Procedure 5515.
Test Process:	• Load data from test file to project *GIGS_project_A2V1depth.* • Import wellbore position data from MD/Inc/Az - GN • Check horizontal locations in project *GIGS_project_A2V1depth* against Test Data.
Test Data:	• *GIGS_wells_5511_wellYNC_input* • *GIGS_wells_5511_wellYNF_input*
Expected Results:	• Results should agree to within 0.1m (100mm) of the Test Data. See files *GIGS_wells_5511_wellYNC_output* and *GIGS_wells_5511_wellYNF_output.* • Test result will be pass or fail. If fail, details of failure should be reported.

Note:	• Wellhead coordinates are defined through offsets from a facility reference point. See figure 9 above. • The well reference point coordinates are given in a different projected CRS to that of the project and correct conversion in the application loading process should be checked. • Both input wells YNC and YNF should be tested: their wellbores are orthogonal to one another. • The same input data is also used in Test Procedure 5515. • If the application cannot import a P7 format file, report this and instead use the ASCII file.

Test Procedure:	**5512 - Import wellbore horizontal location from measured data relative to true north (southern hemisphere)**
Test Purpose:	To verify that the application can correctly load horizontal position from deviated wellbore survey data given as measured depth, inclination and azimuth, with azimuth referenced to true north. Well located in the southern hemisphere.
Test Process:	• Load data from test file to project *GIGS_project_F7V1depth*. • Import wellbore position data from MD/Inc/Az - TN, Southern hemisphere • Check horizontal locations in project *GIGS_project_F7V1depth* against Test Data.
Test Data:	• *GIGS_wells_5512_wellXSJ_input* • *GIGS_wells_5512_wellXSK_input*
Expected Results:	• Results should agree to within 0.1m (100mm) of the Test Data. See file *GIGS_wells_5512_wellXSJ_output* and *GIGS_wells_5512_wellXSK_output.* • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• Grid convergence may be used in the calculation of position from measured data (it does not necessarily have to be). Whilst the magnitude of grid convergence is defined by map projection formulae, there are two opposing conventions for the sign of grid convergence. To ensure that the application performance in this area is fully understood, this Test Procedure repeats Test Procedure 5510 in a southern hemisphere scenario. • The well reference point coordinates are referenced to a geographic CRS and should be converted to the project CRS in the application loading process. • Both input wells XSJ and XSK should be tested; their wellbores are orthogonal to one another. • If the application cannot import a P7 format file, report this and instead use the ASCII file.

Test Procedure:	**5513 - Import wellbore horizontal location from measured data relative to grid north (southern hemisphere)**
Test Purpose:	To verify that the application can correctly load horizontal position from deviated wellbore data given as measured depth, inclination and azimuth, with azimuth referenced to grid north and wellhead location requiring a change of map projection. Well located in the southern hemisphere.
Test Process:	• Load data from test file to project *GIGS_project_F7V1depth*. • Import wellbore position data from MD/Inc/Az - GN - Southern hemisphere • Check horizontal locations in project *GIGS_project_F7V1depth* against Test Data.
Test Data:	• *GIGS_wells_5513_wellYSL_input* • *GIGS_wells_5513_wellYSM_input*
Expected Results:	• Results should agree to within 0.1m (100mm) of the Test Data. See files *GIGS_wells_5513_wellYSL_output* and *GIGS_wells_5513_wellYSM_output.* • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• See Test Procedure 5512 for grid convergence comment. This Test Procedure repeats that in 5511 for a southern hemisphere location. • Wellhead coordinates are defined through offsets from a facility reference point. See figure 10 above. • The well reference point coordinates are given in a different projected CRS to that of the project and correct conversion in the application loading process should be checked. • Both input wells YSL and YSM should be tested; their wellbores are orthogonal to one another. • If the application cannot import a P7 format file, report this and instead use the ASCII file.

Test Procedure:	**5514 - Import wellbore vertical location from measured data relative to true north (northern hemisphere)**
Test Purpose:	To verify that the application can correctly load vertical position from deviated wellbore survey data given as measured depth, inclination and azimuth with azimuth referenced to true north. Well located in the northern hemisphere. This test complements that in Test Procedure 5510.
Test Process:	• Load data from test files to project *GIGS_project_A2V1depth.* • Import wellbore depth data from MD/Inc/Az - TN • Check vertical locations in project *GIGS_project_A2V1depth* against Test Data.
Test Data:	• *GIGS_wells_5514_wellXNE_input* • *GIGS_wells_5514_wellXNH_input*
Expected Results:	• Results should agree to within 0.1m (100mm) of the Test Data. See files *GIGS_wells_5514_wellXNE_output* and *GIGS_wells_5514_wellXNH_output.* • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• The same input data is also used in Test Procedure 5510. • If the application cannot import a P7 format file, report this and instead use the ASCII file.

Test Procedure:	**5515 - Import wellbore vertical location from measured data relative to grid north (northern hemisphere)**
Test Purpose:	To verify that the application can correctly load vertical position from deviated wellbore data given as measured depth, inclination and azimuth, with azimuth referenced to grid north and well reference point requiring a change of vertical datum. Well located in the northern hemisphere. This test complements those in Test Procedures 5508 and 5511.
Test Process:	• Load data from test files to project *GIGS_project_A2V1depth.* • Import wellbore depth data from MD/Inc/Az with change of vertical datum • Check vertical locations in project *GIGS_project_A2V1depth* against Test Data.
Test Data:	• *GIGS_wells_5515_wellD_input* • *GIGS_wells_5515_wellYNC_input* • *GIGS_wells_5515_wellYNF_input*
Expected Results:	• Results should agree to within 0.1m (100mm) of the Test Data. See files *GIGS_wells_5515_wellD_output*, *GIGS_wells_5515_wellYNC_output*, and *GIGS_wells_5515_wellYNF_output.* • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• The input data is also used in Test Procedures 5508 and 5511 • The well reference point coordinates are referenced to a CRS with a different vertical datum to that of the project and correct transformation in the application loading process should be checked. • If the application cannot import a P7 format file, report this and instead use the ASCII file.

Test Procedure:	**5516 - Import wellbore depth data with TVDBML reference**
Test Purpose:	To verify that the application can correctly load vertical position from wellbore data referenced to TVDBML.
Test Process:	• Load data from test files to project *GIGS_project_A2V1depth.* • Import wellbore depth data with TVDBML reference • Check vertical locations in project *GIGS_project_A2V1depth* against Test Data.
Test Data:	*GIGS_wells_5516_wellG_input*
Expected Results:	• The application should adjust 'depths below mud line' to be 'depths below <project vertical CRS>'. Results should agree to within 0.1m (100mm) of the Test Data. See file *GIGS_wells_5516_wellG_output* • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• The input data is also used in Test Procedure 5509. • If the application cannot import a P7 format file, report this and instead use the ASCII file.

Test Procedure:	**5517 - Import wellbore depth data with vertical unit change**
Test Purpose:	To verify that the application can correctly load vertical position when referenced to a different vertical CRS to that of the project.
Test Process:	• Load data from test files to project *GIGS_project_A2V1depth*. • Import wellbore depth data with change of vertical CS • Check vertical locations in project *GIGS_project_A2V1depth* against Test Data.
Test Data:	*GIGS_wells_5517_wellB_input*
Expected Results:	• The application should convert depth data given in feet to metres. Results should agree to within 0.1m (100mm) of the Test Data. See file *GIGS_wells_5517_wellB_output.* • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• The same input data are also used in Test Procedure 5507. • If the application cannot import a P7 format file, report this and instead use the ASCII file.

Test Procedure:	**5518 - Export wellbore data with conversion (map projection) change**
Test Purpose:	To verify that the application correctly exports wellbore data when a change of map projection is required.
Test Process:	• In project *GIGS_project_A2V1depth*, export the Test Data. • Verify coordinates in exported data file against Test Data.
Test Data:	Well B from project *GIGS_project_A2V1depth*, with exported horizontal coordinates to be referenced to *GIGS_projCRS_A1.*
Expected Results:	• The application exports horizontal locations correctly. Results should agree to within 0.1m (100mm) of the Test Data. See file *GIGS_wells_5518_output*. (The same output file applies to all of Test Procedures 5518, 5521, 5522 and 5525). • The application exports CRS definition correctly. • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• This test assumes that Well B has been correctly loaded to the project (see Test Procedure 5507). • The Test Data is also used in Test Procedure 5521.

Test Procedure:	**5519 - Export wellbore data with geographic CRS change**
Test Purpose:	To verify that the application correctly exports wellbore data when a change of geographic CRS is required.
Test Process:	• In project *GIGS_project_A2V1depth*, export data as described in Test Data. • Verify coordinates in exported data file against Test Data.
Test Data:	Well D from project from project *GIGS_project_A2V1depth*, with exported horizontal coordinates to be referenced to *GIGS_geogCRS_B.*
Expected Results:	• The application exports horizontal locations correctly. Results should agree to within 0.1m (100mm) of the Test Data. See file *GIGS_wells_5519_output.* • The application exports CRS definitions correctly. • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	This test assumes that Well D has been correctly loaded to the project (see Test Procedure 5508).

Test Procedure:	**5520 - Export wellbore data with change of horizontal CRS units**
Test Purpose:	To verify that the application correctly exports wellbore data when a change of horizontal CRS unit is involved.
Test Process:	• In project *GIGS_project_A2V1depth*, export data as described in Test Data. • Verify coordinates in exported data file against Test Data.
Test Data:	Well G from project *GIGS_project_A2V1depth*, with exported horizontal coordinates to be referenced to *GIGS_projCRS_A23*.
Expected Results:	• The application exports horizontal locations correctly. Results should agree to within 0.3 ftUS (4in) of the Test Data. See file *GIGS_wells_5520_output*. (The same output data applies to both of Test Procedures 5520 and 5524). • The application exports CRS definition correctly. • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	This test assumes that Well G has been correctly loaded to the project (see Test Procedure 5509).

Test Procedure:	**5521 - Export wellbore data with vertical CRS change**
Test Purpose:	To verify that the application correctly exports wellbore data when a change of vertical CRS is involved.
Test Process:	• In project *GIGS_project_A2V1depth* export data as described in Test Data. • Verify coordinates in exported data file against Test Data.
Test Data:	Well B from project *GIGS_project_A2V1depth*, with exported horizontal coordinates to be referenced to *GIGS_projCRS_A1* and exported vertical coordinates to be referenced to *GIGS_ vertCRS_W1 depth*.
Expected Results:	• The application exports vertical locations correctly. Results should agree to within 0.1m (100mm) of the Test Data. See file *GIGS_wells_5521_output*. (The same output data applies to all of Test Procedures 5518, 5521, 5522 and 5525). • The application exports CRS definition correctly. • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• This test assumes that Well B has been correctly loaded to project A7V (see Test Procedure 5507). • The Test Data is also used for Test Procedure 5518.

Test Procedure:	**5522 - Transfer wellbore data with conversion (map projection) change**
Test Purpose:	To verify that the application correctly transfers wellbore data to another project when a change of map projection is required.
Test Process:	• In project *GIGS_project_A2V1depth* select Test Data. • Transfer to project *GIGS_project_A1W1depth*. • Verify data in project *GIGS_project_A1W1depth* against Test Data.
Test Data:	Well B as loaded to project *GIGS_project_A2V1depth*.
Expected Results:	• The application transfers horizontal locations correctly. Results should agree to within 0.1m (100mm) of the Test Data. See file *GIGS_wells_5522_output*. (The same output data applies to all of Test Procedures 5518, 5521, 5522 and 5525). • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• This test involves a change of CRS from source project CRS to target project CRS. The test assumes that the application applies a coordinate change and then stores coordinates in the CRS to which the target project is referenced. • The test assumes that Well B has been correctly loaded to the source project A7V (see Test Procedure 5507). • The Test Data is also used for Test Procedure 5525. • The application should retain an audit trail of coordinate change actions. See Series 6000 tests.

Test Procedure:	5523 - Transfer wellbore data with geographic CRS change
Test Purpose:	To verify that the application correctly transfers wellbore data to another project when a change of geodetic datum is required.
Test Process:	• In project *GIGS_project_A2V1depth* select Test Data. • Transfer to project *GIGS_project_B2V1depth*. • Verify data in project *GIGS_project_B2V1depth* against Test Data.
Test Data:	Well D as loaded to project *GIGS_project_A2V1depth*.
Expected Results:	• The application transfers horizontal locations correctly. Results should agree to within 0.1m (100mm) of the Test Data. See file *GIGS_wells_5523_output*. • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• This test involves a change of CRS from the CRS to which the source project is referenced to the CRS to which the target project is referenced. The test assumes that the application applies a coordinate change and then stores coordinates in the CRS to which the target project is referenced. • The test assumes that Well D has been correctly loaded to the source project (see Test Procedure 5508).

Test Procedure:	5524 - Transfer wellbore data with horizontal CRS unit change
Test Purpose:	To verify that the application correctly transfers wellbore data to another project when a change of horizontal CRS unit is involved.
Test Process:	• In project *GIGS_project_A2V1depth* select Test Data. • Transfer selected data to project *GIGS_project_A23V1depth*. • Verify data in project *GIGS_project_A23V1depth* against Test Data.
Test Data:	Well G as loaded to project *GIGS_project_A2V1depth*.
Expected Results:	• The application transfers horizontal locations correctly. Results should agree to within 0.3 ftUS (4in) of the Test Data. See file *GIGS_wells_5524_output*. (The same output file applies to both of Test Procedures 5520 and 5524). • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• This test involves a change of CRS from the CRS to which the source project is referenced to the CRS to which the target project is referenced. The test assumes that the application applies a coordinate change and then stores coordinates in the CRS to which the target project is referenced. • The test assumes that Well G has been correctly loaded to the source project (see Test Procedure 5509).

Test Procedure:	5525 - Transfer wellbore data with vertical CRS change
Test Purpose:	To verify that the application correctly transfers wellbore data to another project when a change of vertical CRS is involved.
Test Process:	• In project *GIGS_project_A2V1depth* select Test Data. • Transfer selected data to project *GIGS_project_A1W1depth*. • Verify data in project *GIGS_project_A1W1depth* against Test Data.
Test Data:	Well B as loaded to project *GIGS_project_A2V1depth*.
Expected Results:	• The application transfers vertical locations correctly. Results should agree to within 0.1m (100mm) of the Test Data. See file *GIGS_wells_5525_output*. (The same output data applies to Test Procedures 5518, 5521, 5522 and 5525). • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• This test involves a change of vertical datum from source project to target project. The test assumes that the application applies a coordinate change and then stores coordinates in the CRS to which the target project is referenced. • The test assumes that Well B has been correctly loaded to the source project (see Test Procedure 5507).

Test Procedure:	5526 - Import wellbore depth data with ellipsoidal vertical data
Test Purpose:	To verify that the application can correctly load wellbore vertical position when referenced to a different vertical datum to that of the project. This test compliments that in Test Procedure 5506.
Test Process:	• Load data from test files to project *GIGS_project_A2V1depth*. • Import wellbore depth data with change of vertical CS • Check vertical locations in project *GIGS_project_A2V1depth* against Test Data.
Test Data:	*GIGS_wells_5526_wellA_input*
Expected Results:	• The application should adjust 'depths below ellipsoid' to reference 'depths below <project vertical CRS>' using the EGM2008 geoid model. Results should agree to within 0.1m (100mm) of the Test Data. See file *GIGS_wells_5526_wellA_output*. • Test result will be pass or fail. If fail, details of failure should be reported.
Note:	• The same input data are also used in Test Procedure 5506. • If the application cannot import a P7 format file, report this and instead use the ASCII file.

End of 5500 Test Procedures

2.11.8 7000 Deprecation Test Procedures

The Test Procedures for this series are designed to verify the geodetic data object deprecation functionality of the software. The Test Data comprises a number of entities that have been deprecated in the EPSG Dataset, alongside deprecation details. The Test Procedure should identify if these entities are present in the application's predefined geodetic parameter library, and if so, how they are represented.

Test Procedure:	7001 - Deprecated EPSG data
Test Purpose:	To verify whether reference data bundled with the application recognises the EPSG deprecation flag.
Test Process:	Review definitions of EPSG deprecated data included in the application.
Test Data:	EPSG Dataset and file *GIGS_dep_7001*. As a minimum those geodetic data objects relevant to the application's area of use should be tested.
Expected Results:	Data marked as deprecated in the EPSG Dataset should either be clearly distinguished from valid data or should not be present in the application libraries.
Note:	Applications may lag behind updates to the EPSG Dataset. The Test Data deliberately uses deprecations made several years ago, which by now should be recognised as deprecated by the application.

End of 7000 Test Procedures

Appendix A: GIGS Test Dataset Index and Maps

The following index applies only to the ASCII base class Test Data files (i.e., not the P-format files) - depending on the chosen, or derived, Test Dataset format, the actual file names and structure may be different (see Section 2.3 and 2.4).

Table A1: Index of GIGS Test Procedure objects and components

Test Proc.#	Test Object/Subject	Test Data Input File Name(s)	GIGS CRS(s) used	Test Data Output File Name(s)
2000 - Predefined geodetic data objects				
2201	unit of measure	GIGS_lib_2201_Unit		N/A
2202	ellipsoid	GIGS_lib_2202_Ellipsoid		N/A
2203	prime meridian	GIGS_lib_2203_PrimeMeridian		N/A
2204	geodetic datum	GIGS_lib_2204_GeodeticDatum		N/A
2205	geodetic CRS	GIGS_lib_2205_GeodeticCRS		N/A
2206	conversion	GIGS_lib_2206_Conversion		N/A
2207	projected CRS	GIGS_lib_2207_ProjectedCRS		N/A
2208	coordinate transformation	GIGS_lib_2208_CoordTfm		N/A
2209	vertical datum	GIGS_lib_2209_VerticalDatum		N/A
2210	vertical CRS	GIGS_lib_2210_VerticalCRS		N/A
2211	vertical transformation	GIGS_lib_2211_VertTfm		N/A
3000 - User-defined geodetic data objects				
3201	unit of measure	GIGS_user_3201_Unit		N/A
3202	ellipsoid	GIGS_user_3202_Ellipsoid		N/A
3203	prime meridian	GIGS_user_3203_PrimeMeridian		N/A
3204	geodetic datum	GIGS_user_3204_GeodeticDatum		N/A
3205	geodetic CRS	GIGS_user_3205_GeodeticCRS		N/A

Test Proc.#	Test Object/Subject	Test Data Input File Name(s)	GIGS CRS(s) used	Test Data Output File Name(s)
3206	conversion	GIGS_user_3206_Conversion		N/A
3207	projected CRS	GIGS_user_3207_ProjectedCRS		N/A
3208	coordinate transformation	GIGS_user_3208_CoordTfm (+GIGS_user_3208_CoordTfm_61004_N_SLOPE.LAS; GIGS_user_3208_CoordTfm_61004_N_SLOPE.LOS; GIGS_user_3208_CoordTfm_61844_QUE27-98.gsb – if required)		N/A
3209	vertical datum	GIGS_user_3209_VerticalDatum		N/A
3210	vertical CRS	GIGS_user_3210_VerticalCRS		N/A
3211	vertical transformation	GIGS_user_3211_VertTfm		N/A
3212	concatenated transformation	GIGS_user_3212_ConcatTfm		N/A
5100 - Data Operations - Conversion				
		Note: if using P1/11 subclass files, only single file is needed		
5101	Software performance - Conversions - Transverse Mercator	GIGS_conv_5101_TM_input_part1; GIGS_conv_5101_TM_input_part2; GIGS_conv_5101_TM_input_part3; GIGS_conv_5101_TM_input_part4	A<>A2 A<>A1 F<>F7 G<>G11	*GIGS_conv_5101_TM_output_part1; GIGS_conv_5101_TM_output_part2; GIGS_conv_5101_TM_output_part3; GIGS_conv_5101_TM_output_part4 *depending on formula in application, use either output files _JHS or _USGS
5102	Software performance - Conversions - Lambert Conic Conformal (1SP)	GIGS_conv_5102_LCC1_input_part1; GIGS_conv_5102_LCC1_input_part2	M<>M25 H<>H19	GIGS_conv_5102_LCC1_output_part1; GIGS_conv_5102_LCC1_output_part2;
5103	Software performance - Conversions - Lambert Conic Conformal (2SP)	GIGS_conv_5103_LCC2_input_part1; GIGS_conv_5103_LCC2_input_part2; GIGS_conv_5103_LCC2_input_part3	E<>E6 G<>G17 G<>G18	GIGS_conv_5103_LCC2_output_part1; GIGS_conv_5103_LCC2_output_part2; GIGS_conv_5103_LCC2_output_part3
5104	Software performance - Conversions - Oblique Stereographic	GIGS_conv_5104_OblStereo_input	C<>C4	GIGS_conv_5104_OblStereo_output
5105	Software performance - Conversions - Oblique Mercator	GIGS_conv_5105_HOM-B_input_part1; GIGS_conv_5105_HOM-B_input_part2	G<>G13 K<>K26	GIGS_conv_5105_HOM-B_output_part1; GIGS_conv_5105_HOM-B_output_part2
5106	Software performance - Conversions - Hotine Oblique Mercator	GIGS_conv_5106_HOM-A_input	G<>G14	GIGS_conv_5106_HOM-A_output

Test Proc.#	Test Object/Subject	Test Data Input File Name(s)	GIGS CRS(s) used	Test Data Output File Name(s)
5107	Software performance - Conversions - American Polyconic	GIGS_conv_5107_AmPolyC_input	G<>G12	GIGS_conv_5107_AmPolyC_output
5108	Software performance - Conversions - Cassini-Soldner	GIGS_conv_5108_Cass_input	G<>G15	GIGS_conv_5108_Cass_output
5109	Software performance - Conversions - Albers Equal Area	GIGS_conv_5109_Albers_input	F<>F9	GIGS_conv_5109_Albers_output
5110	Software performance - Conversions - Lambert Azimuthal Equal Area	GIGS_conv_5110_LAEA_input	G<>G16	GIGS_conv_5110_LAEA_output
5111	Software performance - Conversions - Mercator (1SP)	GIGS_conv_5111_MercA_input_part1; GIGS_conv_5111_MercA_input_part2	L<>L27 D<>D5	GIGS_conv_5111_MercA_output_part1; GIGS_conv_5111_MercA_output_part2
5112	Software performance - Conversions - Mercator (2SP)	GIGS_conv_5112_MercB_input	Y<>Y24	GIGS_conv_5112_MercB_output
5113	Software performance - Conversions - Transverse Mercator (South Orientated)	GIGS_conv_5113_TMSO_input	G<>G10	GIGS_conv_5113_TMSO_output
5200 - Data Operations – Coordinate Transformation				
		Note: if using P1/11 subclass files, only single file is needed		
5201	Software performance - Conversions - Geographic<>Geocentric	GIGS_tfm_5201_GeogGeocen_input	A	GIGS_tfm_5201_GeogGeocen_output
5202	(Test Procedure removed, replaced by tests 5211 through 5213)			
5203	Software performance - transformations - Position Vector (geographic 2D domain)	GIGS_tfm_5203_PosVec_input_part1; GIGS_tfm_5203_PosVec_input_part2	B<>A	GIGS_tfm_5203_PosVec_output_part1; GIGS_tfm_5203_PosVec_output_part2
5204	Software performance - transformations - Coordinate Frame (geographic 2D domain)	GIGS_tfm_5204_CoordFrame_input_part1; GIGS_tfm_5204_CoordFrame_input_part2	E<>A	GIGS_tfm_5204_CoordFrame_output_part1; GIGS_tfm_5204_CoordFrame_output_part2
5205	Software performance - transformations - Molodensky-Badekas (geographic domain)	GIGS_tfm_5205_MolBad_input_part1; GIGS_tfm_5205_MolBad_input_part2	C<>A	GIGS_tfm_5205_MolBad_output_part1; GIGS_tfm_5205_MolBad_output_part2
5206	Software performance - transformations - NADCON	*GIGS_tfm_5206_Nadcon_input_part1; GIGS_tfm_5206_Nadcon_input_part2 GIGS_tfm_5206_Nadcon_input_part3 *if early-binding use part 2 and 3, or if late-binding use part 1	J<>Z	GIGS_tfm_5206_Nadcon_output

