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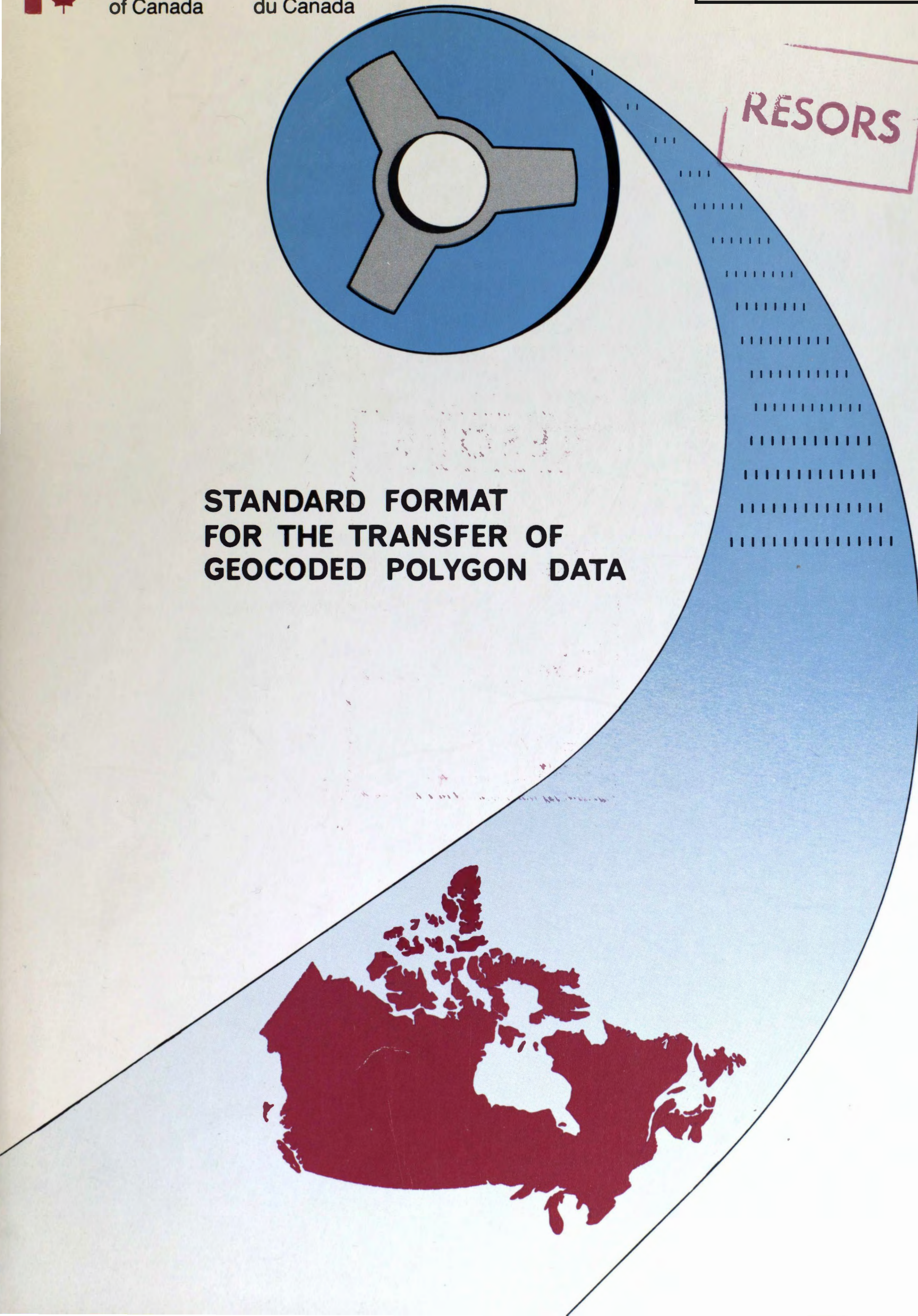
STANDARD FORMAT FOR THE TRANSFER OF GEOCODED POLYGON DATA



STANDARD FORMAT FOR THE TRANSFER OF GEOCODED INFORMATION IN SPATIAL DATA POLYGON FILES

SPATIAL DATA TRANSFER COMMITTEE

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ABSTRACT

This report describes a standard format for the transfer, via computer compatible tape, of geocoded information in spatial data polygon files. The format was developed through the mutual efforts of four departments in the Government of Canada: Energy, Mines, and Resources, Environment Canada, Statistics Canada, and Agriculture Canada. Staff from these departments established the Spatial Data Transfer Committee (SDTC), which completed the design of this format in 1979. The format described in this report also conforms to "The CCT Family of Tape Formats" superstructure developed by the LANDSAT Ground Station Operators Working Group. The SDTC intends to use this format for the exchange of geocoded information.

RESUME

Ce rapport décrit le format standard pour le transfert, via des bandes magnétiques pour ordinateur, d'information géographique numérique dans des fichiers de données à polygonation spatiale. Ce format est le fruit des efforts conjoints de quatre ministères du gouvernement canadien: Energie, Mines et Ressources Canada, Environnement Canada, Statistique Canada et Agriculture Canada. Un comité, "The Spatial Data Transfer Committee (SDTC)", composé de personnel de ces ministères, a complété l'élaboration de ce format en 1979. Celui-ce, tel qui décrit dans le présent rapport, est conforme aux spécifications de la superstructure des "formats de la famille des bandes magnétiques pour ordinateur (CCT)" développée par le "Landsat Ground Station Operations Working Group". Le SDTC a l'intention d'utiliser ce format pour les échanges d'information géographicque digitalisée.

PREFACE

This document is the result of the work of an adhoc committee formed by agencies from within the Government of Canada concerned with the high cost of updating geocoded data bases with timely resource information. The members of the committee were volunteers from:

1. The Canada Centre For Remote Sensing (CCRS), Department of Energy Mines and Resources;

2. Geocartographics Group, Statistics Canada;

3. Lands Directorate, Envirionment Canada;

4. Lands Resource and Research Institute, Agriculture Canada.

The name of this committee was the Spatial Data Transfer Committee, SDTC.

The objectives of this committee were:

1. to devise standard formats for the interchange of spatial data;

2. to develop software to convert between the standard formats;

3. to conduct a demonstration data transfer project.

In fulfillment of the first of these objectives a standard format for the interchange of spatially encoded data in the form of polygon chains is described herein. An attempt has been made to define this format with the following properties:

1. Machine and Language independence. The format should be easily processable with a variety of computers and computer languages. For this reason, all fields are either ASCII or binary integer in type and are multiples of 4 bytes in length.

2. Expandability. The format should be easily revisable and evolvable. Extra space has been reserved for the addition of information at a later date. Moreover, the structure has been set up in anticipation of revisions to this format and of designs of other spatial data transfer formats. These might include formats for line and point data. Thus, a family of spatial data transfer formats is expected.

3. Generality. The family of spatial data formats should be sufficiently general to accomodate the variety of geographic information utilized by the participating agencies.

4. Self-definition. The files should be self-defining with respect to the spatial and descriptive data in the files. In addition to attribute names, provision has been made for the inclusion of common spatial parameters such as map projections and ground resolution.

With the formulation of this format a demonstration transfer will be conducted between CCRS and Lands Directorate. The data involved in this transfer will be thematic data acquired and provided by CCRS from the digital analysis of the Multispectral Scanner (MSS) of the LANDSAT series of satellites.

This format incorporates the superstructure and conforms to the design standards for Computer Compatible Tape (CCT) formats as established by the Landsat Ground Station Operators Working Group (LGSOWG) Configuration Control Board (CCB). These standards are set out in the report, "The CCT Family of Tape Formats." (1).

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1. INTRODUCTION

The Government of Canada has a number of large geographic information digital data bases. These require periodic updating to reflect the changing environment they represent. In addition, new data bases to meet new applications will be constructed in the future. The creation of new data bases and the updating of the existing ones will benefit from the incorporation of remotely sensed data or the exchange of information obtained from existing data bases, or both.

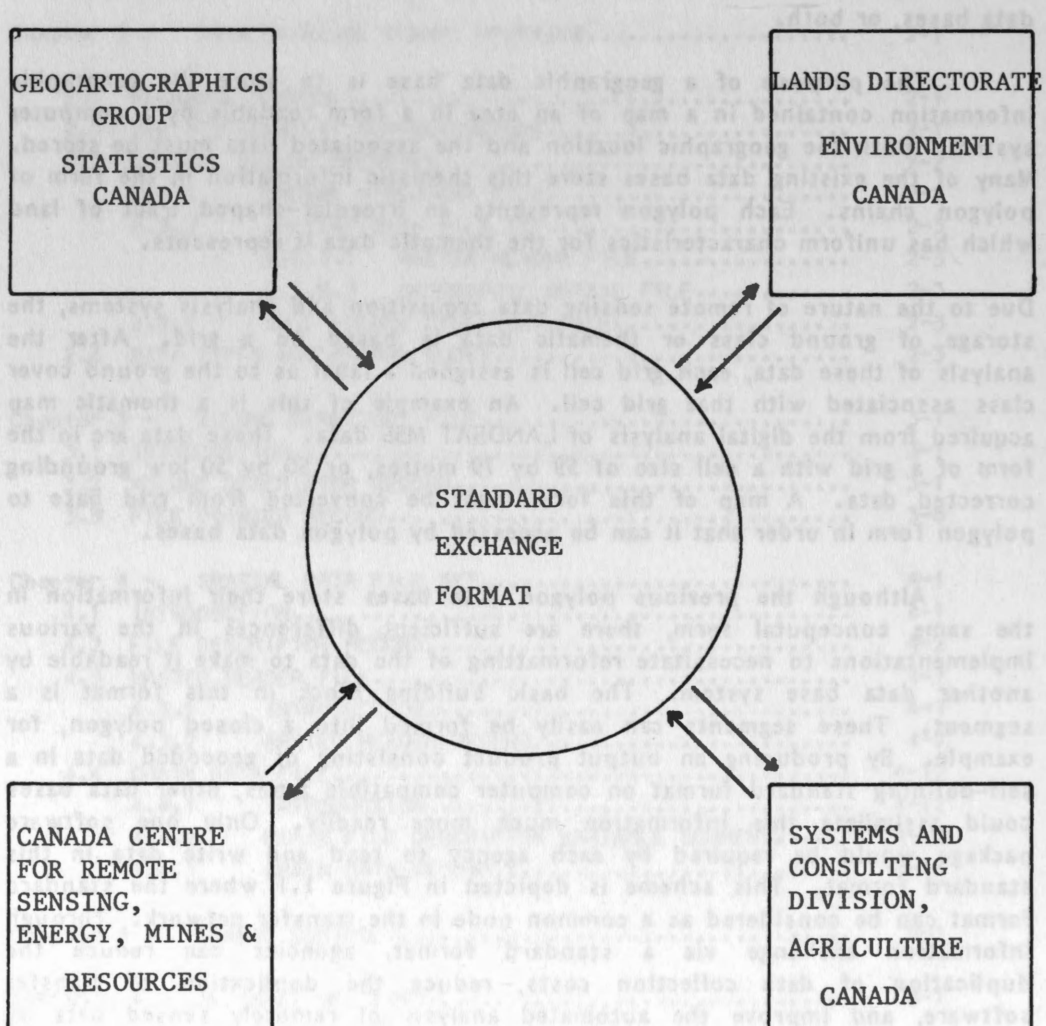
The purpose of a geographic data base is to store the geographic information contained in a map of an area in a form readable by a computer system. Both the geographic location and the associated data must be stored. Many of the existing data bases store this thematic information in the form of polygon chains. Each polygon represents an irregular-shaped tract of land which has uniform characteristics for the thematic data it represents.

