Sri Lanka National
Spatial Data Infrastructure

Supporting Sustainable National and Local Development

POLICY, GOVERNANCE AND STANDARDS STUDY

Volume 3 of 3

Standards Framework

FINAL REPORT

30 December, 2016

GPCGIS
A Global Network of Information Professionals

Sri Lanka National Spatial Data Infrastructure

POLICY, GOVERNANCE AND STANDARDS STUDY

Volume 3 of 3
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Prepared for

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EXECUTIVE SUMMARY

This report summarizes the Governance Framework and Procedures for the Sri Lanka National Spatial Data Infrastructure (SL-NSDI) programme. This report is one of three volumes that together comprise the "Policy, Governance and Standards" report as follows:

Vol 1 – SL-NSDI Policy Framework Development
Vol 2 – SL-NSDI Governance Model and Processes
Vol 3 – SL-NSDI Standards Framework Development (current document)

As outlined in this document, the SL-NSDI programme is to provide leadership in the adoption of standards that will support interoperability across the community of stakeholders. The use of standards by all community members will ensure that the investment in data, applications and computing infrastructure can be optimized, systems can

There are a wide variety of existing standards that have been developed internationally specifically for or related to Geographic Information System (GIS) and National Spatial Data Infrastructure (NSDI). These can be categorized as falling generally into several categories, including:

Terminology and Definitions. It is important that the SL-NSDI community ultimately speaks the same "language" when referring to terminology and definitions. Adopting a standard glossary can support this and help to avoid miscommunication or confusion.

Metadata. A standardized catalog providing a complete accounting of all the fundamental geospatial data sets (FGDS) available across the SL-NSDI community is one of the foundation components of the programme. The catalog describes the source of the information and a series of standard characteristics that can interpreted to understand whether a dataset is appropriate for a specific application.

Data Content. Data content standard ensure that any FGDS that is published through the SL-NSDI contains the information that is needed in common by the stakeholders. Data content standards provide an agreed target to be fulfilled by the assigned data custodiann organization, and source of information that is known and reliable for use by the community.

Data Standard Interchange Formats. It can be expected that some stakeholders may be using different systems for developing and managing their GIS data. It is therefore important that data format interchange standards be adopted that will allow the lossless conversion of data to required formats.

Data Principles and Structures. How real world features are represented in a digital GIS environment is important in allowing this information to be manipulated and analyzed effectively. Lower level standards regarding data structure can be referenced to ensure

that any open source or commercial systems that are implemented incorporate these lower level standards to ensure consistency and interoperability.

Software Principles and Functions. How GIS and related software functions is important to ensure consistency and interoperability across systems. Lower level standards regarding software principles and functions can be referenced to ensure that any open source or commercial systems that are implemented incorporate these standards.

The international GIS and NSDI communities have over the past two decades developed and adopted a wide range of standards that cover all the key requirements of the SL-NSDI. Several international and national organizations have been active in the development of standards and these communities continue to develop new standards and evolve legacy standards as new principles and technological capabilities arise. The organizations that have been consulted in compiling the standards listed in this document include the following:

International Standards Organisation (ISO). ISO/TC 211 is a standard technical committee formed within ISO, tasked with covering the areas of digital geographic information (such as used by geographic information systems) and geomatics. It is responsible for preparation of a series of International Standards and Technical Specifications numbered in the number range starting at 19101.[1] ISO/TC 211 applies a rigorous, systematic process inclusive of broad professional consultation and involvement in the development and refinement of standards over time.

Open Geospatial Consortium (OGC). The Open Geospatial Consortium (OGC), an international voluntary consensus standards organization, originated in 1994. In the OGC, more than 500 commercial, governmental, nonprofit and research organizations worldwide collaborate in a consensus process encouraging development and implementation of open standards for geospatial content and services, sensor web and Internet of Things, GIS data processing and data sharing.

U.S. Federal Geographic Data Committee (FGDC). The United States Federal Geographic Data Committee (FGDC) is an organized structure of Federal geospatial professionals and constituents that provide executive, managerial, and advisory direction and oversight for geospatial decisions and initiatives across the U.S. Federal government. The FGDC is chaired by the Secretary of the Interior with the Deputy Director for Management, OMB as Vice-Chair. FGDC has since its inception facilitated the development or adoption of existing geospatial standards and guidelines. This has involved a structured process involving a broad spectrum of stakeholder organizations and individuals.

INSPIRE. INSPIRE is "an EU initiative to establish an infrastructure for spatial information in Europe that is geared to help to make spatial or geographical information more accessible and interoperable for a wide range of purposes supporting sustainable

[1] https://en.wikipedia.org/wiki/ISO/TC_211_Geographic_information/Geomatics

development". The INSPIRE directive lays down a general framework for a Spatial Data Infrastructure (SDI) for the purposes of European Community environmental policies and policies or activities which may affect the environment. INSPIRE is based on the infrastructures for spatial information established and operated by the member states of the European Union. The directive addresses 34 spatial data themes needed for environmental applications.

Other. Some de facto standards have emerged through various research and development efforts and are now in common usage in the industry.

The referenced standards are described in extensive documentation that is general accessible online. Those standards that have been deemed to be applicable to the SL-NSDI are not included in their entirety in this document. Rather, an abstract of each standard as provided by the source organization is included along with a summary of how that standard may be applicable to the SL-NSDI programme.

Not all standards will be equally applicable or of immediate significance to the SL-NSDI. Some will be immediately required (e.g. metadata), others will be developed through a continuous process over time (e.g. data content) and others are lower-level, highly technical standards that will only be referenced or used to ensure compliance of commercial and open-source systems and services. For the purposes of the SL-NSDI, the first two relevance classes mentioned are of primary importance to the program and are therefore given more attention in this report and reflected in related SL-NSDI reports. Lower level standards are developed and maintained by international organizations who focus on these issues on behalf of the global geospatial community, thus it is suggested that the SL-NSDI program reference, monitor and otherwise take advantage of those developments rather than making direct investment of time and resources. A matrix is provided in Section 1.4 of this report to distinguish the various classes of standards in terms of their relevance to the SL-NSDI program.

List of Abbreviations and Acronyms

CINTEC		Council for Information Technology (CINTEC)
DMC		Disaster Management Centre
FGDS		Fundamental Geospatial Data Sets (FGDS).
Geomaturity		Geomaturity is a measure of the level of technical and institutional development in regards to the use of GIS technology in an organization.
Geoportal		Web-based portal for discovering, accessing and viewing GIS data services
Geospatial Data		"Geospatial data" means information that identifies the geographic location and characteristics of natural or constructed features and boundaries on the earth. This information may be derived from, among other things, remote sensing, mapping, and surveying technologies. Statistical data may be included in this definition at the discretion of the collecting agency.
GIS		Geographic Information System
GPS		Global Positioning System
GSL-NSDI		Global Spatial Data Infrastructure
ICT		Information and Communication Technologies
ICTA		Information and Communications Technology Authority
IP		Internet Protocol
IT		Information Technology
ISO		International Standards Organisation
ISO/TC		International Standards Organisation/Technical Committee
ISP		Internet Service Provider
LGN		Lanka Government Network
National Geospatial Data Clearinghouse		The "National Geospatial Data Clearinghouse" means a distributed network of geospatial data producers, managers, and users linked electronically
NMP		National Map Portal
NSL-NSDI		National Spatial Data Infrastructure. An institutional and technical framework for coordinating and sharing geospatial information across a stakeholder community.
OECD		Organisation for Economic Cooperation and Development
OGC		Open Geospatial Consortium
PDF		Portable Document Format
RDBMS		Relational Data Base Management System
RTI		Right To Information
SDD		Spatial Data Dictionary
SDE		Spatial Data Engine
SL-NSDI		Spatial Data Infrastructure
SL-NSDI		Sri Lanka National Spatial Data Infrastructure" (SL-NSDI) means the technology, policies, standards, and human resources necessary to

		acquire, process, store, distribute, and improve utilization of geospatial data
SME		Subject Matter Expert
SOA		Service Oriented Architecture
TOR		Terms of Reference
UN		United Nations
VGI		Volunteered Geographic Information
WofG		Whole of Government
WFS		Web Feature Service
WMS		Web Map Service
XML –		eXtensible Markup Language

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1 INTRODUCTION

This report represents the "Standards Framework" component of the "Policy, Governance and Standards Study" portion of the Sri Lanka National Spatial Data Infrastructure (Sri Lanka NSDI) program which is currently underway. This is one of several components being carried out by different teams in a series of parallel and overlapping activities that are intended to expedite the planning, design and development of the foundation program and system for the Sri Lanka NSDI.

The ICTA has developed a conceptual model for the NSDI as represented in the following figure:

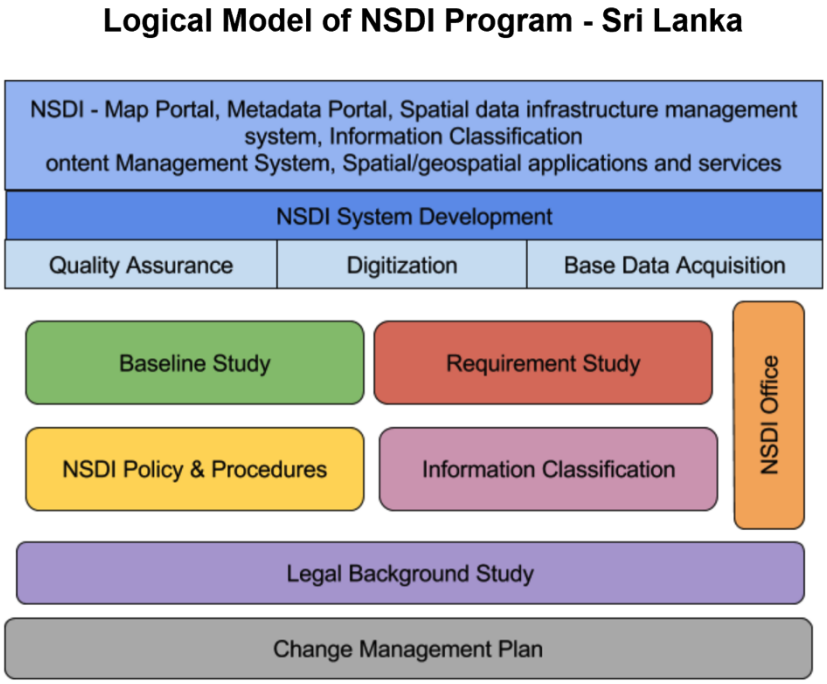

Figure 1 - Logical Model of Sri Lanka NSDI Program

The individual efforts and their interdependencies as defined by the ICTA are illustrated in the following figure. The position of this Policy, Governance and Standards Study (Policies and Procedures) is highlighted in the diagram.

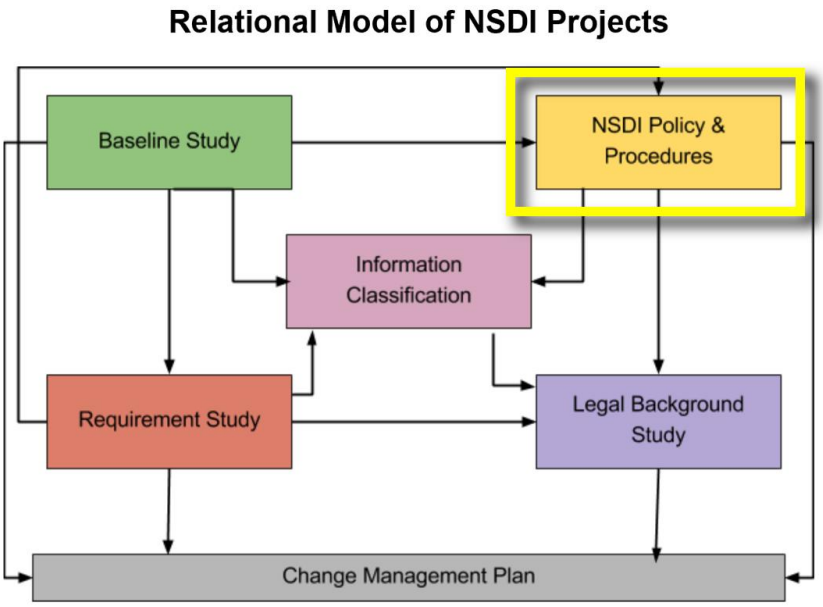

Figure 2 – Relationship Model of NSDI Projects

1.1 Background and Current Situation

With the aims of improving optimum use of spatial data across the government and making effective evidence based decisions, Information and Communication Technology Agency of Sri Lanka (ICTA) is in the process of implementing a National Spatial Data Infrastructure (NSDI) program, in collaboration with stakeholder institutions. NSDI has been identified as one of the key initiatives identified under the National Digital Policy of the Government of Sri Lanka; "Digitalization of the Economy". ICTA has obtained the service of this Consultant (individual) to carry out a requirement study to define in detail the system requirements, related specifications, conduct information classification, system prototype model and the implementation approach.

The Government of Sri Lanka has spatial information collected by various government departments. Spatial information technology skills are highly developed in some of the government institutions and the systems used to collect this information are also advanced.
Usage of spatial information across government institutions in a collaborative manner is in significance with respect to the service provisioning and decision making process. Further, spatial information is not able to be easily shared between organizations at the present time; nor is it accessible to the broader community.

Spatial data sets are collected by a number of government organizations to support conducting of an organization's business and not with other agencies' needs in mind. These data are managed in closed systems and this has created a multitude of information silos. Currently, data collected by organizations is not accessible. It is difficult to know what information is available and where it is held. This has led to several organizations collecting the same information because they are unaware that the information already exists.

Organizations across the government sector recognize that current processes are inefficient and that more cooperation across the sector is required. However, existing data sharing policies are restricting

collaboration. There is a significant paper trail of agreements that need to be processed before data sets can be transferred from one organization to another. Manual data sharing procedures contribute to delay in sharing, and the effort required to manually integrate updates from one agency to another is labour intensive and time consuming. The NSDI program has been conceived to address these issues and facilitate a process of standardizing and streamlining the development and sharing of geospatial data across government and other sectors of Sri Lanka society.

1.2 Major Components of the Study Work Program

Accomplishing the general and specific goals and objectives for this activity requires a comprehensive and systematic approach. A work program for addressing the development of the SL-NSDI Policy, Governance and Standards component is defined here, comprising three interdependent implementation tracks intended to address the scope as defined in the EOI. These tracks are designed to build on the results of the Baseline Study and Requirements Assessment efforts. The three Tracks include the following:

Track 1 – SL-NSDI Policy Framework Development
Track 2 – SL-NSDI Standards Framework Development
Track 3 – SL-NSDI Governance Model and Processes

The tracks outlined above have been carried out as parallel activities, with incorporation of as-needed interdependencies and coordination among them and with parallel related activities being carried out by others, as illustrated previously in Figure 1. The current report addresses Track 2 – SL-NSDI Standards Framework Development

1.3 Standards Framework Structure

There are a wide variety of existing standards that have been developed internationally specifically for or related to Geographic Information System (GIS) and National Spatial Data Infrastructure (NSDI). These can be categorized as falling generally into X categories, including:

Terminology and Definitions. It is important that the SL-NSDI community ultimately speaks the same "language" when referring to terminology and definitions. Adopting a standard glossary can support this and help to avoid miscommunication or confusion.

Metadata. A standardized catalog providing a complete accounting of all the fundamental geospatial data sets (FGDS) available across the SL-NSDI community is one of the foundation components of the programme. The catalog describes the source of the information and a series of standard characteristics that can interpreted to understand whether a dataset is appropriate for a specific application.

Data Content. Data content standard ensure that any FGDS that is published through the SL-NSDI contains the information that is needed in common by the stakeholders. Data content

standards provide an agreed target to be fulfilled by the assigned data custodian organization, and source of information that is known and reliable for use by the community.

Data Standard Interchange Formats. It can be expected that some stakeholders may be using different systems for developing and managing their GIS data. It is therefore important that data format interchange standards be adopted that will allow the lossless conversion of data to required formats.

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The international GIS and NSDI communities have over the past two decades developed and adopted a wide range of standards that cover all the key requirements of the SL-NSDI. Several international and national organizations have been active in the development of standards and these communities continue to develop new standards and evolve legacy standards as new principles and technological capabilities arise. The organizations that have been consulted in compiling the standards listed in this document are listed below. The standards frameworks established by each of these organizations has a certain internal logic and integrity, thus the document is organized according to the authoring organizations to keep the families of standards intact for the benefit of the reader. However, not all of these standards are of equal immediate significance to the SL-NSDI initiative, thus a matrix providing a ranking of the standards is provided in the section following to provide the reader with a convenient way to reference those standards that are most relevant.

The key standards organizations referenced for this study include the following:

International Standards Organisation (ISO). ISO/TC 211 is a standard technical committee formed within ISO, tasked with covering the areas of digital geographic information (such as used by geographic information systems) and geomatics. It is responsible for preparation of a series of International Standards and Technical Specifications numbered in the number range starting at 19101.[2] ISO/TC 211 applies a rigorous, systematic process inclusive of broad professional consultation and involvement in the development and refinement of standards over time.

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collaborate in a consensus process encouraging development and implementation of open standards for geospatial content and services, sensor web and Internet of Things, GIS data processing and data sharing.

U.S. Federal Geographic Data Committee (FGDC). The United States Federal Geographic Data Committee (FGDC) is an organized structure of Federal geospatial professionals and constituents that provide executive, managerial, and advisory direction and oversight for geospatial decisions and initiatives across the U.S. Federal government. The FGDC is chaired by the Secretary of the Interior with the Deputy Director for Management, OMB as Vice-Chair. FGDC has since its inception facilitated the development or adoption of existing geospatial standards and guidelines. This has involved a structured process involving a broad spectrum of stakeholder organizations and individuals.

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The referenced standards are described in extensive documentation that is general accessible online. Those standards that have been deemed to be applicable to the SL-NSDI are not included in their entirety in this document. Rather, an abstract of each standard as provided by the source organization is included along with a summary of how that standard may be applicable to the SL-NSDI programme.

1.4 Significance to SL-NSDI

Not all standards will be equally applicable or of immediate significance to the SL-NSDI. Some will be immediately required (e.g. metadata), others will be developed incrementally through a continuous process over time (e.g. data content) and others are lower-level, highly technical standards that will only be referenced or used to ensure compliance of commercial and open-source systems and services. For the purposes of the SL-NSDI, the first two relevance classes mentioned are of primary importance to the program and are therefore given more attention in this report and reflected in related SL-NSDI reports. Lower level standards are developed and maintained by international organizations who focus on these issues on behalf of the global geospatial community, thus it is suggested that the SL-NSDI program reference, monitor and otherwise take advantage of those developments rather than making direct investment of time and resources. The below matrix is provided to distinguish the various classes of standards in terms of their relevance to the SL-NSDI program.

Table 1 - Standards Significance to SL-NSDI Programme

Standards Author Organization	Section and Title Reference in Document	H*	M	R
ISO	2.1 ISO 31000:2009 Risk Management – Principles and Guidelines		X	
ISO	2.2 ISO/TC211 Glossary of Terms		X	
ISO	2.3 ISO 6709:2008 Standard representation of geographic point location by coordinates.			X
ISO	2.4 ISO 19101:2002 Geographic information -- Reference model – Part 1 Fundamentals			X
ISO	2.5 ISO/TS 19101-2:2008 Geographic information -- Reference model -- Part 2: Imagery			X
ISO	2.6 ISO/TS 19103:2015 Geographic information -- Conceptual schema language			X
ISO	2.7 ISO/TS 19104:2016 Geographic information – Terminology		X	
ISO	2.8 ISO 19105:2000 Geographic information -- Conformance and testing			X
ISO	2.9 ISO 19106:2004 Geographic information -- Profiles			X
ISO	2.10 ISO 19107:2003 Geographic information -- Spatial schema			X
ISO	2.11 ISO 19108:2002 Geographic information -- Temporal schema			X
ISO	2.12 ISO/CD 19109 Geographic information -- Rules for application schema			X
ISO	2.13 ISO 19112:2003 Geographic information -- Spatial referencing by geographic identifiers			X
ISO	2.14 ISO 19113:2002 Geographic information -- Quality principles		X	
ISO	2.15 ISO 19157:2013 Geographic information -- Data quality		X	
ISO	2.16 ISO 19115:2003 Geographic information -- Metadata	X		
ISO	2.17 ISO/DIS 19115-1 Geographic information -- Metadata -- Part 1: Fundamentals	X		
ISO	2.18 ISO 19115-2:2009 Geographic information -- Metadata -- Part 2: Extensions for imagery and gridded data	X		
ISO	2.19 ISO 19116:2004 Geographic information -- Positioning services			X
ISO	2.20 ISO 19118:2011 Geographic information – Encoding			X

ISO	2.21 ISO 19119:2016 Geographic information – Services	X		
ISO	2.22 ISO/TR 19120:2001 Geographic information -- Functional standards.		X	
ISO	2.23 ISO/TR 19121:2000 Geographic information -- Imagery and gridded data		X	
ISO	2.24 ISO/TR 19122:2004 Geographic information/Geomatics -- Qualification and certification of personnel		X	
ISO	2.25 ISO 19123:2005 Geographic information -- Schema for coverage geometry and functions.			X
ISO	2.26 ISO 19125-1:2004 Geographic information -- Simple feature access -- Part 1: Common architecture			X
ISO	2.27 ISO 19125-2:2004 Geographic information -- Simple feature access -- Part 2: SQL option			X
ISO	2.28 ISO 19126:2009 Geographic information -- Feature concept dictionaries and registers			X
ISO	2.29 ISO/TS 19127:2005 Geographic information -- Geodetic codes and parameters			X
ISO	2.30 ISO 19128:2005 Geographic information -- Web map server interface			X
ISO	2.31 ISO/TS 19129:2009 Geographic information -- Imagery, gridded and coverage data framework			X
ISO	2.32 ISO/TS 19130:2010 Geographic information - Imagery sensor models for geopositioning			X
ISO	2.33 ISO/DTS 19130-2 Geographic information -- Imagery sensor models for geopositioning -- Part 2: SAR, InSAR, Lidar and Sonar			X
ISO	2.34 ISO 19131:2007 Geographic information -- Data product specifications			X
ISO	2.35 ISO 19132:2007 Geographic information -- Location-based services -- Reference model			X
ISO	2.36 ISO 19133:2005 Geographic information -- Location-based services -- Tracking and navigation			X
ISO	2.37 ISO 19134:2007 Geographic information -- Location-based services -- Multimodal routing and navigation			X

ISO	2.38 ISO 19135:2005 Geographic information -- Procedures for item registration			X
ISO	2.39 ISO 19136:2007 Geographic information -- Geography Markup Language (GML)		X	
ISO	2.40 ISO 19137:2007 Geographic information -- Core profile of the spatial schema			X
ISO	2.41 ISO/TS 19138:2006 Geographic information -- Data quality measures		X	
ISO	2.42 ISO/TS 19139:2007 Geographic information -- Metadata -- XML schema implementation	X		
ISO	2.43 ISO/DTS 19139-2 Geographic Information -- Metadata -- XML Schema Implementation -- Part 2: Extensions for imagery and gridded data	X		
ISO	2.44 ISO 19141:2008 Geographic information -- Schema for moving features			X
ISO	2.45 ISO 19142:2010 Geographic information -- Web Feature Service		X	
ISO	2.46 ISO 19143:2010 Geographic information -- Filter encoding			X
ISO	2.47 ISO 19144-1:2009 Geographic information -- Classification systems -- Part 1: Classification system structure		X	
ISO	2.48 ISO 19144-2:2012 Geographic information - Classification systems -- Part 2: Land Cover Meta Language (LCML)		X	
ISO	2.49 ISO/DIS 19145 Geographic information -- Registry of representations of geographic point location			X
ISO	2.50 ISO 19146:2010 Geographic information -- Cross-domain vocabularies		X	
ISO	2.51 ISO/CD 19147 Geographic information -- Location based services -- Transfer Nodes			X
ISO	2.52 ISO 19148:2012 Geographic information -- Linear referencing		X	
ISO	2.53 ISO 19149:2011 Geographic information -- Rights expression language for geographic information -- GeoREL			X
ISO	2.54 ISO/PRF TS 19150-1 Geographic information -- Ontology -- Part 1: Framework		X	
ISO	2.55 ISO/CD 19150-2 Geographic information -- Ontology -- Part 2: Rules for developing ontologies in the Web Ontology Language (OWL)		X	

ISO	2.56 ISO/FDIS 19152 Geographic information -- Land Administration Domain Model (LADM)	X		
ISO	2.57 ISO/DIS 19153 Geospatial Digital Rights Management Reference Model (GeoDRM RM)		X	
ISO	2.58 ISO/WD 19154 Geographic information -- Ubiquitous public access -- Reference model		X	
ISO	2.59 ISO 19155:2012 Geographic information -- Place Identifier (PI) architecture			X
ISO	2.60 ISO 19156:2011 Geographic information -- Observations and measurements			X
ISO	2.61 ISO/DIS 19157 Geographic information -- Data quality		X	
ISO	2.62 ISO/TS 19158:2012 Geographic information—Quality assurance of data supply		X	
ISO	2.63 ISO/WD 19160-1 Addressing -- Part 1: Conceptual model	X		
OGC	3.1 OpenGIS® Filter Encoding Implementation Specification, version 1			X
OGC	3.2 OpenGIS® Web Map Context (WMC) Documents Implementation Specification, Version 1.1.0 w/Corrigendum 1			X
OGC	3.3 OpenGIS® Web Processing Service, Version: 1.0.0 w/ Corrigendum			X
OGC	3.4 OpenGIS® Symbology Encoding Implementation Specification, version 1.1.0			X
OGC	3.5 OpenGIS® Styled Layer Descriptor (SLD) Profile of the OpenGIS® Web Map Service (WMS) Encoding Standard			X
OGC	3.6 Augmented Reality Markup Language (ARML 2.0)			X
OGC	3.7 City GML		X	
OGC	3.8 Coordinate Transformation Service			X
OGC	3.9 GeoPackage Encoding Standard			X
OGC	3.10 OGC GeoScience Markup Language (GeoSciML)			X
OGC	3.11 GeoSPARQL – A Geographic Query Language for RDF Data			X
OGC	3.12 Geospatial User Feedback (GUF)		X	
OGC	3.13 OGC IndoorGML			X
OGC	3.14 KML		X	
OGC	3.15 Land and Infrastructure (LandInfra)	X		
OGC	3.16 Location Service (OpenLS)			X

OGC	3.17 Open GeoSMS Standard - Core			X
OGC	3.18 Open Modelling Interface (OpenMI) Interface Standard			X
OGC	3.19 Ordering Services Framework for Earth Observation Products Interface Standard			X
OGC	3.20 OGC Sensor Web Enablement (SWE)			X
OGC	3.21 OGC WaterML	X		
FGDC	4.1 Geospatial Positioning Accuracy Standards, Part 4: Architecture, Engineering, Construction and Facilities Management		X	
FGDC	4.2 Geospatial Positioning Accuracy Standards, Part 5: Standards for Nautical Charting Hydrographic Surveys		X	
FGDC	4.3 Content Standards for Digital Orthoimagery		X	
FGDC	4.4 Utilities Data Content Standard, FGDC-STD-010-2000		X	
INSPIRE	5.1 Data Specification on Addresses – Technical Guidelines		X	
INSPIRE	5.2 Data Specification on Administrative Units – Technical Guidelines		X	
INSPIRE	5.3 Data Specification on Cadastral Parcels – Technical Guidelines		X	
INSPIRE	5.4 Data Specification on Coordinate Reference Systems – Technical Guidelines		X	
INSPIRE	5.5 Data Specification on Geographical Names – Technical Guidelines		X	
INSPIRE	5.6 Data Specification on Hydrography – Technical Guidelines 3.1		X	
INSPIRE	5.7 Data Specification on Protected Sites – Technical Guidelines		X	
INSPIRE	5.8 Data Specification on Transport Networks – Technical Guidelines		X	
Other	6.1 GeoTIFF			X
Other	6.2 Network Common Data Form (NetCDF)			X

*H = High Significance to early stage

M = Moderate Significance

R = Reference Standard. Mostly used by software developers

2 INTERNATIONAL STANDARDS ORGANISATION (ISO) TECHNICAL COMMITTEE 211 (TC 211).

ISO/TC 211 is a standard technical committee formed within ISO, tasked with covering the areas of digital geographic information (such as used by geographic information systems) and geomatics. It is responsible for preparation of a series of International Standards and Technical Specifications numbered in the number range starting at 19101.[3] ISO/TC 211 applies a rigorous, systematic process inclusive of broad professional consultation and involvement in the development and refinement of standards over time. It is therefore recommended that the SL-NSDI adopt and following these standards to the extent that they are relevant to the Sri Lanka context. The following outlines those specific ISO/TC 211 standards that have some relevance to the SL-NSDI, with some explanation of such relevance to the programme. Links to the website locations where each ISO standard can be purchased are provided.

A majority of the text in the following sections has been excerpted or paraphrased from the available ISO resources online.

2.1 ISO 31000:2009 Risk Management – Principles and Guidelines

ISO 31000:2009 provides principles and generic guidelines on risk management. This guide is not specific to any industry or sector and can be used by any public, private or community enterprise, association, group or individual.

This guide can be applied throughout the life of an organization, and to a wide range of activities, including strategies and decisions, operations, processes, functions, projects, products, services and assets. It can also be applied to any type of risk, whatever its nature, whether having positive or negative consequences.

Although ISO 31000:2009 provides generic guidelines, it is not intended to promote uniformity of risk management across organizations. The design and implementation of risk management plans and frameworks will need to take into account the varying needs of a specific organization, its particular objectives, context, structure, operations, processes, functions, projects, products, services, or assets and specific practices employed.

It is intended that ISO 31000:2009 be utilized to harmonize risk management processes in existing and future standards. It provides a common approach in support of standards dealing with specific risks and/or sectors, and does not replace those standards.

ISO 31000:2009 is not intended for the purpose of certification.

[3] https://en.wikipedia.org/wiki/ISO/TC_211_Geographic_information/Geomatics

This guideline provides useful information for the preparation of business continuity and disaster recovery plans, both for individual organizations as well as the SL-NSDI community as a whole.

This standard can be acquired at the following link:
http://www.iso.org/iso/catalogue_detail?csnumber=43170

2.2 ISO/TC211 Glossary of Terms

The ISO/TC 211 Multi-Lingual Glossary of Terms is a compilation of terms developed from International Standards developed by ISO/TC 211. Its purpose is to encourage consistency in the use and interpretation of geospatial terms. Every record in the glossary includes a term, its definitions and a reference to an authoritative source document. Abbreviations, examples and notes are also included where available. Terms and definitions that are under review (due to a revision of an International standard) are clearly identified.

This glossary can provide a useful reference for the SL-NSDI and a basis for the development of an adapted version that contains terminology that is specific to Sri Lanka.

This multi-lingual glossary can be accessed at the following URL:
http://www.isotc211.org/Terminology.htm

2.3 ISO 6709:2008 Standard representation of geographic point location by coordinates.

This International Standard is applicable to the interchange of coordinates describing geographic point location. It specifies the representation of coordinates, including latitude and longitude, to be used in data interchange. It additionally specifies representation of horizontal point location using coordinate types other than latitude and longitude. It also specifies the representation of height and depth that may be associated with horizontal coordinates. Representation includes units of measure and coordinate order.

This International Standard is not applicable to the representation of information held within computer memories during processing and in their use in registers of geodetic codes and parameters.

This International Standard supports point location representation through the eXtensible Markup Language (XML) and, recognizing the need for compatibility with the previous version of this International Standard, ISO 6709:1983, allows for the use of a single alpha-numeric string to describe point locations.

For computer data interchange of latitude and longitude, this International Standard generally suggests that decimal degrees be used. It allows the use of sexagesimal notations: degrees, minutes and decimal minutes or degrees, minutes, seconds and decimal seconds. This International Standard does not require special internal procedures, file-organization techniques, storage medium, languages, etc., to be used in its implementation.

This standard is useful as a general technical reference for software and data developers who are involved with the SL-NSDI.