Test Proc.#	Test Object/Subject	Test Data Input File Name(s)	GIGS CRS(s) used	Test Data Output File Name(s)
5207	Software performance - transformations - NTv2	GIGS_tfm_5207_NTv2_input_part1; GIGS_tfm_5207_NTv2_input_part2	X<>F J<>Z	GIGS_tfm_5207_NTv2_output_part1; GIGS_tfm_5207_NTv2_output_part2
5208	Software performance - transformations - Longitude rotation	GIGS_tfm_5208_LonRot_input	T<>H	GIGS_tfm_5208_LonRot_output
5209	Software performance - conversions - UKOOA P6 bin grid	GIGS_tfm_5209_BinGrid_input	Bin Grid <> A1	GIGS_tfm_5209_BinGrid_output
5210	Software performance - transformations - vertical offset	GIGS_tfm_5210_VertOff_input	W1<>V1 with both heights and depths	GIGS_tfm_5210_VertOff_output
5211	Software performance - transformations - geocentric translations (geocentric domain)	GIGS_tfm_5211_3trnslt_Geocen_input	B<>A	GIGS_tfm_5211_3trnslt_Geocen_output
5212	Software performance - transformations - geocentric translations (geographic 3D domain)	GIGS_tfm_5212_3trnslt_Geog3D_input	B<>A	*GIGS_tfm_5212_3trnslt_Geog3D_output *depending on formula in application, use either output files _AbrMol or _EPSGconcat
5213	Software performance - transformations - geocentric translations (geographic 2D domain)	GIGS_tfm_5213_3trnslt_Geog2D_input	B<>A	*GIGS_tfm_5213_3trnslt_Geog2D_output *depending on formula in application, use either output files _AbrMol or _EPSGconcat
5300 - Data Operations - 2D Seismic				
		Note: if using P1/11 or P1/90 subclass files, only single file is needed		
5301	(Test Procedure removed)			
5302	(Test Procedure removed)			
5303	(Test Procedure removed)			
5304	(Test Procedure removed)			
5305	(Test Procedure removed)			
5306	Import 2D seismic position data with conversion (map projection) change (1) - full CRS definition.	GIGS_seis2D_5306_input_part1; GIGS_seis2D_5306_input_part2	A1 > A2	GIGS_seis2D_5306_output
5307	Import 2D seismic position data with conversion (map projection) change (2) - EPSG CRS identification.	GIGS_seis2D_5307_input;	A1 > A2	GIGS_seis2D_5307_output
5308	Import 2D seismic position data with geodetic datum change (1) - full CRS definition.	GIGS_seis2D_5308_input_part1; GIGS_seis2D_5308_input_part2	B > A2	GIGS_seis2D_5308_output

Test Proc.#	Test Object/Subject	Test Data Input File Name(s)	GIGS CRS(s) used	Test Data Output File Name(s)
5309	Import 2D seismic position data with geodetic datum change (2) - EPSG CRS identification.	GIGS_seis2D_5309_input	B > A2	GIGS_seis2D_5309_output
5310	Import 2D seismic position data with change of horizontal units	GIGS_seis2D_5310_input	A23 > A2	GIGS_seis2D_5310_output
5311	Import 2D seismic position data given in grads	GIGS_seis2D_5311_input	Agr > A2	GIGS_seis2D_5311_output
5312	Import 2D seismic position data with vertical datum change.	GIGS_seis2D_5312_input_part1;	W1height > V1depth W1depth > V1depth	GIGS_seis2D_5312_output
5313	Import 2D seismic position data with ellipsoidal height.	GIGS_seis2D_5313_input	A > V1depth	GIGS_seis2D_5313_output
5314	Import 2D seismic position data with change of vertical units.	GIGS_seis2D_5314_input	V2height > V1depth	GIGS_seis2D_5314_output
5315	Import and "decimate" 2D seismic position data	GIGS_seis2D_5315_input	n/a	GIGS_seis2D_5315_output
5316	Export 2D seismic position data with conversion (map projection) change.	(Test Data loaded to project in earlier tests)	A2 > A1	GIGS_seis2D_5316_output
5317	Export 2D seismic position data with geodetic datum change.	(Test Data loaded to project in earlier tests)	A2 > B2	GIGS_seis2D_5317_output
5318	Export 2D seismic position data with change of horizontal units.	(Test Data loaded to project in earlier tests)	A2 > A23	GIGS_seis2D_5318_output
5319	Export 2D seismic position data with vertical datum change.	(Test Data loaded to project in earlier tests)	V1depth > W1depth	GIGS_seis2D_5319_output
5320	Transfer 2D seismic position data with conversion (map projection) change.	(Test Data loaded to project in earlier tests)	A2 > A1	GIGS_seis2D_5320_output
5321	Transfer 2D seismic position data with geodetic datum change.	(Test Data loaded to project in earlier tests)	A2 > B2	GIGS_seis2D_5321_output
5322	Transfer 2D seismic position data with change of horizontal CRS units.	(Test Data loaded to project in earlier tests)	A2 > A23	GIGS_seis2D_5322_output
5323	Transfer 2D seismic position data with vertical datum change.	(Test Data loaded to project in earlier tests)	V1depth > W1depth	GIGS_seis2D_5323_output
5324	Import 2D seismic position data with geodetic datum change using NADCON	GIGS_seis2D_5324_input	J > Z	GIGS_seis2D_5324_output
5325	Import 2D seismic position data with geodetic datum change using NTv2	GIGS_seis2D_5325_input	J > Z	GIGS_seis2D_5325_output

Test Proc.#	Test Object/Subject	Test Data Input File Name(s)	GIGS CRS(s) used	Test Data Output File Name(s)
5400 - Data Operations - 3D Seismic				
5401	(Test Procedure removed)			
5042	(Test Procedure removed)			
5403	Import 3D seismic position data with CRS change	GIGS_seis3D_5403_surveyA_input; GIGS_seis3D_5403_surveyB_input; GIGS_seis3D_5403_surveyC_input; GIGS_seis3D_5403_surveyD_input	A1 > A2 A > A2	GIGS_seis3D_5403_surveyA_output; GIGS_seis3D_5403_surveyA_output_axes; GIGS_seis3D_5403_surveyB_output; GIGS_seis3D_5403_surveyB_output_axes; GIGS_seis3D_5403_surveyC_output; GIGS_seis3D_5403_surveyC_output_axes; GIGS_seis3D_5403_surveyD_output; GIGS_seis3D_5403_surveyD_output_axes
5404	Export 3D seismic position data with CRS change.	(Test Data loaded to project in earlier tests)	A2 > A1	GIGS_seis3D_5404_output
5405	Transfer 3D seismic position data with CRS change.	(Test Data loaded to project in earlier tests)	A2 > A1	GIGS_seis3D_5405_output
5406	Import P6 extent and coverage records	GIGS_seis3D_5406_SurveyE_input.P6* *Test Data only offered as P6 as specifically test P-formats	A2	GIGS_seis3D_5406_surveyE_output
5407	Import P6 extent records with conversion (map projection) change	GIGS_seis3D_5407_surveyE_input.P6* *Test Data only offered as P6 as specifically test P-formats	A2 > A1	GIGS_seis3D_5407_surveyE_output
5500 - Data Operations - Well Data				
5501	(Test Procedure removed)			
5503	(Test Procedure removed)			
5504	(Test Procedure removed)			
5505	(Test Procedure removed)			
5506	Import wellbore position data from latitude, longitude	GIGS_wells_5506_wellA_input	A > A2	GIGS_wells_5506_wellA_output
5507	Import wellbore position data from EN	GIGS_wells_5507_wellB_input	A2	GIGS_wells_5507_wellB_output
5508	Import wellbore position data from different EN	GIGS_wells_5508_wellD_input	A1 > A2	GIGS_wells_5508_wellD_output

Test Proc.#	Test Object/Subject	Test Data Input File Name(s)	GIGS CRS(s) used	Test Data Output File Name(s)
5509	Import wellbore position data from different geodetic datum	GIGS_wells_5509_wellG_input	B > A2	GIGS_wells_5509_wellG_output
5510	Import wellbore position data from MD/Inc/Az - TN	GIGS_wells_5510_wellXNE_input; GIGS_wells_5510_wellXNH_input	A2	GIGS_wells_5510_wellXNE_output; GIGS_wells_5510_wellXNH_output
5511	Import wellbore position data from MD/Inc/Az - GN	GIGS_wells_5511_wellYNC_input; GIGS_wells_5511_wellYNF_input	A1 > A2	GIGS_wells_5511_wellYNC_output; GIGS_wells_5511_wellYNF_output
5512	Import wellbore position data from MD/Inc/Az - TN (Southern Hemisphere)	GIGS_wells_5512_wellXSJ_input; GIGS_wells_5512_wellXSK_input	F > F1	GIGS_wells_5512_wellXSJ_output; GIGS_wells_5512_wellXSK_output
5513	Import wellbore position data from MD/Inc/Az - GN (Southern Hemisphere)	GIGS_wells_5513_wellYSL_input; GIGS_wells_5513_wellYSM_input	F7 > F1	GIGS_wells_5513_wellYSL_output; GIGS_wells_5513_wellYSM_output
5514	Import wellbore depth data from MD/Inc/Az	GIGS_wells_5514_wellXNE_input; GIGS_wells_5514_wellXNH_input	V1 depth	GIGS_wells_5514_wellXNE_output; GIGS_wells_5514_wellXNH_output
5515	Import wellbore depth data with change of vertical datum	GIGS_wells_5515_wellD_input; GIGS_wells_5515_wellYNC_input; GIGS_wells_5515_wellYNF_input	W1 depth > V1 depth	GIGS_wells_5515_wellD_output; GIGS_wells_5515_wellYNC_output; GIGS_wells_5515_wellYNF_output
5516	Import wellbore depth data with TVDBML reference	GIGS_wells_5516_wellG_input	V1 depth	GIGS_wells_5516_wellG_output
5517	Import wellbore depth data with change of vertical CRS unit	GIGS_wells_5517_wellB_input	V1depth ft and m	GIGS_wells_5517_wellB_output
5518	Export wellbore data with conversion (map projection) change.	(Test Data loaded to project in earlier tests)	A2 > A1	GIGS_wells_5518_output
5519	Export wellbore data with geodetic datum change.	(Test Data loaded to project in earlier tests)	A2 > B	GIGS_wells_5519_output
5520	Export wellbore data with change of horizontal CRS units.	(Test Data loaded to project in earlier tests)	A2 > A23	GIGS_wells_5520_output
5521	Export wellbore data with vertical datum change.	(Test Data loaded to project in earlier tests)	V1 depth > W1 depth	GIGS_wells_5521_output
5522	Transfer wellbore data with conversion (map projection) change.	(Test Data loaded to project in earlier tests)	A2 > A1	GIGS_wells_5522_output
5523	Transfer wellbore data with geodetic datum change.	(Test Data loaded to project in earlier tests)	A2 > B	GIGS_wells_5523_output

Test Proc.#	Test Object/Subject	Test Data Input File Name(s)	GIGS CRS(s) used	Test Data Output File Name(s)
5524	Transfer wellbore data with change of horizontal CRS units.	(Test Data loaded to project in earlier tests)	A2 > A23	GIGS_wells_5524_output
5525	Transfer wellbore data with vertical datum change.	(Test Data loaded to project in earlier tests)	V1 depth > W1 depth	GIGS_wells_5525_output
5526	Import wellbore depth data referenced to ellipsoidal height	GIGS_wells_5526_wellA_input	A > V1 depth	GIGS_wells_5526_wellA_output
7000 - Deprecation				
7001	Recognise EPSG deprecated data	GIGS_dep_7001	N/A	N/A

GIGS Test Dataset Index Maps

Small-scale Map of all GIGS Test Dataset Points (symbolised by Series)

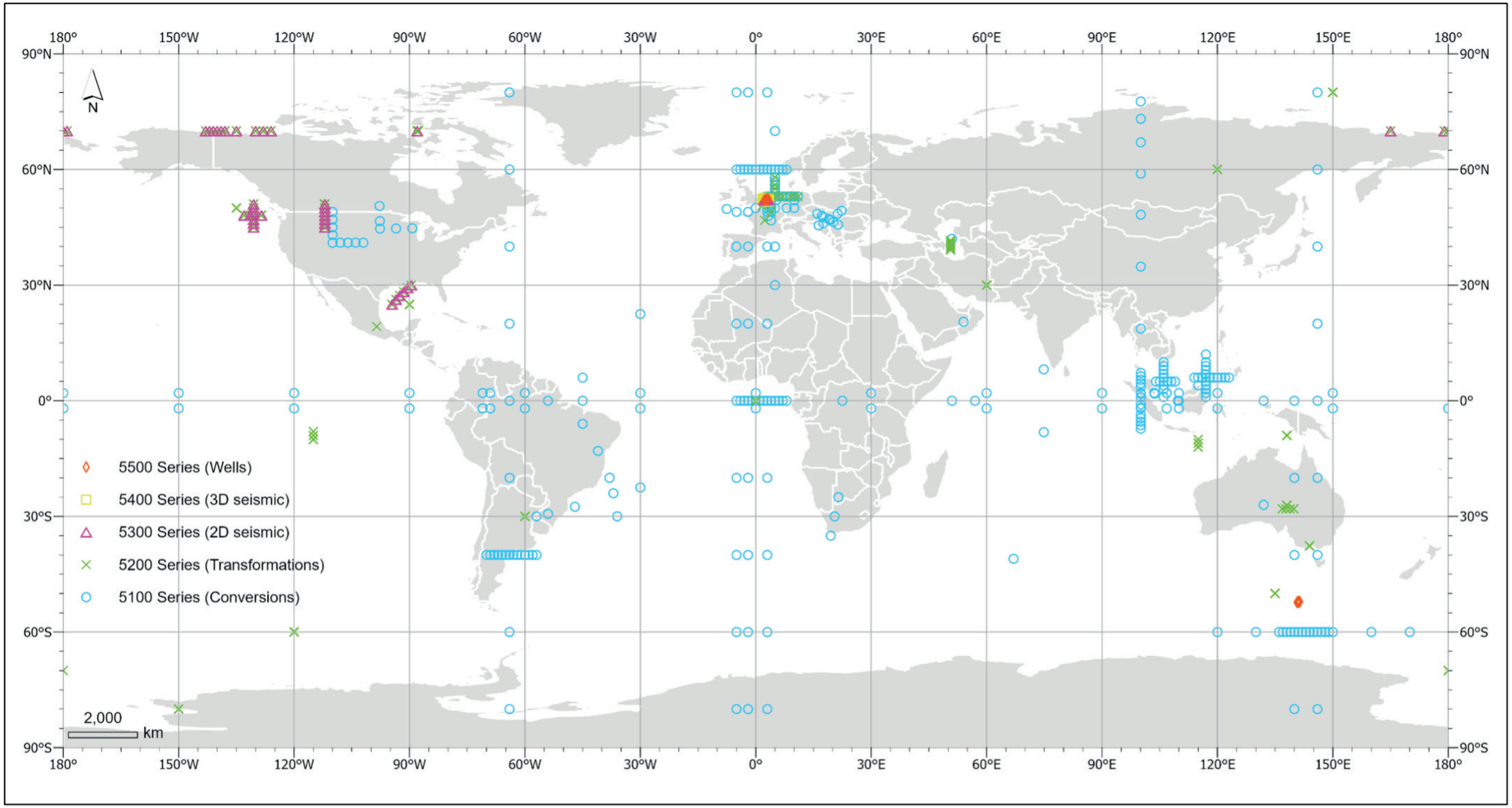


Figure A1: Small-scale map of all GIGS Test Dataset Points

Large-scale Map of GIGS Test Dataset Points focused on Southern North Sea (symbolised by Series)

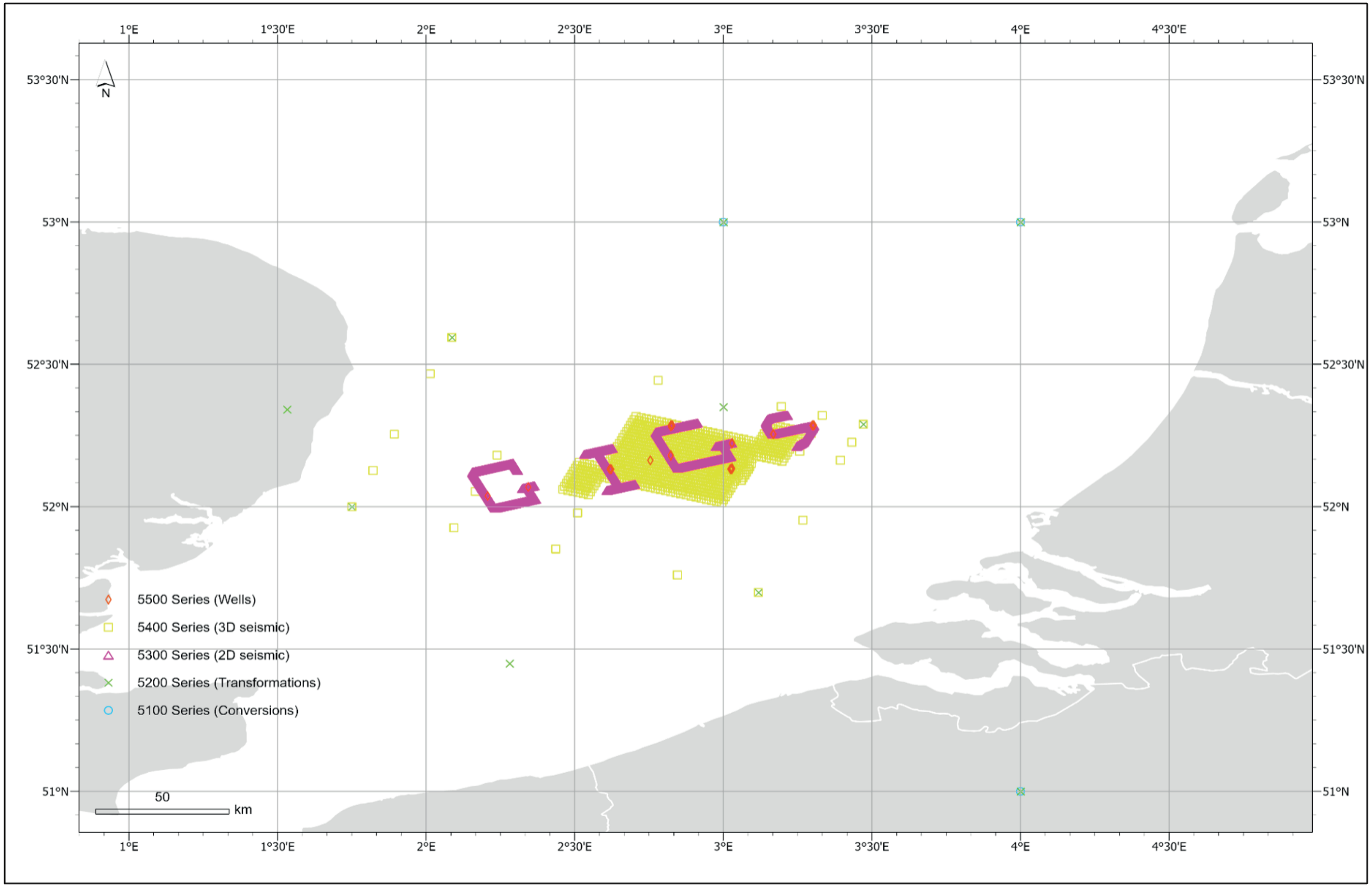


Figure A2: Large-scale map of GIGS Test Dataset Points focused on Southern North Sea

Small-scale Map of all 5100 Series (Conversions) GIGS Test Dataset Points (symbolised by Test Procedure)

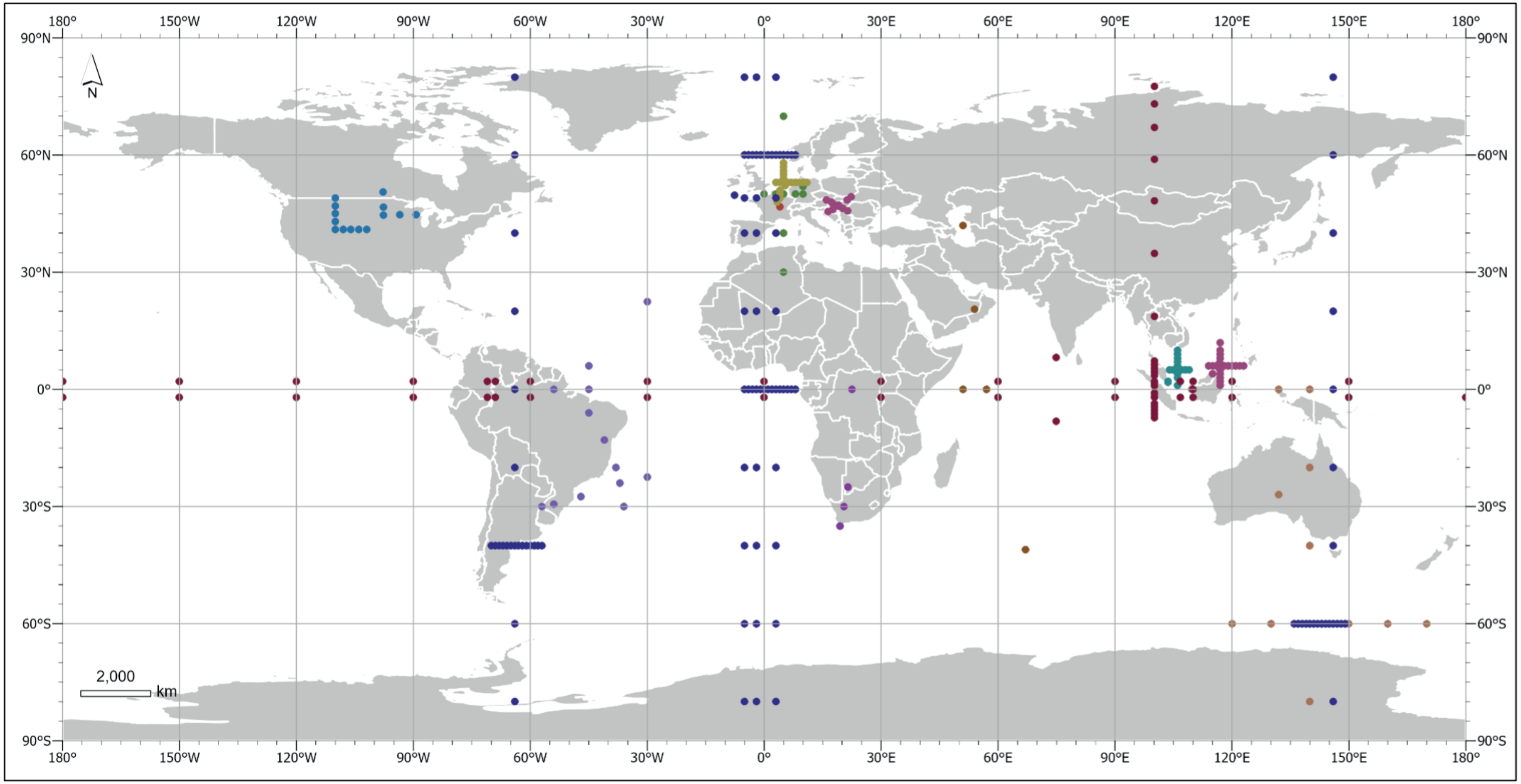


Figure A3: Small-scale map of all 5100 Series GIGS Test Dataset Points

Small-scale Map of all 5200 Series (Transformations) GIGS Test Dataset Points (symbolised by Test Procedure)