Due to the nature of remote sensing data acquisition and analysis systems, the storage of ground class or thematic data is based on a grid. After the analysis of these data, each grid cell is assigned a label as to the ground cover class associated with that grid cell. An example of this is a thematic map acquired from the digital analysis of LANDSAT MSS data. These data are in the form of a grid with a cell size of 59 by 79 metres, or 50 by 50 low grounding corrected data. A map of this form must be converted from grid base to polygon form in order that it can be accessed by polygon data bases.

Although the previous polygon data bases store their information in the same conceptual form, there are sufficient differences in the various implementations to necessitate reformatting of the data to make it readable by another data base system. The basic building block in this format is a segment. These segments can easily be formed into a closed polygon, for example. By producing an output product consisting of geocoded data in a self-defining standard format on computer compatible tapes, other data bases could assimilate this information much more readily. Only one software package would be required by each agency to read and write data in this standard format. This scheme is depicted in Figure 1.1 where the standard format can be considered as a common node in the transfer network. Through information exchange via a standard format, agencies can reduce the duplication of data collection costs, reduce the duplication of transfer software, and improve the automated analysis of remotely sensed data by incorporating historical information from existing databases.

FIGURE 1.1

EXCHANGING DATA BETWEEN AGENCIES



2. DATA EXCHANGE FORMAT OVERVIEW

2.1 EXCHANGE MEDIUM

The medium of data transfer will be a computer tape in this standard format. No restrictions on recording mode, density, or tape length will be made. These parameters will be decided by the two agencies involved in the data transfer. However, the preferred form of the medium will be a 9 track, 1600 BPI, 2400 foot reel of tape. The tape will not have any of the industry standard tape labels on it.

2.2 THE "CCT FAMILY" SUPERSTRUCTURE

The LGSOWG Configuration Control Board has approved a tape formatting concept referred to as the "Superstructure" (1). This Superstructure is a combination of precisely defined records and a method of employing them. To conform to the Superstructure concept, the following records are incorporated in the Spatial Data Transfer Committee's format:

1. Volume Descriptor Records
2. File Pointer Records
3. File Descriptor Records

These records are defined by the LGSOWG-CCB. See Figure 2.3 for schematic represenations of the three record types. The File Descriptor Record contains a segment called the File Descriptor Variable Segment. This segment is a user-defined part of the record, as opposed to being specified by (1). All other records used in this format are defined by the Spatial Data Transfer Committee. In addition to the File Descriptor Segments of the File Descriptor Records, the Spatial Data Transfer Committee has defined the following records which are defined in detail in Chapter 4:

1. The Master Header Record,
2. The Chain Data Records

The organization of the Logical Volume, Physical Volume and Volume Set also conform to theSuperstructure. In this format, we restrict a Volume Set to only one Logical Volume, though this restriction is not in the Superstructure.

2.3 LOGICAL VOLUME OVERVIEW

In this format, we are defining a Volume Set, which will consist of only one Logical Volume. A Logical Volume consists of 3 sections. These sections are:

1. Volume Directory File
2. Spatial Data File Set(s)
3. Null Volume Directory File

A Logical Volume starts with a Volume Directory File and ends with a Null Volume Directory File. The Volume Directory File, Spatial Data File Set, and Null Volume Directory File are described in brief in section 3.3.1 to 3.3.3 and in detail in chapters 4 and 5.

A Logical Volume consists of one or more Physical Volumes. Each Physical Volume has a Volume Directory File as the first file. Each Physical Volume terminates with an End-Of-Volume (EOV), which is two End-Of-File's (EOF's) in succession. A Volume Set, hence a Logical Volume, is terminated by an End-Of-Set (EOS), which is an End-Of-Volume followed by an End-Of-File (i.e., three EOF's in a row).

See Figures 3.1 and 3.2 for a schematic representation of a Volume Set. Figure 3.1 shows two Spatial Data File Sets on one Physical Volume. Figure 3.2 shows one Spatial Data File Set on two Physical Volumes.

2.3.1 VOLUME DIRECTORY FILE

This file is the first file of a Logical Volume. If the Logical Volume spans more than one Physical Volume, then each Physical Volume begins with a Volume Directory File. This file describes the Logical Volume and the types of files on the Logical Volume. It also gives information on the arrangement of files on the Physical Volume on which this Volume Directory File is located. See Figure 3.1 for a representation of the Volume Directory File. The Volume Directory File consists of two types of records;

1. The Volume Descriptor Record. This is the first record of the Volume Directory File. It describes the Logical Volume and gives labelling information for this Physical Volume.

2. The File Pointer Record. These records contain information on each of the files on the Logical Volume. There is one File Pointer Record for each file on the Logical Volume.

2.3.2 SPATIAL DATA FILE SET

A Spatial Data File Set consists of a pair of files. The first file of each pair is the Master Header File. The second is the Geographic Detail File. Each file of the Spatial Data File Set starts with a File Descriptor Record followed by the data records in the format specific to the type of file as shown in Figure 2.1. The File Descriptor Records are part of the Superstructure and contain information about the data records that follow them.

2.3.2.1 MASTER HEADER FILE

This file contains information as to the type of encoding employed to store the data and overall geographic reference points for the data.

2.3.2.2 GEOGRAPHIC DETAIL FILE

For this format the Geographic Detail File implemented is the Chain Data File. The Chain Data File contains the actual detailed geocoded information.

2.3.3 NULL VOLUME DIRECTORY FILE

This file terminates a Logical Volume. It consists of one record, the Volume Descriptor Record, with the appropriate fields set to identify it as the Null Volume Directory File. The Null Volume Directory File is followed by an End-Of-Set (3 EOF's in a row).

2.4 DATA TYPES AND RECORD CODES

There are two data types used in this format. These are 7-bit ASCII characters written in 8-bit bytes and 32-bit binary integers written in 4 bytes. The data type for each field is given in the Data Field Explanations for each record. ASCII field names begin with the letter B, while 32-bit integer field names begin with J.

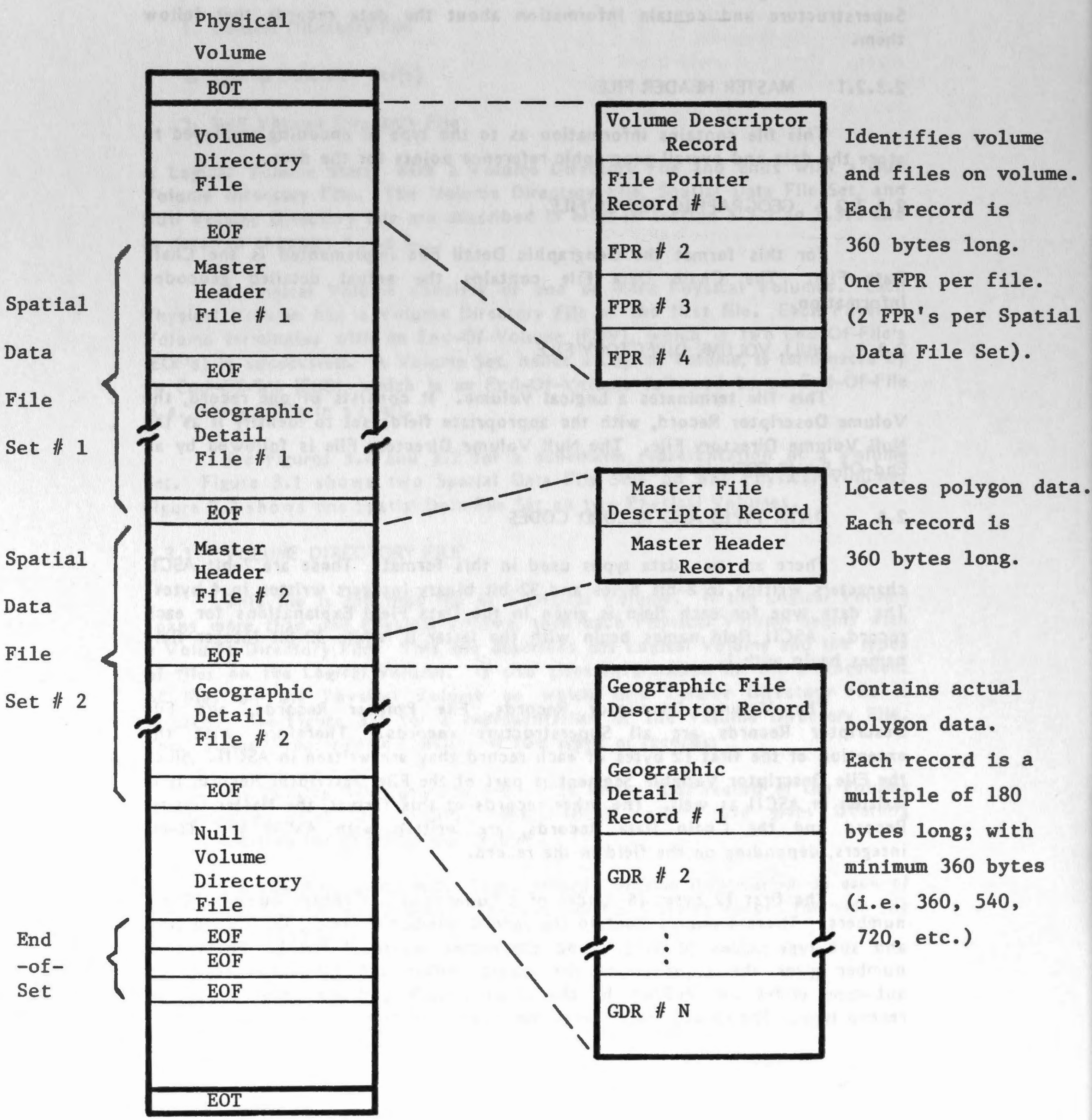
The Volume Descriptor Records, File Pointer Records, and File Descriptor Records are all Superstructure records. Therefore, with the exception of the first 12 bytes of each record they are written in ASCII. Since the File Descriptor Variable Segment is part of the File Descriptor Record, it is written in ASCII as well. The other records of this format, the Master Header Record and the Chain Data Records, are written with ASCII and 32-bit integers, depending on the field in the record.

The first 12 bytes (6 fields) of a Superstructure record contain binary numbers. These numbers contain the record number (1 field), the record type and sub-type codes (4 fields), and the record length (1 field). The record number gives the sequence of the record within the file. The type and sub-type codes are defined by the LGSOWG-CCB and are unique for each record type. The record length gives the number of bytes in the record.

