Designation: E2468 – 05 (Reapproved 2012)

Standard Practice for Metadata to Support Archived Data Management Systems[1]

This standard is issued under the fixed designation E2468; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This standard practice describes a hierarchical outline of sections and elements to be used in developing metadata to support archived data management systems. Specifically, the standard establishes the names of metadata elements and compound elements to be used in the metadata, the definitions of these metadata elements and compound elements, and suggested information about and examples of the values that are to be provided for the metadata elements.

1.2 The metadata to be developed using this standard includes qualitative and quantitative data that is associated with an information system or information object for the purposes of description, administration, legal requirements, technical functionality, use and usage, and preservation. As such, it can be differentiated from other metadata in that it describes and provides an interpretation of an organized collection of data, not a single data element.

1.3 This standard is intended for use by those developing, managing, or maintaining an archived data management system. For example, public agencies can specify that this standard be used in the development of a metadata framework for data archives. Data collectors and data processing intermediaries may also use this standard to create metadata describing the original collection conditions and intermediate processing steps. The development of metadata by data collectors and data processing intermediaries can greatly assist in the development of comprehensive metadata by the data archive manager. The standard is intended for use by all levels of government and the private sector.

1.4 This standard is applicable to various types of operational data collected by intelligent transportation systems (ITS) and stored in an archived data management system. Similarly, the standard can also be used with other types of historical traffic and transportation data collected and stored in an archived data management system.

1.5 This standard does not specify the means by which metadata is to be organized in a computer system or in a data transfer, nor the means by which metadata is to be transmitted, communicated, or presented to the user. Additionally, the standard is not intended to reflect or imply a specific implementation design. An implementation design requires adapting the structure and form of the standard to meet specific application and environment requirements.

1.6 This standard adopts with minimal changes the Federal Geographic Data Committee's (FGDC's) existing Content Standard for Digital Geospatial Metadata (FGDC-STD-001-1998) as the recommended metadata framework for archived data management systems. The FGDC metadata standard was chosen as the framework because of its relevance and established reputation among the spatial data community. A benefit of using the FGDC standard is the widespread availability of informational resources and software tools to create, validate, and manage metadata (see http://www.fgdc.gov/metadata/links/metalinks.html). Commentary and several examples are provided in this standard to illustrate the use of the FGDC standard in the ITS domain. The detail of the standard may appear intimidating, but the examples in the Appendix illustrate the relative simplicity of the standard when implemented.

1.7 Users of this standard should note that several sections of the metadata standard (that is, Annex A3 and Annex A4) address spatial referencing documentation, which may not be applicable to all data archives. These spatial referencing sections are designated as mandatory-if-applicable, which means that metadata is not required for these sections if spatial referencing is not used. Annex A6, Distribution Information, is also designated as mandatory-if-applicable and thus may not be required.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E867 Terminology Relating to Vehicle-Pavement Systems

E2259 Guide for Archiving and Retrieving Intelligent Transportation Systems-Generated Data

[1] This practice is under the jurisdiction of ASTM Committee E17 on Vehicle - Pavement Systems and is the direct responsibility of Subcommittee E17.52 on Traffic Monitoring.

Current edition approved July 1, 2012. Published July 2012Last previous version approved 2005 as D2468–05. DOI: 10.1520/E2468-05R12.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

2.2 *American National Standards Institute (ANSI) Standards:*

ANSI INCITS 30-1997 (R2003) Representation of Calendar Date and Ordinal Date for Information Interchange (formerly ANSI X3.30-1985, also formerly FIPS 4-1)[3]

ANSI X3.43-1986 Representations of Local Time of Day for Information Interchange[3]

ANSI X3.51-1975 Representations of Universal Time, Local Time Differentials, and United States Time Zone References for Information Interchange[3]

ANSI INCITS 61-1986 (R2002) Representation of Geographic Point Locations for Information Interchange (formerly ANSI X3.61-1986 (R1997), also formerly FIPS 70-1)[3]

2.3 *Federal Geographic Data Committee (FGDC) Standard:*

FGDC-STD-001-1998 Content Standard for Digital Geospatial Metadata, Version 2.0

2.4 *Federal Information Processing Standards (FIPS):*

FIPS PUB 4-1 (1988) Representation for Calendar Date and Ordinal Date for Information Interchange

FIPS PUB 55-3 (1994) Codes for Named Populated Places, Primary County Divisions, and Other Locational Entities of the United States, Puerto Rico, and the Outlying Areas

FIPS PUB 70-1 (1986) Representation of Geographic Point Locations for Information Interchange

FIPS PUB 173-1 (1994) Spatial Data Transfer Standard (STDS)

2.5 *Department of Defense:*

MIL-STD-600006 (1992) Vector Product Format (VPF)

MIL-A-89007 (1989) ARC Digitized Raster Graphics (ADRG)

2.6 *International Organization for Standardization (ISO):*

ISO 19115 (2003) Geographic Information—Metadata

3. Terminology

3.1 *Definitions:*

3.1.1 *archived data management subsystem, n*—a subsystem of the National ITS Architecture that provides a means for several organizations to collect, store, and subsequently, analyze and retrieve data from ITS data sources, usually by way of one or more ITS centers.

3.1.2 *archived data management system, n*—this is a specific implementation of an archived data management subsystem within the context of a local, regional, or statewide ITS architecture.

3.1.3 *attribute, n*—a defined property or characteristic; subset of an entity. In common terms, an attribute is typically a column in a relational database or a property in an object-oriented environment.

3.1.4 *before the common era, n*—sometimes abbreviated BCE, the period preceding a year near the birth of Jesus, coinciding with the period from 1 BC and earlier. It is synonymous with the period called before the Christian era and is sometimes used as a religiously neutral alternative to it.

3.1.5 *catalog, n*—a structured description of data being stored or transferred in data flows as described in the National ITS Architecture.

3.1.6 *common era, n*—sometimes abbreviated CE, the period beginning with a year near the birth of Jesus, coinciding with the period from AD 1 onwards. It is synonymous with the period called the Christian era and is sometimes used as a religiously neutral alternative to it.

3.1.7 *compound element, n*—a group or combination of groups of metadata elements. All compound elements are described by metadata elements, either directly or through intermediate compound elements. Compound elements represent higher-level concepts that cannot be represented by individual metadata elements.

3.1.8 *data processing intermediary, n*—a person or entity who transforms and supplies data that they did not directly collect themselves.

3.1.9 *data set, n*—a logical collection of data that supports a user function; could include one or more data tables, files, or sources.

3.1.10 *entity, n*—an existing or real thing. In relation to a database, an entity is a single person, place, or thing about which data can be stored. In common terms, an entity can be represented by one or more tables in a relational database or an object in an object-oriented environment.

3.1.11 *metadata, n*—data about data, or more precisely, definitional and descriptive data that provides information about or documentation of other data managed within an application or environment.

3.1.12 *metadata element, n*—a logically primitive item of metadata that forms the basic building block for this metadata standard.

3.1.13 *National ITS Architecture, n*—a document prepared through the sponsorship of the U.S. DOT that provides a common structure for the design of intelligent transportation systems giving a framework around which multiple design approaches can be developed by defining: *(a)* the functions that must be performed to implement a given user service; *(b)* the physical entities or subsystems where these functions reside; *(c)* the interfaces/information flows between the physical subsystems; and *(d)* the communication requirements for the information flows.

3.1.14 *production rules, n*—a standardized method of illustrating how metadata elements and compound elements are combined into a defined hierarchical metadata structure. Production rules also illustrate the optionality and repeating nature of metadata elements and compound elements.

3.2 Additional terms included in this standard but not defined here may be found in the glossary for the existing FGDC metadata standard at the following address: http://geology.usgs.gov/tools/metadata/standard/glossary.html. Many of the terms in the FGDC glossary are from FIPS 173 (Spatial Data Transfer Standard, or SDTS).

[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

4. Summary of Practice

4.1 The seven basic sections included in this metadata content standard are shown in Fig. 1 and summarized as follows:

4.1.1 *Identification Information,* or basic information about the data set. For example, what is the name of the data set? Who developed the data set? What geographic area does it cover? What themes of information does it cover? How current are the data? Are there restrictions on accessing or using the data?

4.1.2 *Data Quality Information,* or a general assessment of the quality of the data set. For example, how good are the data? Is information available that allows a user to decide if the data are suitable for his or her purpose? What is the positional and attribute accuracy? Are the data complete? Were the consistency of the data verified? What data were used to create the data set, and what processes were applied to these sources?

4.1.3 *Spatial Data Organization Information,* or the mechanism used to represent spatial information in the data set. For example, what spatial data model was used to encode the spatial data? How many spatial objects are there? Are methods other than coordinates, such as street addresses, used to encode locations?

4.1.4 *Spatial Reference Information,* or the description of the reference frame for, and the means to encode, coordinates in the data set. For example, are coordinate locations encoded using longitude and latitude? Is a map projection or grid system, such as the State Plane Coordinate System, used? What horizontal and vertical datums are used? What parameters should be used to convert the data to another coordinate system?

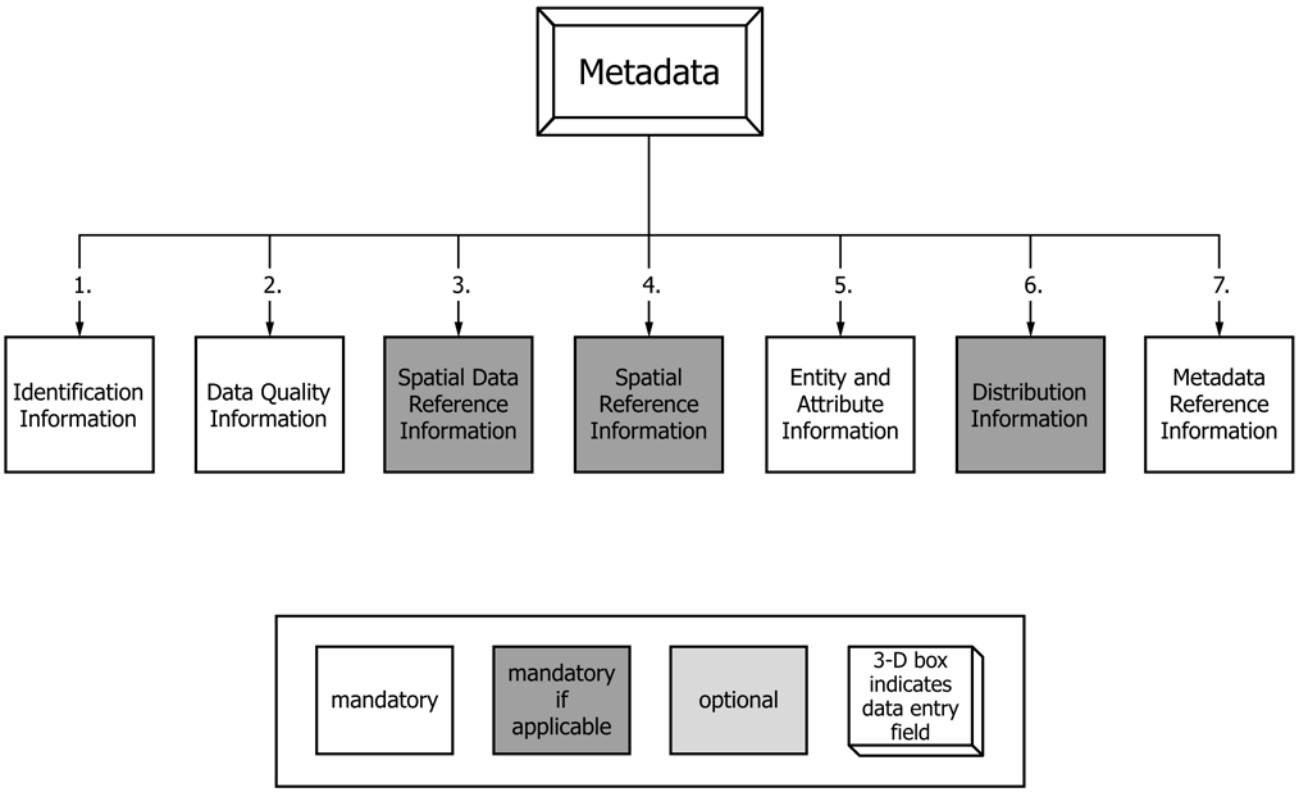
4.1.5 *Entity and Attribute Information,* or details about the information content of the data set, including the entity types, their attributes, and the domains from which attribute values may be assigned. For example, what geographic information (roads, houses, elevation, temperature, etc.) is included? How is this information encoded? Were codes used? What do the codes mean?

4.1.6 *Distribution Information,* or information about the distributor of and options for obtaining the data set. For example, from whom can I obtain the data? What formats are available? What media are available? Are the data available online? What is the price of the data (if any)?

4.1.7 *Metadata Reference Information,* or information on the currentness of the metadata information and the responsible party. For example, when were the metadata compiled? By whom?

4.2 This standard practice adopts with minimal change an existing FGDC metadata standard to document data stored in archived data management systems. This standard addresses the three types of metadata as defined in Guide E2259 and outlined here:

4.2.1 *Archive Structure Metadata,* or descriptive data about the structure of the data archive itself and of the data and information in the archive that facilitate use of the archive



(Source: Adapted from FGDC Metadata Workbook – Version 2.0)

FIG. 1 FGDC Content Standard for Digital Geospatial Metadata

(*Identification Information, Spatial Reference Information, Entity and Attribute Information,* and *Distribution Information* in this standard).

4.2.2 *Processing Documentation Metadata,* or information that describes the processes applied to the data from original source data through to storage in an archived data management system (*Data Quality Information* and *Spatial Data Organization Information* in this standard).

4.2.3 *Data Collection System Metadata,* or data about the conditions and procedures under which original source data were observed, surveyed, measured, gathered, collected, as well as about the equipment that was used (*Data Quality Information, Entity and Attribute Information,* and *Metadata Reference Information* in this standard).

4.3 This standard includes three additional sections that are referenced by the other sections of the metadata standard. These last three sections are always used within other sections and are never used alone. The three sections are as follows:

4.3.1 *Citation Information,* or the recommended reference to be used for the data set.

4.3.2 *Time Period Information,* or information about the date and time of an event.

4.3.3 *Contact Information,* or the identity of, and means to communicate with, person(s) and organization(s) associated with the data set.

4.4 Each of the seven basic sections of the metadata content standard has an optionality associated with it: mandatory, mandatory-if-applicable, and optional. Four of the seven sections are mandatory—*Identification Information, Data Quality Information, Entity and Attribute Information,* and *Metadata Reference Information*—and these four sections form what is considered the "core" for metadata that conform to this standard. The remaining three sections are mandatory-if-applicable.

4.5 Within each of the seven basic sections of metadata, there are compound elements and metadata elements that also have an optionality associated with it: mandatory, mandatory-if-applicable, and optional. The optionality of these compound elements and metadata elements are assigned in this standard. Mandatory elements are considered essential for metadata functionality, whereas optional elements are considered desirable but not essential.

5. Significance and Use

5.1 Put simply, metadata is "data about data" and typically describes the content, quality, lineage, organization, availability, and other characteristics of the data. Metadata is typically used to: *(1)* determine the availability of certain data (for example, through searches of a data catalog or clearinghouse); *(2)* determine the fitness of data for an intended use; *(3)* determine the means of accessing data; and *(4)* enhance data analysis and interpretation by better understanding the data collection and processing procedures.

5.2 The use of metadata among current implementations of archived data management systems is limited and is not uniform; in fact, this deficiency was the original impetus for this metadata standard. There are several possible reasons for the limited and inconsistent use of metadata: *(1)* the deployment of archived data management systems is still in the early stages since its formal inclusion in the National ITS Architecture in 1999; *(2)* to date, no formal metadata structure has been designated (the National ITS Architecture only refers to a generic "data catalog"); and *(3)* writing good documentation (that is, metadata) is typically the last and least enjoyed aspect of developing information systems.

5.3 The use of metadata among the spatial data community is widespread and relatively uniform, due mostly to Executive Order 12906 issued in 1994 which called for the creation of a National Spatial Data Infrastructure (NSDI). This Executive Order mandated the creation of metadata standards, which were to be developed and maintained by the FGDC, a 19-member interagency committee. The spatial data community operates several metadata clearinghouses that, in effect, serve as virtual card catalogs to vast collections of online spatial data. Federal, State, and local agencies have adopted the FGDC metadata standard and use it to document available datasets. Significant resources from numerous agencies have been placed into the development of the NSDI and supporting elements like the FGDC metadata standard. Notwithstanding these significant resources, the adoption and implementation of the FGDC metadata standard by other agencies and entities in the past 8 to 10 years has been remarkable.

5.4 The 10-year vision for metadata implementation in archived data management systems should resemble (at a minimum) the current state of metadata implementation in the spatial data community. This vision for ADMS metadata includes the following: *(1)* a consortium of agencies that develop and maintain various metadata standards and supporting guidance; *(2)* metadata clearinghouses that advertise available data sets as well as fully support the operational concept of a virtual data warehouse as defined in the National ITS Architecture; and *(3)* widespread adoption and implementation of standardized ADMS metadata structures among public (Federal, State, and local) transportation agencies and private companies.

5.5 This metadata standard may be implemented in several ways. Some metadata producers may desire to implement metadata that can be easily read by humans, which would likely include many unrestricted free text entries. Other metadata producers may wish to implement metadata that is easily interpreted by computer systems. If automated computer interpretation of metadata is desired, more specificity may have to be applied to certain metadata elements to restrict domain values beyond free text.

5.6 The detail of this standard may appear intimidating, but the examples in the Appendix illustrate the relative simplicity of the standard when implemented. The existing FGDC standard offers the widespread availability of resources and tools to create, validate, and manage metadata (see http://www.fgdc.gov/metadata/links/metalinks.html). The implementation of this metadata standard in a basic information system should require minimal staff time and effort.

6. Organization of the Standard

6.1 This standard adopts with minimal changes the existing FGDC *Content Standard for Digital Geospatial Metadata* as the recommended metadata framework, and includes nearly all of the text (with commentary and usage notes included where necessary) of the existing FGDC standard. The commentary has been added to provide additional information and discussion that is to be considered separate from the standard, and is distinguished from the metadata content standard by the use of a leading title of "Usage Note".

6.1.1 *Usage Note*—When commentary has been added as a supplement to this metadata content standard, the commentary will be distinguished from the standard by the use of a leading title of "*Usage Note*."

6.2 *Numbered Sections:*

6.2.1 The standard is organized in a hierarchy of metadata elements and compound elements that define the information content for metadata to document a set of digital data (see Fig. 1). The starting point is *Metadata*. The compound element *Metadata* is composed of other compound elements representing different concepts about the data set. Each of these compound elements has a numbered section in the standard. In each numbered section, these compound elements are defined by other compound elements and metadata elements. The *Citation Information*, *Time Period Information*, and *Contact Information* sections are special sections that specify metadata elements used by other sections. These sections are defined once for convenience in separate sections.

6.2.2 Each section begins with the name and definition of the compound element that defines the section. The name and definition are followed by production rules (see 6.10) that define the compound element in terms of metadata elements, either directly or by the use of intermediate compound elements. When intermediate compound elements are used, the production rules for these elements also are provided in this part of the section.

6.2.3 The production rules are followed by a list of names and definitions of compound elements and metadata elements used in the section. Section and element numbers are provided for user navigation of the standard. They are neither authoritative nor intended for use in implementation and are subject to change in future revisions of the standard.

6.2.4 A detailed description for all sections of the metadata content standard is provided in the Annexes of this standard. The Annexes of an ASTM standard are mandatory sections.

6.3 *Compound Elements:*

6.3.1 A compound element is a group or combination of groups of metadata elements. All compound elements are described by metadata elements, either directly or through intermediate compound elements. Compound elements represent higher level concepts that cannot be represented by individual metadata elements. The form for the definition of compound elements is:

Compound element name—definition.
Type: compound
Short Name: [8 characters or less]

6.3.2 The type of "compound" uniquely identifies the compound elements in the lists of terms and definitions.

6.3.3 Short names consisting of eight alphabetic characters or less are included to assist in implementation of the standard. The eight-character short names are provided for programming convenience and should be used as tags in the Extensible Markup Language (XML).

6.4 *Metadata Elements:*

6.4.1 A metadata element is a logically primitive item of metadata. It is a single unit of metadata that cannot be divided and still have meaning. The entry for a metadata element includes the name of the metadata element, the definition of the metadata element, a description of the values that can be assigned to the metadata element (domain), and a short name for the metadata element. The form for the definition of a metadata element is:

Metadata element name—definition.
Type: [integer, real, text, date, or time]
Domain: [describes valid values that can be assigned]
Short Name: [8 characters or less]

6.4.2 The information about the values for the metadata elements includes a description of the type of the value, and a description of the domain of the valid values. The type of the metadata element describes the kind of value to be provided. The choices are "integer" for integer numbers, "real" for real numbers, "text" for ASCII characters, "date" for day of the year, and "time" for time of the day.

6.4.3 The domain describes valid values that can be assigned to the metadata element. The domain may specify a list of valid values, references to lists of valid values, or restrictions on the range of values that can be assigned to a metadata element.

6.4.4 The domain also may note that the domain is free from restrictions, and any values that can be represented by the "type" of the metadata element can be assigned. These unrestricted domains are represented by the use of the word "free" followed by the type of the metadata element (that is, free text, free date, free real, free time, free integer). Some domains can be partly, but not completely, specified. For example, there are several widely used data transfer formats, but there may be many more that are less well known. To allow a producer to describe its data in these circumstances, the convention of providing a list of values followed by the designation of a "free" domain is used. In these cases, assignments of values shall be made from the provided domain when possible. When not possible, providers may create and assign their own value. A created value shall not redefine a value provided by the standard.

6.4.5 Short names consisting of eight alphabetic characters or less are included to assist in user implementation of the standard. The eight-character short names are provided for programming convenience and should be used as tags in the Extensible Markup Language (XML).

6.4.6 Another issue is the representation of null values (representing such concepts as "unknown") in the domain. While this is relatively simple for textual entries (one would enter the text "Unknown"), it is not as simple for the integer, real, date, and time types. (For example, which integer value means "unknown"?). Because conventions for providing this

information vary among implementations, the standard specifies what concepts shall be represented, but does not mandate a means for representing them.

6.4.7 In addition to the values to be represented, the form of representation also is important, especially to applications that will manipulate the metadata elements. The following conventions for forms of values for metadata elements shall be used.

6.5 *Calendar Dates (Years, Months, and Days):*

6.5.1 *Common Era (CE) to December 31, 9999 CE*—Values for day and month of year, and for years, shall follow the calendar date convention (general form of YYYY for year; YYYYMM for month of a year (with month being expressed as an integer), and YYYYMMDD for a day of the year) specified in ANSI INCITS 30-1997 (R2003) (also adopted as FIPS PUB 4-1 1988, formerly ANSI X3.30-1985).

6.5.2 *Before the Common Era (BCE) to 9999 BCE*—Values for day and month of year, and for years, shall follow the calendar date convention, preceded by the lower case letters "bce" (general form of bceYYYY for year; bceYYYYMM for month of a year (with month being expressed as an integer), and bceYYYYMMDD for a day of the year).

6.5.3 *BCE before 9999 BCE*—Values for the year shall consist of as many numeric characters as needed to represent the number of the year BCE, preceded by lower case letters "cc" (general form of ccYYYYYYY...).

6.5.4 *CE after 9999 CE*—Values for the year shall consist of as many numeric characters as needed to represent number of the year CE, preceded by the lower case letters "cd" (general form of cdYYYYYYY...).

6.6 *Time of Day (Hours, Minutes, and Seconds):*

6.6.1 Because some geospatial data and related applications are sensitive to time of day information, three conventions are permitted. Only one convention shall be used for metadata for a data set. The conventions are as follows.

6.6.1.1 *Local Time*—For producers who wish to record time in local time, values shall follow the 24-hour timekeeping system for local time of day in the hours, minutes, seconds, and decimal fractions of a second (to the precision desired) without separators convention (general form of HHMMSSSS) specified in ANSI X3.43-1986.

6.6.1.2 *Local Time with Time Differential Factor*—For producers who wish to record time in local time and the relationship to Universal Time (Greenwich Mean Time), values shall follow the 24-hour timekeeping system for local time of day in hours, minutes, seconds, and decimal fractions of a second (to the resolution desired) without separators convention. This value shall be followed, without separators, by the time differential factor. The time differential factor expresses the difference in hours and minutes between local time and Universal Time. It is represented by a four-digit number preceded by a plus sign (+) or minus sign (-), indicating hours and minutes local time is ahead of or behind Universal Time, respectively. The general form is HHMMSSSSshhmm, where HHMMSSSS is the local time using 24-hour timekeeping (expressed to the precision desired), 's' is the plus or minus sign for the time differential factor, and hhmm is the time differential factor. (This option allows producers to record local time and time zone information. For example, Eastern Standard Time has a time differential factor of -0500, Central Standard Time has a time differential factor of -0600, Eastern Daylight Time has a time differential factor of -0400, and Central Daylight Time has a time differential factor of -0500.) This option is specified in ANSI X3.51-1975.

6.6.1.3 *Universal Time (Greenwich Mean Time)*—For producers who wish to record time in Universal Time (Greenwich Mean Time), values shall follow the 24-hour timekeeping system for Universal Time of day in hours, minutes, seconds, and decimal fractions of a second (expressed to the precision desired) without separators convention, with the upper case letter "Z" directly following the low-order (or extreme right hand) time element of the 24-hour clock time expression. The general form is HHMMSSSSZ, where HHMMSSSS is Universal Time using 24-hour timekeeping, and Z is the letter "Z". This option is specified in ANSI X3.51-1975.

6.7 *Latitude and Longitude:*

6.7.1 Values for latitude and longitude shall be expressed as decimal fractions of degrees. Whole degrees of latitude shall be represented by a two-digit decimal number ranging from 0 through 90. Whole degrees of longitude shall be represented by a three-digit decimal number ranging from 0 through 180. When a decimal fraction of a degree is specified, it shall be separated from the whole number of degrees by a decimal point. Decimal fractions of a degree may be expressed to the precision desired.

6.7.2 Latitudes north of the equator shall be specified by a plus sign (+), or by the absence of a minus sign (-), preceding the two digits designating degrees. Latitudes south of the Equator shall be designated by a minus sign (-) preceding the two digits designating degrees. A point on the Equator shall be assigned to the Northern Hemisphere.

6.7.3 Longitudes east of the prime meridian shall be specified by a plus sign (+), or by the absence of a minus sign (-), preceding the three digits designating degrees of longitude. Longitudes west of the meridian shall be designated by minus sign (-) preceding the three digits designating degrees. A point on the prime meridian shall be assigned to the Eastern Hemisphere. A point on the 180th meridian shall be assigned to the Western Hemisphere. One exception to this last convention is permitted. For the special condition of describing a band of latitude around the earth, the East Bounding Coordinate metadata element shall be assigned the value +180 (180) degrees.

6.7.4 Any spatial address with a latitude of +90 (90) or -90 degrees will specify the position at the North or South Pole, respectively. The component for longitude may have any valid value.

6.7.5 With the exception of the special condition described above, this form is specified in ANSI INCITS 61-1986 (R2002) (formerly ANSI X3.61-1986).

6.8 *Network Addresses and File Names:*

6.8.1 Values for file names, network addresses for computer systems, and related services should follow the Uniform Resource Locator convention of the Internet when possible. See http://www.w3.org/Addressing/ for additional details about the Uniform Resource Locator.

6.9 *Optionality:*

6.9.1 The standard categorizes elements as being mandatory, mandatory-if-applicable, or optional as follows. The production rules in section 6.10 are critical for understanding which sections and elements of the metadata must be included to comply with this standard.

6.9.2 Mandatory elements must be provided. Mandatory elements are comparable to a "shall" statement as used in other traffic engineering standards, such as the Manual on Uniform Traffic Control Devices (MUTCD).

6.9.3 Mandatory-if-applicable elements must be provided if the data set exhibits the defined characteristic or the defined characteristic is known. For example, Section 4 of the metadata content standard contains the compound element "Altitude System Definition" as a mandatory-if-applicable element. If the data set being described has an altitude component (such as the flight height for aerial photography), then this element is mandatory. If the data set being described does not have an altitude component, then this element is not mandatory. In another example, suppose the metadata author can not reasonably determine any information in the mandatory-if-applicable Section 3, "Data Quality Information." In this situation, the section is not mandatory.

6.9.4 Optional elements are provided at the discretion of the metadata producer. Optional elements are comparable to a "may" statement as used in other traffic engineering standards, such as the MUTCD.

6.9.5 The optionality of a section or compound element always takes precedence over the metadata elements that it contains. Once a section or compound element is recognized by the data set producer as applicable, then the optionality of its subordinate elements is to be interpreted. See production rules (see 6.10) for additional interpretive guidance.