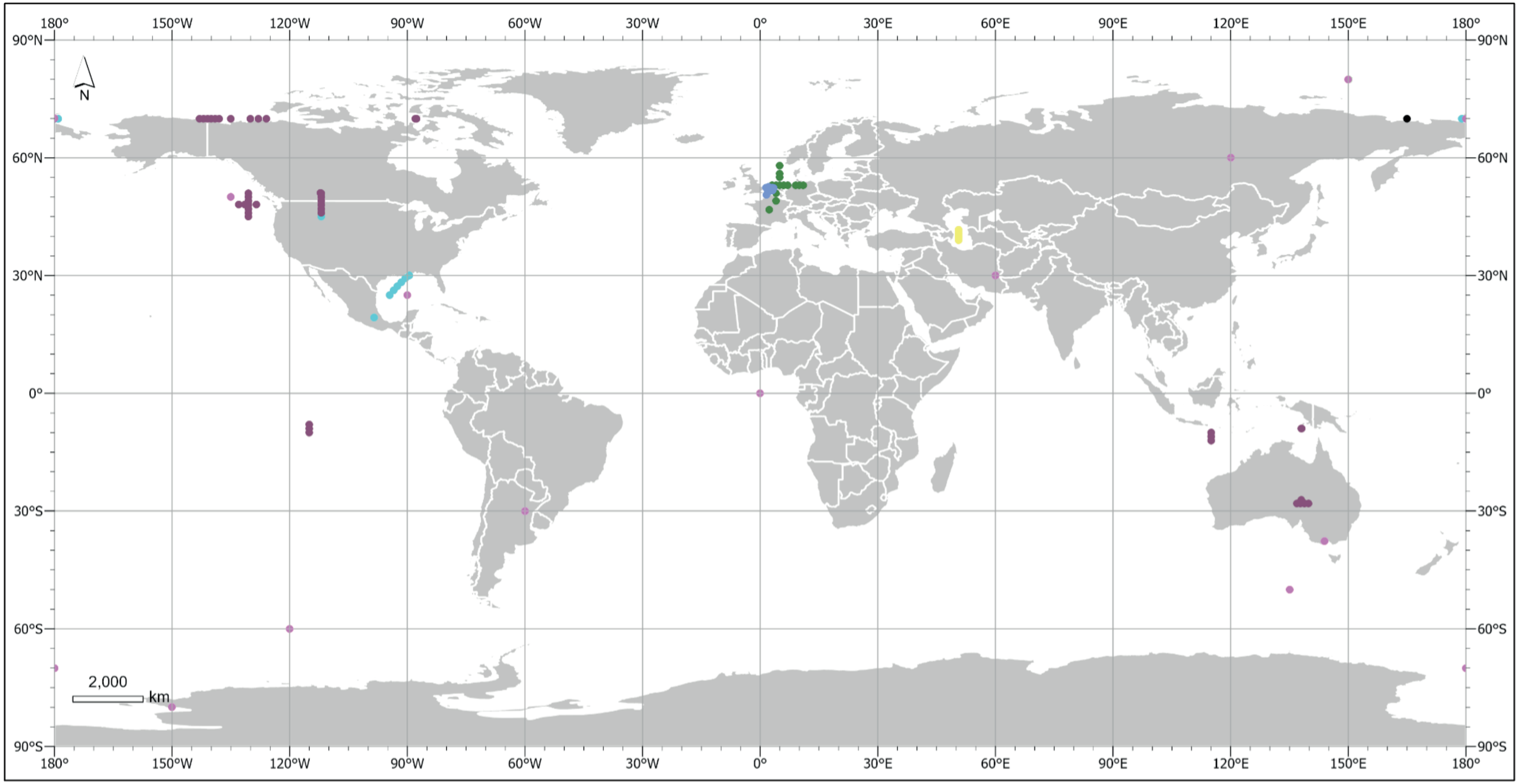


Figure A4: Small-scale map of all 5200 Series GIGS Test Dataset Points

Small-scale Map of all 5300 Series (2D Seismic) GIGS Test Dataset Points (symbolised by Test Procedure)

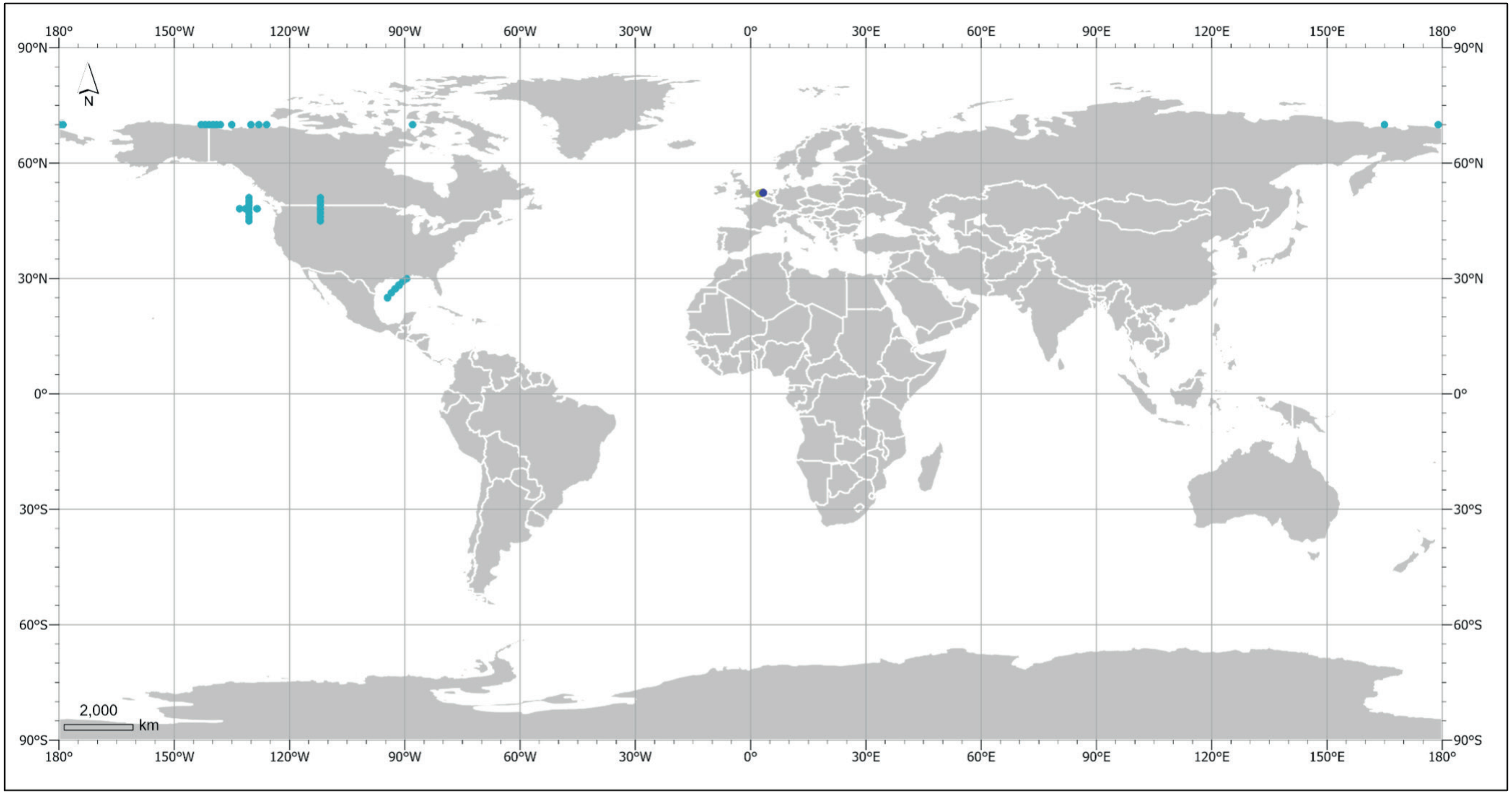


Figure A5: Small-scale map of all 5300 Series (2D Seismic) GIGS Test Dataset Points

Large-scale Map of 5300 Series (2D Seismic) GIGS Test Dataset Points focused on Southern North Sea (symbolised by Test Procedure)

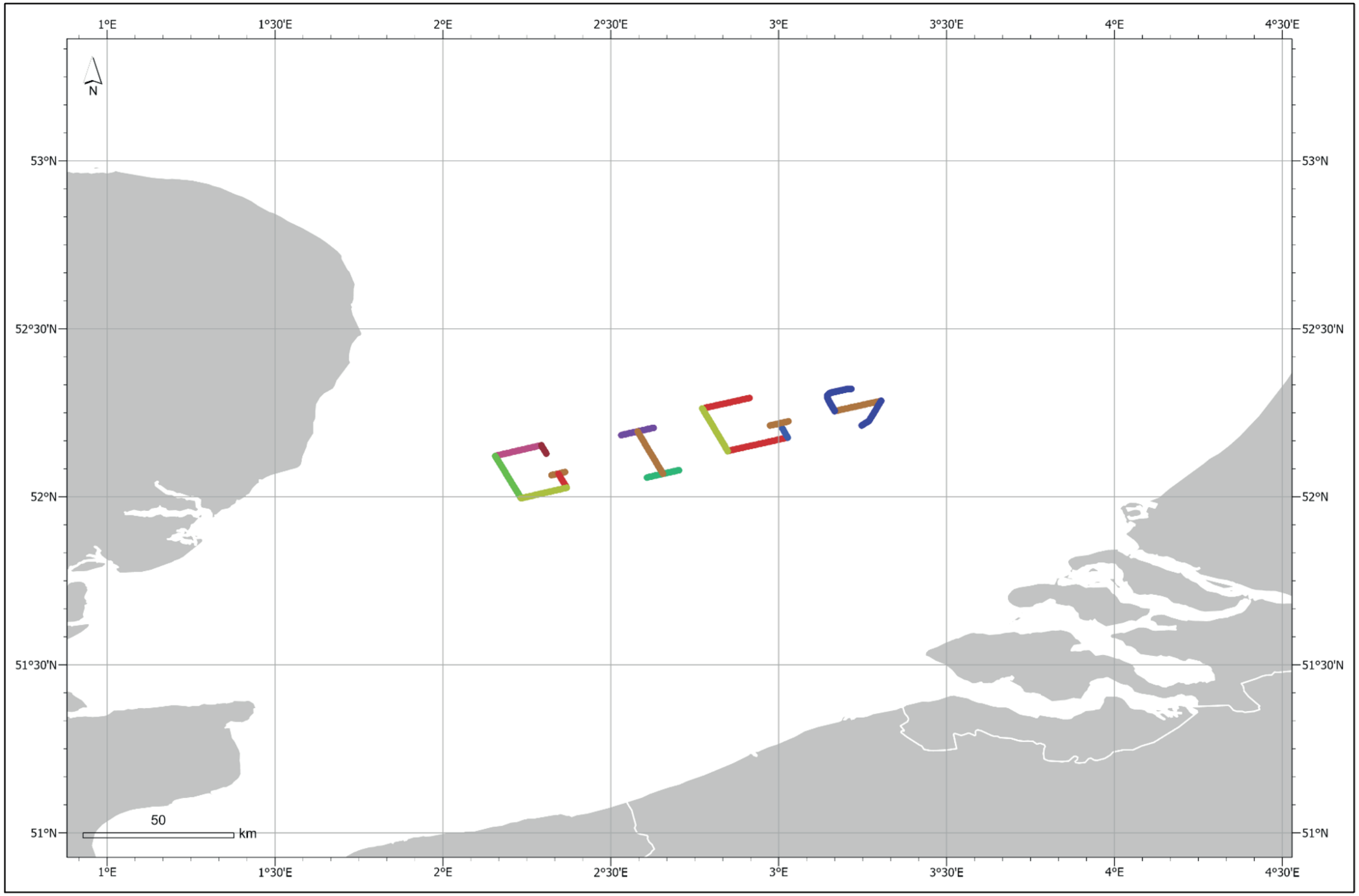


Figure A6: Large-scale map of 5300 Series GIGS Test Dataset Points focused on Southern North Sea

Large-scale Map of 5400 Series (3D Seismic) GIGS Test Dataset Points (symbolised by Test Procedure)

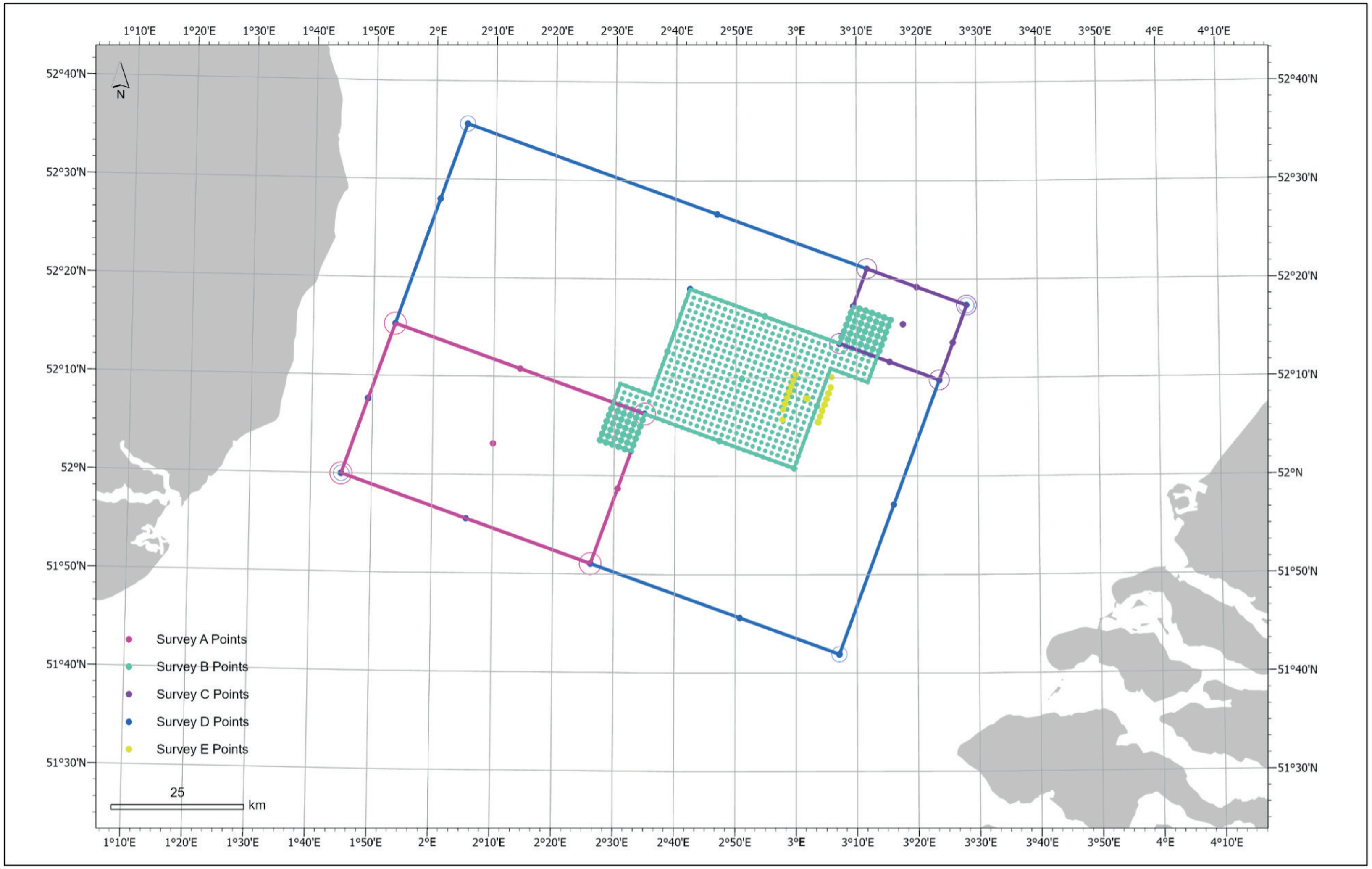


Figure A7: Large-scale map of 5400 Series (3D Seismic) GIGS Test Dataset Points

Small-scale Map of all 5500 Series (Wells) GIGS Test Dataset Points (symbolised by Test Procedure)

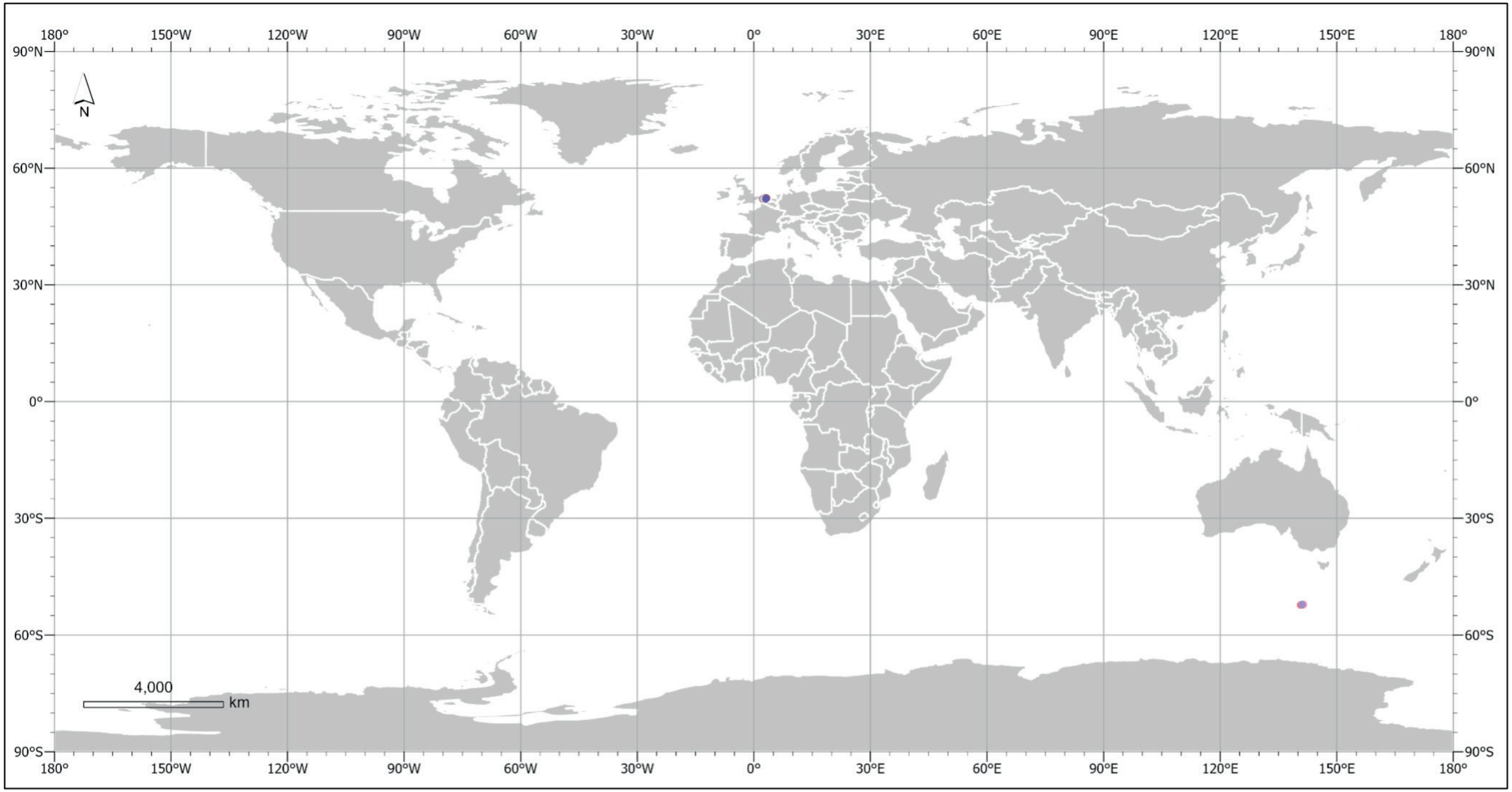


Figure A8: Small-scale map of all 5500 Series GIGS Test Dataset Points

Large-scale Map of 5500 Series (Wells) GIGS Test Dataset Points focused on Southern North Sea (symbolised by Test Procedure)

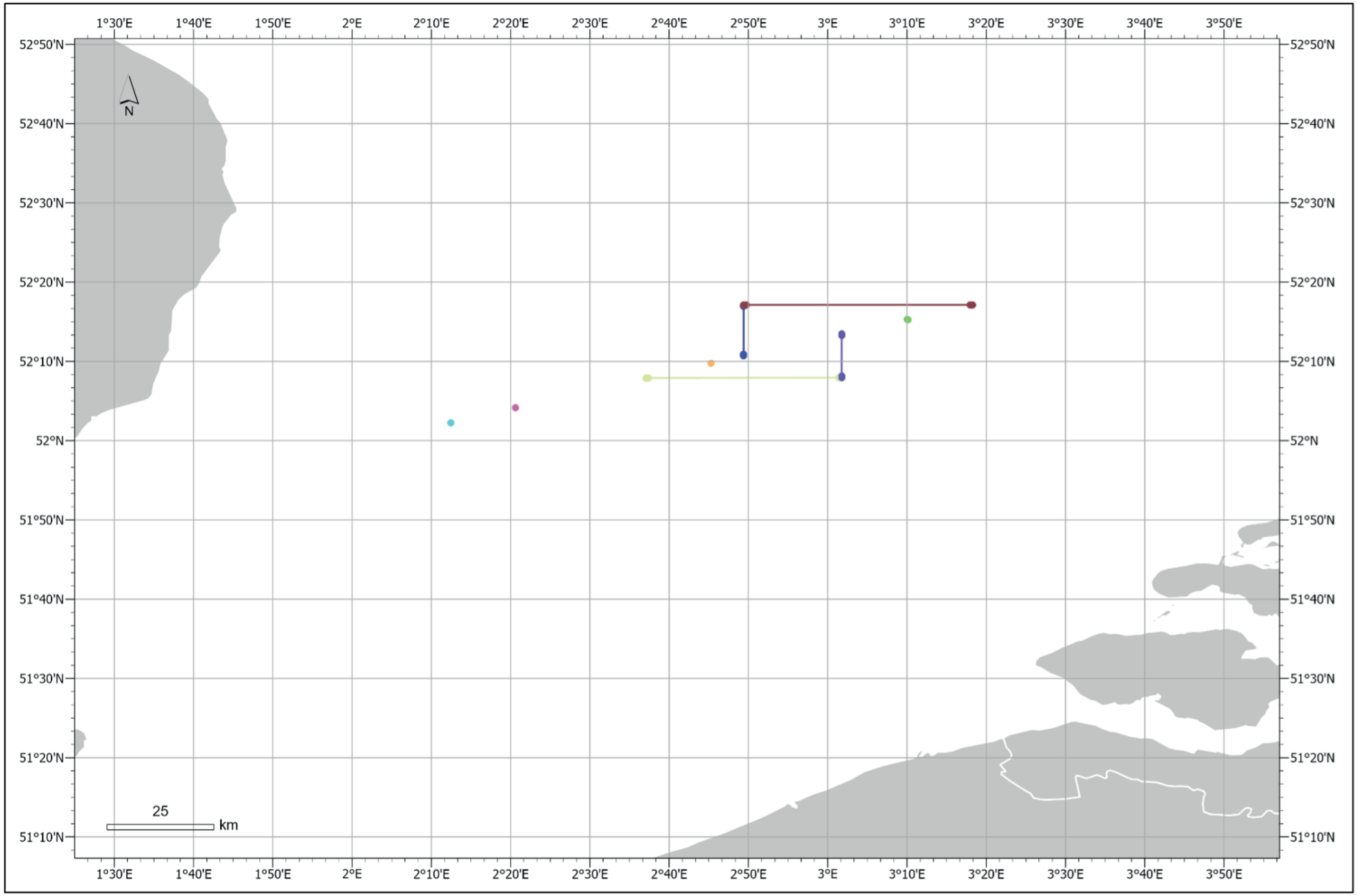


Figure A9: Large-scale map of 5500 Series GIGS Test Dataset Points focused on Southern North Sea

Large-scale Map of 5500 Series (Wells) GIGS Test Dataset Points focused on the South Pacific (symbolised by Test Procedure)

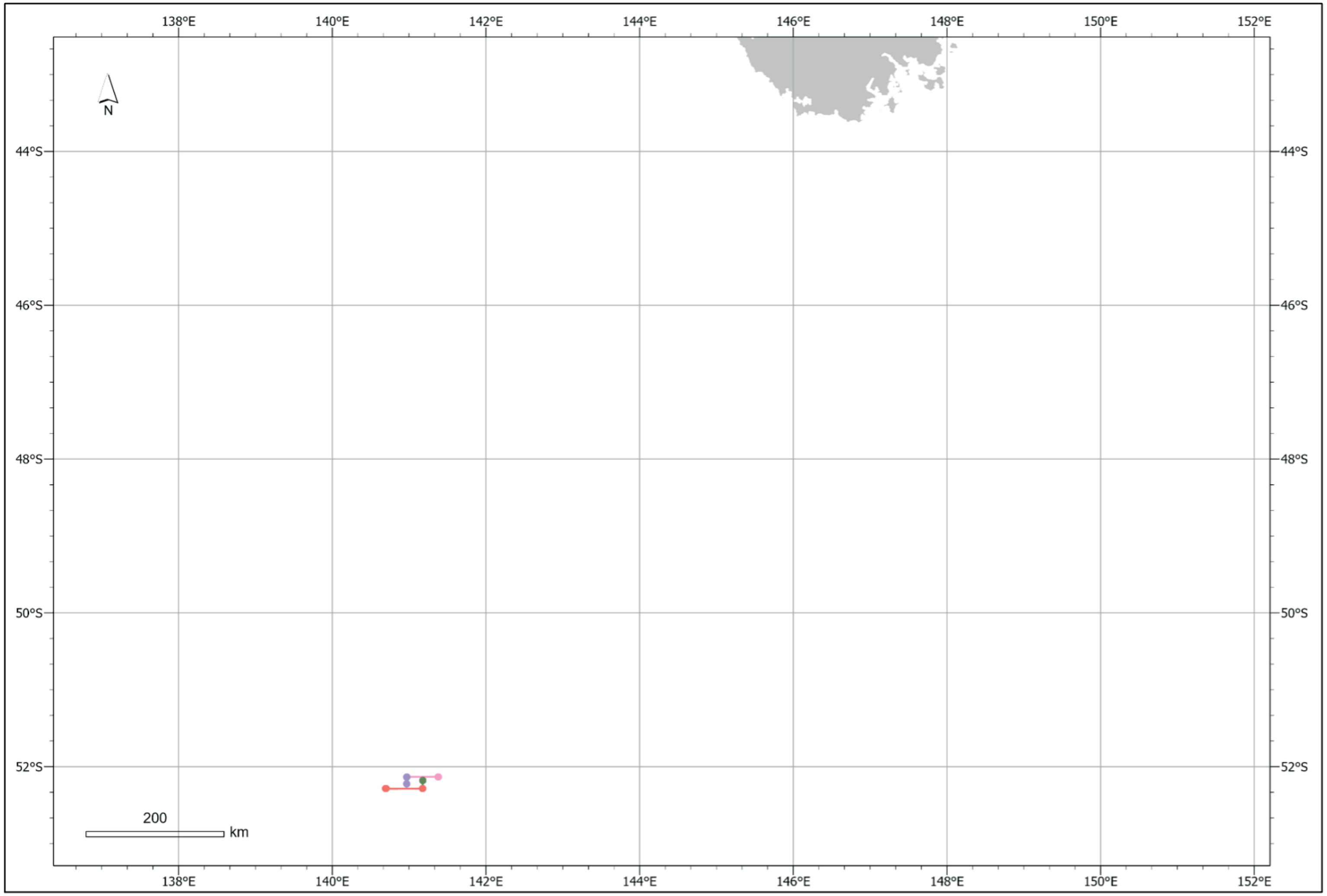


Figure A10: Large-scale map of 5500 Series GIGS Test Dataset Points focused on the South Pacific

Appendix B: Non-EPSG Nomenclature Guide

The following guidance applies when conducting Test Procedures where the geoscience software does not conform to the EPSG model or nomenclature.