This standard can be acquired at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=39242

2.4 ISO 19101:2002 Geographic information -- Reference model – Part 1 Fundamentals

This part of ISO 19101 defines the reference model for standardization in the field of geographic information. This reference model describes the notion of interoperability and sets forth the fundamentals by which this standardization takes place. It provides a guide to structuring geographic information standards in a way that it will enable the universal usage of digital geographic information. It sets out the fundamentals for standardization in geographic information including description, management, and services, and how they are interrelated to support interoperability within the geographic information realm and beyond to ensure interoperability with other information communities. As such, this part of ISO 19101 develops a vision for the standardization in geographic information from which it would be possible to integrate geographic information with other types of information and conversely. Although structured in the context of information technology and information technology standards, this part of ISO 19101 is independent of any application development method or technology implementation approach.

This standard will provide a basis for developers inside and outside of the SL-NSDI community to incorporate geographic interoperability into their data and applications, thus extending the value and impact of geospatial referencing across the Country.

This standard can be acquired at the following link: https://www.iso.org/obp/ui/#iso:std:iso:19101:-1:ed-1:v1:en

2.5 ISO/TS 19101-2:2008 Geographic information -- Reference model -- Part 2: Imagery

This standard defines a reference model for standardization in the field of geographic imagery processing. This reference model identifies the scope of the standardization activity being undertaken and the context in which it takes place. The reference model includes gridded data with an emphasis on imagery. Although structured in the context of information technology and information technology standards, ISO/TS 19101-2:2008 is independent of any application development method or technology implementation approach.

This standard will provide a basis for developers inside and outside of the SL-NSDI community to incorporate geospatial imagery and gridded data into their data and applications, thus extending the value and impact of geospatial referencing across the Country.

This standard can be acquired at the following link:

http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=39983

2.6 ISO/TS 19103:2015 Geographic information -- Conceptual schema language

ISO 19103:2015 provides rules and guidelines for the use of a conceptual schema language within the context of geographic information. This standard is concerned with the adoption and use of a conceptual schema language (CSL) for developing computer interpretable models, or schemas, of geographic information. Standardization of geographic information requires the use of a formal CSL to specify unambiguous schemas that can serve as a basis for data interchange and the definition of interoperable services. An important goal of the ISO geographic information suite of standards is to create a framework in which data interchange and service interoperability can be realized across multiple implementation environments. The adoption and consistent use of a CSL to specify geographic information is of fundamental importance in achieving this goal. The chosen conceptual schema language is the Unified Modeling Language (UML).

This standard provides a basis for developers inside and outside of the SL-NSDI community to develop commonly structured computer interpretable schemas, thus increasing compatibility and interoperability of data and applications services.

This standard can be acquired at the following link:
http://www.iso.org/iso/home/store/catalogue_ics/catalogue_detail_ics.htm?csnumber=56734

2.7 ISO/TS 19104:2016 Geographic information – Terminology

ISO TS 19104:2016 provides the guidelines for collection and maintenance of terminology in the field of geographic information. The standard specifies requirements for the collection, management and publication of terminology in the field of geographic information. The scope of this document includes:

- selection of concepts, harmonization of concepts and development of concept systems,
- structure and content of terminological entries,
- term selection,
- definition preparation,
- cultural and linguistic adaptation,
- layout and formatting requirements in rendered documents, and
- establishment and management of terminology registers.

This standard provides the SL-NSDI community with a framework for developing and maintaining a common lexicon of relevant terminology. This will help to streamline and clarify communications across the community by introducing a common language of terms that are understood by all. The registry for this lexicon would most logically be maintained by the entity responsible for coordinating the overall SL-NSDI initiative.

This standard can be acquired at the following link:
http://www.iso.org/iso/home/store/catalogue_ics/catalogue_detail_ics.htm?csnumber=63541

2.8 ISO 19105:2000 Geographic information -- Conformance and testing

This International Standard specifies the framework, concepts and methodology for testing and criteria to be achieved to claim conformance to the family of ISO geographic information standards. It provides a framework for specifying abstract test suites (ATS) and for defining the procedures to be followed during conformance testing. Conformance may be claimed for data or software products or services or by specifications including any profile or functional standard.

Standardization of test methods and criteria for conformance to geographic information standards will allow verification of conformance to those standards. Verifiable conformance is important to geographic information users, in order to achieve data transfer and sharing. This International Standard is applicable to all the phases of conformance and testing. These phases are characterized by the following major activities:

- the definition of ATS for conformance to the ISO geographic information standards;
- the definition of test methods for conformance to the ISO geographic information standards;
- the conformance assessment process carried out by a testing laboratory for a client, culminating in the production of a conformance test report.

This International Standard specifies the requirements for, and gives guidance on, the procedures to be followed in conformance testing for the ISO geographic information standards. It includes only such information as is necessary to meet the following objectives:

- to achieve confidence in the tests as a measure of conformance;
- to achieve comparability between the results of corresponding tests applied in different places at different times;
- to facilitate communication between the parties responsible for the activities described in 1) and 2).

This standard provides the SL-NSDI community with a framework for confirming conformance with interoperability standards. This will help to reinforce and support common interoperability across the community.

This standard can be acquired at the following link:
https://www.iso.org/obp/ui/#iso:std:26010:en

2.9 ISO 19106:2004 Geographic information -- Profiles

ISO 19106:2004 is intended to define the concept of a profile of the ISO geographic information standards developed by ISO/TC 211 and to provide guidance for the creation of such profiles. Only those components of specifications that meet the definition of a profile contained herein can be established and managed through the mechanisms described in this International Standard. These profiles can be standardized internationally using the ISO standardization process. This document also provides guidance for establishing, managing, and standardizing at the national level.

An ISO geographic information profile is a subset of one or several of the ISO geographic information standards. For example, there may be a profile from ISO 19115 developed to serve a particular application area such as cadastral mapping. The profile would consist of a choice of the metadata elements available in ISO 19115. ISO 19115 would serve as a base standard for the development of the profile. An example for a base standard only introducing a methodology is given by ISO 19110. It contains methods for creating feature and attribute definitions. A profile of ISO 19110 would not contain instances of feature definitions, since there are no instances in the base standard from which to choose. A profile of ISO 19110 would contain only a subset of the rules and methods found in that standard.

This standard provides the SL-NSDI community with a common framework for defining and documenting standards profiles. This will help to establish a common approach to the development or refinement of custom standards across the community.

This standard can be acquired at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19106:ed-1:v1:en

2.10 ISO 19107:2003 Geographic information -- Spatial schema

ISO 19107:2003 specifies conceptual schemas for describing the spatial characteristics of geographic features, and a set of spatial operations consistent with these schemas. It treats vector geometry and topology up to three dimensions. It defines standard spatial operations for use in access, query, management, processing, and data exchange of geographic information for spatial (geometric and topological) objects of up to three topological dimensions embedded in coordinate spaces of up to three axes.

Standardized conceptual schemas for spatial characteristics will increase the ability of the SL-NSDI community to share geographic information among applications. These schemas will be used by geographic information system and software developers and users of geographic information to provide consistently understandable spatial data structures.

This standard can be acquired at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19107:ed-1:v1:en

2.11 ISO 19108:2002 Geographic information -- Temporal schema

This standard defines concepts for describing temporal characteristics of geographic information. It depends upon existing information technology standards for the interchange of temporal information. It provides a basis for defining temporal feature attributes, feature operations, and feature associations, and for defining the temporal aspects of metadata about geographic information. Since this International Standard is concerned with the temporal characteristics of geographic information as they are abstracted from the real world, it emphasizes valid time rather than transaction time.

Historically, temporal characteristics of features have been treated as thematic feature attributes. For example, a feature "Building" may have an attribute "date of construction". However, there is increasing interest in describing the behaviour of features as a function of time. This can be supported to a limited extent when time is treated independently of space. For example, the path followed by a moving object can be represented as a set of features called "way point", each of which is represented as a point and has an attribute that provides the time at which the object was at that spatial position. Behaviour in time may be described more easily if the temporal dimension is combined with the spatial dimensions, so that a feature can be represented as a spatiotemporal object. For example, the path of a moving object could be represented as a curve described by coordinates in x, y and t. This International Standard has been prepared in order to standardize the use of time in feature attributes. Although it does not describe feature geometry in terms of a combination of spatial and temporal coordinates, it has been written to establish a basis for doing so in a future standard within the ISO 19100 series.

This standard provides a common way to express the temporal dimension of data. This will provide developers with the basic formats required to add the spatio-temporal dimension to data in a form that is compatible with other SL-NSDI data and application services.

This standard can be acquired at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19108:ed-1:v1:en

2.12 ISO/CD 19109 Geographic information -- Rules for application schema

ISO 19109:2015 defines rules for creating and documenting application schemas, including principles for the definition of features. The widespread application of computers and geographic information systems (GIS) has led to an increased use of geographic data within multiple disciplines. With current technology as an enabler, society's reliance on such data is growing. Geographic datasets are increasingly being shared and exchanged. They are also used for purposes other than those for which they were produced.

To ensure that data will be understood by both computer systems and users, the data structures for data access and exchange must be fully documented. The interfaces between systems, therefore, need to be defined with respect to data and operations, using the methods standardized in this Standard. For the construction of internal software and data storage within proprietary systems, any method may be used that enables the standardized interfaces to be supported.

An application schema provides the formal description of the data structure and content required by one or more applications. An application schema contains the descriptions of both geographic data and other related data. A fundamental concept of geographic data is the feature.

The scope of this Standard includes the following:

- conceptual modelling of features and their properties from a universe of discourse;
- definition of application schemas;
- use of the conceptual schema language for application schemas;

- transition from the concepts in the conceptual model to the data types in the application schema;
- integration of standardized schemas from other ISO geographic information standards with the application schema.

This standard provides the SL-NSDI community with a basis for establishing a common formal description of the data structure and content required by one or more applications, thus supporting consistency and interoperability across the community. An application schema contains the descriptions of both geographic data and other related data.

This standard can be acquired at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19109:ed-2:v1:en

2.13 ISO 19112:2003 Geographic information -- Spatial referencing by geographic identifiers

ISO 19112:2003 defines the conceptual schema for spatial references based on geographic identifiers. It establishes a general model for spatial referencing using geographic identifiers, defines the components of a spatial reference system and defines the essential components of a gazetteer. Spatial referencing by coordinates is not addressed in this document; however, a mechanism for recording complementary coordinate references is included.

ISO 19112:2003 assists users in understanding the spatial references used in datasets. It enables gazetteers to be constructed in a consistent manner and supports the development of other standards in the field of geographic information. It is applicable to digital geographic data, and its principles may be extended to other forms of geographic data such as maps, charts and textual documents.

This standard provides the SL-NSDI community with a basis for establishing gazetteer and point of interest identifiers as a basis for identify explicit geographic locations.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=26017

2.14 ISO 19113:2002 Geographic information -- Quality principles

ISO 19113:2002 establishes the principles for describing the quality of geographic data and specifies components for reporting quality information. It also provides an approach to organizing information about data quality.

ISO 19113:2002 is applicable to data producers providing quality information to describe and assess how well a dataset meets its mapping of the universe of discourse as specified in the product specification, formal or implied, and to data users attempting to determine whether or not specific geographic data is of sufficient quality for their particular application. This International Standard should be considered by organizations involved in data acquisition and purchase, in such a way that

it makes it possible to fulfil the intentions of the product specification. It can additionally be used for defining application schemas and describing quality requirements.

As well as being applicable to digital geographic data, the principles of ISO 19113:2002 can be extended to identify, collect and report the quality information for a geographic dataset, its principles can be extended and used to identify, collect and report quality information for a dataset series or smaller groupings of data that are a subset of a dataset.

Although ISO 19113:2002 is applicable to digital geographic data, its principles can be extended to many other forms of geographic data such as maps, charts and textual documents.

ISO 19113:2002 does not attempt to define a minimum acceptable level of quality for geographic data.

This standard provides the SL-NSDI community with a basis for defining and assessing data quality characteristics and standards..

This standard can be acquired at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=26018

2.15 ISO 19157:2013 Geographic information -- Data quality

ISO 19157:2013 establishes the principles for describing the quality of geographic data. It

- defines components for describing data quality;
- specifies components and content structure of a register for data quality measures;
- describes general procedures for evaluating the quality of geographic data;
- establishes principles for reporting data quality.

ISO 19157:2013 also defines a set of data quality measures for use in evaluating and reporting data quality. It is applicable to data producers providing quality information to describe and assess how well a data set conforms to its product specification and to data users attempting to determine whether or not specific geographic data are of sufficient quality for their particular application.

ISO 19157:2013 does not attempt to define minimum acceptable levels of quality for geographic data.

This standard provides the SL-NSDI community with a basis for defining data quality assurance criteria and procedures.

This standard can be acquired at the following link:
http://www.iso.org/iso/home/store/catalogue_ics/catalogue_detail_ics.htm?csnumber=32575

2.16 ISO 19115:2003 Geographic information -- Metadata

ISO 19115:2003 defines the schema required for describing geographic information and services. It provides information about the identification, the extent, the quality, the spatial and temporal schema, spatial reference, and distribution of digital geographic data.

ISO 19115:2003 is applicable to:

- the cataloguing of datasets, clearinghouse activities, and the full description of datasets;
- geographic datasets, dataset series, and individual geographic features and feature properties.

ISO 19115:2003 defines:

- mandatory and conditional metadata sections, metadata entities, and metadata elements;
- the minimum set of metadata required to serve the full range of metadata applications (data discovery, determining data fitness for use, data access, data transfer, and use of digital data);
- optional metadata elements - to allow for a more extensive standard description of geographic data, if required;
- a method for extending metadata to fit specialized needs.

Though ISO 19115:2003 is applicable to digital data, its principles can be extended to many other forms of geographic data such as maps, charts, and textual documents as well as non-geographic data.

NOTE Certain mandatory metadata elements may not apply to these other forms of data.

This standard is to be adopted as the official metadata catalog standard for the SL-NSDI community. This standard data catalog will be a fundamental cornerstone of the SL-NSDI programme.

This standard can be acquired at the following link:
http://www.iso.org/iso/catalogue_detail?csnumber=26020

2.17 ISO/DIS 19115-1 Geographic information -- Metadata -- Part 1: Fundamentals

ISO 19115-1:2014 defines the schema required for describing geographic information and services by means of metadata. It provides information about the identification, the extent, the quality, the spatial and temporal aspects, the content, the spatial reference, the portrayal, distribution, and other properties of digital geographic data and services.

ISO 19115-1:2014 is applicable to:

- the cataloguing of all types of resources, clearinghouse activities, and the full description of datasets and services;
- geographic services, geographic datasets, dataset series, and individual geographic features and feature properties.

ISO 19115-1:2014 defines:

- mandatory and conditional metadata sections, metadata entities, and metadata elements;

- the minimum set of metadata required to serve most metadata applications (data discovery, determining data fitness for use, data access, data transfer, and use of digital data and services);
- optional metadata elements to allow for a more extensive standard description of resources, if required;
- a method for extending metadata to fit specialized needs.

Though ISO 19115-1:2014 is applicable to digital data and services, its principles can be extended to many other types of resources such as maps, charts, and textual documents as well as non-geographic data. Certain conditional metadata elements might not apply to these other forms of data.

This standard is to be adopted as the official metadata catalog standard for the SL-NSDI community, as one part of ISO 19115.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_ics/catalogue_detail_ics.htm?csnumber=53798

2.18 ISO 19115-2:2009 Geographic information -- Metadata -- Part 2: Extensions for imagery and gridded data

ISO 19115-2:2009 extends the existing geographic metadata standard by defining the schema required for describing imagery and gridded data. It provides information about the properties of the measuring equipment used to acquire the data, the geometry of the measuring process employed by the equipment, and the production process used to digitize the raw data. This extension deals with metadata needed to describe the derivation of geographic information from raw data, including the properties of the measuring system, and the numerical methods and computational procedures used in the derivation. The metadata required to address coverage data in general is addressed sufficiently in the general part of ISO 19115.

This standard is to be adopted as the official metadata catalog standard for the SL-NSDI community, as one part of ISO 19115.

This standard can be acquired at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=39229

2.19 ISO 19116:2004 Geographic information -- Positioning services

ISO 19116:2004 specifies the data structure and content of an interface that permits communication between position-providing device(s) and position-using device(s) so that the position-using device(s) can obtain and unambiguously interpret position information and determine whether the results meet the requirements of the use. A standardized interface of geographic information with position allows the integration of positional information from a variety of positioning technologies into a variety of geographic information applications, such as surveying, navigation and intelligent transportation systems. ISO 19116:2004 will benefit a wide range of applications for which positional information is important.

This standard will support location based service delivery and other important non-traditional uses of location information from mobile devices and applications related to the SL-NSDI.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=37805

2.20 ISO 19118:2011 Geographic information – Encoding

ISO 19118:2011 specifies the requirements for defining encoding rules for use for the interchange of data that conform to the geographic information in the set of International Standards known as the "ISO 19100 series".

ISO 19118:2011 specifies requirements for creating encoding rules based on UML schemas, requirements for creating encoding services, and requirements for XML-based encoding rules for neutral interchange of data.

ISO 19118:2011 does not specify any digital media, does not define any transfer services or transfer protocols, nor does it specify how to encode inline large images.

This standard supports the development of interoperability in data exchange between different formats. This is a low level technical standard that will be useful for SL-NSDI software developers as a reference.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=44212

2.21 ISO 19119:2016 Geographic information – Services

ISO 19119:2016 defines requirements for how platform neutral and platform specific specification of services shall be created, in order to allow for one service to be specified independently of one or more underlying distributed computing platforms.

ISO 19119:2016 defines requirements for a further mapping from platform neutral to platform specific service specifications, in order to enable conformant and interoperable service implementations.

ISO 19119:2016 addresses the Meta:Service foundation of the ISO geographic information reference model described in ISO 19101- 1:2014, Clause 6 and Clause 8, respectively.

ISO 19119:2016 defines how geographic services shall be categorised according to a service taxonomy based on architectural areas and allows also for services to be categorised according to a usage life cycle perspective, as well as according to domain specific and user defined service taxonomies, providing support for easier publication and discovery of services.

This standard provides a basis for standardizing the categorization and discovery of application services. This is a low level technical standard that will be useful for SL-NSDI software developers as a reference.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=59221

2.22 ISO/TR 19120:2001 Geographic information -- Functional standards.

This Technical Report seeks to identify the components of those recognized functional standards and to identify elements that can be harmonized between these standards and with the ISO/TC 211 base standards. This Technical Report provides a starting point for a feedback cycle between the functional standards communities and the ISO 19100 series component project teams.

This Technical Report provides the SL-NSDI community with a framework for understanding relationships between existing functional standards that are in use today and the base standards of the ISO/TC 211 framework. This is a low level technical standard that will be useful for SL-NSDI software developers as a reference.

This Technical Report can be acquired at the following link:
https://www.iso.org/obp/ui/#iso:std:28928:en

2.23 ISO/TR 19121:2000 Geographic information -- Imagery and gridded data

This Technical Report reviews the manner in which raster and gridded data is currently being handled in the Geomatics community in order to propose how this type of data should be supported by geographic information standards.

This Technical Report identifies those aspects of imagery and gridded data that have been standardized or are being standardized in other ISO committees and external standards organizations, and that influence or support the establishment of raster and gridded data standards for geographic information. It also describes the components of those identified ISO and external imagery and gridded data standards that can be harmonized with the ISO 19100 series of geographic information/geomatics standards.

A plan is presented for ISO/TC 211 to address imagery and gridded data in an integrated manner, within the ISO 19100 series of geographic information standards.

This Technical Report provides the SL-NSDI community with insights into how the international community is standardizing imagery and gridded data.

This Technical Report can be acquired at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:tr:19121:ed-1:v1:en

2.24 ISO/TR 19122:2004 Geographic information/Geomatics -- Qualification and certification of personnel

ISO/TR 19122:2004 is applicable to the following aspects of the field of Geographic Information/Geomatics:

- To develop a Type 3 report, which describes a system for the qualification and certification, by a central independent body, of personnel in the field of Geographic Information/Geomatics.
- To define the boundaries between Geographic Information/ Geomatics and other related disciplines and professions.
- To specify technologies and tasks pertaining to Geographic Information/Geomatics.
- To establish skill sets and competency levels for technologists, professional staff and management in the field.
- To research the relationship between this initiative and other similar certification processes performed by existing professional associations.
- To develop a plan for the accreditation of candidate institutions and programs, for the certification of individuals in the workforce, and for collaboration with other professional bodies.

This Technical Report provides the SL-NSDI community with a system for the qualification and certification of geo-professional staff.

This Technical Report provides the SL-NSDI community with insights into how the international community is standardizing imagery and gridded data.

This Technical Report can be acquired at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:tr:19121:ed-1:v1:en

2.25 ISO 19123:2005 Geographic information -- Schema for coverage geometry and functions.

ISO 19123:2005 defines a conceptual schema for the spatial characteristics of coverages. Coverages support mapping from a spatial, temporal or spatiotemporal domain to feature attribute values where feature attribute types are common to all geographic positions within the domain. A coverage domain consists of a collection of direct positions in a coordinate space that may be defined in terms of up to three spatial dimensions as well as a temporal dimension. Examples of coverages include rasters, triangulated irregular networks, point coverages and polygon coverages. Coverages are the prevailing data structures in a number of application areas, such as remote sensing, meteorology and mapping of bathymetry, elevation, soil and vegetation.

ISO 19123:2005 defines the relationship between the domain of a coverage and an associated attribute range. The characteristics of the spatial domain are defined whereas the characteristics of the attribute range are not part of ISO 19123:2005.

This standard is a useful reference for technical members of the SL-NSDI community to understand the nature and structure of coverages.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=40121

2.26 ISO 19125-1:2004 Geographic information -- Simple feature access -- Part 1: Common architecture

ISO 19125-1:2004 establishes a common architecture for geographic information and defines terms to use within the architecture. It also standardizes names and geometric definitions for Types for Geometry.

ISO 19125-1:2004 does not place any requirements on how to define the Geometry Types in the internal schema nor does it place any requirements on when or how or who defines the Geometry Types. ISO 19125-1:2004 does not attempt to standardize and does not depend upon any part of the mechanism by which Types are added and maintained.

This standard is a useful reference for technical members of the SL-NSDI community to develop a common understanding of geospatial architectural names and definitions.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=40114

2.27 ISO 19125-2:2004 Geographic information -- Simple feature access -- Part 2: SQL option

This part of ISO 19125:2004 specifies an SQL schema that supports storage, retrieval, query and update of simple geospatial feature collections via the SQL Call Level Interface (SQL/CLI) and establishes an architecture for the implementation of feature tables.

This part of ISO 19125:2004 defines terms to use within the architecture. of geographic information and defines a simple feature profile of ISO 19107. In addition, this part of ISO 19125:2004 describes a set of SQL Geometry Types together with SQL functions on those types. The Geometry Types and Functions described represent a profile of ISO 13249-3.

This part of ISO 19125:2004 standardizes the names and geometric definitions of the SQL Types for Geometry and the names, signatures and geometric definitions of the SQL Functions for Geometry.

This part of ISO 19125:2004 does not attempt to standardize and does not depend upon any part of the mechanism by which Types are added and maintained in the SQL environment, including the following:

- the syntax and functionality provided for defining types;
- the syntax and functionality provided for defining SQL functions;

- the physical storage of type instances in the database;
- specific terminology used to refer to User Defined Types, for example, UDT.

This standard is a useful reference for technical members of the SL-NSDI community to develop a common understanding of SQL/CLI.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=40115

2.28 ISO 19126:2009 Geographic information -- Feature concept dictionaries and registers

ISO 19126:2009 specifies a schema for feature concept dictionaries to be established and managed as registers. It does not specify schemas for feature catalogues or for the management of feature catalogues as registers. However, because feature catalogue are often derived from feature concept dictionaries, ISO 19126:2009 does specify a schema for a hierarchical register of feature concept dictionaries and feature catalogues. These registers are in accordance with ISO 19135.

This standard is a useful reference for technical members of the SL-NSDI community to develop a common schema for feature concept dictionaries to be established and managed as registers.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=44075

2.29 ISO/TS 19127:2005 Geographic information -- Geodetic codes and parameters

ISO TS 19127:2005 defines rules for the population and maintenance of registers of geodetic codes and parameters and identifies the data elements, in compliance with ISO 19135 and ISO 19111, required within these registers. Recommendations for the use of the registers, the legal aspects, the applicability to historic data, the completeness of the registers, and a mechanism for maintenance are specified by the registers themselves.

This provides a standard for the development and maintenance of a register of geodetic codes, parameters and data elements in Sri Lanka.

This standard can be acquired at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=41784

2.30 ISO 19128:2005 Geographic information -- Web map server interface

ISO 19128:2005 specifies the behaviour of a service that produces spatially referenced maps dynamically from geographic information. It specifies operations to retrieve a description of the maps offered by a server, to retrieve a map, and to query a server about features displayed on a map. ISO

19128:2005 is applicable to pictorial renderings of maps in a graphical format; it is not applicable to retrieval of actual feature data or coverage data values.

This standard is useful as a technical reference for web map server interface functionality.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=32546

2.31 ISO/TS 19129:2009 Geographic information -- Imagery, gridded and coverage data framework

ISO/TS 19129:2009 defines the framework for imagery, gridded and coverage data. This framework defines a content model for the content type imagery and for other specific content types that can be represented as coverage data. These content models are represented as a set of generic UML patterns for application schemas.

This Technical Specification recognizes that there are many overlapping imagery and gridded data specifications in wide use that differ significantly in how the information content is structured for encoding and in what choices of information form the content model. Different types of encoding may be appropriate in different situations. However, differences in content are difficult to reconcile. The existing different encoding standards do not necessarily conflict because they represent different ways of providing the same information in different contexts. Differences in content are also permitted for different situations, but the content definition must be the same in similar situations for interchange to be achieved without loss of information.

Most of the existing specifications for imagery and gridded data used in industry specify how content is to be expressed, rather than the content itself. They relate content to encoding, encapsulation and transfer of data. Those content descriptions that do appear to vary from one specification to another may not be in conflict or incompatible but reflect different real world situations that require different treatments.

This Technical Specification combines a number of well-defined content structures in accordance with ISO 19123, the International Standard for coverage geometry and functions together with metadata, spatial referencing and other aspects of imagery, gridded and coverage data into a framework. This will foster a convergence at the content model level for existing imagery, gridded and coverage data while allowing for backward compatibility with the identified suite of existing standards.

This standard is useful as a technical reference for imagery and coverage content models in use by the SL-NSDI stakeholder community.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=43041

2.32 ISO/TS 19130:2010 Geographic information - Imagery sensor models for geopositioning

ISO/TS 19130:2010 identifies the information required to determine the relationship between the position of a remotely sensed pixel in image coordinates and its geoposition. It supports exploitation of remotely sensed images. It defines the metadata to be distributed with the image to enable user determination of geographic position from the observations.

ISO/TS 19130:2010 specifies several ways in which information in support of geopositioning may be provided.

1. It may be provided as a sensor description with the associated physical and geometric information necessary to rigorously construct a Physical Sensor Model. For the case where precise geoposition information is needed, ISO/TS 19130:2010 identifies the mathematical formulae for rigorously constructing Physical Sensor Models that relate two-dimensional image space to three-dimensional ground space and the calculation of the associated propagated errors. ISO/TS 19130:2010 provides detailed information for three types of passive electro-optical/infrared (IR) sensors (frame, pushbroom and whiskbroom) and for an active microwave sensing system [Synthetic Aperture Radar (SAR)]. It provides a framework by which these sensor models can be extended to other sensor types.

2. It may be provided as a True Replacement Model, using functions whose coefficients are based on a Physical Sensor Model so that they provide information for precise geopositioning, including the calculation of errors, as precisely as the Physical Sensor Model they replace.

3. It may be provided as a Correspondence Model that provides a functional fitting based on observed relationships between the geopositions of a set of ground control points and their image coordinates.

4. It may be provided as a set of ground control points that can be used to develop a Correspondence Model or to refine a Physical Sensor Model or True Replacement Model.

ISO/TS 19130:2010 does not specify either how users derive geoposition data or the format or content of the data the users generate.

This standard is useful as a technical reference for documenting or interpreting the imagery geopositioning models that will be in use by the SL-NSDI stakeholder community.

This standard can be acquired at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=51789

2.33 ISO/DTS 19130-2 Geographic information -- Imagery sensor models for geopositioning -- Part 2: SAR, InSAR, Lidar and Sonar

ISO/TS 19130-2:2014 supports exploitation of remotely sensed images. It specifies the sensor models and metadata for geopositioning images remotely sensed by Synthetic Aperture Radar (SAR), Interferometric Synthetic Aperture Radar (InSAR), LIght Detection And Ranging (lidar), and SOund Navigation And Ranging (sonar) sensors. The specification also defines the metadata needed for the aerial triangulation of airborne and spaceborne images.

ISO/TS 19130-2:2014 specifies the detailed information that shall be provided for a sensor description of SAR, InSAR, lidar, and sonar sensors with the associated physical and geometric information necessary to rigorously construct a physical sensor model. For the case where precise geoposition information is needed, this Technical Specification identifies the mathematical formulae for rigorously constructing physical sensor models that relate two-dimensional image space to three-dimensional ground space and the calculation of the associated propagated error.

ISO/TS 19130-2:2014 does not specify either how users derive geoposition data or the format or content of the data the users generate.

This standard is useful as a technical reference for documenting or interpreting sensor models and metadata for geopositioning images remotely sensed by Synthetic Aperture Radar (SAR), Interferometric Synthetic Aperture Radar (InSAR), LIght Detection And Ranging (lidar), and SOund Navigation And Ranging (sonar) sensors.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_ics/catalogue_detail_ics.htm?ics1=35&ics%202=%20240&ics3=70&csnumber=56113

2.34 ISO 19131:2007 Geographic information -- Data product specifications

ISO 19131:2007 specifies requirements for the specification of geographic data products, based upon the concepts of other ISO 19100 International Standards. It also provides help in the creation of data product specifications, so that they are easily understood and fit for their intended purpose.

A data product specification is a detailed description of a dataset or dataset series together with additional information that will enable it to be created, supplied to and used by another party. It is a precise technical description of the data product in terms of the requirements that it will or may fulfil. However, the data product specification only defines how the dataset should be. For various reasons, compromises may need to be made in the implementation. The metadata associated with the product dataset should reflect how the product dataset actually is.

A data product specification may be created and used on different occasions, by different parties and for different reasons. It may, for example, be used for the original process of collecting data as well as for products derived from already existing data. It may be created by producers to specify their product or by users to state their requirements.

The purpose of this International Standard is to provide practical help in the creation of data product specifications, in conformance with other existing standards for geographic information. An aim is to produce a complete list of the items used to specify a data product.

This International Standard makes references to parts of existing standards. Some of the items used to specify the data in a data product can also be used as metadata for a resulting dataset with the same data product.

It is not necessary for a data product specification to specify the production process, but only the resulting data product. Nevertheless, it may include production and maintenance aspects if judged necessary to describe the data product.

This International Standard describes the content and structure of a data product specification. An example of a data product specification is presented in Annex F.

When an item for a data product specification is already defined in another standard of the ISO 19100 series, a reference to that document is explicitly made.

This International Standard can be used by producers, providers and potential users of data products within the SL-NSDI community.

This standard can be acquired at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19131:ed-1:v1:en

2.35 ISO 19132:2007 Geographic information -- Location-based services -- Reference model

ISO 19132:2007 defines a reference model and a conceptual framework for location-based services (LBS), and describes the basic principles by which LBS applications may interoperate. This framework references or contains an ontology, a taxonomy, a set of design patterns and a core set of LBS service abstract specifications in UML. ISO 19132:2007 further specifies the framework's relationship to other frameworks, applications and services for geographic information and to client applications.

ISO 19132:2007 addresses, for an LBS system, the first three basic viewpoints as defined in the Reference Model for Open Distributed Processing (RM-ODP, see ISO/IEC 10746-1). These viewpoints are the Enterprise Viewpoint – detailing the purpose, scope, and policies of the system; Information Viewpoint – detailing the semantics of information and processing within the system; Computational Viewpoint – detailing the functional decomposition of the system.