FIGURE 2.1

TWO SPATIAL DATA FILE SETS

ON ONE PHYSICAL VOLUME



The record type and sub-type codes are each one byte long. The actual values for each field are given in the Data Field Explanations for each records. These values are summarized below in octal:

Byte No.	5	6	7	8
Field No.	2	3	4	5
Field Type	1st Sub-type Code	Type Code	2nd Sub-type Code	3rd Sub-type Code
Volume Descriptor Record Code	300	300	022	022
Null Volume Descriptor Code	300	300	077	022
File Pointer Record Code	333	300	022	022
File Descriptor	077	300	022	022

Binary integers are all 32-bit numbers and are referred to as INTEGER*4, since 4 bytes are required to store the number. The field names for this type of data all start with the letter J. The first byte of an INTERGER*4 number is the most significant byte and contains the sign bit. The last byte is the least significant one. Since this is a tape format, the terms first and last refer to the sequential ordering of bytes on the tape. The following illustrates the ordering of an INTEGER*4 number:

Byte No.	1	2	3	4
Bit No.	87654321	87654321	87654321	87654321
Bit Weight	S,30..24	23....16	15.....8	7......0

Number 8 of a Byte is the Most Significant Bit (MSB). The Bit Weight gives the exponent to the base 2 for that bit (i.e., weight 30 means 2**30). The S is for the sign bit. For example, all Superstructure records with the exception of the records in the Geographic Detail File are 360 bytes long. Therefore, the 4 bytes of the record length field appear as 0,0,1,104 (bytes 9 to 12 of field 6, respectively) in decimal value. This equals 1 * 2**8 + 104 = 360.

3. VOLUME DIRECTORY FILE

3.1 INTRODUCTION

The Volume Directory File is part of the Superstructure of the Tape format. The format of the file has been defined in (1). The format given in that document is for a general Volume Directory File. The implementation of the format specific to the Spatial Data Transfer Committee is given below.

A Logical Volume starts with a Volume Directory File. The Volume Directory File consists of two types of records:

1. The Volume Descriptor Record, and

2. File Pointer Records

If a Logical Volume spans more than one Physical Volume, then this file is at the beginning of each Physical Volume, and fields 13, 19, 20 and 22 of the Volume Descriptor Record are updated in each Volume Directory File. If a Logical Volume is split among Physical Volumes within a file, then field 22 of the File Pointer Record, which refers to the split file is also updated on the repeated Volume Directory File. The rest of the Volume Directory Files are identical throughout a Logical Volume.

3.2 VOLUME DESCRIPTOR RECORD

The Volume Descriptor is the first record of the Volume Directory File. Its basic layout and content are illustrated in Figure 3.1. After the firest 16 bytes (fields 1 to 8) of general information, the remainder of the record is composed of four segments.

The first segment (fields 9 to 12) identifies the document that describes the superstructure format (i.e., reference (1)). It also identifies the software used to create the superstructure on the tape. The second segment (fields 13 to 29) provides basic information about the Logical Volume and gives the number of pointer records in the Volume Directory File. Since there is one pointer record for each file in the Logical Volume other than the Volume Directory File, this also gives the number of files. There are two files in a Spatial Data File Set, so the number of Spatial Data File Sets is given as the number of File Pointer Records divided by two.

The third segment (field 30) is spare, which is reserved for expansion of control information in future Volume Descriptor revisions. The fourth segment (field 31), the local use segment, provides space for whatever notation or information the tape user wants to carry with the Volume Directory. This segment has not been defined by the Spatial Data Transfer Committee, so it will be filled by ASCII blanks, the same as segment three.

The individual data items of the Volume Descriptor record are listed in Table 3.1 and explained in Table 3.2.

FIGURE 3.1

SCHEMATIC REPRESENTATION OF

THE SUPERSTRUCTURE RECORDS

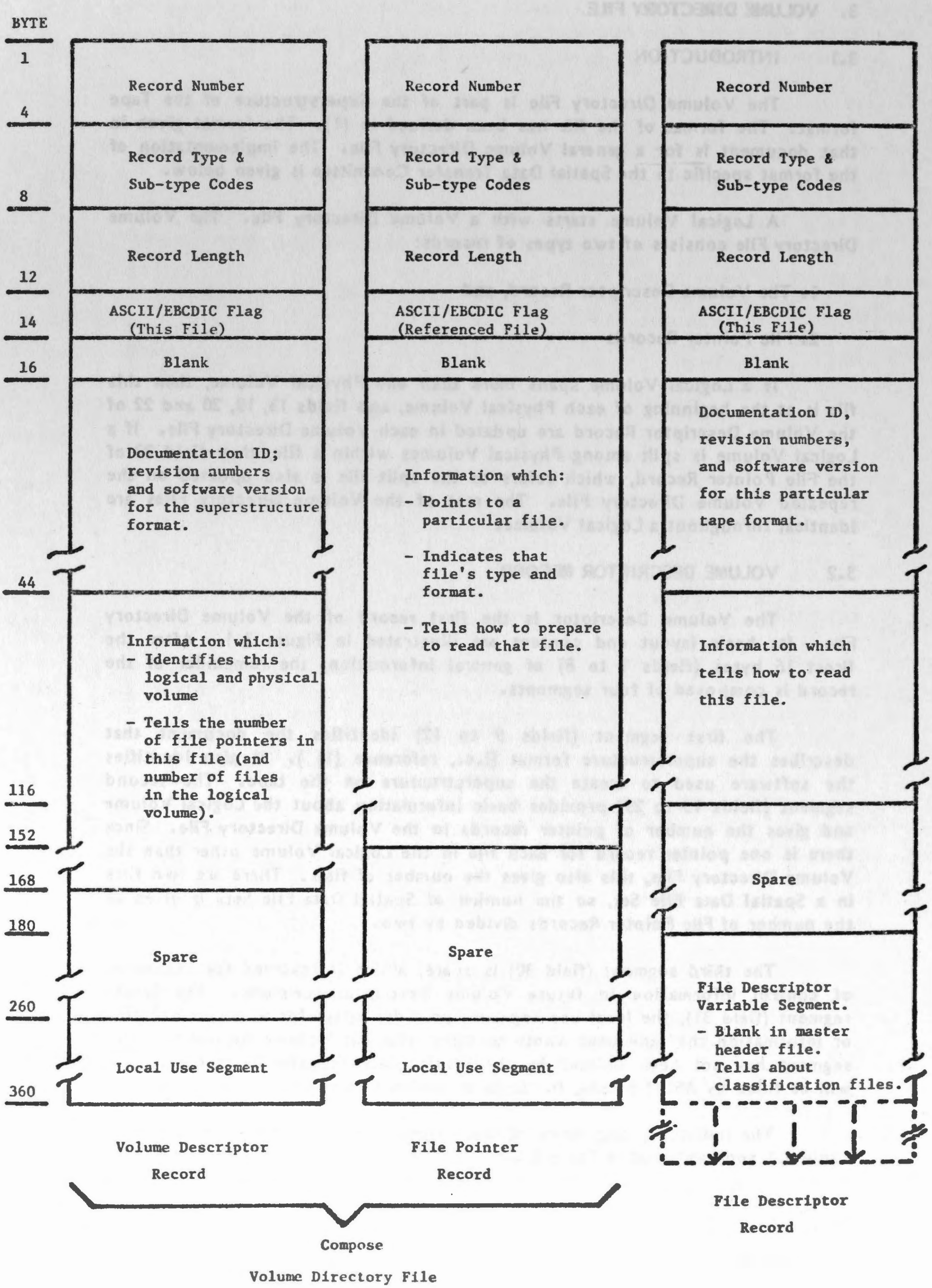


TABLE 3.1

VOLUME DESCRIPTOR RECORD

NO.	BYTE NOS.		DESCRIPTION
1	1-4		Record Number
2	5	***	300 (8) = Volume Directory code (1st record sub-type code)
3	6		Record Type Code = 300 (8) = Superstructure
4	7		007(8) if Null Volume Directory File, 022(8) otherwise. (2nd record sub-type code)
5	8		022(8) (3rd record sub-type code)
6	9-12		Length of this record (360 bytes)
7	13-14		ASCII/EBCDIC Flag (= A #, where # is a blank)
8	15-16		2 Blanks
9	17-28		Superstructure control document number
10	29-30		Superstructure control document revision number
11	31-32		Superstructure record format revision letter
12	33-44		Software release number
13	45-60	**	Tape Identifier for physical volume containing this volume descriptor.
14	61-76	*	Logical Volume Identifier
15	77-92		Volume Set Identifier
16	93-94		Number of Physical Volumes in the Set
17	95-96		Physical Volume Number, Start of Logical Volume
18	97-98		Physical Volume Number, End of Logical Volume
19	99-100	**	Physical Volume Number containing this Volume Descriptor
20	101-104	**	First Referenced File Number in this Physical Volume
21	105-108		Logical Volume Number within Volume Set
22	109-112	**	Logical Volume Number within Physical Volume
23	113-120	*	Logical Volume Creation Date
24	121-128	*	Logical Volume Creation Time
25	129-140	*	Logical Volume Generating Country
26	141-148	*	Logical Volume Generating Agency
27	149-160	*	Logical Volume Generating Facility
28	161-164	*	Number of Pointer Records in Volume Directory
29	165-168	*	Number of Records in Volume Directory
30	169-260		Volume Descriptor Spare Segment
31	261-360		Local Use Segment

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* Unused in NullVolume Directory File
** Fields to be updated in a repeated Volume Directory File
*** Numbers followed by (8) are in OCTAL

TABLE 3.2

VOLUME DESCRIPTOR RECORD
DATA FIELD EXPLANATIONS

Fields 1 to 6 are binary encoded fields. All other fields are in ASCII. Alphanumeric character strings are left-justified and numeric character strings are right-justified. Any fields not used are filled with ASCII blanks. Numbers which do not fill the field should be padded with leading blanks. The Volume Descriptor Record occupies 360 bytes.

Field	EXPLANATIONS
1	An INTEGER*4 number containing the record number of this record within the file. For the Volume Descriptor Record, this number is always 1.
2	The first sub-type code for this record. This code is 300(8) for the Volume Descriptor Record.
3	This is the record type code. This code is 300(8) for the Superstructure records.
4	This is the second sub-type code for the record. If this record is in the Null Volume Directory File, then this field is coded 077(8). For all other Volume Directories, this is coded 022(8).
5	This is the third sub-type code for the record. Since none of the Superstructure records use this code, the field contains 022(8), which is the default code.
6	This field contains an INTEGER*4 number giving the length of this record in bytes. The length of the Volume Descriptor Record is 360 bytes.
7	The ASCII/EBCDIC flag indicates if the alphanumeric information in the Volume Directory File is in ASCII or EBCDIC. For this format, ASCII will be used, so this field will contain A# where # denotes an ASCII blank.
8	Two ASCII blanks.
9	12 characters giving the Superstructure Format Control Document identifying number; i.e., the document number for reference (1) - (CCB-CCT-0002).