The ISO/EPSG model represents the consensus of best practice that has evolved over 30 years of digital geospatial data management. While it is assumed that future geoscience software will follow the model, the current generation of geoscience software does not always do so. The GIGS Test Dataset may be used with such geoscience software if the software's model can be mapped to the ISO/EPSG model. In this document it is impossible to cover all non-conformant cases. Commonly encountered issues are:

- Nomenclature.
- Axes names and abbreviations and coordinate order may be hard-wired into the software rather than being dependent upon CRS definition
- Units.
- Although not part of any formal CRS definition, some geoscience software requires that a datum definition includes a transformation to WGS 84.

The most common is the use of 'coordinate system' to mean the ISO/EPSG entity coordinate reference system. In the ISO/EPSG model, coordinate system is just one part of a CRS. Other commonly encountered incorrectly used terms are 'datum shift' for coordinate transformation, and 'spheroid' for ellipsoid.

The names of coordinate conversion and coordinate transformation methods may sometimes be problematic. Where particular terms are known to be encountered, these are noted in the relevant Test Procedures in Series 1000. Another problem is that a single method name may be used to apply to formulae that give significantly different results. This becomes apparent when results do not correspond with the "expected results" in the Test Dataset.

The names of coordinate conversion and transformation method parameters may sometimes be problematic. One term may incorrectly be used for all of 'latitude of origin', 'latitude of natural origin' and 'latitude of false origin'; similarly for longitude with the added complication that it may be called 'central meridian'. 'False easting', 'easting at false origin' and 'easting at projection centre' may all be called 'false easting'; similarly for 'false northing'.

Care must be taken by the Evaluator to recognise such disparity in terms in particular software and discretion used in undertaking associated Test Procedures; it is recommended that terminology differences are reported.

Appendix C: GIGS to EPSG Code/Name Relationship

The correlation between GIGS entities and "real world systems" as documented in the EPSG Dataset is shown below, with the understanding that the official EPSG CRSs are limited to their specified "area of use" as defined in the EPSG Dataset, whereas the corresponding GIGS CRSs have unlimited area of use (i.e., they may be used for any geographic area of the Earth). This table only shows horizontal geodetic data objects as the EPSG equivalence for vertical objects is much simpler and can be found in the headers of respective Test Dataset files.

Table C1: Index of GIGS Test Dataset objects and associated EPSG Code/Names

GIGS Object Name	GIGS Code	Object Type	EPSG Name	EPSG Code	Comment
GIGS geodetic datum A	66001	Geodetic datum	World Geodetic System 1984 ensemble	6326	Use as ensemble, or specific realisation
GIGS geodetic datum B	66002	Geodetic datum	Ordnance Survey of Great Britain 1936	6277	
GIGS geodetic datum B'	66017	Geodetic datum	N/A	N/A	Specific for early binding with EPSG transformation 1314
GIGS geodetic datum C	66003	Geodetic datum	Amersfoort	6289	
GIGS geodetic datum C'	66018	Geodetic datum	N/A	N/A	Specific for early binding with GIGS coordinate transformation 61003
GIGS geodetic datum D	66004	Geodetic datum	Batavia (Jakarta)	6813	
GIGS geodetic datum E	66005	Geodetic datum	Reseau National Belge 1972	6313	
GIGS geodetic datum E'	66023	Geodetic datum	N/A	N/A	Specific for early binding with EPSG coordinate transformation 15929
GIGS geodetic datum F	66006	Geodetic datum	Geocentric Datum of Australia 1994	6283	
GIGS geodetic datum G	66007	Geodetic datum	European Terrestrial Reference System 1989 ensemble; Geodetic Datum of Malaysia 2000; NAD83 (High Accuracy Reference Network); Posiciones Geodesicas Argentinas 1998; Sistema de Referencia Geocentrico para las AmericaS 2000	6258; 6742; 6152; 6190; 6674	For late binding systems only. This GIGS Datum is functionally equivalent to any static datum defined as part of a geodetic CRS that uses the GRS 1980 ellipsoid
GIGS geodetic datum H	66008	Geodetic datum	Nouvelle Triangulation Francaise (Paris)	6807	
GIGS geodetic datum J	66009	Geodetic datum	North American Datum 1927	6267	
GIGS geodetic datum J'	66021	Geodetic datum	N/A	N/A	Specific for early binding with EPSG coordinate transformation 1243
GIGS geodetic datum J''	66019	Geodetic datum	N/A	N/A	

GIGS Object Name	GIGS Code	Object Type	EPSG Name	EPSG Code	Comment
GIGS geodetic datum J'''	66020	Geodetic datum	N/A	N/A	Specific for early binding with EPSG coordinate transformation 1693
GIGS geodetic datum T	66010	Geodetic datum	Nouvelle Triangulation Francaise	6275	
GIGS geodetic datum L	66011	Geodetic datum	Batavia	6211	
GIGS geodetic datum K	66012	Geodetic datum	Hungarian Datum 1972	6237	
GIGS geodetic datum X	66013	Geodetic datum	Australian Geodetic Datum 1966	6202	
GIGS geodetic datum X'	66022	Geodetic datum	N/A	N/A	Specific for early binding with EPSG coordinate transformation 15786
GIGS geodetic datum Y	66014	Geodetic datum	Pulkovo 1942	6284	
GIGS geodetic datum Z	66015	Geodetic datum	North American Datum 1983	6269	
GIGS geodetic datum M	66016	Geodetic datum	European Datum 1950	6230	
GIGS geodetic datum ZZ	66269	Geodetic datum	North American Datum 1983	6269	
GIGS geodetic datum AA	66326	Geodetic datum	World Geodetic System 1984 ensemble	6326	
GIGS geodetic datum BB	66277	Geodetic datum	Ordnance Survey of Great Britain 1936	6277	
GIGS geodetic datum CC	66289	Geodetic datum	Amersfoort	6289	
GIGS geodetic datum DD	66813	Geodetic datum	Batavia (Jakarta)	6813	
GIGS geodetic datum EE	66313	Geodetic datum	Reseau National Belge 1972	6313	
GIGS geodetic datum FF	66283	Geodetic datum	Geocentric Datum of Australia 1994	6283	
GIGS geodetic datum HH	66807	Geodetic datum	Nouvelle Triangulation Francaise (Paris)	6807	
GIGS geocenCRS A	64001	Geodetic CRS	WGS 84	4978	
GIGS geog3DCRS A	64002	Geodetic CRS	WGS 84	4979	
GIGS geogCRS A	64003	Geodetic CRS	WGS 84	4326	
GIGS geogCRS Alonlat	64004	Geodetic CRS	N/A	N/A	No direct EPSG equivalent; WGS 84 with CS axes changed
GIGS geogCRS Agr	64033	Geodetic CRS	N/A	N/A	Latitude and longitude for GIGS geogCRS A in degrees, for GIGS geogCRS Agr in grads
GIGS geog3DCRS B	64019	Geodetic CRS	N/A	N/A	No direct EPSG equivalent
GIGS geogCRS B	64005	Geodetic CRS	OSGB36	4277	
GIGS geog3DCRS C	64021	Geodetic CRS	N/A	N/A	No direct EPSG equivalent
GIGS geogCRS C	64006	Geodetic CRS	Amersfoort	4289	
GIGS geogCRS D	64007	Geodetic CRS	Batavia (Jakarta)	4813	
GIGS geog3DCRS E	64022	Geodetic CRS	N/A	N/A	No direct EPSG equivalent

GIGS Object Name	GIGS Code	Object Type	EPSG Name	EPSG Code	Comment
GIGS geogCRS E	64008	Geodetic CRS	Belge 1972	4313	
GIGS geogCRS F	64009	Geodetic CRS	GDA94	4283	
GIGS geogCRS G	64010	Geodetic CRS	ETRS89; GDM2000; NAD83(HARN); POSGAR98; SIRGAS 2000; Hartebeesthoek94	4258; 4742; 4152; 4190; 4674; 4148	For late binding systems only. This GIGS CRS is functionally equivalent to any geodetic CRS with a static datum using the GRS 1980 ellipsoid
GIGS geogCRS H	64011	Geodetic CRS	NTF (Paris)	4807	
GIGS geogCRS J	64012	Geodetic CRS	NAD27	4267	
GIGS geogCRS T	64013	Geodetic CRS	NTF	4275	
GIGS geogCRS L	64014	Geodetic CRS	Batavia	4211	
GIGS geogCRS K	64015	Geodetic CRS	HD72	4237	
GIGS geogCRS X	64016	Geodetic CRS	AGD66	4202	
GIGS geogCRS Y	64017	Geodetic CRS	Pulkovo 1942	4284	
GIGS geogCRS Z	64018	Geodetic CRS	NAD83	4269	
GIGS geogCRS M	64020	Geodetic CRS	ED50	4230	
GIGS geogCRS ZZ	64269	Geodetic CRS	NAD83	4269	
GIGS geogCRS BB	64277	Geodetic CRS	OSGB36	4277	
GIGS geogCRS FF	64283	Geodetic CRS	GDA94	4283	
GIGS geogCRS CC	64289	Geodetic CRS	Amersfoort	4289	
GIGS geogCRS EE	64313	Geodetic CRS	Belge 1972	4313	
GIGS geogCRS AA	64326	Geodetic CRS	WGS 84	4326	
GIGS geogCRS HH	64807	Geodetic CRS	NTF(Paris)	4807	
GIGS geogCRS DD	64813	Geodetic CRS	Batavia (Jakarta)	4813	
GIGS geogCRS B'	64023	Geodetic CRS	N/A	N/A	Specific for early binding with EPSG transformation 1314
GIGS geog3DCRS B'	64024	Geodetic CRS	N/A	N/A	Specific for early binding with EPSG transformation 1314
GIGS geogCRS C'	64025	Geodetic CRS	N/A	N/A	Specific for early binding with GIGS coordinate transformation 61003
GIGS geog3DCRS C'	64026	Geodetic CRS	N/A	N/A	Specific for early binding with GIGS coordinate transformation 61003
GIGS geogCRS E'	64027	Geodetic CRS	N/A	N/A	Specific for early binding with EPSG coordinate transformation 15929
GIGS geog3DCRS E'	64028	Geodetic CRS	N/A	N/A	Specific for early binding with EPSG coordinate transformation 15929
GIGS geogCRS J'	64029	Geodetic CRS	N/A	N/A	Specific for early binding with EPSG coordinate transformation 1243

GIGS Object Name	GIGS Code	Object Type	EPSG Name	EPSG Code	Comment
GIGS geogCRS J''	64030	Geodetic CRS	N/A	N/A	Specific for early binding with EPSG coordinate transformation 1241
GIGS geogCRS J'''	64031	Geodetic CRS	N/A	N/A	Specific for early binding with EPSG coordinate transformation 1693
GIGS geogCRS X'	64032	Geodetic CRS		N/A	Specific for early binding with EPSG coordinate transformation 15786
GIGS projCRS A1	62001	Projected CRS	WGS 84 / UTM zone 31N	32631	
GIGS projCRS A1-2	62002	Projected CRS	N/A	N/A	No direct EPSG equivalent; similar to WGS 84 / UTM zone 31N but with different Coordinate System
GIGS projCRS A1-3	62003	Projected CRS	N/A	N/A	No direct EPSG equivalent; similar to WGS 84 / UTM zone 31N but with different Coordinate System
GIGS projCRS A1-4	62004	Projected CRS	N/A	N/A	No direct EPSG equivalent; similar to WGS 84 / UTM zone 31N but with different Coordinate System
GIGS projCRS A1-5	62005	Projected CRS	N/A	N/A	No direct EPSG equivalent; similar to WGS 84 / UTM zone 31N but with different Coordinate System
GIGS projCRS A1-6	62006	Projected CRS	N/A	N/A	No direct EPSG equivalent; similar to WGS 84 / UTM zone 31N but with different Coordinate System
GIGS projCRS A2	62007	Projected CRS	N/A	N/A	No direct EPSG equivalent; would be equivalent to WGS 84 / British National Grid. For GIGS purposes only - no equivalent system exists in the real world.
GIGS projCRS A21	62008	Projected CRS	N/A	N/A	To be used as an alternative to GIGS projCRS A2 if the software is unable to define a Transverse Mercator projection with latitude of natural origin not on the equator.
GIGS projCRS B2	62009	Projected CRS	OSGB36 / British National Grid	27700	

GIGS Object Name	GIGS Code	Object Type	EPSG Name	EPSG Code	Comment
GIGS projCRS B22	62010	Projected CRS	N/A	N/A	To be used as an alternative to GIGS projCRS B2 if the software is unable to define a Transverse Mercator projection with latitude of natural origin not on the equator.
GIGS projCRS C4	62011	Projected CRS	Amersfoort / RD New	28992	
GIGS projCRS D5	62012	Projected CRS	N/A	N/A	Equivalent to Batavia / NEIEZ (code 3001) except that its definition is with respect to the Jakarta meridian; See GIGS projCRS L27 (62037)
GIGS projCRS E6	62013	Projected CRS	Belge 1972 / Belgian Lambert 72	31370	
GIGS projCRS F7	62014	Projected CRS	GDA94 / MGA zone 54	28354	
GIGS projCRS F8	62015	Projected CRS	GDA94 / MGA zone 55	28355	
GIGS projCRS F9	62016	Projected CRS	GDA94 / Australian Albers	3577	
GIGS projCRS G10	62017	Projected CRS	Hartebeesthoek94 / Lo21	2049	
GIGS projCRS G11	62018	Projected CRS	POSGAR 98 / Argentina 5	22175	
GIGS projCRS G12	62019	Projected CRS	SIRGAS2000 / Brazil Polyconic	5880	
GIGS projCRS G13	62020	Projected CRS	N/A	N/A	No direct EPSG equivalent; Functionally equivalent to GDM2000 / East Malaysia BRSO; utilising different projection
GIGS projCRS G14	62021	Projected CRS	GDM2000 / East Malaysia BRSO	3376	
GIGS projCRS G15	62022	Projected CRS	GDM2000 / Johor Grid	3377	
GIGS projCRS G16	62023	Projected CRS	ETRS89-extended / LAEA Europe	3035	
GIGS projCRS G17	62024	Projected CRS	NAD83(HARN) / Utah North (ft)	2921	
GIGS projCRS G18	62025	Projected CRS	NAD83(HARN) / Utah North (ftUS)	3568	
GIGS projCRS H19	62026	Projected CRS	NTF (Paris) / Lambert zone II	27572	
GIGS projCRS A23	62027	Projected CRS	N/A	N/A	No direct EPSG equivalent; would be equivalent to WGS 84 / BLM 31N (ftUS). For GIGS purposes only - no equivalent system exists in the real world.
GIGS projCRS Y24	62034	Projected CRS	Pulkovo 1942 / Caspian Sea Mercator	3388	

GIGS Object Name	GIGS Code	Object Type	EPSG Name	EPSG Code	Comment
GIGS projCRS M25	62035	Projected CRS	N/A	N/A	No direct EPSG equivalent; Deprecated EPSG projCRS 2192 ED50 / France EuroLambert; remains relevant as represents LCC 1SP; not to be confused with replacement EPSG projCRS 2154 RGF93 / Lambert-93 (LCC 2SP)
GIGS projCRS K26	62036	Projected CRS	HD72 / EOV	23700	
GIGS projCRS L27	62037	Projected CRS	Batavia / NEIEZ	3001	
GIGS projCRS J28	62038	Projected CRS	NAD27 / UTM zone 8N	26708	
GIGS projCRS Z28	62039	Projected CRS	NAD83 / UTM zone 8N	26908	
GIGS projCRS AA1	62028	Projected CRS	WGS 84 / UTM zone 31N	32631	
GIGS projCRS BB2	62029	Projected CRS	OSGB36 / British National Grid	27700	
GIGS projCRS CC4	62030	Projected CRS	Amersfoort / RD New	28992	
GIGS projCRS EE6	62031	Projected CRS	Belge 1972 / Belgian Lambert 72	31370	
GIGS projCRS FF8	62032	Projected CRS	GDA94 / MGA zone 54	28354	
GIGS projCRS HH19	62033	Projected CRS	NTF (Paris) / Lambert zone II	27572	
GIGS ellipsoid A	67030	Ellipsoid	WGS 84	7030	
GIGS ellipsoid B	67001	Ellipsoid	Airy 1830	7001	
GIGS ellipsoid C	67004	Ellipsoid	Bessel 1841	7004	
GIGS ellipsoid E	67022	Ellipsoid	International 1924	7022	
GIGS ellipsoid F	67019	Ellipsoid	GRS 1980	7019	
GIGS ellipsoid H	67011	Ellipsoid	Clarke 1880 (IGN)	7011	
GIGS ellipsoid I	67052	Ellipsoid	Clarke 1866 Authalic Sphere	7052	
GIGS ellipsoid J	67008	Ellipsoid	Clarke 1866	7008	
GIGS ellipsoid K	67036	Ellipsoid	GRS 1967	7036	
GIGS ellipsoid X	67003	Ellipsoid	Australian National Spheroid	7003	
GIGS ellipsoid Y	67024	Ellipsoid	Krassowsky 1940	7024	
GIGS PM A	68901	Prime Meridian	Greenwich	8901	
GIGS PM D	68908	Prime Meridian	Jakarta	8908	
GIGS PM H	68903	Prime Meridian	Paris	8903	
GIGS PM I	68904	Prime Meridian	Bogota	8904	
GIGS conversion 1	65001	Conversion	UTM zone 31N	16031	
GIGS conversion 2	65002	Conversion	British National Grid	19916	
GIGS conversion 4	65004	Conversion	RD New	19914	
GIGS conversion 5	65005	Conversion	Netherlands East Indies Equatorial Zone (Jkt)	5328	
GIGS conversion 6	65006	Conversion	Belgian Lambert 72	19961	

GIGS Object Name	GIGS Code	Object Type	EPSG Name	EPSG Code	Comment
GIGS conversion 7	65007	Conversion	Australian Map Grid zone 54	17454	
GIGS conversion 8	65008	Conversion	Australian Map Grid zone 55	17455	
GIGS conversion 9	65009	Conversion	Australian Albers	17365	
GIGS conversion 10	65010	Conversion	South African Survey Grid zone 21	17521	
GIGS conversion 11	65011	Conversion	Argentina zone 5	18035	
GIGS conversion 12	65012	Conversion	Brazil Polyconic	19941	
GIGS conversion 13	65013	Conversion	N/A	N/A	No direct EPSG equivalent; EPSG 19894 but referenced using Hotine Oblique Mercator (variant B) rather than Hotine Oblique Mercator (variant A) method
GIGS conversion 14	65014	Conversion	Borneo RSO	19894	
GIGS conversion 15	65015	Conversion	Johor Grid	19893	
GIGS conversion 16	65016	Conversion	Europe Equal Area 2001	19986	
GIGS conversion 17	65017	Conversion	SPCS83 Utah North zone (International feet)	15362	
GIGS conversion 18	65018	Conversion	SPCS83 Utah North zone (US Survey feet)	15297	
GIGS conversion 19	65019	Conversion	Lambert zone II	18082	
GIGS conversion 2 alt A	65021	Conversion	N/A	N/A	No direct EPSG equivalent; Alternative when applied to WGS 84 ellipsoid; Only needed if 61002 is not possible
GIGS conversion 2 alt B	65022	Conversion	N/A	N/A	No direct EPSG equivalent; Alternative when applied to Airy 1830 ellipsoid; Only needed if 61002 is not possible
GIGS conversion 23	65023	Conversion	N/A	N/A	No direct equivalent; but would be called BLM 31N (ftUS); EPSG 16031 (UTM zone 31N) but Units in ftUS rather than m
GIGS conversion 24	65024	Conversion	Caspian Sea Mercator	19884	
GIGS conversion 25	65025	Conversion	N/A	N/A	No direct EPSG equivalent; Deprecated EPSG 18086 France EuroLambert; remains relevant as represents LCC 1SP; not to be confused with replacement EPSG 18085 Lambert-93 (LCC 2SP)
GIGS conversion 26	65026	Conversion	Egyseges Orszagos Vetuleti	19931	

GIGS Object Name	GIGS Code	Object Type	EPSG Name	EPSG Code	Comment
GIGS conversion 27	65027	Conversion	Netherlands East Indies Equatorial Zone	19905	
GIGS conversion 28	65028	Conversion	UTM zone 8N	16008	
GIGS geogCRS A to WGS 84 (1)	61001	Coordinate Transformation	N/A	N/A	No direct EPSG equivalent
GIGS geogCRS B to GIGS geogCRS A (1)	61196	Coordinate Transformation	OSGB36 to WGS 84 (2)	1196	
GIGS geogCRS B to GIGS geogCRS A (2)	61314	Coordinate Transformation	OSGB36 to WGS 84 (6)	1314	
GIGS geogCRS C to GIGS geogCRS A (1)	61002	Coordinate Transformation	N/A	N/A	No direct EPSG equivalent
GIGS geogCRS C to GIGS geogCRS A (2)	15934	Coordinate Transformation	Amersfoort to WGS 84 (3)	15934	
GIGS geogCRS C to GIGS geogCRS A (3)	61003	Coordinate Transformation	N/A	N/A	No direct EPSG equivalent; parameter values taken from 15740 Amersfoort to ETRS89 (4)
GIGS geogCRS D to GIGS geogCRS L (1)	61759	Coordinate Transformation	Batavia (Jakarta) to Batavia (1)	1759	
GIGS geogCRS E to GIGS geogCRS A (1)	61610	Coordinate Transformation	BD72 to WGS 84 (2)	1610	
GIGS geogCRS E to GIGS geogCRS A (2)	15929	Coordinate Transformation	BD72 to WGS 84 (3)	15929	
GIGS geogCRS F to GIGS geogCRS A (1)	61150	Coordinate Transformation	GDA94 to WGS 84 (1)	1150	
GIGS geogCRS H to GIGS geogCRS T (1)	61763	Coordinate Transformation	NTF (Paris) to NTF (1)	1763	
GIGS geogCRS J to GIGS geogCRS A (1)	61173	Coordinate Transformation	NAD27 to WGS 84 (4)	1173	
GIGS geogCRS J to GIGS geogCRS A (2)	61004	Coordinate Transformation	N/A	N/A	No direct EPSG equivalent; files included with GIGS Test Dataset
GIGS geogCRS J to GIGS geogCRS A (3)	61692	Coordinate Transformation	NAD27 to WGS 84 (34)	1692	
GIGS geogCRS K to GIGS geogCRS A (1)	61242	Coordinate Transformation	HD72 to WGS 84 (4)	1242	
GIGS geogCRS L to GIGS geogCRS A (1)	61123	Coordinate Transformation	Batavia to WGS 84 (1)	8452	
GIGS geogCRS M to GIGS geogCRS A (1)	61275	Coordinate Transformation	ED50 to WGS 84 (17)	1275	
GIGS geogCRS T to GIGS geogCRS A (1)	61193	Coordinate Transformation	NTF to WGS 84 (1)	1193	
GIGS geogCRS X to GIGS geogCRS A (1)	15788	Coordinate Transformation	AGD66 to WGS 84 (16)	15788	
GIGS geogCRS Y to GIGS geogCRS A (1)	61254	Coordinate Transformation	Pulkovo 1942 to WGS 84 (1)	1254	
GIGS geogCRS Z to GIGS geogCRS A (1)	61188	Coordinate Transformation	NAD83 to WGS 84 (1)	1188	

Appendix D: GIGS Project Definitions

For the Data Operations tests (5000 Series), Test Data must be loaded into the geoscience software. This will normally require the creation of a 'project' within the software. To comply with the test scenarios these projects need to be defined to reference specific coordinate reference systems.