The fourth and fifth viewpoints are addressed only in requirements or examples. These are the Engineering Viewpoint – detailing the infrastructure for distribution; Technology Viewpoint – detailing the technology for implementation;

Reference models and frameworks can be defined at a variety of levels, from conceptual design to software documentation. ISO 19132:2007 defines the conceptual framework for and the type of applications included within LBS, establishes general principles for LBS for both mobile and fixed clients, specifies the interface for data access while roaming, defines the architectural relationship with other ISO geographic information standards, and identifies areas in which further standards for LBS are required.

ISO 19132:2007 does not address rules by which LBS are developed, nor general principles for roaming agreements for mobile clients and tracking targets.

This Standard can be used by location based service (LBS) developers within the SL-NSDI community to define and document services.

This standard can be acquired at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=40601

2.36 ISO 19133:2005 Geographic information -- Location-based services -- Tracking and navigation

ISO 19133:2005 describes the data types, and operations associated with those types, for the implementation of tracking and navigation services. It is designed to specify web services that can be made available to wireless devices through web-resident proxy applications, but is not restricted to that environment.

This Standard can be used by location based service (LBS) developers within the SL-NSDI community to define and document tracking and navigation services.

This standard can be acquired at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19133:ed-1:v1:en

2.37 ISO 19134:2007 Geographic information -- Location-based services -- Multimodal routing and navigation

ISO 19134:2006 specifies the data types and their associated operations for the implementation of multimodal location-based services for routing and navigation. It is designed to specify web services that may be made available to wireless devices through web-resident proxy applications, but is not limited to that environment.

This Standard can be used by location based service (LBS) developers within the SL-NSDI community to define and document multimodal routing and navigation services.

This standard can be acquired at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=32552

2.38 ISO 19135:2005 Geographic information -- Procedures for item registration

ISO 19135:2005 specifies procedures to be followed in establishing, maintaining and publishing registers of unique, unambiguous and permanent identifiers, and meanings that are assigned to items of geographic information. In order to accomplish this purpose, ISO 19135:2005 specifies elements of information that are necessary to provide identification and meaning to the registered items and to manage the registration of these items.

This Standard can be used by the SL-NSDI community to define and document fundamental registries that have a geographic dimension or that can relate to a geographic location. This will need to be aligned and integrated with the eGovernment registries.

This standard can be acquired at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=32553

ISO/TS 19135-2:2012 Geographic information - Procedures for item registration -- Part 2: XML schema implementation

This Technical Specification defines Geographic ReGister XML (grg) encoding, an XML schema implementation derived from ISO 19135. The ISO 19135 series standardizes the procedures for the registration of geographic items. Since it does not provide any encoding for the storage and exchange of registers and register items, implementations may vary based on the interpretation of the base standard.

This Technical Specification defines an XML encoding for the storage and exchange of ISO 19135-compliant registers and register items. This encoding conforms to the rules described in ISO/TS 19139.

The encoding defined in this Technical Specification is intended to be extended to specific registers, e.g. ISO 191451) for registers of representations of geographic point location.

This Specification can be used by the SL-NSDI community to structure geographic register encoding. This will need to be aligned and integrated with the eGovernment registries.

This standard can be acquired at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:ts:19135:-2:ed-1:v1:en

2.39 ISO 19136:2007 Geographic information -- Geography Markup Language (GML)

The Geography Markup Language (GML) is an XML encoding in compliance with ISO 19118 for the transport and storage of geographic information modelled in accordance with the conceptual modelling framework used in the ISO 19100 series of International Standards and including both the spatial and non-spatial properties of geographic features.

ISO 19136:2007 defines the XML Schema syntax, mechanisms and conventions that:

- provide an open, vendor-neutral framework for the description of geospatial application schemas for the transport and storage of geographic information in XML;
- allow profiles that support proper subsets of GML framework descriptive capabilities;
- support the description of geospatial application schemas for specialized domains and information communities;
- enable the creation and maintenance of linked geographic application schemas and datasets;
- support the storage and transport of application schemas and data sets;
- increase the ability of organizations to share geographic application schemas and the information they describe.

Implementers may decide to store geographic application schemas and information in GML, or they may decide to convert from some other storage format on demand and use GML only for schema and data transport.

NOTE If an ISO 19109 conformant application schema described in UML is used as the basis for the storage and transportation of geographic information, ISO 19136 provides normative rules for the mapping of such an application schema to a GML application schema in XML Schema and, as such, to an XML encoding for data with a logical structure in accordance with the ISO 19109 conformant application schema.

GML can be used by the SL-NSDI community to support standard interchange formatting of data.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=32554

2.40 ISO 19137:2007 Geographic information -- Core profile of the spatial schema

ISO 19137:2007 defines a core profile of the spatial schema specified in ISO 19107 that specifies, in accordance with ISO 19106, a minimal set of geometric elements necessary for the efficient creation of application schemata.

It supports many of the spatial data formats and description languages already developed and in broad use within several nations or liaison organizations.

This standard will be useful to the SL-NSDI community as a technical reference in understanding spatial data formats and description languages from other countries and organizations.

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=32555

2.41 ISO/TS 19138:2006 Geographic information -- Data quality measures

ISO/TS 19138:2006 defines a set of data quality measures. These can be used when reporting data quality for the data quality subelements identified in ISO 19113. Multiple measures are defined for each data quality subelement, and the choice of which to use will depend on the type of data and its intended purpose.

The data quality measures are structured so that they can be maintained in a register established in conformance with ISO 19135.

ISO/TS 19138:2006 does not attempt to describe every possible data quality measure, only a set of commonly used ones.

This standard can provide the SL-NSDI community with a set of common quality measurement standards for all fundamental geospatial data sets (FGDS).

This standard can be acquired at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=32555

2.42 ISO/TS 19139:2007 Geographic information -- Metadata -- XML schema implementation

ISO/TS 19139:2007 defines Geographic MetaData XML (gmd) encoding, an XML Schema implementation derived from ISO 19115.

The importance of metadata describing digital geographic data is explained in detail in the text of ISO 19115. ISO 19115 provides a structure for describing digital geographic data by defining metadata elements and establishing a common set of metadata terminology, definitions and extension procedures. ISO 19115 is abstract in that it provides a worldwide view of metadata relative to geographic information, but no encoding.

Since ISO 19115 does not provide any encoding, the actual implementation of geographic information metadata could vary based on the interpretation of metadata producers. In an attempt to facilitate the standardization of implementations, this comprehensive metadata implementation specification provides a definitive, rule-based encoding for applying ISO 19115. This Technical Specification provides Extensible Markup Language (XML) schemas that are meant to enhance interoperability by providing a common specification for describing, validating and exchanging metadata about

geographic datasets, dataset series, individual geographic features, feature attributes, feature types, feature properties, etc.

ISO 19115 defines general-purpose metadata in the field of geographic information. More detailed metadata for geographic data types and geographic services are defined in other ISO 19100 series standards and user extensions (ISO 19115). This Technical Specification is also intended to define implementation guidelines for general-purpose metadata. Where necessary, interpretations of some other ISO 19100 series standards are incorporated.

ISO 19118 describes the requirements for creating encoding rules based on UML schemas and the XML-based encoding rules as well as providing an introduction to XML. This Technical Specification utilizes the encoding rules defined in ISO 19118 and provides the specific details of their application with regard to deriving XML schema for the UML models in ISO 19115.

This standard provides the SL-NSDI community with an XML coding schema standard for the metadata described in ISO 19115.

This standard can be acquired at the following link:
https://www.iso.org/obp/ui/#iso:std:32557:en

2.43 ISO/DTS 19139-2 Geographic Information -- Metadata -- XML Schema Implementation -- Part 2: Extensions for imagery and gridded data

ISO 19139-2:2012 defines Geographic Metadata for imagery and gridded data (gmi) encoding. This is an XML Schema implementation derived from ISO 19115-2.

This standard is an extension of the previous XML coding schema addressing imagery and gridded data.

This standard can be referenced at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=57104.

2.44 ISO 19141:2008 Geographic information -- Schema for moving features

ISO 19141:2008 defines a method to describe the geometry of a feature that moves as a rigid body. Such movement has the following characteristics.

- The feature moves within any domain composed of spatial objects as specified in ISO 19107.
- The feature may move along a planned route, but it may deviate from the planned route.
- Motion may be influenced by physical forces, such as orbital, gravitational, or inertial forces.
- Motion of a feature may influence or be influenced by other features, for example:
  - The moving feature might follow a predefined route (e.g. road), perhaps part of a network, and might change routes at known points (e.g. bus stops, waypoints).

- Two or more moving features may be "pulled" together or pushed apart (e.g. an airplane will be refuelled during flight, a predator detects and tracks a prey, refugee groups join forces).
- Two or more moving features may be constrained to maintain a given spatial relationship for some period (e.g. tractor and trailer, convoy).

ISO 19141:2008 does not address other types of change to the feature. Examples of changes that are not adressed include the following:

- The deformation of features.
- The succession of either features or their associations.
- The change of non-spatial attributes of features.
- The feature's geometric representation cannot be embedded in a geometric complex that contains the geometric representations of other features, since this would require the other features' representations to be updated as the feature moves.

Because ISO 19141:2008 is concerned with the geometric description of feature movement, it does not specify a mechanism for describing feature motion in terms of geographic identifiers. This is done, in part, in ISO 19133.

This standard provides a technical reference for SL-NSDI database and software developers to understand the management of moving features.

This standard can be referenced at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=41445

2.45 ISO 19142:2010 Geographic information -- Web Feature Service

This International Standard specifies the behaviour of a web feature service that provides transactions on and access to geographic features in a manner independent of the underlying data store. It specifies discovery operations, query operations, locking operations, transaction operations and operations to manage stored parameterized query expressions.

Discovery operations allow the service to be interrogated to determine its capabilities and to retrieve the application schema that defines the feature types that the service offers.

Query operations allow features or values of feature properties to be retrieved from the underlying data store based upon constraints, defined by the client, on feature properties.

Locking operations allow exclusive access to features for the purpose of modifying or deleting features.

Transaction operations allow features to be created, changed, replaced and deleted from the underlying data store.

Stored query operations allow clients to create, drop, list and describe parameterized query expressions that are stored by the server and can be repeatedly invoked using different parameter values.

NOTE This International Standard does not address the access control issues.

This International Standard defines 11 operations:
— GetCapabilities (discovery operation);
— DescribeFeatureType (discovery operation);
— GetPropertyValue (query operation);
— GetFeature (query operation);
— LockFeature (locking operation);
— GetFeatureWithLock (query and locking operation);
— Transaction (transaction operation);
— CreateStoredQuery (stored query operation);
— DropStoredQuery (stored query operation);
— ListStoredQueries (stored query operation);
— DescribeStoredQueries (stored query operation).

This standard provides a mechanism for the publishing of map information over the web. This is one of several standards that will be most critical to the SL-NSDI.

This standard can be referenced at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19142:ed-1:v1:en

2.46 ISO 19143:2010 Geographic information -- Filter encoding

ISO 19143:2010 describes an XML and KVP encoding of a system neutral syntax for expressing projections, selection and sorting clauses collectively called a query expression. These components are modular and intended to be used together or individually by other International Standards which reference ISO 19143:2010.

ISO 19143:2010 defines an abstract component, named AbstractQueryExpression, from which other specifications can subclass concrete query elements to implement query operations.

It also defines an additional abstract query component, named AbstractAdhocQueryExpresison, which is derived from AbstractQueryExpression and from which other specifications can subclass concrete query elements which follow the following query pattern:
•An abstract query element from which service specifications can subclass a concrete query element that implements a query operation that allows a client to specify a list of resource types, an optional projection clause, an optional selection clause, and an optional sorting clause to query a subset of resources that satisfy the selection clause.

This pattern is referred to as an ad hoc query pattern since the server in not aware of the query until it is submitted for processing. This is in contrast to a stored query expression, which is stored and can be invoked by name or identifier.

ISO 19143:2010 also describes an XML and KVP encoding of a system-neutral representation of a select clause. The XML representation is easily validated, parsed and transformed into a server-specific language required to retrieve or modify object instances stored in some persistent object store.

This standard provides a technical reference for the encoding of system-neutral query expressions.

This standard can be referenced at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=42137

2.47 ISO 19144-1:2009 Geographic information -- Classification systems -- Part 1: Classification system structure

ISO 19144-1:2009 establishes the structure of a geographic information classification system, together with the mechanism for defining and registering the classifiers for such a system. It specifies the use of discrete coverages to represent the result of applying the classification system to a particular area and defines the technical structure of a register of classifiers in accordance with ISO 19135.

This part of ISO 19144 is based on publications of the Food and Agriculture Organization (FAO) of the United Nations. The first in a series of International Standards related to geographic classification systems, it defines the structure of such systems, together with the mechanism for defining and registering classifiers.

Since there are many different possible application areas, there is no single classification system that will serve all needs. The method by which classifiers are defined depends upon the application area. In addition, the classifiers used within a particular application area might not be adequate for all situations encountered within that application area and could need to be augmented over time. To facilitate extension of the set of classifiers in a particular application area, classifiers are registered in a register structure compliant with ISO 19135. This allows the set of classifiers to be maintained. The use of the ISO 19135 registration mechanism allows for separate registers to be defined for different sets of classifiers within multiple information communities, thereby satisfying application needs. This approach allows for independence between information communities, but also allows relationships to be developed between different classification systems that potentially allow the conversion, or partial conversion, of data from one classification system to another, or the fusion of data from two separate sources.

The concept of classification systems is well known in the geographic information community. A classification system can be used to subdivide any geographic area into small units, each of which carries an identifier that describes its type. The results can then be represented as a discrete coverage as described in ISO 19123. Many such classification systems can be defined to address any geographic area. Different application areas and different information communities can define their own classification systems. However, if the classification system is defined in a compatible way,

interaction between different information communities becomes possible. In addition, in a particular application area, it is desirable that there be a few well-established classification systems, and that these themselves be standardized within information communities.

This standard provides the SL-NSDI community with a common framework for structuring data classification systems.

This standard can be referenced at the following link:
https://www.iso.org/obp/ui/#iso:std:32562:en

2.48 ISO 19144-2:2012 Geographic information - Classification systems -- Part 2: Land Cover Meta Language (LCML)

ISO 19144-2:2012 specifies a Land Cover Meta Language (LCML) expressed as a UML metamodel that allows different land cover classification systems to be described based on the physiognomic aspects. ISO 19144-2:2012 also specifies the detailed structure of a register for the extension of LCML but does not specify the maintenance of the register. ISO 19144-2:2012 recognizes that there exist a number of land cover classification systems. It provides a common reference structure for the comparison and integration of data for any generic land cover classification system, but does not intend to replace those classification systems.

Efficient assessment of land cover and the ability to monitor change are fundamental to sustainable management of natural resources, environmental protection, food security and successful humanitarian programmes. Such information is also required to help towards raising levels of nutrition, improving agricultural productivity, enhancing the lives of rural populations and contributing to sustainable growth of the world economy. However, in the past, policy-makers and planners have not had access to reliable and comparable land cover data, not only for lower-income countries but also at the regional and global levels.

Access has been limited by two factors: Lack of mapping activities and lack of commonality between systems. The solution has been to carry out separate regional mapping projects using national or regional land cover classification systems. However, it has not been possible to compare or to exchange information between current systems.

The aim of this part of ISO 19144 is to enable the comparison of information from existing classification systems in a meaningful way without replacing them. The aim is to complement the development of future classification systems that can offer more reliable collection methods for particular national or regional purposes by allowing them to be described in a consistent manner.

A critical factor in implementing such global activities is the availability of a common, umbrella land cover classification system structure. This then provides a reliable basis for interaction without replacing the increasing number of national, regional and global land cover mapping and monitoring activities. This enables comparisons of land cover classes to be made regardless of mapping scale, land cover type, data collection method or geographic location.

Another critical factor is the availability of a common reference for land cover classification systems. This part of ISO 19144 provides a metalanguage expressed as a UML model that allows different land cover classification systems to be described.

This part of ISO 19144 establishes a metalanguage for a set of objects and rules (language) to describe land cover features based on physiognomy that can be part of different land cover legends (nomenclature). This provides a framework for comparing different systems and nomenclatures such as Corine, Africover, Anderson (USGS), Global Map and national systems without replacing them. This is not a description of a nomenclature nor is it a description of a specific set of classes.

This standard provides the SL-NSDI community with a common framework for structuring and comparing land cover classifications schemes.

This standard can be referenced at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19144:-2:ed-1:v1:en

2.49 ISO/DIS 19145 Geographic information -- Registry of representations of geographic point location

ISO 19145:2013 specifies the process for establishing, maintaining and publishing registers of representation of geographic point location in compliance with ISO 19135. It identifies and describes the information elements and the structure of a register of representations of geographic point location including the elements for the conversion of one representation to another.

ISO 19145:2013 also specifies the XML implementation of the required XML extension to ISO/TS 19135-2, for the implementation of a register of geographic point location representations.

ISO 6709:2008 standardizes the mechanisms for the interoperability of geographic point location representations. However, the representation of geographic point locations takes various schemes (e.g. ISO 6709:1983, DCMI Point encoding scheme, KML, GeoVRML, Natural Area Coding System, ISO 8211, GML Point Profile) depending of the application in which they are used. Accordingly, ISO 6709:2008 recognizes and supports flexibility in the representation of geographic point locations and the requirement for universal interpretation. In order to support the use of a variety of geographic point location representations, ISO 6709:2008 introduces the requirement of a registry of geographic point location representations. A registry of representations of geographic point location gives access to the description of the format in which a geographic point location is encoded and also identifies conversion services to transform the representation of the geographic point location to another representation. As such, knowing in which format a geographic point location is encoded and the format in which it must be encoded for its use by a specific application, it can be possible to perform the appropriate transformation of the representation of a geographic point location. However, this requires that encoding formats and their descriptions need to be made accessible either as part of the geographic point location representation itself or from a registry of representations of geographic point locations. As such, the definition of a standard structure for a registry of representations of geographic point location is required. Such a registry will support the required flexibility identified in ISO 6709:2008 for efficient syntactic interoperability of geographic point location information.

This International Standard defines a standard structure of a register in Unified Modelling Language (UML) that supports the description of geographic point location representation (Clause 7). It also defines the XML implementation of the register's UML structure by extending ISO/TS 19135-2, Annex A. Although the structure for the description of geographic point location representation takes its roots in ISO 19135, it extends that International Standard with specific requirements to an extent that it goes beyond the definition of a profile of ISO 19135.

This standard provides the SL-NSDI application and database developers with a common UML structure for describing geographic point location representation.

This standard can be referenced at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19145:ed-1:v1:en

2.50 ISO 19146:2010 Geographic information -- Cross-domain vocabularies

ISO 19146:2010 defines a methodology for cross-mapping technical vocabularies that have been adopted by industry-specific geospatial communities. It also specifies an implementation of ISO 19135 for the registration of geographic information concepts for the purpose of integrating multiple domain-based vocabularies.

A common language is an essential prerequisite to effective communication. However, a simple knowledge of a language's vocabulary is insufficient to ensure communication integrity. A word can have several meanings depending on the context in which it is used. Similarly, a concept can be referenced by several words, each communicating a different connotation or level of emphasis.

The issues associated with the correct use of language extend far beyond day-to-day communication. Every field of endeavour, from engineering to cookery, has its own technical language and vocabulary. In order to participate in discussions on a subject, it is necessary to understand both the subject's terminology and the context in which it is to be used. The imprecise use of technical or professional language (for example, by using two terms interchangeably when, in fact, they have distinctly different connotations) gives rise to the same traps and dangers associated with the inappropriate use of a spoken language.

This International Standard establishes a methodology for cross-mapping technical vocabularies that have been adopted by industry-focussed geospatial communities (for example, geospatial communities supporting the transport or utilities industries). The processes relate to the unique identification of concepts and ensuring the existence of monosemic relations between concepts and designations. The methodology aims to ensure the consistent use of cross-mapping processes when associating disparate geospatial vocabularies and identifying synonyms.

It is not the objective of this International Standard to define an ontology or taxonomy for geographic information and geomatics. Its purpose is to provide rules for ensuring consistency when implementing cross-mapping processes. The rules, however, have been developed with regard to taxonomic and ontological concepts and with a view to enabling semantic interoperability. Their

application to vocabulary cross-mapping, therefore, can be expected to provide input to any future ontology/taxonomy initiatives.

This International Standard applies the provisions of ISO 19135 to the registration of geospatial concepts. An online register of cross-mapped terminology entries, conforming to the requirements of ISO 19135, is associated with this International Standard. Administrative arrangements for the population and maintenance of the online register are beyond the scope of this International Standard. However, the provisions of ISO 19135 relating to the maintenance of registers apply.

This International Standard adopts terms and concepts that are taken from UML and terminology theory and practice. A cross-mapping between the two terminologies can be found in ISO/TR 24156:2008.

This standard provides the SL-NSDI community with a common methodology for cross-mapping technical vocabularies that have been adopted by industry-focussed geospatial communities.

This standard can be referenced at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19146:ed-1:v1:en

2.51 ISO/CD 19147 Geographic information -- Location based services -- Transfer Nodes

ISO 19147:2015 specifies the data types and code lists associated with those types for the implementation of transfer nodes and their services in transport modelling and location based services.

It includes the following:

- defines transfer nodes in a multimodal way so that the definition is general and valid for all types of transport means and modes;
- links transfer nodes to a location;
- focuses on the attributes defining the transfer node in relation to nodes in mode-specific networks;
- defines the attributes of transfer nodes that are relevant for travel planning and modelling of interoperable transport systems by transport planners;
- defines a set of services and facilities that may be related to transfer nodes and a way to provide information on accessibility, deviations and restrictions related to these services and facilities.

ISO 19147:2015 is applicable for transport infrastructure owners and operators when defining and/or describing their transport infrastructure and for transport-related Service Providers when providing information to travellers and others.

It is limited to the transport of persons and is also limited to the static getting-on and getting-off points. The main focus is on transfer nodes being part of public transport networks, that are located in road networks, but this International Standard is also applicable for transfer nodes in rail networks and in air and sea transport networks.

This standard provides the SL-NSDI community with a common structure for defining transfer nodes in a multi-modal transport system.

This standard can be referenced at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=44874

2.52 ISO 19148:2012 Geographic information -- Linear referencing

ISO 19148:2012 specifies a conceptual schema for locations relative to a one-dimensional object as measurement along (and optionally offset from) that object. It defines a description of the data and operations required to use and support linear referencing. The standard is applicable to transportation, utilities, location-based services and other applications which define locations relative to linear objects. It specifies a conceptual schema for locations relative to a one-dimensional object as measurement along (and optionally offset from) that object. It defines a description of the data and operations required to use and support linear referencing.

This International Standard is a description of the data and operations required to support linear referencing. This includes Linear Referencing Systems, linearly located events and linear segments.

Linear Referencing Systems enable the specification of positions along linear objects. The approach is based upon the Generalized Model for Linear Referencing first standardized within ISO 19133:2005, 6.6. This International Standard extends that which was included in ISO 19133, both in functionality and explanation.

ISO 19109 supports features representing discrete objects with attributes having values which apply to the entire feature. ISO 19123 allows the attribute value to vary, depending upon the location within a feature, but does not support the assignment of attribute values to a single point or length along a linear feature. Linearly located events provide the mechanism for specifying attribution of linear objects when the attribute value varies along the length of a linear feature. A Linear Referencing System is used to specify where along the linear object each attribute value applies. The same mechanism can be used to specify where along a linear object another object is located, such as guardrail or a traffic accident.

It is common practice to segment a linear object having linearly located events, based upon one or more of its attributes. The resultant linear segments are attributed with just the attributes used in the segmentation process, insuring that the linear segments are homogeneous in value for these segmenting attributes.

This standard provides the SL-NSDI community with a common structure for describing linear reference features and events.

This standard can be referenced at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19148:ed-1:v1:en

2.53 ISO 19149:2011 Geographic information -- Rights expression language for geographic information -- GeoREL

ISO 19149:2011 defines an XML-based vocabulary or language to express rights for geographic information in order that digital licenses can be created for such information and related services. This language, GeoREL, is an extension of the rights expression language in ISO/IEC 21000-5 and is to be used to compose digital licenses. Each digital license will unambiguously express those particular rights that the owners (or their agent) of a digital geographic resource extend to the holders of that license. The digital rights management system in which these licenses are used can then offer ex ante (before the fact) protection for all such resources.

NOTE The proper use of a GeoREL includes the preservation of rights access by formula expressed in usage licenses. Thus, data in the public or private domain, when protected, remain in their respective domains if the usage rights granted so state.

These "rights" are not always covered by copyright law, and are often the result of contracts between individuals that specify the proper and allowed uses of resources, as opposed to the threat of copyright litigations which is an ex post facto (after the fact) remediation measure, not an ex ante protection measure. ISO 19149:2011 is not a reflection of, or extension of, copyright law.

Mechanisms for the enforcement and preservation of those contract rights are specified in ISO/IEC 21000, and it is not the intention of ISO 19149:2011 to replace nor redefine those mechanisms, but to use them as previously standardized.

This standard provides the SL-NSDI community with a common structure for documenting rights and usage conditions associated with data and applications.

This standard can be referenced at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=32567

2.54 ISO/PRF TS 19150-1 Geographic information -- Ontology -- Part 1: Framework

ISO/TS 19150-1:2012 defines the framework for semantic interoperability of geographic information. This framework defines a high level model of the components required to handle semantics in the ISO geographic information standards with the use of ontologies.

For more than two decades (since the World Wide Web was established) the web has been a network of data with proper syntax (structure) but without any meaning (semantics) to the machine. The Semantic Web has introduced the Web of data. The Semantic Web became an extension of the already existing web of data, by adding machine-processable data (with embedded semantics) as opposed to just documents. It can be seen as a tremendous worldwide open database that people can query from their own perspective, understanding, or abstraction of real world phenomena or events and get accurate, detailed, and appropriate answers. This approach involves reasoning capabilities based on ontologies. Following this path the notion of “Linked Data” has been introduced for data of various

kinds, coming from different sources, to be connected together on the Web by the way of HTTP URIs. As a consequence, the Semantic Web and Linked Data bring new opportunities for the geographic information realm to lay out a new generation of standards in order to benefit from these in achieving semantic interoperability of geographic information.

Ontology consists of a formal representation of phenomena of a universe of discourse with an underlying vocabulary including definitions and axioms that make the intended meaning explicit and describe phenomena and their interrelationships. It supports the representation of concepts that supports the interpretation of data and reasoning to concur to semantic interoperability. Data from different disciplines including geographic information can be integrated and contribute to addressing from specific (e.g. oil spill) to global problems (e.g. climate change).

This Technical Specification defines a high level framework that structures the standards specifically addressing the semantics of geographic information through ontologies. The proposed other parts of the framework include:

ISO 19150-2, Geographic information — Ontology — Part 2: Rules for developing ontologies in the Web Ontology Language (OWL), defines rules and guidelines for the development of ontologies in OWL-DL, including a mapping between UML class diagram elements and OWL-DL and rules for describing application schemas in OWL-DL.

ISO 19150-3, Geographic information — Ontology — Part 3: Semantic operators, defines semantic proximity operators between concepts that complement geometric and temporal operators.

ISO 19150-4, Geographic information — Ontology — Part 4: Service ontology, identifies the framework for service ontology and defines the description of Web services for geographic information in an ontology language.

ISO 19150-5, Geographic information — Ontology — Part 5: Domain ontology registry, defines an international registry of geographic information domain ontologies and its maintenance.

ISO 19150-6, Geographic information — Ontology — Part 6: Service ontology registry, defines an international registry of geographic information service ontologies and its maintenance.

These parts are completed with the ISO/TC 211 Harmonized ontologies that consist of a set of OWL-DL ontologies that translate and complement the ISO/TC 211 Harmonized models developed in UML.

This Technical Specification is intended to be used primarily by standards developers in geographic information. It can also benefit information system analysts, program planners and developers of ISO geographic information standards. It will improve understanding of the basic principles of semantic interoperability and their consistent application to geographic information.

This Technical Specification provides the SL-NSDI community with a technical reference for monitoring ongoing developments in geographic ontologies as well as a common framework for building semantic interoperability into the future programme as it develops.

This Technical Specification can be referenced at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:ts:19150:-1:ed-1:v1:en

2.55 ISO/CD 19150-2 Geographic information -- Ontology -- Part 2: Rules for developing ontologies in the Web Ontology Language (OWL)

ISO 19150-2:2015 defines rules and guidelines for the development of ontologies to support better the interoperability of geographic information over the Semantic Web. The Web Ontology Language (OWL) is the language adopted for ontologies.

It defines the conversion of the UML static view modeling elements used in the ISO geographic information standards into OWL. It further defines conversion rules for describing application schemas based on the General Feature Model defined in ISO 19109 into OWL.

It does not define semantics operators, rules for service ontologies, and does not develop any ontology.

This Standard provides the SL-NSDI community with ontology rules and guidelines to support better interoperability over the web and across the community.

This Standard can be referenced at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=57466

2.56 ISO/FDIS 19152 Geographic information -- Land Administration Domain Model (LADM)

This Standard defines a reference Land Administration Domain Model (LADM) covering basic information-related components of land administration (including those over water and land, and elements above and below the surface of the earth). It provides an abstract, conceptual model with four packages related to parties (people and organizations); basic administrative units, rights, responsibilities, and restrictions (ownership rights); spatial units (parcels, and the legal space of buildings and utility networks); spatial sources (surveying), and spatial representations (geometry and topology). It also provides terminology for land administration, based on various national and international systems, that is as simple as possible in order to be useful in practice. The terminology allows a shared description of different formal or informal practices and procedures in various jurisdictions. The Standard provides a basis for national and regional profiles and enables the combining of land administration information from different sources in a coherent manner.

This Standard provides the SL-NSDI community with a common framework for describing information-related components of land administration..

This Standard can be referenced at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=51206

2.57 ISO/DIS 19153 Geospatial Digital Rights Management Reference Model (GeoDRM RM)

ISO 19153:2014 is a reference model for digital rights management (DRM) functionality for geospatial resources (GeoDRM). As such, it is connected to the general DRM market in that geospatial resources shall be treated as nearly as possible like other resources, such as music, text, or services. It is not the intention to reinvent a market nor the technology that already exists and is thriving, but to make sure that a larger market has access to geospatial resources through a mechanism that it understands and that is similar to and consistent with the ones already in use.

ISO 19153:2014 does not replace any previous standards, but it is dependent upon them. Each resource and service standard that exists or will exist becomes a resource description in ISO 19153:2014, and hopefully will be subject to the same protection that is afforded to other resources.

This International Standard defines:

- A conceptual model for digital rights management of geospatial resources, providing a framework and reference for more detailed specification in this area.
- A metadata model for the expression of rights that associate users to the acts that they can perform against a particular geospatial resource, and associated information used in the enforcement and granting of those rights, such as owner metadata, available rights, and issuer of those rights.
- Requirements that are placed on rights management systems for the enforcement of those rights. A rights management system shall be necessary and sufficient: it shall implement only those restrictions necessary to enforce the rights defined therein, and it shall be sufficient to enforce those rights.
- How this is to work conceptually in the larger DRM context to ensure the ubiquity of geospatial resources in the general services market.

- A resource in this context is a data file, or service for geographic information or process.

This abstract descriptive standard builds on and complements the existing standards, and defines at an abstract level a rights model to enable the digital rights management of standards-based geospatial resources. Future GeoDRM standards will be written to implement the concepts defined in ISO 19153:2014.

This Standard provides the SL-NSDI community with a conceptual framework for digital rights management.

This Standard can be referenced at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=32571

2.58 ISO/WD 19154 Geographic information -- Ubiquitous public access -- Reference model

ISO 19154:2014 defines a reference model for ubiquitous public access (UPA) to geographic information. This reference model uses standard concepts from both the Open distributed processing Reference model (RM-ODP) in ISO/IEC 10746- 1 and ISO 19101.