TABLE 3.2 (cont'd)
VOLUME DESCRIPTOR RECORD
DATA FIELD EXPLANATIONS

Field	EXPLANATIONS
10	2 characters indicating the revision number or letter of the Superstructure Format Control Document. Coded #A, for the original draft (# is an ASCII blank).
11	2 characters indicating the revision letter of the Superstructure Record formats. Coded #A for the original draft. This code updates one letter character, alphabetically, each time there is a change to the format of a Superstructure Record (as opposed to a change to the control document which may not have been a change in the actual record format). The 26th revision is coded AA, the 27th AB, and so on.
12	12 characters identifying the software version used to write this Logical Volume; i.e., the program name and version number.
13	This is a 16 character code also written or printed externally on the Physical Volume and used to uniquely reference a particular CCT. Also called the Tape Identifier. When a Logical Volume spans more than one Physical Volume, this code is updated for the continuing Physical Volumes.
14	This is a 16 character code which uniquely identifies the Logical Volume; e.g., OTTAWA 001. For this implementation, this code is the same on all Physical Volumes of a Logical Volume.
15	A second 16 character field for identifying the Volume Set. Since only one Logical Volume is allowed on a Volume Set, this field may be used as a continuation of field 14.
16	An integer which indicates the total number of Physical Volumes in a Volume Set. A blank field indicates that the information was not available at the time the Logical Volume was recorded. (2 characters)
17	This indicates the sequence number of the Physical Volume within a Volume Set, which contains the 1st record of the Logical Volume. For this format, this will always be 1. (2 characters)
18	This field indicates the sequence number of the last Physical Volume of a Volume Set. It should be coded blank if unknown at the time of recording. If the Logical Volume is contained on one Physical Volume, this field will have the same value as field 17. (2 characters)

TABLE 3.2 (cont'd)

VOLUME DESCRIPTOR RECORD
DATA FIELD EXPLANATIONS

Field	EXPLANATIONS
19	This is the sequence number within the Volume Set of the Physical Volume that contains this Volume Directory File. If a Logical Volume is contained on one Physical Volume, then this value is the same as that for field 17. The value in this field must lie within the values for fields 17 and 18, inclusively. For example, if field 17 has a 1 and field 18 has a 3, then the value in field 19 can be 1, 2 or 3 only. (2 characters)
20	This field gives the file number within the Logical Volume which follows this Volume Directory. If this is not the first Volume Directory of a Logical Volume, then this value may be greater than one. Volume Directory Files are not included in the file sequence number count. (4 characters)
21	This indicates the sequence number of the present Logical Volume within a Volume Set. The Null Volume Directory is included in this count. In this implementation, the value in this field will always be 1. (4 characters)
22	This is the sequence number of the present Logical Volume within a Physical Volume. For this implementation, this field will always be 1. (4 characters)
23	8 characters for the date the Logical Volume was recorded. The code is of the form: YYYYMMDD where Y is year, M is month, and D is day (e.g., 19790622 is June 22, 1979).
24	8 characters for the time when the Logical Volume was recorded. The code is of the form: HHMMSSXX, wehre H is hours, M is minutes, S is seconds, and X is hundredths of seconds.
25	12 characters for the name of the country generating this Logical Volume (e.g., CANADA ######, where # is a blank).
26	8 characters for the laboratory or centre generating this Logical Volume (e.g., EMR/CCRS).
27	12 characters identifying the computer facility on which the Logical Volume was recorded (e.g., CIAS-70#####).
28	The number of File Pointer Records in this Directory File. This gives the number of data files on the Logical Volume, which is twice the number of Spatial Data File Sets on the Volume. (4 characters)
29	Total number of records in this Volume Directory. This will be the number of File Pointer Records plus one (for this record) in this implementation. (4 characters)

TABLE 3.2 (cont'd)
VOLUME DESCRIPTOR RECORD
DATA FIELD EXPLANATIONS

Field	EXPLANATIONS
30	92 bytes reserved for future revisions of this record format. This is reserved by the LGSOWG-CCB. This field is currently blanked.
31	100 bytes available for local use. This format does not use this field, so it is filled with ASCII blanks.

3.3 FILE POINTER RECORD

File Pointer records reside in the Volume Directory File. There is one File Pointer Record for each data file of the Logical Volume. These records are recorded in the same sequence as the files to which they point. Since a Spatial Data File Set consists of two files, there are two File Pointer Records for each Spatial Data File Set. The first File Pointer Record of the pair points to the Master Header File, while the second points to the Geographic Detail File.

The general record format and content of the File Pointer record are illustrated in Figure 3.2. After the first 16-bytes (fields 1 to 8) of general information, there are three data segments. The first segment (fields 9 to 22) supplies information which points to (locates) one particular data file, indicates that file's format, and tells how to prepare to read the file. The second segment (field 23) is spare and is reserved for expansion of the File Pointer information segment in the future. The third segment (field 24) provides space which the tape user may use as desired.

The individual fields of the File Pointer Record are listed in Table 3.3 and explained in Table 3.4.

FIGURE 3.2

ONE SPATIAL DATA FILE SET

ON TWO PHYSICAL VOLUMES

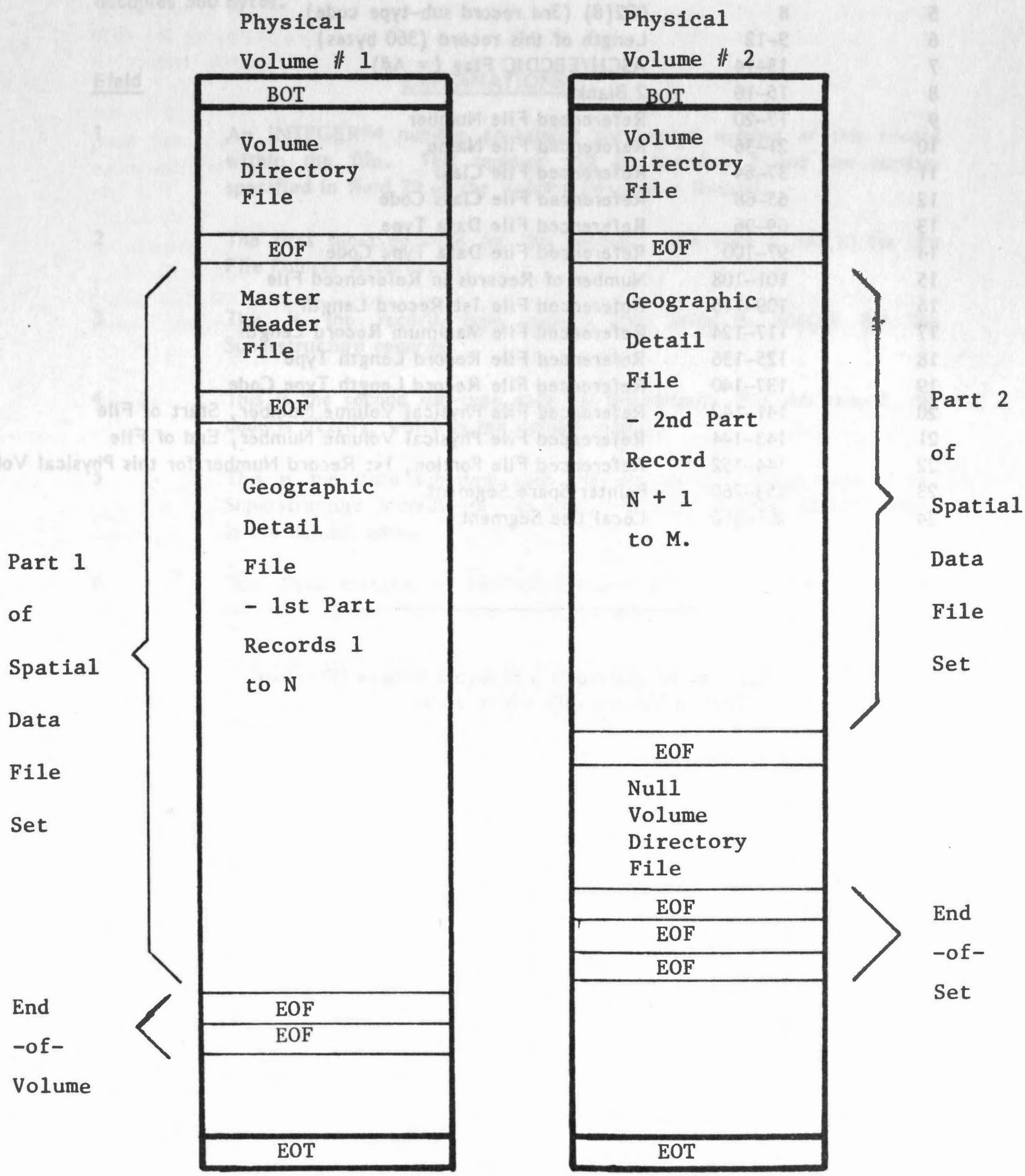

TABLE 3.3
FILE POINTER RECORD

Field	Byte Nos.	DESCRIPTION
1	1–4	Record Number
2	5	333(8) = File Pointer record (1st record sub-type code)
3	6	Record Type Code = 300(8) = Superstructure
4	7	022(8) (2nd record sub-type code)
5	8	022(8) (3rd record sub-type code)
6	9–12	Length of this record (360 bytes)
7	13–14	ASCII/EBCDIC Flag (= A#)
8	15–16	2 Blanks
9	17–20	Referenced File Number
10	21–36	Referenced File Name
11	37–64	Referenced File Class
12	65–68	Referenced File Class Code
13	69–96	Referenced File Data Type
14	97–100	Referenced File Data Type Code
15	101–108	Number of Records in Referenced File
16	109–116	Referenced File 1st Record Length
17	117–124	Referenced File Maximum Record Length
18	125–136	Referenced File Record Length Type
19	137–140	Referenced File Record Length Type Code
20	141–142	Referenced File Physical Volume Number, Start of File
21	143–144	Referenced File Physical Volume Number, End of File
22	144–152 *	Referenced File Portion, 1st Record Number for this Physical Volume
23	153–260	Pointer Spare Segment
24	261–360	Local Use Segment

*** Field to be updated in a repeated Volume Directory if Logical Volume split within a file.**

TABLE 3.4
FILE POINTER RECORD
DATA FIELD EXPLANATIONS

Fields 1 to 6 are binary encoded fields. All other fields are in ASCII. Alphanumeric character strings are left-justified and numeric character strings are right-justified. Any fields not used are filled with ASCII blanks. Numbers which do not fill the field should be padded with leading blanks. The File Pointer Record occupies 360 bytes.

Field	EXPLANATIONS
1	An INTEGER*4 number containing the record number of this record within the file. This number will be between 2 and the number specified in field 29 of the Volume Descriptor Record.
2	The first sub-type code for this record. This code is 333(8) for the File Pointer Records.
3	This is the record type code. This code is 300(8) for the Superstructure records.
4	This is the second sub-type code for the record. For this record, the code is 022(8), which is the default code.
5	This is the third sub-type code for the record. Since none of the Superstructure records use this code, the field contains 022(8), which is the default code.
6	This field contains an INTEGER*4 number giving the length of this record in bytes. This value is 360 for this record.
7	The ASCII/EBCDIC flag indicates if the alphanumeric information in the Referenced File is in ASCII or EBCDIC. For this format, ASCII will be used, so this field will contain A#, where # denotes an ASCII blank.
8	Two ASCII blanks.

TABLE 3.4 (cont'd)
FILE POINTER RECORD
DATA FIELD EXPLANATIONS

Field	EXPLANATIONS
9	Sequence number within the Logical Volume of the file referenced by this pointer. This is also the sequence number of the File Pointer Record within the Volume Directory. The first file following the first Volume Directory (2nd file of the Logical Volume) is file number 1. (4 characters)
10	A 16-character name which is the unique identification provided when the volume directory is created in order to specify the file referenced by this pointer.
11	This is a 28-character description of the class to which the referenced file belongs. The class of a file is based on the nature of its content. Since there are only two types of files in this format, this file should contain "POLYGON MASTER HEADER FILE" or "POLYGON CHAIN DATA FILE".
12	The 4-byte code for the class described in field 11. Either "PMHF" or "PCDF", for Master Header File or Chain Data File, respectively.
13	This 28-character field indicates the data type contained in the referenced file. For this format, all files contain a mixture of binary and ASCII. Therefore, this field contains: "MIXED BINARY AND ASCII".
14	The 4-byte code for the data type described in field 13. This field contains: "MBAA".
15	This 8 character field indicates the number of records in the referenced file. If this number is not known at the creation time, then this field is blank.
16	8 characters for the length, in bytes, of the File Descriptor Record in the referenced file. A blank field indicates that the information was not available at the time the Logical Volume was recorded. For the Master Header File, this field will contain 360. The Chain Data File may have longer records, which are multiples of 180 bytes.