6.9.6 Mandatory sections in the standard have some metadata elements that are always required for all types of geospatial data sets. For comparison with other metadata standards, these elements are referred to as "core" elements.

6.10 *Production Rules:*

6.10.1 A production rule specifies the relationship between a compound element, metadata elements, and other (lower-level) compound elements. The production rules in this section are critical for understanding how different sections and elements of the metadata standard fit together when producing metadata. Each production rule has a left side (identifier) and a right side (expression) connected by the symbol "=", meaning that the term on the left side is replaced by or produces the term on the right side. Terms on the right side are either other compound elements or individual metadata elements. By making substitutions using matching terms in the production rules, one can explain higher-level concepts using metadata elements. The symbols used in the production rules have the following meaning.

6.10.1.1 *Symbol Meaning:*

=	is replaced by, produces, consists of
+	and
[|]	selection; select one term from the list of enclosed terms (exclusive or). Terms are separated by "|"
m{ }n	iteration; the term(s) enclosed is(are) repeated from "m" to "n" times
( )	optional; the term(s) enclosed is(are) optional

6.10.1.2 *Examples:*

a = b + c	"a consists of b and c"
a = [b | c]	"a consists of one of b or c"
a = 4{b}6	"a consists of four to six occurrences of b"
a = b + (c)	"a consists of b and optionally c"

6.10.2 *Interpreting the Production Rules*—The terms bounded by parentheses, "(" and "),"" are optional and are provided at the discretion of the data producer. If a producer chooses to provide information enclosed by parentheses, the producer shall follow the production rules for the enclosed information. For example, if the producer decides to provide the optional information described in the term "(a + b + c)," the producer shall provide all elements within the parentheses—that is, "a" and "b" and "c."

6.10.3 Only for terms bounded by parentheses does the producer have the discretion of deciding whether or not to provide the information.

6.10.4 The variation among the ways in which geospatial data are produced and distributed, the fact that all geospatial data does not have the same characteristics, and the issue that all details of data sets that are in work or are planned may not be decided, caused the need to express the concept of "mandatory-if-applicable." This concept means that if the data set exhibits (or, for data sets that are in work or planned, it is known that the data set will exhibit) a defined characteristic, then the producer shall provide the information needed to describe that characteristic. This concept is described by the production rule: 0{ term }1.

6.11 *Extensibility:*

6.11.1 Extended metadata elements may be defined by a data set producer or a user community. Extended elements are metadata elements outside the standard, but needed by the data set producer.

6.12 *User Feedback and Input on Metadata:*

6.12.1 The domain values of many metadata elements in this standard are free text, which means that metadata producers have the flexibility to include as little or as much documentation as they desire. Metadata producers should consider the feedback and input from the respective data users in determining the appropriate level of detail for free text fields in metadata.

7. Overview of the Metadata Standard

7.1 Fig. 1 provides an overview of the sections included in the metadata standard. The sections are shown with a shading corresponding to the optionality of each section. The details for

each section, including information for each compound element and metadata element, are contained in the Annexes, which are mandatory sections of the standard.

7.2 Fig. 2 provides an overview of Section 1, *Identification Information*. This section of the metadata content is to contain basic information about the data set. The details on compound elements and metadata elements for Section 1 are provided in Annex A1.

7.3 Fig. 3 provides an overview of Section 2, *Data Quality Information*. This section of the metadata content is to contain a general assessment of the quality of the data set. The details on compound elements and metadata elements for Section 2 are provided in Annex A2.

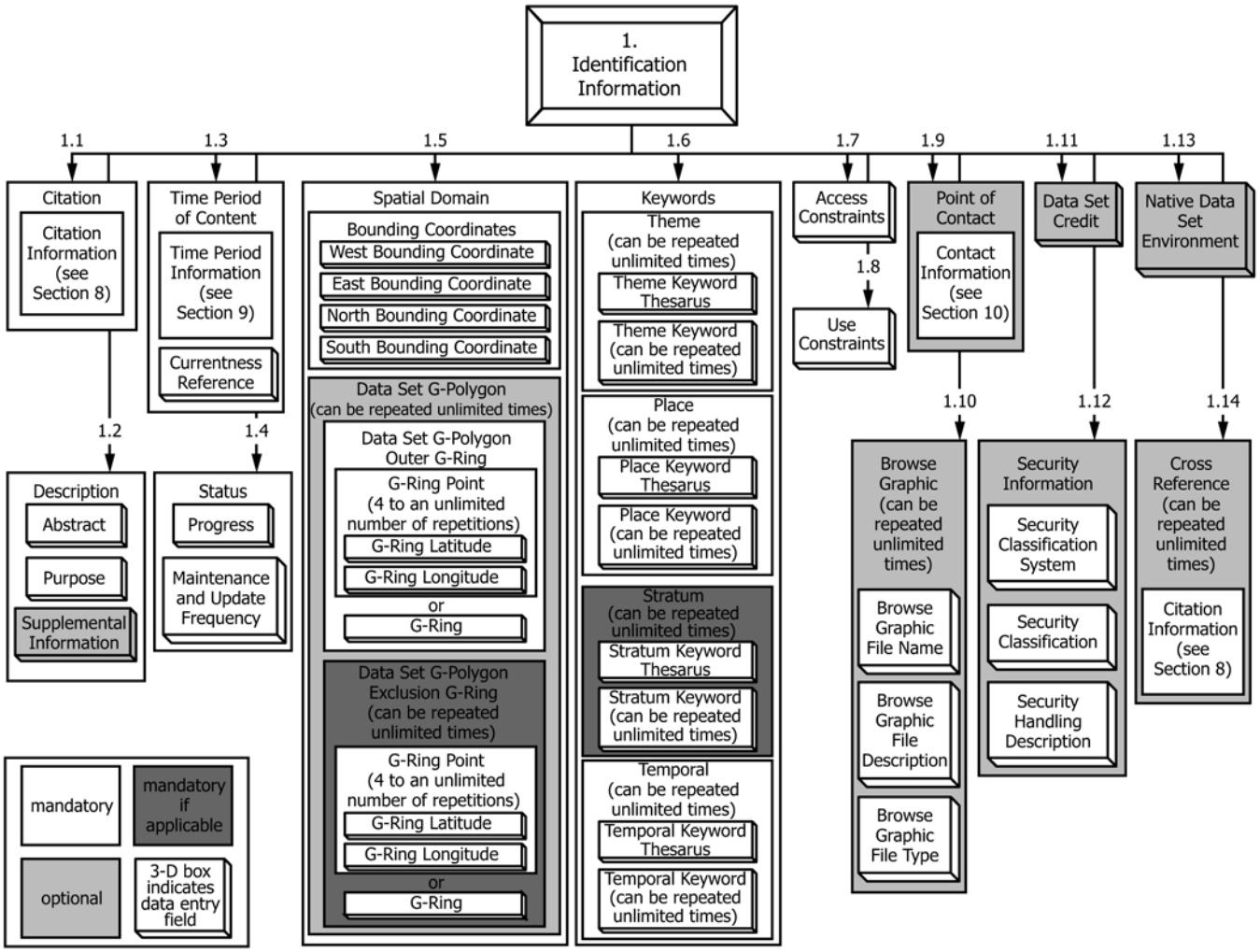
7.4 Fig. 4 provides an overview of Section 3, *Spatial Data Organization Information*. This section of the metadata content is to describe the general mechanism used to represent spatial information in the data set. The details on compound elements and metadata elements for Section 3 are provided in Annex A3.

7.5 Fig. 5 provides an overview of Section 4, *Spatial Reference Information*. This section of the metadata content is to describe the reference frame for, and the means to encode, coordinates in the data set. The details on compound elements and metadata elements for Section 4 are provided in Annex A4.

7.6 Fig. 6 provides an overview of Section 5, *Entity and Attribute Information*. This section of the metadata content is to contain details about the information content of the data set, including the entity types, their attributes, and the domains from which attribute values may be assigned. The details on compound elements and metadata elements for Section 5 are provided in Annex A5.

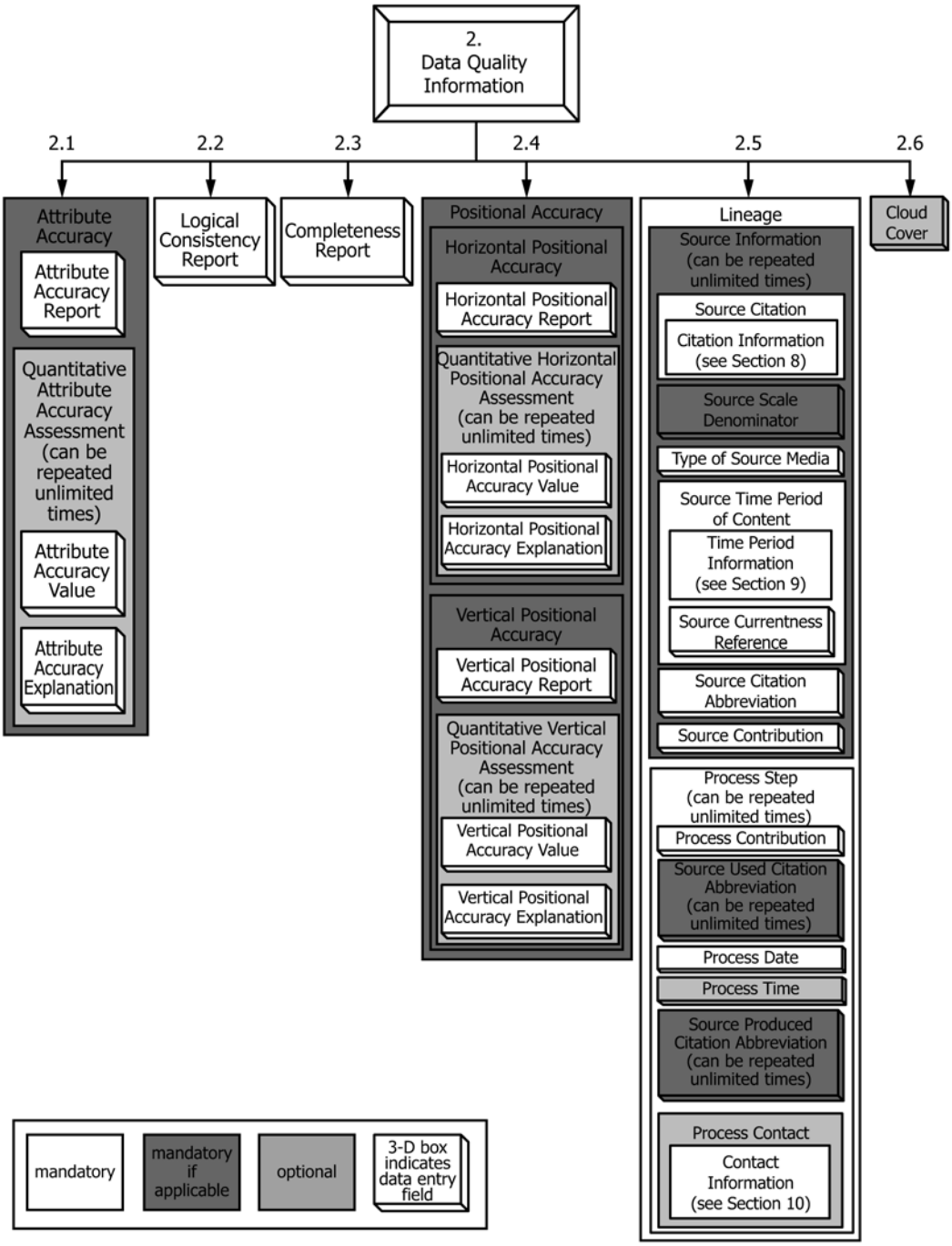
7.7 Fig. 7 provides an overview of Section 6, *Distribution Information*. This section of the metadata content is to provide information about the distributor of and options for obtaining the data set. The details on compound elements and metadata elements for Section 6 are provided in Annex A6.

7.8 Fig. 8 provides an overview of Section 7, *Metadata Reference Information*. This section of the metadata content is to contain information on the currentness of the metadata and the responsible party. The details on compound elements and metadata elements for Section 7 are provided in Annex A7.



(Source: Adapted from FGDC Metadata Workbook – Version 2.0)

FIG. 2 Metadata for Identification Information (Annex A1)



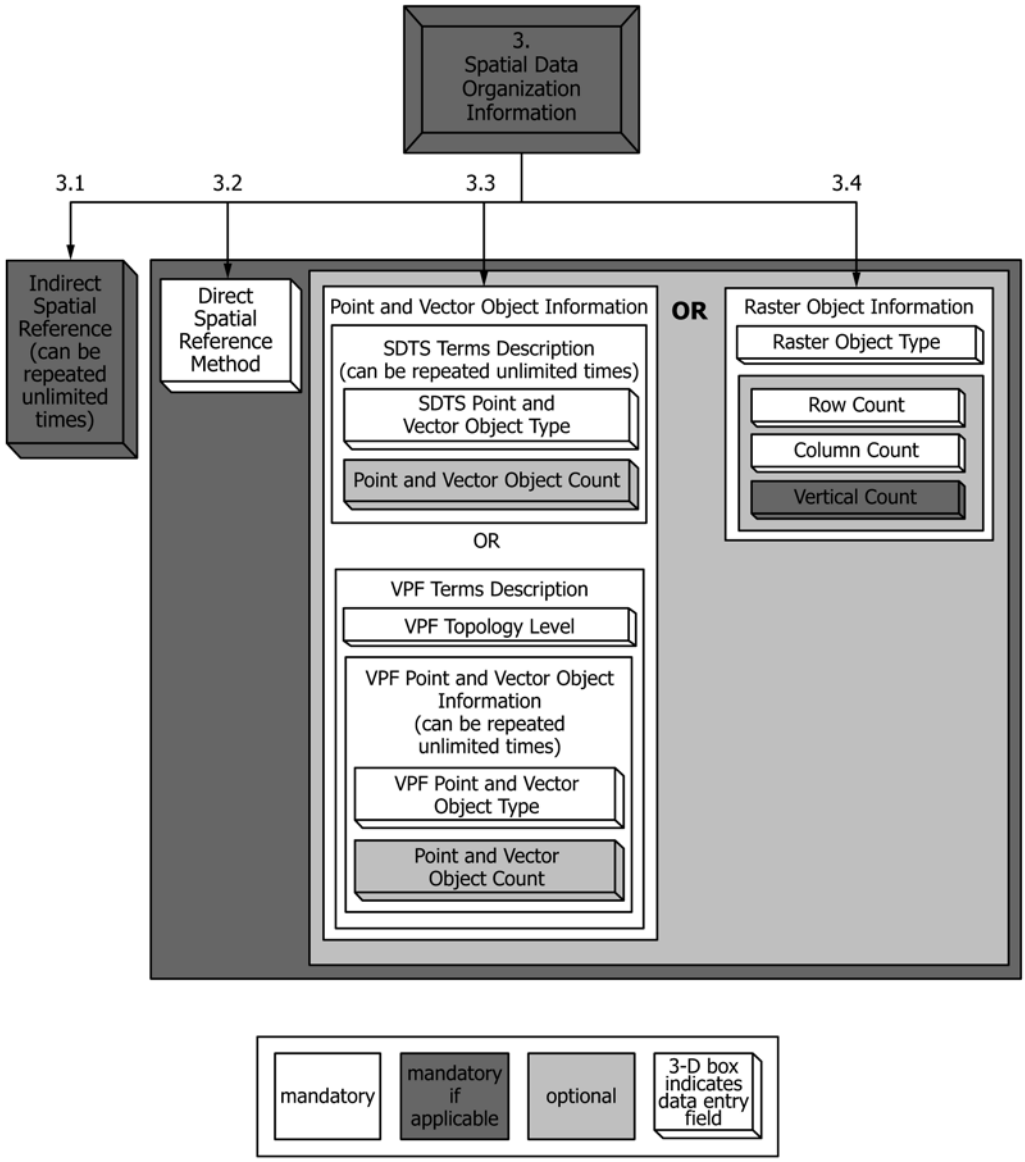
(Source: Adapted from FGDC Metadata Workbook – Version 2.0)

FIG. 3 Metadata for Data Quality Information (Annex A2)

7.9 Fig. 9 provides an overview of Section 8, *Citation Information*; Section 9, *Time Period Information*; and Section 10, *Contact Information*. These supplemental sections are referenced in several other primary sections of the metadata content standard. The details on compound elements and metadata elements for Sections 8 through 10 are provided in Annex A8 through Annex A10, respectively.

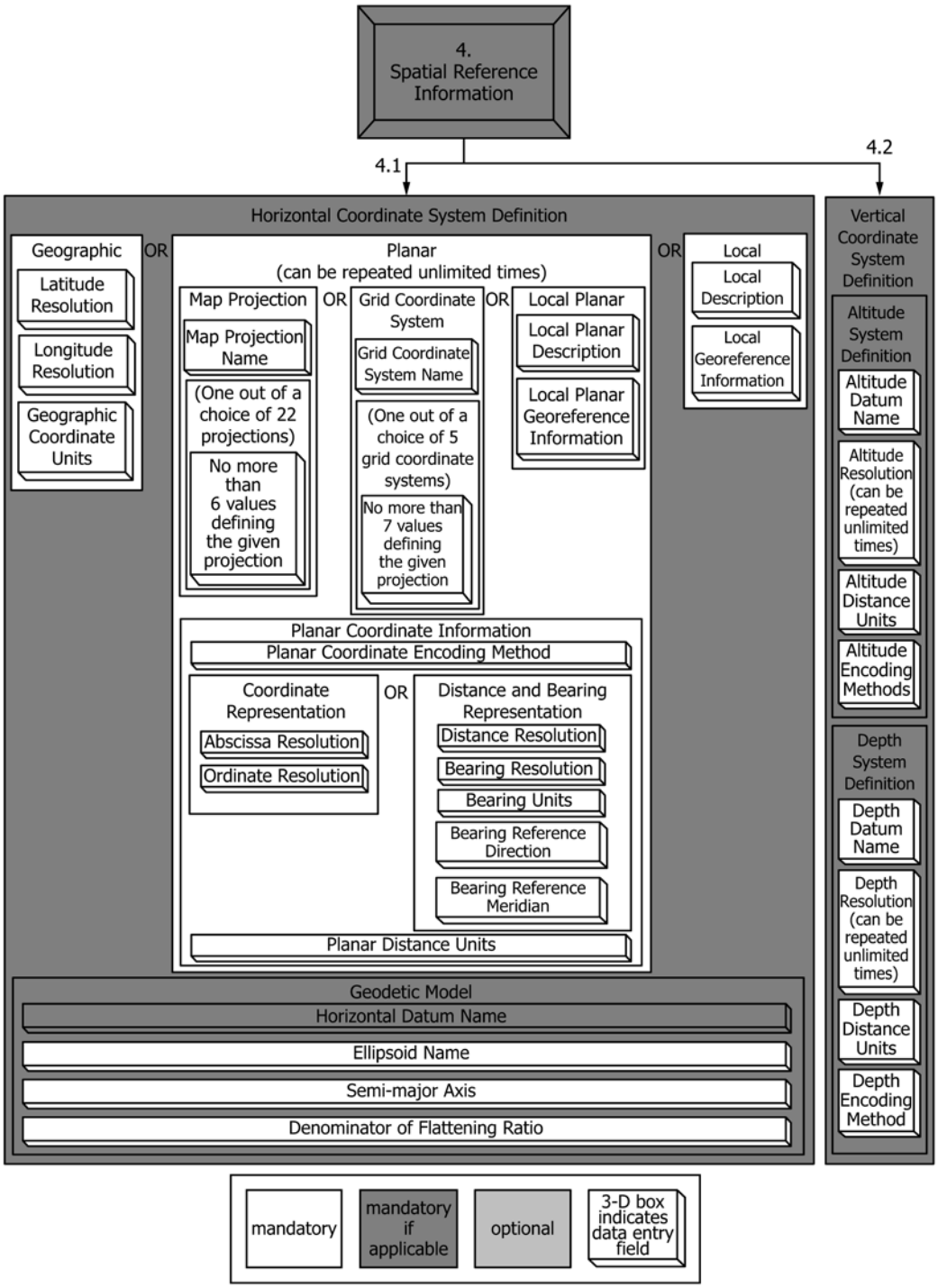
8. Keywords

8.1 archived data; archived data management system; data set documentation; metadata



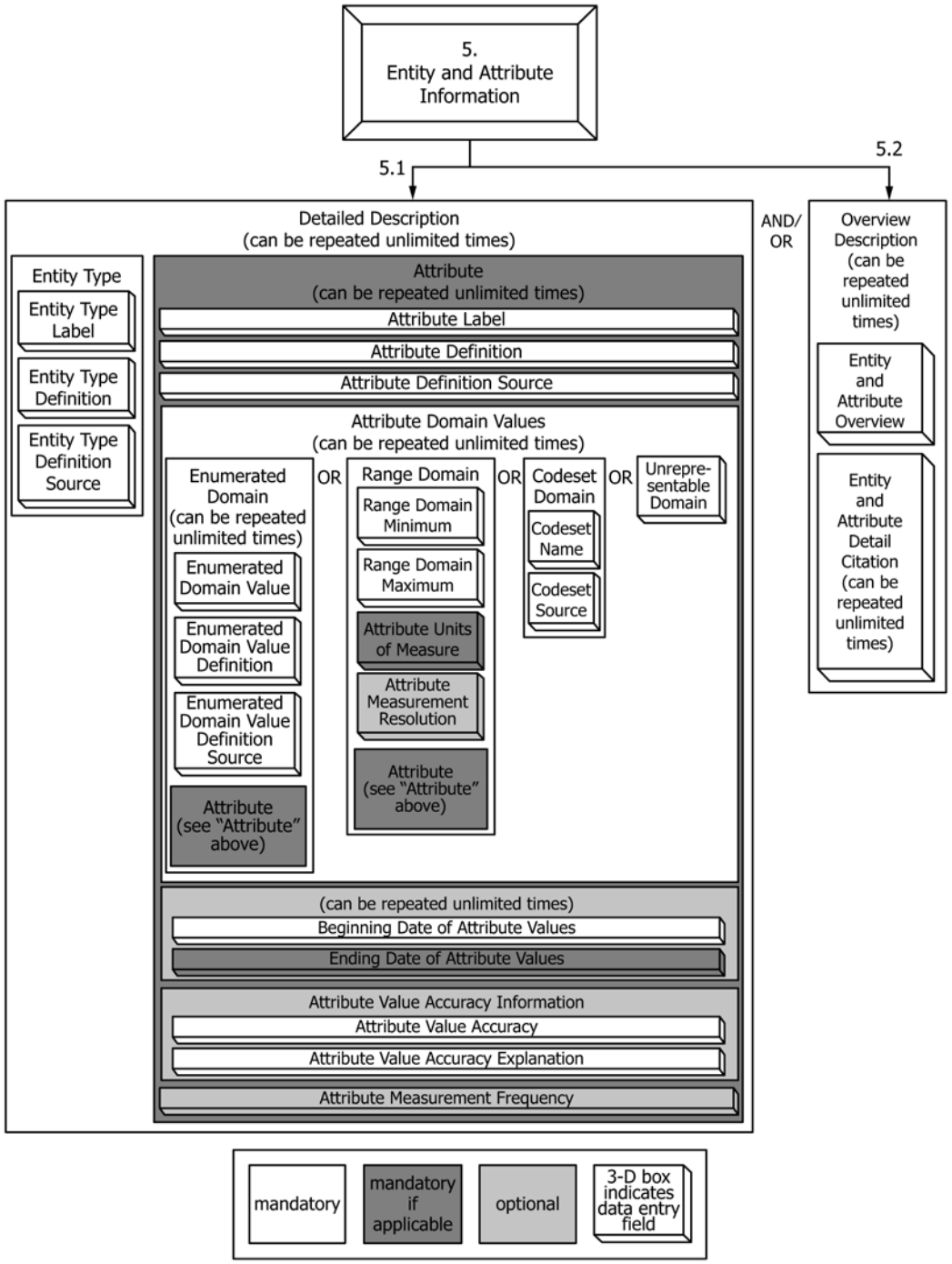
(Source: Adapted from FGDC Metadata Workbook – Version 2.0)

FIG. 4 Metadata for Spatial Data Organization Information (Annex A3)



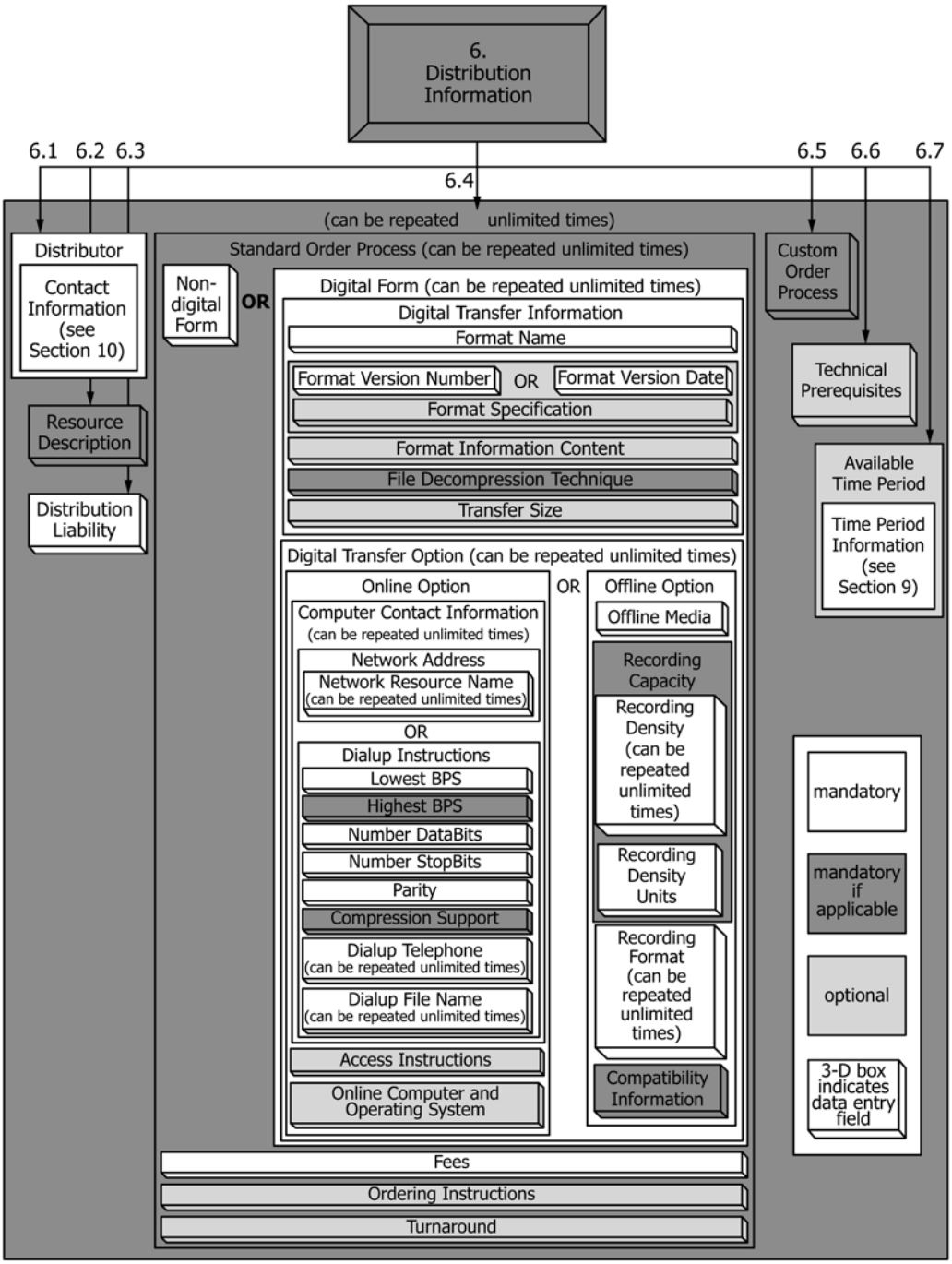
(Source: Adapted from FGDC Metadata Workbook – Version 2.0)

FIG. 5 Metadata for Spatial Reference Information (Annex A4)