The reference model specified in ISO 19154:2014 defines the following:

- conceptual models for ubiquitous public access (UPA) to geographic information;
- a reference model and framework to support current and future specification development in this area;
- the semantics of information and processing within systems and services for the UPA of geographic information;
- the architectural relationship between this International Standard and other ISO geographic information standards.

ISO 19154 is applicable to location-based services (LBS), ubiquitous computing environments, linked open data, and other domains that require a seamless public access to geographic information.

Although structured in the context of information technology and information technology standards, ISO 19154:2014 is independent of any application development method or technology implementation approach.

The use of ubiquitous computing in geographic information is often obstructed by legal concerns about the rights of the holders and owners of data and other intellectual property resources. It can be the case that once data or other resource is released into any unconstrained and unprotected environment, the value of the holding is decreased because the underlying data theoretically becomes available from other sources. The multimedia industry has taken the lead in solving this problem by creating a general model for digital rights protection, in which a language was developed in order that instances of those rights might be documented, a rights expression language, specifically in ISO/IEC 21000-5, the ISO REL. This language, used in conjunction with Digital Rights Management (DRM) systems, can protect the value of data and still allow it to be distributed subject to a system of licensing, trust and enforcement.

This International Standard extends the ISO REL to encompass the concerns of holders of geographic data and service resources to equally ensure their protection. This allows the geographic information market to operate with minimal constraints derived from the need for the protection of intellectual property.

There are two major sources for foundational material for this work:

- The first source is ISO/IEC 21000, a multiple part standard that defines digital rights management in general. There is no need to extend this basic foundation for expressing and enforcing rights for resources except in those cases where the special requirements of geographic information and services make it necessary.

- The second source is ISO 19153 (originally an Open Geospatial Abstract Specification volume), which enumerates these special cases for geographic information as well as providing an overall reference model using common geographic information terms that ties the work of the ISO/IEC 21000 work into this spatial standard.

Given these two foundations, the purpose of this International Standard is to extend the ISO REL, consistent with the requirements for such extensions given in ISO/IEC 21000-5, to cover the special cases enumerated in ISO 19153.

This Standard provides the SL-NSDI community with a common reference model for ubiquitous public access.

This Standard can be referenced at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19149:ed-1:v1:en

2.59 ISO 19155:2012 Geographic information -- Place Identifier (PI) architecture

ISO 19155:2012 specifies an architecture that defines a reference model with an encoding method for an identifier of a place. The concept of "place" within ISO 19155:2012 includes "places" not only in the real world but also those in the virtual world. These "places" are identified using either coordinate identifiers, geographic identifiers, or virtual world identifiers such as URI. In ISO 19155:2012, an identifier of a place is referred to as a Place Identifier (PI).

The reference model defines a mechanism to match multiple Place Identifiers to the same place. In addition, a data structure and set of service interfaces are also defined in this reference model.

ISO 19155:2012 is applicable to location based services, emergency management services and other application domains that require a common architecture, across specific domains, for the representation of place descriptions using coordinate, geographic, or virtual world identifiers.

The rapid development of information technology has blurred the boundaries between the real and virtual worlds in such a way that they cannot easily be disassociated from each other. Humans can reference places in both worlds and easily differentiate between them. However for computers to clearly differentiate these places, a set of matched linkages between them are required.

In the discipline of geography, space normally refers to the surface of the earth. However, in other disciplines, space can refer to different paradigms. In architecture, space may be the extent of a room or a building. In mathematics, space is defined as a set having structure. In the context of the World Wide Web space is defined by URLs/URIs that identify web pages.

Within this International Standard “space” is considered as a set having structure, in which a position or location identifies an element.

Currently, within the domain of ISO/TC 211, standards exist for precise positioning and locating using either coordinates or geographic identifiers. However, the concept of place is broader than both position and location. A "place" is referred to as a "position" when that place is identified using coordinates. Similarly, a "place" is referred to as a "location" when that place is identified using geographic identifiers. However, existing standards defined by ISO/TC 211 do not provide a mechanism for the representation of a virtual "place" such as a website, or a construct acting as a "common base" which can be used to refer to the other types of identifiers.

Within this International Standard, "place" is defined as an identifiable part of any space. This may include "places" existing not only in the real world but also those in the virtual world. Places are identified using either "position" by coordinates, "location" by geographic identifiers, or "virtual world identifiers" such as a URI.

In this International Standard, the identifier of a place is referred to as a Place Identifier (PI). A single "place" may be identified using several separate Place Identifiers. Place descriptions are used for information retrieval. In reality, those identifiers often refer to the same place. Currently these relationships are difficult for machines to correctly distinguish, which impedes the discovery and retrieval of information. The conceptual architecture and reference model defined in this International Standard provides a mechanism for solving these problems.

When implemented, this architecture would enable the access and sharing of place descriptions using the Place Identifier as the standardized method.

Within the reference model, place descriptions are defined using a PI. A PI consists of a reference system (RS), a value, and the valid temporal period of that value.

The internal format and content of the value are determined by each community or domain. The content of the values are not subject to any kind of standardization or unification by this International Standard. The RS is also defined by each community, and should be unique across multiple communities. Subsequently, Place Identifiers are unique within each RS. However, the values of the Place Identifiers may be similar or even identical across multiple communities. This distributed concept ensures that each community would maintain their own Place Identifiers. Well formed Place Identifiers may be shared between communities.

Instead of specifying a framework for a globally unique type of identifier, the key idea of the architecture defined in this International Standard enables the original place descriptions to be easily maintained, without requiring difficult conversions and cross-community harmonization.

An encoding scheme based on Geography Markup Language (GML) (ISO 19136:2007) is normatively defined in this International Standard. In addition, a group of alternate encoding schemes are presented as informative annexes. Depending on the encoding method of choice, globally unique Place Identifiers may be created resulting from the requirements of the encoding method used.

Methods for the conversion of "located features" to Place Identifiers are not covered within the scope of this International Standard. While the direct relationship with the PI Architecture and other Spatial

Data Infrastructures (SDIs) is not explained, an implementation of the PI Architecture can be considered part of an SDI. Various constructs, such as registries and databases, may be used to store Place Identifiers. The flexible structure of the Place Identifier will allow for data stored in common GI systems to be easily registered as Place Identifiers, however, the design and implementation of those procedures is out of scope of this International Standard.

This Standard provides the SL-NSDI community with a common framework and coding method for the identification of places.

This Standard can be referenced at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19155:ed-1:v1:en

2.60 ISO 19156:2011 Geographic information -- Observations and measurements

ISO 19156:2011 defines a conceptual schema for observations, and for features involved in sampling when making observations. These provide models for the exchange of information describing observation acts and their results, both within and between different scientific and technical communities.

Observations commonly involve sampling of an ultimate feature-of-interest. ISO 19156:2011 defines a common set of sampling feature types classified primarily by topological dimension, as well as samples for ex-situ observations. The schema includes relationships between sampling features (sub-sampling, derived samples).

This International Standard arises from work originally undertaken through the Open Geospatial Consortium's Sensor Web Enablement (SWE) activity. SWE is concerned with establishing interfaces and protocols that will enable a "Sensor Web" through which applications and services will be able to access sensors of all types, and observations generated by them, over the Web. SWE has defined, prototyped and tested several components needed for a Sensor Web, namely:

- Sensor Model Language (SensorML).
- Observations & Measurements (O&M).
- Sensor Observation Service (SOS).
- Sensor Planning Service (SPS).
- Sensor Alert Service (SAS).

This International Standard specifies the Observations and Measurements schema, including a schema for sampling features.

The content presented here derives from an earlier version published by Open Geospatial Consortium as OGC 07-022r1, Observations and Measurements — Part 1 — Observation schema and OGC 07-002r3, Observations and Measurements — Part 2 — Sampling Features. A technical note describing the changes from the earlier version is available from the Open Geospatial Consortium (see http://www.opengeospatial.org/standards/om).

This Standard provides the SL-NSDI community with a common schema for recording interoperable sensor web observations and associated values.

This Standard can be referenced at the following link:
https://www.iso.org/obp/ui/#iso:std:iso:19156:ed-1:v1:en

2.61 ISO/DIS 19157 Geographic information -- Data quality

ISO 19157:2013 establishes the principles for describing the quality of geographic data. It

- defines components for describing data quality;
- specifies components and content structure of a register for data quality measures;
- describes general procedures for evaluating the quality of geographic data;
- establishes principles for reporting data quality.

ISO 19157:2013 also defines a set of data quality measures for use in evaluating and reporting data quality. It is applicable to data producers providing quality information to describe and assess how well a data set conforms to its product specification and to data users attempting to determine whether or not specific geographic data are of sufficient quality for their particular application.

ISO 19157:2013 does not attempt to define minimum acceptable levels of quality for geographic data.

This Standard provides the SL-NSDI community with a common framework for defining and recording data quality.

This Standard can be referenced at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=32575

2.62 ISO/TS 19158:2012 Geographic information—Quality assurance of data supply

ISO/TS 19158:2012 provides a framework for quality assurance specific to geographic information. It is based upon the quality principles and quality evaluation procedures of geographic information identified in ISO 19157 and the general quality management principles defined in ISO 9000.

The framework defined in ISO/TS 19158:2012 enables a customer to satisfy itself that its suppliers, both internal and external, are capable of delivering geographic information to the required quality. Fundamental to the framework is the assurance of the supplier's ability to understand and meet the quality requirements. Through the quality assurance framework both the customer and the supplier are able to consider the quality required at the earliest opportunity in the production/update process.

Principles and responsibilities of the relationship between the customer and the supplier that facilitate the framework are provided. The responsibility for the quality assessment procedure is shared between the customer and the supplier.

ISO/TS 19158:2012 is applicable to customers and suppliers of all geographic information where the quality of the product may be impacted upon by the supplier's processes in any of the following scenarios:

1) there is an agreement or legislation for the supply of data acquisition services,
2) data acquisition services are being tendered for, and
3) one or more suppliers exist in the supply chain.

ISO/TS 19158:2012 is not applicable for the supply of legacy datasets or "off the shelf" products where there is no further data production or update activity to manage.

This Standard provides the SL-NSDI community with a common framework for defining data quality for both internal use and tendering.

This Standard can be referenced at the following link:
http://www.iso.org/iso/catalogue_detail.htm?csnumber=32576

2.63 ISO/WD 19160-1 Addressing -- Part 1: Conceptual model

ISO 19160-1:2015 defines a conceptual model for address information (address model), together with the terms and definitions that describe the concepts in the model. Lifecycle, metadata, and address aliases are included in the conceptual model. The model is presented in the Unified Modeling Language (UML).

The model provides a common representation of address information, independent of actual addressing implementations. It is not intended to replace conceptual models proposed in other specifications, but provides a means to cross-map between different conceptual models for address information and enables the conversion of address information between specifications.

The model provides a basis for developing address specifications by individual countries or communities.

This Standard provides the SL-NSDI community with a common model for street addressing.

This Standard can be referenced at the following link:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=61710

3 OPEN GEOSPATIAL CONSORTIUM (OGC)

The Open Geospatial Consortium (OGC), an international voluntary consensus standards organization, originated in 1994. In the OGC, more than 500 commercial, governmental, nonprofit and research organizations worldwide collaborate in a consensus process encouraging development and implementation of open standards for geospatial content and services, sensor web and Internet of Things, GIS data processing and data sharing.

The following summarizes those OGC standards that may have significant relevance to the SL-NSDI community. Some of these standards are directly relevant to database and application developers while others are more low level standards intended to support general interoperability across systems from different commercial software vendors and open source software communities.

3.1 OpenGIS® Filter Encoding Implementation Specification, version 1

A filter expression is a construct used to constrain the property values of an object type for the purpose of identifying a subset of object instances to be operated upon in some manner. This specification describes an XML encoding of the OGC Common Catalog Query Language (CQL) as a system neutral representation of a query predicate. Using the numerous XML tools available today, such an XML representation can be easily validated, parsed and then transformed into whatever target language is required to retrieve or modify object instances stored in a persistent object store. For example, an XML encoded filter could be transformed into a WHERE clause for a SQL SELECT statement to fetch data stored in a SQL-based relational database. Similarly, an XML encoded filter expression could be transformed into an XPath or XPointer expression for fetching data from XML documents. A large class of OpenGIS; web based service requires the ability to express filter expressions in XML. The filter encoding described in this document is a common component that can be used by a number of OGC web services. Any service that requires the ability to query objects from a web-accessible repository can make use of the XML filter encoding described in this document. For example, a web feature service may use the XML filter encoding in a GetFeature operation to define query constraints.

This Standard provides the SL-NSDI community with a common framework for XML encoded filgers

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/filter

3.2 OpenGIS® Web Map Context (WMC) Documents Implementation Specification, Version 1.1.0 w/Corrigendum 1

This is a companion specification to the OGC Web Map Service Interface Implementation Specification. WMS specifies how individual map servers describe and provide their map content. The Context specification states how a specific grouping of one or more maps from one or more map servers can be described in a portable, platform-independent format for storage in a repository or for transmission between clients. This description is known as a "Web Map Context Document," or simply a "Context." A Context document includes information about the server(s) providing layer(s) in the overall map, the bounding box and map projection shared by all the maps, sufficient operational

metadata for Client software to reproduce the map, and ancillary metadata used to annotate or describe the maps and their provenance for the benefit of human viewers. A Context document is structured using eXtensible Markup Language (XML). Annex A of the specification contains the XML Schema against which Context

This Standard provides the SL-NSDI community with a common framework for XML encoded filgers

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/wmc

3.3 OpenGIS® Web Processing Service, Version: 1.0.0 w/ Corrigendum

This is a companion specification to the OGC Web Map Service Interface Implementation WPS provides client access across a network to pre-programmed calculations and/or computation models that operate on spatially referenced data. WPS defines a standardized interface that facilitates the publishing of geospatial processes, and the discovery of and binding to those processes by clients. Processes include any algorithm, calculation or model that operates on spatially referenced data. Publishing means making available machine-readable binding information as well as human-readable metadata that allows service discovery and use. The calculation can be extremely simple or highly complex, with any number of data inputs and outputs.

This Standard provides the SL-NSDI community with a common framework for Web Processing Service (WPS) Interface Implementation.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/wps

3.4 OpenGIS® Symbology Encoding Implementation Specification, version 1.1.0

Symbology Encoding (SE) defines an XML language to encode user-defined styling information that can be applied to digital Feature and Coverage data. SE defines the grammar for styling map data independent of any service interface specification and defines styling language rules that the client and server can both understand to portray the output of Web Map Servers, Web Feature Servers and Web Coverage Servers. SE graphical parameters and their values are derived from SVG/CSS2 standards with identical names and semantics.

This Standard provides the SL-NSDI community with a common language for encoding user-defined symbology.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/symbol

3.5 OpenGIS® Styled Layer Descriptor (SLD) Profile of the OpenGIS® Web Map Service (WMS) Encoding Standard

This specification addresses the need for geospatial consumers (either humans or machines) to control the visual portrayal of the data with which they work. The OpenGIS Web Map Service (WMS) Implementation Specification supports the ability for an information provider to specify very basic styling options by advertising a preset collection of visual portrayals for each available data set. However, while a WMS can provide the user with a choice of style options, the WMS can only tell the user the name of each style. It cannot tell the user what the portrayal will look like on the map. More importantly, the user has no way of defining styling rules. This specification defines a styling language for both purposes that the client and server can both understand.

This Standard provides the SL-NSDI community with a specification for a styling language for both previewing what a style will look like on a map as well as a basis for defining styling rules.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/sld

3.6 Augmented Reality Markup Language (ARML 2.0)

This OGC® Standard defines the Augmented Reality Markup Language 2.0 (ARML 2.0). ARML 2.0 allows users to describe virtual objects in an Augmented Reality (AR) scene with their appearances and their anchors (a broader concept of a location) related to the real world. Additionally, ARML 2.0 defines ECMAScript bindings to dynamically modify the AR scene based on user behavior and user input.

This Standard provides the SL-NSDI software developers with a specification for describing virtual objects in an Augmented Reality (AR) scene.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/arml

3.7 City GML

CityGML is an open data model and XML-based format for the storage and exchange of virtual 3D city models. It is an application schema for the Geography Markup Language version 3.1.1 (GML3), the extendible international standard for spatial data exchange issued by the Open Geospatial Consortium (OGC) and the ISO TC211. The aim of the development of CityGML is to reach a common definition of the basic entities, attributes, and relations of a 3D city model. This is especially important with respect to the cost-effective sustainable maintenance of 3D city models, allowing the reuse of the same data in different application fields.

This Standard provides the SL-NSDI community with a common schema for developing and using 3D city models.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/citygml

3.8 Coordinate Transformation Service

The OpenGIS® Coordinate Transformation Service Standard (CT) provides a standard way for software to specify and access coordinate transformation services for use on specified spatial data. This standard addresses a key requirement for overlaying views of geodata ("maps") from diverse sources: the ability to perform coordinate transformation in such a way that all spatial data are defined relative to the same spatial reference system.

This Standard provides the SL-NSDI community with a standard way to specify and access coordinate transformation service.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/ct

3.9 GeoPackage Encoding Standard

A GeoPackage is a platform-independent SQLite database file that may contain:

- vector geospatial features
- tile matrix sets of imagery and raster maps at various scales
- extensions

Since a GeoPackage is a database, it supports direct use, meaning that its data can be accessed and updated in a "native" storage format without intermediate format translations. GeoPackages are interoperable across all enterprise and personal computing environments, and are particularly useful on mobile devices like cell phones and tablets in communications environments with limited connectivity and bandwidth. This OGC® Encoding Standard defines the schema for a GeoPackage, including table definitions, integrity assertions, format limitations, and content constraints. The allowable content of a GeoPackage is entirely defined in this specification.

This Standard provides the SL-NSDI community with a method to encode simple geospatial data in a platform independent manner, particularly for use on mobile devices or other situations with limited connectivity.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/geopackage

3.10 OGC GeoScience Markup Language (GeoSciML)

GeoSciML is a model of geological features commonly described and portrayed in geological maps, cross sections, geological reports and databases. The model was developed by the IUGS CGI

(Commission for the Management and Application of Geoscience Information) and version 4.1 is the first version officially submitted as an OGC standard. This specification describes a logical model and GML/XML encoding rules for the exchange of geological map data, geological time scales, boreholes, and metadata for laboratory analyses. It includes a Lite model, used for simple map-based applications; a basic model, aligned on INSPIRE, for basic data exchange; and an extended model to address more complex scenarios.

The specification also provides patterns, profiles (most notably of Observations and Measurements - ISO19156), and best practices to deal with common geoscience use cases.

This Standard provides the SL-NSDI community with a common model for mapping geology and related information.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/geosciml

3.11 GeoSPARQL – A Geographic Query Language for RDF Data

The OGC GeoSPARQL standard supports representing and querying geospatial data on the Semantic Web. GeoSPARQL defines a vocabulary for representing geospatial data in RDF, and it defines an extension to the SPARQL query language for processing geospatial data. In addition, GeoSPARQL is designed to accommodate systems based on qualitative spatial reasoning and systems based on quantitative spatial computations.

This Standard provides the SL-NSDI community with a common way to query geospatial data on the Semantic Web.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/geosparql

3.12 Geospatial User Feedback (GUF)

This standard defines a conceptual Geospatial User Feedback (GUF) data model (OGC 15-097) and a practical XML encoding of the conceptual model (OGC 15-098). Geospatial User Feedback is metadata that is predominantly produced by the consumers of geospatial data products as they use and gain experience with those products. The standard allows for documenting feedback items such as ratings, comments, quality reports, citations, significant events, etc. about the usage of the data. Feedback items can be aggregated in collections and summaries of the collections can also be described. This standard complements existing metadata conventions whereby documents recording dataset characteristics and production workflows are generated by the creator, publisher, or curator of a data product. As a part of metadata, the GUF data model reuses some elements of ISO 19115-1:2014 (the updated version of the OGC Abstract Specification Topic 11) but not the general structure. This selective use of ISO metadata elements prioritizes interoperability with developing ISO metadata models. The conceptual encoding is designed to be used combination with an encoding standard.

Initially an XML encoding following the ISO 19139 encoding rules is specified in a separate OGC implementation standard (OGC 15-098). In the future other encodings may be defined, including examples such as the use of JSON-LD based on parts of schema.org.

This Standard provides the SL-NSDI community with a common way to collect and manage user feedback regarding data products.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/guf

3.13 OGC IndoorGML

This OGC® IndoorGML standard specifies an open data model and XML schema for indoor spatial information. IndoorGML is an application schema of OGC® GML 3.2.1. While there are several 3D building modelling standards such as CityGML, KML, and IFC, which deal with interior space of buildings from geometric, cartographic, and semantic viewpoints, IndoorGML intentionally focuses on modelling indoor spaces for navigation purposes.

This Standard provides the SL-NSDI community with a common schema for the development and use of indoor spatial information, expecially for navigation purposes (such as in a large facility or shopping center).

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/indoorgml

3.14 KML

Google submitted KML (formerly Keyhole Markup Language) to the Open Geospatial Consortium (OGC) to be evolved within the OGC consensus process with the following goal: KML Version 2.2 has been adopted as an OGC implementation standard. Future versions may be harmonized with relevant OGC standards that comprise the OGC standards baseline. There are four objectives for this standards work:

- That there be one international standard language for expressing geographic annotation and visualization on existing or future web-based online and mobile maps (2d) and earth browsers (3d).
- That KML be aligned with international best practices and standards, thereby enabling greater uptake and interoperability of earth browser implementations.
- That the OGC and Google will work collaboratively to ensure that the KML implementer community is properly engaged in the process and that the KML community is kept informed of progress and issues.
- That the OGC process will be used to ensure proper life-cycle management of the KML Standard, including such issues as backwards compatibility.

The OGC has developed a broad Standards Baseline. Google and the OGC believe that having KML fit within that family will encourage broader implementation and greater interoperability and sharing of earth browser content and context.

KML is an XML language focused on geographic visualization, including annotation of maps and images. Geographic visualization includes not only the presentation of graphical data on the globe, but also the control of the user's navigation in the sense of where to go and where to look.

From this perspective, KML is complementary to most of the key existing OGC standards including GML (Geography Markup Language), WFS (Web Feature Service) and WMS (Web Map Service). Currently, KML 2.2 utilizes certain geometry elements derived from GML 2.1.2. These elements include point, line string, linear ring, and polygon.

The OGC and Google have agreed that there can be additional harmonization of KML with GML (e.g. to use the same geometry representation) in the future. The Mass Market Geo Working Group (MMWG) in the OGC will establish such additional harmonization activities. OGC specifications such as Context and Styled Layer Descriptor (SLD) may be considered.

This Standard provides the SL-NSDI community with a common framework for accessing and using KML information.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/kml

3.15 Land and Infrastructure (LandInfra)

The scope of the Land and Infrastructure Conceptual Model is land and civil engineering infrastructure facilities. Anticipated subject areas include facilities, projects, alignment, road, railway, survey, land features, land division, and “wet” infrastructure (storm drainage, wastewater, and water distribution systems). The initial release of this standard is targeted to support all of these except wet infrastructure.

Land provides the environment upon which infrastructure facilities exist. This standard includes division of land based on administrative (jurisdictions and districts) as well as interests in land (e.g., land parcels, easements, and condominiums). The standard also includes support for topography (terrain) as well as subsurface information. Finally, this standard regards the surveying needed to locate infrastructure facilities on the terrain in compliance with interests in land.

This Standard is an evolving suite of standards that provide the SL-NSDI community with conceptual schema for encoding land and infrastructure items.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/landinfra

3.16 Location Service (OpenLS)

The OpenGIS® Open Location Services Interface Standard (OpenLS) specifies interfaces that enable companies in the Location Based Services (LBS) value chain to "hook up" and provide their pieces of applications such as emergency response (E-911, for example), personal navigator, traffic information service, proximity service, location recall, mobile field service, travel directions, restaurant finder, corporate asset locator, concierge, routing, vector map portrayal and interaction, friend finder, and geography voice-graphics. These applications are enabled by interfaces that implement OpenLS services such as a Directory Service, Gateway Service, Geocoder Service, Presentation (Map Portrayal) Service and others.

This interface standard provides the SL-NSDI community with a common way to develop and use location based services.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/ols

3.17 Open GeoSMS Standard - Core

The OGC Open GeoSMS Standard provides developers with an extended Short Message Service (SMS) encoding and interface to facilitate communication of location content between different LBS (Location-Based Service) devices or applications. SMS is the open text communication service standard most commonly used in phone, web and mobile communication systems for the exchange of short text messages between fixed line or mobile phone devices. The lightweight and easy to implement Open GeoSMS Standard facilitates interoperability between mobile applications and the rapidly expanding world of geospatial applications and services that implement OGC standard interfaces, encodings and best practices.

This interface standard provides SL-NSDI developers with a way to enable the encoding, transmission and utilization of geospatial information using SMS.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/opengeosms

3.18 Open Modelling Interface (OpenMI) Interface Standard

The purpose of the Open Modelling Interface (OpenMI) is to enable the runtime exchange of data between process simulation models and also between models and other modelling tools such as databases and analytical and visualization applications. Its creation has been driven by the need to understand how processes interact and to predict the likely outcomes of those interactions under given conditions. A key design aim has been to bring about interoperability between independently developed modelling components, where those components may originate from any discipline or supplier. The ultimate aim is to transform integrated modelling into an operational tool accessible to

all and so open up the potential opportunities created by integrated modelling for innovation and wealth creation.

This interface standard provides SL-NSDI developers with a way to enable the runtime exchange of data between process simulation models.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/openmi

3.19 Ordering Services Framework for Earth Observation Products Interface Standard

This OGC® standard specifies the interfaces, bindings, requirements, conformance classes, and a framework for implementing extensions that enable complete workflows for ordering of Earth Observation (EO) data products.

This interface standard provides SL-NSDI developers with a way to enable complete workflows for ordering of Earth Observation (EO) data products.

This Standard can be referenced at the following link:
http://www.opengeospatial.org/standards/oseo

3.20 OGC Sensor Web Enablement (SWE)

The OGC's Sensor Web Enablement (SWE) standards enable developers to make all types of sensors, transducers and sensor data repositories discoverable, accessible and useable via the Web.

SWE standards are developed and maintained by OGC members who participate the OGC Technical Committee's Sensor Web Enablement Working Group .

SWE offers integrators:

- Open interfaces for sensor web applications
- "Hooks" for IEEE 1451, TML, CAP, WS-N, ASAP
- Imaging device interface support
- Opportunity to participate in an open process to shape standards
- Sensor location tied to geospatial standards
- Fusion of sensor data with other spatial data
- Ties to IEEE and other standards organizations

Sensor technology, computer technology and network technology are advancing together while demand grows for ways to connect information systems with the real world. Linking diverse technologies in this fertile market environment, integrators are offering new solutions for plant security, industrial controls, meteorology, geophysical survey, flood monitoring, risk assessment, tracking, environmental monitoring, defense, logistics and many other applications.

The SWE effort involves OGC members in developing the global framework of standards and best practices that make linking of diverse sensor related technologies fast and practical. Standards make it possible to put the pieces together in an efficient way that protects earlier investments, prevents lock-in to specific products and approaches, and allows for future expansion. Standards also influence the design of new component products. Business needs drive the process. Technology providers and solutions providers need to stay abreast of these evolving standards if they are to stay competitive.

This suite of standards provide SL-NSDI developers with a common framework for the collection, management, communications and utilization of sensor data.

This suite of standards can be referenced at the following link:
http://www.opengeospatial.org/ogc/markets-technologies/swe

3.21 OGC WaterML

WaterML 2.0 is a standard information model for the representation of water observations data, with the intent of allowing the exchange of such data sets across information systems. Through the use of existing OGC standards, it aims at being an interoperable exchange format that may be re-used to address a range of exchange requirements, some of which are described later in this document.

This standard provides the SL-NSDI community with a common model for the representation of water observations data.

This suite of standards can be referenced at the following link:
http://www.opengeospatial.org/standards/waterml

4 U.S. FEDERAL GEOGRAPHIC DATA COMMITTEE (FGDC)

The United States Federal Geographic Data Committee (FGDC) is an organized structure of Federal geospatial professionals and constituents that provide executive, managerial, and advisory direction and oversight for geospatial decisions and initiatives across the U.S. Federal government. In accordance with Office of Management and Budget (OMB) Circular A-16, the FGDC is chaired by the Secretary of the Interior with the Deputy Director for Management, OMB as Vice-Chair.

FGDC has since its inception facilitated the development or adoption of existing geospatial standards and guidelines. This has involved a structured process involving a broad spectrum of stakeholder organizations and individuals.

Standards from the FGDC are included here only if they are not redundant with other sources, are directly applicable to Sri Lanka, or represent a model that could reasonably be adapted in the future to align with the needs of the SL-NSDI community.

4.1 Geospatial Positioning Accuracy Standards, Part 4: Architecture, Engineering, Construction and Facilities Management

This standard defines accuracy criteria, accuracy testing methodology, and accuracy reporting criteria for object features depicted on A/E/C spatial data products and related control surveys. It references established voluntary standards that may be used for some smaller-scale A/E/C mapping applications. In addition, an Appendix A contains general guidance for specifying accuracy criteria for selected types of A/E/C features or control surveys. Using the standards and guidance contained in this section, end users of A/E/C products (e.g., planners, designers, constructors) can specify surveying and mapping accuracy requirements needed for their projects or specific CADD/GIS layers, levels, or entities. From these specifications, data producers (e.g., surveyors, mappers, photogrammetrists) can determine the instrumentation, procedures, and quality control processes required to obtain and verify the defined accuracies.

This standard can provide the SL-NSDI community with a useful reference in the development of A/E/C data accuracy standards for Sri Lanka.

This standard can be referenced at the following link:
https://www.fgdc.gov/standards/projects/accuracy/part4/index_html

4.2 Geospatial Positioning Accuracy Standards, Part 5: Standards for Nautical Charting Hydrographic Surveys

For the purposes of this Standard, hydrographic surveys are defined as those surveys conducted to determine the configuration of the bottom of water bodies and to identify and locate all features, natural and man-made, that may affect navigation. Nautical charts are compilations of data from numerous sources, principally hydrographic surveys, designed specifically to meet the requirements of marine navigation. This standard provides minimum standards for the horizontal and vertical accuracy of features associated with hydrographic surveys that support nautical charting. Such features include, but are not limited to, water depths, objects on the seafloor, navigational aids, and shoreline. The scope of these standards includes the coastal waters of the U.S. and its territories, and would need to be adapted for the Sri Lanka context.

This standard can provide the SL-NSDI community with a useful reference in the development of hydrographic and nautical chart data accuracy standards for Sri Lanka.

This standard can be referenced at the following link:
https://www.fgdc.gov/standards/projects/accuracy/part5/index_html

4.3 Content Standards for Digital Orthoimagery

The objective of this standard is to define the orthoimage theme of the digital geospatial data framework and envisioned by the FGDC . It is the intent of this standard to set a common baseline

that will ensure the widest utility of digital orthoimagery for the user and producer communities through enhanced data sharing and the reduction of redundant data production. The standard describes the processing, accuracy, reporting, and applications considerations for digital orthoimagery.

This standard can provide the SL-NSDI community with a useful reference in the development of a common orthoimagery specification for Sri Lanka.

This standard can be referenced at the following link:
https://www.fgdc.gov/standards/projects/orthoimagery/index_html

4.4 Utilities Data Content Standard, FGDC-STD-010-2000

The purpose of this Utilities Geospatial Data Content Standard (hereafter abbreviated as Utilities Standard) is to standardize geospatial information for utility systems. This standard specifies the names, definitions, and domains for utility system components that can be geospatially depicted as feature types and their non-graphical attributes. This Utilities Standard is classified as a Data Content Standard in the Federal Geographic Data Committee (FGDC) Standards Reference Model.