TABLE 3.4 (cont'd)
FILE POINTER RECORD
DATA FIELD EXPLANATIONS

Field	EXPLANATIONS
17	8 character field for the length, in bytes, of the longest record in the referenced file other than the File Descriptor Record. Since this format has fixed record lengths within a file, the value here is the same as in Field 16.
18	12 characters for the record-length type. For this format, fixed length records are used, so this field will contain "FIXED LENGTH". The record length is given in field 17.
19	4-byte code for the record-length type in field 18. For this format, this is "FIXD".
20	2 characters for the Physical Volume sequence number which contains the first record of the referenced file. This may be left blank if the information is unknown at the time of recording.
21	2 characters for the Physical Volume sequence number which contains the last record of the referenced file. This may be left blank if the information is unknown at the time of recording.
22	When a portion of the referenced file is on the previous Physical Volume, this 8-character number is the record number of the first record of the referenced file to be recorded on this Physical Volume. In all other conditions, this number is 1. This is the only field in a File Pointer Record to be changed on a repeated Volume Directory and is only changed in the File Pointer Record that refers to the split file.
23	108 bytes reserved for subsequent revisions. This is reserved by the LGSOWG-CCB.
24	100 bytes available for local use. This format does not use this field.

TABLE 3.4 (cont'd)

FILE POINTER RECORD

DATA FIELD EXPLANATIONS

Field	EXPLANATIONS
17	8-character field for the length, in bytes, of the longest record in the referenced file [illegible]. Since this format has fixed record lengths [illegible] the value here is the same as in field 16.
18	12 characters for the record-length type. For this format, fixed length records are used, so this field will contain "FIXED LENGTH". The record length is given in field 17.
19	4-byte code for the record-length type in field 18. For this format, this is "FIXD".
20	2 characters for the Physical Volume sequence number which contains the first record of the referenced file. This may be left blank if the information is unknown at the time of recording.
21	2 characters for the Physical Volume sequence number which contains the last record of the referenced file. This may be left blank if the information is unknown at the time of recording.
22	When a portion of the referenced file is on the previous Physical Volume, this 8-character number is the record number of the first record of the referenced file to be recorded on this Physical Volume. In all other conditions, this number is 1. This is the only field in a File Pointer Record to be changed on a repeated Volume Directory and is only changed in the File Pointer Record that refers to the split file.
23	208 bytes reserved for subsequent revisions. This is reserved by the LGSOWG-CCB.
24	100 bytes available for local use. This format does not use this field.

4. SPATIAL DATA FILE SET

4.1 INTRODUCTION

A Spatial Data File Set consists of two files. The first file is the Master Header File. This is followed by the Geographic Detail File. The Master Header File gives the geographic location, resolution, and positional accuracy of the data in the Geographic Detail File. The Geographic Detail File contains the geographic data. In this specification, the Geographic Detail File implemented is called the Chain Data File. For the rest of this chapter, the terms Chain Data File and Chain Data Record refer to this specific format of the Geographic Detail File. If an item refers to the Geographic Detail File, then that item refers to the concept of the Geographic Detail File and is not bound by this specific implementation.

Each file has a File descriptor Record as the first record. This record has two parts. The first part is 180 bytes long and is defined by the LGSOWG–CCB (1). The format of the first part is the same for all file types. The second part, from bytes 181 to the End–Of–Record (EOR), is called the File Descriptor Variable Segment. The File Descriptor Variable Segment is user–defined and contains information about the format of the data in the other records of the file. The format for this part depends on the file type. Therefore, there are two types of File Descriptor Variable Segments for the Spatial Data File Set, one for the Master Header File and one for the Chain Data File.

The Spatial Data File Set format is described in the sections below. The first part of the File Descriptor Record is described. This part has the same format for both files of the Spatial Data File Set, although the values in some of the fields are different. These differences are noted. Next, the format for the Master Header File is described. This consists of a description of the File Descriptor Variable Segment and the Master Header Record. The Chain Data File format is given next. This consists of the File Decriptor Variable Segment for the Chain Data File and the Chain Data Record.

4.2 FILE DESCRIPTOR RECORD

A File Descriptor Record introduces each data file. The general record format and content are illustrated in Figure 3.1. Following the first 16-bytes (fields 1 to 8) of general information, there are four segments.

The first segment (fields 9 to 12) identifies the documentation of the format of this data file and the software version used to produce the data file. In other words, wile the segment comparable to this in the Volume Descriptor Record identifies current documentation of the Superstructure formats, this field identifies current documentation of the formats of the remainder of the records in this file. The second segment (fields 13 to 27) provides the basic information necessary to read this file (the file containing this file descriptor record). The third segment (field 28) is the spare which is reserved for expansion in the future. The fourth segment (field 29) is referred to as the File Descriptor Variable Segment. This is because this segment varies with the file type. Just as a particular file type indicates a particular file format, it also implies a particular File Descriptor Variable Segments. The File Descriptor Variable Segments for the two file types in the Spatial Data File Set are described in the sections for each file type.

The data fields of the File Descriptor Record (other than those of the Variable Segment) are listed in Table 4.1 and explained in Table 4.2.

TABLE 4.1
FILE DESCRIPTOR RECORD

Field	Byte Nos.	DESCRIPTION
1	1-4	Record Number
2	5	007(8) = File Descriptor Record (1st record sub-type code)
3	6	Record Type Code = 300(8) = Superstructure
4	7	022(8) (2nd record sub-type code)
5	8	022(8) (3rd record sub-type code)
6	9-12 *	Length of this record
7	13-14	ASCII/EBCDIC Flag (= A#)
8	15-16	2 Blanks
9	17-28	Control Document Number for this data File Format
10	29-30	Control Document Revision Number
11	31-32	File Design Descriptor Letter
12	33-44	Software Release Number
13	45-48 *	File Number
14	49-64 *	File Name
15	65-68	Record Sequence and Location Type Flag
16	69-76	Sequence Number Location
17	77-80	Sequence Number Field Length
18	81-84	Record Code and Location Type Flag
19	85-92	Record Code Location
20	93-96	Record Code Field Length
21	97-100	Record Length and Location Type Flag
22	101-108	Record Length Location
23	109-112	Record Length Field Length
24	113	Flag indicating that data interpretation information is included within the field descriptor record.
25	114	Flag indicating that data interpretation information is included within the file in record(s) other than the descriptor.
26	115	Flag indicating that data display information is included within the file descriptor record.
27	116	Flag indicating that data display information is included within the file in record(s) other than the file descriptor.
28	117-180	Reserved Segment
29	181-EOR	File Descriptor Variable Segment (EOR = End-of-Record)

---

* These fields may contain different values for Master Header File and Chain Data File in a File Set.

TABLE 4.2
FILE DESCRIPTOR RECORD
DATA FIELD EXPLANATIONS

Fields 1 to 6 are binary encoded fields. All other fields are in ASCII. Alphanumeric character strings are left-justified and numeric character strings are right-justified. Any fields not used are filled with ASCII blanks. Numbers which do not fill the field should be padded with leading blanks.

Field	EXPLANATIONS
1	An INTEGER*4 number containing the record number of this record within the file. For the File Descriptor Record, this number is always 1.
2	The first sub-type code for this record. This code is 077(8) for the File Descriptor Record.
3	This is the record type code. This code is 300(8) for the Superstructure records.
4	This is the second sub-type code for the record. For this record, the code is 022(8), the default code.
5	This is the third sub-type code for the record. Since none of the Superstructure records use this code, the field contains 022(8), which is the default code.
6	This field contains an INTEGER*4 number giving the length of this record in bytes. For the Master Header File, this is 360 bytes. For the Chain Data File, this length is decided by the user creating the tape.
7	The ASCII/EBCDIC flag indicates if the alphanumeric information in the Referenced File is in ASCII or EBCDIC. For this format, ASCII will be used, so this field will contain A#, where # denotes an ASCII blank.
8	Two ASCII blanks.

TABLE 4.2 (cont'd)
FILE DESCRIPTOR RECORD
DATA FIELD EXPLANATIONS

Field	EXPLANATIONS
9	12 characters containing the number for the document that controls this file format; i.e., this document's number : FOR-SDP-001.
10	2 bytes giving the revision number of the control document defining the current file format; i.e., #A for the original version of this document - # is ASCII blank.
11	2 bytes giving the revision letter of the file format (as opposed to revisions which affect the control document without affecting the file format). For description of the lettering scheme, see field 11 of the Volume Descriptor Record, Table 4.2. Initially coded #A for this format.
12	12 characters identifying the software version used to write this file. This field should be the same as that in field 12 of the Volume Descriptor Record).
13 **	4-byte sequence number of this file within the Logical Volume.
14 **	This is the unique 16-character identification of the present file as stated in field 10 of the File Pointer Record of the Volume Directory File.
15	This 4-byte field indicates if the other records in the file have sequence numbers. This format does not use record sequence numbers; therefore, this field should contain NSEQ.
16	8 blanks, since no sequence numbers are used.
17	4 blanks, since no sequence numbers are used.

** Field updated for Chain File Descriptor Record or other Spatial Data File Sets.

TABLE 4.2 (cont'd)
FILE DESCRIPTOR RECORD
DATA FIELD EXPLANATIONS

Field	EXPLANATIONS
18	4-byte flag to indicate if the other records in the file have a record-type code. This format does not use record-type codes, therefore this field should contain NTYP.
19	8 blanks since no record-type codes are used.
20	4 blanks since no record-type codes are used.
21	4-byte flag to indicate if the other records in the file contain their record-lengths. Since the record lengths are fixed, the length information is not contained in each record; therefore, this field should contain NLGT.
22	8 blanks, since no record-length information is contained in the other records.
23	4 blanks, since no record-length information is contained in the other records.
24-27	4 blanks. These are included to conform to the Superstructure for CCT's.
28	64 bytes for future expansion. Reserved by the LGSOWG-CCB.
29	File descriptor variable segment. Filled with ASCII blanks for the Master Header File. Described in Section 5.4.2 for the Chain Data File.

4.3 MASTER HEADER FILE

4.3.1 INTRODUCTION

The Master Header File consists of two records, each 360 bytes long. The first record is the File Descriptor Record. The first three segments (bytes 1 to 180) of this record have been described in the preceding section. The fourth segment, the File Descriptor Variable Segment (bytes 181 to 360), is not used in this implementation of the Master Header File, so this segment is filled with ASCII blanks. The second reçord is called the Master Header Record. It contains the geographic location, resolution and accuracy of the associated Geographic Detail File. The Master Header Record is described in the following sub-section.

4.3.2 MASTER HEADER RECORD

The Master Header Record is 360 bytes long. It is the second of the two records that make up the Master Header File. This record is divided into six segments. The first segment (fields 1 to 3) contains text giving the title and location of the area covered by the Chain Data File, as well as any miscellaneous text the user wishes to add. The second segment (fields 4 to 6) gives the map projection used in the spatial encoding of the data. The third segment (fields 7 to 14) gives the geographic location of the area covered in the Chain Data File. This segment gives latitude and longitude as well as the co-ordination in the map projection given in the second segment. The fourth segment (fields 15 to 18) gives information on the scale, resolution and positional accuracy of the data. Segment five (fields 19 to 21) has information on the format of the Chain Data File, while segment 6 (field 22) is a spare segment. The data fields of the Master Header Record are listed in Table 4.3 and explained in Table 4.4 Details on the parameters and co-ordinate formats currently in use can be found in Appendix C.