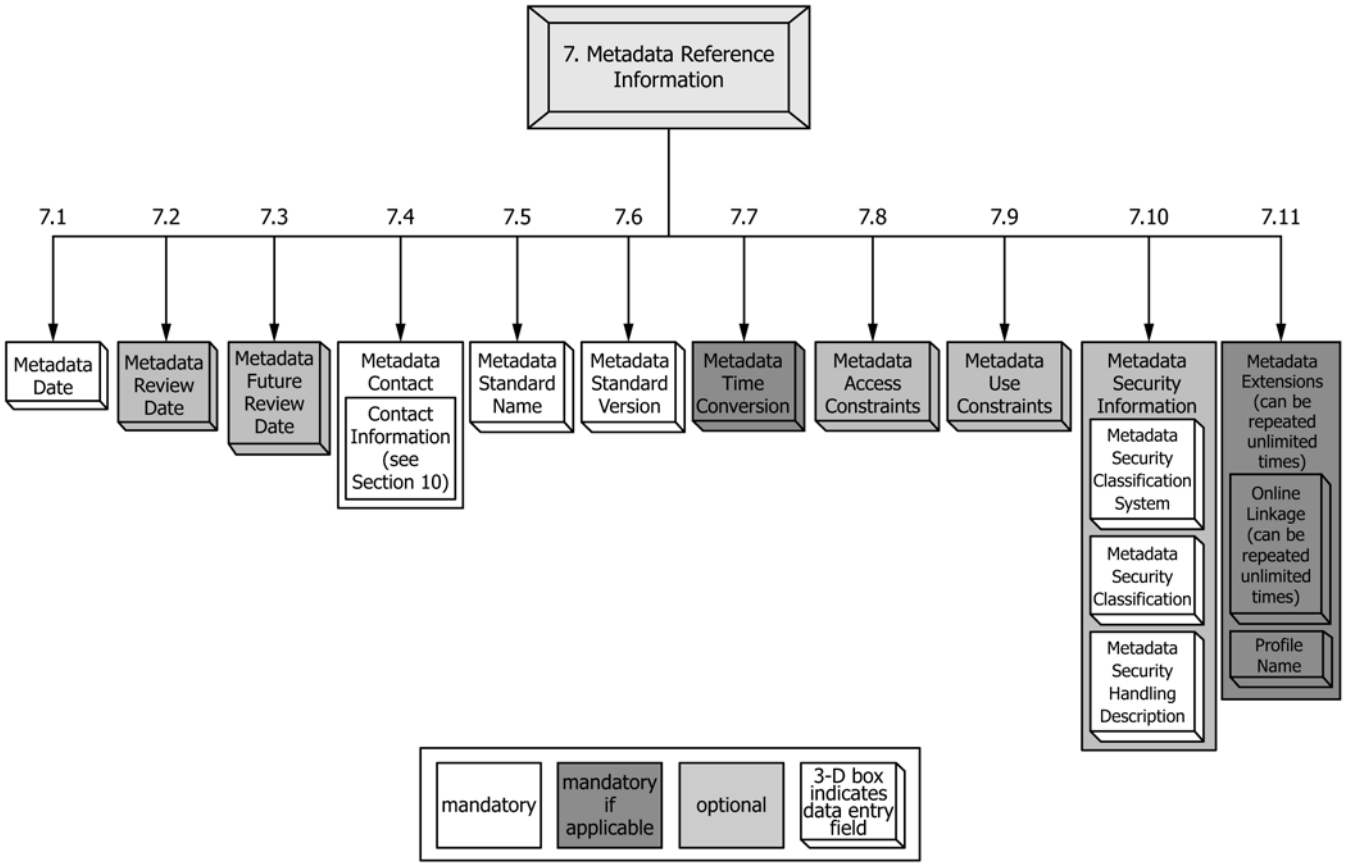
(Source: FGDC Metadata Workbook – Version 2.0)

FIG. 6 Adapted from Metadata for Entity and Attribute Information (Annex A5)



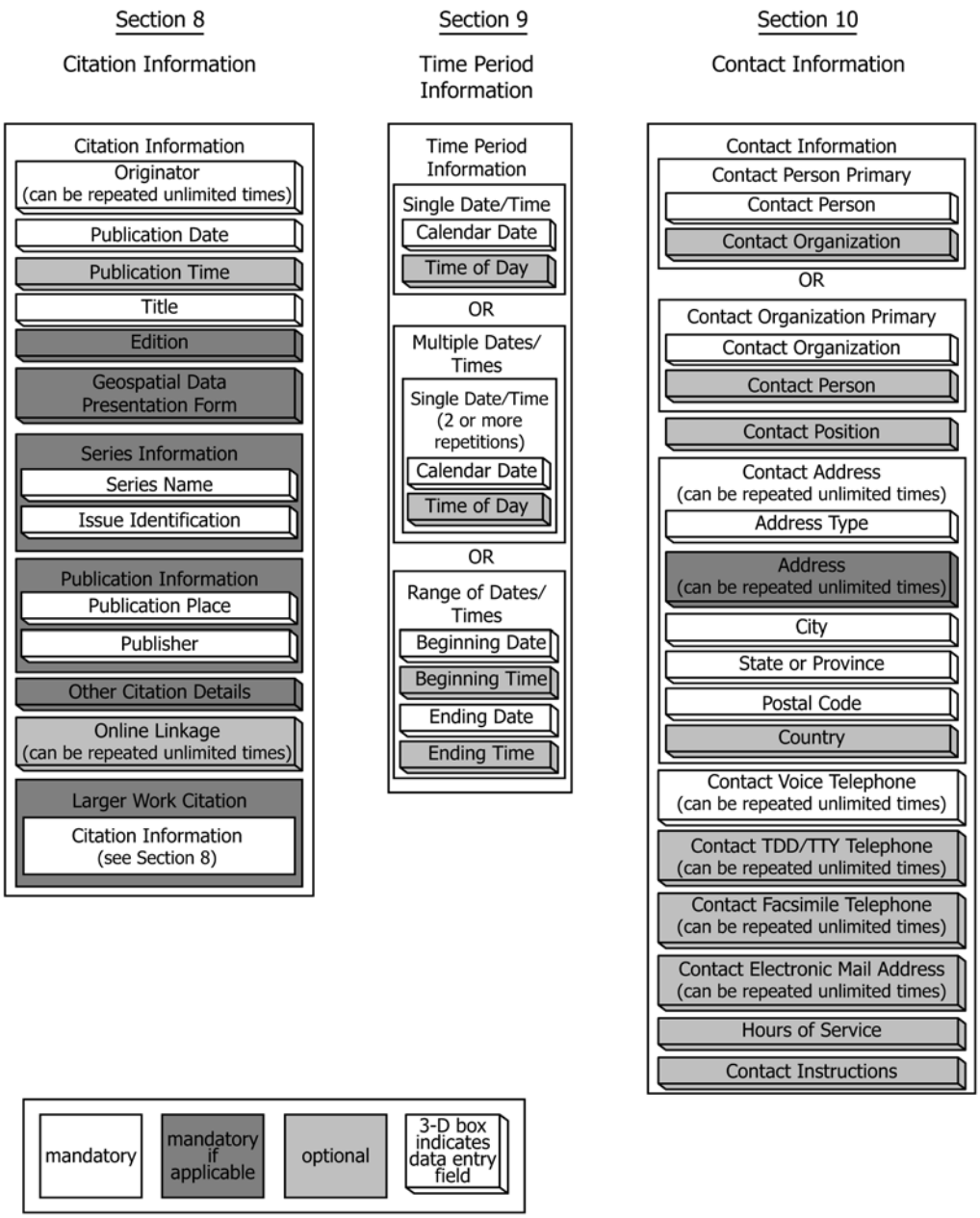
(Source: Adapted from FGDC Metadata Workbook – Version 2.0)

FIG. 7 Metadata for Distribution Information (Annex A6)



(Source: Adapted from FGDC Metadata Workbook – Version 2.0)

FIG. 8 Metadata for Metadata Reference Information (Annex A7)



(Source: Adapted from FGDC Metadata Workbook – Version 2.0)

FIG. 9 Metadata for Citation Information (Annex A8), Time Period Information (Annex A9), and Contact Information (Annex A10)

ANNEXES

(Mandatory Information)

METADATA

Metadata—Data about the content, quality, condition, and other characteristics of data (see Fig. 1). Annex A1 through Annex A7 define the terms on the right side of the production rule.

Type: compound
Short Name: metadata

Metadata =
Identification_Information +
Data_Quality_Information +
0{Spatial_Data_Organization_Information}1 +
0{Spatial_Reference_Information}1 +
Entity_and_Attribute_Information +
0{Distribution_Information}n +
Metadata_Reference_Information

A1. IDENTIFICATION INFORMATION

INTRODUCTION

Identification Information—Basic information about the data set (see Fig. 2).

Type: compound
Short Name: idinfo

Identification_Information =
Citation +
Description +
Time_Period_of_Content +
Status +
Spatial_Domain +
Keywords +
Access_Constraints +
Use_Constraints +
(Point_of_Contact) +
(1{Browse_Graphic}n) +
(Data_Set_Credit) +
(Security_Information) +
(Native_Data_Set_Environment) +
(1{Cross_Reference}n)

Citation =
Citation_Information (see Annex A8 for production rules)

Description =
Abstract +
Purpose +
(Supplemental_Information)

Time_Period_of_Content =
Time_Period_Information (see Annex A9 for production rules) +
Currentness_Reference

Status =
Progress +
Maintenance_and_Update_Frequency

Spatial_Domain =
Bounding_Coordinates +
(1{Data_Set_G-Polygon}n)

Bounding_Coordinates =
West_Bounding_Coordinate +
East_Bounding_Coordinate +
North_Bounding_Coordinate +
South_Bounding_Coordinate

```
Data_Set_G-Polygon =
        Data_Set_G-Polygon_Outer_G-Ring +
        0{Data_Set_G-Polygon_Exclusion_G-Ring}n

Data_Set_G-Polygon_Outer_G-Ring =
        [4{G-Ring_Point}n | G-Ring]

Data_Set_G-Polygon_Exclusion_G-Ring =
        [4{G-Ring_Point}n | G-Ring]

G-Ring_Point =
        G-Ring_Latitude +
        G-Ring_Longitude

Keywords =
        1{Theme}n +
        1{Place}n +
        0{Stratum}n +
        1{Temporal}n

Theme =
        Theme_Keyword_Thesaurus +
        1{Theme_Keyword}n

Place =
        Place_Keyword_Thesaurus +
        1{Place_Keyword}n

Stratum =
        Stratum_Keyword_Thesaurus +
        1{Stratum_Keyword}n

Temporal =
        Temporal_Keyword_Thesaurus +
        1{Temporal_Keyword}n

Point_of_Contact =
        Contact_Information (see Annex A10 for production rules)

Browse_Graphic =
        Browse_Graphic_File_Name +
        Browse_Graphic_File_Description +
        Browse_Graphic_File_Type

Security_Information =
        Security_Classification_System +
        Security_Classification +
        Security_Handling_Description

Cross_Reference =
        Citation_Information (see Annex A8 for production rules)
```

A1.1 *Citation*—Information to be used to reference the data set.

Type: compound
Short Name: citation

Usage Note—Metadata elements for the "Citation" element—Because the "Citation" elements are required by several sections of the metadata, these elements were grouped in Annex A8 rather than being repeated in each applicable section.

Usage Note—Unique identifiers for linking metadata to the data it describes—In implementing a metadata solution, it will be necessary for data archive administrators to unambiguously link the metadata to the data it describes. Several metadata elements in this section, when taken in combination, can serve as a unique identifier for metadata. For example, "Title" and "Edition" could be used to form a unique identifier. Similarly, "Title" and "Metadata Date" (see A7.1) could also be used as a unique identifier.

A1.2 *Description*—A characterization of the data set, including its intended use and limitations.

Type: compound
Short Name: descript

A1.2.1 *Abstract*—A brief narrative summary of the data set.

Type: text
Domain: free text
Short Name: abstract

A1.2.2 *Purpose*—A summary of the intentions with which the data set was developed.

Type: text
Domain: free text
Short Name: purpose

Usage Note—Difference between the "Abstract" and the "Purpose" elements—The "Abstract" elements briefly describes the "what" aspects of the data set , such as defining the information contained in the data set, defining the area covered, defining the functional roadway class or facility type that is described and identifying the roads and travel routes that are included. The "Purpose" describes the "why" aspects of the data set. (For example, why was the data set created?)

A1.2.3 *Supplemental Information*—Other descriptive information about the data set.

Type: text
Domain: free text
Short Name: supplinf

Usage Note—Supplemental information for archived traffic data—This section can include overview information about the spatial and temporal granularity of data. For example, how closely spaced are roadway sensors that collect data? How often do sensors provide data updates? Descriptive information of the coverage of the data can also be included here. For example, for which routes or areas are data reported?

A1.3 *Time Period of Content*—Time period(s) for which the data set corresponds to the currentness reference.

Type: compound
Short Name: timeperd

Usage Note—Metadata elements for the "Time Period of Content" element—Because the "Time Period of Content" elements are required by several sections of the metadata, these elements were grouped in Annex A9 rather than being repeated in each applicable section.

A1.3.1 *Currentness Reference*—The basis on which the time period of content information is determined.

Type: text
Domain: "ground condition" "publication date" free text
Short Name: current

Usage Note—Meaning of the "Currentness Reference"—Information about the currentness of a data set (that is, information about how "up-to-date" is a data set) is important to many, if not most, potential users. Most users are interested in the currentness of a data set related to the "ground condition" (that is, when the "real world" looked the way it is described in the data set). Unfortunately, sometimes only the time that the information was recorded or published is known. The "Currentness Reference" element requires the producer to identify if the "Time Period of Content" dates and times refer to the ground condition, or some later time when the information was recorded, published, etc.

A1.4 *Status*—The state of and maintenance information for the data set.

Type: compound
Short Name: status

A1.4.1 *Progress*—The state of the data set.

Type: text
Domain: "Complete" "In work" "Planned"
Short Name: progress

A1.4.2 *Maintenance and Update Frequency*—The frequency with which changes and additions are made to the data set after the initial data set is completed.

Type: text
Domain: "Continually" "Daily" "Weekly" "Monthly" "Annually" "Unknown" "As needed" "Irregular" "None planned" free text
Short Name: update

Usage Note—Difference between "Update Frequency" and temporal granularity—The temporal granularity of a data set is the time resolution at which the data set is stored, whereas the update frequency describes how often new data values are added or included. For example, a data archive may store traffic detector data that has been summarized into 15-minute increments throughout the day. Now assume this archive receives new data every day from the previous day. In this example, the temporal granularity is 15 minutes, whereas the update frequency is daily. The update frequency may vary widely; therefore, only common update frequencies are provided in the enumerated domain values. If your update frequency does not match one of these domain values, then metadata producers may use the free text domain value to more accurately characterize the update frequency.

A1.5 *Spatial Domain*—The geographic areal domain of the data set.

Type: compound
Short Name: spdom

A1.5.1 *Bounding Coordinates*—The limits of coverage of a data set expressed by latitude and longitude values in the order western-most, eastern-most, northern-most, and southern-most. For data sets that include a complete band of latitude around the earth, the West Bounding Coordinate shall be assigned the value -180.0, and the East Bounding Coordinate shall be assigned the value 180.0.

Type: compound
Short Name: bounding

Usage Note—Mandatory nature of "Bounding Coordinates" for data sets that do not contain spatially referenced data—The "Bounding Coordinates" are mandatory for all data sets. If the data set does not contain spatially referenced data, approximate latitude and longitude values for bounding coordinates can be obtained from a variety of sources, including consumer mapping software and web-based applications. For example, approximate latitude and longitude values can easily be obtained from the U.S. Geological Survey (USGS) National Map at http://nationalmap.gov. Please note that only valid latitude and longitude values can be entered for the "Bounding Coordinates." Ordinary place names (such as King County or Seattle, Washington) can be entered as "Place Keywords" in Section A1.6.

A1.5.1.1 *West Bounding Coordinate*—Western-most coordinate of the limit of coverage expressed in longitude.

Type: real
Domain: -180.0 <= West Bounding Coordinate < 180.0
Short Name: westbc

A1.5.1.2 *East Bounding Coordinate*—Eastern-most coordinate of the limit of coverage expressed in longitude.

Type: real
Domain: -180.0 <= East Bounding Coordinate <= 180.0
Short Name: eastbc

A1.5.1.3 *North Bounding Coordinate*—Northern-most coordinate of the limit of coverage expressed in latitude.

Type: real
Domain: -90.0 <= North Bounding Coordinate <= 90.0;
North Bounding Coordinate >= South Bounding Coordinate
Short Name: northbc

A1.5.1.4 *South Bounding Coordinate*—Southern-most coordinate of the limit of coverage expressed in latitude.

Type: real
Domain: -90.0 <= South Bounding Coordinate <= 90.0;
South Bounding Coordinate <= North Bounding Coordinate
Short Name: southbc

A1.5.2 *Data Set G-Polygon*—Coordinates defining the outline of an area covered by a data set.

Type: compound
Short Name: dsgpoly

A1.5.2.1 *Data Set G-Polygon Outer G-Ring*—The closed nonintersecting boundary of an interior area.

Type: compound
Short Name: dsgpolyo

A1.5.2.1.1 *G-Ring Point*—A single geographic location.

Type: compound
Short Name: grngpoin

A1.5.2.1.1.1 *G-Ring Latitude*—The latitude of a point of the g-ring.

Type: real
Domain: -90.0 <= G-Ring Latitude <= 90.0
Short Name: gringlat

A1.5.2.1.1.2 *G-Ring Longitude*—The longitude of a point of the g-ring.

Type: real
Domain: -180.0 <= G-Ring Longitude < 180.0
Short Name: gringlon

A1.5.2.1.2 *G-Ring*—A set of ordered pairs of floating-point numbers, separated by commas, in which the first number in each pair is the longitude of a point and the second is the latitude of the point. Longitude and latitude are specified in decimal degrees with north latitudes positive and south negative, east longitude positive and west negative.

Type: text
Domain: -90<= Latitude_elements <= 90, -180 <= Longitude_
Elements = 180
Short Name: gring

A1.5.2.2 *Data Set G-Polygon Exclusion G-Ring*—The closed nonintersecting boundary of a void area (or "hole" in an interior area).

Type: compound
Short Name: dsgpolyx

Usage Note—Definition of G-Polygon, G-Ring, and "outer" and "inner" G-Ring—The terminology of G-Polygon and G-Ring is taken from the Spatial Data Transfer Standard. In simple terms, a G-Polygon is a closed, connected (contiguous) area. A G-Ring is a set of coordinates that defines a boundary of the area. The first and last points in the set of coordinates must be the same. The "outer" G-Ring describes the outside edge of the G-Polygon. "Inner" G-Rings describe any "holes" that may occur in the G-Polygon.

Usage Note—Difference between the "Bounding Coordinates" and the "Data Set G-Polygon"—The "Bounding Coordinates" are the west-, east-, north-, and south-most extent of the data set. The g-rings that describe the "Data Set G-Polygon" form the outline of the data set.

Usage Note—Supplemental information on "Bounding Coordinates" and "Data Set G-Polygons"—The purpose of the "Spatial Domain" compound element is to describe the "footprint" of the data set. This footprint can be used for spatial searches in data catalogs and other purposes. Comments received during the development of the standards recommended requiring the "Bounding Coordinates" instead of the more demanding (but more exact) "Data Set G-Polygons". To provide a common means of conducting spatial searches on all metadata, "Bounding Coordinates" were made mandatory. Many users indicated a desire to provide the "Data Set G-Polygons" to allow the results of spatial searches to be more exact, and so the "Data Set G-Polygon" elements were added as an option.

Usage Note—Inclusion of four or more points in a G-Ring—The ring must be closed (that is, the first and last points must be the same). So the minimum number of points to describe a triangle is four (point 1, point 2, point 3, point 1).

A1.6 *Keywords*—Words or phrases summarizing an aspect of the data set.

Type: compound
Short Name: keywords

Usage Note—Purpose of "Keywords" element—A keyword is a word or phrase that signifies the meaning or main ideas of a data set. They often are used as an index to the contents of a data set. The standards provide for four types of keywords: theme (the subject of the data set, such as wetlands, vegetation, etc.), place (the geographic location of the data set, such as Montgomery County, Yellowstone National Park), stratum (the vertical location of the data set, such as seafloor, seabed, troposphere, stratosphere), and temporal (time references for a data set, such as a specific date or range of dates expressed in days, months, or years).

A1.6.1 *Theme*—Subjects covered by the data set.

Type: compound
Short Name: theme

A1.6.1.1 *Theme Keyword Thesaurus*—Reference to a formally registered thesaurus or a similar authoritative source of theme keywords. (For example, the Transportation Research Board's (TRB's) Transportation Research Thesaurus at http://www4.trb.org/trb/tris.nsf/web/trt is one possible thesaurus from which theme keywords could be selected.)

Type: text
Domain: "None" free text
Short Name: themekt

A1.6.1.2 *Theme Keyword*—Common-use word or phrase used to describe the subject of the data set.

Type: text
Domain: free
text Short Name: themekey

A1.6.2 *Place*—Geographic locations characterized by the data set.

Type: compound
Short Name: place

A1.6.2.1 *Place Keyword Thesaurus*—Reference to a formally registered thesaurus or a similar authoritative source of place keywords. (For example, the USGS Geographic Names Information System (GNIS) at http://geonames.usgs.gov is one possible thesaurus from which place keywords could be selected. The Federal Information Processing Standard (FIPS) 55 is another authoritative source from which state, county, city, and other place names and codes can be selected.)

Type: text
Domain: "None" "Geographic Names Information System" free text
Short Name: placekt

A1.6.2.2 *Place Keyword*—The geographic name of a location covered by a data set.

Type: text
Domain: free text
Short Name: placekey

A1.6.3 *Stratum*—Layered, vertical locations characterized by the data set.

Type: compound
Short Name: stratum

A1.6.3.1 *Stratum Keyword Thesaurus*—Reference to a formally registered thesaurus or a similar authoritative source of stratum keywords.

Type: text
Domain: "None" free text
Short Name: stratkt

A1.6.3.2 *Stratum Keyword*—The name of a vertical location used to describe the locations covered by a data set.

Type: text
Domain: free text
Short Name: stratkey

A1.6.4 *Temporal*—Time period(s) characterized by the data set.

Type: compound
Short Name: temporal

A1.6.4.1 *Temporal Keyword Thesaurus*—Reference to a formally registered thesaurus or a similar authoritative source of temporal keywords.

Type: text
Domain: "None" free text
Short Name: tempkt

A1.6.4.2 *Temporal Keyword*—The name of a time period covered by a data set.

Type: text
Domain: free text
Short Name: tempkey

A1.7 *Access Constraints*—Restrictions and legal prerequisites for accessing the data set. These include any access constraints applied to assure the protection of privacy or intellectual property, and any special restrictions or limitations on obtaining the data set.

Type: text
Domain: "None" free text
Short Name: accconst

A1.8 *Use Constraints*—Restrictions and legal prerequisites for using the data set after access is granted. These include any use constraints applied to assure the protection of privacy or intellectual property, and any special restrictions or limitations on using the data set.

Type: text
Domain: "None" free text
Short Name: useconst

Usage Note—Information provided for "Access Constraints" and "Use Constraints"— The types of constraints intended are those applied to ensure rights of privacy or intellectual property, and any other special restrictions, limitations, or warranties on obtaining or using the information resources, or its component products. Recommendations on the types of uses to which the data set may or may not be applied should be described in the "Purpose" metadata element (see A1.2.2). Descriptions of data quality should be provided using the elements in Annex A2.

A1.9 *Point of Contact*—Contact information for an individual or organization that is knowledgeable about the data set.

Type: compound Short
Name: ptcontac

Usage Note—Metadata elements for the "Point of Contact" element—Because the "Point of Contact" elements are required by several sections of the metadata, these elements were grouped in Annex A10 rather than being repeated in each applicable section.

Usage Note—Difference between the "Originator" in compound element "Citation" (see A1.1) and the "Point of Contact" element—The "Originator" is the person(s) and organization(s) that developed the data set. The "Point of Contact" is the person(s) and organization(s) that can be contacted if questions arise about the data set. The "Originator" and the "Point of Contact" may be the same.

A1.10 *Browse Graphic*—A graphic that provides an illustration of the data set. The graphic should include a legend for interpreting the graphic.

Type: compound Short
Name: browse

Usage Note—Purpose of a "Browse Graphic"—A "Browse Graphic" is an image of the data set. The image allows prospective users to move beyond textual descriptions and see what the data set looks like. The image might show a simple display of the data set, the results of an application that used the data set, different aspects of the quality of the data set, or other information.

A1.10.1 *Browse Graphic File Name*—Name of a related graphic file that provides an illustration of the data set.

Type: text
Domain: free text
Short Name: browsen

A1.10.2 *Browse Graphic File Description*—A text description of the illustration.

Type: text
Domain: free text Short
Name: browsed

A1.10.3 *Browse Graphic File Type*—Graphic file type of a related graphic file.

Type: text
Domain: domain values in the table below; free text
Short Name: browset

Domain	Value Definition
"CGM"	Computer Graphics Metafile
"EPS"	Encapsulated Postscript format
"EMF"	Enhanced Metafile
"GIF"	Graphic Interchange Format
"JPEG"	Joint Photographic Experts Group format
"PBM"	Portable Bit Map format
"PS"	Postscript format
"TIFF"	Tagged Image File Format
"WMF"	Windows metafile
"XWD"	X-Windows Dump

A1.11 *Data Set Credit*—Recognition of those who contributed to the data set.

Type: text
Domain: free text
Short Name: datacred

Usage Note—Purpose of the "Data Set Credit" metadata element—The "Data Set Credit" metadata element was provided to allow the originator to recognize other person(s), organization(s), or events that made the data set possible. These might include sponsors, sources of funds, reviewers, dedications, etc.

A1.12 *Security Information*—Handling restrictions imposed on the data set because of national security, privacy, or other concerns.

Type: compound Short
Name: secinfo

A1.12.1 *Security Classification System*—Name of the classification system.

Type: text
Domain: free text
Short Name: secsys

A1.12.2 *Security Classification*—Name of the handling restrictions on the data set.

Type: text
Domain: "Top secret" "Secret" "Confidential" "Restricted"
"Unclassified" "Sensitive" free text
Short Name: secclass

Usage Note—Purpose of the "Security Classification" metadata element—The "Security Classification" metadata element may be useful to indicate those data sets that have restricted access due to homeland security concerns. If the specific security classification is not available as one of the enumerated domain values, then free text may be used to accurately characterize the classification.

A1.12.3 *Security Handling Description*—Additional information about the restrictions on handling the data set.

Type: text
Domain: free text
Short Name: sechandl

A1.13 *Native Data Set Environment*—A description of the data set in the producer's processing environment, including items such as the name of the software (including version), the computer operating system, file name (including host-, path-, and filenames), and the data set size.

Type: text
Domain: free text
Short Name: native

A1.14 *Cross Reference*—Information about other, related data sets that are likely to be of interest.

Type: compound
Short Name: crossref

Usage Note—Metadata elements for the "Cross Reference" element—Because the "Cross Reference" elements are required by several sections of the metadata, these elements were grouped in Annex A8 rather than being repeated in each applicable section.

A2. DATA QUALITY INFORMATION

INTRODUCTION

Data Quality Information—A general assessment of the quality of the data set (see Fig. 3). The optionality of this "Data Quality Information" section has been changed from the FGDC standard to be mandatory. The developers of this standard felt that, even if nothing is known about data quality, the metadata producer should formally disclose that fact in this section. Information on traffic data quality measures that can be reported in this section is included in "Traffic Data Quality Measurement: Final Report" published by the Federal Highway Administration (FHWA) in September 2004 and available at http://itsdocs.fhwa.dot.gov/jpodocs/repts te/14058.htm In fact, three of the FHWA's traffic data quality measures are directly supported in Annex A2: accuracy, completeness, and validity (called logical consistency in this standard). Two of the other three FHWA traffic data quality measures (timeliness and coverage) can be also be included in the "Completeness Report" (see A2.3), as the domain for this section is "free text." The remaining data quality measure from the FHWA report, accessibility, can be reported in Annex A6, "Distribution Information". (Recommendations on information to be reported and tests to be performed for spatial data are found in "Spatial Data Quality," which is chapter 3 of part 1 in FIPS PUB 173).

Usage Note—Format of data quality information— Data quality and other information can be provided in the form of browse graphics, or through online services. To provide non-textual information, furnish the URL of the graphic or service at the appropriate place in the quality report.

Usage Note—Mandatory nature of "Data Quality Information"—This section, "Data Quality Information," is mandatory for all data sets. Certain information about the quality aspects of data collection may not be known or can not be determined with reasonable effort; however, data producers or data intermediaries will likely conduct some basic quality tests or have a rudimentary notion of data quality before further distributing data. This basic quality information should be documented in this section, and supplemented if possible with more detailed information about original source data and how it was collected. If nothing is known about data quality, this should be indicated in this section.