This Utilities Standard supports large-scale, intra-city applications such as engineering and life cycle maintenance of utility systems. The components of each utility system described in this Utilities Standard are considered to represnent features located outside the foundation of an enclosed structure. This Utilities Standard describes eleven feature classes: compressed air, electrical distribution, electrical monitoring/control, fuel distribution, heating/cooling systems, industrial waste, natural gas distribution, saltwater, storm drainage collection, wastewater collection, and water distribution. This standard does not contain all features necessary to describe or model communications, alarm systems, or long distance utilities networks that stretch between cities. As with the Spatial Data Transfer Standard (SDTS), this standard uses a logical data model.

This standard can provide the SL-NSDI community with a useful reference in the development of a common utilities data content specification for Sri Lanka.

This standard can be referenced at the following link:
https://www.fgdc.gov/standards/projects/utilities/index_html

5 INSPIRE

INSPIRE is "an EU initiative to establish an infrastructure for spatial information in Europe that is geared to help to make spatial or geographical information more accessible and interoperable for a wide range of purposes supporting sustainable development".

The INSPIRE directive lays down a general framework for a Spatial Data Infrastructure (SDI) for the purposes of European Community environmental policies and policies or activities which may affect the environment. The INSPIRE Directive entered into force on 15 May 2007.

INSPIRE is based on the infrastructures for spatial information established and operated by the member states of the European Union. The directive addresses 34 spatial data themes needed for environmental applications.

To ensure that the spatial data infrastructures of the member states are compatible and usable in a community and transboundary context, the INSPIRE Directive requires that additional legislation or common Implementing Rules (IR) are adopted for a number of specific areas (metadata, interoperability of spatial data sets and services, network services, data and service sharing and monitoring and reporting). These are published either as Commission Regulations or as Decisions.[4]

The INSPIRE initiative has facilitated the development of a series of standards and guidelines that have some relevance to Sri Lanka. The following summarizes those that are most relevant and provide material that will be a useful reference in the formulation of detailed standards within the SL-NSDI programme.

5.1 Data Specification on Addresses – Technical Guidelines

The data specification defines an address as: "An identification of the fixed location of a property, e.g. plot of land, building, part of building, way of access or other construction, by means of a structured composition of geographic names and identifiers."

A number of different object types can be related to property. The most commonly recognised types that have addresses are land parcels and buildings (including flats or apartments). In some countries additional objects have an address, such as street furniture, water pumping stations, mooring places, car parks and agricultural barns. Collectively, objects which can have addresses are referred to as addressable objects.

The spatial data theme Addresses is not isolated from other spatial data themes and it has a useful property where it can be used to link and join information from other data sets. The data specification is concerned with the structure of an address and does not attempt to define the structure of the addressable object to which it relates. The data specification does though include associations from the address to the two INSPIRE themes Cadastral Parcels and Buildings.

This standard can provide the SL-NSDI community with a useful reference in the development of a common address data content specification for Sri Lanka.

This standard can be referenced at the following link:
http://inspire.ec.europa.eu/id/document/tg/ad

5.2 Data Specification on Administrative Units – Technical Guidelines

According to the definition of the Directive, administrative units are ―units of administration dividing areas where Member States have and/or exercise jurisdictional rights for local, regional and national governance, separated by administrative boundaries‖. Based on the reference materials and the user requirements, the Thematic Working Group has added some other fundamental aspects like the hierarchical structure of administrative units and the relations with statistical units that have already been defined and in use within the EU-administration.

[4] https://en.wikipedia.org/wiki/Infrastructure_for_Spatial_Information_in_the_European_Community

Administrative units in INSPIRE play the role of generic information locators. Their main uses include:

- Searching / filtering other spatial data based on a name or code.
- Linking / publishing thematic information in a rapid and comparable way.
- Finding competent authorities e.g. in case of disasters, for environmental protection, etc. In addition administrative units may provide the frame for a boundary-based analysis of consistency of spatial objects (similar classification, geometrical matching) as required in Art. 8(4) and 10(2) of the Directive.

The administrative units data theme model is divided in two application schemas:

The core element of the Administrative Units application schema is the administrative unit represented by a surface geometry. In accordance with the Directive, each administrative unit carries a unique identifier. Administrative units are further described by their geographical name, the country of location, the national administrative code, and the hierarchical level within the administrative structure of the country. This information is completed, if available, with the life cycle information (when the administrative unit has been inserted or changed in the dataset, and when it has been (if ever) superseded or retired in the spatial data set), the name of the corresponding national level and the residence of the administrative authority.

The administrative division of the Members States follows a hierarchical structure where the lowest level units (often communes) are united in higher level units (like provinces, counties, etc) that compose other units at a higher level. It must be ensured that an administrative unit of an upper level is composed of one or more administrative units of a lower level. Lowest level administrative

13 Statistical units, such as NUTS (Nomenclature of Territorial Statistical Units) regions, are defined in the Statistical units data theme, which is part of INSPIRE Annex III. units are further characterised by their geometry and, where available, by the corresponding local administrative unit code. A special spatial object type called condominium has been introduced for describing independent administrative areas that are administered by two or more countries.

Administrative units are separated by administrative boundaries that are specified as lines. As mandatory properties they carry a unique identifier, information on the country, the administrative hierarchic level and their own geometry. These are complemented, when available, with the legal and technical status of the boundary and the life cycle information.

The MaritimeUnits application schema models the existing maritime zones. These are stripes or belts of sea defined according international treaties and conventions, where the coastal States execute their jurisdictional rights. Depending on the zone type property, they may concern an area of seabed, ocean floor, subsoil, resources, or even the air space over the sea, for cadastral, administrative, economic, security or safety purposes. These rights are established by the United Nations Convention on the Law of the Sea (UNCLOS). The baseline, the line from which the outer limits of the territorial sea is measured, serves as reference to calculate the breath of territorial sea, while determines the outer limits of other maritime zones by establishing respectively different distances measured from it.

In contrast to the AdministrativeUnits model, no hierarchical structure is established between different maritime zones. However, they share common properties with administrative units, like the unique identifier and the country the maritime zone belongs to. All this information is again complemented, if available, with the life cycle information and the geographical name.

Following a common modelling approach with administrative units, maritime zones are separated by maritime boundaries that are specified as lines. As mandatory properties they carry a unique identifier,

information on the country, and their own geometry. These are complemented, when available, with the legal and technical status of the boundary and the life cycle information.

This standard can provide the SL-NSDI community with a useful reference in the development of a common administrative area data content specifications for Sri Lanka.

This standard can be referenced at the following link:
http://inspire.ec.europa.eu/id/document/tg/au

5.3 Data Specification on Cadastral Parcels – Technical Guidelines

The cornerstone of the specification development was the definition of the Directive on the cadastral parcels: "areas defined by cadastral parcels or equivalent". In accordance with the particular legal system each Member State runs a related register under the responsibility of the government. Such registers are often called cadastre, sometimes land or other type of registry. Regardless of the name of the system, the basic unit of area is the parcel. Cadastral parcels usually form a continuous partition of the national territory by the exception where some land owned by the governments13 is not subject of registration. The generic definition of cadastral parcels has been complemented by the Thematic Working Group to fit better with user requirements in the following way: the cadastral parcels should be, as much as possible, single areas of Earth surface (land and/or water) under homogenous real property rights and unique ownership, where real property rights and ownership are defined by national laws.

INSPIRE does not aim at harmonising the concepts of ownership and rights related to the parcels, but focuses on the geometrical aspects as presented in the national systems of the Member States.

Cadastral parcels in INSPIRE should serve the purpose of generic information locators. Having included the reference to the national registers as a property (attribute) of the INSPIRE parcels national data sources can be reached. Using this two-step approach other information, like rights and owners can be accessed fully respecting the national legislation on data protection. The data model for INSPIRE cadastral parcels has been prepared in a way that supports compatibility with the upcoming international standard on Land Administration Domain Model14. The Land Administration Domain Model (LADM) provides a wider context for the INSPIRE cadastral parcels because LADM includes additional information on rights (bound to national legislation) and owners, which are outside the direct scope of INSPIRE.

This standard can provide the SL-NSDI community with a useful reference in the development of a common cadastral data content specifications for Sri Lanka.

This standard can be referenced at the following link:
http://inspire.ec.europa.eu/id/document/tg/cp

5.4 Data Specification on Coordinate Reference Systems – Technical Guidelines

The scope of the theme Coordinate reference systems covers the Geodetic Coordinate Reference Systems (CRS) required for uniquely referencing spatial information in space as a set of coordinates (X, Y, Z) and/or latitude (φ), longitude (λ) and either ellipsoidal (h) or gravity-related height (H).

This specification establishes:

a. The geodetic datums and coordinate reference systems to be used when making spatial data sets available for INSPIRE, unless otherwise required for data of a specific theme. Particularly, the following ones are adopted:

   - The European Terrestrial Reference System 1989 (ETRS89), as geodetic datum within its scope.
   - The European Vertical Reference System (EVRS), to express gravity-related heights on land within its scope.
   - Barometric pressure, converted to height using ISO 2533:1975 International Standard Atmosphere, to express heights in the free atmosphere.
   - The Lowest Astronomical Tide (LAT), as reference surface to express depth values representing the sea floor in marine areas with an appreciable tidal range.
   - The Mean Sea Level (MSL), or a well-defined reference level close to the MSL, as reference surface to express depth values representing the sea floor in marine areas without an appreciable tidal range, in open oceans and effectively in waters deeper than 200 metres.

b. Plane coordinates reference systems (map projections) adopted and recommended for different purposes, covering the requirements of the INSPIRE transformation services and view services as well. Particularly, at least the coordinate reference systems for two-dimensional geodetic coordinates (latitude, longitude) shall be available for the display of spatial data sets with the view network service (Regulation No 976/200915).
c. The identifiers for the different types of coordinates that shall be used.

The document also provides rules and guidance on geodetic coordinate reference systems, vertical reference systems and map projections for their use outside of continental Europe (e.g. overseas territories).

This standard can provide the SL-NSDI community with a useful reference in the development of a common Coordinate Reference System specification for Sri Lanka.

This standard can be referenced at the following link:
http://inspire.ec.europa.eu/id/document/tg/rs

5.5 Data Specification on Geographical Names – Technical Guidelines

Names of areas, regions, localities, cities, suburbs, towns or settlements, or any geographical or topographical feature of public or historical interest. [Directive 2007/2/EC].

This data specification describes concepts related with geographical names, i.e. proper nouns applied to a natural, man-made or cultural real world entity. The data specification is guided by the multi-language and multi-scriptual situation in Europe: a geographic entity can have different names in one or several languages, and each name can have different spellings, i.e. spellings in different scripts.

Because of this multi-language and multi-scriptual context, this specification defines a product that is feature oriented in order to enable to express which different names are used to designate one given place. In other words, the spatial objects defined in this specification are the ‘named places’, and the ‘geographical names’ are seen as information related to a named place. However, the product focuses

on the description of names rather than the description of spatial objects: it particularly describes characteristics of names like their language and spellings in different scripts.

In some cases names can be applied as attributes of appropriately modelled spatial objects in other themes defined by INSPIRE. However, often the definition, classification, geometry and other attributes of these objects do not necessary correspond with the respective named places as defined by this data specification, which focuses on the names aspects. Besides, commonly named geographic entities such as elevations, islands or coastal land formations are seldom modelled as spatial objects in other themes, while they are modelled as named places in this specification.

This standard can provide the SL-NSDI community with a useful reference in the development of a common Geographic Names System specification for Sri Lanka.

This standard can be referenced at the following link:
http://inspire.ec.europa.eu/id/document/tg/gn

5.6 Data Specification on Hydrography – Technical Guidelines 3.1

The theme ―Hydrography is a basic reference component and, therefore, of interest for many users and uses. Hydrography in the context of this data specification is involved with the description of the sea, lakes, rivers and other waters, with their phenomena and all hydrographic-related elements.

For mapping purposes (to provide a map background for orientation and to understand place relationships), it includes the representation of all main hydrographic elements – both natural and artificial. To fulfill reporting requirements of EC water-related directives it includes the river and channel network; surface water bodies within river basin districts are categorised as rivers, lakes, transitional waters or coastal waters, or as artificial surface water bodies or heavily modified surface water bodies. Furthermore, a topologically-sound river network is necessary for GIS-based spatial analysis and modelling.

Geographically, the theme ―Hydrography‖ covers all inland water and marine areas covered by river basin districts as defined by WFD.

This standard can provide the SL-NSDI community with a useful reference in the development of a common Hydrographic data specification for Sri Lanka.

This standard can be referenced at the following link:
http://inspire.ec.europa.eu/id/document/tg/hy

5.7 Data Specification on Protected Sites – Technical Guidelines

According to the International Union for the Conservation of Nature (IUCN) a Protected Site is an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means.

Within the INSPIRE context, Protected Sites may be located in terrestrial, aquatic and/or marine environments, and may be under either public or private ownership. They may include localities with

protection targets defined by different sectors and based on different objectives. Objectives for protection may include: the conservation of nature; the protection and maintenance of biological diversity and of natural resources and the protection of person-made objects including buildings, pre-historic and historic archaeological sites, other cultural objects, or sites with specific geological, hydrogeological or geomorphological value. Protected Sites may receive protection due to more than one type of objective, and may have a double or multifarious designation status.

Protected Sites may differ greatly in their reasons for protection, their designation and their management. Examples of legislation under which Protected Sites included in this INSPIRE theme are designated, managed and regulated include:

- the Habitats Directive (1992) (Directive 92/43/EC);
- the Birds Directive (1979) (Directive 79/409/EC);
- the Water Framework Directive (2000) (Directive 2000/60/EEC)
- the World Heritage Convention (1975);
- the Ramsar Convention (1971);
- the Barcelona Convention (1976);
- the Helsinki Convention (1974);
- the OSPAR Convention (1992) and
- the national laws of each European country and EU and international sector policies (for example, relating to forests or fisheries).

This standard can provide the SL-NSDI community with a useful reference in the development of a common Protected Sites data specification for Sri Lanka.

This standard can be referenced at the following link:
http://inspire.ec.europa.eu/id/document/tg/ps

5.8 Data Specification on Transport Networks – Technical Guidelines

The transport component should comprise of an integrated transport network, and related features, that are seamless within each national border. In accordance with Article 10(2) of the INSPIRE Directive, national transport networks may also be seamless at European level, i.e. connected at national borders. Transportation data includes topographic features that are related to transport by road, rail, water, and air. It is important that the features form networks where appropriate, and that links between different networks are established, i.e. multi-modal nodes, especially at the local level, in order to satisfy the requirements for intelligent transport systems such as location based services (LBS) and telematics. The transport network should also support the referencing of transport flows to enable the navigation services.

The data specification is extensive, covering major transport networks types that are defined in the five distinct transport themes (sub-themes): Road, Rail, Water, Air transport and Cableways15, including the connections between those types. The sub-themes are defined in a way that they can be used together to support an integrated approach to transport and they may be used with other spatial data themes. It is evident that there are a very large number of applications that can potentially use the Transport networks.

Taking into account the variety of responsibilities in collecting, managing and using the data and different approaches in the data base management practice, from simple models to complex data arrangements, this data specification is provided as basic framework and with the purpose to maximize the reuse and sharing of the data about a network. It is mainly focused on the "widely reused – widely referenced" segments of spatial objects, supporting the loose linkage between the diverse organizational data with these spatial objects and allowing the extensibility to fit into diverse applications and users needs.

This approach provides a framework for users to configure and associate their own information (from surface condition surveys, to journey planning, to trans-European transport policy making etc.) using existing transport networks information in each Member State.

The datasets in scope are used extensively at the "local level" and extended to regional, national and European levels. This data specification provides a coherent approach to the forms of the representation (physical topographic area objects or centreline representations) and consistency between data sets, the latest as different types of coherence (between spatial objects of the same theme at different levels of detail, between different spatial objects within a same area or coherence at state boundaries).

All the spatial data sub-themes are based on the INSPIRE Generic Conceptual Model (GCM) that relies on several ISO 19100 series of geographic information standards to provide the foundations for specific aspects of interoperability.

Within the GCM, the Generic Network Model (GNM) is defined to be shared by any network spatial data theme (e.g. Hydrography) to ensure a consistent approach across all network themes.

Specific mechanisms, used in the data specification and defined in the GNM, include:

- Network connection mechanism to establish the cross-border connectivity (a simple cross-referencing system to establish cross-border connections between the transport networks) or to establish intermodal connectivity (by linking two transport network elements from different transport networks which use a different mode of transport);
- Object referencing to support the reuse of information (for example to avoid the duplication of the geometry and to link complementary feature types from different organistaions);
- Linear referencing to support and link the different transport properties to the transport elements – it is used to position phenomena along a linear object, using a distance from the beginning of the linear object and
- The mechanism to combine the network elements into high-level semantic meanings.

The elements in the network are handled as nodes, links, aggregated links, areas and points. In addition, the individual transport links can be combined to form transport link sequences or further – the combination of both can be used to form the transport link sets.

The data specification includes three types of geometry: (a) (topographic) area objects, (b) centreline objects and (c) point objects. The types (a) and (b) may be alternative representations of the same real world phenomena about which the user can associate their own information (objects). The type (c) is, apart from network nodes, only included in the specification for marker posts. The basic spatial representation type is 2D vector.

This standard can provide the SL-NSDI community with a useful reference in the development of a common Transportation data specification for Sri Lanka.

This standard can be referenced at the following link:
http://inspire.ec.europa.eu/id/document/tg/tn

6 OTHER COMMUNITY MAINTAINED STANDARDS.

Some de facto standards have emerged through various research and development efforts and are now in common usage in the industry. This section includes those that have some direct relevance to the SL-NSDI programme.

6.1 GeoTIFF

GeoTIFF represents an effort by over 160 different remote sensing, GIS, cartographic, and surveying related companies and organizations to establish a TIFF based interchange format for georeferenced raster imagery. GeoTIFF has become an international standard that is periodically updated through broad professional consultation. It is recommended that the SL-NSDI adopt this standard and continue to follow and apply the refinements to the standard over time.

GeoTIFF is a public domain specification which allows georeferencing information to be embedded within a TIFF file. The potential additional information includes projections, coordinate systems, ellipsoids, datums, and other information needed to establish the spatial reference for the imagery or gridded data contained in the file. The GeoTIFF format augments the TIFF format, so TIFF-enabled software incapable of reading and interpreting the specialized georeferencing metadata should still be able to open a GeoTIFF file sufficiently to at least view the image or scanned map data. The GeoTIFF specification defines a set of TIFF tags provided to describe geographic and cartographic information associated with TIFF imagery that originates from such sources as satellite imaging systems, scanned aerial photography, scanned maps, digital elevation models, or as a result of geographic analyses. Its aim is to allow the means for tying a raster image to a known model space or map projection, and for describing those projections. The tags documented in the GeoTIFF specification are to be considered completely orthogonal to the raster-data descriptions of the TIFF specification, and impose no restrictions on how the standard TIFF tags are to be interpreted, which color spaces or compression types are to be used, etc.

This standard is maintained and used by a large number of organizations involved in geospatial technologies. It is suggested that the SL-NSDI community adopt the standard and monitor the evolution of the standard in the future.

The standard is freely available and can be accessed online at http://trac.osgeo.org/geotiff/.

6.2 Network Common Data Form (NetCDF)

NetCDF (Network Common Data Form) is a set of software libraries and self-describing, machine-independent data formats that support the creation, access, and sharing of array-oriented scientific data.
NetCDF is product of the Unidata community. Unidata is a diverse community of education and research institutions with the common goal of sharing geoscience data and the tools to access and visualize that data. For more than 30 years, Unidata has been providing data, software tools, and

support to enhance Earth-system education and research. Funded primarily by the National Science Foundation (NSF), Unidata is one of the University Corporation for Atmospheric Research (UCAR)'s Community Programs (UCP).

This standard is maintained and used by a large number of scientific organizations involved in scientific research and data collection. It is suggested that the SL-NSDI community adopt the standard and monitor the evolution of the standard in the future.

The standard can be accessed online at http://www.unidata.ucar.edu/software/netcdf/

ANNEX A – GEOSPATIAL DATA DICTIONARY

The information in this Annex has been adapted from the specifications developed and implemented by Geosciences Australia. [5] This is included here as an example data dictionary that can be emulated for the development of similar documentation for each of the Fundamental Geospatial Data Sets (FGDS) that are to be adopted in the future by the SL-NSDI.

The Spatial Data Dictionary is a specification for the capture of geoscientific spatial data. It describes fields for each feature type in a database, containing the themes currently created from Geoscience Australia's databases. It forms a foundation for the production of geoscientific spatial data by specifying rules regarding the structure of such data.

The dictionary covers such matters as allowable coverage names, feature types, and attribute values. A theme is a set of spatial objects. Some of the themes in this data dictionary have associated look-up tables. Look-up tables store an additional array of attributes that may be linked to the primary attribute table of a theme. Object type, feature definition, field type, attribute case, compulsion for data entry, a list of valid values and any rules or comments regarding the feature are also given in this data dictionary.

Definitions, Rules and Terminology

Introduction & Document Structure

A data dictionary is a description of fields for each feature type in a database. The Geoscience Australia Data Dictionary for Spatiial Data contains a description of all the themes currently created from GA's databases. A theme is a set of spatial objects. Some of the themes in this data dictionary have associated look-up tables. Look-up tables store an additional array of attributes that may be linked to the primary attribute table of a theme. Object type, feature definition, field type, attribute case, compulsion for data entry, a list of valid values and any rules or comments regarding the feature are also given in this data dictionary.

1.1 Maintenance

This document is subject to periodic updates. Requests to include new themes and/or attributes into the data dictionary should be submitted to the DMQ Team Leader **by e- mailing to *datagc@ga.gov.au*** . Please consult the work instruction below before making requests.

Click here for "Instructions for updating the Data Dictionary"

1.2 Terminology

Coverage is an ArcInfo term for a theme or a layer
PAT file is an
ArcInfo term
for a Polygon

[5] http://www.ga.gov.au/data-pubs/data-standards/standard-symbols/spatial-data-dictionary

Attribute
Table or a
Point Attribute
Table AAT
file is an
ArcInfo term
for an Arc
Attribute
Table
RECNO is an internal record number for an ArcInfo attribute table

1.3 Field formats

Field Type	Explanation
20,20,C	character field 20 characters long
8,8,I	integer field 8 digits long i.e. smallest number available is -9999999 and largest number available is 99999999
9,9,N,3	numerical field with 3 decimal places e.g. 12345.789 i.e. smallest number available is -9999.999 and largest number available is 99999.999

1.4 General rules

Theme is a set of spatial objects - a coverage in ArcInfo or ArcView, a shape file in ArcView and a table in MapInfo. Some of the themes may have associated look-up tables. Where possible, directory structure should be used to denote themes spatial location, scale or other properties.

All fields for each theme defined in this document must be listed in the order and size as specified.

Where valid values are listed, any unlisted values are invalid. Only valid values may be used.

All themes must be in double precision unless there is a very good reason why single precision is the only option. This matter is to be confirmed with the Divisional Data Administrator.

Annotations are not allowed in the GIS and Oracle themes under any circumstances. Cartographic coverages exist for such purpose. They are named by adding the 'MAP' suffix to the theme name. Cartographic themes may contain annotation, lead lines, and other cartographic symbology required for plotting. However, duplication of features between the GIS/Oracle and cartographic 'MAP' coverages should be avoided, if possible.

GIS data sourced form other agencies e.g. mineral deposit data from State Mines Departments, does not need to comply to the AGSO's Geoscience GIS Data Dictionary.

Some of the themes may have an ArcInfo regions topology. Regions should be converted to polygons before attempting to export data into ArcView or MapInfo formats.

All themes must be documented and have accompanied metadata that conforms to current ANZLIC standard for Core Metadata Elements.

1.5 Text field rules

Only upper case characters are allowed in the upper case fields.
Mixed case fields may contain both upper and lower case characters. Upper case characters are preferred.
For mixed case fields first letter in a sentence should always start with the upper case.
Only one space is allowed between words.
All sentences should be completed with full stop.
A punctuation mark should always follow the word without any spaces between word and the punctuation mark. A word immediately after the punctuation mark should be separated from the punctuation mark by a single space.

Field Type	Attribute value example
Mixed case field	Shale, siltstone and sandstone. Minor volcanic conglomerate.
Upper case field	SHALE, SILTSTONE AND SANDSTONE. MINOR VOLCANIC CONGLOMERATE.

1.6 Numeric field rules

Where value of a numerical item is not known and should not equal to zero, the value should be set to -9. Examples are points where all structural measurements were not completed.

1.7 UFI Field Numbering Rules

Unique Feature Identifier (UFI) field is compulsory for all features in a theme and must be populated. If theme (coverage) is constructed in Arc/INFO GIS, the ufi for a feature other than a polygon (e.g. point or line) is calculated as:

```
calculate ufi = $recno
```

If feature is a polygon, the universal (world) polygon must be accounted for and the ufi is therefore calculated as:

```
reselect $recno ne 1 calculate ufi
= $recno - 1
```

1.8 Annotation rules

Annotation subclasses should be named same as the items whose value the annotation represents. For example annotation for geological polygons in GEOLANN coverage would have subclass plot_symb i.e. anno.plot_symb. In all other cases user is allowed to name its own annotation subclasses.

1.9 Polygon labelling rules

Meaning	Character	Map Label	Map Symbol
Proterozoic 'P'	-P	Pfb	-Pfb
Cambrian 'C'	-C	COlj	-COlj
pre-Cambrian	p-C	pCg	p-Cg
Triassic 'T'	-R	Rm	-Rm
Subscript	>	Pg_a	-Pg>a
Superscript	^	Cla^1	-Cla^1
Combined units	,	Qa, Qs	Qa,Qs
Overlying	/	Qs Pg	Qs/-Pg
Complex relationships	use brackets ()	Qs Pla, Plm	Qs/(-Pla,-Plm)
		Tla, Qr Qc	Tla,(Qr/Qc)
		Tla, Qr, Qz Plm	Tla,((Qr,Qz)/-Plm)

1.10 GIS analysis look-up tables

For all themes in the data dictionary a GIS analysis look-up tables are allowed. The tables should have any other items of interest for a GIS analysis. The tables naming convention follows 8.3 format:

`<theme>.<GA><S|L|P>`

where `<theme>` is the standard theme name
`<GA>` stands for GIS Analysis
`<S|L|P>` one of feature-type identifiers; S for point (spot), L for line (arc) and P for polygon themes Tables should be defined according to the following rules:

- the item *ufi* is used as a link to respective AAT or PAT file of the theme
- only *ufi*s for tagged features should appear in the table
- the item *ufi* should always be the first item in the table
- other user-defined items should not appear in the data dictionary

Example

Geologist may want to tag particular arcs in GEOL theme as major greenstone belt boundaries. In this case, the GEOL.GAL GIS analysis look-up table would have the following structure:

ufi	greenstone	description	other2	etc...
12331	Y	Major greenstone belt boundary		N
12562			High percentage	Y
14522	Y	Major greenstone belt boundary		Y

Analysis items, i.e. *greenstone* in the above example, should be kept in respective feature tables - AATs and/or PATs while data set is in construction stage. Once data set is complete, the analysis attributes should be moved to their respective look-up tables.

1.11 Standard theme naming convention

Theme Domain	ArcInfo coverage name	sociated Look- up Table(s)	Feature Geometry Type(s)	ArcView and MapInfo naming convention in 8.3 file name format
Geology Themes				
Geology	GEOL	GEOL.LUT	Polygon, Line	GEOLP, GEOLL
Geology structural lines	STRLINE		Line	STRLINE
Geology cross-section	XGEO*nn*	GEOL.LUT	Polygon, Line	XGEO*nn*P, XGEO*nn*L
Geology cross-section structural lines	XGEOL*nn*		Line	XGEOL*nn*
Generalised geology	GEOL*nnn*	GEOL.LUT	Polygon, Line	GEOL*nnn*P, GEOL*nnn*L
Solid geology	SOLGEOL	GEOL.LUT	Polygon, Line	SOLGEOLP, SOLGEOLL
Generalised solid geology	SOLG*nnn*	GEOL.LUT	Polygon, Line	SOLG*nnn*P, SOLG*nnn*L
Solid geology structural lines	SOLGSTR		Line	SOLGSTR
Lithology	LITHOLGY		Polygon, Line	LITHOLGYP, LITHOLGYL
Geological regions	GEOREGN		Polygon, Line	GEOREGNP, GEOREGNL
Geological provinces	GEOLPROV		Polygon	GEOLPROVP, GEOLPROVL
Metamorphism	METAMRPH*n*		Polygon, Line	METMRP*n*P, METMRP*n*L
Alteration zones	ALTZONE		Polygon, Line	ALTZONEP, ALTZONEL
Regolith-landform	REGO	REGO.LUT	Polygon, Line	REGOP, REGOL
Regolith lines	REGOLIN		Line	REGOLIN
Regolith points	REGOPNT		Point	REGOPNT
Earthquake hazard	QUAKEHAZ		Polygon, Line	QUAKHAZP, QUAKHAZL
Geophysics Themes				
Geophysical interpretation	GPHINT*n*		Polygon, Line	GPHINT*n*P, GPHINT*n*L
Geophysical lines	GPHLIN*n*		Line	GPHLIN*n*
Geophysical points	GPHPNT*n*		Point	GPHPNT*n*
Geophysical cross-section	XGPH*nn*		Polygon, Line	XGPH*nn*P, XGPH*nn*L
Airborne electromagnetic (AEM) interpretation (including adjunct features)	AEMINT*n* AEMADJ*n*		Polygon, Line Polygon, Line	AEMINT*n*P, AEMINT*n*L AEMADJ*n*P, AEMADJ*n*L
Airborne electromagnetic (AEM) lines and points (including adjunct features)	AEMLIN*n* AEMPTS*n* AEMADJL*n* AEMADJP*n*		Line Point Line Point	AEMLIN*n* AEMPTS*n* AEMADJL*n* AEMADJP*n*
Remote sensing interpretation	SATINT*n*		Polygon, Line	SATINT*n*P, SATINT*n*L
Remote sensing lines	SATLIN*n*		Line	SATLIN*n*
Depth to basement	BASDPT*n*		Line, Point	BASDPT*n*L, BASDPT*n*S
Seismic survey lines	SEISMIC		Line	SEISMIC
Seismic velocities	SEISVEL		Point	SEISVEL
Geochemistry and Geochronology Themes				
Geochemistry	OZCHEM		Point	OZCHEM
SHRIMP dating	SHRIMP	SHRIMP.LUT	Point	SHRIMP
Theme Domain	**ArcInfo coverage name**	**sociated Look- up Table(s)**	**Feature Geometry Type(s)**	**ArcView and MapInfo naming convention in 8.3 file name format**

Geochemistry and Geochronology Themes (continued)

Sm-Nd dating	SMND	SMND.LUT	Point	SMND
Rb-Sr dating	RBSR		Point	RBSR
U-Pb dating	UPB		Point	UPB
Mineral Deposits and Mineral Potential Assessment Themes				
OZMIN mineral deposits	OZMIN	OZMIN.COM OZMIN.EXT OZMIN.LTH OZMIN.MIN	Point	OZMIN
Mineral deposits including historical data	DEPOSIT	DEPOSIT.COM	Point	DEPOSIT
Mineral localities	MINLOC		Point	MINLOC
Mineral exploration and mining titles	MINRTLE	MINRTLE.LUT	Region, Line	MINRTLEP, MINRTLEL
Petroleum exploration and development titles	PETRTLE	PETRTLE.LUT	Region, Line	PETRTLEP, PETRTLEL
Petroleum wells	WELLS		Point	WELLS
Open cut mines and quarries	MINES		Polygon, Line	MINESP, MINESS
Mineral deposit tracts	MOD*nnX*		Polygon, Line	MOD*nnX*P, MOD*nnX*L
Mineral potential (combined)	MINPOT		Polygon, Line	MINPOTP, MINPOTL
Weighted mineral potential (combined)	WMINPOT		Polygon, Line	WMINPOTP, WMINPOTL
Mineral potential	COMP WCOMP CUMU WCUMU		Polygon, Line Polygon, Line Polygon, Line Polygon, Line	COMPP, COMPL WCOMPP, WCOMPL CUMUP, CUMUL WCUMUP, WCUMUL
Certainty of the mineral potential assessment	COMPCERT CUMUCERT		Polygon, Line Polygon, Line	COMPCRTP, COMPCRTP CUMUCRTP, CUMUCRTL
Certainty (combined) of the mineral potential assessment	CERT		Polygon, Line	CERTP, CERTL
Surveys and Field Observation Themes				
Field sites	SITES		Point	SITES
Regolith-landform site descriptions	RTSITES	RTZONES.LUT RTSITES.LUT	Point	RTSITES
Outcrops	OUTCROP		Point	OUTCROP
Rocks	ROCKS	ROCKS.LUT	Point	ROCKS
Structural measurements	STRUC		Point	STRUC
Drill holes and measured sections	SECHOLE	SECHOLE.LTH SECHOLE.STR SECHOLE.SVY	Point	SECHOLE
Linear geology from drill holes (DEVIANT)	DHGEOL	DHGEOL.LUT	Point	DHGEOL
Measured sections (DEVIANT database)	MSRSECT	MSRSECT.LUT	Point	MSRSECT
Petrographic descriptions	PETROG	PETROG.DAT PETROG.MIN	Point	PETROG
Field photos	PHOTO		Point	PHOTO
Theme Domain	**ArcInfo coverage name**	**sociated Look- up Table(s)**	**Feature Geometry Type(s)**	**ArcView and MapInfo naming convention in 8.3 file name format**
Surveys and Field Observation Themes (continued)				
Fossils	FOSSIL		Point	FOSSIL
Ship surveys	SHIPSURV		Line	SHIPSURV
Marine survey point	MARINEPT		Point	MARINEPT