TABLE 4.3
MASTER HEADER RECORD

Field	Label	Byte Nos.	DESCRIPTION
1	BTITLE	1-40	Spatial Data Set Title
2	BGEO	41-120	Geographic Location Text
3	BTEXT	121-160	Descriptive Text
4	BMPCTN	161-180	Map Projection Descriptor
5	BMPCOD	181-184	Map Projection Code
6	JPARAM	185-224	Map Projection Parameters
7	JBLL	225-232	Map Projection Co-ordinates: Lower Left Boundary
8	JBLR	233-240	Map Projection Co-ordinates: Lower Right Boundary
9	JBUR	241-248	Map Projection Co-ordinates: Upper Right Boundary
10	JBUL	249-256	Map Projection Co-ordinates: Upper Left Boundary
11	JLATLL	257-264	Lat/Long: Lower Left
12	JLATLR	265-272	Lat/Long: Lower Right
13	JLATUR	273-280	Lat/Long: Upper Right
14	JLATUL	281-288	Lat/Long: Upper Left
15	JSCALE	289-292	Scale Factor
16	JXREL	293-296	Ground X Resolution
17	JYREL	297-300	Ground Y Resolution
18	JPERR	301-304	Standard Error in Positional Accuracy
19	JFSSQN	305-308	Spatial Data File Set Sequence Number
20	JFTYP	309-312	Code for Spatial Data Format Type
21	JBLKDS	313-316	Blocks per Record in Geographic Detail File
22	MSPARE	317-360	Spare - reserved for future expansion

TABLE 4.4
MASTER HEADER RECORD
DATA FIELD EXPLANATIONS

All fields are in the format specified. INTEGER*4 is an integer 4 bytes long (32-bits). This integer format has the first byte of the field as the most significant, while the last byte of the field is the least significant. See Section 2.4 for details. All ASCII text is left-justified and padded on the right with ASCII blanks to fill the field.

Field	EXPLANATIONS
1	BTITLE ASCII 40 Bytes This is the title for the geographic location of the spatially encoded data.
2	BGEO ASCII 80 Bytes These 80 characters of text describe the geographic location of the spatial data. This is meant to be of general interest to the parties involved in the data transfer as other fields in the header specify the location in Latitude and Longitude coordinates.
3	BTEXT ASCII 80 Bytes These 80 characters are used to provide further descriptive information about the Spatial Data File Set.
4	BMPCTN ASCII 20 Bytes This field contains 20 characters which are used as descriptive text for the map projection employed in the spatial encoding of the data; e.g., UTM. See Appendix C.
5	BMPCOD INTEGER*4 4 Bytes This field specifies the map projection of the spatially encoded data. The committee has chosen the following values for projections most commonly employed in Canada. 0100 – Latitude/Longitude 0200 – Universal Transverse Mercator (UTM) 0201 – Modified Transverse Mercator (MTM) 0202 – Transverse Mercator 0203 – Mercator 0204 – Space Oblique Mercator (SOM) 0205 – Hotine Oblique Mercator (HOM) 0300 – Lambert Conformal 0400 – Stereographic 0500 – Polyconic As the need arises additional codes can be assigned to other map projections. See Appendix C.

TABLE 4.4 (cont'd)

MASTER HEADER RECORD
DATA FIELD EXPLANATIONS

Field	EXPLANATIONS
6	JPARAM INTEGER*4 10 by 4 Bytes This field is used to store parameters relevant to the map projection used in the Spatial Data File Set. For example, if the data were in the Transverse Mercator projection, parameters would be zone width, central meridian, and scaling factor. See Appendix C for details on this field for each projection.
7-10	JBLL,JBLR INTEGER*4 4 by 8 Bytes JBUR,JBUL These four fields are used to store the pairs of coordinates, in the map projection employed, of four corners of a quadrilateral spanning the geographical location of the Spatial Data File Set. These values would be used as a quick reference to the geographical location of the Spatial Data File Set. The order of the corners is Lower Left, Lower Right, Upper Right and Upper Left, respectively. See Appendix C for details on co-ordinate formats for each projection.
11-14	JLATLL,JLATLR INTEGER*4 4 by 8 Bytes JLATUR,JLATUL These four fields are the corresponding latitude and longitude values of the four points previously chosen in fields 11-14. See Appendix C for detils on co-ordinate formats for Latitude/Longitude.
15	JSCALE INTEGER*4 4 Bytes This is the coordinate scale factor relating distance in the Spatial Data File Set projection with the corresponding distance on the ground. This is similar to map scale. For example, if the scale factor were 250000, any distance in the file would have to be multiplied by 250000 to obtain the corresponding distance on the ground.

TABLE 4.4 (cont'd)
MASTER HEADER RECORD
DATA FIELD EXPLANATIONS

Field	EXPLANATIONS		
16	JXREL	INTEGER*4	4 Bytes
	This is the ground X resolution of the data storage in centimetres.		
17	JYREL	INTEGER*4	4 Bytes
	This is the ground Y resolution in centimetres.		
18	JPERR	INTEGER*4	4 Bytes
	This is the standard deviation in the positional accuracy of a resolution element or datum point in the Spatial Data File Set.		
19	JFSSQN	INTEGER*4	4 Bytes
	This is the sequence number of this Spatial Data File Set on this particular tape.		
20	JFTYP	INTEGER*4	4 Bytes
	The purpose of this field is to give an integer which informs the software as to the type of spatial encoding used in the following data storage of the Spatial Data File Set. For the Chain Data Record used in the Chain Data File, the code is 11, for Chain format #1.		
21	JBLKDS	INTEGER*4	4 Bytes
	JBLKDS is the physical blocking factor of the following geographic detail file. This will normally be 1.		
22	MSPARE		4 Bytes
	Spare section, reserved for future expansion. It is filed with INTEGER zeros.		

4.4 CHAIN DATA FILE

4.4.1 INTRODUCTION

The Chain Data File is a specific implementation of the Geographic Detail File. It consists of a File Descriptor Record and any number of Chain Data Records. The File Descriptor Record consists of the fixed segments described above in section 4.2, "FILE DESCRIPTOR RECORD". It also contains the File Descriptor Variable Segment for the Chain Data File. This segment (bytes 181 to End-of-Record of the File Descriptor Record) contains a description of the classification fields in the Chain Data Record.

The Chain Data Record contains the polygon boundary information consisting of a chain of co-ordinate pairs. In addition to the co-ordinates, the record includes classification information for the regions to the left and right of the chain. The references to right and left are made with respect to an observer at the starting point of the chain and facing along the chain.

The minimum size of the File Descriptor Record is 360 bytes, so that the File Descriptor Variable Segment can fit into the File Descriptor Record. This sets the minimum record size of the Chain Data File, since all records in one file are to be the same length. However, it is anticipated that the Chain Data Records will be longer than 360 bytes, so this restriction should have negligible effect. The length of the records in the Chain Data File are further restricted to be multiples of 180 bytes. The length of the records in the file is contained in fields 16 or 17 of the File Pointer Record for this file.

4.4.2 CHAIN FILE DESCRIPTOR VARIABLE SEGMENT

This segment starts at byte 181 of the Chain File Descriptor Record, the first record of the Chain Data File. It contains information on the format of the classification fields in the following Chain Data Records.

The classification fields in the Chain Data Record, one for the left-side and one for the right-side of the chain, are fields N bytes long. These fields are divided into M sub-fields. Each sub-field represents a sub-class within the classification. The length of the classification fields (N) and the number of sub-classes (M) are given in fields 1 and 2 of the File Descriptor Variable Segment.

The fields 3 to L of the File Descriptor Variable Segment give information on each of the M sub-classes. The number of fields depends on the number of sub-classes in the classification. If there are M sub-classes, then this second part of the File Desscriptor Variable Segment has 2*M fields. Thus, the number of fields used in the File Descriptor Variable Segment(L) is 2*M + 2. The 2*M fields are grouped into pairs. The first field of the pair gives the name of the corresponding sub-class in the Chain Data Record. The second field gives the length of the sub-field. For example, suppose that the classification fields are 64 bytes long and are divided into 2 sub-fields, one of 16 bytes and the other of 48 bytes. Therefore, N equals 64 and M equals 2. The number of fields in the second part of the File Descriptor Variable Segment is 2*2 or 4 fields (fields 3 to 6 of the File Descriptor Variable Segment). Field 3 gives the name of the sub-classification represented by the 16-byte sub-field in the Chain Data Record. For this example, we will call it "Gross Class". Field 4 of the File Descriptor Variable Segment will contain 16, which is the length of the first sub-field. Field 5 might contain "Finer Class", which is the name of the second sub-class. Field 6 will contain 48, the length of the second classification sub-field.

The remainder of the File Descriptor Variable Segment, from field L+1 to the End-of-Record, is spare and is filled with ASCII blanks. The record length is the same as the record length for the Chain Data Records.

The data fields of the Chain File Descriptor Variable Segment are listed in Table 4.5 and explained in Table 4.6. The byte numbers for the data fields are the byte numbers within the File Descriptor Variable Segment. Since the File Descriptor Variable Segment starts at byte 181 of the File Descriptor Record, to get the byte number within the File Descriptor Record, add 180. Thus, byte 23 in the File Descriptor Variable Segment is byte 23 + 180 = 203 in the File Descriptor Record.

TABLE 4.5

CHAIN FILE DESCRIPTOR VARIABLE SEGMENT

Field	Label	Byte Nos.	DESCRIPTION
1	BCLEN	1-4	Polygon Descriptor Field Length
2	BSUBNO	5-8	Number of Sub-classes in Descriptor Field
3	BNAME1	9-24	Name of First Sub-Class Descriptor
4	BLEN1	25-28	Length of First Sub-class Descriptor Field
5	BNAME2	29-44	Name of Second Sub-class Decriptor
6	BLEN2	45-48	Length of Second Sub-Class Descriptor Field
7	BNAME3	49-64	Name of Third Sub-class Descriptor
8	BLEN3	65-68	Length of Third Sub-class Descriptor Field
9	BNAME4	69-84	Name of Fourth Sub-class Descriptor
10	BLEN4	85-88	Length of Fourth Sub-class Descriptor Field
11	BNAME5	89-104	Name of Fifth Sub-class Descriptor
12	BLEN5	105-108	Length of Fifth Sub-class Descriptor Field
13	CSPARE	109-EOR	Spare (EOR = End-of-record).

TABLE 4.6

CHAIN FILE DESCRIPTOR VARIABLE SEGMENT
DATA FIELD EXPLANATIONS

All fields are in ASCII. Alphanumeric character strings are left-justified and numeric character strings are right-justified. Any fields not used are filled with ASCII blanks. Numbers which do not fill the field should be padded with leading blanks.

Field	Explanations		
1	BCLEN	ASCII	4 Bytes

This is the total number of bytes in each classification field for the polygons, one lying on the right and one on the left of the chain. The field length is variable but must be a multiple of 4 bytes.