Type: compound
Short Name: dataqual

Data_Quality Information =
0{Attribute_Accuracy}1 +
Logical_Consistency Report +
Completeness_Report +
0{Positional_Accuracy}1 +
Lineage +
(Cloud_Cover)

Attribute_Accuracy =
Attribute_Accuracy_Report +
(1{Quantitative_Attribute_Accuracy_Assessment}n)

Quantitative_Attribute_Accuracy_Assessment =
Attribute_Accuracy_Value +
Attribute_Accuracy_Explanation

Positional_Accuracy =
0{Horizontal_Positional_Accuracy}1 +
0{ Vertical_Positional_Accuracy}1

Horizontal_Positional_Accuracy =
Horizontal_Positional_Accuracy Report +
(1{Quantitative_Horizontal_Positional_Accuracy_Assessment}n)

Quantitative_Horizontal_Positional_Accuracy Assessment =
Horizontal_Positional_Accuracy Value +
Horizontal_Positional_Accuracy Explanation

Vertical_Positional_Accuracy =
Vertical_Positional_Accuracy Report +
(1{Quantitative_Vertical_Positional_Accuracy_Assessment}n)

Quantitative_Vertical_Positional_Accuracy Assessment =
Vertical_Positional_Accuracy Value +
Vertical_Positional_Accuracy_Explanation

Lineage =
0{Source_Information}n +
1{Process_Step}n

Source_Information =
Source_Citation +
0{Source_Scale_Denominator}1 +
Type_of_Source_Media +
Source_Time_Period_of_Content +
Source_Citation_Abbreviation +
Source_Contribution

Source_Citation =
Citation_Information (see Annex A8 for production rules)

Source_Time_Period_of_Content =
Time_Period_Information (see Annex A9 for production rules) +
Source_Currentness_Reference

Process_Step =
Process_Description +
0{Source_Used_Citation_Abbreviation}n +
Process_Date +

(Process_Time) +
0{Source_Produced_Citation_Abbreviation}n +
(Process_Contact)

Process_Contact =
Contact_Information (see Annex A10 for production rules)

A2.1 *Attribute Accuracy*—An assessment of the accuracy of the identification of entities and assignment of attribute values in the data set.

Type: compound
Short Name: attracc

A2.1.1 *Attribute Accuracy Report*—An explanation of the accuracy of the identification of the entities and assignments of values in the data set and a description of the tests used.

Type: text
Domain: free text
Short Name: attraccr

A2.1.2 *Quantitative Attribute Accuracy Assessment*—A value assigned to summarize the accuracy of the identification of the entities and assignments of values in the data set and the identification of the test that yielded the value.

Type: compound
Short Name: qattracc

A2.1.2.1 *Attribute Accuracy Value*—An estimate of the accuracy of the identification of the entities and assignments of attribute values in the data set.

Type: text
Domain: "Unknown" free text
Short Name: attraccv

A2.1.2.2 *Attribute Accuracy Explanation*—The identification of the test that yielded the Attribute Accuracy Value.

Type: text
Domain: free text
Short Name: attracce

Usage Note—Difference between the "Attribute Accuracy Report" and the "Quantitative Attribute Accuracy Assessment"—Note that the following commentary applies to both the attribute and positional accuracy elements. The "Attribute Accuracy Report" is a complete description of the accuracy of the attribute information in the data set. Include the identification of tests used, testing methodology, results obtained, etc. In developing the FGDC metadata standard, reviewers asked that a summary method of providing results also be permitted. While this summary method would not relieve producers of the obligation to provide a thorough report, it would allow users, especially those using a data catalog, to quickly exclude those data sets that obviously would not serve a user's needs. The "Quantitative Attribute Accuracy Assessment" (and its horizontal and vertical accuracy counterparts) were provided in response to this request. A producer identifies the test used by name and the value obtained from the test. The derivation of these values should be described in the accuracy reports.

Usage Note—SDTS commentary on attribute accuracy:

(1) Attribute Accuracy—Accuracy assessment for measures on a continuous scale shall be performed using procedures similar to those used for positional accuracy (providing a numerical estimate of expected discrepancies). The report of a test of attribute accuracy shall include the data of the test and the dates of the materials used. In the case of different dates, the report shall describe the rates of change in the phenomena classified. Spatial variations in attribute accuracy may be reported in a quality overlay.

(2) Accuracy tests for categorical attributes may be performed by one of the following methods. All methods shall make reference to map scale in interpreting classifications.

(3) Deductive Estimate—Any estimate, even a guess based on experience, is permitted. The basis for the deduction shall be explained. Statements such as "good" or "poor" should be explained in as quantitative a manner as possible.

(4) Tests Based on Independent Samples—A misclassification matrix shall be reported as counts of sample units cross-tabulated by the categories of the sample and of the tested material. The sampling procedure and the location of sample units shall be described.

(5) Tests Based on Polygon Overlay—A misclassification matrix shall be reported as areas. The relationship between the two maps shall be explained; as far as possible, the two sources should be independent and on should have higher accuracy.

A2.2 *Logical Consistency Report*—An explanation of the fidelity of relationships in the data set and tests used.

Type: text
Domain: free text
Short Name: logic

Usage Note—SDTS commentary on logical consistency (also known as validity in FHWA's "Traffic Data Quality Measurement" report):

(1) Logical Consistency—A report on logical consistency shall describe the fidelity of relationships encoded in the data structure of the digital spatial data. The report shall detail the tests performed and the results of the tests.

(2) Tests of Valid Values—Tests for permissible values may be applied to any data structure. Such a test can detect gross blunders, but it does not ensure all aspects of logical consistency. Tests of valid values are also called quality control checks or rules. Different tests may be applied to address these questions, but the quality report shall contain a description of the tests applied or a reference to documentation of the software used. The report shall state whether all inconsistencies were corrected or it shall detail the remaining errors by case. The quality report shall identify the software (name and version) used to verify these conditions.

(3) Date of Test— The report shall include the date on which the tests were applied. If corrections and modifications have occurred after the test for logical consistency, the quality report shall indicate how the new information was checked for logical consistency.

A2.3 *Completeness Report*—Information about omissions, selection criteria, generalization, definitions used, and other rules used to derive the data set.

Type: text
Domain: free text
Short Name: complete

Usage Note—SDTS commentary on completeness:

(1) Completeness—The quality report shall include information about selection criteria, definitions used and other relevant mapping rules. For example, geometric thresholds such as minimum area or minimum width shall be reported.

(2) In encoding spatial entities, standard geocodes (such as described in the FIPS codes for States, counties, municipalities, and places) shall be employed if possible. Deviations from standard definitions and interpretations shall be described.

(3) The report on completeness shall describe the relationship between the objects represented and the abstract universe of all such objects. In particular, the report shall describe the exhaustiveness of a set of features. Exhaustiveness concerns spatial and taxonomic (attribute) properties, both of which can be tested. A test for spatial completeness can be obtained from topological tests for logical consistency described in 3.4.3 of SDTS. Tests for taxonomic completeness operate by comparison of a master list of geocodes to the codes actually appearing in the file. The procedures used for testing and the results shall be described in the quality report.

A2.4 *Positional Accuracy*—An assessment of the accuracy of the positions of spatial objects.

Type: compound
Short Name: posacc

A2.4.1 *Horizontal Positional Accuracy*—An estimate of accuracy of the horizontal positions of the spatial objects.

Type: compound
Short Name: horizpa

A2.4.1.1 *Horizontal Positional Accuracy Report*—An explanation of the accuracy of the horizontal coordinate measurements and a description of the tests used.

Type: text
Domain: free text
Short Name: horizpar

A2.4.1.2 *Quantitative Horizontal Positional Accuracy Assessment*—Numeric value assigned to summarize the accuracy of the horizontal coordinate measurements and the identification of the test that yielded the value.

Type: compound
Short Name: qhorizpa

A2.4.1.2.1 *Horizontal Positional Accuracy Value*— An estimate of the accuracy of the horizontal coordinate measurements in the data set expressed in (ground) meters.

Type: real
Domain: free real
Short Name: horizpav

A2.4.1.2.2 *Horizontal Positional Accuracy Explanation*— The identification of the test that yielded the Horizontal Positional Accuracy Value.

Type: text
Domain: free text
Short Name: horizpae

A2.4.2 *Vertical Positional Accuracy*—An estimate of accuracy of the vertical positions in the data set.

Type: compound
Short Name: vertacc

A2.4.2.1 *Vertical Positional Accuracy Report*—An explanation of the accuracy of the vertical coordinate measurements and a description of the tests used.

Type: text
Domain: free text
Short Name: vertaccr

A2.4.2.2 *Quantitative Vertical Positional Accuracy Assessment*—Numeric value assigned to summarize the accuracy of vertical coordinate measurements and the identification of the test that yielded the value.

Type: compound
Short Name: qvertpa

A2.4.2.2.1 *Vertical Positional Accuracy Value*— An estimate of the accuracy of the vertical coordinate measurements in the data set expressed in (ground) meters.

Type: real
Domain: free real
Short Name: vertaccv

A2.4.2.2.2 *Vertical Positional Accuracy Explanation*— The identification of the test that yielded the Vertical Positional Accuracy Value.

Type: real
Domain: free text
Short Name: vertacce

Usage Note—Difference between the "Positional Accuracy" reports and the "Positional Quantitative Accuracy Assessments"—See Usage Note for "Attribute Accuracy" (section A2.1).

Usage Note—SDTS commentary on positional accuracy:

(1) Positional Accuracy—The quality report portion on positional accuracy shall include the degree of compliance to the spatial registration standard (see section 4.1.3.5 of SDTS). Quality of control surveys shall be reported by using the procedures established in the geodetic standard. If a separate control survey has been used, it shall be described in the standard form, even if results fall below the recognized classification thresholds.

(2) Descriptions of positional accuracy shall consider the quality of the final product after all transformations. The information on transformations forms a part of the lineage portion of the quality report.

(3) The report of any test of positional accuracy shall include the date of the test. Variations in positional accuracy shall be reported either as additional attributes of each spatial object of through a quality overlay (reliability diagram).

(4) Measures of positional accuracy may be obtained by one of the following optional methods.

(5) Deductive Estimate—Any deductive statement based on knowledge of errors in each production step shall include reference to complete calibration tests and shall also describe assumptions concerning error propagation. Results from deductive estimates shall be distinguished from results of other tests.

(6) Internal Evidence—Federal Geodetic Control Committee procedures will be used for tests based on repeated

measurement and redundancy such as closure of traverse or residuals from an adjustment.

(7) Comparison to Source—When using graphic inspection of results (“check plots”), the geometric tolerances applied shall be reported and the method of registration shall also be described. Use of check plots shall be included in the lineage portion.

(8) Independent Source of Higher Accuracy—The preferred test for positional accuracy is a comparison to an independent source of higher accuracy. The test shall be conducted using the rules prescribed in the “ASPRS Accuracy Standards for Large Scale Maps” (see 1.3.3 of SDTS). When the dates of testing and source material differ, the report shall describe the procedures used to ensure that the results relate to positional error and not to temporal effects. The numerical results in ground units, as well as the number and location of the test points, shall be reported. A statement of compliance to a particular threshold is not adequate in itself. This test may only be applicable to well-defined points.

A2.5 *Lineage*—Information about the events, parameters, and source data which constructed the data set, and information about the responsible parties.

Type: compound
Short Name: lineage

Usage Note—SDTS commentary on “Lineage”:

(1) Lineage—The lineage portion of a quality report shall include a description of the source material from which the data were derived and the methods of derivation, including all transformations involved in producing the final digital files. The description shall include the dates of the source material and the dates of ancillary information used for update. The date assigned to a source shall reflect the date that the information corresponds to the ground; however, if this date in not known, then a date of publication may be used, if declared as such.

(2) Any database created by merging information obtained from distinct sources shall be described in sufficient detail to identify the actual source for each element in the file. In these cases, either a lineage code on each element or a quality overlay (course data index, etc.) shall be required.

A2.5.1 *Source Information*—List of sources and a short discussion of the information contributed by each.

Type: compound
Short Name: srcinfo

A2.5.1.1 *Source Citation*—Reference for a source data set.

Type: compound
Short Name: srccite

Usage Note—Metadata elements for the “Source Citation” element—Because the “Source Citation” elements are required by several sections of the metadata, these elements were grouped in Annex A8 rather than being repeated in each applicable section.

A2.5.1.2 *Source Scale Denominator*—The denominator of the representative fraction on a map (for example, on a 1:24,000-scale map, the Source Scale Denominator is 24000).

Type: integer
Domain: Source Scale Denominator > 1
Short Name: srcscale

A2.5.1.3 *Type of Source Media*—The medium of the source data set.

Type: text
Domain: “paper” “stable-base material” “microfiche” “microfilm” “audiocassette” “chart” “filmstrip” “transparency” “videocassette” “videodisc” “videotape” “physical model” “computer program” “disc” “cartridge tape” “magnetic tape” “online” “CDROM” “electronic bulletin board” “electronic mail system” free text
Short Name: typesrc

A2.5.1.4 *Source Time Period of Content*—Time period(s) for which the source data set corresponds to the ground.

Type: compound
Short Name: srctime

A2.5.1.4.1 *Source Currentness Reference*—The basis on which the source time period of content information of the source data set is determined.

Type: text
Domain: “ground condition” “publication date” free text
Short Name: srccurr

A2.5.1.5 *Source Citation Abbreviation*—Short-form alias for the source citation.

Type: text
Domain: free text
Short Name: srccitea

A2.5.1.6 *Source Contribution*—Brief statement identifying the information contributed by the source to the data set.

Type: text
Domain: free text
Short Name: srccontr

A2.5.2 *Process Step*—Information about a single event.

Type: compound
Short Name: procstep

Usage Note—Definition of “Process Step” and importance for archived data management systems—A process step is any transformation that has materially affected data values since its original collection at a source. The “Lineage” and “Process Step” compound elements are mandatory because this description of changes to original source data is highly desired by most archived data users.

A2.5.2.1 *Process Description*—An explanation of the event and related parameters or tolerances.

Type: text
Domain: free text
Short Name: procdesc

A2.5.2.2 *Source Used Citation Abbreviation*—The Source Citation Abbreviation of a data set used in the processing step.

Type: text
Domain: Source Citation Abbreviations from the Source Information entries for the data set.
Short Name: srcused

A2.5.2.3 *Process Date*—The date when the event was completed.

Type: date
Domain: “Unknown” “Not complete” free date
Short Name: procdate

A2.5.2.4 *Process Time*—The time when the event was completed.

Type: time
Domain: free time
Short Name: proctime

A2.5.2.5 *Source Produced Citation Abbreviation*—The Source Citation Abbreviation of an intermediate data set that *(1)* is significant in the opinion of the data producer, *(2)* is generated in the processing step, and *(3)* is used in later processing steps.

Type: text
Domain: Source Citation Abbreviations from the Source Information entries for the data set.
Short Name: srcprod

A2.5.2.6 *Process Contact*—The party responsible for the processing step information.

Type: compound
Short Name: proccont

Usage Note—Metadata elements for the "Process Contact" element—Because the "Process Contact" elements are required by several sections of the metadata, these elements were grouped in Annex A10 rather than being repeated in each applicable section.

A2.6 *Cloud Cover*—Area of a data set obstructed by clouds, expressed as a percentage of the spatial extent.

Type: integer
Domain: 0 <= Cloud Cover <= 100 "Unknown"
Short Name: cloud

A3. SPATIAL DATA ORGANIZATION INFORMATION

INTRODUCTION

Spatial Data Organization Information—The mechanism used to represent spatial information in the data set (see Fig. 4). This section is mandatory-if-applicable. Thus, if the data set being documented does not contain spatially referenced data, this section is not required. Additional information on geospatial transportation data framework standards and associated data models can be found at the Geospatial One-Stop (GOS) at http://www.geo-one-stop.gov/standards.

Type: compound
Short Name: spdoinfo

```
Spatial_Data_Organization_Information =
                                        0{Indirect_Spatial_Reference}n +
                                        0{Direct_Spatial_Reference_Method +
                                        ( [Point_and_Vector_Object_Information |
                                        Raster_Object_Information] )}1

Point_and_Vector_Object_Information =
                                        [1{SDTS_Terms_Description}n |
                                        VPF_Terms_Description]

SDTS_Terms_Description =
                                        SDTS_Point_and_Vector_Object_Type +
                                        (Point_and_Vector_Object_Count)

VPF_Terms_Description =
                                        VPF_Topology_Level +
                                        1{VPF_Point_and_Vector_Object_Information}n

VPF_Point_and_Vector_Object_Information =
                                        VPF_Point_and_Vector_Object_Type +
                                        (Point_and_Vector_Object_Count)

Raster_Object_Information =
                                        Raster_Object_Type +
                                        (Row_Count +
                                        Column_Count +
                                        0{Vertical_Count}1 )
```

A3.1 *Indirect Spatial Reference*—Name of types of geographic features, addressing schemes, or other means through which locations are referenced in the data set.

Type: text
Domain: free text
Short Name: indspref

Usage Note—Definition of "Indirect Spatial Reference"—An "Indirect Spatial Reference" is any way to describe a location without using coordinates. Indirect spatial reference methods typically use a geographic feature, such as a county, state, township or section of the Public Land Survey System, or a road, to uniquely identify a place. The reference

may use the name of the feature (for example, "Westmoreland County") or a code that identifies the feature (for example, a county FIPS code). Other examples of indirect spatial references include street addresses, linear reference systems, published map grids, address block numbers, and parcel numbers from tax maps.

Usage Note—Inclusion of "Indirect Spatial Reference" in the metadata standard—Indirect spatial references are included because they are a very common means by which observations or other attribute information is tied to a place. The location of many socioeconomic, environmental, and other data often are referenced by identifying a unit of political geography (for example, a city, county, or state), census geography (for example, block, block group, or tract), street address, linear referencing systems (for example, milepost), and so on. While these indirect spatial references alone may not be sufficient for geographic analyses, they can serve as a means to link the attribute data to coordinate descriptions of the places to which the attribute data apply.

A3.2 *Direct Spatial Reference Method*—The system of objects used to represent space in the data set.

Type: text
Domain: "Point" "Vector" "Raster"
Short Name: direct

A3.3 *Point and Vector Object Information*—The types and numbers of vector or nongridded point spatial objects in the data set.

Type: compound
Short Name: ptvctinf

A3.3.1 *SDTS Terms Description*—Point and vector object information using the terminology and concepts from "Spatial Data Concepts," which is Chapter 2 of Part 1 in Department of Commerce, 1992, Spatial Data Transfer Standard (SDTS) (Federal Information Processing Standard 173): Washington, Department of Commerce, National Institute of Standards and Technology. (Note that this reference to the SDTS is used ONLY to provide a set of terminology for the point and vector objects.)

Type: compound
Short Name: sdtsterm

A3.3.1.1 *SDTS Point and Vector Object Type*—Name of point and vector spatial objects used to locate zero-, one-, and two-dimensional spatial locations in the data set.

Type: text
Domain: (The domain is from "Spatial Data Concepts," which is Chapter 2 of Part 1 in Department of Commerce, 1992, Spatial Data Transfer Standard (SDTS) (Federal Information Processing Standard 173): Washington, Department of Commerce, National Institute of Standards and Technology):
"Point" "Entity point" "Label point" "Area point" "Node, planar graph"
"Node, network" "String" "Link" "Complete chain" "Area chain"
"Network chain, planar graph" "Network chain, nonplanar graph"
"Circular arc, three point center" "Elliptical arc" "Uniform B-spline"
"Piecewise Bezier" "Ring with mixed composition"
"Ring composed of strings" "Ring composed of chains"
"Ring composed of arcs" "G-polygon" "GT-polygon composed of rings"
"GT-polygon composed of chains"
"Universe polygon composed of rings"
"Universe polygon composed of chains"
"Void polygon composed of rings" "Void polygon composed of chains"
Short Name: sdtstype

A3.3.1.2 *Point and Vector Object Count*—The total number of the point or vector object type occurring in the data set.

Type: integer
Domain: Point and Vector Object Count > 0
Short Name: ptvctcnt

A3.3.2 *VPF Terms Description*—Point and vector object information using the terminology and concepts from Department of Defense, 1992, Vector Product Format (MIL-STD-600006): Philadelphia, Department of Defense, Defense Printing Service Detachment Office. (Note that this reference to the VPF is used ONLY to provide a set of terminology for the point and vector objects.)

Type: compound
Short Name: vpfterm

A3.3.2.1 *VPF Topology Level*—The completeness of the topology carried by the data set. The levels of completeness are defined in Department of Defense, 1992, Vector Product Format (MIL-STD-600006): Philadelphia, Department of Defense, Defense Printing Service Detachment Office.

Type: integer
Domain: 0 <= VPF Topology Level <= 3
Short Name: vpflevel

A3.3.2.2 *VPF Point and Vector Object Information*—Information about VPF point and vector objects.

Type: compound
Short Name: vpfinfo

A3.3.2.2.1 *VPF Point and Vector Object Type*—Name of point and vector spatial objects used to locate zero-, one-, and two-dimensional spatial locations in the data set.

Type: text
Domain: (The domain is from Department of Defense, 1992, Vector Product Format (MIL-STD-600006): Philadelphia, Department of Defense, Defense Printing Service Detachment Office): "Node"
"Edge" "Face" "Text"
Short Name: vpftype

A3.4 *Raster Object Information* —The types and numbers of raster spatial objects in the data set.

Type: compound
Short Name: rastinfo

A3.4.1 *Raster Object Type*—Raster spatial objects used to locate zero-, two-, or three-dimensional locations in the data set.

Type: text
Domain: (With the exception of "voxel", the domain is from "Spatial Data Concepts," which is chapter 2 of part 1 in Department of Commerce, 1992, Spatial Data Transfer Standard (SDTS) (Federal Information Processing Standard 173): Washington, Department of Commerce, National Institute of Standards and Technology): "Point"
"Pixel" "Grid Cell" "Voxel"
Short Name: rasttype

A3.4.2 *Row Count*—The maximum number of raster objects along the ordinate (*y*) axis. For use with rectangular raster objects.

Type: Integer
Domain: Row Count > 0
Short Name: rowcount

A3.4.3 *Column Count*—The maximum number of raster objects along the abscissa (*x*) axis. For use with rectangular raster objects.

Type: Integer
Domain: Column Count > 0
Short Name: colcount

A3.4.4 *Vertical Count*—The maximum number of raster objects along the vertical (z) axis. For use with rectangular volumetric raster objects (voxels).

Type: Integer
Domain: Depth Count > 0
Short Name: vrtcount

Usage Note—Recording the resolution of raster objects—Coordinate resolution information is encoded in Annex A4. For raster data recorded in geographic (longitude-latitude) coordinates, use "Latitude Resolution" (A4.1.1.1) and "Longitude Resolution" (A4.1.1.2). For planar (x-y) coordinates, use "Abscissa Resolution" (A4.1.2.4.2.1) and "Ordinate Resolution" (A4.1.2.4.2.2). For other (local) systems, include resolution information in "Local Description" (A4.1.3.1). The resolution of vertical measurements should be provided in "Altitude Resolution" (A4.2.1.2) for altitudes or elevations and "Depth Resolution" (A4.2.2.2) for depths.

A4. SPATIAL REFERENCE INFORMATION

INTRODUCTION

Spatial Reference Information—The description of the reference frame for, and the means to encode, coordinates in the data set (see Fig. 5). This section is mandatory-if-applicable. Thus, if the data set being documented does not contain spatially referenced data, this section is not required. Additional information on geospatial transportation data framework standards and associated data models can be found at the Geospatial One-Stop (GOS) at http://www.geo-onestop. gov.

Type: compound
Short Name: spref

```
Spatial_Reference_Information =
        0{Horizontal_Coordinate_System_Definition}1 +
        0{Vertical_Coordinate_System_Definition}1

Horizontal_Coordinate_System_Definition =
        [Geographic |
        1{Planar}n |
        Local] +
        0{Geodetic_Model}1

Geographic =
        Latitude_Resolution +
        Longitude_Resolution +
        Geographic_Coordinate_Units

Planar =
        [Map_Projection |
        Grid_Coordinate_System |
        Local_Planar] +
        Planar_Coordinate_Information

Map_Projection =
        Map_Projection_Name +
        [Albers_Conical_Equal_Area |
        Azimuthal_Equidistant |
        Equidistant_Conic |
        Equirectangular |
        General_Vertical_Near-sided_Perspective |
        Gnomonic |
        Lambert_Azimuthal_Equal_Area |
        Lambert_Conformal_Conic |
        Mercator |
        Modified_Stereographic_for_Alaska |
        Miller_Cylindrical |
        Oblique_Mercator |
        Orthographic |
        Polar_Stereographic |
        Polyconic |
        Robinson |
        Sinusoidal |
        Space_Oblique_Mercator_(Landsat) |
```

```
                                    Stereographic |
                                    Transverse Mercator |
                                    van_der_Grinten |
                                    Map_Projection_Parameters]

            Albers_Conical_Equal_Area =
                                    1{Standard_Parallel}2 +
                                    Longitude_of_Central_Meridian +
                                    Latitude_of_Projection_Origin +
                                    False_Easting +
                                    False_Northing

              Azimuthal_Equidistant =
                                    Longitude_of_Central_Meridian +
                                    Latitude_of_Projection_Origin +
                                    False_Easting +
                                    False_Northing

               Equidistant_Conic =
                                    1{Standard_Parallel}2 +
                                    Longitude_of_Central_Meridian +
                                    Latitude_of_Projection_Origin +
                                    False_Easting +
                                    False_Northing

                Equirectangular =
                                    Standard_Parallel +
                                    Longitude_of_Central_Meridian +
                                    False_Easting +
                                    False_Northing

General_Vertical_Near-sided_Perspective =
                                    Height_of_Perspective_Point_Above_Surface +
                                    Longitude_of_Projection_Center +
                                    Latitude_of_Projection_Center +
                                    False_Easting +
                                    False_Northing

                      Gnomonic =
                                    Longitude_of_Projection_Center +
                                    Latitude_of_Projection_Center +
                                    False_Easting +
                                    False_Northing

    Lambert_Azimuthal_Equal_Area =
                                    Longitude_of_Projection_Center +
                                    Latitude_of_Projection_Center +
                                    False_Easting +
                                    False_Northing

        Lambert_Conformal_Conic =
                                    1{Standard_Parallel}2 +
                                    Longitude_of_Central_Meridian +
                                    Latitude_of_Projection_Origin +
                                    False_Easting +
                                    False_Northing

                     Mercator =
                                    [Standard_Parallel |
                                    Scale_Factor_at_Equator] +
                                    Longitude_of_Central_Meridian +
                                    False_Easting +
                                    False_Northing

Modified_Stereographic_for_Alaska =
                                    False_Easting +
                                    False_Northing

          Miller_Cylindrical =
                                    Longitude_of_Central_Meridian +
                                    False_Easting +
                                    False_Northing

             Oblique_Mercator =
                                    Scale_Factor_at_Center_Line +
                                    [Oblique_Line_Azimuth |
                                    Oblique_Line_Point] +
                                    Latitude_of_Projection_Origin +
```

False_Easting +
False_Northing

Oblique_Line_Azimuth =
Azimuthal_Angle +
Azimuth_Measure_Point_Longitude

Oblique_Line_Point =
2{Oblique_Line_Latitude +
Oblique_Line_Longitude}2

Orthographic =
Longitude_of_Projection_Center +
Latitude_of_Projection_Center +
False_Easting +
False_Northing

Polar_Stereographic =
Straight-Vertical_Longitude_from_Pole +
[Standard_Parallel |
Scale_Factor_at_Projection_Origin] +
False_Easting +
False_Northing

Polyconic =
Longitude_of_Central_Meridian +
Latitude_of_Projection_Origin +
False_Easting +
False_Northing

Robinson =
Longitude_of_Projection_Center +
False_Easting +
False_Northing

Sinusoidal =
Longitude_of_Central_Meridian +
False_Easting +
False_Northing

Space_Oblique_Mercator_(Landsat) =
Landsat_Number +
Path_Number +
False_Easting +
False_Northing

Stereographic =
Longitude_of_Projection_Center +
Latitude_of_Projection_Center +
False_Easting +
False_Northing

Transverse_Mercator =
Scale_Factor_at_Central_Meridian +
Longitude_of_Central_Meridian +
Latitude_of_Projection_Origin +
False_Easting +
False_Northing

van_der_Grinten =
Longitude_of_Central_Meridian +
False_Easting +
False_Northing

Map_Projection_Parameters =
Appropriate metadata elements A4.1.2.1.23.1 through A4.1.2.1.23.18
to document the map projection parameters.