Swath boundaries	SWATHBDY		Polygon, Line	SWTHBDYP, SWTHBDYL

Offshore boundaries	OFFSHBDY		Line	OFFSHBDY
Earthquakes	EQUAKES		Point	EQUAKES
Landslides	LANDSLID		Point	LANDSLID
Australian Fundamental Gravity Network stations	AFGNSTN		Point	AFGNSTN
Index of gravity geophysical surveys	GRAVSRV		Point	GRAVSRV
Index of airborne geophysical surveys	AIRBSRV		Region, Line	AIRBSRVP, AIRBSRVL
Urban Infrastructure Themes				
Buildings	BUILDNG		Point	BUILDNG
Urban areas	URBAN		Polygon, Line	URBANP, URBANL
Roads	ROAD		Line	ROAD
Railways	RAILWAY		Line	RAILWAY
Assessment of the exposure to flood at a spot height	SPOTFLD		Point	SPOTFLD
Electrical power grid	POWER		Line, Point	POWERL, POWERS
Water network	WATER		Line, Point	WATERL, WATERS
Sewerage network	SEWER		Line, Point	SEWERL, SEWERS
Natural gas distribution network	GAS		Line, Point	GASL, GASS
Pipelines	PIPELINE		Line	PIPELINE
Oil and gas fields	OILFLDS		Polygon, Line	OILFLDSP, OILFLDSL
Telecommunications infrastructure	TELECOM		Line, Point	TELECOML, TELECOMS
Culture	CULT		Line, Point	CULTL, CULTS
Land use (ANZLUC)	LANDUSE		Polygon, Line	LANDUSEP, LANDUSES
Terrain Physiography Themes				
Drainage	DRAIN		Line, Point	DRAINL, DRAINS
Water bodies	WTRBDY		Polygon, Line	WTRBDYP, WTRBDYL
Relief	RELIEF HYPSO		Line, Point Polygon, Line	RELIEFL, RELIEFS HYPSOP, HYPSOL
Bathymetry	BATHY		Line	BATHY
Cartographic Themes				
Frame	FRAME		Polygon, Line	FRAMEP, FRAMEL
Map grid, graticule and border	MAPGRID		Line	MAPGRID
Cross-section line(s)	XLINE		Line	XLINE

1.12 Generalised themes

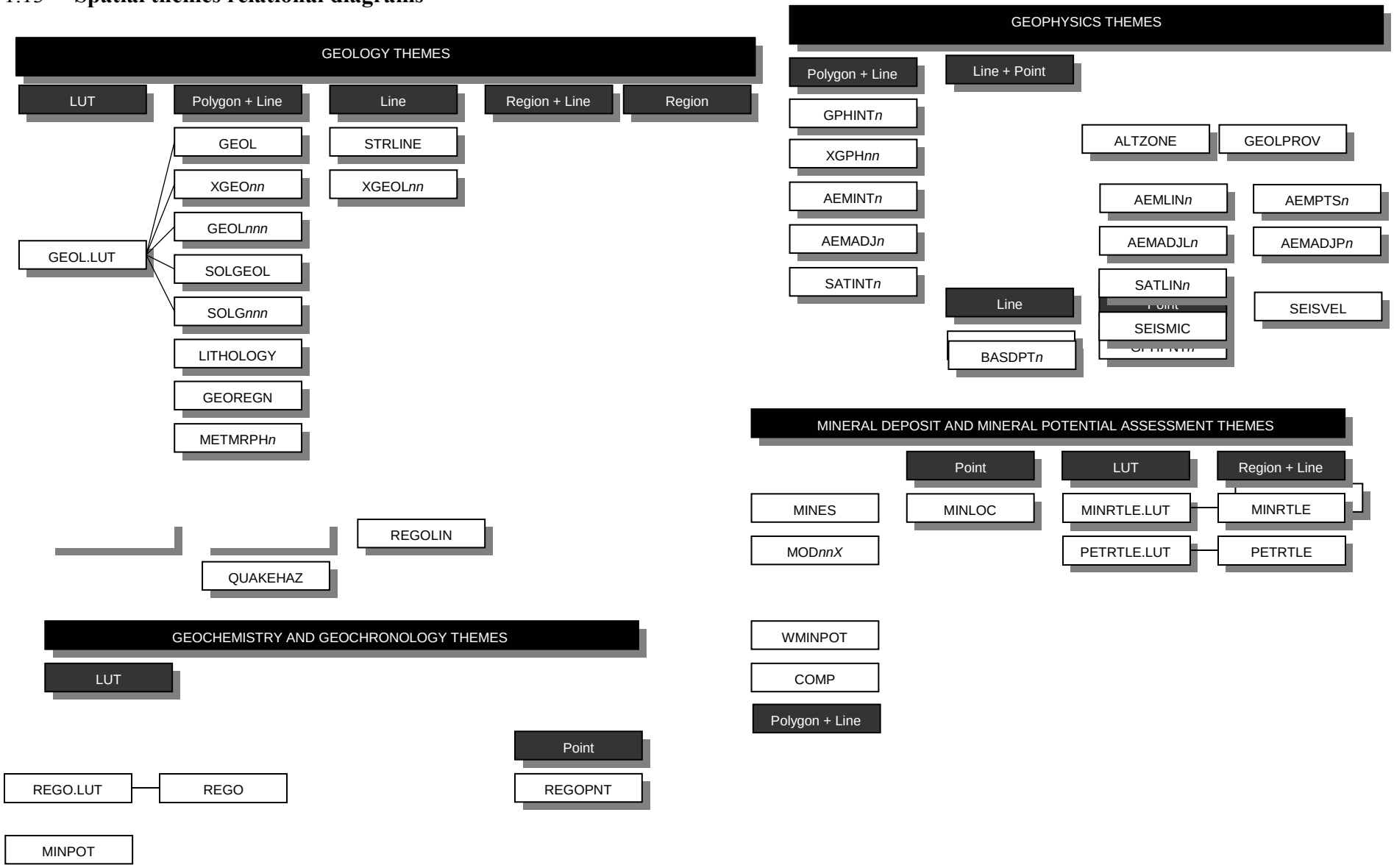
Generalised geology GEOL*nnn* and generalised solid geology SOLG*nnn* are themes derived from GEOL or SOLGEOL themes respectively and where *nnn* represent intended scale of generalisation, for example:

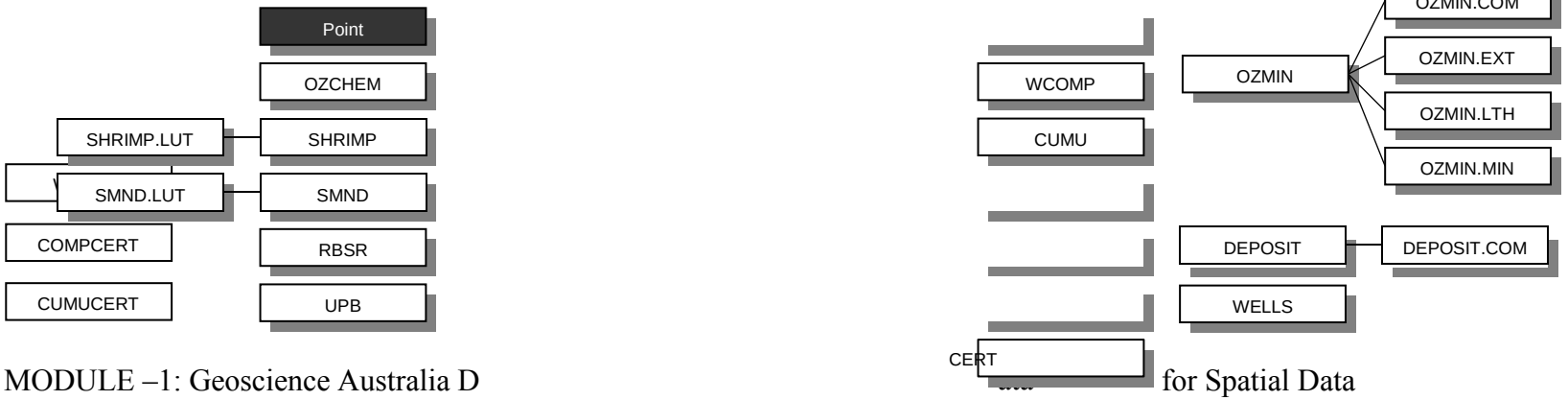
***nnn* suffix**	**Intended map scale**
100	1:100,000
250	1:250,000
500	1:500,000
10m	1:1,000,000
25m	1:2,500,000
5m	1:5,000,000

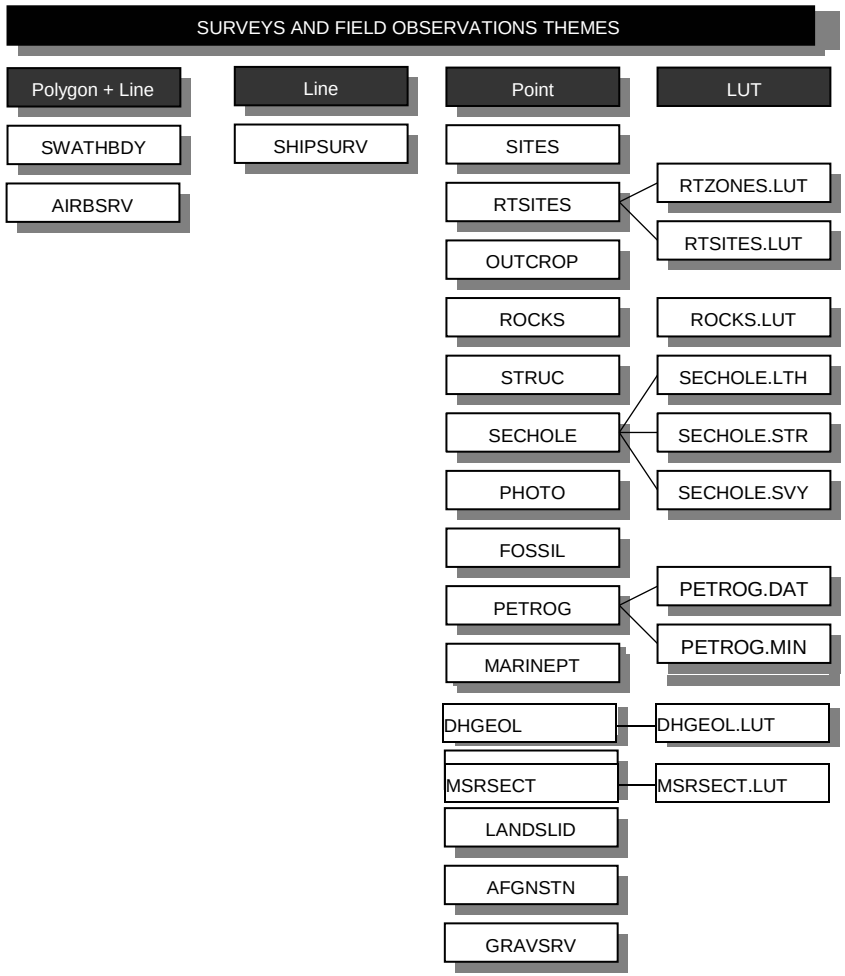
Coverages with the same name must be kept in different workspaces and are for INTERNAL USE only.

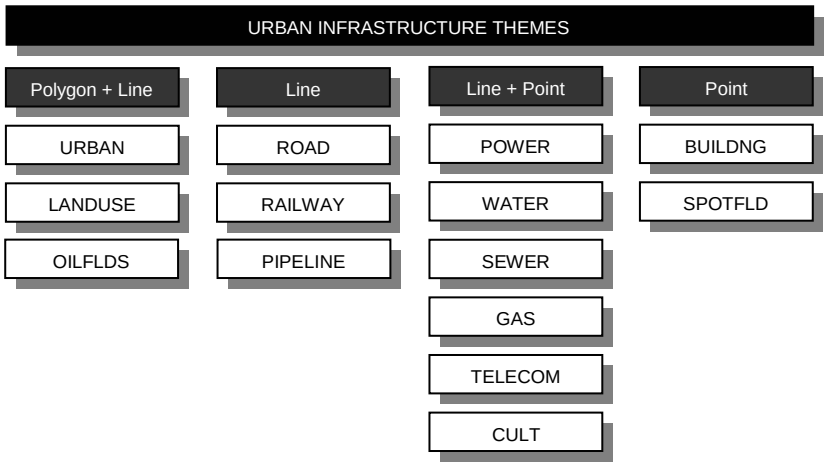
MODULE –1: Geoscience Australia Data Dictionary for Spatial Data 7

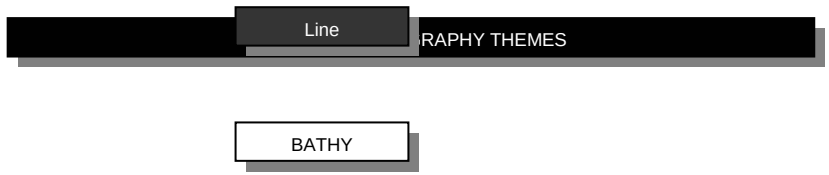
1.13 Spatial themes relational diagrams




Point
OZCHEM
SHRIMP.LUT
SHRIMP
SMND.LUT
SMND
COMPCERT
RBSR
CUMUCERT
UPB
WCOMP
CUMU
CERT
OZMIN
OZMIN.COM
OZMIN.EXT
OZMIN.LTH
OZMIN.MIN
DEPOSIT
DEPOSIT.COM
WELLS

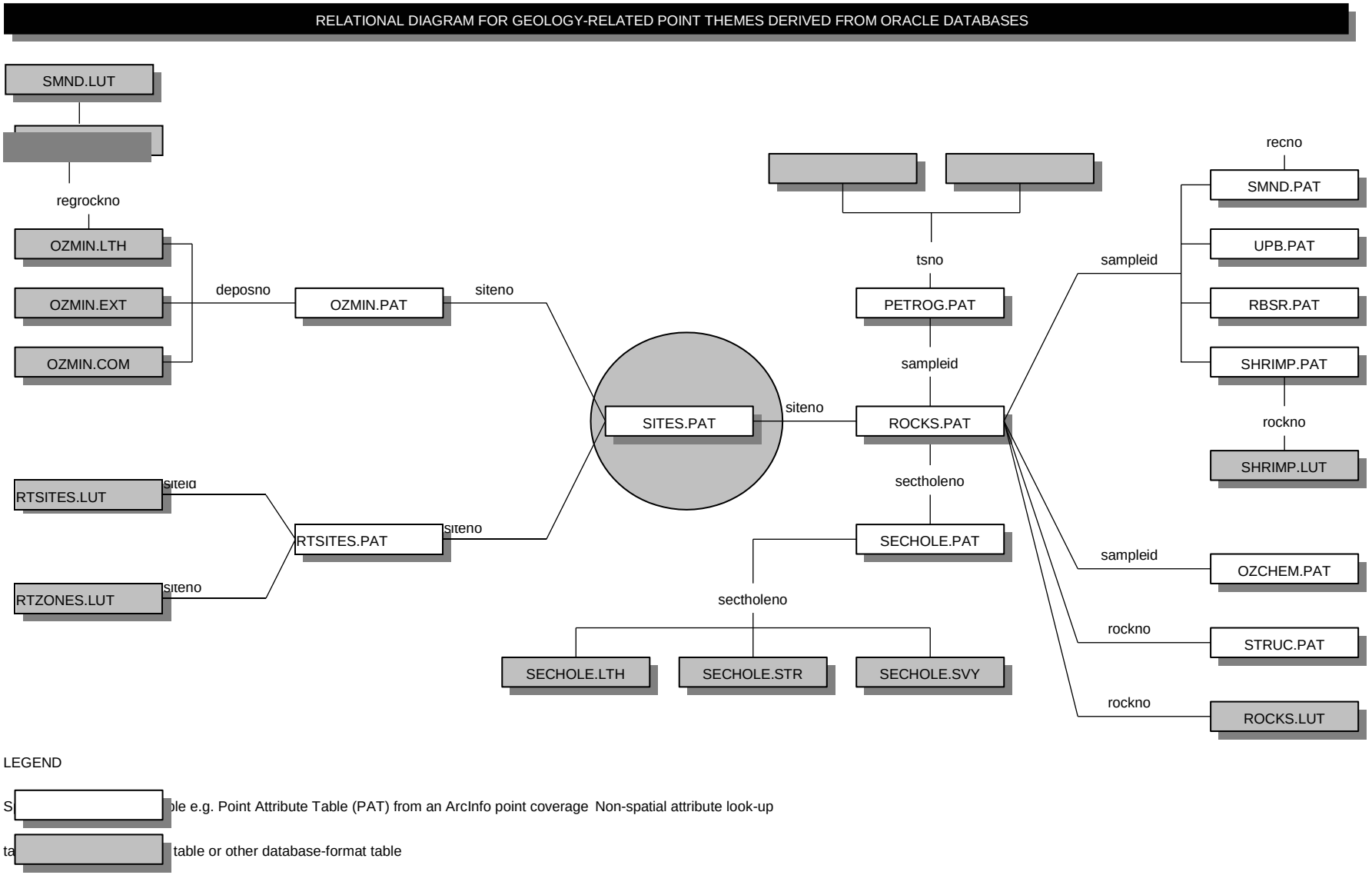

SURVEYS AND FIELD OBSERVATIONS THEMES
Polygon + Line
SWATHBDY
AIRBSRV
Line
SHIPSURV
Point
SITES
RTSITES
OUTCROP
ROCKS
STRUC
SECHOLE
PHOTO
FOSSIL
PETROG
MARINEPT
DHGEOL
MSRSECT
LANDSLID
AFGNSTN
GRAVSRV
LUT
RTZONES.LUT
RTSITES.LUT
ROCKS.LUT
SECHOLE.LTH
SECHOLE.STR
SECHOLE.SVY
PETROG.DAT
PETROG.MIN
DHGEOL.LUT
MSRSECT.LUT


URBAN INFRASTRUCTURE THEMES
Polygon + Line
URBAN
LANDUSE
OILFLDS
Line
ROAD
RAILWAY
PIPELINE
Line + Point
POWER
WATER
SEWER
GAS
TELECOM
CULT
Point
BUILDNG
SPOTFLD


Line
RAPHY THEMES
BATHY


CARTOGRAPHIC THEMES
Any Feature
themeMAP


Polygon + Line
WTRBDY
HYPSO
Line + Point
DRAIN
RELIEF
Polygon + Line
FRAME
Line
MAPGRID
XLINE


RELATIONAL DIAGRAM FOR GEOLOGY-RELATED POINT THEMES DERIVED FROM ORACLE DATABASES
SMND.LUT
regrockno
OZMIN.LTH
OZMIN.EXT
OZMIN.COM
deposno
OZMIN.PAT
siteno
SITES.PAT
RTSITES.LUT
siteid
RTSITES.PAT
siteno
RTZONES.LUT
siteno
tsno
PETROG.PAT
sampleid
siteno
ROCKS.PAT
sectholeno
SECHOLE.PAT
sectholeno
SECHOLE.LTH
SECHOLE.STR
SECHOLE.SVY
recno
SMND.PAT
UPB.PAT
RBSR.PAT
SHRIMP.PAT
rockno
SHRIMP.LUT
sampleid
OZCHEM.PAT
rockno
STRUC.PAT
rockno
ROCKS.LUT
LEGEND
ble e.g. Point Attribute Table (PAT) from an ArcInfo point coverage
Non-spatial attribute look-up
table or other database-format table

1.14 How to read this Data Dictionary

Name *The verbal name of the theme*

Name *The name of the digital theme*
Description *A short description of the type of data in this theme*
Type *Whether the theme is a point, line, polygon, region, point/line or polygon/line theme*
Linked table *Any linked look-up tables for this theme are listed here*
Linked table *The name of any linked theme*

Note *Any special notes relating to the theme*

Object	Feature Class	Feature	Feature Definition	Attributes
Whether the feature class is polygon, arc (line), or point	*The name of the feature class*	*The attribute value for the feature field*	*The definition of the feature*	*The list of fields applying to the feature*

Object	Field Name	Field Type	Case	Compulsory	Valid Values	Description of Field	Rules
Whetеher the field is applying to a polygon, arc (line) or point	*The name of the field*	*The type of field and its width*	*The case for char fields - upper, lower or mixed*	*Whether it is compulsory to have entries in this field*	*The list of valid attribute values*	*A description of the meaning of the field*	*Any rules applying to the use of this field, or any comments about the field*

Selected Authority Tables

1.1 Feature codes

RULES

1. Classification of linear features is governed by geological certainty and positional accuracy. For example, boundaries are established or inferred. Established boundaries may be accurate, approximate or concealed. Inferred boundaries are approximate and may be concealed (deduced, not observed). A concealed but not inferred boundary is one established by sub-surface exploration or is an established boundary beneath cover.
2. Feature code is an integer number comprised of: the 'section' to which the feature belongs (first 2 digits), the number of the feature (next 3 digits), and the classification (positional accuracy/geological certainty) of the feature (last 2 digits).
3. Some features only have the 'undefined', or '00', accuracy/certainty codes listed. However, new codes can be created by using the CLASS tables to alter the last two digits of the feature code.
4. The coding system has been designed for use in both digital (GIS) data and to facilitate cartographic symbolisation on maps. For this reason a single feature type
   e.g. marker bed, may have multiple feature codes because it has multiple symbols. This is not ideal.
5. In digital data, descriptions such as 'tick on younger rocks' (faults) and 'double arrow indicates steeper limb' (folds) are meaningless because the cartographic symbolisation is not present. Therefore, as a general rule, the line must be orientated such that particular characteristic described is dextral ie when viewed from the start point to the end point ('FROM' node to the 'TO' node) the characteristic described (the younger rocks, or the steeper limb) is on the right. This orientation of the line is often required for cartographic line symbolisation in any case.
6. Dextral is to the right of a line when viewing from the start node. Sinistral is to the left.

LINE CLASSIFICATIONS

Geological classes

1 UNDEFINED
2 ACCURATE
3 APPROXIMATE
4 INFERRED
5 CONCEALED
6 INFERRED-CONCEALED

Geophysical classes

7 PROBABLE
8 SPECULATIVE

Regolith classes
11 BURIED
12 INVERTED
13 EXTRUDED

POINT CLASSIFICATIONS

Use of coding for 'point' accuracy:

1 UNDEFINED – e.g. map data (could also be 02)
2 ACCURATE – e.g. DGPS, field measurement
3 APPROXIMATE – e.g. GPS, interpreted data, map data

TYPE	FEAT_CODE	DESCRIPT	CLASS	DEENO
		00.000 MISCELLANEOUS		
Line	00 001 00	Tile frame - plotted	0	0
Line	00 002 00	Tile frame - not plotted	0	0
Line	00 003 00	Polygon splitting line - not plotted	0	0
Line	00 004 00	Graphics linework - not plotted	0	0
Line	00 005 00	Closing line	0	0
Line	00 006 00	Water feature boundary – rivers, coastlines or lakes	0	0
Line	00 007 00	Cultural boundary – roads, tracks etc	0	0
Line	00 008 00	Administrative boundary – state borders, political or other admin boundaries	0	0
Line	00 009 00	Geological boundary – province boundaries, faults and other geological boundaries	0	0
		10.000 GEOLOGICAL BOUNDARIES		
Line	10 001 00	Geological boundary	0	0
Line	10 001 01	Geological boundary, accurate	1	0
Line	10 001 02	Geological boundary, approximate	2	0
Line	10 001 03	Geological boundary, inferred	3	0
Line	10 001 04	Geological boundary, concealed	4	0
Line	10 001 05	Geological boundary, inferred, concealed	5	0
Line	10 002 00	Sedimentary facies boundary	0	0
Line	10 002 01	Sedimentary facies boundary, accurate	1	0
Line	10 002 02	Sedimentary facies boundary, approximate	2	0
Line	10 002 03	Sedimentary facies boundary, inferred	3	0
Line	10 002 04	Sedimentary facies boundary, concealed	4	0
Line	10 002 05	Sedimentary facies boundary, inferred, concealed	5	0
Line	10 003 00	Transitional geological boundary	0	0
Line	10 004 00	Alluvial boundary	0	0
Line	10 005 00	Bedrock boundary	0	0
Line	10 006 00	Geological boundary between intrusive rocks, younger rocks on right	0	0
Line	10 007 00	Geological region boundary	0	0
Line	10 008 00	Miscellaneous boundary	0	0
Line	10 009 00	Metamorphic facies boundary	0	0
Line	10 010 00	Alteration zone boundary	0	0
Line	10 011 00	Metamorphic isograd showing index minerals	0	0
Line	10 012 00	Metamorphic isograd showing index minerals	0	0
Line	10 013 00	Palaeogeographic lithology boundary	0	0
Line	10 014 00	Palaeogeographic environment boundary	0	0
Line	10 015 00	Geological province boundary		
		10.030 UNCONFORMITIES		

Line	10 030 00	Unconformity. Younger rocks to right	0	0
Line	10 031 00	Angular unconformity. Younger rocks to right	0	0

Line	10 032 00	Disconformity. Younger rocks to right	0	0
Line	10 033 00	Nonconformity. Younger rocks to right	0	0
Line	10 034 00	Paraconformity. Younger rocks to right	0	0
Line	10 035 00	Unconformity	0	0
Line	10 036 00	Angular unconformity	0	0
Line	10 037 00	Disconformity	0	0
Line	10 038 00	Nonconformity	0	0
Line	10 039 00	Paraconformity	0	0
		10.050 GEOLOGICAL MARKERS		
Line	10 050 00	Marker bed/band	0	0
Line	10 051 00	Marker bed/band	0	0
Line	10 052 00	Marker bed/band	0	0
Line	10 053 00	Marker bed/band	0	0
Line	10 054 00	Thin bed or layer	0	0
Line	10 055 00	Thin bed or layer	0	0
Line	10 056 00	Thin bed or layer	0	0
Point	10 057 00	Small outcrop	0	0
		11.000 FAULTS		
Line	11 001 00	Fault	0	0
Line	11 001 01	Fault, accurate	1	0
Line	11 001 02	Fault, approximate	2	0
Line	11 001 03	Fault, inferred	3	0
Line	11 001 04	Fault, concealed	4	0
Line	11 001 05	Fault, inferred, concealed	5	0
Line	11 002 00	Fracture or minor fault	0	0
Line	11 002 01	Fracture or minor fault, accurate	1	0
Line	11 002 02	Fracture or minor fault, approximate	2	0
Line	11 002 03	Fracture or minor fault, inferred	3	0
Line	11 002 04	Fracture or minor fault, concealed	4	0
Line	11 002 05	Fracture or minor fault, inferred, concealed	5	0
Line	11 003 00	Vertical fault	0	0
Line	11 003 01	Vertical fault, accurate	1	0
Line	11 003 02	Vertical fault, approximate	2	0
Line	11 003 03	Vertical fault, inferred	3	0
Line	11 003 04	Vertical fault, concealed	4	0
Line	11 003 05	Vertical fault, inferred, concealed	5	0
Line/Pattern	11 004 00	Normal fault. Younger rocks on right	0	0
Line/Pattern	11 004 01	Normal fault, accurate. Younger rocks on right	1	0
Line/Pattern	11 004 02	Normal fault, approximate. Younger rocks on right	2	0
Line/Pattern	11 004 03	Normal fault, inferred. Younger rocks on right	3	0
Line/Pattern	11 004 04	Normal fault, concealed. Younger rocks on right	4	0
Line/Pattern	11 004 05	Normal fault, inferred, concealed. Younger rocks on right	5	0

Line/Pattern	11 005 00	Low-angle normal fault. Younger rocks on right	0	0
Line/Pattern	11 005 01	Low-angle normal fault, accurate. Younger rocks on right	1	0
Line/Pattern	11 005 02	Low-angle normal fault, approximate. Younger rocks on right	2	0

Line/Pattern	11 005 03	Low-angle normal fault, inferred. Younger rocks on right	3	0
Line/Pattern	11 005 04	Low-angle normal fault, concealed. Younger rocks on right	4	0
Line/Pattern	11 005 05	Low-angle normal fault, inferred, concealed. Younger rocks on right	5	0
Line/Pattern	11 006 00	High-angle normal fault. Younger rocks on right	0	0
Line/Pattern	11 006 01	High-angle normal fault, accurate. Younger rocks on right	1	0
Line/Pattern	11 006 02	High-angle normal fault, approximate. Younger rocks on right	2	0
Line/Pattern	11 006 03	High-angle normal fault, inferred. Younger rocks on right	3	0
Line/Pattern	11 006 04	High-angle normal fault, concealed. Younger rocks on right	4	0
Line/Pattern	11 006 05	High-angle normal fault, inferred, concealed. Younger rocks on right	5	0
Line/Pattern	11 007 00	Thrust-fault. Younger rocks on right	0	0
Line/Pattern	11 007 01	Thrust-fault, accurate. Younger rocks on right	1	0
Line/Pattern	11 007 02	Thrust-fault, approximate. Younger rocks on right	2	0
Line/Pattern	11 007 03	Thrust-fault, inferred. Younger rocks on right	3	0
Line/Pattern	11 007 04	Thrust-fault, concealed. Younger rocks on right	4	0
Line/Pattern	11 007 05	Thrust-fault, inferred, concealed. Younger rocks on right	5	0
Line/Pattern	11 008 00	High-angle thrust-fault. Younger rocks on right	0	0
Line/Pattern	11 008 01	High-angle thrust-fault, accurate. Younger rocks on right	1	0
Line/Pattern	11 008 02	High-angle thrust-fault, approximate. Younger rocks on right	2	0
Line/Pattern	11 008 03	High-angle thrust-fault, inferred. Younger rocks on right	3	0
Line/Pattern	11 008 04	High-angle thrust-fault, concealed. Younger rocks on right	4	0
Line/Pattern	11 008 05	High-angle thrust-fault, inferred, concealed. Younger rocks on right	5	0
Point	11 009 00	Relative vertical displacement of fault, 'up' side is on right	0	0
Point	11 010 00	Relative displacement of fault	0	0
Point	11 011 00	Sense of relative displacement of upper plate of fault	0	0
Point	11 012 00	Striated slickensides of fault	0	0
Line	11 013 00	Line of faulted outcrop	0	0
Line	11 014 00	Post-intrusive fault along intrusive boundary	0	0
Line	11 015 00	Intrusive boundary along pre-existing fault	0	0
Line/Pattern	11 016 00	Klippe. Younger rocks on right	0	0
Point	11 017 00	Dip of fault plane	0	0
Point	11 018 00	Inclined fault, sense of displacement not known	0	0
		11.020 FAULTS - CRUSHING, SHEARING, SCHISTOSITY		
Line	11 020 00	Fault with crushing	0	0
Line	11 021 00	Fault with breccia	0	0
Line	11 022 00	Fault with filling	0	0
Line	11 023 00	Shear zone	0	0
Line	11 023 04	Shear zone, concealed		
Line	11 024 00	Wide shear zone	0	0
Line	11 025 00	Mylonite zone	0	0
Line	11 026 00	Breccia zone (pseudoconglomerate or tectonic melange)	0	0
Point	11 027 00	Shearing of schistosity	0	0
Point	11 028 00	Dip of shear zone	0	0
		12.000 DYKES		