GIGS project names have been constructed from the required horizontal and vertical CRS names. For example, "GIGS project A9V1depth" is to be referenced to horizontal CRS "A9" and vertical CRS "V1 depth". The project CRSs are detailed below:

GIGS_project_A2V1depth

This project is used for many of the GIGS well and seismic location import tests. This project should be referenced to the following horizontal and vertical CRSs:

Horizontal CRS: GIGS projCRS A2

Vertical CRS: GIGS vertCRS V1 depth

1) The project area covers the following geographic bounding rectangle:
   north: 52°40'N, south: 51°40'N, west: 1°40'E, east: 3°40'E
2) Horizontal CRS: GIGS projCRS A2

This is equivalent to the geodetically fictitious CRS WGS 84 / British National Grid except that "A2" is not limited by the associated EPSG Area of Use limitations for the British National Grid conversion.

Defining parameters are built up through Test Procedures 3001 through 3006 and possibly 3007.

Alternatively, if the required predefined library components are available, the CRS could be defined through association of the British National Grid conversion with WGS 84 geodetic datum and an appropriate Cartesian coordinate system, assuming that associated EPSG area of use limitations are overridden. Note: this can only be done in software in which the ellipsoid parameters are part of the datum definition and are not part of the conversion definition.

Horizontal CRS components:

Ellipsoid: GIGS ellipsoid A, a = 6,378,137.0m, 1/f = 298.2572236 (= WGS 84, EPSG ellipsoid code 7030)

Prime meridian: GIGS PM A (= Greenwich, EPSG prime meridian code 8901)

Geodetic datum: name = GIGS geodetic datum A. (= WGS 84, EPSG datum code 6326)
(Coordinate transformation relationship to WGS 84: geocentric translations dX=dY=dZ=0)

Conversion: GIGS conversion 2 (= British National Grid, EPSG conversion code 19916):

method = Transverse Mercator (= EPSG coordinate operation method code 9807)
latitude of natural origin = 49°N
longitude of natural origin = 2°W
scale factor at natural origin = 0.9996012717

false easting = 400,000.0 metres
false northing = -100,000.0 metres (note: minus)

Coordinate system: (= EPSG coordinate system code 4400):
first axis = easting, direction = east, abbreviation = E, units = metre
second axis = northing, direction = north, abbreviation = N, units = metre

3) Vertical CRS: GIGS vertCRS V1 depth

This is equivalent to the CRS Baltic 1977 depth (EPSG CRS code 5612) which has no geodetic validity in the project area but, for GIGS purposes, has been assumed to have global applicability.

For GIGS purposes in case the software "assumes" a vertical datum of mean sea level (msl), this CRS has been defined to be equal to unspecified MSLdepth (EPSG CRS code 5715).

Defining parameters are built up through Test Procedures 3008 and possibly 3009.

Vertical CRS components:

Vertical datum (= EPSG datum code 5105):
name = GIGS vertical datum V
Coordinate system (= EPSG coordinate system code 6498):
axis = Depth, direction = down, abbreviation = D, unit = metre

GIGS_project_F1V_F7V1depth

This project is used for some GIGS well tests.

This project should be referenced to the following horizontal and vertical CRSs:

Horizontal: GIGS projCRS F7

Vertical: GIGS vertCRS V1 depth

1) The project area covers the following geographic bounding rectangle:
   north: 51°40'S, south: 52°40'S, west: 139°40'E, east: 141°40'E

2) Horizontal CRS: GIGS projCRS F7

This GIGS projCRS F7 is equivalent to the EPSG CRS GDA 94 / MGA zone 54 (EPSG CRS code 28354) except "F7" is not limited by the associated EPSG Area of Use for that CRS.

Defining parameters are built up through Test Procedures 3001 through 3006 and possibly 3007.

Horizontal CRS definitions as follows:

Ellipsoid: GIGS ellipsoid A, a = 6,378,137.0m, 1/f = 298.2572221 (= GRS 80, EPSG ellipsoid code 7019)

Prime meridian: GIGS PM A (= Greenwich, EPSG prime meridian code 8901)

Geodetic datum: name = GIGS geodetic datum F. (= GDA 94, EPSG datum code 6283)

(Coordinate transformation relationship to WGS 84: geocentric translations dX=dY=dZ=0)

Conversion: GIGS conversion 7 (= MGA zone 54, EPSG conversion code 17354):

method = Transverse Mercator (= EPSG coordinate operation method code 9807)
latitude of natural origin = 0°N
longitude of natural origin = 141°E
scale factor at natural origin = 0.9996
false easting = 500,000.0 metres
false northing = 10,000,000.0 metres

Coordinate system (= EPSG coordinate system code 4400):

first axis = easting, direction = east, abbreviation = E, units = metre
second axis = northing, direction = north, abbreviation = N, units = metre

3) Vertical CRS GIGS vertCRS V1 depth
See GIGS_project_A2V1depth.

GIGS_project_A1W_A1W1depth

This project is used for some GIGS seismic location and wellbore transfer tests. This project should be referenced to the following horizontal and vertical CRSs:

Horizontal: GIGS projCRS A1

Vertical: GIGS vertCRS W1 depth

1) The project area covers the following geographic bounding rectangle:
north: 52°40'N, south: 51°40'N, west: 1°40'E, east: 3°40'E

2) Horizontal CRS: GIGS projCRS A1

This is equivalent to EPSG CRS WGS 84 / UTM zone 31N (EPSG CRS code 32631) except that "A1" is not limited by the associated EPSG Area of Use for that CRS.

Defining parameters are built up through Test Procedures 3001 through 3006 and possibly 3007.

Horizontal CRS components:

Ellipsoid: GIGS ellipsoid A, a = 6,378,137.0m, 1/f = 298.2572236 (= WGS 84, EPSG ellipsoid code 7030)

Prime Meridian: GIGS PM A (= Greenwich, EPSG prime meridian code 8901)

Geodetic Datum: name = GIGS geodetic datum A (= WGS 84, EPSG datum code 6326)

(Coordinate transformation relationship to WGS 84: geocentric translations dX=dY=dZ=0)

Conversion: GIGS conversion 1 (= UTM zone 31N, EPSG conversion code 16031):

method = Transverse Mercator (= EPSG coordinate operation method code 9807)
latitude of natural origin = 0°N
longitude of natural origin = 3°E
scale factor at natural origin = 0.9996
false easting = 500,000.0 metres
false northing = 0.0 metres

Coordinate system (= EPSG coordinate system code 4400):

first axis = easting, direction = east, abbreviation = E, units = metre
second axis = northing, direction = north, abbreviation = N, units = metre

3) Vertical CRS "GIGS vertCRS W1 depth

This is equivalent to the EPSG CRS Caspian depth (EPSG CRS code 5706) which has no geodetic validity in the project area but, for GIGS purposes, has been assumed to have global applicability.

For GIGS purposes in case the software "assumes" a vertical datum of msl, this vertical datum has been defined (through GIGS coordinate transformation codes 65440, 65441, 65400 and 65438) to be equal to 28m below GIGS vertical datum V which, as elsewhere, has been defined to be equal to unspecified msl.

Defining parameters are built up through Test Procedure 3008 and possibly 3009.

Vertical CRS components:

Vertical datum: name = GIGS vertical datum W (= EPSG datum code 5105)
Coordinate system (= EPSG coordinate system code 6498):
axis = Depth, direction = down, abbreviation = D, unit = metre

GIGS_project_A9V_A23V1depth

This project is used for some GIGS seismic location and wellbore transfer tests. This project should be referenced to the following horizontal and vertical CRSs, which are defined below:

Horizontal: GIGS projCRS A23

Vertical: GIGS vertCRS V1 depth

1) The project area covers the following geographic bounding rectangle:
north: 52°40'N, south: 51°40'N, west: 1°40'E, east: 3°40'E

2) Horizontal CRS: GIGS projCRS A23

This is equivalent to WGS 84 / UTM zone 31N in US survey feet. There is no equivalent to this fictitious CRS in the EPSG Dataset.

Defining parameters are built up through Test Procedures 3001 through 3006 and possibly 3007.

Horizontal CRS components:

Ellipsoid: GIGS ellipsoid A, a = 6,378,137.0m, 1/f = 298.2572236 (= WGS 84, EPSG ellipsoid code 7030)

Prime Meridian: GIGS PM A (= Greenwich, EPSG prime meridian code 8901)

Geodetic Datum: name = GIGS geodetic datum A (= WGS 84, EPSG datum code 6326)

(Coordinate transformation relationship to WGS 84: geocentric translations dX=dY=dZ=0)

Conversion: GIGS conversion 23.

method = Transverse Mercator (= EPSG coordinate operation method code 9807)
latitude of natural origin = 0°N
longitude of natural origin = 3°E
scale factor at natural origin = 0.9996
false Easting = 1,640,416.667 US survey feet
false Northing = 0.0 US survey feet

1 US survey foot = 12/39.37 metres

Coordinate system (= EPSG coordinate system code 4497):

first axis = easting, direction = east, abbreviation = X, units = US survey foot

second axis = northing, direction = north, abbreviation = Y, units = US survey foot

3) Vertical CRS: GIGS vertCRS V1 depth
See GIGS_project_A2V1depth.

GIGS_project_B1V_B2V1depth

This project is used for some GIGS seismic location and wellbore transfer tests. This project should be referenced to the following horizontal and vertical CRSs,

Horizontal: GIGS projCRS B2

Vertical: GIGS vertCRS V1 depth

1) The project area covers the following geographic bounding rectangle:
north: 52°40'N, south: 51°40'N, west: 1°40'E, east: 3°40'E

2) Horizontal CRS: GIGS projCRS B2

This is equivalent to EPSG CRS OSGB36 / British National Grid (EPSG CRS code 27700) except that for GIGS purposes the area of applicability is fictitiously extended. That is, GIGS ProjCRS B1 is not limited by the associated EPSG Area of Use for EPSG Code 27700.

Defining parameters are built up through Test Procedures 3001 through 3006 and possibly 3007.

Horizontal CRS components:

Ellipsoid: GIGS ellipsoid B, a = 6,377,563.396m, 1/f = 299.3249646 (= Airy 1830, EPSG ellipsoid code 7001)

Prime Meridian: GIGS PM A (= Greenwich, EPSG prime meridian code 8901)

Geodetic Datum: name = GIGS geodetic datum B (= Ordnance Survey of Great Britain 1936, EPSG datum code 6277)

(For GIGS purposes only, GIGS geogCRS B is defined with the relationship to GIGS geogCRS A (WGS 84): geocentric translations dX=371m, dY=-112 m (note: minus) and dZ=434m)

Conversion: GIGS conversion 2 (= British National Grid, EPSG conversion code 19916)

method = Transverse Mercator (= EPSG coordinate operation method code 9807)
latitude of natural origin = 49°N
longitude of natural origin = 2°W
scale factor at natural origin = 0.9996012717
false easting = 400,000.0 metres
false northing = -100,000.0 metres (note: minus)

Coordinate system (= EPSG coordinate system code 4400):

first axis = easting, direction = east, abbreviation = E, units = metre
second axis = northing, direction = north, abbreviation = N, units = metre

3) Vertical CRS: GIGS vertCRS V1 depth
See GIGS_project_A2V1depth.

GIGS_project_Z28V1depth

This project is used for some GIGS seismic location tests. This project should be referenced to the following horizontal and vertical CRSs:

Horizontal: GIGS projCRS Z28

Vertical: GIGS vertCRS V1 depth

1) The project area covers the following geographic bounding rectangle:
north: 75°N, south: 15°N, west: 165°E, east: 85°W. Note that this crosses the 180° meridian.

2) Horizontal CRS: GIGS projCRS Z28

This is equivalent to EPSG CRS NAD83 / UTM zone 8N (EPSG CRS code 26908) except that for GIGS purposes the area of applicability is fictitiously extended. That is, GIGS ProjCRS Z28 is not limited by the associated EPSG Area of Use for EPSG Code 26908.

Defining parameters are built up through Test Procedures 3001 through 3006 and possibly 3007.

Horizontal CRS components:

Ellipsoid: GIGS ellipsoid J, a = 6,378206.4m, 1/f = 294.9786982 (= Clarke 1866, EPSG ellipsoid code 7008)

Prime Meridian: GIGS PM A (= Greenwich, EPSG prime meridian code 8901)

Geodetic Datum: name = GIGS geodetic datum J (=North American Datum 1927, EPSG datum code 6267)

(For GIGS purposes only, GIGS geogCRS J is defined with the relationship to GIGS geogCRS A (WGS 84): geocentric translations dX=-8m (note: minus), dY=160m and dZ=176m)

Conversion: GIGS conversion 28 (= UTM zone 8N, EPSG conversion code 16008)

method = Transverse Mercator (= EPSG coordinate operation method code 9807)
latitude of natural origin = 0°N
longitude of natural origin = 135°W
scale factor at natural origin = 0.9996
false easting = 500,000.0 metres
false northing = 0.0 metres

Coordinate system (= EPSG coordinate system code 4400):

first axis = easting, direction = east, abbreviation = E, units = metre
second axis = northing, direction = north, abbreviation = N, units = metre

3) Vertical CRS: GIGS vertCRS V1 depth
See GIGS_project_A2V1depth.

Appendix E: GIGS Supported Coordinate Operation Methods

Test Datasets were produced for many of the conversion and transformation methods as identified in the EPSG Dataset. Methods identified as high or medium priority for the energy industry have been addressed and associated Test Data are provided. The table below, lists the included methods and also notes the mechanism used for calculating the test point data. In most cases, spreadsheets developed by EPSG for verifying formulae published in IOGP Report 373-07-02 – *Geomatics Guidance Note Number 7, part 2 - Coordinate Conversions and Transformations including Formulas* are available upon request. All of the conversion and transformation Test Data have been rigorously verified using independently sourced geodetic software.

Table E1: Index of GIGS Test Dataset coordinate operation methods

EPSG Method Name	EPSG Method Code	Calculation Method for Test Data
Transverse Mercator	9807	EPSG calculations
Lambert Conic Conformal (1SP)	9801	EPSG calculations
Lambert Conic Conformal (2SP)	9802	EPSG calculations
Oblique Stereographic	9809	EPSG calculations
Hotine Oblique Mercator (variant A)	9812	EPSG calculations
Hotine Oblique Mercator (variant B)	9815	EPSG calculations
American Polyconic	9818	EPSG calculations
Cassini-Soldner	9806	EPSG calculations
Albers Equal Area	9822	Geomatrix
Lambert Azimuthal Equal Area	9820	EPSG calculations
Mercator (variant A)	9804	EPSG calculations
Mercator (variant B)	9805	EPSG calculations
Transverse Mercator (South Orientated)	9808	EPSG calculations
Geographic/geocentric conversions	9602	EPSG calculations
Geocentric translations (geocentric domain)	1031	EPSG calculations
Geocentric translations (geog2D domain)	9603	EPSG calculations
Geocentric translations (geog3D domain)	1035	EPSG calculations
Abridged Molodensky	9605	EPSG calculations
Position Vector transformation (geog2D domain)	9606	EPSG calculations
Position Vector transformation (geog3D domain)	1037	EPSG calculations
Coordinate Frame Rotation (geog2D domain)	9607	EPSG calculations
Coordinate Frame Rotation (geog3D domain)	1038	EPSG calculations
Molodensky-Badekas (geog2D domain)	9636	EPSG calculations
Molodensky-Badekas (geog3D domain)	1039	EPSG calculations
NADCON	9613	US National Geodetic Survey (NGS) online calculator
NTv2	9615	Natural Resources Canada and Land Victoria (Australia) online calculators
Longitude rotation	9601	Manual
UKOOA P6 seismic bin grid transformation	9666	EPSG calculations
Vertical Offset	9616	EPSG calculations

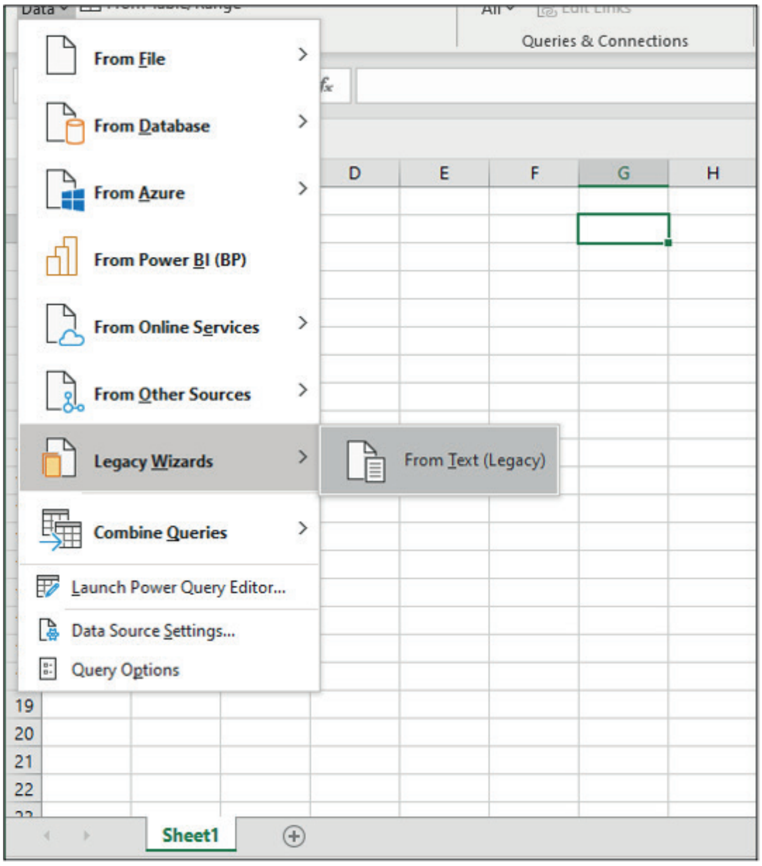
Appendix F: Test Dataset Excel Files Guide

Where the Evaluator requires the Test Dataset files to be read in Excel there are a number of workflows that can be used to correctly load the data in a controlled way, avoiding truncation and rounding issues. A data import wizard should always be used, as loading the files directly (either by 'Open', drag and drop or through Windows Explorer) may cause formatting problems. It is highly recommended that Method 3 is used. Note these recommendations are only valid at the time of publication and pertain to the specific software versions available at such time. IOGP takes no responsibility for the accuracy of the content within.

Method 1: Using "From Text" Text Import Wizard (legacy)

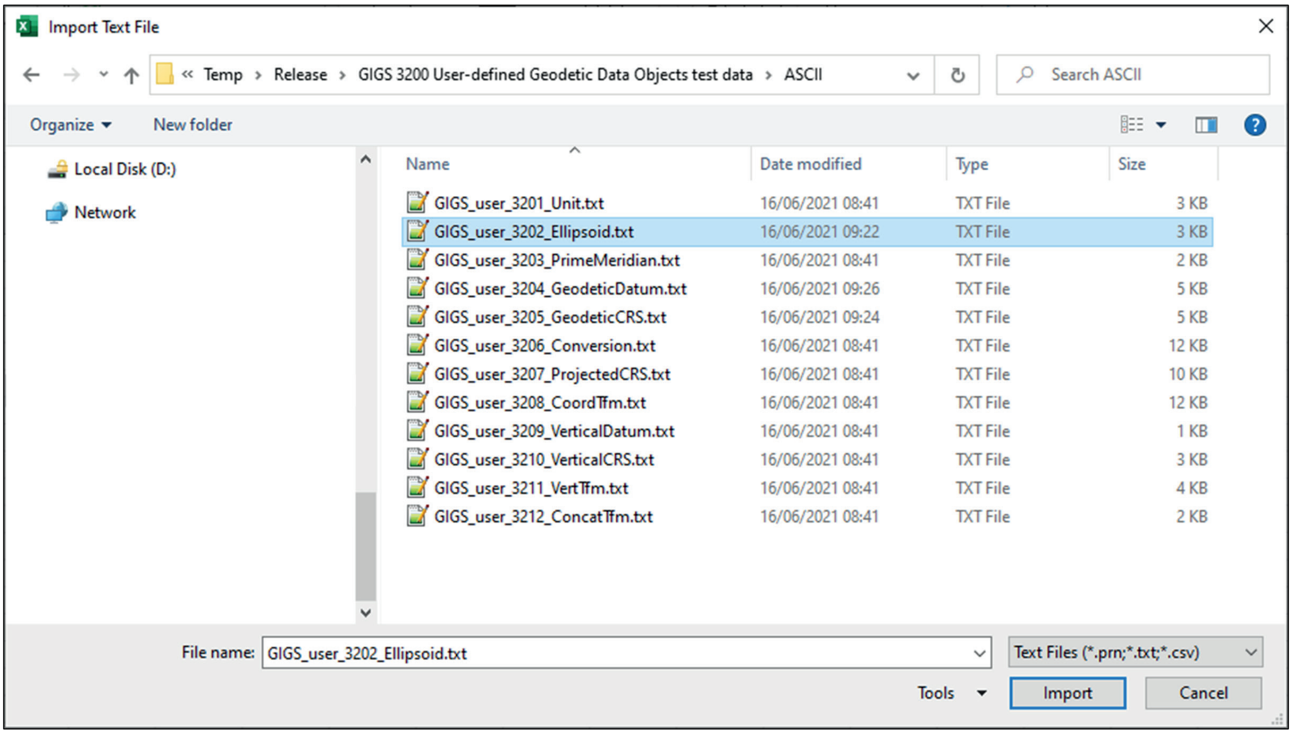
The Excel legacy Text Import Wizard is present in pre-2016 versions of Office, or can be enabled for use in newer versions[22]

To load a Test Dataset file, open the From Text Wizard from the Get Data function in the Get and Transform Data section (Data ribbon).