Grid_Coordinate_System =
Grid_Coordinate_System_Name +
[Universal_Transverse_Mercator]
Universal_Polar_Stereographic |
State_Plane_Coordinate_System |
ARC_Coordinate_System |
Other_Grid_System's_Definition]

Universal_Transverse_Mercator =
UTM_Zone_Number +

```
                                    Transverse_Mercator

Universal_Polar_Stereographic =
                                    UPS_Zone_Identifier +
                                    Polar_Stereographic

State_Plane_Coordinate_System =
                                    SPCS_Zone_Identifier +
                                    [Lambert_Conformal_Conic |
                                    Transverse_Mercator |
                                    Oblique_Mercator |
                                    Polyconic]

ARC_Coordinate_System =
                                    ARC_System_Zone_Identifier +
                                    [Equirectangular |
                                    Azimuthal_Equidistant]

Local_Planar =
                                    Local_Planar_Description +
                                    Local_Planar_Georeference_Information

Planar_Coordinate_Information =
                                    Planar_Coordinate_Encoding_Method +
                                    [Coordinate_Representation |
                                    Distance_and_Bearing_Representation] +
                                    Planar_Distance_Units

Coordinate_Representation =
                                    Abscissa_Resolution +
                                    Ordinate_Resolution

Distance_and_Bearing_Representation =
                                    Distance_Resolution +
                                    Bearing_Resolution +
                                    Bearing_Units +
                                    Bearing_Reference_Direction +
                                    Bearing_Reference_Meridian

Local =
                                    Local_Description +
                                    Local_Georeference_Information

Geodetic_Model =
                                    0{Horizontal_Datum_Name}1 +
                                    Ellipsoid_Name +
                                    Semi-major_Axis +
                                    Denominator_of_Flattening_Ratio

Vertical_Coordinate_System_Definition =
                                    0{Altitude_System_Definition}1 +
                                    0{Depth_System_Definition}1

Altitude_System_Definition =
                                    Altitude_Datum_Name +
                                    1{Altitude_Resolution}n +
                                    Altitude_Distance_Units +
                                    Altitude_Encoding_Method

Depth_System_Definition =
                                    Depth_Datum_Name +
                                    1{Depth_Resolution}n +
                                    Depth_Distance_Units +
                                    Depth_Encoding_Method
```

A4.1 *Horizontal Coordinate System Definition*—The reference frame or system from which linear or angular quantities are measured and assigned to the position that a point occupies.

Type: compound
Short Name: horizsys

A4.1.1 *Geographic*—The quantities of latitude and longitude which define the position of a point on the Earth's surface with respect to a reference spheroid.

Type: compound
Short Name: geograph

A4.1.1.1 *Latitude Resolution*—The minimum difference between two adjacent latitude values expressed in Geographic Coordinate Units of measure.

Type: real
Domain: Latitude Resolution > 0.0
Short Name: latres

A4.1.1.2 *Longitude Resolution*—The minimum difference between two adjacent longitude values expressed in Geographic Coordinate Units of measure.

Type: real
Domain: Longitude Resolution > 0.0
Short Name: longres

A4.1.1.3 *Geographic Coordinate Units*—Units of measure used for the latitude and longitude values.

Type: text
Domain: "Decimal degrees" "Decimal minutes" "Decimal seconds" "Degrees and decimal minutes" "Degrees, minutes, and decimal seconds" "Radians" "Grads"
Short Name: geogunit

A4.1.2 *Planar*—The quantities of distances, or distances and angles, which define the position of a point on a reference plane to which the surface of the Earth has been projected.

Type: compound
Short Name: planar

Usage Note—Commentary on "Map Projection" and "Grid Coordinate System"—Remember that the purpose of the metadata standards is to allow the description of data sets. The standards provide explicit means to encode parameters for map projections and grid systems that are commonly used in the United States, as well as the means to develop encodings of parameters for map projections and grid systems that are used less frequently. You only need to use the parts of the standards for the maps projections and grid systems that you use in your data sets. The rest of the map projections and grid systems don't apply to you; ignore them.

A4.1.2.1 *Map Projection*—The systematic representation of all or part of the surface of the Earth on a plane or developable surface.

Type: compound
Short Name: mapproj

A4.1.2.1.1 *Map Projection Name*—Name of the map projection.

Type: text
Domain: "Albers Conical Equal Area" "Azimuthal Equidistant" "Equidistant Conic" "Equirectangular" "General Vertical Near-sided Projection" "Gnomonic" "Lambert Azimuthal Equal Area" "Lambert Conformal Conic" "Mercator" "Modified Stereographic for Alaska" "Miller Cylindrical" "Oblique Mercator" "Orthographic" "Polar Stereographic" "Polyconic" "Robinson" "Sinusoidal" "Space Oblique Mercator" "Stereographic" "Transverse Mercator" "van der Grinten" free text
Short Name: mapprojn

A4.1.2.1.2 *Albers Conical Equal Area*—Contains parameters for the Albers Conical Equal Area projection.

Type: compound
Short Name: albers

A4.1.2.1.3 *Azimuthal Equidistant*—Contains parameters for the Azimuthal Equidistant projection.

Type: compound
Short Name:azimequi

A4.1.2.1.4 *Equidistant Conic*—Contains parameters for the Equidistant Conic projection.

Type: compound
Short Name: equicon

A4.1.2.1.5 *Equirectangular*—Contains parameters for the Equirectangular projection.

Type: compound
Short Name: equirect

A4.1.2.1.6 *General Vertical Near-sided Perspective*— Contains parameters for the General Vertical Near-sided Perspective projection.

Type: compound
Short Name: gvnsp

A4.1.2.1.7 *Gnomonic*—Contains parameters for the Gnomonic projection.

Type: compound
Short Name: gnomonic

A4.1.2.1.8 *Lambert Azimuthal Equal Area*—Contains parameters for the Lambert Azimuthal Equal Area projection.

Type: compound
Short Name: lamberta

A4.1.2.1.9 *Lambert Conformal Conic*—Contains parameters for the Lambert Conformal Conic projection.

Type: compound
Short Name: lambertc

A4.1.2.1.10 *Mercator*—Contains parameters for the Mercator projection.

Type: compound
Short Name: mercator

A4.1.2.1.11 *Modified Stereographic for Alaska*— Contains parameters for the Modified Stereographic for Alaska projection.

Type: compound
Short Name: modsak

A4.1.2.1.12 *Miller Cylindrical*—Contains parameters for the Miller Cylindrical projection.

Type: compound
Short Name: miller

A4.1.2.1.13 *Oblique Mercator*—Contains parameters for the Oblique Mercator projection.

Type: compound
Short Name: obqmerc

A4.1.2.1.14 *Orthographic*—Contains parameters for the Orthographic projection.

Type: compound
Short Name: orthogr

A4.1.2.1.15 *Polar Stereographic*—Contains parameters for the Polar Stereographic projection.

Type: compound
Short Name: polarst

A4.1.2.1.16 *Polyconic*—Contains parameters for the Polyconic projection.

Type: compound
Short Name: polycon

A4.1.2.1.17 *Robinson*—Contains parameters for the Robinson projection.

Type: compound
Short Name: robinson

A4.1.2.1.18 *Sinusoidal*—Contains parameters for the Sinusoidal projection.

Type: compound
Short Name: sinusoid

A4.1.2.1.19 *Space Oblique Mercator (Landsat)*— Contains parameters for the Space Oblique Mercator (Landsat) projection.

Type: compound
Short Name: spaceobq

A4.1.2.1.20 *Stereographic*—Contains parameters for the Stereographic projection.

Type: compound
Short Name: stereo

A4.1.2.1.21 *Transverse Mercator*—Contains parameters for the Transverse mercator projection.

Type: compound
Short Name: transmer

A4.1.2.1.22 *van der Grinten*—Contains parameters for the van der Grinten projection.

Type: compound
Short Name: vdgrin

A4.1.2.1.23 *Map Projection Parameters*—A complete parameter set of the projection that was used for the data set. The information provided shall include the names of the parameters and values used for the data set that describe the mathematical relationship between the Earth and the plane or developable surface for the projection.

Type: compound
Short Name: mapprojp

A4.1.2.1.23.1 *Standard Parallel*—Line of constant latitude at which the surface of the Earth and the plane or developable surface intersect.

Type: real
Domain: -90.0 <= Standard Parallel <= 90.0
Short Name: stdparll

A4.1.2.1.23.2 *Longitude of Central Meridian*—The line of longitude at the center of a map projection generally used as the basis for constructing the projection.

Type: real
Domain: -180.0 <= Longitude of Central Meridian < 180.0
Short Name: longcm

A4.1.2.1.23.3 *Latitude of Projection Origin*—Latitude chosen as the origin of rectangular coordinates for a map projection.

Type: real
Domain: -90.0 <= Latitude of Projection Origin <= 90.0
Short Name: latprjo

A4.1.2.1.23.4 *False Easting*—The value added to all "*x*" values in the rectangular coordinates for a map projection. This value frequently is assigned to eliminate negative numbers. Expressed in the unit of measure identified in Planar Coordinate Units.

Type: real
Domain: free real
Short Name: feast

A4.1.2.1.23.5 *False Northing*—The value added to all "*y*" values in the rectangular coordinates for a map projection. This value frequently is assigned to eliminate negative numbers. Expressed in the unit of measure identified in Planar Coordinate Units.

Type: real
Domain: free real
Short Name: fnorth

A4.1.2.1.23.6 *Scale Factor at Equator*—A multiplier for reducing a distance obtained from a map by computation or scaling to the actual distance along the equator.

Type: real
Domain: Scale Factor at Equator > 0.0
Short Name: sfequat

A4.1.2.1.23.7 *Height of Perspective Point Above Surface*—Height of viewpoint above the Earth, expressed in meters.

Type: real
Domain: Height of Perspective Point Above Surface > 0.0
Short Name: heightpt

A4.1.2.1.23.8 *Longitude of Projection Center*— Longitude of the point of projection for azimuthal projections.

Type: real
Domain: -180.0 <= Longitude of Projection Center < 180.0
Short Name: longpc

A4.1.2.1.23.9 *Latitude of Projection Center*—Latitude of the point of projection for azimuthal projections.

Type: real
Domain: -90.0 <= Latitude of Projection Center <= 90.0
Short Name: latprjc

A4.1.2.1.23.10 *Scale Factor at Center Line*—A multiplier for reducing a distance obtained from a map by computation or scaling to the actual distance along the center line.

Type: real
Domain: Scale Factor at Center Line > 0.0
Short Name: sfctrlin

A4.1.2.1.23.11 *Oblique Line Azimuth*—Method used to describe the line along which an oblique mercator map projection is centered using the map projection origin and an azimuth.

Type: compound
Short Name: obqlazim

A4.1.2.1.23.11.1 *Azimuthal Angle*—Angle measured clockwise from north, and expressed in degrees.

Type: real
Domain: 0.0 <= Azimuthal Angle < 360.0
Short Name: azimangl

A4.1.2.1.23.11.2 *Azimuth Measure Point Longitude*— Longitude of the map projection origin.

Type: real
Domain: -180.0 <= Azimuth Measure Point Longitude < 180.0
Short Name: azimptl

A4.1.2.1.23.12 *Oblique Line Point*—Method used to describe the line along which an oblique mercator map projection is centered using two points near the limits of the mapped region that define the center line.

Type: compound
Short Name: obqlpt

A4.1.2.1.23.12.1 *Oblique Line Latitude*—Latitude of a point defining the oblique line.

Type: real
Domain: -90.0 <= Oblique Line Latitude <= 90.0
Short Name: obqllat

A4.1.2.1.23.12.2 *Oblique Line Longitude*—Longitude of a point defining the oblique line.

Type: real
Domain: -180.0 <= Oblique Line Longitude < 180.0
Short Name: obqllong

A4.1.2.1.23.13 *Straight Vertical Longitude from Pole*—Longitude to be oriented straight up from the North or South Pole.

Type: real
Domain: -180.0 <= Straight Vertical Longitude from Pole < 180.0
Short Name: svlong

A4.1.2.1.23.14 *Scale Factor at Projection Origin*— A multiplier for reducing a distance obtained from a map by computation or scaling to the actual distance at the projection origin.

Type: real
Domain: Scale Factor at Projection Origin > 0.0
Short Name: sfprjorg

A4.1.2.1.23.15 *Landsat Number*—Number of the Landsat satellite. (Note: This metadata element exists solely to provide a parameter needed to define the space oblique mercator projection. It is not used to identify data originating from a remote sensing vehicle.)

Type: Integer
Domain: free integer
Short Name: landsat

A4.1.2.1.23.16 *Path Number*—Number of the orbit of the Landsat satellite. (Note: This metadata element exists solely to provide a parameter needed to define the space oblique mercator projection. It is not used to identify data originating from a remote sensing vehicle.)

Type: integer
Domain: 0 < Path Number < 251 for Landsats 1, 2, or 3 0 < Path Number < 233 for Landsats 4 or 5, free integer
Short Name: pathnum

A4.1.2.1.23.17 *Scale Factor at Central Meridian*— A multiplier for reducing a distance obtained from a map by computation or scaling to the actual distance along the central meridian.

Type: real
Domain: Scale Factor at Central Meridian > 0.0
Short Name: sfctrmer

A4.1.2.1.23.18 *Other Projection's Definition*— A description of a projection, not defined elsewhere in the standard, that was used for the data set. The information provided shall include the name of the projection, names of parameters and values used for the data set, and the citation of the specification for the algorithms that describe the mathematical relationship between Earth and plane or developable surface for the projection.

Type: text
Domain: free text

A4.1.2.2 *Grid Coordinate System*—A plane-rectangular coordinate system usually based on, and mathematically adjusted to, a map projection so that geographic positions can be readily transformed to and from plane coordinates.

Type: compound
Short Name gridsys

A4.1.2.2.1 *Grid Coordinate System Name*—Name of the grid coordinate system.

Type: text
Domain: "Universal Transverse Mercator" "Universal Polar Stereographic" "State Plane Coordinate System 1927" "State Plane Coordinate System 1983" "ARC Coordinate System" "other grid system"
Short Name: gridsysn

A4.1.2.2.2 *Universal Transverse Mercator (UTM)*— A grid system based on the transverse mercator projection, applied between latitudes 84 degrees north and 80 degrees south on the Earth's surface.

Type: compound
Short Name: utm

A4.1.2.2.2.1 *UTM Zone Number*—Identifier for the UTM zone.

Type: integer
Domain: 1 <= UTM Zone Number <= 60 for the northern hemisphere; -60 <= UTM Zone Number <= -1 for the southern hemisphere
Short Name: utmzone

A4.1.2.2.3 *Universal Polar Stereographic (UPS)*— A grid system based on the polar stereographic projection, applied to the Earth's polar regions north of 84 degrees north and south of 80 degrees south.

Type: compound
Short Name: ups

A4.1.2.2.3.1 *UPS Zone Identifier*—Identifier for the UPS zone.

Type: text
Domain: "A" "B" "Y" "Z"
Short Name: upszone

A4.1.2.2.4 *State Plane Coordinate System (SPCS)*— A plane-rectangular coordinate system established for each state in the United States by the National Geodetic Survey.

Type: compound
Short Name: spcs

A4.1.2.2.4.1 *SPCS Zone Identifier*—Identifier for the SPCS zone.

Type: text
Domain: Four-digit numeric codes for the State Plane Coordinate Systems based on the North American Datum of 1927 are found in Department of Commerce, 1986, Representation of geographic point locations for information interchange (Federal Information Processing Standard 70-1): Washington: Department of Commerce, National Institute of Standards and Technology. Codes for the State Plane Coordinate Systems based on the North American Datum of 1983 are found in Department of Commerce, 1989 (January), State Plane Coordinate System of 1983 (National Oceanic and Atmospheric Administration Manual NOS NGS 5): Silver Spring, Maryland, National Oceanic and Atmospheric Administration, National Ocean Service, Coast and Geodetic Survey.
Short Name: spcszone

A4.1.2.2.5 *ARC Coordinate System*—The Equal Arc-second Coordinate System, a plane- rectangular coordinate system established in Department of Defense, 1990, Military specification ARC Digitized Raster Graphics (ADRG) (MIL-A-89007): Philadelphia, Department of Defense, Defense Printing Service Detachment Office.

Type: compound
Short Name: arcsys

A4.1.2.2.5.1 *ARC System Zone Identifier*—Identifier for the ARC Coordinate System Zone.

Type: integer
Domain: 1 <= ARC System Zone Identifier <= 18
Short Name: arczone

A4.1.2.2.6 *Other Grid System's Definition*—A complete description of a grid system, not defined elsewhere in this standard, that was used for the data set. The information provided shall include the name of the grid system, the names of the parameters and values used for the data set, and the citation of the specification for the algorithms that describe the mathematical relationship between the Earth and the coordinates of the grid system.

Type: text
Domain: free text
Short Name: othergrd

A4.1.2.3 *Local Planar*—Any right-handed planar coordinate system of which the *z*-axis coincides with a plumb line through the origin that locally is aligned with the surface of the Earth.

Type: compound
Short Name: localp

Usage Note—Definition of "Local Planar" system—A local planar coordinate system is any planar coordinate system for which the relationship between the planar coordinates and geographic (latitude and longitude) coordinates is not known. In these cases, the standards ask the producer to describe the coordinate system (the orientation of the axes, etc.) and any means that can be used to link the local system to geographic coordinates.

A4.1.2.3.1 *Local Planar Description*—A description of the local planar system.

Type: text
Domain: free text
Short Name: localpd

A4.1.2.3.2 *Local Planar Georeference Information*— A description of the information provided to register the local planar system to the Earth (for example, control points, satellite ephemeral data, inertial navigation data).

Type: text
Domain: free text
Short Name: localpgi

A4.1.2.4 *Planar Coordinate Information*—Information about the coordinate system developed on the planar surface.

Type: compound
Short Name: planci

A4.1.2.4.1 *Planar Coordinate Encoding Method*— The means used to represent horizontal positions.

Type: text
Domain: "coordinate pair" "distance and bearing" "row and column"
Short Name: plance

A4.1.2.4.2 *Coordinate Representation*—The method of encoding the position of a point by measuring its distance from perpendicular reference axes (the "coordinate pair" and "row and column" methods).

Type: compound
Short Name: coordrep

A4.1.2.4.2.1 *Abscissa Resolution*—The (nominal) minimum distance between the "*x*" or column values of two adjacent points, expressed in Planar Distance Units of measure.

Type: real
Domain: Abscissa Resolution > 0.0
Short Name: absres

A4.1.2.4.2.2 *Ordinate Resolution*—The (nominal) minimum distance between the "*y*" or row values of two adjacent points, expressed in Planar Distance Units of measure.

Type: real
Domain: Ordinate Resolution > 0.0
Short Name: ordres

Usage Note—Definition of coordinate resolution—The coordinate resolution is the smallest difference that can be encoded between the adjacent coordinate values in the data set. In raster data sets, these values normally are the dimensions of the pixel or grid cell. In vector data sets, the resolution is the shortest line that can be encoded in the data set.

A4.1.2.4.3 *Distance and Bearing Representation*—A method of encoding the position of a point by measuring its distance and direction (azimuth angle) from another point.

Type: compound
Short Name: distbrep

A4.1.2.4.3.1 *Distance Resolution*—The minimum distance measurable between two points, expressed Planar Distance Units of measure.

Type: real
Domain: Distance Resolution > 0.0
Short Name: distres

A4.1.2.4.3.2 *Bearing Resolution*—The minimum angle measurable between two points, expressed in Bearing Units of measure.

Type: real
Domain: Bearing Resolution > 0.0
Short Name: bearres

A4.1.2.4.3.3 *Bearing Units*—Units of measure used for angles.

Type: text
Domain: "Decimal degrees" "Decimal minutes" "Decimal seconds" "Degrees and decimal minutes" "Degrees, minutes, and decimal seconds" "Radians" "Grads"
Short Name: bearunit

A4.1.2.4.3.4 *Bearing Reference Direction*—Direction from which the bearing is measured.

Type: text
Domain: "North" "South"
Short Name: bearrefd

A4.1.2.4.3.5 *Bearing Reference Meridian*—Axis from which the bearing is measured.

Type: text
Domain: "Assumed" "Grid" "Magnetic" "Astronomic" "Geodetic"
Short Name: bearrefm

A4.1.2.4.4 *Planar Distance Units*—units of measure used for distances.

Type: text
Domain: "meters" "international feet" "survey feet" free text
Short Name: plandu

A4.1.3 *Local*—A description of any coordinate system that is not aligned with the surface of the Earth.

Type: compound
Short Name: local

Usage Note—Definition of "Local" system—A local system is a local coordinate system in any non-planar, non-geographic coordinate system. Examples include oblique photography and unrectified satellite images. In these cases, the standards ask the producer to describe the coordinate system and any means that can be used to link the local system to geographic coordinates.

A4.1.3.1 *Local Description*—A description of the coordinate system and its orientation to the surface of the Earth.

Type: text
Domain: free text
Short Name: localdes

A4.1.3.2 *Local Georeference Information*—A description of the information provided to register the local system to the Earth (for example, control points, satellite ephemeral data, inertial navigation data).

Type: text
Domain: free text
Short Name: localgeo

A4.1.4 *Geodetic Model*—Parameters for the shape of the earth.

Type: compound
Short Name: geodetic

A4.1.4.1 *Horizontal Datum Name*—The identification given to the reference system used for defining the coordinates of points.

Type: text
Domain: "North American Datum of 1927" "North American Datum of 1983" free text
Short Name: horizdn

A4.1.4.2 *Ellipsoid Name*—Identification given to established representations of the Earth's shape.

Type: text
Domain: "Clarke 1866" "Geodetic Reference System 80" free text
Short Name: ellips

Usage Note—Relationship between horizontal datums and ellipsoids—A horizontal datum is defined in part by the parameters of a reference ellipsoid.

Usage Note—Ellipsoids associated with the horizontal datums listed in the domain of the "Horizontal Datum Name" element:

Horizontal Datum	Ellipsoid
North American Datum of 1927	Clarke 1866
North American Datum of 1983	Geodetic Reference System 80

A4.1.4.3 *Semi-major Axis*—Radius of the equatorial axis of the ellipsoid.

Type: real
Domain: Semi-major Axis > 0.0
Short Name: semiaxis

A4.1.4.4 *Denominator of Flattening Ratio*—The denominator of the ratio of the difference between the equatorial and polar radii of the ellipsoid when the numerator is set to 1.

Type: real
Domain: Denominator of Flattening > 0.0
Short Name: denflat

A4.2 *Vertical Coordinate System Definition*—The reference frame or system from which vertical distances (altitudes or depths) are measured.

Type: compound
Short Name: vertdef

A4.2.1 *Altitude System Definition*—The reference frame or system from which altitudes (elevations) are measured. The term "altitude"' is used instead of the common term "elevation" to conform to the terminology in Federal Information Processing Standards 70-1 and 173.

Type: compound
Short Name: altsys

A4.2.1.1 *Altitude Datum Name*—The identification given to the surface taken as the surface of reference from which altitudes are measured.

Type: text
Domain: "National Geodetic Vertical Datum of 1929" "North American Vertical Datum of 1988" free text
Short Name: altdatum

A4.2.1.2 *Altitude Resolution*—The minimum distance possible between two adjacent altitude values, expressed in Altitude Distance Units of measure.

Type: real
Domain: Altitude Resolution > 0.0
Short Name: altres

A4.2.1.3 *Altitude Distance Units*—Units in which altitudes are recorded.

Type: text
Domain: "meters" "feet" free text
Short Name: altunits

A4.2.1.4 *Altitude Encoding Method*—The means used to encode the altitudes.

Type: text
Domain: "Explicit elevation coordinate included with horizontal coordinates" "Implicit coordinate" "Attribute values"
Short Name: altenc

A4.2.2 *Depth System Definition*—The reference frame or system from which depths are measured.

Type: compound
Short Name: depthsys

A4.2.2.1 *Depth Datum Name*—The identification given to surface of reference from which depths are measured.

Type: text
Domain: "Local surface" "Chart datum; datum for sounding reduction" "Lowest astronomical tide" "Highest astronomical tide" "Mean low water" "Mean high water" "Mean sea level" "Land survey datum" "Mean low water springs" "Mean high water springs" "Mean low water neap" "Mean high water neap" "Mean lower low water" "Mean lower low water springs" "Mean higher high water" "Mean higher low water" "Mean lower high water" "Spring tide" "Tropic lower low water" "Neap tide" "High water" "Higher high water" "Low water" "Low-water datum" "Lowest low water" "Lower low water" "Lowest normal low water" "Mean tide level" "Indian spring low water" "High-water full and charge" "Low-water full and charge" "Columbia River datum" "Gulf Coast low water datum" "Equatorial springs low water" "Approximate lowest astronomical tide" "No correction" free text
Short Name: depthdn

A4.2.2.2 *Depth Resolution*—The minimum distance possible between two adjacent depth values, expressed in Depth Distance Units of measure.

Type: real
Domain: Depth Resolution > 0.0
Short Name: depthres

A4.2.2.3 *Depth Distance Units*—Units in which depths are recorded.

Type: text
Domain: "meters" "feet" free text
Short Name: depthdu

A4.2.2.4 *Depth Encoding Method*—The means used to encode depths.

Type: text
Domain: "Explicit depth coordinate included with horizontal coordinates" "Implicit coordinate" "Attribute values"
Short Name: depthem

A5. ENTITY AND ATTRIBUTE INFORMATION

INTRODUCTION

Entity and Attribute Information—Details about the information content of the data set, including the entity types, their attributes, and the domains from which attribute values may be assigned (see Fig. 6).

Usage Note— Purpose of the "Entity and Attribute Information" section—Users of a data set need to know the meaning of entity, attribute, and attribute value information associated with the spatial information. For example, a data set might include the entity "road". A "road" might have the attribute "road type," which can be assigned the attribute values of "heavy duty," "medium duty," "light duty," or "trail." The producer of the data set may have different definitions for "road," "road type," "heavy duty," "medium duty," "light duty," or "trail" than a user. The "Entity and Attribute Information" section provides the way for a producer to describe the meaning of this nonspatial entity, attribute, and attribute value information so a user can understand the information content of a data set and use the data appropriately. Note that entities could also include pre-defined data filters, forms, reports, or queries in a traditional database management system. These entities should be documented in this section.

Usage Note—Mandatory nature of "Entity and Attribute Information" section—Users of this standard should note that the existing FGDC metadata content standard lists this section as mandatory-if-applicable. However, the ADMS community developing this standard has changed the optionality to mandatory. The standard development committee felt that the section was critically important and that all data archives will contain entities and attributes, thus the section would always be applicable and consequently mandatory.

Usage Note—Difference between "Detailed Description" and "Overview Description" elements—The "Overview Description" elements refer to the source of the complete description, and do not allow a producer merely to summarize the information content. The "Overview Description" provides the elements needed to give users a sense of the information content and a reference to the source(s) of the complete description. Note that the "Overview Description" does not relieve the producer of the responsibility to provide a complete description when this information becomes available. As stated above, users must have access to the meanings of the entities, attributes, and attribute values in a data set. The "Detailed Description" provides the elements needed to describe these meanings. In developing the FGDC metadata standards, reviewers noted that they often had complete data dictionaries for the entity, attribute, and attribute value information, and preferred to refer to the existing descriptions instead of duplicating them. The two approaches can be used together to document a data set. The "Overview Description" would be used to describe data for which a complete description is available elsewhere; the "Detailed Description" would be used to describe data for which a complete description has not been compiled elsewhere. For example, assume that we are documenting archived traffic detector data. Many of the attribute definitions are likely to be defined in another standard. Therefore, the "Overview Description" is a reference to this source standard that defines the attributes in detail. If the referenced standard does not define certain attributes in the archived data, then the "Detailed Description" elements would be used.

Type: compound
Short Name: eainfo

```
Entity_and_Attribute_Information =
                    [1{Detailed_Description}n |
                    1{Overview_Description}n |
                    1{Detailed_Description}n +
                    1{Overview_Description}n]

Detailed_Description =
                    Entity_Type +
                    0{Attribute}n

Entity_Type =
                    Entity_Type_Label +
                    Entity_Type_Definition +
                    Entity_Type_Definition_Source
```

```
Attribute =
        Attribute_Label +
        Attribute_Definition +
        Attribute_Definition_Source +
        1{Attribute_Domain_Values}n +
        0{Beginning_Date_of_Attribute_Values +
        0{Ending_Date_of_Attribute_Values}1}n +
        (Attribute_Value_Accuracy_Information) +
        (Attribute_Measurement_Frequency)

Attribute_Domain_Values =
        [Enumerated_Domain |
        Range_Domain |
        Codeset_Domain |
        Unrepresentable_Domain]

Enumerated_Domain =
        1{Enumerated_Domain_Value +
        Enumerated_Domain_Value_Definition +
        Enumerated_Domain_Value_Definition_Source +
        0{Attribute}n }n

Range_Domain =
        Range_Domain_Minimum +
        Range_Domain_Maximum +
        0{Attribute_Units_of_Measure}1 +
        (Attribute_Measurement_Resolution) +
        0{Attribute}n

Codeset_Domain=
        Codeset_Name +
        Codeset_Source

Attribute_Value_Accuracy_Information =
        Attribute_Value_Accuracy +
        Attribute_Value_Accuracy_Explanation

Overview_Description =
        Entity_and_Attribute_Overview +
        1{Entity_and_Attribute_Detail_Citation}n
```

A5.1 *Detailed Description*—Description of the entities, attributes, attribute values, and related characteristics encoded in the data set.

Type: compound
Short Name: detailed

A5.1.1 *Entity Type*—The definition and description of a set into which similar entity instances are classified.

Type: compound
Short Name: enttype

A5.1.1.1 *Entity Type Label*—The name of the entity type.

Type: text
Domain: free text
Short Name: enttypl

A5.1.1.2 *Entity Type Definition*—The description of the entity type.