2 BSUBNO ASCII 4 Bytes

This is the number of sub-classes into which a polygon classification is divided. Therefore, this is the number of sub-fields in the polygon classification fields.

3 BNAME1 ASCII 16 Bytes

This is the ASCII name of the first classification sub-class.

4 BLEN1 ASCII 4 Bytes

This gives the length, in bytes, of the first sub-field in the classification fields of the Chain Data Record. This sub-field contains the first sub-class of the classification.

5 BNAME2 ASCII 16 Bytes

This is the ASCII description of the second sub-class classification, which is contained in the second sub-field of the classification fields of the Chain Data Record.

6 BLEN2 ASCII 4 Bytes

Length, in bytes, of the second sub-field of the classification fields of the Chain Data Records.

4.4.3 CHAIN DATA RECORD

The Chain Data Record is the record that contains the actual polygon chain. There is at most one chain per Chain Data Record. However, there may be more than one Chain Data Record per chain. The length of the Chain Data Record is given in Field 17 of the File Pointer Record for this file. This length must be a multiple of 180 bytes with a minimum length of 360 bytes.

A Chain Data Record has 4 segments. The first segment (fields 1 and 2) identifies the chain by its number. The second segment (fields 3 to 5) identify the polygon on the left side of the chain. This includes the polygon number, classification, and area. The third segment (fields 6 to 8) is for the same information about the right polygon. Segment four contains the number of points in the chain and the (X,Y) pairs of points that make up the chain. Appendix C gives the formats for the (X,Y) co-ordinate pairs for the projections currently in use.

The number of points in a chain is variable. There are 8 bytes required for each point. The record size should be chosen to accomodate most chains in one record. A chain may require more than one record. This can be accomodated in the next record(s) by updating the chain number segment (segment 1), repeating segments 2 and 3, then continuing with the point pairs.

The references to right and left are made with respect to an observer at the starting point of a chain and facing along the chain.

The data fields for the Chain Data Record are listed in Table 4.7 and explained in Table 4.8.

TABLE 4.7
CHAIN DATA RECORD

Field	Label	Byte Nos.	DESCRIPTION
1	JCHNUM	1-4	Chain Number
2	JRCNUM	5-8	Sub-chain Number
3	BLSCLA	9-M	*Left Polygon Descriptor
4	JLSNUM	M+1 -M+4	Left Polygon Number
5	JLSARA	M+5 -M+8	Left Polygon Area
6	BRSCLA	M+9 -N	**Right Polygon Descriptor
7	JRSNUM	N+1 -N+4	Right Polygon Number
8	JRSARA	N+5 -N+8	Right Polygon Area
9	JPTNUM	N+9 -N+12	Total Number of Points in Chain
10	JXPT1	N+13-N+16	First X Co-ordinate in Chain
11	JYPT1	N+17-N+20	First Y Co-ordinate in Chain
12	JXPT2	N+21-N+24	Second X Co-ordinate in Chain
13	JYPT2	N+25-N+28	Second Y Co-ordinate in Chain
		N+29-EOR	Further (X,Y) pairs of Points (EOR = End-of-Record).

---

* M can be 12, 16, 20, 24, etc. (i.e. M = I*4 + 8, where I is an Integer).

** N can be M+16, M+20, etc.

TABLE 4.8
CHAIN DATA RECORD
DATA FIELD EXPLANATIONS

All fields are in the format specified. INTEGER*4 is an integer 4 bytes long (32-bytes). This integer format has the first byte of the field as the most significant, while the last byte of the field is the least significant. See Section 3.4 for details. All ASCII text is left-justified and padded on the right with ASCII blanks to fill the field.

Field **EXPLANATIONS**

1 JCHNUM INTEGER*4 4 Bytes
JCHNUM is the chain number within the data set. Chains will be numbered sequentially in ascending order.

2 JRCNUM INTEGER*4 4 Bytes
This is the record or sub-chain number within one chain. This field will normally contain 1 but will be incremented appropriately when a chain is long enough to span more than one record. This field can be regarded as a counter for the sub-chain within a complete chain.

3 BLSCLA ASCII Multiple of 4 Bytes
This is the classification of the polygon on the left side of this chain. The total length of this field is determined by the value of BCLEN in the Chain File Descriptor Variable Segment. The decomposition of the classification data into sub-fields is determined by fields 4 and on of the Chain File Descriptor Variable Segment.

4 JLSNUM INTEGER*4 4 Bytes
JLSNUM is the polygon number on the left side of this chain. This number is a unique identifier for this polygon.

5 JLSARA INTEGER*4 4 Bytes
This is the area of the polygon on theleft side in hectares.

6 BRSCLA ASCII Multiple of 4 Bytes
This is the classification of thepolygon on theright side. This field has the same structure as BLSCLA.

7 JRSNUM INTEGER*4 4 Bytes
This the polygon number on theright side of the chain.

8 JRSARA INTEGER*4 4 Bytes
This is the area of the polygon on the right side of the chain in hectares.

TABLE 4.8 (cont'd)
CHAIN DATA RECORD
DATA FIELD EXPLANATIONS

Field	EXPLANATIONS		
9	JPTNUM	INTEGER*4	4 Bytes
	The total number of points in the chain.		
10	JXPT1	INTEGER*4	4 Bytes
	First X coordinate in the chain. This is given in the co-ordinates of the map projection given in fields 4 and 5 of the Master Header Record (BMPCTN and JMPCOD). See Appendix C		
11	JYPT1	INTEGER*4	4 Bytes
	First Y coordinate in the chain. See Appendix C.		
12	JXPT2	INTEGER*4	4 Bytes
	Second X coordinate in the chain. See Appendix C.		
13	JYPT2	INTEGER*4	4 Bytes
	Second Y coordinate in the chain. See Appendix C.		

Further pairs of points in the chain are continued in the same manner as the points in fields 12 and 13 (X and Y, respectively). The total number of points depends on the chain. A pair of points requires 8 bytes. The rest of the record, from the last pair of points to the End-of-Record, is zero-filled. If the chain is continued with more records, then fields 1 through 9 are repeated in the next record with field number 2 being incremented each time a record is spanned.

TABLE 4.8 (cont'4)

CHAIN DATA RECORD

DATA FIELD EXPLANATIONS

<u>Field</u> <u>EXPLANATIONS</u>

9 JPNTNM INTEGER*4 4 Bytes
The total number of points in the chain.

10 JXPT1 INTEGER*4 4 Bytes
First X coordinate in the chain. This is given in the co-ordinates of the map projection given in fields 4 and 5 of the Master Header Record (JMPCTN and JMZCOD). See Appendix C.

11 JYPT1 INTEGER*4 4 Bytes
First Y coordinate in the chain. See Appendix C.

12 JXPT2 INTEGER*4 4 Bytes
Second X coordinate in the chain. See Appendix C.

13 JYPT2 INTEGER*4 4 Bytes
Second Y coordinate in the chain. See Appendix C.

Further pairs of points in the chain are continued in the same manner as the points in fields 12 and 13 (X and Y, respectively). The total number of points depends on the chain. A pair of points requires 8 bytes. The rest of the record, from the last pair of points to the End-of-Record, is zero-filled. If the chain is continued with more records, then fields 1 through 9 are repeated in the next record with field number 2 being incremented each time a record is spanned.

5. CHANGE CONTROL

This is the first version of this standard format. Future changes will be incorporated into the format by the Spatial Data Transfer Committee so that compatibility with previous versions, is maintained. Revised chapters or sections of this report will be made available in the future.

We anticipate that the correspondence in regard to and in maintenance of this format will rotate from agency to agency in the SDTC. Until further notice, any comments with regard to this format, such as suggestions for revisions, should be addressed to:

Dr. David Goodenough,
Canada Centre for Remote Sensing,
Department of Energy, Mines and Resources,
2464 Sheffield Road,
Ottawa, Ontario.
Canada K1A 0Y7

APPENDIX A

GLOSSARY OF TERMS

This appendix is a glossary of terms used in this document.

BLOCK - A collection of characters written or read as a unit. In this format, a block contains exactly one record. Blocks are separated by interblock gaps, sometimes called interrecord gaps.

BPI - Bits per Inch, a reference to the recording density on the magnetic tape; also referred to as Characters-per-Inch (CPI). Generally, 800 or 1600 BPI tapes are used.

CCRS/EMR - Canada Centre for Remote Sensing, a branch of the Department of Energy Mines, and Resources of the Government of Canada.

CCT - Computer Capatible Tape; a magnetic tape that can be read by a computer.

CHAIN - A string of points between nodal junctions.

EOF - End-Of-File, also called a Tape Mark. A delimiter used to indicate the boundary between files. In this format a EOF is a one-byte block or record consisting of the ASCII end-of-file character (octal 032).

EOR - End-Of-Record, the last byte of a record.

EOS - End-Of-Set, three EOF's in a row. Note that each EOF is a separate block. The EOS denotes the end of a Volume Set as well as the end of the data recorded on the Physical Volume.

EOV - End-Of-Volume, two EOF'S in a row. Note that each EOF is a separate block. The EOV denotes the end of the data recorded on the Physical Volume.

FIELD - A logical element of data within a record or a collection of sub-fields. A field may be a number, or numbers, or a collection of characters. Field sizes and data types are dependant on the format of the record.

GLOSSARY OF TERMS

FILE	– A collection of information consisting of records pertaining to a single subject. A file begins at the end of the preceding file or the beginning of tape, and ends with an EOF.
FILE SET	– A collection of one or more related files. In this format, the SDFS is a collection of 2 files.
GG/SC	– Geocartographics Group, Statistics Canada, of the Government of Canada.
LD/DOE	– Lands Directorate of the Department of the Environment of the Government of Canada.
LGSOWG-CCB	– Landsat Ground Station Operators Working Group, Configuration Control Board. An international body that is defining a standard for CCT's for exchanging satellite remote sensing data.
LOGICAL VOLUME	– A collection of related files and file sets. In this format, a Logical Volume is the same as a Volume Set. A Logical Volume may span one or more Physical Volumes.
MSS	– Multi-Spectral Scanner, the major sensor system employed on LANDSAT Satellites.
NODAL JUNCTION	– Meeting place of 3 or more lines.
PHYSICAL VOLUME	– A physical unit of storage media. For this format, this is completely synonymous with "reel of magnetic tape". A Physical Volume has foil markers at the beginning and at the end of the tape.
POINT	– Single (X,Y) coordinate pair.
POLYGON	– A closed region bounded by straight line segments that can be constructed from points, lines, or chains.
RECORD	– A collection of related data treated as a logical unit. In this format, a record occupies one block on the magnetic tape.

SCD/AC	– Systems and Consulting Division of the Department of Agriculture of the Government of Canada.
SDFS	– Spatial Data File Set, a logical collection of spatial data files.
SDTC	– Spatial Data Transfer Committee.
SEGMENT	– In the context of records, a segment is a sub-division of a record. A segment contains one or more fields. For polygons, a segment is a line defined by two points.
SUPERSTRUCTURE	– The tape format structure developed by LGSOWG for CCTs.
VOLUME SET	– A collection of Logical Volumes. The collection may span one or more Physical Volumes. A Volume Set ends with an EOS.

GLOSSARY OF TERMS

FILE – [illegible] consisting of records [illegible] to a single subject. A file begins at the end [illegible] beginning of tape, [illegible] with an EOF.

FILE SET – [illegible] related files. In this format, the SDF is a collection of 2 files.