Line	12 001 00	Dyke or vein	0	0
Line	12 002 00	Dyke or vein	0	0

Line	12 003 00	Sill	0	0
Line	12 003 01	Sill, accurate	1	0
Line	12 003 02	Sill, approximate	2	0
Line	12 301 01	Dyke, accurate	1	0
Line	12 301 02	Dyke, approximate	2	0
Line	12 302 01	Vein, accurate	1	0
Line	12 302 02	Vein, approximate	2	0
		13.000 FOLDS - MISCELLANEOUS		
Line	13 001 00	Fold axial surface trace	0	0
Line	13 001 01	Fold axial surface trace, accurate	1	0
Line	13 001 02	Fold axial surface trace, approximate	2	0
Line	13 001 03	Fold axial surface trace, inferred	3	0
Line	13 001 04	Fold axial surface trace, concealed	4	0
Line	13 001 05	Fold axial surface trace, inferred, concealed	5	0
Point	13 002 00	First folding episode (F1)	0	1
Point	13 003 00	Second folding episode (F2)	0	2
Point	13 004 00	Third folding episode (F3)	0	3
Point	13 005 00	Horizontal fold axis	0	0
Point	13 006 00	Dip of fold axial surface	0	0
Point	13 007 00	Plunge of fold axis	0	0
Point	13 008 00	Direction of facing of fold	0	0
Line	13 009 00	Trend of closely-spaced folds	0	0
		13.020 FOLDS - ANTICLINES, SYNCLINES		
Line/Point	13 020 00	Anticline	0	0
Line/Point	13 020 01	Anticline, accurate	1	0
Line/Point	13 020 02	Anticline, approximate	2	0
Line/Point	13 020 03	Anticline, inferred	3	0
Line/Point	13 020 04	Anticline, concealed	4	0
Line/Point	13 020 05	Anticline, inferred, concealed	5	0
Line/Point	13 021 00	Syncline	0	
Line/Point	13 021 01	Syncline, accurate	1	0
Line/Point	13 021 02	Syncline, approximate	2	0
Line/Point	13 021 03	Syncline, inferred	3	0
Line/Point	13 021 04	Syncline, concealed	4	0
Line/Point	13 021 05	Syncline, inferred, concealed	5	0
Line/Point	13 022 00	Anticline; steeper, thinned limb on right	0	0
Line/Point	13 022 01	Anticline, accurate; steeper, thinned limb on right	1	0
Line/Point	13 022 02	Anticline, approximate; steeper, thinned limb on right	2	0
Line/Point	13 022 03	Anticline, inferred; steeper, thinned limb on right	3	0
Line/Point	13 022 04	Anticline, concealed; steeper, thinned limb on right	4	0
Line/Point	13 022 05	Anticline, inferred, concealed; steeper, thinned limb on right	5	0
Line/Point	13 023 00	Syncline; steeper, thinned limb on right	0	0

Line/Point	13 023 01	Syncline, accurate; steeper, thinned limb on right	1	0
Line/Point	13 023 02	Syncline, approximate; steeper, thinned limb on right	2	0
Line/Point	13 023 03	Syncline, inferred; steeper, thinned limb on right	3	0

[redacted]				
Line/Point	13 023 05	Syncline, inferred, concealed; steeper, thinned limb on right	5	0
Line/Point	13 024 00	Overturned anticline	0	0
Line/Point	13 024 01	Overturned anticline, accurate	1	0
Line/Point	13 024 02	Overturned anticline, approximate	2	0
Line/Point	13 024 03	Overturned anticline, inferred	3	0
Line/Point	13 024 04	Overturned anticline, concealed	4	0
Line/Point	13 024 05	Overturned anticline, inferred, concealed	5	0
Line/Point	13 025 00	Overturned anticline showing dips of limbs	0	0
Line/Point	13 025 01	Overturned anticline, accurate, showing dips of limbs	1	0
Line/Point	13 025 02	Overturned anticline, approximate, showing dips of limbs	2	0
Line/Point	13 025 03	Overturned anticline, inferred, showing dips of limbs	3	0
Line/Point	13 025 04	Overturned anticline, concealed, showing dips of limbs	4	0
Line/Point	13 025 05	Overturned anticline, inferred, concealed, showing dips of limbs	5	0
Line/Point	13 026 00	Overturned syncline	0	0
Line/Point	13 026 01	Overturned syncline, accurate	1	0
Line/Point	13 026 02	Overturned syncline, approximate	2	0
Line/Point	13 026 03	Overturned syncline, inferred	3	0
Line/Point	13 026 04	Overturned syncline, concealed	4	0
Line/Point	13 026 04	Overturned syncline, inferred, concealed	5	0
Line/Point	13 027 00	Overturned syncline showing dips of limbs	0	0
Line/Point	13 027 01	Overturned syncline, accurate, showing dips of limbs	1	0
Line/Point	13 027 02	Overturned syncline, approximate, showing dips of limbs	2	0
[redacted]				
Line/Point	13 027 05	Overturned syncline, inferred, concealed, showing dips of limbs	5	0
Line/Point	13 028 00	Reclined anticline	0	0
Line/Point	13 028 01	Reclined anticline, accurate	1	0
Line/Point	13 028 02	Reclined anticline, approximate	2	0
Line/Point	13 028 03	Reclined anticline, inferred	3	0
Line/Point	13 028 04	Reclined anticline, concealed	4	0
Line/Point	13 028 05	Reclined anticline, inferred, concealed	5	0
Line/Point	13 029 00	Reclined syncline	0	0
Line/Point	13 029 01	Reclined syncline, accurate	1	0
Line/Point	13 029 02	Reclined syncline, approximate	2	0
[redacted]				
Line/Point	13 029 05	Reclined syncline, inferred, concealed	5	0
		13.030 FOLDS - RECUMBENT FOLDS		
Line/Point	13 030 00	Recumbent anticline	0	0

Line/Point	13 030 01	Recumbent anticline, accurate	1	0
Line/Point	13 030 02	Recumbent anticline, approximate	2	0
Line/Point	13 030 03	Recumbent anticline, inferred	3	0

Line/Point	13 030 04	Recumbent anticline, concealed	4	0
Line/Point	13 030 05	Recumbent anticline, inferred, concealed	5	0
Line/Point	13 031 00	Recumbent syncline	0	0
Line/Point	13 031 01	Recumbent syncline, accurate	1	0
Line/Point	13 031 02	Recumbent syncline, approximate	2	0
Line/Point	13 031 03	Recumbent syncline, inferred	3	0
Line/Point	13 031 04	Recumbent syncline, concealed	4	0
Line/Point	13 031 05	Recumbent syncline, inferred, concealed	5	0
		13.032 FOLDS - VERTICAL FOLDS		
Line/Point	13 032 00	Vertical anticline	0	0
Line/Point	13 032 01	Vertical anticline, accurate	1	0
Line/Point	13 032 02	Vertical anticline, approximate	2	0
Line/Point	13 032 03	Vertical anticline, inferred	3	0
Line/Point	13 032 04	Vertical anticline, concealed	4	0
Line/Point	13 032 05	Vertical anticline, inferred, concealed	5	0
Line/Point	13 033 00	Vertical syncline	0	0
Line/Point	13 033 01	Vertical syncline, accurate	1	0
Line/Point	13 033 02	Vertical syncline, approximate	2	0
Line/Point	13 033 03	Vertical syncline, inferred	3	0
Line/Point	13 033 04	Vertical syncline, concealed	4	0
Line/Point	13 033 05	Vertical syncline, inferred, concealed	5	0
		13.034 FOLDS - ASYMMETRICAL FOLDS		
Line/Point	13 034 00	Asymmetrical anticline; steeper limb on right	0	0
Line/Point	13 034 01	Asymmetrical anticline, accurate; steeper limb on right	1	0
Line/Point	13 034 02	Asymmetrical anticline, approximate; steeper limb on right	2	0
Line/Point	13 034 03	Asymmetrical anticline, inferred; steeper limb on right	3	0
Line/Point	13 034 04	Asymmetrical anticline, concealed; steeper limb on right	4	0
Line/Point	13 034 05	Asymmetrical anticline, inferred, concealed; steeper limb on right	5	0
Line/Point	13 035 00	Asymmetrical syncline; steeper limb on right	0	0
Line/Point	13 035 01	Asymmetrical syncline, accurate; steeper limb on right	1	0
Line/Point	13 035 02	Asymmetrical syncline, approximate; steeper limb on right	2	0
Line/Point	13 035 03	Asymmetrical syncline, inferred; steeper limb on right	3	0
Line/Point	13 035 04	Asymmetrical syncline, concealed; steeper limb on right	4	0
Line/Point	13 035 05	Asymmetrical syncline, inferred, concealed; steeper limb on right	5	0
Line/Point	13 036 00	Asymmetrical anticline with same dip on both limbs; thinned limb on right	0	0
Line/Point	13 036 01	Asymmetrical anticline, accurate, with same dip on both limbs; thinned limb on right	1	0
Line/Point	13 036 02	Asymmetrical anticline, approximate, with same dip on both limbs; thinned limb on right	2	0
Line/Point	13 036 03	Asymmetrical anticline, inferred, with same dip on both limbs; thinned limb on right	3	0
Line/Point	13 036 04	Asymmetrical anticline, concealed, with same dip on both limbs; thinned limb on right	4	0
Line/Point	13 036 05	Asymmetrical anticline, inferred, concealed, with same dip on both limbs; thinned limb on right	5	0
Line/Point	13 037 00	Asymmetrical syncline with same dip on both limbs; thinned limb on right	0	0
Line/Point	13 037 01	Asymmetrical syncline, accurate, with same dip on both limbs; thinned limb on right	1	0

Line/Point	13 037 02	Asymmetrical syncline, approximate, with same dip on both limbs; thinned limb on right	2	0
Line/Point	13 037 03	Asymmetrical syncline, inferred, with same dip on both limbs; thinned limb on right	3	0
Line/Point	13 037 04	Asymmetrical syncline, concealed, with same dip on both limbs; thinned limb on right	4	0

Line/Point	13 037 05	Asymmetrical syncline, inferred, concealed, with same dip on both limbs; thinned limb on right	5	0
Line/Point	13 038 00	Inverted anticline	0	0
Line/Point	13 038 01	Inverted anticline, accurate	1	0
Line/Point	13 038 02	Inverted anticline, approximate	2	0
Line/Point	13 038 03	Inverted anticline, inferred	3	0
Line/Point	13 038 04	Inverted anticline, concealed	4	0
Line/Point	13 038 05	Inverted anticline, inferred, concealed	5	0
Line/Point	13 039 00	Inverted syncline	0	0
Line/Point	13 039 01	Inverted syncline, accurate	1	0
Line/Point	13 039 02	Inverted syncline, approximate	2	0
Line/Point	13 039 03	Inverted syncline, inferred	3	0
Line/Point	13 039 04	Inverted syncline, concealed	4	0
Line/Point	13 039 05	Inverted syncline, inferred, concealed	5	0
Line/Point	13 040 00	Inverted anticline; steeper, thinned limb on right	0	0
Line/Point	13 040 01	Inverted anticline, accurate; steeper, thinned limb on right	1	0
Line/Point	13 040 02	Inverted anticline, approximate; steeper, thinned limb on right	2	0
Line/Point	13 040 03	Inverted anticline, inferred; steeper, thinned limb on right	3	0
Line/Point	13 040 04	Inverted anticline, concealed; steeper, thinned limb on right	4	0
Line/Point	13 040 05	Inverted anticline, inferred, concealed; steeper, thinned limb on right	5	0
Line/Point	13 041 00	Inverted syncline; steeper, thinned limb on right	0	0
Line/Point	13 041 01	Inverted syncline, accurate; steeper, thinned limb on right	1	0
Line/Point	13 041 02	Inverted syncline, approximate; steeper, thinned limb on right	2	0
Line/Point	13 041 03	Inverted syncline, inferred; steeper, thinned limb on right	3	0
Line/Point	13 041 04	Inverted syncline, concealed; steeper, thinned limb on right	4	0
Line/Point	13 041 05	Inverted syncline, inferred, concealed; steeper, thinned limb on right	5	0
Line/Point	13 042 00	Inverted overturned anticline	0	0
Line/Point	13 042 01	Inverted overturned anticline, accurate	1	0
Line/Point	13 042 02	Inverted overturned anticline, approximate	2	0
Line/Point	13 042 03	Inverted overturned anticline, inferred	3	0
Line/Point	13 042 04	Inverted overturned anticline, concealed	4	0
Line/Point	13 042 05	Inverted overturned anticline, inferred, concealed	5	0
Line/Point	13 043 00	Inverted overturned syncline	0	0
Line/Point	13 043 01	Inverted overturned syncline, accurate	1	0
Line/Point	13 043 02	Inverted overturned syncline, approximate	2	0
Line/Point	13 043 03	Inverted overturned syncline, inferred	3	0
Line/Point	13 043 04	Inverted overturned syncline, concealed	4	0
Line/Point	13 043 05	Inverted overturned syncline, inferred, concealed	5	0
Line/Point	13 044 00	Inverted vertical anticline	0	0
Line/Point	13 044 01	Inverted vertical anticline, accurate	1	0
Line/Point	13 044 02	Inverted vertical anticline, approximate	2	0
Line/Point	13 044 03	Inverted vertical anticline, inferred	3	0

Line/Point	13 044 04	Inverted vertical anticline, concealed	4	0
Line/Point	13 044 05	Inverted vertical anticline, inferred, concealed	5	0
Line/Point	13 045 00	Inverted vertical syncline	0	0

Line/Point	13 045 01	Inverted vertical syncline, accurate	1	0
Line/Point	13 045 02	Inverted vertical syncline, approximate	2	0
Line/Point	13 045 03	Inverted vertical syncline, inferred	3	0
Line/Point	13 045 04	Inverted vertical syncline, concealed	4	0
Line/Point	13 045 05	Inverted vertical syncline, inferred, concealed	5	0
Line/Point	13 046 00	Inverted asymmetrical anticline; steeper limb on right	0	0
Line/Point	13 046 01	Inverted asymmetrical anticline, accurate; steeper limb on right	1	0
Line/Point	13 046 02	Inverted asymmetrical anticline, approximate; steeper limb on right	2	0
Line/Point	13 046 03	Inverted asymmetrical anticline, inferred; steeper limb on right	3	0
Line/Point	13 046 04	Inverted asymmetrical anticline, concealed; steeper limb on right	4	0
Line/Point	13 046 05	Inverted asymmetrical anticline, inferred, concealed; steeper limb on right	5	0
Line/Point	13 047 00	Inverted asymmetrical syncline; steeper limb on right	0	0
Line/Point	13 047 01	Inverted asymmetrical syncline, accurate; steeper limb on right	1	0
Line/Point	13 047 02	Inverted asymmetrical syncline, approximate; steeper limb on right	2	0
Line/Point	13 047 03	Inverted asymmetrical syncline, inferred; steeper limb on right	3	0
Line/Point	13 047 04	Inverted asymmetrical syncline, concealed; steeper limb on right	4	0
Line/Point	13 047 05	Inverted asymmetrical syncline, inferred, concealed; steeper limb on right	5	0
Line/Point	13 048 00	Inverted asymmetrical anticline with same dip on both limbs; thinned limb on right	0	0
Line/Point	13 048 01	Inverted asymmetrical anticline, accurate, with same dip on both limbs; thinned limb on right	1	0
Line/Point	13 048 02	Inverted asymmetrical anticline, approximate, with same dip on both limbs; thinned limb on right	2	0
Line/Point	13 048 03	Inverted asymmetrical anticline, inferred, with same dip on both limbs; thinned limb on right	3	0
Line/Point	13 048 04	Inverted asymmetrical anticline, concealed, with same dip on both limbs; thinned limb on right	4	0
Line/Point	13 048 05	Inverted asymmetrical anticline, inferred, concealed, with same dip on both limbs; thinned limb on right	5	0
Line/Point	13 049 00	Inverted asymmetrical syncline with same dip on both limbs; thinned limb on right	0	0
Line/Point	13 049 01	Inverted asymmetrical syncline, accurate, with same dip on both limbs; thinned limb on right	1	0
Line/Point	13 049 02	Inverted asymmetrical syncline, approximate, with same dip on both limbs; thinned limb on right	2	0
Line/Point	13 049 03	Inverted asymmetrical syncline, inferred, with same dip on both limbs; thinned limb on right	3	0
Line/Point	13 049 04	Inverted asymmetrical syncline, concealed, with same dip on both limbs; thinned limb on right	4	0
Line/Point	13 049 05	Inverted asymmetrical syncline, inferred, concealed, with same dip on both limbs; thinned limb on right	5	0
Line/point	13 050 00	Monocline	0	0
Line/point	13 050 01	Monocline, accurate	1	0
Line/point	13 050 02	Monocline, approximate	2	0
Line/point	13 050 03	Monocline, inferred	3	0
Line/point	13 050 04	Monocline, concealed	4	0
Line/point	13 050 05	Monocline, inferred, concealed	5	0
Line/point	13 051 00	Fault-induced monocline	0	0
Line/point	13 051 01	Fault-induced monocline, accurate	1	0
Line/point	13 051 02	Fault-induced monocline, approximate	2	0
Line/point	13 051 03	Fault-induced monocline, inferred	3	0
Line/point	13 051 04	Fault-induced monocline, concealed	4	0
Line/point	13 051 05	Fault-induced monocline, inferred, concealed	5	0

		13.060 FOLDS, FACING NOT KNOWN		
Line/Point	13 060 00	Antiform	0	0
Line/Point	13 060 01	Antiform, accurate	1	0

Line/Point	13 060 02	Antiform, approximate	2	0
Line/Point	13 060 03	Antiform, inferred	3	0
Line/Point	13 060 04	Antiform, concealed	4	0
Line/Point	13 060 05	Antiform, inferred, concealed	5	0
Line/Point	13 061 00	Synform	0	0
Line/Point	13 061 01	Synform, accurate	1	0
Line/Point	13 061 02	Synform, approximate	2	0
Line/Point	13 061 03	Synform, inferred	3	0
Line/Point	13 061 04	Synform, concealed	4	0
Line/Point	13 061 05	Synform, inferred, concealed	5	0
Line/Point	13 062 00	Antiform; steeper, thinned limb on right	0	0
Line/Point	13 062 01	Antiform, accurate; steeper, thinned limb on right	1	0
Line/Point	13 062 02	Antiform, approximate; steeper, thinned limb on right	2	0
Line/Point	13 062 03	Antiform, inferred; steeper, thinned limb on right	3	0
Line/Point	13 062 04	Antiform, concealed; steeper, thinned limb on right	4	0
Line/Point	13 062 05	Antiform, inferred, concealed; steeper, thinned limb on right	5	0
Line/Point	13 063 00	Synform, steeper, thinned limb on right	0	0
Line/Point	13 063 01	Synform, accurate; steeper, thinned limb on right	1	0
Line/Point	13 063 02	Synform, approximate; steeper, thinned limb on right	2	0
Line/Point	13 063 03	Synform, inferred; steeper, thinned limb on right	3	0
Line/Point	13 063 04	Synform, concealed; steeper, thinned limb on right	4	0
Line/Point	13 063 05	Synform, inferred, concealed; steeper, thinned limb on right	5	0
Line/Point	13 064 00	Overturned antiform	0	0
Line/Point	13 064 01	Overturned antiform, accurate	1	0
Line/Point	13 064 02	Overturned antiform, approximate	2	0
Line/Point	13 064 03	Overturned antiform, inferred	3	0
Line/Point	13 064 04	Overturned antiform, concealed	4	0
Line/Point	13 064 05	Overturned antiform, inferred, concealed	5	0
Line/Point	13 065 00	Overturned synform	0	0
Line/Point	13 065 01	Overturned synform, accurate	1	0
Line/Point	13 065 02	Overturned synform, approximate	2	0
Line/Point	13 065 03	Overturned synform, inferred	3	0
Line/Point	13 065 04	Overturned synform, concealed	4	0
Line/Point	13 065 05	Overturned synform, inferred, concealed	5	0
Line/Point	13 066 00	Recumbent fold, facing not known	0	0
Line/Point	13 066 01	Recumbent fold, accurate, facing not known	1	0
Line/Point	13 066 02	Recumbent fold, approximate, facing not known	2	0
Line/Point	13 066 03	Recumbent fold, inferred, facing not known	3	0
Line/Point	13 066 04	Recumbent fold, concealed, facing not known	4	0
Line/Point	13 066 05	Recumbent fold, inferred, concealed, facing not known	5	0
Line/Point	13 067 00	Vertical fold, facing not known	0	0
Line/Point	13 067 01	Vertical fold, accurate, facing not known	1	0

Line/Point	13 067 02	Vertical fold, approximate, facing not known	2	0
Line/Point	13 067 03	Vertical fold, inferred, facing not known	3	0
Line/Point	13 067 04	Vertical fold, concealed, facing not known	4	0

Line/Point	13 067 05	Vertical fold, inferred, concealed, facing not known	5	0
Line/Point	13 068 00	Asymmetrical antiform, steeper limb on right	0	0
Line/Point	13 068 01	Asymmetrical antiform, accurate; steeper limb on right	1	0
Line/Point	13 068 02	Asymmetrical antiform, approximate; steeper limb on right	2	0
Line/Point	13 068 03	Asymmetrical antiform, inferred; steeper limb on right	3	0
Line/Point	13 068 04	Asymmetrical antiform, concealed; steeper limb on right	4	0
Line/Point	13 068 05	Asymmetrical antiform, inferred, concealed; steeper limb on right	5	0
Line/Point	13 069 00	Asymmetrical synform, steeper limb on right	0	0
Line/Point	13 069 01	Asymmetrical synform, accurate; steeper limb on right	1	0
Line/Point	13 069 02	Asymmetrical synform, approximate; steeper limb on right	2	0
Line/Point	13 069 03	Asymmetrical synform, inferred; steeper limb on right	3	0
Line/Point	13 069 04	Asymmetrical synform, concealed; steeper limb on right	4	0
Line/Point	13 069 05	Asymmetrical synform, inferred, concealed; steeper limb on right	5	0
Line/Point	13 070 00	Asymmetrical antiform with same dip on both limbs; thinned limb on right	0	0
Line/Point	13 070 01	Asymmetrical antiform, accurate, with same dip on both limbs; thinned limb on right	1	0
Line/Point	13 070 02	Asymmetrical antiform, approximate, with same dip on both limbs; thinned limb on right	2	0
Line/Point	13 070 03	Asymmetrical antiform, inferred, with same dip on both limbs; thinned limb on right	3	0
Line/Point	13 070 04	Asymmetrical antiform, concealed, with same dip on both limbs; thinned limb on right	4	0
Line/Point	13 070 05	Asymmetrical antiform, inferred, concealed, with same dip on both limbs; thinned limb on right	5	0
Line/Point	13 071 00	Asymmetrical synform with same dip on both limbs; thinned limb on right	0	0
Line/Point	13 071 01	Asymmetrical synform, accurate, with same dip on both limbs; thinned limb on right	1	0
Line/Point	13 071 02	Asymmetrical synform, approximate, with same dip on both limbs; thinned limb on right	2	0
Line/Point	13 071 03	Asymmetrical synform, inferred, with same dip on both limbs; thinned limb on right	3	0
Line/Point	13 071 04	Asymmetrical synform, concealed, with same dip on both limbs; thinned limb on right	4	0
Line/Point	13 071 05	Asymmetrical synform, inferred, concealed, with same dip on both limbs; thinned limb on right	5	0
Line/point	13 072 00	Monoform	0	0
Line/Point	13 072 01	Monoform, accurate	1	0
Line/Point	13 072 02	Monoform, approximate	2	0
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Line/Point	13 072 04	Monoform, concealed	4	0
Line/Point	13 072 05	Monoform, inferred, concealed	5	0
		13.100 FOLDS - MINOR FOLDS		
Point	13 100 00	Minor anticline	0	0
Point	13 101 00	Minor syncline	0	0
Point	13 102 00	Minor anticline showing plunge	0	0
Point	13 103 00	Minor anticline showing plunge	0	0
Point	13 104 00	Minor syncline showing plunge	0	0
Point	13 105 00	Minor syncline showing plunge	0	0
Point	13 106 00	Reclined minor anticline showing plunge and dip of axial surface. Dot indicates proved direction of facing	0	0
Point	13 107 00	Reclined minor syncline showing plunge and dip of axial surface. Dot indicates proved direction of facing	0	0
Point	13 108 00	Minor antiform showing plunge	0	0
Point	13 109 00	Minor antiform showing plunge	0	0

Point	13 110 00	Minor synform showing plunge	0	0
Point	13 111 00	Minor synform showing plunge	0	0
Point	13 112 00	Minor fold showing plunge	0	0

Point	13 113 00	Minor fold showing plunge	0	0
Point	13 114 00	Overturned minor fold showing plunge	0	0
Point	13 115 00	Reclined minor fold, facing of strata not known	0	0
Point	13 116 00	Asymmetrical minor fold showing plunge	0	0
Point	13 117 00	Folded bedding showing plunge	0	0
Point	13 118 00	Kink fold showing plunge	0	0
Point	13 119 00	Locality of superposed folds	0	0
Point	13 120 00	Direction of facing of minor fold	0	0
3.130 FOLDS - VERGENCE				
Point	13 130 00	Vergence to right in upright horizontal/overturned fold	0	0
Point	13 131 00	Vergence to left in upright horizontal/overturned fold	0	0
Point	13 132 00	Vergence to right in recumbent fold. Arrow shows direction to next (structurally lower) fold hinge	0	0
Point	13 133 00	Vergence to left in recumbent fold. Arrow shows direction to next (structurally lower) fold hinge	0	0
Point	13 134 00	Vergence to right in upright/overturned/vertical/reclined plunging fold	0	0
Point	13 135 00	Vergence to left in upright/overturned/vertical/reclined plunging fold	0	0
Point	13 136 00	Plunge of chert boudins	0	0
Point	13 137 00	Plunge of chert contortions	0	0
		14.000 BEDDING		
Point	14 001 00	Strike and dip of strata	0	0
Point	14 002 00	Strike and dip of strata, proved direction of facing/younging	0	0
Point	14 003 00	Strike and dip of strata, facing/younging not known	0	0
Point	14 004 00	Strike and dip of strata at geological boundary	0	0
Point	14 005 00	Prevailing strike and dip of strata	0	0
Point	14 006 00	Strike of strata, dip indeterminate	0	0
Point	14 007 00	Vertical strata	0	0
Point	14 008 00	Vertical strata, proved direction of facing/younging	0	0
Point	14 009 00	Vertical strata, facing/younging not known	0	0
Point	14 010 00	Horizontal strata	0	0
Point	14 011 00	Strike and dip of inverted strata	0	0
Point	14 012 00	Strike and dip of inverted strata, proved direction of facing/younging	0	0
Point	14 013 00	Horizontal inverted strata	0	0
		14.300 PHOTO-INTERPRETED BEDDING		
Point	14 030 00	Strike and dip of strata, dip less than 5 degrees	0	0
Point	14 031 00	Strike and dip of strata, dip 5 to 15 degrees	0	0
Point	14 032 00	Strike and dip of strata, dip 15 to 45 degrees	0	0
Point	14 033 00	Strike and dip of strata, dip greater than 45 degrees	0	0
Point	14 034 00	Strike and dip of strata, dip not estimated	0	0
Point	14 035 00	Vertical strata	0	0
Point	14 036 00	Horizontal strata	0	0
		14.050 MISCELLANEOUS BEDDING		
Point	14 050 00	Curving dip	0	0
Point	14 051 00	Dip slope	0	0
Point	14 052 00	Strike and dip of foresets	0	0

Point	14 053 00	Range of strike and dip of irregular foresets	0	0
Point	14 054 00	Dip on exhumed erosion surface	0	0

Point	14 055 00	Generalised strike and overall dip of crumpled/undulating strata	0	0
Point	14 056 00	Overall dip of gently folded strata	0	0
Point	14 057 00	Overall dip of strongly deformed strata	0	0
Point	14 058 00	Facing of beds/top of bed	0	0
Point	14 059 00	Facing of lava flows/facing of pillow lavas	0	0
Point	14 060 00	Direction and sense of movement of sediment-bearing currents	0	0
Point	14 061 00	Direction of movement of sediment-bearing currents, sense not known	0	0
Point	14 062 00	Glacial striae showing sense of movement	0	0
Point	14 063 00	Glacial striae, sense of movement not known	0	0
Point	15 001 00	Strike and dip of joint	0	0
Point	15 001 01	Strike and dip of joint, accurate	1	0
Point	15 002 00	Prevailing strike and dip of joint	0	0
Point	15 003 00	Vertical joint	0	0
Point	15 004 00	Horizontal joint	0	0
Line	15 005 00	Joint, interpreted from airphotos	0	0
Line	15 006 00	Joint	0	0
Point	15 007 00	Columnar joints showing plunge	0	0
Line	15 009 01	Joint, accurate		
Point	16 001 00	Strike and dip of foliation	0	0
Point	16 002 00	Prevailing strike and dip of foliation	0	0
Point	16 003 00	Strike and dip of foliation, dip indeterminate	0	0
Point	16 004 00	Vertical foliation	0	0
Point	16 005 00	Horizontal foliation	0	0
Point	16 006 00	Strike and dip of late stage schistosity associated with retrograde metamorphism	0	0
Point	16 007 00	Strike and dip of mylonite foliation (c - plane)	0	0
Line	16 008 00	General trend of foliation in metamorphic rocks	0	0
Line	16 009 00	General trend of foliation in medium to high grade metamorphic rocks	0	0
Line	16 010 00	General trend of foliation in migmatite and gneiss	0	0
Point	17 001 00	Strike and dip of cleavage	0	0
Point	17 002 00	Prevailing strike and dip of cleavage	0	0
Point	17 003 00	Strike and dip of cleavage, indeterminate	0	0
Point	17 004 00	Vertical cleavage	0	0
Point	17 005 00	Horizontal cleavage	0	0
Line	17 310 00	Cleavage		
		18.000 LINEATION		
Point	18 001 00	Plunge of lineation	0	0
Point	18 002 00	Vertical lineation	0	0
Point	18 003 00	Horizontal lineation	0	0
Point	18 004 00	Plunge of bedding-cleavage intersection	0	0

Point	18 005 00	Horizontal bedding-cleavage intersection	0	0
Point	18 006 00	Plunge of crenulation	0	0
Point	18 007 00	Horizontal crenulation	0	0