Type: text
Domain: free text
Short Name: enttypd

A5.1.1.3 *Entity Type Definition Source*—The authority of the definition.

Type: text
Domain: free text
Short Name: enttypds

A5.1.2 *Attribute*—A defined characteristic of an entity.

Type: compound
Short Name: attr

A5.1.2.1 *Attribute Label*—The name of the attribute.

Type: text
Domain: free text
Short Name: attrlabl

A5.1.2.2 *Attribute Definition*—The description of the attribute. The attribute definition should also describe the attribute type (for example, ASN.1 data types such as INTEGER, BOOLEAN, REAL, BIT STRING, ENUMERATED, etc.), length, format, and unit of measure, if applicable.

Type: text
Domain: free text
Short Name: attrdef

Usage Note—Documenting data granularity— Temporal and spatial granularity defines the level of detail in time and space at which the data being described has been summarized or is being reported. For example, traffic data may have a temporal granularity of 15 minutes, which means that traffic counts and speeds have been aggregated into 15-minute summary periods. Traffic data with a spatial granularity by direction means that data from all functional lanes in a defined direction has been combined. The "Attribute Definition" section can be used to describe granularity of data, as well as the

"Supplemental Information" section in A1.2.3. If the granularity of the data has changed since original field collection, these details can be described in the "Lineage" section in A2.5.

A5.1.2.3 *Attribute Definition Source*—The authority of the definition.

Type: text
Domain: free text
Short Name: attrdefs

A5.1.2.4 *Attribute Domain Values*—The valid values that can be assigned for an attribute.

Type: compound
Short Name: attrdomv

Usage Note—Definition of domain, enumerated domain, range domain, codeset domain, and unrepresentable domain:

(1) A domain is the set of possible data values of an attribute. From the example used above, the domain for the attribute "road type" consists of "heavy duty," "medium duty," "light duty," and "trail."

(2) An enumerated domain is one comprised of a list of values. The "road type" attribute has an enumerated domain which contains the values "heavy duty," medium duty," "light duty," and "trail." In this case, the list of possible values, the definitions of the values, and the sources of the definitions should be provided.

(3) A range domain is one comprised of a sequence, series, or scale of (usually numeric) values between limits. For example, an attribute of age might have a range domain of integers from 0 to 100. In this case, the minimum and maximum values should be provided.

(4) A codeset domain is one in which the data values of defined by a set of codes. Examples include the Federal Information Processing Standards that contain numeric codes for nations, States, and counties. In this case, the title of the publication containing the code set and the source of the codeset should be provided.

(5) An unrepresentable doma in is one for which the set of data values cannot be represented. Reasons include attributes whose values do not exist in a known, predefined set (for example, the values for an attribute of people's names), or attributes whose values cannot be depicted using the forms of representation (available character set, etc) used for the metadata. In these cases, the information content of the set of values should be provided.

Usage Note—Purpose of the "Attribute" compound element at the end of the "Enumerated Domain" and "Range Domain" compound elements—Comments provided during the public review of the FGDC standard requested the ability to document a construct named "attribute of attribute value." This construct allows additional information to be provided about an attribute value assigned to an entity. For example, an entity "well" may have an attribute "product." The attribute values for "product" include "water" and other items. Additional information about the water from the well may be known. Using the "attribute of attribute value" construct, the value "water" is assigned attributes (for example "water characteristics") that provide this information.

A5.1.2.4.1 *Enumerated Domain*—The members of an established set of valid values.

Type: compound
Short Name: edom

A5.1.2.4.1.1 *Enumerated Domain Value*—The name or label of a member of the set.

Type: text
Domain: free text
Short Name: edomv

A5.1.2.4.1.2 *Enumerated Domain Value Definition*— The description of the value.

Type: text
Domain: free text
Short Name: edomvd

A5.1.2.4.1.3 *Enumerated Domain Value Definition Source*—The authority of the definition.

Type: text
Domain: free text
Short Name: edomvds

A5.1.2.4.2 *Range Domain*—The minimum and maximum values of a continuum of valid values.

Type: compound
Short Name: rdom

A5.1.2.4.2.1 *Range Domain Minimum*—The least value that the attribute can be assigned.

Type: text
Domain: free text
Short Name: rdommin

A5.1.2.4.2.2 *Range Domain Maximum*—The greatest value that the attribute can be assigned.

Type: text
Domain: free text
Short Name: rdommax

A5.1.2.4.2.3 *Attribute Units of Measure*—The standard of measurement for an attribute value.

Type: text
Domain: free text
Short Name: attrunit

A5.1.2.4.2.4 *Attribute Measurement Resolution*— The smallest unit increment to which an attribute value is measured.

Type: real
Domain: Attribute Measurement Resolution > 0.0
Short Name: attrmres

A5.1.2.4.3 *Codeset Domain*—Reference to a standard or list which contains the members of an established set of valid values.

Type: compound
Short Name: codesetd

A5.1.2.4.3.1 *Codeset Name*—The title of the codeset.

Type: text
Domain: free text
Short Name: codesetn

A5.1.2.4.3.2 *Codeset Source*—The authority for the codeset.

Type: text
Domain: free text
Short Name: codesets

A5.1.2.4.4 *Unrepresentable Domain*—Description of the values and reasons why they cannot be represented.

Type: text
Domain: free text
Short Name: udom

A5.1.2.5 *Beginning Date of Attribute Values*—Earliest or only date for which the attribute values are current. In cases when a range of dates are provided, this is the earliest date for which the information is valid.

Type: date
Domain: free date
Short Name: begdatea

A5.1.2.6 *Ending Date of Attribute Values*—Latest date for which the information is current. Used in cases when a range of dates are provided.

Type: date
Domain: free date
Short Name: enddatea

A5.1.2.7 *Attribute Value Accuracy Information*—An assessment of the accuracy of the assignment of attribute values.

Type: compound
Short Name: attrvai

Usage Note—Purpose of "Attribute Value Accuracy Information" and relation to "Attribute Accuracy" in Annex A2—In developing the FGDC metadata standards, reviewers asked for the ability to report the accuracy of the values assigned to an attribute with the definition of the attribute. The ability to summarize the accuracy was included as an option. The complete report of the accuracy should be included in the "Attribute Accuracy" element in Annex A2.

A5.1.2.7.1 *Attribute Value Accuracy*—An estimate of the accuracy of the assignment of attribute values.

Type: real
Domain: free real
Short Name: attrva

A5.1.2.7.1 *Attribute Value Accuracy Explanation*— The definition of the Attribute Value Accuracy measure and units, and a description of how the estimate was derived.

Type: text
Domain: free text
Short Name: attrvae

A5.1.2.8 *Attribute Measurement Frequency*—The frequency with which attribute values are added.

Type: real
Domain: "Unknown" "As needed" "Irregular" "None planned" free text
Short Name: attrmfrq

A5.2 *Overview Description*—Summary of, and citation to detailed description of, the information content of the data set.

Type: compound
Short Name: overview

A5.2.1 *Entity and Attribute Overview*—Detailed summary of the information contained in a data set.

Type: text
Domain: free text
Short Name: eaover

A5.2.2 *Entity and Attribute Detail Citation*—Reference to the complete description of the entity types, attributes, and attribute values for the data set. The reference (for example, a standardized data dictionary) shall provide adequate information to properly interpret the entities and attributes.

Type: text
Domain: free text
Short Name: eadetcit

A6. DISTRIBUTION INFORMATION

INTRODUCTION

Distribution Information—Information about the distributor of and options for obtaining the data set (see Fig. 7). This section is mandatory-if-applicable. Thus, if the data set being documented is not distributed, this section is not required.

Type: compound
Short Name: distinfo

```
Distribution_Information =
                    Distributor +
                    0{Resource_Description}1 +
                    Distribution_Liability +
                    0{Standard_Order_Process}n +
                    0{Custom_Order_Process}1 +
                    (Technical_Prerequisites) +
                    (Available_Time_Period)

          Distributor =
                    Contact_Information (see Annex A10 for production rules)

Standard_Order_Process =
                    [Non-digital_Form |
                    1{Digital_Form}n ] +
                    Fees +
                    (Ordering_Instructions) +
                    (Turnaround)
```

```
Digital_Form =
        Digital_Transfer_Information +
        Digital_Transfer_Option

Digital_Transfer_Information =
        Format_Name +
        ([Format_Version_Number |
        Format_Version_Date] +
        (Format_Specification) ) +
        (Format_Information_Content) +
        0{File_Decompression_Technique}1 +
        (Transfer_Size)

Digital_Transfer_Option =
        1{ [Online_Option |
        Offline_Option] }n

Online_Option =
        1{Computer_Contact_Information}n +
        (Access_Instructions) +
        (Online_Computer_and_Operating_System)

Computer_Contact_Information =
        [Network_Address |
        Dialup_Instructions]

Network_Address =
        1{Network_Resource_Name}n

Dialup_Instructions =
        Lowest_BPS +
        0{Highest_BPS}1 +
        Number_DataBits +
        Number_StopBits +
        Parity +
        0{Compression_Support}1 +
        1{Dialup_Telephone}n +
        1{Dialup_File_Name}n

Offline_Option =
        Offline_Media +
        0{Recording_Capacity}1
        1{Recording_Format}n +
        0{Compatibility_Information}1

Recording_Capacity =
        1{Recording Density}n +
        Recording_Density_Units

Available_Time_Period =
        Time_Period_Information (see Annex A9 for production rules)
```

A6.1 *Distributor*—The party from whom the data set may be obtained.

Type: compound
Short Name: distrib

Usage Note—Metadata elements for the "Distributor" element—Because the elements are required by another section, the elements were grouped in Annex A10.

A6.2 *Resource Description*—The identifier by which the distributor knows the data set.

Type: text
Domain: free text
Short Name: resdesc

Usage Note—Example of "Resource Description"—A "Resource Description" is a label by which a data set can be requested from a distributor. A catalog number is an example of a "Resource Description."

A6.3 *Distribution Liability* —Statement of the liability assumed by the distributor.

Type: text
Domain: free text
Short Name: distliab

A6.4 *Standard Order Process*—The common ways in which the data set may be obtained or received, and related instructions and fee information.

Type: compound
Short Name: stdorder

A6.4.1 *Non-digital Form*—The description of options for obtaining the data set on non-computer- compatible media.

Type: text
Domain: free text
Short Name: nondig

A6.4.2 *Digital Form*—The description of options for obtaining the data set on computercompatible media.

Type: compound
Short Name: digform

Usage Note—Commentary on Digital Form section—The "Digital Form" section could include a description of pre-defined reports or queries that are used to streamline automated retrieval of data from traditional database management systems. This type of documentation could also be included in Annex A5, in which pre-defined reports or queries are considered to be entities.

A6.4.2.1 *Digital Transfer Information*—Description of the form of the data to be distributed.

Type: compound
Short Name: digtinfo

A6.4.2.1.1 *Format Name*—The name of the data transfer format.

Type: text
Domain: domain values from the table below; free text
Short Name: formname

Domain Value	Definition
"ARCE"	ARC/INFO Export format
"ARCG"	ARC/INFO Generate format
"ASCII"	ASCII file, formatted for text attributes, declared format
"BIL"	Imagery, band interleaved by line
"BIP"	Imagery, band interleaved by pixel
"BSQ"	Imagery, band interleaved sequential
"CDF"	Common Data Format
"CFF"	Cartographic Feature File (U.S. Forest Service)
"COORD"	User-created coordinate file, declared format
"DEM"	Digital Elevation Model format (U.S. Geological Survey)
"DFAD"	Digital Feature Analysis Data (National Imagery and Mapping Agency)
"DGN"	Microstation format (Intergraph Corporation)
"DIGEST"	Digital Geographic Information Exchange Standard
"DLG"	Digital Line Graph (U.S. Geological Survey)
"DTED"	Digital Terrain Elevation Data (MIL-D-89020)
"DWG"	AutoCAD Drawing format
"DX90"	Data Exchange '90
"DXF"	AutoCAD Drawing Exchange Format
"ERDAS"	ERDAS image files (ERDAS Corporation)
"GRASS"	Geographic Resources Analysis Support System
"HDF"	Hierarchical Data Format
"IGDS"	Interactive Graphic Design System format (Intergraph Corporation)
"IGES"	Initial Graphics Exchange Standard
"MOSS"	Multiple Overlay Statistical System export file
"netCDF"	network Common Data Format
"NITF"	National Imagery Transfer Format
"RPF"	Raster Product Format (National Imagery and Mapping Agency)
"RVC"	Raster Vector Converted format (MicroImages)
"RVF"	Raster Vector Format (MicroImages)
"SDTS"	Spatial Data Transfer Standard (Federal Information Processing Standard 173)
"SIF"	Standard Interchange Format (DOD Project 2851)
"SLF"	Standard Linear Format (National Imagery and Mapping Agency)
"TIFF"	Tagged Image File Format
"TGRLN"	Topologically Integrated Geographic Encoding and Referencing (TIGER) Line format (Bureau of the Census)
"VPF"	Vector Product Format (National Imagery and Mapping Agency)

Usage Note—Documentation of a format not listed here—As described in the domain, users can add items to the list (the domain allows "free text"). Please use a character string different from those in the list. Consider using the full name of the format.

A6.4.2.1.2 *Format Version Number*—Version number of the format.

Type: text
Domain: free text
Short Name: formvern

A6.4.2.1.3 *Format Version Date*—Date of the version of the format.

Type: date
Domain: free date
Short Name: formverd

A6.4.2.1.4 *Format Specification*—Name of a subset, profile, or product specification of the format.

Type: text
Domain: free text
Short Name: formspec

A6.4.2.1.5 *Format Information Content*—Description of the content of the data encoded in a format.

Type: text
Domain: free text
Short Name: formcont

Usage Note—Purpose of "Format Information Content" Element—In developing the FGDC metadata standards, some reviewers noted that their data are distributed in a series of files, each of which has a different format and information content. For example, the spatial data might be distributed in format *x*, and the attribute data in format *y*. The reviewers asked for the ability to describe which data are encoded in which format. The "Format Information Content" element provides this capability:

Digital Form
  Digital Transfer Information
    Format Name: x
      Format Information Content: spatial objects with unique identifiers and coordinate data
  Digital Transfer Information
    Format Name: y
      Format Information Content: attribute data and the unique identifiers of the spatial objects. The identifiers are used to link the spatial objects and attributes.

A6.4.2.1.6 *File Decompression Technique*—Recommendations of algorithms or processes (including means of obtaining these algorithms or processes) that can be applied to read or expand data sets to which data compression techniques have been applied.

Type: text
Domain: "No compression applied", free text
Short Name: filedec

A6.4.2.1.7 *Transfer Size*—The size, or estimated size, of the transferred data set in megabytes.

Type: real
Domain: Transfer Size > 0.0
Short Name: transize

A6.4.2.2 *Digital Transfer Option*—The means and media by which a data set is obtained from the distributor.

Type: compound
Short Name: digtopt

A6.4.2.2.1 *Online Option*—Information required to directly obtain the data set electronically.

Type: compound
Short Name: onlinopt

A6.4.2.2.1.1 *Computer Contact Information*—Instructions for establishing communications with the distribution computer.

Type: compound
Short Name: computer

A6.4.2.2.1.1.1 *Network Address*—The electronic address from which the data set can be obtained from the distribution computer.

Type: compound
Short Name: networka

A6.4.2.2.1.1.1.1 *Network Resource Name*—The name of the file or service from which the data set can be obtained.

Type: text
Domain: free text
Short Name: networkr

Usage Note—Definition of "Network Resource Name"—A "Network Resource Name" is the name of the data set on the network. When appropriate, Uniform Resource Locators (URL) should be provided.

Usage Note—Difference between the "Network Resource Name" and the "Online Linkage" (A8.10) metadata element—The "Network Resource Name" is the name of the file or service from which the data set can be obtained *from a distributor*. Different distributors that provide online access to a data set probably would do so from different sites. The "Online Linkage " is the name of the file or service maintained by the originator (when used with "Citation" (A1.1)) or the name of the file or service from which the data set was obtained (when used with "Source Citation" (A2.5.1.1)).

A6.4.2.2.1.1.2 *Dialup Instructions*—Information required to access the distribution computer remotely through telephone lines.

Type: compound
Short Name: dialinst

A6.4.2.2.1.1.2.1 *Lowest BPS*—Lowest or only speed for the connection's communication, expressed in bits per second.

Type: integer
Domain: Lowest BPS >= 110
Short Name: lowbps

A6.4.2.2.1.1.2.2 *Highest BPS*—Highest speed for the connection's communication, expressed in bits per second. Used in cases when a range of rates are provided.

Type: integer
Domain: Highest BPS > Lowest BPS
Short Name: highbps

A6.4.2.2.1.1.2.3 *Number DataBits*—Number of data bits in each character exchanged in the communication.

Type: integer
Domain: 7 <= Number DataBits <= 8
Short Name: numdata

A6.4.2.2.1.1.2.4 *Number StopBits*—Number of stop bits in each character exchanged in the communication.

Type: integer
Domain: 1 <= Number StopBits <= 2
Short Name: numstop

A6.4.2.2.1.1.2.5 *Parity*—Parity error checking used in each character exchanged in the communication.

Type: text
Domain: "None" "Odd" "Even" "Mark" "Space"
Short Name: parity

A6.4.2.2.1.1.2.6 *Compression Support*—Data compression available through the modem service to speed data transfer.

Type: text
Domain: "V.32" "V.32bis" "V.42" "V.42bis" free text
Short Name: compress

A6.4.2.2.1.1.2.7 *Dialup Telephone*—The telephone number of the distribution computer.

Type: text
Domain: free text
Short Name: dialtel

A6.4.2.2.1.1.2.8 *Dialup File Name*—The name of a file containing the data set on the distribution computer.

Type: text
Domain: free text
Short Name: dialfile

A6.4.2.2.1.2 *Access Instructions*—Instructions on the steps required to access the data set.

Type: text
Domain: free text
Short Name: accinstr

A6.4.2.2.1.3 *Online Computer and Operating System*— The brand of distribution computer and its operating system.

Type: text
Domain: free text
Short Name: oncomp

A6.4.2.2.2 *Offline Option*—Information about media-specific options for receiving the data set.

Type: compound
Short Name: offoptn

A6.4.2.2.2.1 *Offline Media*—Name of the media on which the data set can be received.

Type: text
Domain: "CD-ROM" "3-½ in. floppy disk" "5-¼ in. floppy disk" "9-track tape" "4 mm cartridge tape" "8 mm cartridge tape" "¼-in. cartridge tape" free text
Short Name: offmedia

A6.4.2.2.2.2 *Recording Capacity*—The density of information to which data are written. Used in cases where different recording capacities are possible.

Type: compound
Short Name: reccap

A6.4.2.2.2.2.1 *Recording Density*—The density in which the data set can be recorded.

Type: real
Domain: Recording Density > 0.0
Short Name: recden

A6.4.2.2.2.2.2 *Recording Density Units*—The units of measure for the recording density.

Type: text
Domain: free text
Short Name: recdenu

A6.4.2.2.2.3 *Recording Format*—The options available or method used to write the data set to the medium.

Type: text
Domain: "cpio" "tar" "High Sierra" "ISO 9660" "ISO 9660 with Rock Ridge extensions" "ISO 9660 with Apple HFS extensions" free text
Short Name: recfmt

A6.4.2.2.2.4 *Compatibility Information*—Description of other limitations or requirements for using the medium.

Type: text
Domain: free text
Short Name: compat

A6.4.3 *Fees*—The fees and terms for retrieving the data set.

Type: text
Domain: free text
Short Name: fees

A6.4.4 *Ordering Instructions*—General instructions and advice about, and special terms and services provided for, the data set by the distributor.

Type: text
Domain: free text
Short Name: ordering

A6.4.5 *Turnaround*—Typical turnaround time for the filling of an order.

Type: text
Domain: free text
Short Name: turnarnd

A6.5 *Custom Order Process*—Description of custom distribution services available, and the terms and conditions for obtaining these services.

Type: text
Domain: free text
Short Name: custom

A6.6 *Technical Prerequisites* —Description of any technical capabilities that the consumer must have to use the data set in the form(s) provided by the distributor.

Type: text
Domain: free text
Short Name: techpreq

A6.7 *Available Time Period*—The time period when the data set will be available from the distributor.

Type: compound
Short Name: availabl

Usage Note—Metadata elements for the "Available Time Period" element—Because the elements are required by another section, the elements were grouped in Annex A9.

A7. METADATA REFERENCE INFORMATION

INTRODUCTION

Metadata Reference Information—Information on the currentness of the metadata information, and the responsible party (see Fig. 8).

Type: compound
Short Name: metainfo

```
Metadata_Reference_Information =
                                    Metadata_Date +
                                    (Metadata_Review_Date) +
                                    (Metadata_Future_Review_Date) +
                                    Metadata_Contact +
                                    Metadata_Standard_Name +
                                    Metadata_Standard_Version +
                                    0{Metadata_Time_Convention}1 +
                                    (Metadata_Access_Constraints) +
                                    (Metadata_Use_Constraints) +
                                    (Metadata_Security_Information) +
                                    0{Metadata_Extensions}n

                  Metadata_Contact =
                                    Contact_Information (see Annex A10 for production rules)

   Metadata_Security_Information =
                                    Metadata_Security_Classification_System +
                                    Metadata_Security_Classification +
                                    Metadata_Security_Handling_Description

               Metadata_Extensions =
                                    0{Online_Linkage}n +
                                    0{Profile_Name}1
```

A7.1 *Metadata Date*—The date that the metadata were created or last updated.

Type: date
Domain: free date
Short Name: metd

Usage Note—Unique identifiers for linking metadata to the data it describes—In implementing a metadata solution, it will be necessary for data archive administrators to unambiguously link the metadata to the data it describes. Several metadata elements in this section, when taken in combination, can serve as a unique identifier for metadata. For example, "Title" (see A8.4) and "Edition" (see A8.5) could be used to form a unique identifier. Similarly, "Title"and "Metadata Date" could also be used as a unique identifier.

A7.2 *Metadata Review Date*—The date of the latest review of the metadata entry.

Type: date
Domain: free date; Metadata Review Date later than Metadata Date
Short Name: metrd

A7.3 *Metadata Future Review Date*—The date by which the metadata entry should be reviewed.

Type: date
Domain: free date; Metadata Future Review Date later than Metadata Review Date
Short Name: metfrd

A7.4 *Metadata Contact*—The party responsible for the metadata information.

Type: compound
Short Name: metc

Usage Note—Metadata elements for the "Metadata Contact" element—Because the "Metadata Contact" elements are required by several sections of the metadata, these element s were grouped in Annex A10 rather than being repeated in each applicable section.

Usage Note—Commentary on "Metadata Contact—The metadata contact should be the organization or person that can answer questions about the metadata or can receive reports about errors in the metadata.

A7.5 *Metadata Standard Name*—The name of the metadata standard used to document the data set.

Type: text
Domain: "FGDC Content Standard for Digital Geospatial Metadata" free text
Short Name: metstdn

A7.6 *Metadata Standard Version*—Identification of the version of the metadata standard used to document the data set.

Type: text
Domain: free text
Short Name: metstdv

A7.7 *Metadata Time Convention* —Form used to convey time of day information in the metadata entry. Used if time of day information is included in the metadata for a data set.

Type: text
Domain: "local time" "local time with time differential factor" "universal time"
Short Name: mettc

A7.8 *Metadata Access Constraints*—Restrictions and legal prerequisites for accessing the metadata. These include any access constraints applied to assure the protection of privacy or intellectual property, and any special restrictions or limitations on obtaining the metadata.

Type: text
Domain: free text
Short Name: metac

A7.9 *Metadata Use Constraints* —Restrictions and legal prerequisites for using the metadata after access is granted. These include any metadata use constraints applied to assure the protection of privacy or intellectual property, and any special restrictions or limitations on using the metadata.

Type: text
Domain: free text
Short Name: metuc

A7.10 *Metadata Security Information*—Handling restrictions imposed on the metadata because of national security, privacy, or other concerns.

Type: compound
Short Name: metsi

A7.10.1 *Metadata Security Classification System*—Name of the classification system for the metadata.

Type: text
Domain: free text
Short Name: metscs

A7.10.2 *Metadata Security Classification*—Name of the handling restrictions on the metadata.

Type: text
Domain: "Top secret" "Secret" "Confidential" "Restricted" "Unclassified" "Sensitive" free text
Short Name: metsc

A7.10.3 *Metadata Security Handling Description*—Additional information about the restrictions on handling the metadata.

Type: text
Domain: free text
Short Name: metshd

A7.11 *Metadata Extensions*—a reference to extended elements to the standard which may be defined by a metadata producer or a user community. Extended elements are elements outside of this the standard, but needed by the metadata producer.

Type: compound
Short Name: metextns

A7.11.1 *Online Linkage*—The name of an online computer resource that contains the metadata extension information for the data set. Entries should follow the Uniform Resource Locator convention of the Internet.

Type: text
Domain: free text
Short Name: onlink

A7.11.2 *Profile Name*—The name given to a document that describes the application of the Standard to a specific user community.

Type: text
Domain: free text
Short Name: metprof

A8. CITATION INFORMATION

INTRODUCTION

Citation Information—The recommended reference to be used for the data set (see Fig. 9). (Note: this section provides a means of stating the citation of a data set, and is used by other sections of the metadata standard. This section is never used alone.)

Type: compound
Short Name: citeinfo

Citation_Information =
1{Originator}n +
Publication_Date +
(Publication_Time) +
Title +
0{Edition}1 +
0{Geospatial_Data_Presentation_Form}1 +
0{Series_Information}1 +
0{Publication_Information}1 +
0{Other_Citation_Details}1 +
(1{Online_Linkage}n) +
0{Larger_Work_Citation}1

Series_Information =
Series_Name +
Issue_Identification

Publication_Information =
Publication_Place +
Publisher

Larger_Work_Citation =
Citation_Information

A8.1 *Originator*—The name of an organization or individual that developed the data set. If the name of editors or compilers are provided, the name must be followed by "(ed.)" or "(comp.)" respectively.

Type: text
Domain: "Unknown" free text
Short Name: origin

A8.2 *Publication Date*—The date when the data set is published or otherwise made available for release.

Type: date
Domain: "Unknown" "Unpublished material" free date
Short Name: pubdate

A8.3 *Publication Time*—The time of day when the data set is published or otherwise made available for release.

Type: time
Domain: "Unknown" free time
Short Name: pubtime

A8.4 *Title*—The name by which the data set is known.

Type: text
Domain: free text
Short Name: title

Usage Note—Unique identifiers for linking metadata to the data it describes—In implementing a metadata solution, it will be necessary for data archive administrators to unambiguously link the metadata to the data it describes. Several metadata elements in this section, when taken in combination, can serve as a unique identifier for metadata. For example, "Title" and "Edition" (see A8.5) could be used to form a unique identifier. Similarly, "Title" and "Metadata Date" (see A7.1) could also be used as a unique identifier.

A8.5 *Edition*—The version of the title.

Type: text
Domain: free text
Short Name: edition

A8.6 *Geospatial Data Presentation Form*—The mode in which the geospatial data are represented.

Type: text
Domain: (the listed domain is partially from pp. 88-91 in Anglo-American Committee on Cataloguing of Cartographic Materials, 1982, Cartographic materials: A manual of interpretation for AACR2: Chicago, American Library Association): "atlas" "audio" "diagram" "document" "globe" "map" "model" "multimedia presentation" "profile" "raster digital data" "remote-sensing image" "section" "spreadsheet" "tabular digital data" "vector digital data" "video" "view" free text
Short Name: geoform

Usage Note—Use of "Geospatial Data Presentation Form" element—The "Geospatial Data Presentation Form" is to identify the (usually "cartographic") style (if any) with which the originator intended that the information be presented to the user. For example, a paper map would have a "map" geospatial presentation form. A scanned image of a map also has "map"

as the geospatial presentation form. Vector data digitized from a map would not have a presentation form if no particular method of presenting the data to users was intended by the originator.

Usage Note—Examples for each domain value of the "Geospatial Data Presentation Form" element—Most of the examples are taken from Cartographic Material: A Manual of Interpretation for AACR2 (Anglo-American Committee on Cataloguing of Cartographic Materials 1982):

Domain Value	Examples
atlas	boundary atlas: geological atlas; historical atlas; plat book; road atlas; statistical atlas (collections of maps, geospatial illustrations, and other information)
diagram	block diagram; fence diagram; reliability diagram; triangulation diagram (illustrations of specific relationships)
globe	terrestrial globe; celestial globe (physical models of celestial bodies)
map	aeronautical chart; base map; cadastral map; chart; index map; orthophotomap; plan; plat; relief map; thematic map
model	relief model (other physical models of geospatial data)
profile	(an illustration showing a vertical section of the ground) remote-sensing image, aerial photograph; photomosaic; infrared scanning image; multispectral scanning image; Sidelooking Airborne Radar (SLAR) image; SPOT image
section	geologic section
view	panorama; perspective view

A8.7 *Series Information*—The identification of the series publication of which the data set is a part.