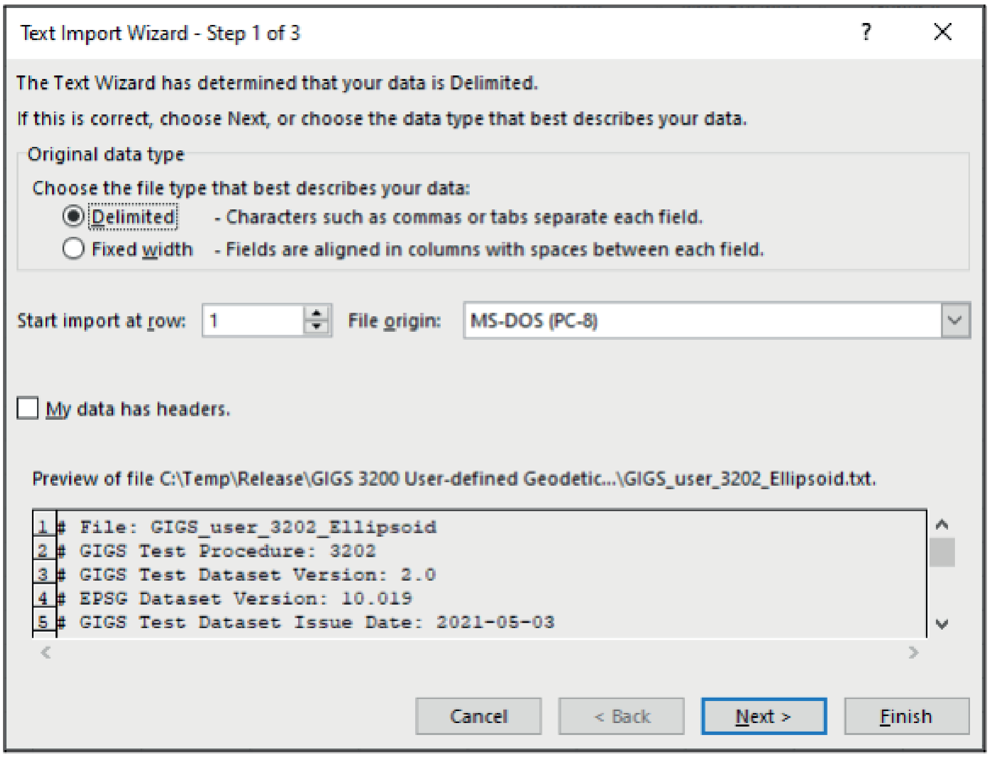


[22] https://support.microsoft.com/en-us/office/text-import-wizard-c5b02af6-fda1-4440-899f-f78bafe41857

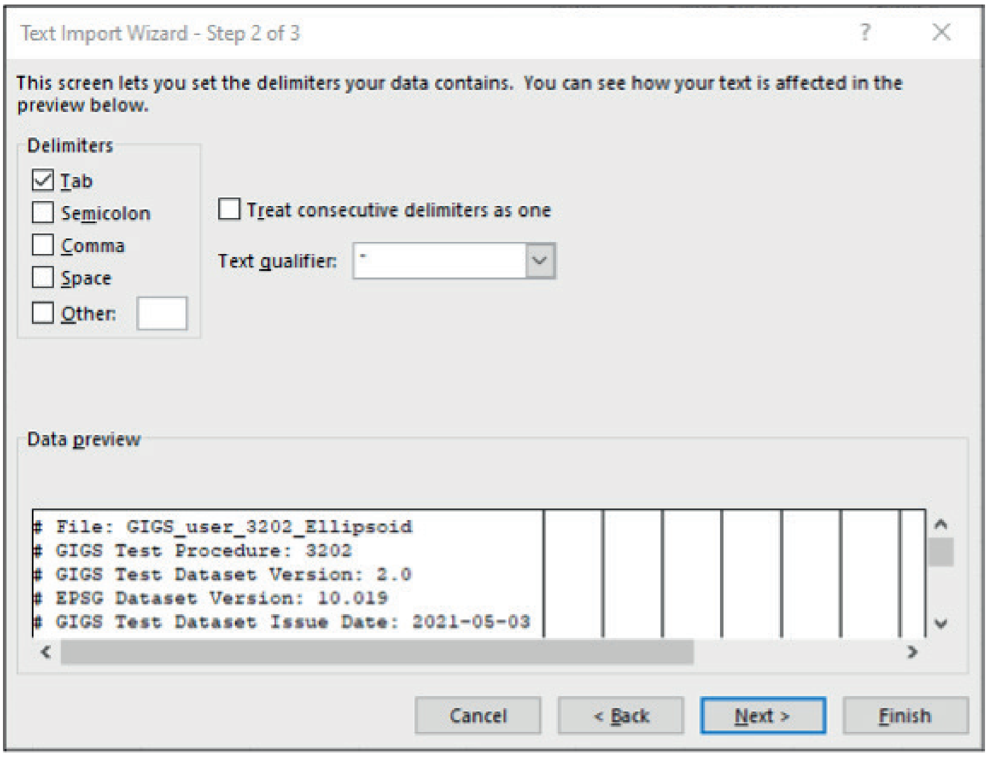
Select the file to import



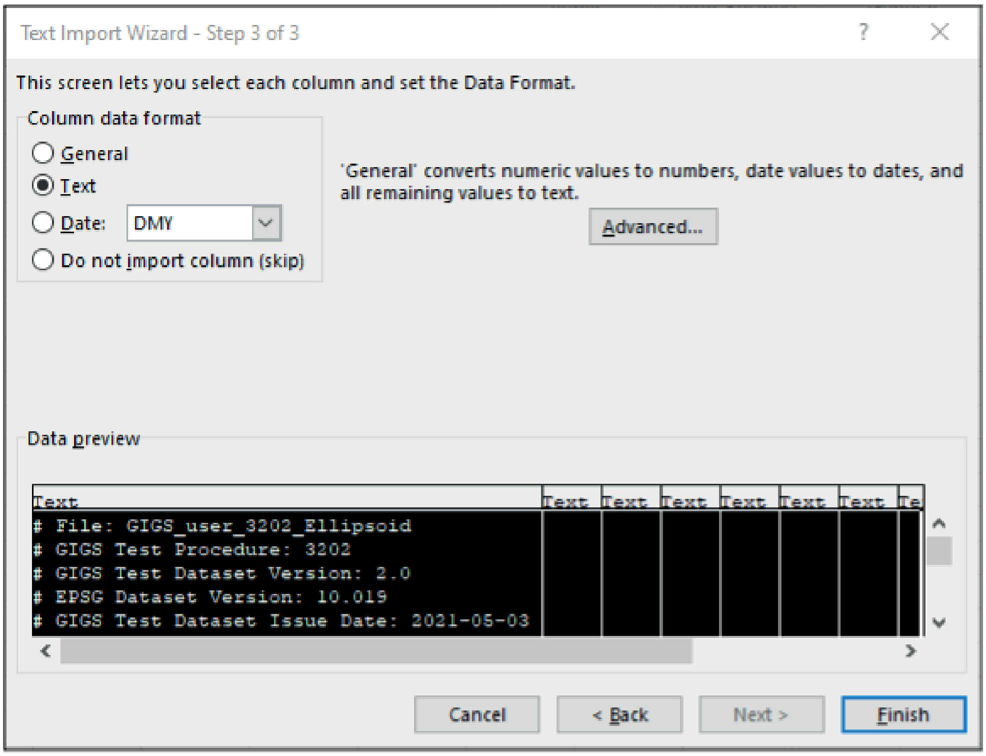
Select Delimited



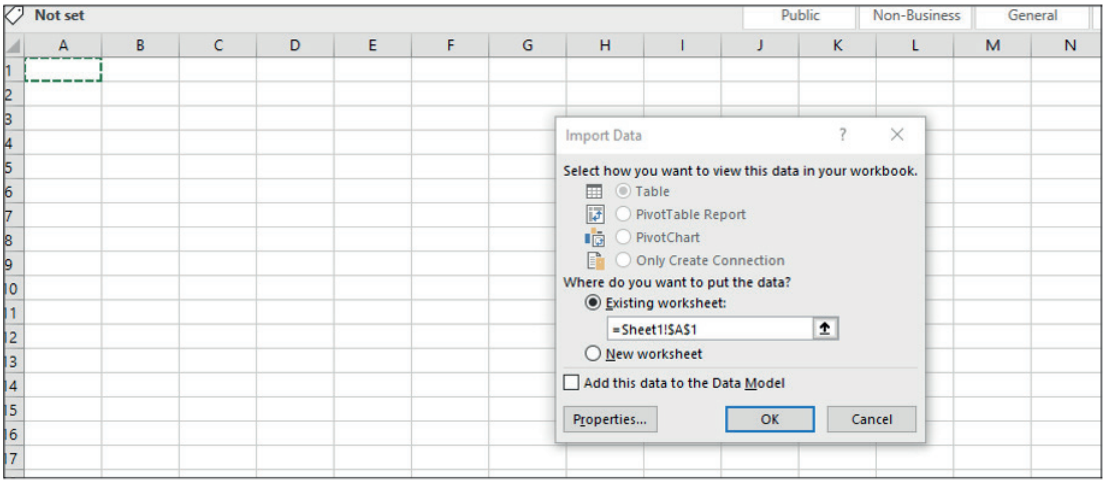
Tick on Tab



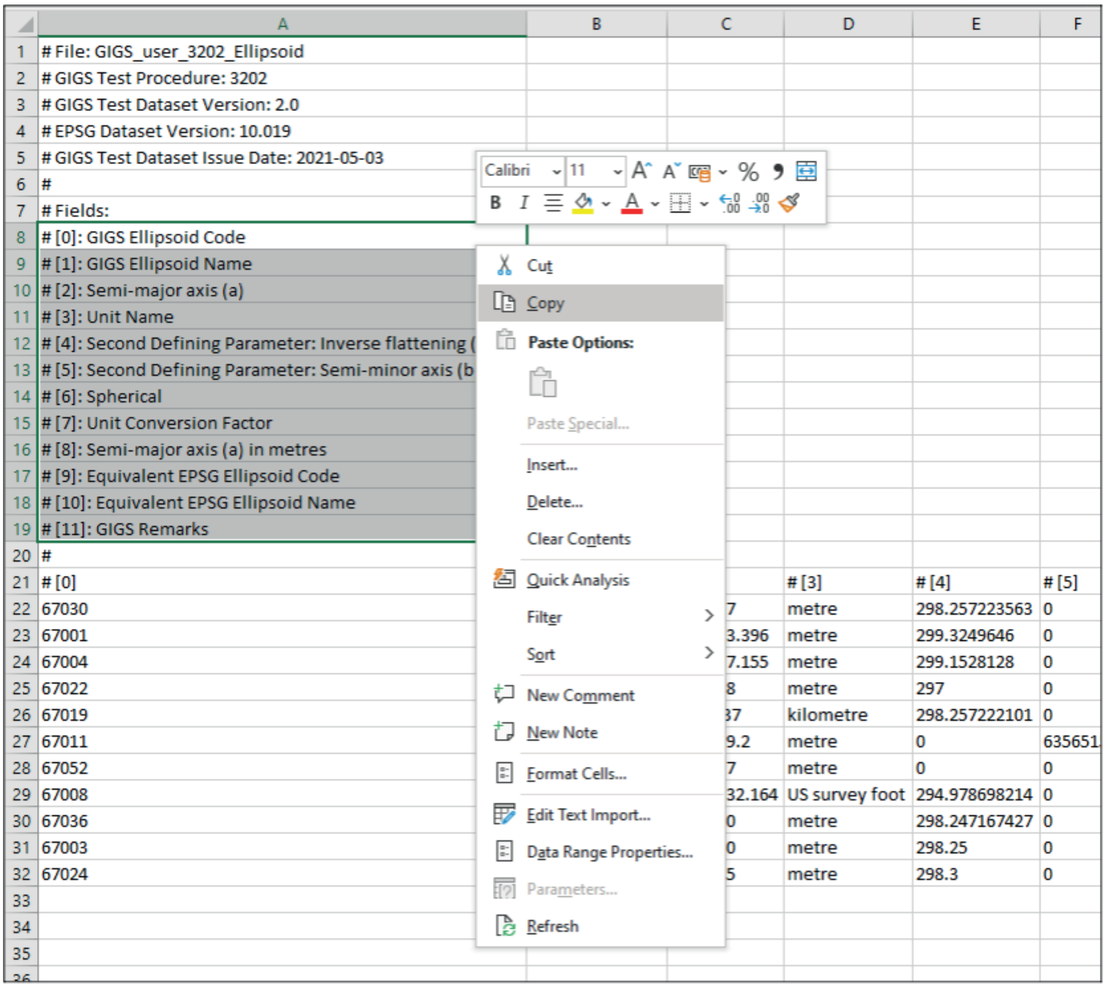
Select all columns (using shift + right click) in Data Preview and tick on Text



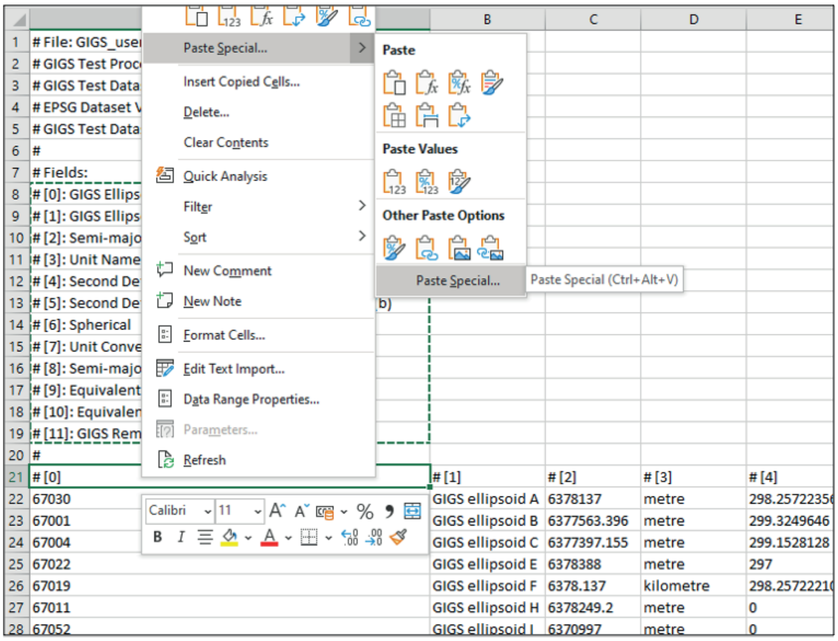
Select Existing Worksheet and cell A1



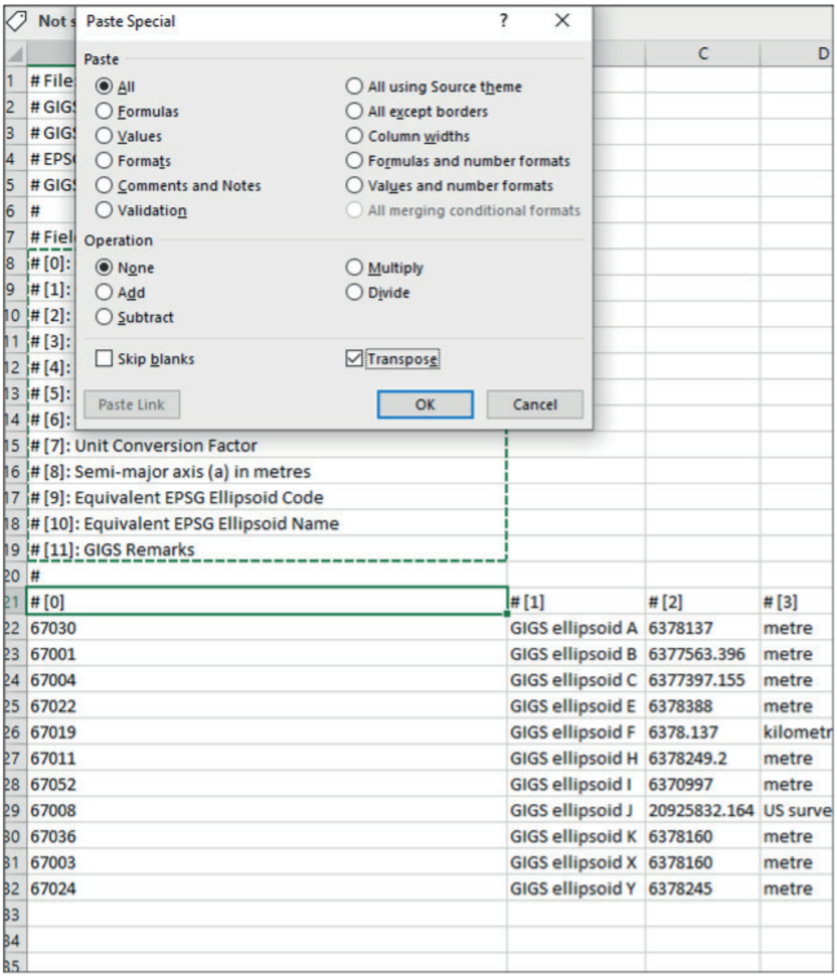
To help column identification, select the Field names in the hash header and copy



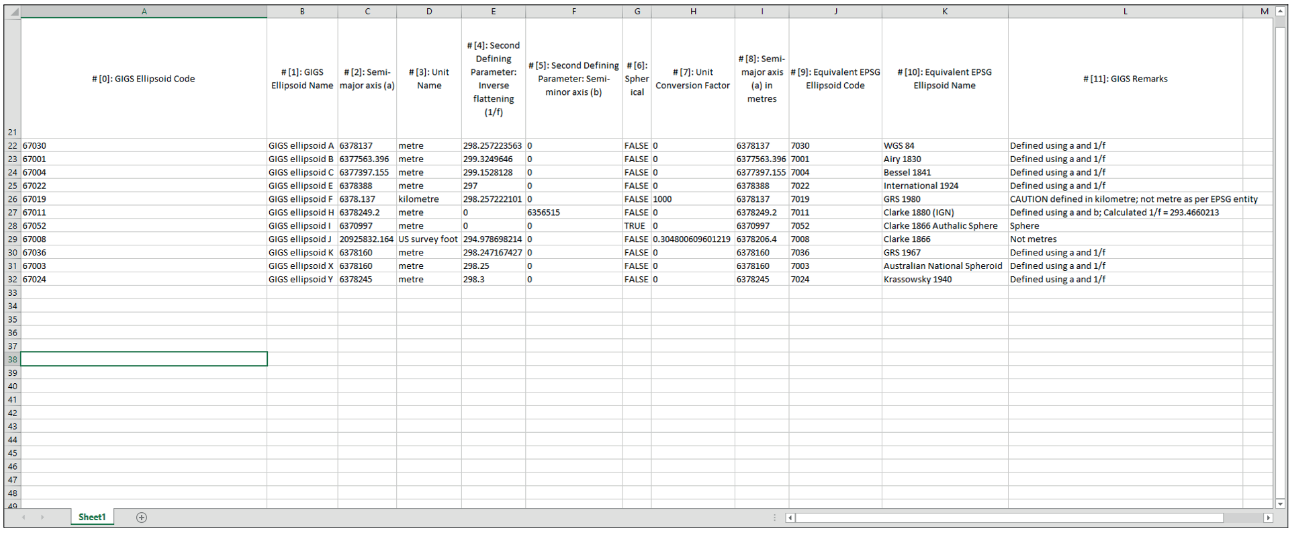
Right click on the final hash row (in the first column) and select Paste Special



Select Transpose



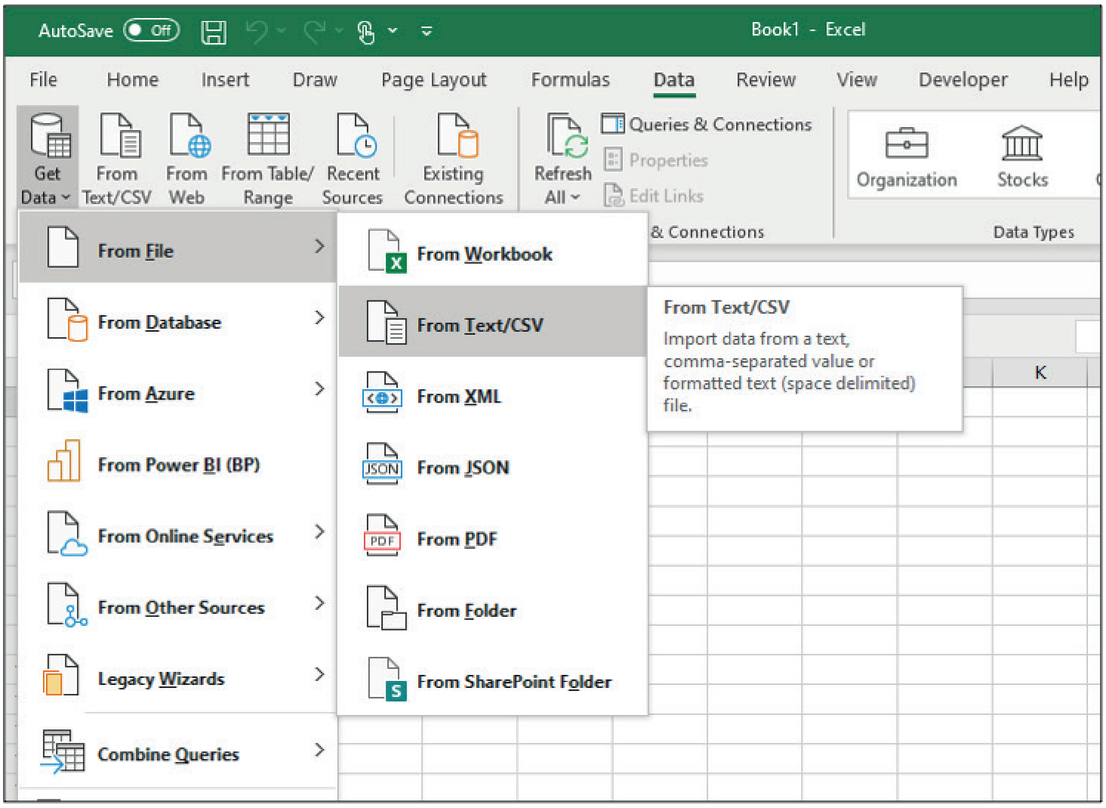
If required, hide the hash header and set column names to Wrap Text, adjust column widths until suitable