Point	18 008 00	Plunge of mineral elongation/alignment	0	0
Point	18 009 00	Horizontal mineral elongation/alignment	0	0
Point	18 010 00	Plunge of igneous lineation	0	0
Point	18 011 00	Vertical igneous lineation	0	0
Point	18 012 00	Horizontal igneous lineation	0	0
		19.000 IGNEOUS BANDING		
Point	19 001 00	Strike and dip of platy alignment/igneous banding	0	0
Point	19 002 00	Prevailing strike and dip of platy alignment/igneous banding	0	0
Point	19 003 00	Strike and dip of platy alignment/igneous banding, dip indeterminate	0	0
Point	19 004 00	Vertical platy alignment/igneous banding	0	0
Point	19 005 00	Horizontal platy alignment/igneous banding	0	0
Point	19 006 00	Igneous layering. Arrow indicates proved direction of facing	0	0
Point	19 301 00	Eutaxitic foliation	0	0
Point	19 302 00	Horizontal eutaxitic foliation	0	0
Point	19 303 00	Overturned eutaxitic foliation	0	0
20.000 STRUCTURAL LINES				
Line	20 001 00	Lineament	0	0
Line	20 002 00	Trend-line	0	0
21.000 FOSSIL LOCALITIES				
Point	21 001 00	Fossil locality	0	0
Point	21 002 00	Macrofossil locality	0	0
Point	21 003 00	Microfossil locality	0	0
Point	21 004 00	Trace fossil locality	0	0
Point	21 005 00	Fossil wood locality	0	0
Point	21 006 00	Oncolite locality	0	0
Point	21 007 00	Palynomorph locality	0	0
Point	21 008 00	Plant fossil locality	0	0
Point	21 009 00	Stromatolite locality	0	0
Point	21 010 00	Vertebrate fossil locality	0	0
Point	21 011 00	Fish fossil locality	0	0
Point	21 012 00	Burrow locality	0	0
Point	21 013 00	Graptolite fossil locality	0	0
21.020 SPECIMEN LOCALITIES				
Point	21 020 00	Specimen locality	0	0
Point	21 021 00	Observation locality	0	0
Point	21 022 00	Excursion locality	0	0
Point	21 023 00	Sample locality for isotopic age determination	0	0
21.040 SECTIONS				
Line	21 040 00	Type section	0	0
Point	21 041 00	Type locality	0	0
Line	21 042 00	Measured section	0	0
Line	21 043 00	Geological section	0	0

22.000 MINING/MINERALISATION				
Point	22 001 00	Mineral locality - mine, alluvial workings, prospect or mineral occurrence	0	0

Point	22 002 00	Minor mineral occurrence	0	0
Point	22 003 00	Unworked deposit	0	0
Point	22 004 00	Mine or prospect; may be abandoned	0	0
Point	22 005 00	Major mine	0	0
Point	22 006 00	Mine/minor mine	0	0
Point	22 007 00	Abandoned mine	0	0
Point	22 008 00	Prospect	0	0
Point	22 009 00	Abandoned prospect	0	0
Line	22 010 00	Open cut or quarry	0	0
Point	22 011 00	Major open cut or quarry	0	0
Point	22 012 00	Minor open cut or quarry	0	0
Point	22 013 00	Open cut or quarry, abandoned/not working	0	0
Point	22 014 00	Major alluvial workings	0	0
Point	22 015 00	Alluvial workings/minor alluvial workings	0	0
Point	22 016 00	Alluvial workings, abandoned/not being worked	0	0
Line	22 017 00	Shallow lead	0	0
Line	22 018 00	Deep lead	0	0
Line/Point	22 019 00	Costean/trench	0	0
Point	22 020 00	Treatment plant	0	0
Point	22 021 00	Treatment plant, not operating/abandoned	0	0
Point	22 022 00	Adit	0	0
Line	22 023 00	Limit of exploration activity/extent of prospected area	0	0
Point	22 024 00	Drill hole	0	0
Point	22 025 00	Vertical drill hole	0	0
Point	22 026 00	Inclined drill hole	0	0
	22 301 01	Shallow workings, accurate	1	0
	22 301 02	Shallow workings, approximate	2	0
	22 302 01	Alluvial gold workings, accurate	1	0
	22 302 02	Alluvial gold workings, approximate	2	0
	22 303 01	Shallow lead, accurate	1	0
	22 303 02	Shallow lead, approximate	2	0
Line	22 304 01	Deep lead, accurate	1	0
Line	22 304 02	Deep lead, approximate	2	0
Line	22 305 01	Goldfield, accurate	1	0
Line	22 305 02	Goldfield, approximate	2	0
Point	22 306 00	Quartz reef	0	0
Point	22 307 00	Quartz reef, worked	0	0
Point	22 308 00	Worked quartz reef, inclined	0	0
Point	22 309 00	Worked quartz reef, vertical	0	0
Point	22 310 00	Battery plant	0	0
Line	22 311 00	Sulphide mineralisation	0	0
	22 312 00	Mullock heap	0	0

22 313 00	Subsurface working plan	0	0
22 314 00	Puddling site	0	0

22.100 MINING/MINERALISATION

22 100 00	Main shaft	0	0
22 101 00	Main shaft with depth in metres	0	0
22 102 00	Main shaft showing number of compartments	0	0
22 103 00	Main shaft showing number of compartments and depth in metres	0	0
22 104 00	Shaft extending above and below plan level	0	0
22 105 00	Accessible shaft extending below plan level	0	0
22 106 00	Accessible shaft extending above plan level	0	0
22 107 00	Inaccessible shaft	0	0
22 108 00	Head of rise or winze	0	0
22 109 00	Inaccessible head of rise or winze	0	0
22 110 00	Foot of rise or winze	0	0
22 111 00	Inaccessible foot of rise or winze	0	0
22 112 00	Rise or winze extending through level	0	0
22 113 00	Inaccessible rise or winze extending through level	0	0
22 114 00	Inclined accessible shaft extending below plan level	0	0
22 115 00	Inclined accessible shaft extending below plan level with length in metres	0	0
22 116 00	Inclined accessible shaft extending below plan level	0	0
22 117 00	Inclined accessible shaft extending below plan level with length in metres	0	0
22 118 00	Cross-section of cross-cut or drive; same side of plane of section as observer	0	0
22 119 00	Cross-section of cross-cut or drive; opposite side of plane of section to observer	0	0
22 120 00	Cross-section of cross-cut or drive extending across plane of section	0	0
22 121 00	Ore chute	0	0
22 122 00	Plan of stope	0	0
22 123 00	Section of stope	0	0
22 124 00	Lagging or cribbing along drive	0	0
22 125 00	Workings caved or otherwise inaccessible	0	0
22 126 00	Filled workings	0	0
22 127 00	Portal and approach of tunnel or adit	0	0
22 128 00	Portal and approach of tunnel or adit	0	0
22 129 00	Elevation of roof (back) of underground workings	0	0
22 13 000	Elevation of floor of underground workings	0	0
22 131 00	Natural surface	0	0
22 132 00	Information projected onto a section from near side	0	0
22 133 00	Information projected onto a section from far side	0	0
22 134 00	Sample line	0	0
22 135 00	Grab-sample locality	0	0
22 136 00	Drill hole	0	0
22 137 00	Diamond-drill hole showing projection in horizontal plane and inclination	0	0
22 138 00	Vertical diamond-drill hole with depth in metres	0	0
22 139 00	Costean or trench	0	0
22 140 00	Costean or trench	0	0
22 141 00	Prospecting pit	0	0

22 142 00	Open cut or quarry	0	0
22 143 00	Dump/mining dump	0	0

Point	23 001 00	Oil seep	0	0
Point	23 002 00	Gas seep	0	0
Point	23 003 00	Oil and gas seep or show	0	0
Point	23 004 00	Oil seep reported (by geoscientist) but not relocated	0	0
Point	23 005 00	Gas seep reported (by geoscientist) but not relocated	0	0
Point	23 006 00	Oil and gas seep reported (by geoscientist) but not relocated	0	0
Point	23 007 00	Mud volcano	0	0
Point	23 008 00	Mud volcano without hydrocarbons	0	0
Point	23 009 00	Mud volcano with hydrocarbons	0	0
Point	23 020 00	Petroleum exploration well, proposed site	0	0
Point	23 021 00	Petroleum exploration well, drilling	0	0
Point	23 022 00	Petroleum exploration well, dry, abandoned	0	0
Point	23 023 00	Petroleum exploration well with show of oil	0	0
Point	23 024 00	Petroleum exploration well with show of oil, abandoned	0	0
Point	23 025 00	Petroleum exploration well with show of gas	0	0
Point	23 026 00	Petroleum exploration well with show of gas, abandoned	0	0
Point	23 027 00	Petroleum exploration well with show of oil and gas	0	0
Point	23 028 00	Petroleum exploration well with show of oil and gas, abandoned	0	0
Point	23 029 00	Stratigraphic hole for petroleum exploration	0	0
Point	23 030 00	Oil well	0	0
Point	23 031 00	Oil well, shut in/suspended	0	0
Point	23 032 00	Oil well, abandoned	0	0
Point	23 033 00	Gas well	0	0
Point	23 034 00	Gas well, shut in/suspended	0	0
Point	23 035 00	Gas well, abandoned	0	0
Point	23 036 00	Oil and gas well	0	0
Point	23 037 00	Oil and gas well, shut in/suspended	0	0
Point	23 038 00	Oil and gas well, abandoned	0	0
Point	23 039 00	Gas and condensate well	0	0
Point	23 040 00	Gas and condensate well, shut in/suspended	0	0
Point	23 041 00	Gas and condensate well, abandoned	0	0
Point	23 042 00	Service well	0	0
Point	23 043 00	Service well, abandoned	0	0
Point	23 044 00	Oil field	0	0
Point	23 045 00	Gas field	0	0
Line	23 046 00	Oil pipeline	0	0
Line	23 047 00	Gas pipeline	0	0
Line	23 048 00	Petroleum tenement boundary	0	0
Line	23 049 00	Oil and gas field boundary	0	0
		24.000 GEOPHYSICS BOUNDARIES		
Line	24 001 06	Geological boundary, probable, interpreted from geophysics	6	0

Line	24 001 03	Geological boundary, inferred, interpreted from geophysics	3	0
Line	24 001 07	Geological boundary, speculative, interpreted from geophysics	7	0
Line	24 002 00	Craton boundary	0	0

Line	24 003 00	Province boundary	0	0
Line	24 004 00	Limit of demagnetisation	0	0
Line	24 301 08	Geological boundary, at surface, interpreted from geophysics	8	0
Line	24 301 04	Geological boundary, concealed, interpreted from geophysics	4	0
Line	24 301 09	Geological boundary, mapped	9	0
Line	24 301 10	Geological boundary, interpreted	10	0
Line	24 302 08	Intrusive contact, at surface, interpreted from geophysics	8	0
Line	24 302 04	Intrusive contact, concealed, interpreted from geophysics	4	0
Line	24 303 08	Boundary of intrusive rock, at surface, interpreted from geophysics	8	0
Line	24 303 04	Boundary of intrusive rock, concealed, interpreted from geophysics	4	0
Line	24 305 08	Limit of contact metamorphism, at surface, interpreted from geophysics	8	0
Line	24 305 04	Limit of contact metamorphism, concealed, interpreted from geophysics	4	0
Line	24 306 10	Regional metamorphic isograd, interpreted from geophysics	10	0
Line	24 306 09	Regional metamorphic isograd, mapped	10	0
Line	24 010 06	Major fault, probable, interpreted from geophysics	6	0
Line	24 010 03	Major fault, inferred, interpreted from geophysics	3	0
Line	24 010 07	Major fault, speculative, interpreted from geophysics	7	0
Line	24 011 06	Minor fault, probable, interpreted from geophysics	6	0
Line	24 011 03	Minor fault, inferred, interpreted from geophysics	3	0
Line	24 011 07	Minor fault, speculative, interpreted from geophysics	7	0
Line	24 012 00	Fracture/joint	0	0
Line	24 310 08	Fault, at surface, interpreted from geophysics	8	0
Line	24 310 04	Fault, concealed, interpreted from geophysics	4	0
Line	24 311 08	Shear zone, at surface, interpreted from geophysics	8	0
Line	24 311 04	Shear zone, concealed, interpreted from geophysics	4	0
Line	24 020 00	Normally magnetised dyke or vein	0	0
Line	24 021 00	Remnantly magnetised dyke or vein	0	0
Line	24 320 08	Dyke, at surface, normally magnetic, interpreted from geophysics	8	0
Line	24 320 04	Dyke, concealed, normally magnetic, interpreted from geophysics	4	0
Line	24 321 08	Dyke, at surface, reversely magnetic, interpreted from geophysics	8	0
Line	24 321 04	Dyke, concealed, reversely magnetic, interpreted from geophysics	4	0
Line	24 322 08	Sill, at surface, normally magnetic, interpreted from geophysics	8	0
Line	24 322 04	Sill, concealed, normally magnetic, interpreted from geophysics	4	0
Line	24 323 08	Sill, at surface, reversely magnetic, interpreted from geophysics	8	0
Line	24 323 04	Sill, concealed, reversely magnetic, interpreted from geophysics	4	0
Line	24 324 08	Plug, normal reverse magnetic, at surface, interpreted from geophysics	8	0
Line	24 324 04	Plug, normal reverse magnetic, concealed, interpreted from geophysics	4	0
		24.030 GEOPHYSICS - FOLDS		
Line	24 030 00	Anticline, interpreted from geophysics	0	0
Line	24 031 00	Syncline, interpreted from geophysics	0	0

Line	24 032 00	Antiform, interpreted from geophysics	0	0
Line	24 033 00	Synform, interpreted from geophysics	0	0
Line	24 330 08	Anticline, at surface, interpreted from geophysics	8	0

Line	24 330 04	Anticline, concealed, interpreted from geophysics	4	0
Line	24 331 08	Syncline, at surface, interpreted from geophysics	8	0
Line	24 331 04	Syncline, concealed, interpreted from geophysics	4	0
Line	24 332 08	Antiform, at surface, interpreted from geophysics	8	0
Line	24 332 04	Antiform, concealed, interpreted from geophysics	4	0
Line	24 333 08	Synform, at surface, interpreted from geophysics	8	0
Line	24 333 04	Synform, concealed, interpreted from geophysics	4	0
Line	24 334 08	Monocline, at surface, interpreted from geophysics	8	0
Line	24 334 04	Monocline, concealed, interpreted from geophysics	4	0
		24.040 OTHER GEOPHYSICAL LINES		
Line	24 040 00	Lineament: structural feature of unknown origin, interpreted from geophysics	0	0
Line	24 041 06	Compositional layering, probable, interpreted from geophysics	6	0
Line	24 041 03	Compositional layering, inferred, interpreted from geophysics	3	0
Line	24 041 07	Compositional layering, speculative, interpreted from geophysics	7	0
Line	24 042 00	Trend-line, linear feature of unknown origin, interpreted from geophysics	0	0
Line	24 043 00	Deeply buried positive trend, interpreted from geophysics	0	0
Line	24 044 00	Deeply buried negative trend, interpreted from geophysics	0	0
Line	24 045 00	Palaeodrainage, interpreted from geophysics	0	0
Line	24 340 08	Lineament, at surface, interpreted from geophysics	8	0
Line	24 340 04	Lineament, concealed, interpreted from geophysics	4	0
Line	24 341 08	Bedding trend, at surface, interpreted from geophysics	8	0
Line	24 341 04	Bedding trend, concealed, interpreted from geophysics	4	0
Line	24 342 08	Trend line, highly magnetic, at surface, interpreted from geophysics	8	0
Line	24 342 04	Trend line, highly magnetic, concealed, interpreted from geophysics	4	0
Line	24 343 08	Trend line, weakly magnetic, at surface, interpreted from geophysics	8	0
Line	24 343 04	Trend line, weakly magnetic, concealed, interpreted from geophysics	4	0
Line	24 344 08	Trend line, reversely magnetic, at surface, interpreted from geophysics	8	0
Line	24 344 04	Trend line, reversely magnetic, concealed, interpreted from geophysics	4	0
Line	24 345 08	Prior stream, at surface, interpreted from geophysics	8	0
Line	24 345 04	Prior stream, concealed, interpreted from geophysics	4	0
Line	24 346 08	Volcanic crater wall, at surface, interpreted from geophysics	8	0
Line	24 346 04	Volcanic crater wall, concealed, interpreted from geophysics	4	0
Line	24 347 08	Lava flow boundary, at surface, interpreted from geophysics	8	0
Line	24 347 04	Lava flow boundary, concealed, interpreted from geophysics	4	0
Line	24 348 08	Lunette crest, at surface, interpreted from geophysics	8	0
Line	24 348 04	Lunette crest, concealed, interpreted from geophysics	4	0
Line	24 349 08	Strandline crest, at surface, interpreted from geophysics	8	0
Line	24 349 04	Strandline crest, concealed, interpreted from geophysics	4	0
24.060 GEOPHYSICS - GRAVITY				
Line	24 060 00	Bouguer anomaly contour	0	0
Point	24 061 00	Relative gravity high	0	0
Point	24 062 00	Relative gravity low	0	0

Point	24 063 00	Bouguer anomaly	0	0
Point	24 064 00	Gravity station	0	0
Line	24 065 00	Gravity basement	0	0

Line	24 360 10	Gravity, bouguer anomaly index contour	10	0
Line	24 361 10	Gravity, bouguer anomaly intermediate contour	10	0
		24.070 GEOPHYSICS - MAGNETICS		
Line	24 070 00	Magnetic contour	0	0
Line	24 071 00	Relative magnetic low	0	0
Point	24 072 00	Peak magnetic anomaly	0	0
Point	24 073 00	Positive point magnetic anomaly	0	0
Point	24 074 00	Negative point magnetic anomaly	0	0
Point	24 075 00	Point anomaly	0	0
Line	24 076 00	Magnetic basement	0	0
Line	24 370 10	Magnetics, index contour	10	0
Line	24 371 10	Magnetics, intermediate contour	10	0
Line	24 372 10	Magnetic culture feature	10	0
		24.080 GEOPHYSICS - RADIOMETRICS		
Line	24 080 00	Radiometric contour	0	0
Line	24 081 00	Relative radiometric low	0	0
Point	24 082 00	Peak radiometric anomaly	0	0
Line	24 380 10	Radiometrics, index contour	10	0
Line	24 381 10	Radiometrics, intermediate contour	10	0
		24.090 GEOPHYSICS - SEISMIC		
Line	24 090 00	Seismic traverse line	0	0
Line	24 091 00	Seismic reflecting horizon	0	0
Line	24 092 00	Seismic refracting horizon	0	0
		24.100 AIRBORNE ELECTROMAGNETIC (AEM)		
Line	24 100 00	Conductivity domain boundary	0	0
Line	24 101 00	Boundary of AEM study area	0	0
		24.110 AEM - BOUNDARIES		
Line	24 110 00	Conductive horizon	0	0
Line	24 111 00	Thick conductive horizon	0	0
		24.110 AEM - HORIZONS		
Line	24 112 00	Moderately thick conductive horizon	0	0
Line	24 113 00	Thin conductive horizon	0	0
Line	24 114 00	Short strike length conductive horizon	0	0
Line	24 115 00	Resistive horizon	0	0
Line	24 116 00	Thick resistive horizon	0	0
Line	24 117 00	Moderately thick resistive horizon	0	0
Line	24 118 00	Thin resistive horizon	0	0
Line	24 119 00	Short strike length resistive horizon	0	0
Line	24 120 00	Conductivity horizon	0	0
Line	24 121 00	Conductive marker bed	0	0
Line	24 122 00	Axes of dendritic palaeodrainage pattern	0	0
Line	24 123 00	Resistive marker bed	0	0

Line	24 124 00	Conductivity marker bed	0	0
		24.110 AEM - FAULTS AND SHEARS		
Line	24 130 00	Fault inferred from conductivity pattern	0	0

Line	24 131 00	Major fault inferred from conductivity pattern	0	0
Line	24 132 00	Minor fault inferred from conductivity pattern	0	0
Line	24 133 00	Shear inferred from conductivity pattern	0	0
Line	24 134 00	Major shear inferred from conductivity pattern	0	0
Line	24 135 00	Minor shear inferred from conductivity pattern	0	0
Line	24 136 00	Break in conductivity pattern	0	0
Line	24 137 00	Lineament in conductivity data	0	0
24.110 AEM - DISCRETE CONDUCTIVITY FEATURES				
Point	24 140 00	Priority 1 discrete conductor target	0	0
Point	24 141 00	Priority 2 discrete conductor target	0	0
Point	24 142 00	Priority 3 discrete conductor target	0	0
Point	24 143 00	Discrete conductivity feature	0	0
Line	24 150 00	Powerline source	0	0
Point	24 150 00	Powerline source	0	0
Line	24 150 00	Electric fence	0	0
Point	24 150 00	Electric fence	0	0
Line	24 150 00	Man-made metallic object	0	0
Point	24 150 00	Man-made metallic object	0	0
Line	24 150 00	Line of sferic artifacts	0	0
Point	24 150 00	Sferic artifact	0	0
Line	24 150 00	Line of system geometry artifacts	0	0
Point	24 150 00	System geometry artifact	0	0
Line	24 150 00	Line of noise artifacts	0	0
Point	24 150 00	Noise artifact	0	0
Line	24 150 00	Levelling artifact	0	0
Line	24 150 00	Boundary of adjunct polygon	0	0
		25.000 VOLCANICS		
Point	25 001 00	Volcano	0	0
Point	25 002 00	Major eruptive centre with recorded eruption	0	0
Point	25 003 00	Major eruptive centre, no recorded eruption	0	0
Point	25 004 00	Minor eruptive centre with recorded eruption	0	0
Point	25 005 00	Minor eruptive centre, no recorded eruption	0	0
Point	25 006 00	Volcanic neck/pipe/vent, extinct	0	0
Line	25 007 00	Volcanic crater wall	0	0
Point	25 008 00	Thermal area	0	0
Line	25 009 00	Lava flow boundary	0	0
Line	25 010 11	Lava flow boundary, buried	11	0
Line	25 010 12	Lava flow boundary, inverted	12	0
Line	25 010 13	Lava flow boundary, extruded	13	0
Line	25 012 00	Pyroclastic flow boundary	0	0
Line	25 302 01	Volcanic crater wall, accurate	1	0

Line	25 302 02	Volcanic crater wall, approximate	2	0
Line	25 303 01	Lava flow boundary, accurate	1	0
Line	25 303 02	Lava flow boundary, approximate	2	0

Line	25 303 03	Lava flow boundary, inferred	3	0
Line	25 303 04	Lava flow boundary, concealed	4	0
Line	25 304 00	Pyroclastic flow boundary	0	0
Line	25 304 01	Pyroclastic flow boundary, accurate	1	0
Line	25 304 02	Pyroclastic flow boundary, approximate	2	0
Line	25 304 03	Pyroclastic flow boundary, inferred	3	0
Line	25 304 04	Pyroclastic flow boundary, concealed	4	0
		26.000 TECTONICS		
Line	26 001 00	Boundary of intrusive rock. Longer barbs indicate invaded rock	0	0
Line	26 002 00	Boundary of intrusive rock. Grade of contact metamorphism decreases away from boundary	0	0
Line	26 003 00	Boundary of major structural units	0	0
Line	26 003 03	Boundary of major structural units, inferred	3	0
Line	26 003 04	Boundary of major structural units, concealed	4	0
Line	26 004 00	Boundary of secondary structural units	0	0
Line	26 005 00	Boundary of depositional basin	0	0
Line	26 006 00	Boundary of depositional dome	0	0
Line	26 007 00	Boundary of tectonic basin/centrocline	0	0
Line	26 008 00	Boundary of tectonic dome/pericline	0	0
Line	26 009 00	Boundary of structural low, facing not known	0	0
Line	26 010 00	Boundary of structural high, facing not known	0	0
Line	26 011 00	Brachyanticline	0	0
Line	26 012 00	Flexure	0	0
Line	26 013 01	Structural contour in metres above sea level, accurate	1	0
Line	26 013 02	Structural contour in metres above sea level, approximate	2	0
Line	26 014 00	Structural form line, from drilling data	0	0
Line	26 014 00	Structural form line	1	0
27.000 REGOLITH				
Line	27 001 00	Regolith-landform unit boundary	0	0
Line	27 002 00	Erosional scarp, palaeosurface boundary	0	0
Line	27 003 00	Erosional scarp, unrelated to palaeosurface boundary	0	0
Line	27 004 00	Structural scarp	0	0
Line	27 005 00	Metamorphic aureole scarp	0	0
Line	27 006 00	Fault scarp	0	0
Line	27 007 00	Fault line scarp	0	0
Line	27 008 00	Manmade scarp	0	0
Line	27 009 00	Erosional and structural scarp, palaeosurface boundary	0	0
Line	27 010 00	Erosional and structural scarp, unrelated to palaeosurface boundary	0	0
Line	27 011 00	Erosional and metamorphic aureole scarp, palaeosurface boundary	0	0
Line	27 012 00	Erosional and metamorphic aureole scarp, unrelated to palaeosurface boundary	0	0
Line	27 013 00	Erosional and fault scarp, palaeosurface boundary	0	0
Line	27 014 00	Erosional and fault scarp, unrelated to palaeosurface boundary	0	0
Line	27 015 00	Erosional and fault line scarp, palaeosurface boundary	0	0

Line	27 016 00	Erosional and fault line scarp, unrelated to palaeosurface boundary	0	0
Point	27 017 00	Residual hill	0	0
Point	27 018 00	Basalt capped residual hill	0	0

Point	27 019 00	Sink hole	0	0
Point	27 020 00	Knick point	0	0
Point	27 021 00	Wind gap	0	0
		27.040 REGOLITH - REGOLITH DRAINAGE FEATURES		
Line	27 040 00	Major drainage divide	0	0
Line	27 041 00	Minor drainage divide	0	0
Line	27 042 00	Major palaeodrainage divide	0	0
Line	27 043 00	Minor palaeodrainage divide	0	0
Point	27 044 00	Drainage overflow	0	0
Line	27 045 00	Superimposed drainage	0	0
Point	27 046 00	Superimposed drainage	0	0
Line	27 047 00	Entrenched superimposed drainage	0	0
Point	27 048 00	Entrenched superimposed drainage direction	0	0
Point	27 049 00	Site of river	0	0
Line	27 050 00	Internal drainage depression	0	0
Line	27 051 00	Palaeodrainage	0	0
Line	27 051 12	Palaeodrainage, inverted	12	0
Point	27 052 00	Palaeodrainage direction	0	0
Line	27 053 01	Prior stream, accurate, airphoto interpreted	0	0
Point	27 054 00	Drainage with tail	0	0
Point	27 055 00	Drainage tail	0	0
Point	27 070 00	Major volcanic centre	0	0
Point	27 071 00	Volcanic plug residual	0	0
Point	27 072 00	Eroded volcanic plug	0	0
Point	27 073 00	Major lava flow direction	0	0
90.000 HYDROLOGY				
Line	90 001 00	Coastline	0	0
Line	90 002 00	Lake, perennial	0	0
Line	90 003 00	Lake, non-perennial	0	0
Line	90 004 00	Watercourse, perennial	0	0
Line	90 005 00	Watercourse, non-perennial	0	0
Point	90 006 00	Direction of flow of watercourse	0	0
Point	90 007 00	Waterhole/soak	0	0
Point	90 008 00	Waterhole/soak, persistent	0	0
Line	90 009 00	Waterhole	0	0
Point	90 010 00	Rockhole	0	0
Point	90 011 00	Gnamma hole	0	0
Point	90 012 00	Spring	0	0
Line	90 013 00	Ephemeral water-table pool	0	0
Point	90 014 00	Swamp/marsh	0	0
Line/Point	90 015 00	Swamp/marsh	0	0
Line	90 016 00	Mangroves	0	0

Point	90 017 00	Waterfall	0	0
Point	90 301 00	Swamp	1	0
Line	90 302 00	Water feature		

			90.030 HYDROLOGY - BORES			
Point	90 030 00	Windpump			0	0
Point	90 031 00	Bore			0	0
Point	90 032 00	Bore, abandoned			0	0
Point	90 037 00	Bore, with windpump			0	0
Point	90 038 00	Bore, with pump engine			0	0
Point	90 033 00	Well			0	0
Point	90 034 00	Well, abandoned			0	0
Point	90 037 00	Well, with windpump			0	0
Point	90 035 00	Water tank			0	0
Point	90 036 00	Earth tank or dam			0	0
Point	90 037 00	Water storage			0	0
Point	90 038 00	Dam on stream			0	0
Line	90 039 00	Water pipeline			0	0
Line	90 040 00	Underground water pipeline			0	0
Line	90 041 00	Canal/aqueduct			0	0
			90.050 HYDROLOGY - ARTESIAN			
Point	90 050 00	Artesian bore, flowing			0	0
Point	90 051 00	Artesian bore, abandoned			0	0
Point	90 052 00	Artesian bore, ceased to flow			0	0
Point	90 053 00	Artesian bore, ceased to flow; abandoned			0	0
Point	90 053 00	Artesian bore, capped			0	0
Point	90 054 00	Sub-artesian bore			0	0
Point	90 055 00	Sub-artesian bore, abandoned			0	0
			90.060 HYDROLOGY - SALINITY			
Point	90 060 00	Salty bore, salinity not measured			0	0
Point	90 061 00	Bore, salinity less than 1500 ppm			0	0
Point	90 062 00	Bore, salinity 1500 to 10 000 ppm			0	0
Point	90 063 00	Bore, salinity greater than 10 000 ppm			0	0
			91.000 TOPOGRAPHY/GEOMORPHOLOGY			
Line	91 001 00	Rock ledge/coral reef			0	0
Line	91 002 00	Edge of raised reef terrace			0	0
Point	91 003 00	Rocks awash			0	0
Point	91 004 00	Submerged rock			0	0
Point	91 005 00	Sinkhole			0	0
Line	91 006 00	Sinkhole			0	0
Point	91 007 00	Astrobleme/impact	structure/cryptoexplosive	structure	0	0
Line	91 008 00	Astrobleme/impact	structure/cryptoexplosive	structure	0	0
Line	91 009 00	Strandline			0	0
Line	91 010 00	Sand ridge/dune			0	0
Line	91 011 00	Claypan			0	0
Line	91 012 00	Saltpan			0	0
Line	91 013 00	Escarpment			0	0

Line	91 014 00	Cliff	0	0
Line	91 015 00	Cirque	0	0

Line	91 016 00	Alluvial terrace	0	0
Line	91 017 00	Alluvial fan	0	0
Line	91 018 00	Alluvial fan	0	0
Line	91 019 00	Moraine	0	0
Point	91 020 00	Landslips showing heel of slip and direction of movement	0	0
Point	91 021 00	Landslip	0	0
Line	91 022 00	Landslip	0	0
Line	91 023 00	Landslip	0	0
Line	91 024 00	Miscellaneous boundary	0	0
Point	91 027 01	Elevation in metres, accurate	1	0
Point	91 027 02	Elevation in metres, approximate	2	0
Line	91 028 00	Topographic contour	1	0
Line	91 029 00	Form line	0	0
Line	91 030 00	Bathymetric contour	0	0
Line	91 031 00	Coral reef	0	0
Line	91 301 01	Lunette crest, accurate	1	0
Line	91 301 02	Lunette crest, approximate	2	0
Line	91 301 03	Lunette crest, inferred	3	0
Line	91 302 01	Strandline crest, accurate	1	0
Line	91 302 02	Strandline crest, approximate	2	0
Line	91 303 01	Alluvial terrace, accurate	1	0
Line	91 303 02	Alluvial terrace, approximate	2	0
Line	91 304 00	Miocene shoreline	0	0
Line	91 050 00	Polar ice	0	0
Line	91 051 00	Pack ice	0	0
Line	91 052 00	Shelf ice	0	0
Line	91 053 00	Ice field	0	0
Line	91 054 00	Snow field	0	0
Line	91 055 00	Glacier	0	0
		92.000 CULTURAL FEATURES		
Line	92 001 00	Highway/principal road	0	0
Line	92 002 00	Secondary road	0	0
Line	92 003 00	Minor road	0	0
Line	92 004 00	Vehicle track	0	0
Line	92 005 00	Traverse line	0	0
Line	92 006 00	Railway	0	0
Line	92 007 00	Abandoned railway	0	0
Line	92 008 00	Tunnel	0	0
Point	92 009 00	Bridge	0	0
Line	92 010 00	Fence	0	0
Line	92 011 00	Transmission line	0	0

Point	92 012 00	Aerodrome	0	0
Point	92 013 00	Landing ground	0	0
Line	92 014 00	Landing ground	0	0

Line	92 015 00	Built-up area
Point	92 016 00	City
Point	92 017 00	Town/village/settlement
Point	92 018 00	Homestead/outstation
Point	92 019 00	Building
Point	92 020 00	Yard
Point	92 021 00	Ruin
Point	92 022 00	Tower
Point	92 023 00	Trigonometrical station
Point	92 024 00	Astronomical station
Line	92 025 00	State/Territory border
Line	92 026 00	Minor administrative boundary