Type: compound
Short Name: serinfo

A8.7.1 *Series Name*—The name of the series publication of which the data set is a part.

Type: text
Domain: free text
Short Name: sername

A8.7.2 *Issue Identification*—Information identifying the issue of the series publication of which the data set is a part.

Type: text
Domain: free text
Short Name: issue

Usage Note—Definition of a series—A series is a succession of volumes or issues published with related subjects or authors, similar format and price, or continuous numbering.

A8.8 *Publication Information* —Publication details for published data sets.

Type: compound
Short Name: pubinfo

A8.8.1 *Publication Place*—The name of the city (and state or province, and country, if needed to identify the city) where the data set was published or released.

Type: text
Domain: free text
Short Name: pubplace

A8.8.2 *Publisher*—The name of the individual or organization that published the data set.

Type: text
Domain: free text
Short Name: publish

A8.9 *Other Citation Details*—Other information required to complete the citation.

Type: text
Domain: free text
Short Name: othercit

A8.10 *Online Linkage*—The name of an online computer resource that contains the data set. Entries should follow the Uniform Resource Locator convention of the Internet.

Type: text
Domain: free text
Short Name: onlink

A8.11 *Larger Work Citation*—The information identifying a larger work in which the data set is included.

Type: compound
Short Name: lworkcit

Usage Note—Use of the "Larger Work Citation" element—Sometimes an item is published as part of a larger volume. For example, a map or article originated by John Jones might be published in a book compiled by Charlene Smith. The citation for the map or article item would include Jones as the originator, the date of the item, the title of the item, etc. To obtain a copy of the item, however, one would need to find the published book. The citation of the book would include Smith as the compiler, the publication date of the book, the title of the book, etc. This information about the book in which the item was published is the "Larger Work Citation."

A9. TIME PERIOD INFORMATION

INTRODUCTION

Time Period Information—Information about the date and time of an event (see Fig. 9). (Note: this section provides a means of stating temporal information, and is used by other sections of the metadata standard. This section is never used alone.)

Type: compound
Short Name: timeinfo

Time_Period_Information =
[Single_Date/Time |

```
                                    Multiple_Dates/Times |
                                    Range_of_Dates/Times ]

Single_Date/Time =
                                    Calendar_Date +
                                    (Time_of_Day)

Multiple_Dates/Times =
                                    2{Single_Date/Time}n

Range_of_Dates/Times =
                                    Beginning_Date +
                                    (Beginning_Time) +
                                    Ending_Date +
                                    (Ending_Time)
```

A9.1 *Single Date/Time*—Means of encoding a single date and time.

Type: compound
Short Name: sngdate

A9.1.1 *Calendar Date*—The year (and optionally month, or month and day).

Type: date
Domain: "Unknown" free date
Short Name: caldate

A9.1.2 *Time of Day*—The hour (and optionally minute, or minute and second) of the day.

Type: time
Domain: "Unknown" free time
Short Name: time

A9.2 *Multiple Dates/Times*—Means of encoding multiple individual dates and times.

Type: compound
Short Name: mdattim

A9.3 *Range of Dates/Times*—Means of encoding a range of dates and times.

Type: compound
Short Name: rngdates

A9.3.1 *Beginning Date*—The first year (and optionally month, or month and day) of the event.

Type: date
Domain: "Unknown" free date
Short Name: begdate

A9.3.2 *Beginning Time*—The first hour (and optionally minute, or minute and second) of the day for the event.

Type: time
Domain: "Unknown" free time
Short Name: begtime

A9.3.3 *Ending Date*—The last year (and optionally month, or month and day) for the event.

Type: date
Domain: "Unknown" "Present" free date
Short Name: enddate

A9.3.4 *Ending Time*—The last hour (and optionally minute, or minute and second) of the day for the event.

Type: time
Domain: "Unknown" free time
Short Name: endtime

A10. CONTACT INFORMATION

INTRODUCTION

Contact Information—Identity of, and means to communicate with, person(s) and organization(s) associated with the data set (see Fig. 9). (Note: this section provides a means of identifying individuals and organizations, and is used by other sections of the metadata standard. This section is never used alone.)

Type: compound
Short Name: cntinfo

```
Contact_Information =
                                    [Contact_Person_Primary |
                                    Contact_Organization_Primary] +
                                    (Contact_Position) +
                                    1{Contact_Address}n +
                                    1{Contact_Voice_Telephone}n +
                                    (1{Contact_TDD/TTY_Telephone}n) +
                                    (1{Contact_Facsimile_Telephone}n) +
                                    (1{Contact_Electronic_Mail_Address}n) +
                                    (Hours_of_Service) +
```

(Contact_Instructions)

Contact_Person_Primary =
Contact_Person +
(Contact_Organization)

Contact_Organization_Primary =
Contact_Organization +
(Contact_Person)

Contact_Address =
Address_Type +
0{Address}n +
City +
State_or_Province +
Postal_Code +
(Country)

A10.1 *Contact Person Primary*—The person, and the affiliation of the person, associated with the data set. Used in cases where the association of the person to the data set is more significant than the association of the organization to the data set.

Type: compound
Short Name: cntperp

Usage Note—Difference between the "Contact Person Primary" and "Contact Organization Primary" elements—In developing the FGDC metadata standard, reviewers asked for a way to distinguish cases in which the primary contact was a person, whose organizational affiliation was incidental, versus those in which the primary contact was an organization, whose personnel were incidental. The "Contact Person Primary" element is for the first case; the "Contact Organization Primary" is for the second. Both are comprised of the same elements; the difference is which elements are mandatory and which are optional.

A10.1.1 *Contact Person*—The name of the individual to which the contact type applies.

Type: text
Domain: free text
Short Name: cntper

A10.1.2 *Contact Organization*—The name of the organization to which the contact type applies.

Type: text
Domain: free text
Short Name: cntorg

A10.2 *Contact Organization Primary*—The organization, and the member of the organization, associated with the data set. Used in cases where the association of the organization to the data set is more significant than the association of the person to the data set.

Type: compound
Short Name: cntorgp

A10.3 *Contact Position*—The title of individual.

Type: text
Domain: free text
Short Name: cntpos

A10.4 *Contact Address*—The address for the organization or individual.

Type: compound
Short Name: cntaddr

A10.4.1 *Address Type*—The information provided by the address.

Type: text
Domain: "mailing" "physical" "mailing and physical", free text
Short Name: addrtype

A10.4.2 *Address*—An address line for the address.

Type: text
Domain: free text
Short Name: address

A10.4.3 *City*—The city of the address.

Type: text
Domain: free text
Short Name: city

A10.4.4 *State or Province*—The state or province of the address.

Type: text
Domain: free text
Short Name: state

A10.4.5 *Postal Code*—The ZIP or other postal code of the address.

Type: text
Domain: free text
Short Name: postal

A10.4.6 *Country*—The country of the address.

Type: text
Domain: free text
Short Name: country

A10.5 *Contact Voice Telephone* —The telephone number by which individuals can speak to the organization or individual.

Type: text
Domain: free text
Short Name: cntvoice

A10.6 *Contact TDD/TTY Telephone*—The telephone number by which hearing- impaired individuals can contact the organization or individual.

Type: text
Domain: free text
Short Name: cnttdd

A10.7 *Contact Facsimile Telephone*—The telephone number of a facsimile machine of the organization or individual.

Type: text
Domain: free text
Short Name: cntfax

A10.8 *Contact Electronic Mail Address*—The address of the electronic mailbox of the organization or individual.

Type: text
Domain: free text
Short Name: cntemail

A10.9 *Hours of Service*—Time period when individuals can speak to the organization or individual.

Type: text
Domain: free text
Short Name: hours

A10.10 *Contact Instructions*—Supplemental instructions on how or when to contact the individual or organization.

Type: text
Domain: free text
Short Name: cntinst

APPENDIXES

(Nonmandatory Information)

X1. METADATA RESOURCES

X1.1 Part of the rationale for adopting the existing FGDC metadata content standard was the availability of tools and other resources to create, validate, and manage metadata. The existence of these tools and other resources provide a significant benefit for those creating metadata to support archived data management systems. Additionally, the spatial data community has developed extensive guidance and helpful tips for those new to metadata. The FGDC maintains a comprehensive list of metadata resources and tools at the following website: http://www.fgdc.gov/metadata/links/metalinks.html. Other metadata tools and resources can be found at http://www.geodata.gov/gos.

X1.2 The online FGDC resource listing includes links to items such as the FGDC and other metadata standards, basic information and frequently asked questions (FAQs) about metadata, and metadata creation software. These resources will be particularly helpful to many audiences, particularly those who would like to begin creating metadata without developing customized metadata software. To this end, there are several metadata software applications that can be obtained at no cost.

X1.3 The ASTM subcommittee responsible for developing this standard did discuss the adoption (with slight modifications if needed) of several existing metadata standards. In particular, the subcommittee discussed the adoption of Dublin Core, FGDC Content Standard for Digital Geospatial Metadata (FGDC-STD-001-1998), and ISO 19115 (2003) Geographic Information—Metadata. The subcommittee selected the FGDC metadata standard for three primary reasons: *(1)* its widespread adoption by the GIS community; *(2)* the availability of numerous metadata development and validation tools; and *(3)* its relative simplicity and comprehension by the user community represented in the ASTM standards development subcommittee. It was recognized that the FGDC standard would eventually be migrated to conform or be subsumed by the ISO 19115 standard. However, the timeframe for this migration was not evident, and it was reasoned that metadata migration tools would be available to support the numerous implementations of the existing FGDC standard.

X2. MODIFICATIONS TO THE EXISTING FGDC METADATA STANDARD

X2.1 Several minor modifications were made to the existing FGDC Content Standard for Digital Geospatial Metadata when adopting it in this ASTM standard.

X2.1.1 Section A1.6.2 (*Place*) and A1.6.4 (*Temporal*) were changed from mandatory-if-applicable elements to mandatory elements. This change was made because reviewers of this ASTM standard considered these keyword fields to be essential for data archives.

X2.1.2 Annex A2, *Data Quality Information*, was changed from a mandatory-if-applicable section to a mandatory section. This change was made because reviewers of this ASTM standard considered data quality information to be essential for data archives; thus, even if no information is known about data quality, this should be clearly stated in the metadata.

X2.1.3 Section A3.1, *Indirect Spatial Reference*, was changed from 0{Indirect_Spatial_Reference}1 to 0{ Indirect_Spatial_Reference}n to permit the documentation of multiple indirect spatial references.

X2.1.4 Annex A5, *Entity and Attribute Information*, was changed from a mandatory-if-applicable section to a mandatory section. This change was made because reviewers of this ASTM standard considered this section to be essential for data archives.

X2.1.5 Commentary was added in the form of *Usage Notes* in numerous sections to provide relevant information about implementing the standard in an ADMS.

X3. METADATA EXAMPLES

X3.1 One of the best ways to see how the metadata content standard can be implemented is to examine real-world examples. This appendix contains two metadata examples from the ITS domain: *(1)* traffic data from a roadway sensor system; and *(2)* transit vehicle location and passenger count data from a transit operations system. Both of these examples are based on actual data that has been collected from an operational system and stored in an archived data management system.

X3.1.1 The examples in this appendix were created with a metadata editor (the U.S. Geological Survey [USGS] tkme software) and validated for conformance to the metadata content standard using metadata validation software (USGS mp software). Other software applications are available to support metadata creation, validation, and management. Available software features will vary by application; some advanced metadata applications are closely integrated with the data system and will automatically generate a portion of the required metadata. The simplest method to quickly begin creating metadata at no cost is to use a text editor in combination with an ASCII metadata template (available at http://geology.usgs.gov/tools/metadata/tools/doc/template).

X3.1.2 The examples in this appendix are shown as minimally formatted text. Most metadata editors and compilers provide numerous metadata output options, such as text, modified text, html, xml, sgml, etc. The format in which metadata are stored or exchanged is specific to each implementation and is not included in this standard.

X3.2 *Traffic Data*—The first metadata example describes traffic data collected by the Texas Department of Transportation from a roadway sensor system in 2002. The traffic data was postprocessed and archived by the Texas Transportation Institute, who also created the metadata.

2002 Austin Freeway Operations Traffic Data Archive

Identification Information:
  Citation:
    Citation Information:
      Originator: Texas Transportation Institute
      Originator: Texas Department of Transportation
      Publication Date: 20030522
      Title: 2002 Austin Freeway Operations Traffic Data Archive
      Edition: Version 1.0
      Geospatial Data Presentation Form: spreadsheet
      Publication Information:
        Publication Place: College Station, Texas
        Publisher: Texas Transportation Institute
  Description:
  Abstract:
  This dataset contains archived traffic data that were collected during 2002 on select Austin area freeways by the Texas Department of Transportation (TxDOT). The data were originally collected by the Operations Group of the Austin District of TxDOT for the purposes of traffic management and traveler information. The data were provided to the Texas Transportation Institute (TTI), who performed additional quality assurance, summarized and re-organized the original source data for eventual use and distribution.
  This data archive contains traffic data summaries for several different granularity levels in time and space. For example, the available data granularity levels include both 15 and 60 minutes, as well as by lane or all directional lanes combined. The data in this archive have been organized in comma-separated value (csv) ASCII-text files in a way that supports easy import and use in desktop computer spreadsheet or database programs such as Microsoft Excel or Access. Alternatively, the data can also be batch-imported into a relational database management system (RDBMS) such as Oracle or Sybase.
  The data archive also includes a sensor inventory spreadsheet that describes approximate sensor locations, sensor location groupings, and other descriptive information. The sensor inventory spreadsheet was developed by TTI with basic sensor information provided by TxDOT.
  Purpose:
  This dataset can be used for a wide variety of transportation analyses that require or use continuous (24 hours per day, 365 days per year) traffic data. The most common applications include traffic volume summary reports and statistics (for example, AADT, directional and peak hour factors, growth factor, etc.), performance monitoring, and traffic simulation model calibration.
  At this time, TTI is summarizing and distributing this data on behalf of the Austin District of TxDOT. TTI's ultimate goal is to improve transportation decisions through the archiving and sharing of operations-generated data. TTI believes that the re-use of archived operations data will: *(a)* provide more and better information for a wide variety of analyses and decisions; *(b)* maximize the cost-effectiveness of existing data collection infrastructure; *(c)* be much less expensive than manually re-collecting similar data; and *(d)* become a standard practice in public sector transportation as it currently is in many private sector industries.
  Time Period of Content:
    Time Period Information:
      Range of Dates/Times:
        Beginning Date: 20020101
        Ending Date: 20021231
    Currentness Reference: ground condition
  Status:
    Progress: Complete
    Maintenance and Update Frequency: As needed
  Spatial Domain:
    Bounding Coordinates:
      West Bounding Coordinate: -97.82832
      East Bounding Coordinate: -97.66088
      North Bounding Coordinate: 30.51693
      South Bounding Coordinate: 30.21198
  Keywords:
    Theme:

2002 Austin Freeway Operations Traffic Data Archive

Theme Keyword Thesaurus: none
Theme Keyword: traffic operations data
Theme Keyword: ITS data
Theme Keyword: freeways
Theme Keyword: data archive
Place:
Place Keyword Thesaurus: none
Place Keyword: Austin
Place Keyword: Texas
Stratum:
Stratum Keyword Thesaurus: none
Stratum Keyword: roadway
Temporal:
Temporal Keyword Thesaurus: none
Temporal Keyword: Year 2002
Access Constraints: None
Use Constraints: None
Point of Contact:
Contact Information:
Contact Person Primary:
Contact Person: Shawn Turner
Contact Organization: Texas Transportation Institute
Contact Position: Associate Research Engineer
Contact Address:
Address Type: mailing and physical
Address: 3135 TAMU, 405C CE/TTI Bldg.
City: College Station
State or Province: TX
Postal Code: 77843-3135
Country: USA
Contact Voice Telephone: (979) 845-8829
Contact Facsimile Telephone: (979) 845-6008
Contact Electronic Mail Address: shawn-turner@tamu.edu
Data Set Credit:
The Texas Department of Transportation and the Federal Highway Administration have funded several projects that enabled TTI to develop quality assurance and data summarization procedures. These procedures were used in preparing the datasets in this archive.
Native Data Set Environment:
The datasets in this archive are comma-separated values (csv) in ASCII-text files and should be usable in various computer operating environments. The size of the datasets are approximately 430 MB with industry-standard file compression. The datasets were exported to ASCII-text files from The SAS System for Windows (Release 8.01) running on Microsoft Windows 2000 Server (Version 5.00.2195).
Data Quality Information:
Attribute Accuracy:
Attribute Accuracy Report:
No accuracy assessment of the traffic data has been performed. The linear referencing measurements (for example, STN LCTN variable) associated with the sensor inventory spreadsheet have been scaled from construction plans, and as such, are likely accurate to the nearest 500 feet. The XSTREET variable in the sensor inventory was provided by TxDOT and refers to the nearest cross street or intersecting street, which may be up to 1000 feet away from the actual sensor location.
Logical Consistency Report:
The logical consistency of the data values within this data set were checked using basic rules about the relationship of total vehicle volume, lane occupancy and average vehicle speed. These basic rules or quality assurance checks are described later in the process step metadata. The percent trucks value in the dataset was not scrutinized nor subjected to any logical consistency tests.
Completeness Report:
The 2002 annual 5-minute lane-by-lane dataset from which this dataset was derived was 80% complete when averaging together volume, occupancy, and speed values. This means that of all 5-minute periods during each day of the year 2001, on average about 80% of these 5-minute time periods have a data value. When considering the data values separately, the following completeness values apply: traffic volume, 87%; lane occupancy, 87%; and vehicle speed, 65% complete.
The original data source, the 1-minute lane-by-lane dataset provided by TxDOT, was 76% complete. This completeness value was before quality assurance, aggregation, and imputation process steps. When considering the data values separately, the following completeness values apply for original source data: traffic volume, 85%; lane occupancy, 85%; and vehicle speed, 57% complete.
Lineage:
Source Information:
Source Citation:
Citation Information:
Originator: Texas Department of Transportation, Austin District
Publication Date: 2003
Title: 2002 Austin Freeway Operations Traffic Data - Original Source Data
Geospatial Data Presentation Form: tabular digital data
Type of Source Media: CD-ROM
Source Time Period of Content:
Time Period Information:
Range of Dates/Times:
Beginning Date: 20020101
Ending Date: 20021231
Source Currentness Reference: ground condition
Source Citation Abbreviation: 2002 TxDOT-Austin Original Source Data
Source Contribution: The Austin District of TxDOT was the sole source of the original traffic data in its entirety. TTI developed the sensor inventory spreadsheets using basic sensor description information from TxDOT.

2002 Austin Freeway Operations Traffic Data Archive

Process Step:
Process Description:
Process Step 1. Pre-Procesing Original Source Data: The first process step is pre-processing the original source data that TxDOT provides to TTI.

The Austin District of TxDOT sends compressed comma-separated value (csv) files that are organized into different folders by freeway corridor or system controller unit (SCU). Within each freeway corridor folder, there should be a *.zip file for each day of the year, with the filename convention “mmddyy.zip.” Within each *.zip file, there should be 24 files (one for each hour of the day) that contain detector data for that corridor/SCU. Each hourly file has a descriptive long-format name, consisting of the SCU location name, the day of week, and the hour. The filename extension is “.DET” for detector. For example, “IH 0035 SCU Wednesday 1300.DET” contains detector data for the IH-35 SCU for the “1300” hour (13:00-13:59) on a Wednesday.

A shortcoming of the TxDOT ATMS filename convention is that it indicates only the day of the week, not the date. The date stamp on the file itself typically reveals the actual date since it is not contained in the filename. To add datestamps to the filename, we un-zip these files into 52 separate folders that correspond to the week of the year. The file “aus unzip.xls” was used to create a *.bat file for batch processing. We then use a batch renaming program (CKRename) to substitute a datestamp (YYYYMMDD) for the weekday name, treating separately the files in each individual weekly folder. The renamed files have the filename convention ″RR #### SCU YYYYMMDD HHMM.det″ where RR=the route designation (for example, IH, US, etc), ####=the route number (for example, 0035, 0290, etc). These “SCU datestamp added” text files are then compressed for long-term storage. Note that there are probably more efficient solutions to getting the datestamps from these files into SAS (instead of including in the filename).

Once datestamps have been added to the filename, we can then use SAS to import the CSV text files. We have developed “aus reformat.sas” for this purpose. The SAS program “aus reformat.sas” uses a csv template (for example, “aus 2001 US0183.csv”) for each corridor that contains the hourly files to be processed and the corresponding dates. This program combines all original source data (1-minute) for each corridor for the entire year into a single SAS dataset. Thus for 2001 we have 4 SAS datasets, with the filename convention “aus 2001 RR####.” These 4 datasets are then compressed for long-term storage. The data are then ready for the next process step.

In summary, the pre-processing is as follows:

+ unzip original files to folder corresponding to week number of the year using “aus unzip.xls”
+ use batch processing and CKRename to change the weekday name to a datestamp, then compress and store these “datestamp added” text files
+ use “aus reformat.sas” to import the text files into SAS datasets by freeway corridor/SCU

Process _Date: 2003
Process Contact:
Contact Information:
Contact Person Primary:
Contact Person: Shawn Turner
Contact Organization: Texas Transportation Institute
Contact Position: Associate Research Engineer
Contact Address:
Address Type: mailing and physical
Address: 3135 TAMU, 405C CE/TTI Bldg.
City: College Station
State or Province: TX
Postal Code: 77843-3135
Country: USA
Contact Voice Telephone: (979) 845-8829
Contact Facsimile Telephone: (979) 845-6008
Contact Electronic Mail Address: shawn-turner@tamu.edu
Process Step:
Process Description:
Process Step 2. Quality Assurance and Aggregation: The second process step performs quality assurance on the original source data, aggregates 1-minute lane-by-lane source data to 5-minute lane-by-lane data, and creates summary SAS datasets that describe the results of the process step.

This process step is accomplished by running a single SAS program, “aus base YYYY.sas,” where YYYY represents the current year version of the process step. The process step has the following major components: *(1)* quality assurance and cleaning; *(2)* data aggregation and imputation; *(3)* process step summary statistics. These components are described below.

Quality assurance and cleaning performs basic quality tests of data values, flags data values that fail tests, copies failed original data values to separate dataset, then removes the failed original data value from the analysis dataset. A description of the quality assurance tests can be found in the SAS code as well as the Word document “QC for 2001.doc.”

The data aggregation and imputation step takes 1-minute lane-by-lane data and aggregates to 5-minute time periods. This step performs imputation on data values for partially incomplete 5-minute periods by factoring up traffic volume values by the percent of missing periods.

The process step summary statistics describe the results of the process step in quantitative terms. Summary statistics include the total number of records processed from original source data, completeness of data, sources of missing data, and percent of data values failing each quality assurance test. These statistics are presented at the summary dataset level as well as by date and by sensor for each of the major data values (that is, volume, occupancy, speed) in the dataset.

Process Date: 2003
Process Contact:
Contact Information:
Contact Person Primary:
Contact Person: Shawn Turner
Contact Organization: Texas Transportation Institute
Contact Position: Associate Research Engineer
Contact Address:
Address Type: mailing and physical
Address: 3135 TAMU, 405C CE/TTI Bldg.
City: College Station
State or Province: TX
Postal Code: 77843-3135
Country: USA
Contact Voice Telephone: (979) 845-8829
Contact Facsimile Telephone: (979) 845-6008
Contact Electronic Mail Address: shawn-turner@tamu.edu
Process Step:
Process Description:
Process Step 3. Producing Summary Datasets for Archive Loading and Distribution: The third and final process is described below.

2002 Austin Freeway Operations Traffic Data Archive

Once the data have been processed for quality assurance and aggregation to 5-minutes, several SAS programs are used to create summary datasets for archive loading and distribution. The program “aus products-1.sas” is used to create the summary datasets in SAS. This SAS program takes 5-minute lane-by-lane volumes and aggregates the data to 4 pre-defined summary levels: *(1)* 15-minute, by lane; *(2)* 60-minute, by lane; *(3)* 15-minute, all directional lanes combined; and *(4)* 60-minute, all directional lanes combined. The output of this program are 4 SAS datasets.

Once the 4 SAS datasets are created, the SAS program “aus products-2.sas” is used to re-organize, “parse,” and export the data to comma-separated value (csv) ASCII-text files. The data are parsed and re-organized into a size such that they can be imported into a desktop PC-based spreadsheet, which often has a limitation of about 65,000 rows. For each of the 4 summary levels described above, the data are organized by location and then by date. If organized by location, then data for all days of the year at that particular location are exported to the file. If organized by date, then data for all locations for that particular day of the year are exported to the file. These ASCII-text files are then grouped and compressed based upon the summary level and organization grouping. Although this results in data duplication, the size of the data archive is still small enough that the benefits of this organization outweigh the costs of storage.

The last component of this process step is to generate average annual summary statistics using the 4 summary levels described above. This component is performed using the SAS program “aus products-3.sas,” which computes average annual summary statistics for all days of the year as well as only weekdays. These average annual summary statistics are also exported to csv ASCII-text files for the 4 summary levels.

Process Date: 2003
Process Contact:
Contact Information:
Contact Person Primary:
Contact Person: Shawn Turner
Contact Organization: Texas Transportation Institute
Contact Position: Associate Research Engineer
Contact Address:
Address Type: mailing and physical
Address: 3135 TAMU, 405C CE/TTI Bldg.
City: College Station
State or Province: TX
Postal Code: 77843-3135
Country: USA
Contact Voice Telephone: (979) 845-8829
Contact Facsimile Telephone: (979) 845-6008
Contact Electronic Mail Address: shawn-turner@tamu.edu

Entity and Attribute Information:
Overview Description:
Entity and Attribute Overview:
The attributes in this dataset are listed and described below as follows:
ATTRIBUTE LABEL, (Descriptive Name in TMDD Version 1.6 if applicable), definition or description.
DATE, DETECTOR MeasurementDate date, traffic data collection date.
STA TIME, DETECTOR StartTime utc, start time for collecting traffic data.
DET_ ID, DETECTOR Identifier identifier, unique identification number of an individual detector within a network.
STN ID, DETECTOR StationIdentifier identifier, unique identifier for a detector station.
LANE QTY, LINK LaneCounty quantity, the number of lanes at a detector station.
VOLUME, DETECTOR VehicleCount quantity, the number of vehicles detected by a detector during a specific time period.
OCC, DETECTOR Occupancy percent, percent time that a detector is indicating a vehicle presence during a specific time period.
SPEED, LINK AverageSpeed rate, the average vehicle speed at a detector during a specific time period.
TRCK PCT, n.a., the percent of vehicles that have lengths greater than 25 feet.
VSAM PCT, n.a., the percent of total possible records included in calculation of summary statistic.
OSAM PCT, n.a., the percent of total possible records included in calculation of summary statistic.
SSAM PCT, n.a., the percent of total possible records included in calculation of summary statistic.
TSAM PCT, n.a., the percent of total possible records included in calculation of summary statistic.
VOL DAYS, n.a., the number of days of data that have been included in a multi-day summary statistic.
OCC DAYS, n.a., the number of days of data that have been included in a multi-day summary statistic.
SPD DAYS, n.a., the number of days of data that have been included in a multi-day summary statistic.
TRCK DAYS, n.a., the number of days of data that have been included in a multi-day summary statistic.
Entity and Attribute Detail Citation: The authoritative source for several attribute definitions and domain ranges is the Traffic Management Data Dictionary Version 1.6, available at http://www.ite.org.

Distribution Information:
Distributor:
Contact Information:
Contact Person Primary:
Contact Person: Shawn Turner
Contact Organization: Texas Transportation Institute
Contact Position: Associate Research Engineer
Contact Address:
Address Type: mailing and physical
Address: 3135 TAMU, 405C CE/TTI Bldg.
City: College Station
State or Province: TX
Postal Code: 77843-3135
Country: USA
Contact Voice Telephone: (979) 845-8829
Contact Facsimile Telephone: (979) 845-6008
Contact Electronic Mail Address: shawn-turner@tamu.edu
Resource Description: 2001 Austin Freeway Operations Traffic Data Archive
Distribution Liability: This dataset is provided as unofficial traffic data collected by TxDOT and further processed by TTI. While efforts have been made to improve the quality of the data since its original collection, no warranty--express or implied—-is made by TTI or TxDOT as to the accuracy or completeness of this data. Nor shall the fact of distribution consistute any such warranty, and no responsibility is assumed by TTI or TxDOT in connection herewith.
Standard Order Process:
Digital Form:

2002 Austin Freeway Operations Traffic Data Archive

Digital Transfer Information:
Format Name: ASCII
Format Version Number: ANSI X3.4-1968
Format Specification: comma-separated values
File Decompression Technique: Industry-standard file compression utilities can be used to de-compress data from this archive.
Transfer Size: 430 MB
Digital Transfer Option:
Online Option:
Computer Contact Information:
Network Address:
Network Resource Name: ftp://ttiftpu@gibb.tamu.edu:5090/s-turner/aus-2002/
Access Instructions: Public, read-only access to this archive is available with the username “ttiftpg” and password “roadside.” Note that the port is set to “5090,” which may require a change from the default port setting of “21” in most FTP clients.
Offline Option:
Offline Media: CD-ROM
Recording Format: ISO 9660
Fees: This dataset is distributed free of charge.
Metadata Reference Information:
Metadata Date: 20030522
Metadata Contact:
Contact Information:
Contact Person Primary:
Contact Person: Shawn Turner
Contact Organization: Texas Transportation Institute
Contact Position: Associate Research Engineer
Contact Address:
Address Type: mailing and physical
Address: 3135 TAMU, 405C CE/TTI Bldg.
City: College Station
State or Province: TX
Postal Code: 77843-3135
Country: USA
Contact Voice Telephone: (979) 845-8829
Contact Facsimile Telephone: (979) 845-6008
Contact Electronic Mail Address: shawn-turner@tamu.edu
Metadata Standard Name: Content Standard for Digital Geospatial Metadata
Metadata Standard Version: FGDC-STD-001-1998

X3.3 *Transit Data*—The second metadata example describes transit vehicle location data collected and archived by the King County Metro Transit in Washington State. This example is provided in a similar modified text format as the previous traffic data example.