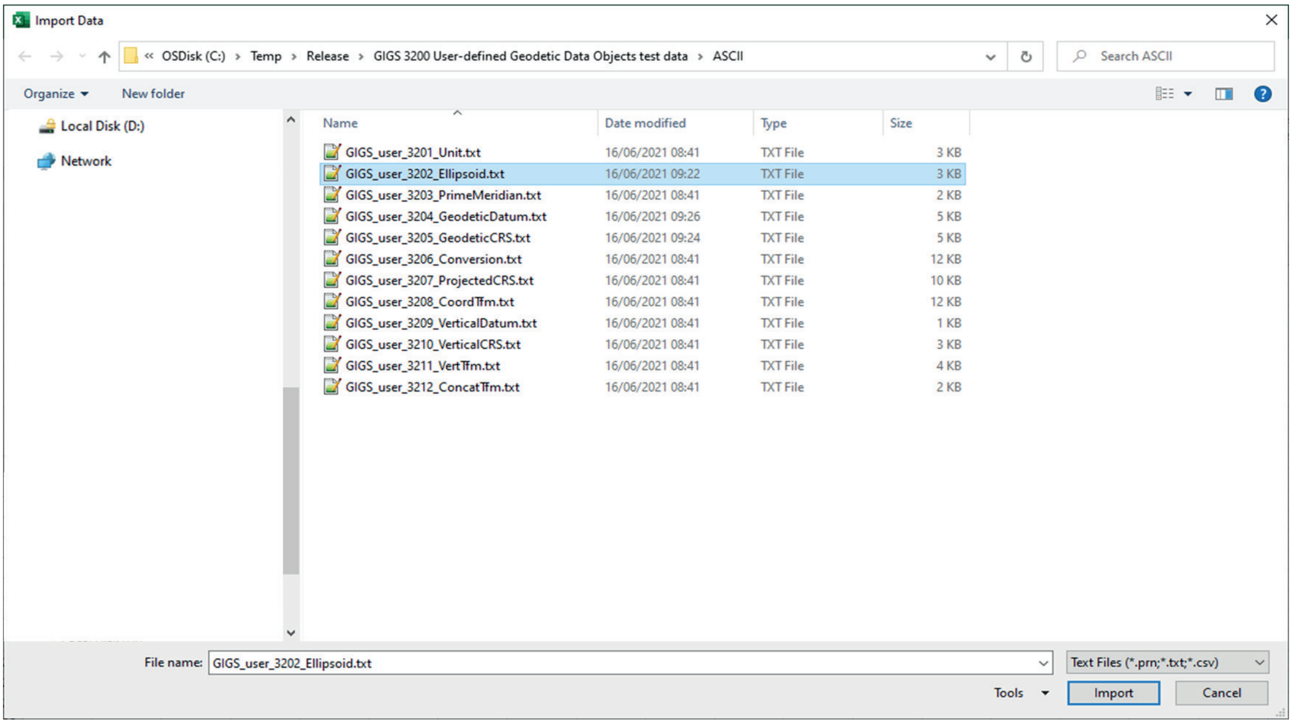
# [0]: GIGS Ellipsoid Code	# [1]: GIGS Ellipsoid Name	# [2]: Semi-major axis (a)	# [3]: Unit Name	# [4]: Second Defining Parameter: Inverse flattening (1/f)	# [5]: Second Defining Parameter: Semi-minor axis (b)	# [6]: Spherical	# [7]: Unit Conversion Factor	# [8]: Semi-major axis (a) in metres	# [9]: Equivalent EPSG Ellipsoid Code	# [10]: Equivalent EPSG Ellipsoid Name	# [11]: GIGS Remarks
67030	GIGS ellipsoid A	6378137	metre	298.257223563	0	FALSE	0	6378137	7030	WGS 84	Defined using a and 1/f
67001	GIGS ellipsoid B	6377563.396	metre	299.3249646	0	FALSE	0	6377563.396	7001	Airy 1830	Defined using a and 1/f
67004	GIGS ellipsoid C	6377397.155	metre	299.1528128	0	FALSE	0	6377397.155	7004	Bessel 1841	Defined using a and 1/f
67022	GIGS ellipsoid E	6378388	metre	297	0	FALSE	0	6378388	7022	International 1924	Defined using a and 1/f
67019	GIGS ellipsoid F	6378.137	kilometre	298.257222101	0	FALSE	1000	6378137	7019	GRS 1980	CAUTION defined in kilometre; not metre as per EPSG entity
67011	GIGS ellipsoid H	6378249.2	metre	0	6356515	FALSE	0	6378249.2	7011	Clarke 1880 (IGN)	Defined using a and b; Calculated 1/f = 293.4660213
67052	GIGS ellipsoid I	6370997	metre	0	0	TRUE	0	6370997	7052	Clarke 1866 Authalic Sphere	Sphere
67008	GIGS ellipsoid J	20925832.164	US survey foot	294.978698214	0	FALSE	0.304800609601219	6378206.4	7008	Clarke 1866	Not metres
67036	GIGS ellipsoid K	6378160	metre	298.247167427	0	FALSE	0	6378160	7036	GRS 1967	Defined using a and 1/f
67003	GIGS ellipsoid X	6378160	metre	298.25	0	FALSE	0	6378160	7003	Australian National Spheroid	Defined using a and 1/f
67024	GIGS ellipsoid Y	6378245	metre	298.3	0	FALSE	0	6378245	7024	Krassowsky 1940	Defined using a and 1/f

Method 2: Using "From Text/CSV" Get Data Wizard (manual)

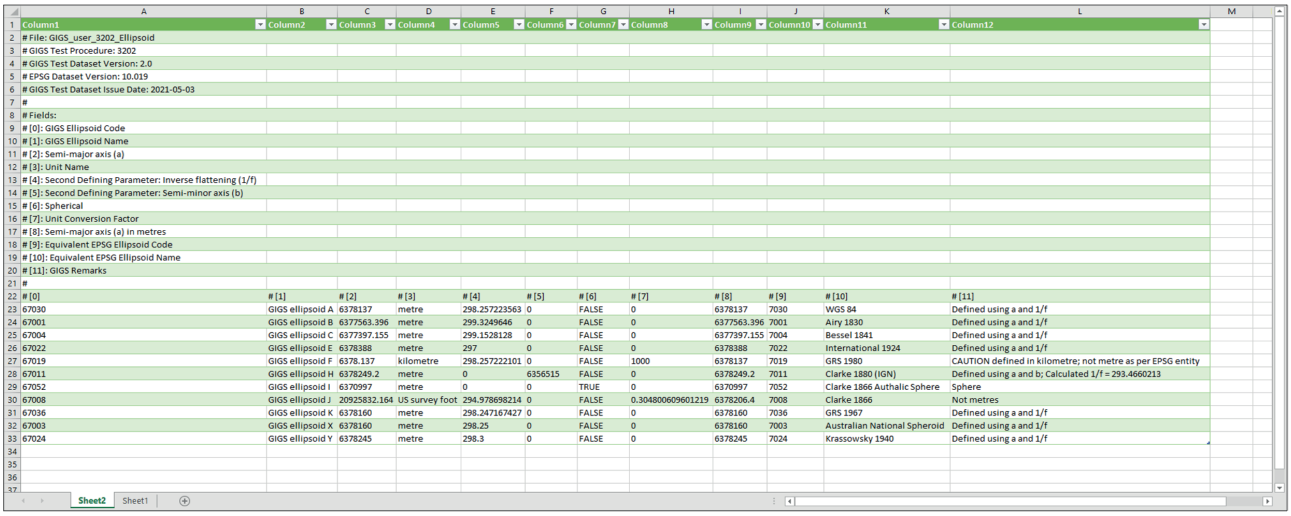
To load a Test Dataset file, open the From Text/CSV Wizard from the Get Data function in the Get and Transform Data section (Data ribbon).



Select the file to import

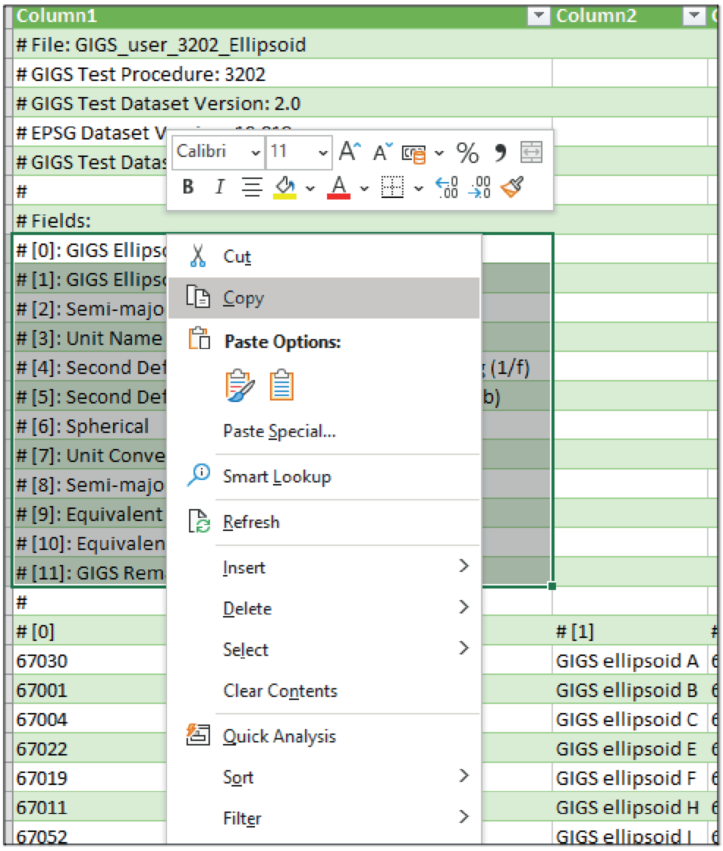


Select Load and data should appear as a Queried table

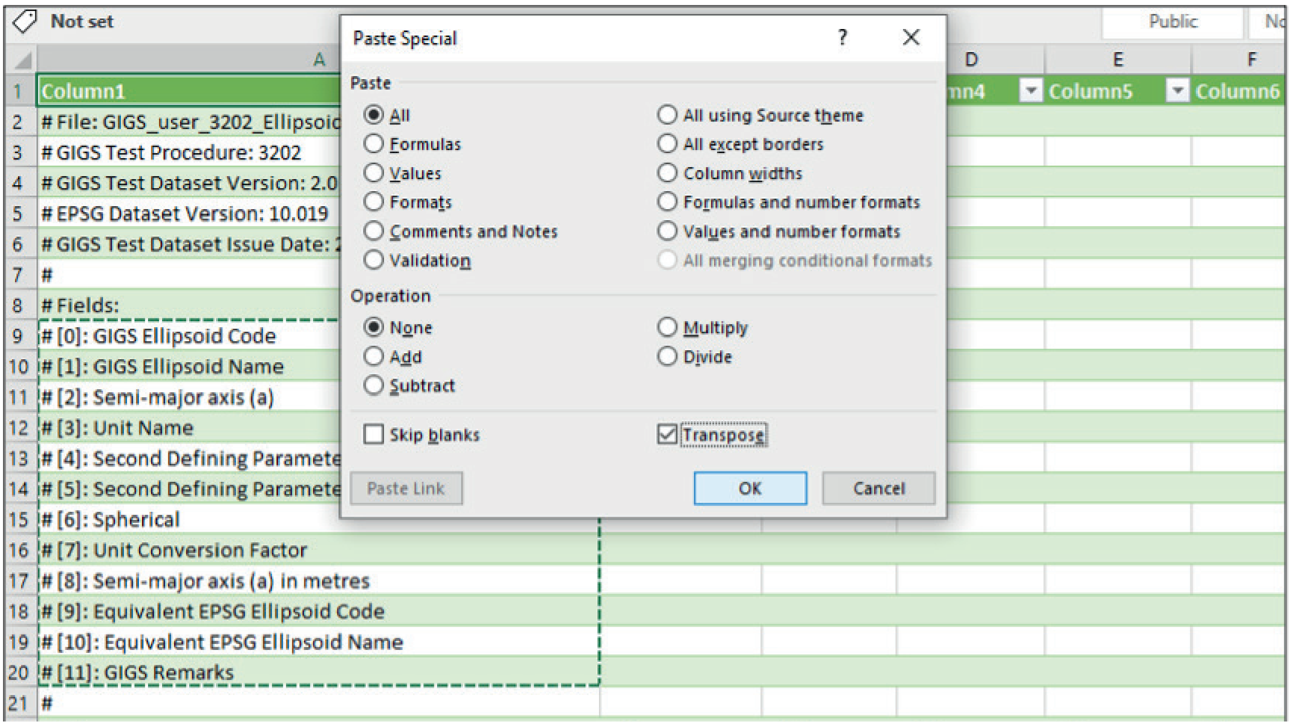


Column1	Column2	Column3	Column4	Column5	Column6	Column7	Column8	Column9	Column10	Column11	Column12
# File: GIGS_user_3202_Ellipsoid											
# GIGS Test Procedure: 3202											
# GIGS Test Dataset Version: 2.0											
# EPSG Dataset Version: 10.019											
# GIGS Test Dataset Issue Date: 2021-05-03											
#											
# Fields:											
# [0]: GIGS Ellipsoid Code											
# [1]: GIGS Ellipsoid Name											
# [2]: Semi-major axis (a)											
# [3]: Unit Name											
# [4]: Second Defining Parameter: Inverse flattening (1/f)											
# [5]: Second Defining Parameter: Semi-minor axis (b)											
# [6]: Spherical											
# [7]: Unit Conversion Factor											
# [8]: Semi-major axis (a) in metres											
# [9]: Equivalent EPSG Ellipsoid Code											
# [10]: Equivalent EPSG Ellipsoid Name											
# [11]: GIGS Remarks											
#											
# [0]	# [1]	# [2]	# [3]	# [4]	# [5]	# [6]	# [7]	# [8]	# [9]	# [10]	# [11]
67030	GIGS ellipsoid A	6378137	metre	298.257223563	0	FALSE	0	6378137	7030	WGS 84	Defined using a and 1/f
67001	GIGS ellipsoid B	6377563.396	metre	299.3249646	0	FALSE	0	6377563.396	7001	Airy 1830	Defined using a and 1/f
67004	GIGS ellipsoid C	6377397.155	metre	299.1528128	0	FALSE	0	6377397.155	7004	Bessel 1841	Defined using a and 1/f
67022	GIGS ellipsoid E	6378388	metre	297	0	FALSE	0	6378388	7022	International 1924	Defined using a and 1/f
67019	GIGS ellipsoid F	6378.137	kilometre	298.257222101	0	FALSE	1000	6378137	7019	GRS 1980	CAUTION defined in kilometre; not metre as per EPSG entity
67011	GIGS ellipsoid H	6378249.2	metre	0	6356515	FALSE	0	6378249.2	7011	Clarke 1880 (IGN)	Defined using a and b; Calculated 1/f = 293.4660213
67052	GIGS ellipsoid I	6370997	metre	0	0	TRUE	0	6370997	7052	Clarke 1866 Authalic Sphere	Sphere
67008	GIGS ellipsoid J	20925832.164	US survey foot	294.978698214	0	FALSE	0.304800609601219	6378206.4	7008	Clarke 1866	Not metres
67036	GIGS ellipsoid K	6378160	metre	298.247167427	0	FALSE	0	6378160	7036	GRS 1967	Defined using a and 1/f
67003	GIGS ellipsoid X	6378160	metre	298.25	0	FALSE	0	6378160	7003	Australian National Spheroid	Defined using a and 1/f
67024	GIGS ellipsoid Y	6378245	metre	298.3	0	FALSE	0	6378245	7024	Krassowsky 1940	Defined using a and 1/f

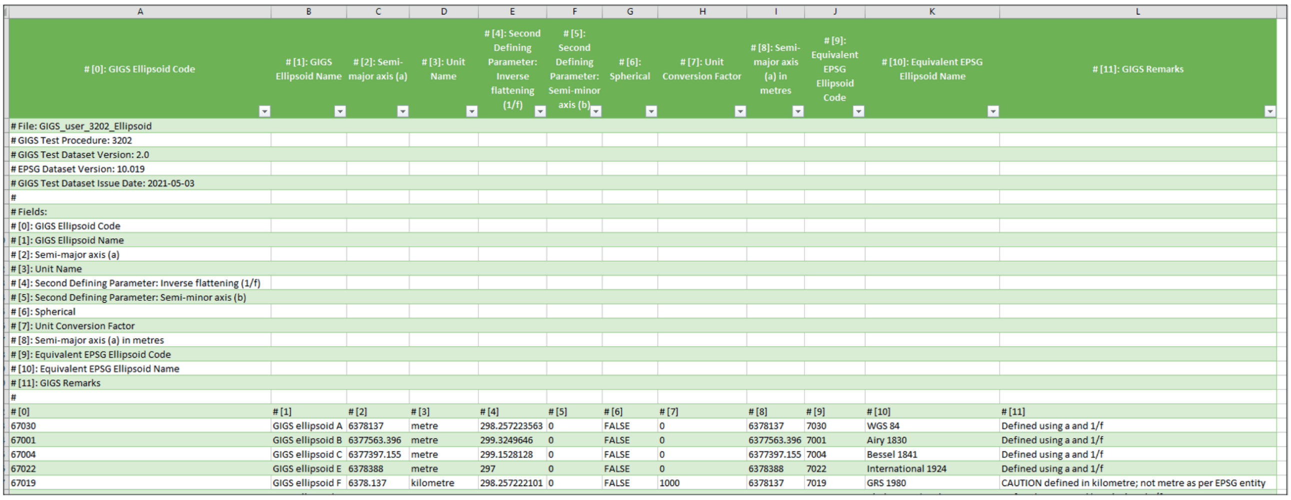
To help column identification, select the Field names in the hash header and copy



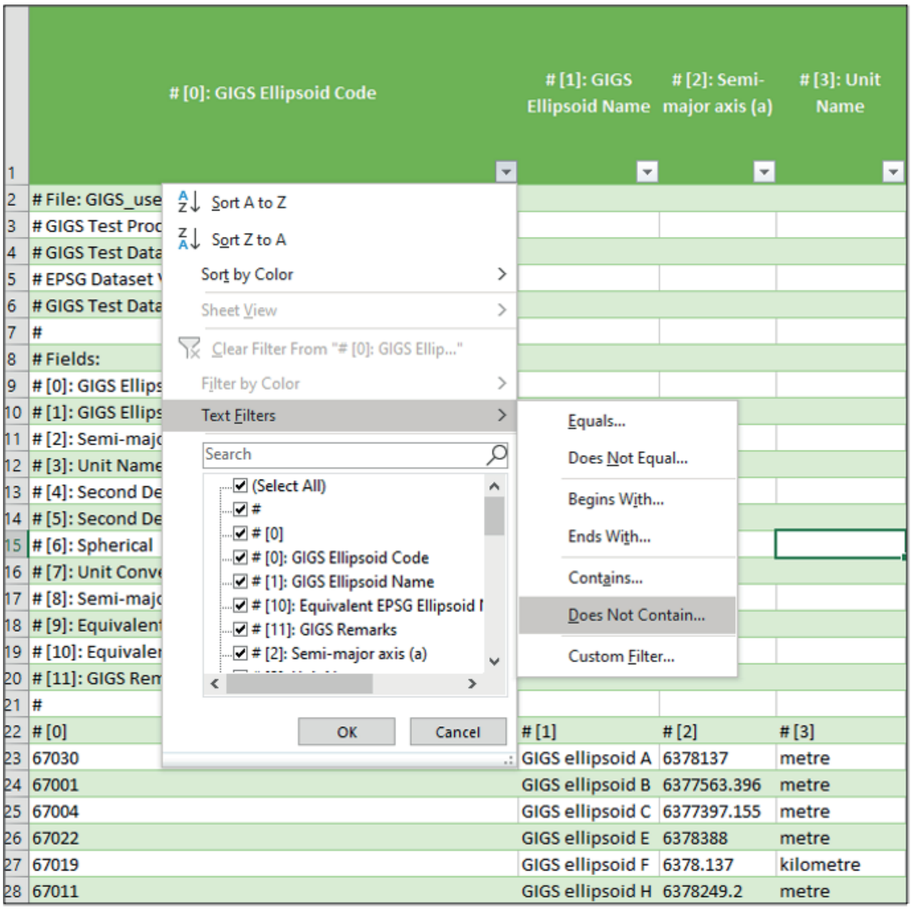
Right click on the first row showing as Column1 (first column) select Paste Special



Select Transpose

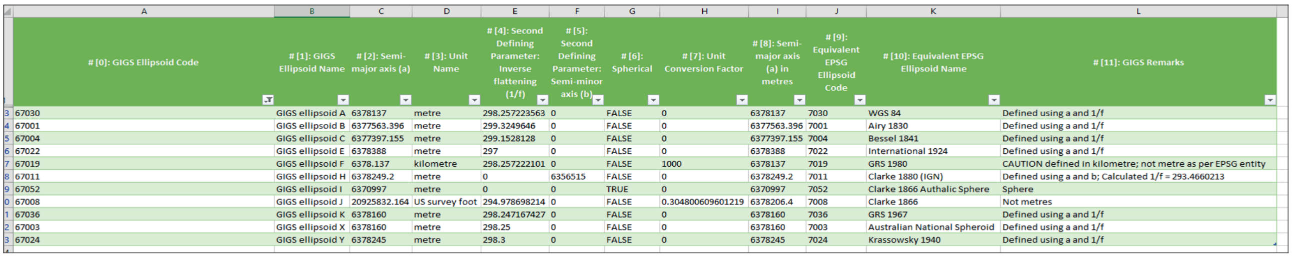


If required, hide the hash header by applying a text filter to the first column



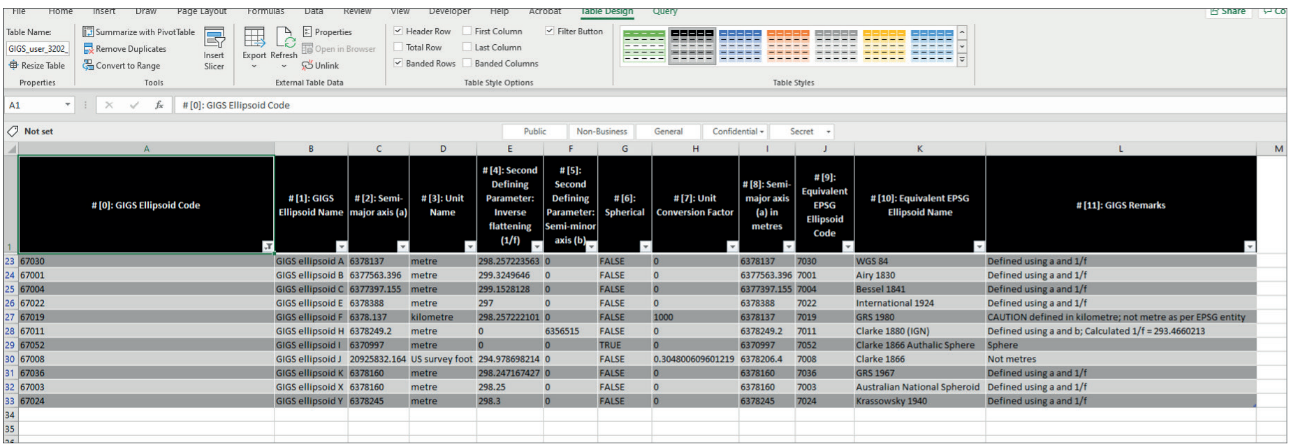
Enter does not contain "#"

Data should then appear with the header filtered out, and is fully sortable



# [0]: GIGS Ellipsoid Code	# [1]: GIGS Ellipsoid Name	# [2]: Semi-major axis (a)	# [3]: Unit Name	# [4]: Second Defining Parameter: Inverse flattening (1/f)	# [5]: Second Defining Parameter: Semi-minor axis (b)	# [6]: Spherical	# [7]: Unit Conversion Factor	# [8]: Semi-major axis (a) in metres	# [9]: Equivalent EPSG Ellipsoid Code	# [10]: Equivalent EPSG Ellipsoid Name	# [11]: GIGS Remarks
67030	GIGS ellipsoid A	6378137	metre	298.257223563	0	FALSE	0	6378137	7030	WGS 84	Defined using a and 1/f
67001	GIGS ellipsoid B	6377563.396	metre	299.3249646	0	FALSE	0	6377563.396	7001	Airy 1830	Defined using a and 1/f
67004	GIGS ellipsoid C	6377397.155	metre	299.1528128	0	FALSE	0	6377397.155	7004	Bessel 1841	Defined using a and 1/f
67022	GIGS ellipsoid E	6378388	metre	297	0	FALSE	0	6378388	7022	International 1924	Defined using a and 1/f
67019	GIGS ellipsoid F	6378.137	kilometre	298.257222101	0	FALSE	1000	6378137	7019	GRS 1980	CAUTION defined in kilometre; not metre as per EPSG entity
67011	GIGS ellipsoid H	6378249.2	metre	0	6356515	FALSE	0	6378249.2	7011	Clarke 1880 (IGN)	Defined using a and b; Calculated 1/f = 293.4660213
67052	GIGS ellipsoid I	6370997	metre	0	0	TRUE	0	6370997	7052	Clarke 1866 Authalic Sphere	Sphere
67008	GIGS ellipsoid J	20925832.164	US survey foot	294.978698214	0	FALSE	0.304800609601219	6378206.4	7008	Clarke 1866	Not metres
67036	GIGS ellipsoid K	6378160	metre	298.247167427	0	FALSE	0	6378160	7036	GRS 1967	Defined using a and 1/f
67003	GIGS ellipsoid X	6378160	metre	298.25	0	FALSE	0	6378160	7003	Australian National Spheroid	Defined using a and 1/f
67024	GIGS ellipsoid Y	6378245	metre	298.3	0	FALSE	0	6378245	7024	Krassowsky 1940	Defined using a and 1/f

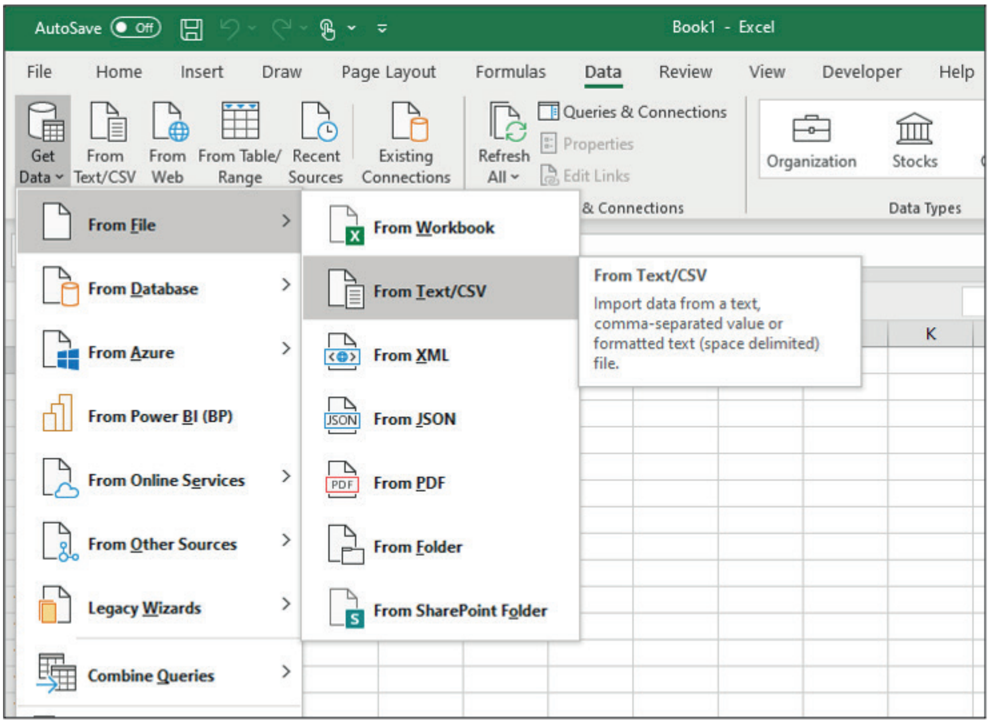
The style of the table can be further refined in the Table Design ribbon



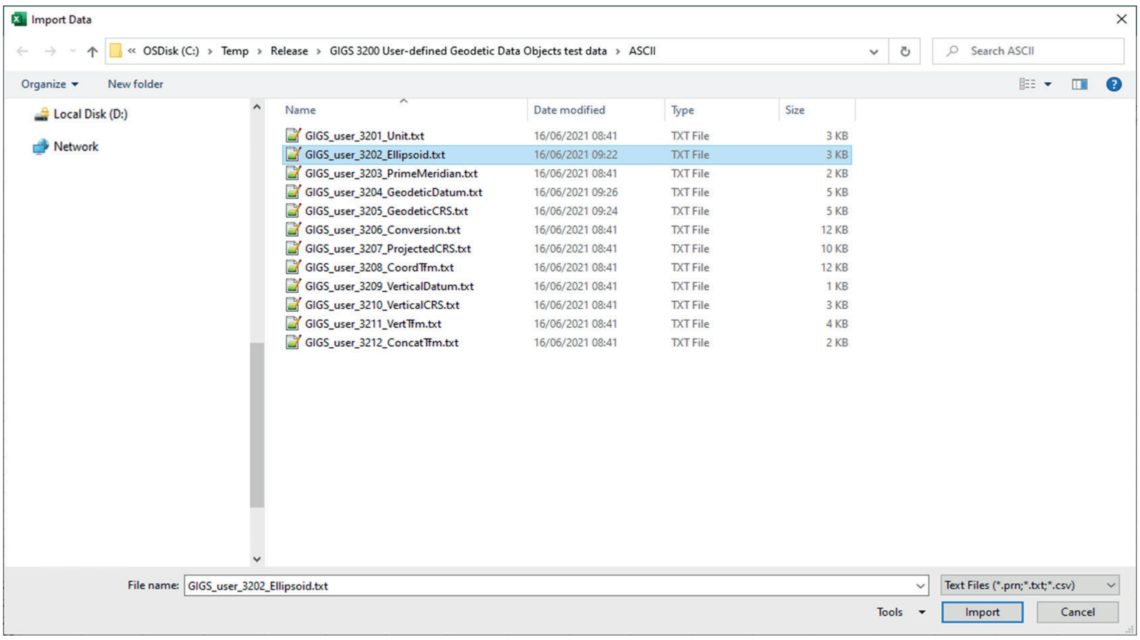
# [0]: GIGS Ellipsoid Code	# [1]: GIGS Ellipsoid Name	# [2]: Semi-major axis (a)	# [3]: Unit Name	# [4]: Second Defining Parameter: Inverse flattening (1/f)	# [5]: Second Defining Parameter: Semi-minor axis (b)	# [6]: Spherical	# [7]: Unit Conversion Factor	# [8]: Semi-major axis (a) in metres	# [9]: Equivalent EPSG Ellipsoid Code	# [10]: Equivalent EPSG Ellipsoid Name	# [11]: GIGS Remarks
67030	GIGS ellipsoid A	6378137	metre	298.257223563	0	FALSE	0	6378137	7030	WGS 84	Defined using a and 1/f
67001	GIGS ellipsoid B	6377563.396	metre	299.3249646	0	FALSE	0	6377563.396	7001	Airy 1830	Defined using a and 1/f
67004	GIGS ellipsoid C	6377397.155	metre	299.1528128	0	FALSE	0	6377397.155	7004	Bessel 1841	Defined using a and 1/f
67022	GIGS ellipsoid E	6378388	metre	297	0	FALSE	0	6378388	7022	International 1924	Defined using a and 1/f
67019	GIGS ellipsoid F	6378.137	kilometre	298.257222101	0	FALSE	1000	6378137	7019	GRS 1980	CAUTION defined in kilometre; not metre as per EPSG entity
67011	GIGS ellipsoid H	6378249.2	metre	0	6356515	FALSE	0	6378249.2	7011	Clarke 1880 (IGN)	Defined using a and b; Calculated 1/f = 293.4660213
67052	GIGS ellipsoid I	6370997	metre	0	0	TRUE	0	6370997	7052	Clarke 1866 Authalic Sphere	Sphere
67008	GIGS ellipsoid J	20925832.164	US survey foot	294.978698214	0	FALSE	0.304800609601219	6378206.4	7008	Clarke 1866	Not metres
67036	GIGS ellipsoid K	6378160	metre	298.247167427	0	FALSE	0	6378160	7036	GRS 1967	Defined using a and 1/f
67003	GIGS ellipsoid X	6378160	metre	298.25	0	FALSE	0	6378160	7003	Australian National Spheroid	Defined using a and 1/f
67024	GIGS ellipsoid Y	6378245	metre	298.3	0	FALSE	0	6378245	7024	Krassowsky 1940	Defined using a and 1/f

Method 3: Using "From Text/CSV" Get Data Wizard and PowerQuery (semi-automated)

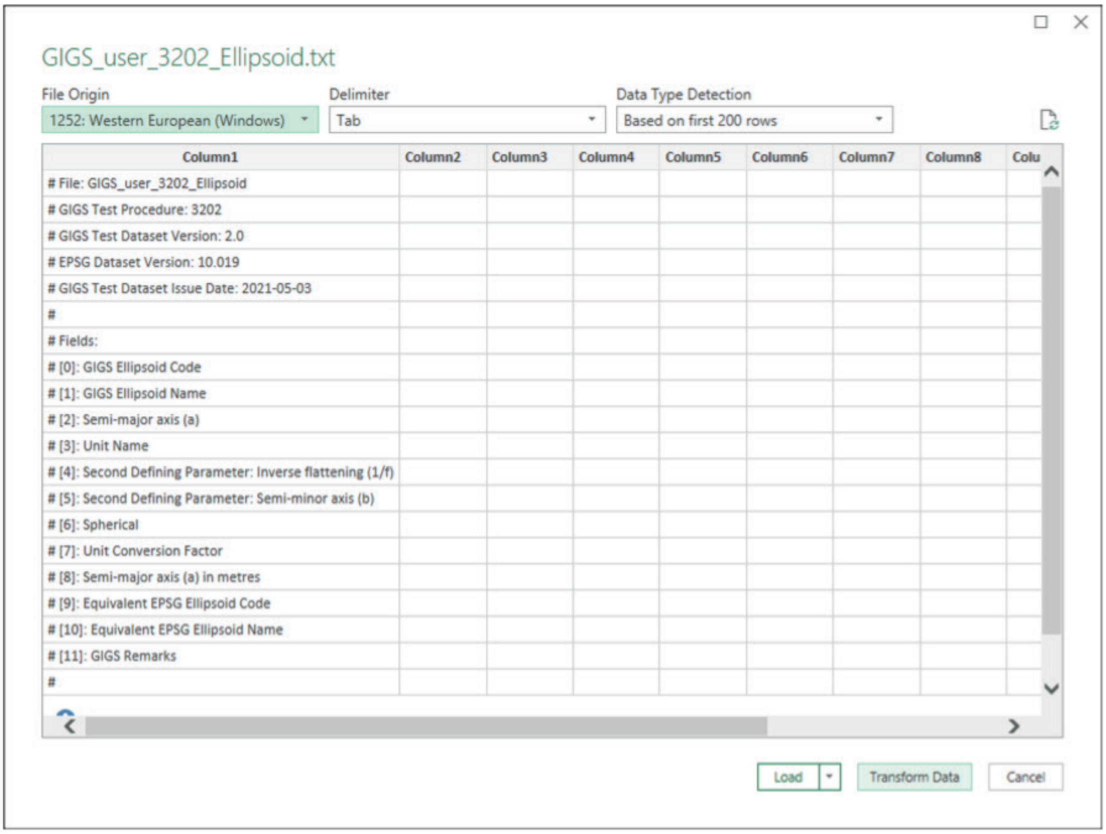
To load a Test Dataset file, open the From Text/CSV Wizard from the Get Data function in the Get and Transform Data section (Data ribbon).



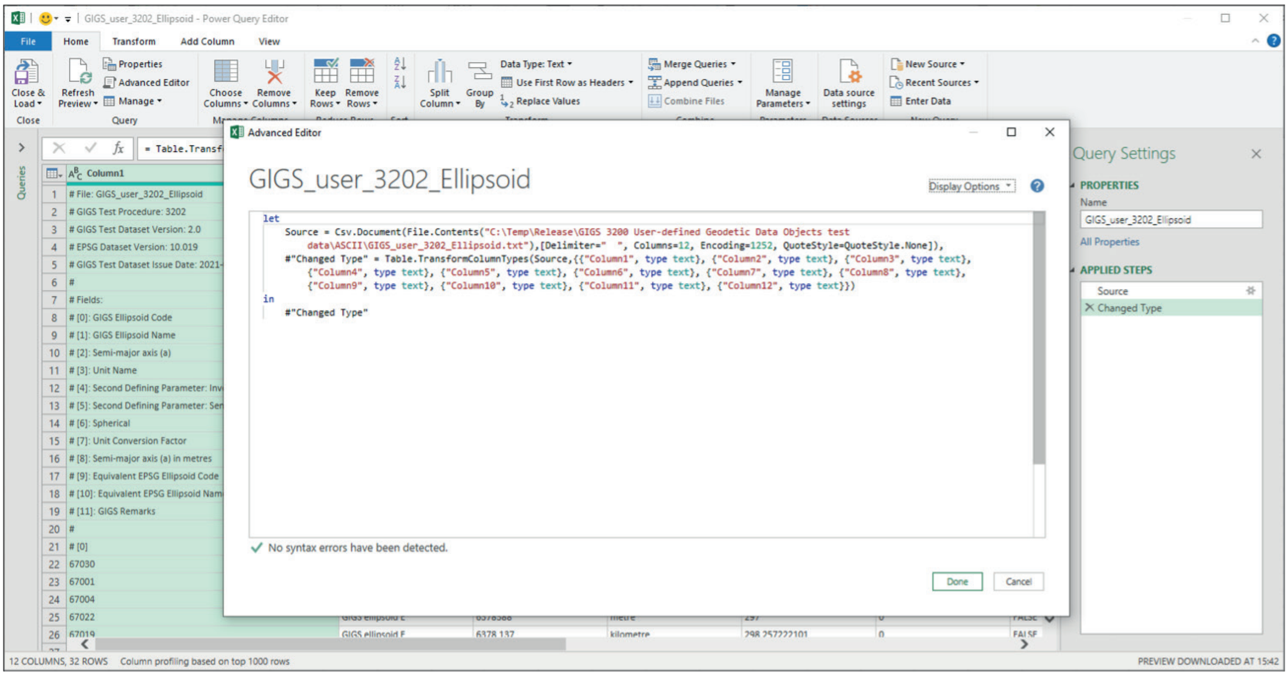
Select the file to import



Select Transform Data



In Power Query Editor, open the Advanced Editor, from the Query section of Home ribbon



Below the “Source =” line (NOTE: this line is typically wrapped, but it depends on the Display Options) insert the following query lines:

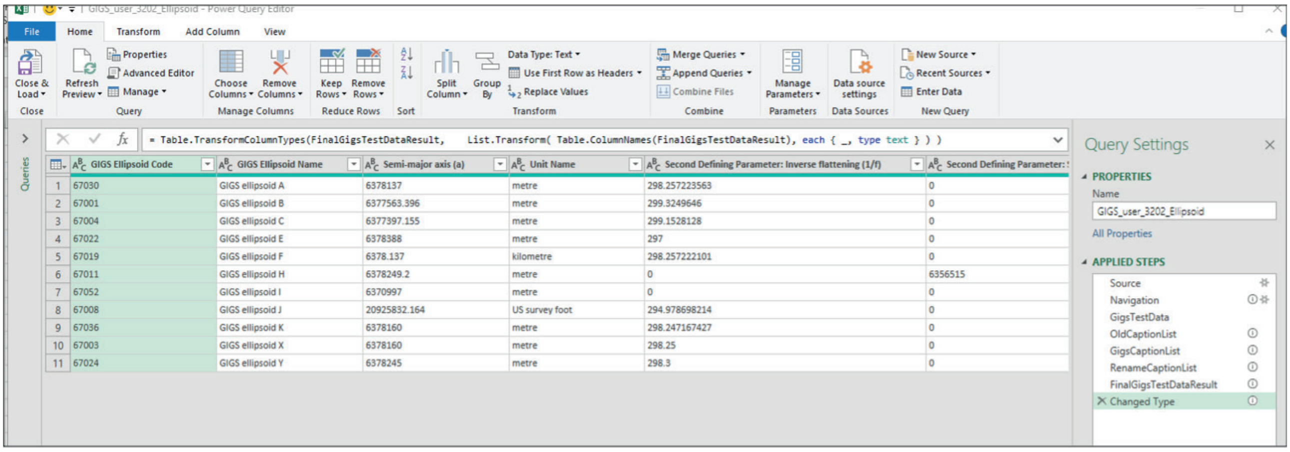
```
/*Remove header information and fetch the Test Data*/
ColName = Table.ColumnNames(Source){0},
GigsTestData = Table.SelectRows(Source, each not Text.StartsWith( Record.Field(
_ , ColName) , “#”)),

/* Extract origina colums names */
OldCaptionList = Table.ColumnNames(Source),

/* Generate new colum names from header information */
GigsCaptionList =
List.Transform(List.RemoveLastN(Table.ToList(Table.SelectRows(Source,
each Text.StartsWith(Record.Field( _ , ColName), “# [“)), Combiner.
CombineTextByDelimiter(“”)),1), each Text.AfterDelimiter( _ , “]:”)),

/* Generate column rename lists */
RenameCaptionList = List.Zip({OldCaptionList, GigsCaptionList}),

/* Rename Gigs Test Data colums */
FinalGigsTestDataResult       = Table.RenameColumns(GigsTestData,
RenameCaptionList),

/* Change all column types to text in order to avoid rounding errors etc */
#”Changed Type” = Table.TransformColumnTypes(FinalGigsTestDataResult,
List.Transform( Table.ColumnNames(FinalGigsTestDataResult), each { _, type
text } ) )
```

The resulting Editor view should appear as below

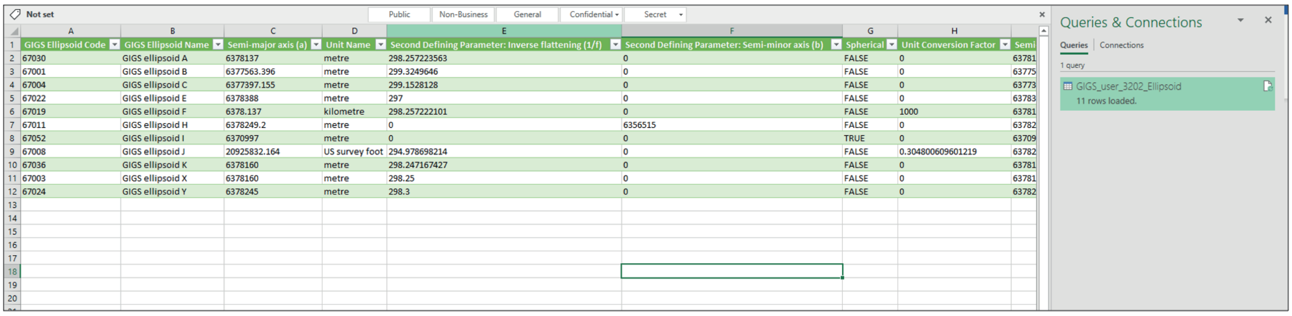
Delete the last line in the "let" section and ensure that the last line in the let section does not end with a comma as illustrated below


```
let
    Source = Csv.Document(File.Contents("C:\Temp\Release\GIGS 3200 User-defined Geodetic Data Objects test data\ASCII\GIGS_user_3202_Ellipsoid.txt"),[Delimiter="	", Columns=12, Encoding=1252,
        QuoteStyle=QuoteStyle.None]),

    /*Remove header information and fetch the test data*/
    ColName = Table.ColumnNames(Source){0},
    GigsTestData = Table.SelectRows(Source, each not Text.StartsWith( Record.Field( _ , ColName) , "#")),

    /* Extract origina colums names */
    OldCaptionList = Table.ColumnNames(Source),

    /* Generate new colum names from header information */
    GigsCaptionList = List.Transform(List.RemoveLastN(Table.ToList(Table.SelectRows(Source, each Text.StartsWith(Record.Field( _ , ColName), "# [")), Combiner.CombineTextByDelimiter("")),1), each
        Text.AfterDelimiter( _ , "]:")),

    /* Generate column rename lists */
    RenameCaptionList = List.Zip({OldCaptionList, GigsCaptionList}),

    /* Rename Gigs Test data colums */
    FinalGigsTestDataResult     = Table.RenameColumns(GigsTestData, RenameCaptionList),

    /* Change all column types to text in order to avoid rounding errors etc */
    #"Changed Type" = Table.TransformColumnTypes(FinalGigsTestDataResult,    List.Transform( Table.ColumnNames(FinalGigsTestDataResult), each { _, type text } ) )

in
    #"Changed Type"
```

Ensure there are no Syntax errors detected and select Done, then select Close & Load

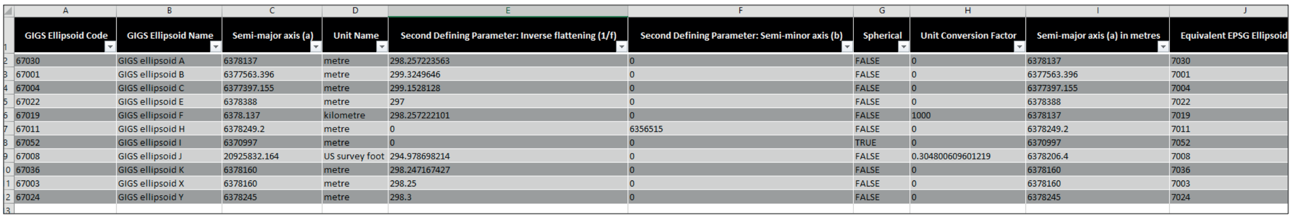


Data should then appear as Queried table in Excel, without a header. Note that if the location/ content of the source txt file changes then the query will need to be updated



GIGS Ellipsoid Code	GIGS Ellipsoid Name	Semi-major axis (a)	Unit Name	Second Defining Parameter: Inverse flattening (1/f)	Second Defining Parameter: Semi-minor axis (b)	Spherical	Unit Conversion Factor	Semi
67030	GIGS ellipsoid A	6378137	metre	298.257223563	0	FALSE	0	63781
67001	GIGS ellipsoid B	6377563.396	metre	299.3249646	0	FALSE	0	63775
67004	GIGS ellipsoid C	6377397.155	metre	299.1528128	0	FALSE	0	63773
67022	GIGS ellipsoid E	6378388	metre	297	0	FALSE	0	63783
67019	GIGS ellipsoid F	6378.137	kilometre	298.257222101	0	FALSE	1000	63781
67011	GIGS ellipsoid H	6378249.2	metre	0	6356515	FALSE	0	63782
67052	GIGS ellipsoid I	6370997	metre	0	0	TRUE	0	63709
67008	GIGS ellipsoid J	20925832.164	US survey foot	294.978698214	0	FALSE	0.304800609601219	63782
67036	GIGS ellipsoid K	6378160	metre	298.247167427	0	FALSE	0	63781
67003	GIGS ellipsoid X	6378160	metre	298.25	0	FALSE	0	63781
67024	GIGS ellipsoid Y	6378245	metre	298.3	0	FALSE	0	63782

The style of the table can be further refined in the Table Design ribbon



GIGS Ellipsoid Code	GIGS Ellipsoid Name	Semi-major axis (a)	Unit Name	Second Defining Parameter: Inverse flattening (1/f)	Second Defining Parameter: Semi-minor axis (b)	Spherical	Unit Conversion Factor	Semi-major axis (a) in metres	Equivalent EPSG Ellipsoid
67030	GIGS ellipsoid A	6378137	metre	298.257223563	0	FALSE	0	6378137	7030
67001	GIGS ellipsoid B	6377563.396	metre	299.3249646	0	FALSE	0	6377563.396	7001
67004	GIGS ellipsoid C	6377397.155	metre	299.1528128	0	FALSE	0	6377397.155	7004
67022	GIGS ellipsoid E	6378388	metre	297	0	FALSE	0	6378388	7022
67019	GIGS ellipsoid F	6378.137	kilometre	298.257222101	0	FALSE	1000	6378137	7019
67011	GIGS ellipsoid H	6378249.2	metre	0	6356515	FALSE	0	6378249.2	7011
67052	GIGS ellipsoid I	6370997	metre	0	0	TRUE	0	6370997	7052
67008	GIGS ellipsoid J	20925832.164	US survey foot	294.978698214	0	FALSE	0.304800609601219	6378206.4	7008
67036	GIGS ellipsoid K	6378160	metre	298.247167427	0	FALSE	0	6378160	7036
67003	GIGS ellipsoid X	6378160	metre	298.25	0	FALSE	0	6378160	7003
67024	GIGS ellipsoid Y	6378245	metre	298.3	0	FALSE	0	6378245	7024

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GIGS is an open-source digital testing framework designed to evaluate the capability of software in establishing and maintaining the integrity of geospatial data. It is primarily aimed at geoscience applications, but elements can be readily applied to any software that handles spatial data. The testing framework comprises a series of qualitative evaluations that assess software functionality and configuration, coupled with data-driven tests that quantify the accuracy and robustness of geodetic engines and libraries, in executing coordinate operations. The test package is supported by two documents, a general Guidance Note on the theory of geospatial integrity and GIGS testing (IOGP Report 430-1) and a comprehensive User Guide providing technical procedures for executing the GIGS tests (IOGP Report 430-2, this document).