APC_LOGTPI

Identification Information:
Citation:
Citation Information:
Originator: Thomas W Friedman, Tony Longo, or Darrel Riley
Publication Date: The table is updated with new data on an ongoing basis.
Title: APC LOGTPI
Geospatial Data Presentation Form: tabular digital data
Online Linkage: \\MITTFREIDMTXP\C$\Documents and Settings\FriedmTW\Desktop\APC ArcGIS Database.mdb
Description:
Abstract: This table has data that is the output from processing APC data. For every successfully processed vehicle assignment or block (<keyblock>), it includes data for every TPI (time point interval, <keytpi>) that is on that block for a specific day (<datedata>).
Purpose: The table is used for many uses of APC data, either directly at the TPI level, or it can be aggregated to trips, time periods, routes, etc. Note this table cannot be used for APC data at the bus stop level. For that use LOGSTOP.
Time Period of Content:
Time Period Information:
Multiple Dates/Times:
Single Date/Time:
Calendar Date: Most recent 3 service changes (approx. 12 months)
Currentness Reference: The <datedata> field (yymmdd) has the year/month/day of the data.
Status:
Progress: In work
Maintenance and Update Frequency: Ongoing, usually once a week.
Spatial Domain:
Bounding Coordinates:
West Bounding Coordinate: -122.412
East Bounding Coordinate: -121.118
North Bounding Coordinate: 47.776
South Bounding Coordinate: 47.107
Keywords:
Theme:
Theme Keyword: Automatic Passenger Counter (APC) Theme Keyword: Ridership

APC_LOGTPI

Theme Keyword: Time Point Interval (TPI)
Theme_Keyword: Schedule Adherence
Place:
Place_Keyword: King County Metro
Stratum:
Stratum Keyword: Time Point Interval (TPI)
Stratum Keyword: Trip
Stratum Keyword: Route
Temporal:
Access Constraints: Use of this table should be limited to persons who are knowledgable in how APC data is collected and processed. Familiarity with transit operations is also beneficial.
Use Constraints: None
Point of Contact:
Contact Information:
Contact Person Primary:
Contact Person: Thomas W Friedman
Contact Organization: King County Metro
Contact Position: Project Manager
Contact Voice Telephone: 206 684-1513
Contact Facsimile Telephone: 206 684-2059
Contact Electronic Mail Address: tom.friedman@metrokc.gov
Security Information:
Security Classification: Restricted
Native Data Set Environment: Oracle
Data Quality Information:
Attribute Accuracy:
Attribute Accuracy Report: Accuracy of ons (PON) and offs (POFF): Our periodic testing with observers yields the following accuracy at the bus stop level: correct>85% of stops; +—1>90% of stops; +-2>97% of stops. Overall accuracy of total ONs and OFFs is about +-5%
Logical Consistency Report: NA
Completeness Report:
Coverage:
This table has data for all successfully processed APC data for the dates covered in <datedata>. At the end of a service change (there are 3 per year) the data usually has at least one observation on 90%, 75%, and 80% , respectively of weekday, Sat., and Sun. scheduled trips. There are usually 3 or more observations on 80% of weekday scheduled trips.
Note: APCs are installed on only about 15% of the fleet, so data is collected on a sampling basis by rotating the vehicles with APCs on all blocks during a service change.
In terms of table size, for one service change (there are 3 per year) the table can have about 1 million rows (TPI events). When aggregated into trips, this results in about 150,000 observed trips per service change.
Lineage:
Process Step:
Process Description:
To get to this table, APC data is processed as follows:
Raw APC data is downloaded from a bus weekly in a packed format.The week's worth of data is unpacked and is then preprocessed into blocks, by comparing the raw data to the scheduled assignments for that bus for that week.
The identified block of data then goes to the Matcher. The first thing the Matcher does is to compare the total ONs and OFFs in the block. If they differ by more than 10%, the processing stops, as the hardware reliability of that block of data is in question.
Next, the Matcher compares the raw data to a template of all scheduled events for that block, including timepoints, signposts, and bus stops.
(Signposts are devices installed at many bus stops that transmit a location code,and when the bus passes the signpost, it records the time and odometer value when it passes that location.) Using this template information, a "match" is made of a bus stop record in the raw data to a scheduled bus stop on the template.
Once the bus stops are identified, the time the bus passed a timepoint is estimated by interpolating the time between the 2 events in the raw data (usually a bus stop) that bound the timepoint based on distance. Note that timepoints are not recorded events, as there is nothing currently available to the APCs that indicate when the bus is at a timepoint.)
The next step is to correct for minor 'error's in the count data. As mentioned above, if a block has major count differences between ONs and OFFs, it is not processed further. This process, called Tuning, makes minor adjustments to the ONs and OFFs to deal with two illogical situations. One is if the load on the bus goes negative, and the other is if the bus returns to the base with a positive load. In either of these cases, the Tuner will modify ONs or OFFs, starting at the bus stop with the most activity in a tuning interval preceding the problem. The load is then recalculated, and if further tuning is needed, the process is repeated until the problem is corrected.
At the completion of the Matching and Tuning, the processed data is output to two tables: one is LOGSTOP, which has data for every bus stop in the block. The other is LOGTPI (this table), which aggregates bus stop data for all stops in the TPI.
Process Contact:
Contact Information:
Contact Person Primary:
Contact Person: Thomas W Friedman, Tony Longo, or Darrel Riley
Contact Organization: King County Metro
Cloud Cover: usually
Entity and Attribute Information:
Detailed Description:
Entity Type:
Entity Type Label: APC LOGTPI
Attribute:
Attribute Label: OBJECTID
Attribute Definition: ?
Attribute Definition Source: ESRI
Attribute Domain Values:
Unrepresentable Domain: Sequential unique whole numbers that are automatically generated.
Attribute:

APC_LOGTPI

Attribute Label: KEYBLOCK
Attribute Definition: The vehicle assigment that the data is for, expressed as drrrxx, where d is the day type (0=wd, 1=sat,2=sun), rrr is the route#, and xx is the run#.
Attribute Domain Values:
Unrepresentable Domain: the valid range of keyblock is whatever blocks are in effect for a specific timeperiod
Attribute:
Attribute Label: BASETMPT
Attribute Definition: The timepoint # of the base (garage) where the block starts and ends.
Attribute Domain Values:
Range Domain:
Range Domain Minimum: 1
Range Domain Maximum: 14
Attribute:
Attribute Label: DATEMATCH
Attribute Definition: The date when the data was processed, expressed as yymmdd.
Attribute Domain Values:
Range Domain:
Range Domain Minimum: first day when data was processed
Range Domain Maximum: last day that data has been processed so far
Attribute:
Attribute Label: DATEDATA
Attribute Definition: The date on which the data was collected, yymmdd.
Attribute Domain Values:
Range Domain:
Range Domain Minimum: first day of service change in this table
Range Domain Maximum: last day of data processed so far
Attribute:
Attribute Label: DAYOFWEEK
Attribute Definition: The day of the week the data was collected on
Attribute Domain Values:
Enumerated Domain:
Enumerated Domain Value: 1
Enumerated Domain Value Definition: Sat
Enumerated Domain:
Enumerated Domain Value: 2
Enumerated Domain Value Definition: Sun
Enumerated Domain:
Enumerated Domain Value: 3
Enumerated Domain Value Definition: Mon
Enumerated Domain:
Enumerated Domain Value: 4
Enumerated Domain Value Definition: Tues
Enumerated Domain:
Enumerated Domain Value: 5
Enumerated Domain Value Definition: Wed
Enumerated Domain:
Enumerated Domain Value: 6
Enumerated Domain Value Definition: Thurs
Enumerated Domain:
Enumerated Domain Value: 7
Enumerated Domain Value Definition: Fri
Attribute:
Attribute Label: COACHTYPE
Attribute Definition: The type of vehicle assigned to this block.
Attribute Domain Values:
Enumerated Domain:
Enumerated Domain Value: 11
Enumerated Domain Value Definition: 30’ diesel
Enumerated Domain:
Enumerated Domain Value: 12
Enumerated Domain Value Definition: vans
Enumerated Domain:
Enumerated Domain Value: 23
Enumerated Domain Value Definition: NF artics (1999
Enumerated Domain:
Enumerated Domain Value: 2 6
Enumerated Domain Value Definition: NF hybrids
Enumerated Domain:
Enumerated Domain Value: 2 8
Enumerated Domain Value Definition: NF diesel (2004)
Enumerated Domain:
Enumerated Domain Value: 32
Enumerated Domain Value Definition: Gillig 40’ (1996)
Enumerated Domain:
Enumerated Domain Value: 36
Enumerated Domain Value Definition: NF low floor 40’
Enumerated Domain:

APC_LOGTPI

Enumerated Domain Value: 40
Enumerated Domain Value Definition: MAN 60' trolley
Attribute:
Attribute Label: NUMSEATS
Attribute Definition: The number of seats on <coachtype>
Attribute Domain Values:
Unrepresentable Domain: varies by coachtype
Attribute:
Attribute Label: KEYCOACH
Attribute Definition: The number of the bus actually used on the <keyblock> on <datedata>
Attribute:
Attribute Label: KEYPCU
Attribute Definition: The ID# of the APC device
Attribute:
Attribute Label: TPISEQN
Attribute Definition: The sequence number of the tpi on this block
Attribute:
Attribute Label: KEYTRIP
Attribute Definition: The Hastus trip ID for the trip that this tpi event is on.
Attribute:
Attribute Label: DIRNAME
Attribute Definition: The compass direction the vehicle is traveling at the time of this event.
Attribute Domain Values:
Enumerated Domain:
Enumerated Domain Value: N
Enumerated Domain Value Definition: North
Enumerated Domain:
Enumerated Domain Value: S
Enumerated Domain Value Definition: South
Enumerated Domain:
Enumerated Domain Value: E
Enumerated Domain Value Definition: East
Enumerated Domain:
Enumerated Domain Value: W
Enumerated Domain Value Definition: West
Attribute:
Attribute Label: TPDELTA
Attribute Definition: The distance from this timepoint to the logged event used for estimating the layover time at this timepoint.
Attribute:
Attribute Label: KEYPATTERN
Attribute Definition: The pattern ID that this trip follows on this tpi event
Attribute:
Attribute Label: KEYTPI
Attribute Definition: The timepoint interval for this event, which is the path the bus travels between two timepoints. The format is DFFFFTTTT, where if D is blank it is a revenue tpi and if D is -, it is a deadhead tpi. FFFF is the 'from' timepoint in the tpi, TTTT is the 'to' timepoint in the tpi.
Attribute:
Attribute Label: DRIVERRUNKEY
Attribute Definition: The ID of the driver on this tpi event on this day.
Attribute:
Attribute Label: RTENACCT
Attribute Definition: The route the bus is on for this tpi event
Attribute:
Attribute Label: EXPRACCT
Attribute Definition: The type of service the bus is on for this tpi event
Attribute Domain Values:
Enumerated Domain:
Enumerated Domain Value: EX
Enumerated Domain Value Definition: express
Enumerated Domain:
Enumerated Domain Value: AT
Enumerated Domain Value Definition: turns back before end of route
Attribute:
Attribute Label: PARTACCT
Attribute Definition: The subpart for this route, such as N for north or S for South, for this tpi event.
Attribute:
Attribute Label: SURCACCT
Attribute Definition: Indicates whether this event is in the peak fare period, $ = yes, blank = no.
Attribute:
Attribute Label: DUMYACCT
Attribute Definition: Indicates whether the bus is traveling inbound (I) or outbound (O). Usually this is relative to the Seattle CBD if the route goes thru the CBD. If not, it is somewhat arbitrarily assigned.
Attribute:
Attribute Label: RTENSIGN
Attribute Definition: same as rtenacct
Attribute:
Attribute Label: EXPRSIGN
Attribute Definition: same as expracct

APC_LOGTPI

Attribute:
Attribute Label: PARTSIGN
Attribute Definition: same as partacct
Attribute:
Attribute Label: SURCSIGN
Attribute Definition: same as surcacct
Attribute:
Attribute Label: DUMYSIGN
Attribute Definition: same as dumyacct
Attribute:
Attribute Label: RTENDPRT
Attribute Definition: same as rtenacct
Attribute:
Attribute Label: EXPRDPRT
Attribute Definition: same as expracct
Attribute:
Attribute Label: PARTDPRT
Attribute Definition: same as partacct
Attribute:
Attribute Label: SURCDPRT
Attribute Definition: same as surcacct
Attribute:
Attribute Label: DUMYDPRT
Attribute Definition: same as dumyacct
Attribute:
Attribute Label: TPIDIST
Attribute Definition: The map distance of the tpi in feet.
Attribute:
Attribute Label: KEYZONE
Attribute Definition: ID of bus stop where the maximum load begins
Attribute:
Attribute Label: NUMSTOPS
Attribute Definition: The number of times the bus stopped in this tpi
Attribute:
Attribute Label: PROFLAG
Attribute Definition: A processing status flag.
Attribute Domain Values:
Enumerated Domain:
Enumerated Domain Value: 0
Enumerated Domain Value Definition: logged complete
Attribute:
Attribute Label: NUMOVLDS
Attribute Definition: The number of times the bus load exceeded the number of seats on this event
Attribute:
Attribute Label: MAXLOAD
Attribute Definition: The maximum # of riders in this event
Attribute:
Attribute Label: TIMDPML
Attribute Definition: The time the bus departed the stop that had the first occurrence of the maximum load in this tpi event.
Attribute:
Attribute Label: TIMDWELL
Attribute Definition: Total dwell time at all the stops in this tpi event (mins)
Attribute:
Attribute Label: PLOAD
Attribute Definition: Passenger load approaching this tpi.
Attribute:
Attribute Label: PON
Attribute Definition: # of persons boarding at all stops in this tpi
Attribute:
Attribute Label: POFF
Attribute Definition: # of persons alighting at all stops in this tpi.
Attribute:
Attribute Label: TIMDEV1
Attribute Definition: estimated schedule deviation in minutes at from (FFFF) timepoint
Attribute:
Attribute Label: TIMSCH1
Attribute Definition: schedule time of departure from 'from' timepoint
Attribute:
Attribute Label: TIMDEV2
Attribute Definition: estimated schedule deviation in minutes at 'to' (TTTT) timepoint
Attribute:
Attribute Label: TIMSCH2
Attribute Definition: schedule time of arrival at 'to' timepoint
Attribute:
Attribute Label: DISPTRV
Attribute Definition: total passenger travel distance (passenger miles) on this tpi event
Attribute:

APC_LOGTPI

Attribute Label: TIMPTRV
Attribute Definition: total passenger travel time (passenger hours) on this tpi event
Attribute:
Attribute_Label: DISOTRV
Attribute_Definition: not used
Attribute:
Attribute_Label: TIMOTRV
Attribute_Definition: not used
Attribute:
Attribute_Label: DISODUR
Attribute_Definition: not used
Attribute:
Attribute_Label: TIMODUR
Attribute_Definition: not used
Attribute:
Attribute_Label: DISXTRV
Attribute_Definition: not used
Attribute:
Attribute_Label: TIMXTRV
Attribute_Definition: not used
Attribute:
Attribute_Label: DISXDUR
Attribute_Definition: not used
Attribute:
Attribute Label: TIMXDUR
Attribute Definition: not used
Overview Description:
Entity and Attribute Overview: The entities (fields) in the table are information that allow the user to get ridership and schedule adherence for a specific tpi on a specific trip on the date of the data (<datedata>). This data can be aggregated for all tpi's in a trip, to get trip totals, and further by route, time of day, etc.
Distribution Information:
Distributor:
Contact Information:
Contact Person Primary:
Contact Person: Thomas W Friedman
Contact Organization: King County Metro
Contact Position: Project Manager
Resource Description: This table is not currently for general distribution. For information on getting information from this table, contact the person below.
Metadata Reference Information:
Metadata Date: 20050412 Metadata Contact:
Contact Information:
Contact Person Primary:
Contact_Person: Thomas W Friedman
Contact_Organization: King County Metro
Contact_Position: Project Manager
Contact_Address:
Address_Type: mailing address
Address: 201 S Jackson St.
Address: ksc-tr-0333
City: Seattle
State_or_Province: WA
Postal_Code: 98104
Country: USA
Contact Voice Telephone: 206 684-1513
Contact Electronic Mail Address: tom.friedman@metrokc.gov
Metadata Standard Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata Standard Version: FGDC-STD-001-1998
Metadata Time Convention: local time
Metadata Extensions:
Online Linkage: http://www.esri.com/metadata/esriprof80.html
Profile Name: ESRI Metadata Profile

X3.4 *Transit Data*—In this third example, the exact same transit metadata from the King County Metro Transit is provided in a frequently asked questions (FAQ) format. As mentioned previously, most metadata editing tools permit the metadata to be exported to numerous output formats.

Frequently-Anticipated Questions

What does this data set describe?
Title: APC_LOGTPI
Abstract:
This table has data that is the output from processing APC data. For every successfully processed vehicle assignment or block (<keyblock>), it includes data for every TPI (time point interval, <keytpi>) that is on that block for a specific day (<datedata>).
1. How should this data set be cited?
Thomas W Friedman, Tony Longo, or Darrel Riley, The table is updated with new data on an ongoing basis., APC_LOGTPI.
Online Links:

Frequently-Anticipated Questions

\\MITTFREIDMTXP\C$\Documents and Settings\FriedmTW\Desktop\APC_ArcGIS_Database.mdb

2. What geographic area does the data set cover?
West_Bounding_Coordinate: -122.412
East_Bounding_Coordinate: -121.118
North_Bounding_Coordinate: 47.776
South_Bounding_Coordinate: 47.107
3. What does it look like?
4. Does the data set describe conditions during a particular time period?
Calendar_Date: Most recent 3 service changes (approx. 12 months)
Currentness Reference:
The <datedata> field (yymmdd) has the year/month/day of the data.
5. What is the general form of this data set?
Geospatial_Data_Presentation_Form: tabular digital data
6. How does the data set represent geographic features?
How are geographic features stored in the data set?
What coordinate system is used to represent geographic features?
7. How does the data set describe geographic features?
APC_LOGTPI
OBJECTID
? (Source: ESRI)
Sequential unique whole numbers that are automatically generated.
KEYBLOCK
The vehicle assigment that the data is for, expressed as drrrxx, where d is the day type (0=wd, 1=sat,2=sun), rrr is the route#, and xx is the run#.
The valid range of keyblock is whatever blocks are in effect for a specific time period.
BASETMPT
The timepoint # of the base (garage) where the block starts and ends.
Range of values
Minimum: 1
Maximum: 14
DATEMATCH
The date when the data was processed, expressed as yymmdd.
Range of values
Minimum: first day when data was processed
Maximum: last day that data has been processed so far
DATEDATA
The date on which the data was collected, yymmdd.
Range of values
Minimum: first day when data was processed
Maximum: last day that data has been processed so far
DATEDATA
The date on which the data was collected, yymmdd.
Range of values
Minimum: first day of service change in this table
Maximum: last day of data processed so far
DAYOFWEEK
The day of the week the data was collected on

Value	Definition
1	Sat
2	Sun
3	Mon
4	Tues
5	Wed
6	Thurs
7	Fri

COACHTYPE
The type of vehicle assigned to this block.

Value	Definition
11	30’ diesel
12	vans
23	NF artics (1999)
26	NF hyhybrids
28	NF diesel (2004)
32	Gillig 40’ (1996)
36	NF low floor 40’
40	MAN 60’ trolley

NUMSEATS
The number of seats on <coachtype>
varies by coachtype
KEYCOACH
The number of the bus actually used on the <keyblock> on <datedata>
KEYPCU
The ID# of the APC device
TPISEQN
The sequence number of the tpi on this block
KEYTRIP
The Hastus trip ID for the trip that this tpi event is on.
DIRNAME

Frequently-Anticipated Questions

The compass direction the vehicle is traveling at the time of this event.

Value	Definition
N	North
S	South
E	East
W	West

TPDELTA
The distance from this timepoint to the logged event used for estimating the layover time at this timepoint.
KEYPATTERN
The pattern ID that this trip follows on this tpi event
KEYTPI
The timepoint interval for this event, which is the path the bus travels between two timepoints. The format is DFFFFTTTT, where if D is blank it is a revenue tpi and if D is -, it is a deadhead tpi. FFFF is the 'from' timepoint in the tpi, TTTT is the 'to' timepoint in the tpi.
DRIVERRUNKEY
The ID of the driver on this tpi event on this day.
RTENACCT
The route the bus is on for this tpi event
EXPRACCT
The type of service the bus is on for this tpi event

Value	Definition
EX	express
AT	turns back before end of route

PARTACCT
The subpart for this route, such as N for north or S for South, for this tpi event.
SURCACCT
Indicates whether this event is in the peak fare period, $ = yes, blank = no.
DUMYACCT
Indicates whether the bus is traveling inbound (I) or outbound (O). Usually this is relative to the Seattle CBD if the route goes thru the CBD. If not, it is somewhat arbitrarily assigned.
RTENSIGN
same as rtenacct
EXPRSIGN
same as expracct
PARTSIGN
same as partacct
SURCSIGN
same as surcacct
DUMYSIGN
same as dumyacct
RTENDPRT
same as rtenacct
EXPRDPRT
same as expracct
PARTDPRT
same as partacct
SURCDPRT
same as surcacct
DUMYDPRT
same as dumyacct
TPIDIST
The map distance of the tpi in feet.
KEYZONE
ID of bus stop where the maximum load begins
NUMSTOPS
The number of times the bus stopped in this tpi
PROFLAG
A processing status flag.

Value	Definition
0	logged complete

NUMOVLDS
The number of times the bus load exceeded the number of seats on this event
MAXLOAD
The maximum # of riders in this event.
TIMDPML
The time the bus departed the stop that had the first occurance of the maximum load in this tpi event.
TIMDWELL
Total dwell time at all the stops in this tpi event (mins).
PLOAD
Passenger load approaching this tpi.
PON
# of persons boarding at all stops in this tpi
POFF
# of persons alighting at all stops in this tpi.
TIMDEV1
estimated schedule deviation in minutes at from (FFFF) timepoint
TIMSCH1
schedule time of departure from 'from' timepoint

Frequently-Anticipated Questions

TIMDEV2
estimated schedule deviation in minutes at 'to' (TTTT) timepoint
TIMSCH2
schedule time of arrival at 'to' timepoint
DISPTRV
total passenger travel distance (passenger miles) on this tpi event
TIMPTRV
total passenger travel time (passenger hours) on this tpi event
DISOTRV
not used
TIMOTRV
not used
DISODUR
not used
TIMODUR
not used
DISXTRV
not used
TIMXTRV
not used
DISXDUR
not used
TIMXDUR
not used

Entity_and_Attribute_Overview:

The entities (fields) in the table are information that allow the user to get ridership and schedule adherence for a specific tpi on a specific trip on the date of the data (<datedata>). This data can be aggregated for all tpi's in a trip, to get trip totals, and further by route, time of day, etc.

Who produced the data set?

1. Who are the originators of the data set? (may include formal authors, digital compilers, and editors)
   Thomas W Friedman, Tony Longo, or Darrel Riley
2. Who also contributed to the data set?
3. To whom should users address questions about the data?
   Thomas W Friedman
   King County Metro
   Project Manager
   206 684-1513 (voice)
   206 684-2059 (FAX)
   tom.friedman@metrokc.gov

Why was the data set created?

The table is used for many uses of APC data, either directly at the TPI level, or it can be aggregated to trips, time periods, routes, etc. Note this table cannot be used for APC data at the bus stop level. For that use LOGSTOP.

How was the data set created?

1. From what previous works were the data drawn?
2. How were the data generated, processed, and modified?

(process 1 of 1)

To get to this table, APC data is processed as follows:

Raw APC data is downloaded from a bus weekly in a packed format.The week's worth of data is unpacked and is then preprocessed into blocks, by comparing the raw data to the scheduled assignments for that bus for that week.

The identified block of data then goes to the Matcher. The first thing the Matcher does is to compare the total ONs and OFFs in the block. If they differ by more than 10%, the processing stops, as the hardware reliability of that block of data is in question.

Next, the Matcher compares the raw data to a template of all scheduled events for that block, including timepoints, signposts, and bus stops. (Signposts are devices installed at many bus stops that transmit a location code,and when the bus passes the signpost, it records the time and odometer value when it passes that location.) Using this template information, a 'match' is made of a bus stop record in the raw data to a scheduled bus stop on the template.

Once the bus stops are identified, the time the bus passed a timepoint is estimated by interpolating the time between the 2 events in the raw data (usually a bus stop) that bound the timepoint based on distance. Note that timepoints are not recorded events, as there is nothing currently available to the APCs that indicate when the bus is at a timepoint.)

The next step is to correct for minor 'error's in the count data. As mentioned above, if a block has major count differences between ONs and OFFs, it is not processed further. This process, called Tuning, makes minor adjustments to the ONs and OFFs to deal with two illogical situations. One is if the load on the bus goes negative, and the other is if the bus returns to the base with a positive load. In either of these cases, the Tuner will modify ONs or OFFs, starting at the bus stop with the most activity in a tuning interval preceding the problem. The load is then recalculated, and if further tuning is needed, the process is repeated until the problem is corrected.

At the completion of the Matching and Tuning, the processed data is output to two tables: one is LOGSTOP, which has data for every bus stop in the block. The other is LOGTPI (this table), which aggregates bus stop data for all stops in the TPI.

Person who carried out this activity:
Thomas W Friedman, Tony Longo, or Darrel Riley King County Metro

3. What similar or related data should the user be aware of?

How reliable are the data; what problems remain in the data set?

1. How well have the observations been checked?

Accuracy of ons (PON) and offs (POFF): Our periodic testing with observers yields the following accuracy at the bus stop level: correct>85% of stops; +-1>90% of stops; +-2>97% of stops. Overall accuracy of total ONs and OFFs is about +-5%

2. How accurate are the geographic locations?
3. How accurate are the heights or depths?
4. Where are the gaps in the data? What is missing?

Coverage: This table has data for all successfully processed APC data for the dates covered in<datedata>. At the end of a service change (there are 3 per year) the data usually has at least one observation on 90%, 75%, and 80% , respectively of weekday, Sat., and Sun. scheduled trips. There are usually 3 or more observations on 80% of weekday scheduled trips.

Frequently-Anticipated Questions

Note: APCs are installed on only about 15% of the fleet, so data is collected on a sampling basis by rotating the vehicles with APCs on all blocks during a service change.

In terms of table size, for one service change (there are 3 per year) the table can have about 1 million rows (TPI events). When aggregated into trips, this results in about 150,000 observed trips per service change.

5. How consistent are the relationships among the observations, including topology?

NA

How can someone get a copy of the data set?

Are there legal restrictions on access or use of the data?

Access_Constraints:

Use of this table should be limited to persons who are knowledgable in how APC data is collected and processed. Familiarity with transit operations is also beneficial.

Use Constraints: None

1. Who distributes the data set? (Distributor 1 of 1)

Thomas W Friedman
King County Metro
Project Manager

2. What's the catalog number I need to order this data set?

This table is not currently for general distribution. For information on getting information from this table, contact the person below.

3. What legal disclaimers am I supposed to read?

4. How can I download or order the data?

Who wrote the metadata?

Dates:

Last modified: 12-Apr-2005

Metadata author:

Thomas W Friedman
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Project Manager
201 S Jackson St.
Seattle, WA. 98104
USA
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tom.friedman@metrokc.gov

Metadata standard:

FGDC Content Standards for Digital Geospatial Metadata (FGDC-STD-001-1998)

Metadata extensions used:

<http://www.esri.com/metadata/esriprof80.html>