GSRD – [illegible] Statistics Canada, of the [illegible]

LD/DOE – Lands Directorate of the Department of the [illegible]

LGSOWG-CCB – Landsat Ground Station Operators Working Group, [illegible] – An international [illegible] CCT's for exchanging satellite [illegible]

LOGICAL VOLUME – A collection of related files and file sets. In this format, a Logical Volume is the same as a Volume Set. A Logical Volume may span one or more Physical Volumes.

MSS – Multi-Spectral Scanner, the major sensor system employed on LANDSAT Satellites.

NODAL JUNCTION – Meeting place of 3 or more lines.

PHYSICAL VOLUME – A physical unit of storage media. For this format, this is completely synonymous with "reel of magnetic tape". A Physical Volume has [illegible] markers at the beginning and at the end of the tape.

POINT – Single (X,Y) coordinate pair.

POLYGON – A closed region bounded by straight line segments [illegible] points, lines, or chains.

RECORD – A collection of related data treated as a logical unit. In this [illegible] block on the magnetic tape.

APPENDIX B

BRIEF DESCRIPTIONS OF IMPORTANT MAP PROJECTIONS

Joel Z. Yan
Geocartographics Group,
Systems and Data Processing Branch,
Statistics Canada

B.1 CYLINDRIC PROJECTIONS

B.1.1. Mercator Projection

The Mercator projection is a conformal cylindrical projection which preserves length along the equator and transforms the equator into a straight line. It can be visualized in terms of a mathematical projection from the earth to a cylinder tangent to the globe along the equator. The meridians are transformed to vertical evenly spaced parallel straight lines intersecting the equator at right angles. The lines of latitude (parallels) are projected into straight but unevenly spaced lines. In order to preserve conformality, the north-south scale is stretched as the latitude increases. The main application of this projection in Canada is for navigational charts.

B.1.2. The Transverse Mercator Projection

If the cylinder mentioned above in the Mercator projection is rotated through 90 degrees so that it is lying "transverse" and is tangent to the globe along a meridian, called the central meridian, the Transverse Mercator projection can be visualized. All of the conformal relationships of the Mercator projection except the rhumb line property are retained in the Transverse Mercator Projection. The central meridian and equator are transformed to straight lines, but the other meridians and parallels become concave. Since there is little distortion near the central meridian, this projection is often used for mapping areas close to the central meridian. Its real importance is in serving as the basis for the zoned Transverse Mercator projections, UTM and 3 Degree TM.

B.1.2.1. Universal Transverse Mercator – The UTM grid system was developed for a world wide plane coordinate referencing system. The earth is divided into sixty zones, each extending through 6 degrees of longitude; the latitude limits are 80 degrees N and 80 degrees S. Each zone has its own central meridian with the zone extending 3 degrees to either side of it. Within each zone there is a Transverse Mercator projection about the central meridian of the zone. The scale factor along the central meridian is less than unity to reduce the maximum scale error within the zone. The zone boundaries and scale factor (0.9996) have been standardized by international agreement. The coordinates are expressed in metres. Northings are measured from the equator which is assigned a northing value of 0. Eastings are measured within the zone from the central meridian which is assigned an easting of 500,000 meters. This projection is in wide use in Canada as the basis for many series of topographic maps.

B.1.2.2 3 Degree Transverse Mercator – This projection is very similar to UTM but the zone width is reduced from 6 degrees to 3 degrees to reduce the scale error. A scale factor of .9999 is used along the central meridian. This projection is in use for mapping by some of the provincial governments including Ontario and Alberta.

B.2 CONIC PROJECTIONS

For conic projections, all parallels of latitude are transformed into concentric circles and meridians are transformed into radii of these circles. They can be visualized geometrically as projections from a sphere to a tangent or secant cone resting over the sphere. One of the most common conic projections is Lambert Conformal.

B.2.1 Lambert Conformal With Two Standard Parallels

This is a projection which is simultaneously conic and conformal. Typically, the cone is a secant cone about the pole intersecting the earth along two parallels, called the standard parallels. Meridians are transformed into equally spaced straight lines meeting the parallels at right angles. Scale is true along the standard parallels, less than 1.0 between them and more than 1.0 outside them. A central meridian and origin point must typically be specified as there is no universal standard. According to Robinson (1969), "area deformation between and near the standard parallels is small and thus the projection provides exceptionally good directional and shape relationships for an east-west latitudinal zone". Consequently, the projection is widely used for air navigation and for meteorological charts in intermediate latitudes.

B.3 AZIMUTHAL PLANE PROJECTIONS

All azimuthal projections involve projections from the surface of the earth onto a plane perpendicular to a line passing through the centre of the earth. The projection is symmetric about the point at which the line intersects the surface of the earth. The variation in scale factor radiates from the centre at the same rate in all directions.

B.3.1. Stereographic Projection

The sterographic projection is the conformal member in the azimuthal family. It is in use as the provincial projection for New Brunswick and Prince Edward Island. Scale is "true" along the circle of intersection between the plane and spheroid. It is greater than 1.0 outside this circle and less than 1.0 inside this circle. The projection has the property that all circles on the earth are preserved. This scale deformation property makes its use advantageous for areas that are more or less square. It is also used for navigation and weather prediction over the polar regions.

APPENDIX C

FORMATS FOR MAP PROJECTIONS AND CO-ORDINATES

The SDTC has designed the format for the spatial data exchange so that many different projections and co-ordinate systems can be used. This appendix lists the projections currently used, together with the formats for the required parameters and co-ordinates.

The following fields may be interpreted differently from one projection to another:

1. In the Master Header Record of the Master Header File:

   1. BMPCTN - Field 4,

   1. BMPCOD - Field 5,

   1. JPARAM - Field 6,

   1. JBLL to JBUL - Fields 7 to 10, and

   1. JLATLL to JLATUL - Fields 11 to 16.

2. In the Chain Data Record of the Chain Data File:

   2. JXPT1 - Field 10,

   2. JYPT1 - Field 11, and

   2. All the rest of the fields which contain the spatial data co-ordinates.

   These fields contain:

   1. The map projection being used to locate the spatial data (BMPCTN and BMPCOD),

   2. The map parameters which describe the projection (JPARAM), and

   3. Co-ordinates of spatial data points, both in Latitude/Longitude (JLATLL to JLATUL) and in the given projection (JBLL to JBUL and JXPT1, JYPT1, etc.).

All of these fields must have specific formats for each projection. The rest of this appendix describes these formats for the projections currently in use. If anyone wishes to use a different projection, then the specification of the projection should follow the outline given in Table C-1.

TABLE C-1

Specification Outline for Map Projections

1) PROJECTION NAME: (The common name used for this projection.)
2) DATE: (To allow users to keep track of revisions and updates.)
3) SPECIFICATION PREPARED BY: (The organization and individual(s) responsible for this specification.)
4) MAP PROJECTION IDENTIFIERS
   4.1) BMPCTN (20 CHARACTERS): (For Field 4 of the Master Header Record.)
   4.2) BMPCOD (4 CHARACTERS): (For Field 5 of the Master Header Record.)
5) MAP PROJECTION PARAMETERS
   5.1) DESCRIPTION: (The general requirements for the projection, extensions to other projections, and implicit parameters.)
   5.2) DETAILS: (Field 6 of the Master Header Record (JPARAM) is labelled JPARAM(1) to JPARAM(10). Each subfield (and each byte within the subfield, if necessary) must be specified as to data type, interpretation, and possible values. Any unused subfield should be assigned an integer zero. JPARAM(10) should be used as the format type code for the Latitude/Longitude co-ordinates, since each projection contains Latitude/Longitude co-ordinates in Fields 11 to 14 of the master Header Record. See the specification for the Latitude/Longitude co-ordinates in Fields 11 to 14 of the Master Header Record. See the specification for the Latitude/Longitude format for details.)
6) CO-ORINDATES (X)
   6.1) FIRST CO-ORDINATE (X)
      6.1.1) NAME: (This is for the first of the pair of co-ordinates needed to locate the spatial data in the given projection.)
      6.1.2) FORMAT: (All first elements of the co-ordinate pairs will be given in this format for this projection. The format may vary from one Spatial Data File Set to another, but it may not vary within a File Set.)
      6.1.3) EXAMPLE: (Give a practical case and show any cases that might be confusing.)
   6.2 SECOND CO-ORDINATE (Y)
      6.2.1) NAME: (Sections 6.2.1 to 6.2.3 are similar to sections 6.1.1 to 6.1.3 above, but with reference to the second element of the co-ordinate pairs (Y).)
      6.2.2) FORMAT:
      6.2.3) EXAMPLE:

COMMENTS: (Anything else that is pertinent and not included in the above.)

TABLE C-2

1) PROJECTION NAME: LATITUDE/LONGITUDE, or GEOGRAPHIC

2) DATE: 01-DEC-1979

3) SPECIFICATION PREPARED BY: Spatial Data Transfer Committee.
4) MAP PROJECTION IDENTIFIERS
4.1) BMPCTN (20 CHARACTERS): "LATITUDE/LONGITUDE"
4.2) BMPCOD (4 CHARACTERS): "0100"

5) MAP PROJECTION PARAMETERS
5.1) DESCRIPTION: Latitude/longitude requires no parameters, so the first 9 4-byte subfields of JPARAM are not used. The last subfield (JPARAM(10)) contains an integer giving the precision of the latitude/longitude co-ordinates.
5.2) DETAILS:
JPARAM(1) to JPARAM(10) - Not used, so filled with integer zeros.
JPARAM(10 - An Integer*4 number giving the format code for the co-ordinates. This code is also the precision of the co-ordinates, i.e., the number of decimal places in the seconds. Current values are:
0 - for no decimal places in seconds,
1 - for 1 decimal place in seconds,
2 - for 2 decimal places in seconds,
3 - for 3 decimal places in seconds.

6) CO-ORDINATES
6.1) FIRST CO-ORDINATE (X)
6.1.1) NAME: Longitude
6.1.2) FORMAT: Longitude is given as an integer in degrees, minutes and seconds with the number of decimal places in the seconds given by JPARAM(10). If JPARAM(10) is 0, then the seconds occupy the units and tens position of the decimal number (i.e., 10**0 and 10**1). The minutes occupy the hundreds and thousands positions (i.e., 10**2 and 10**3), while the degrees occupy the ten thousands, hundred thousands and milions positions (i.e., 10**4, 10**5, and 10**6). A positive value indicates the Western Hemisphere, while a negative value indicates the Eastern Hemisphere. If JPARAM(10) is 1, 2, or 3, then the positions of the degrees, minutes, and seconds are shifted to the left by the appropriate number of digits. Note that the decimal place is implied by JPARAM(10) and does not appear in the number, since longitude is given as an integer. The possible values for Longitude range from -360 Degrees to +360 Degrees.

(6.1.3) EXAMPLE: The Longitude, West 81 Degrees, 49 Minutes, 32.432 Seconds will be given by:

814932 - for JPARAM(10) = 0,
8149324 - for JPARAM(10) = 1,
81493243 - for JPARAM(10) = 2,
814932432 - for JPARAM(10) = 3,

6.2) SECOND CO-ORDINATE(Y)

6.2.1) NAME: Latitude

6.2.2) FORMAT: Same as Longitude. Positive values indicate the Northern Hemisphere, while negative values are for the Southern Hemisphere. Possible values range from -90 Degrees to +90 Degrees.

6.2.3) EXAMPLE: The Latitude, South 23 Degrees, 14 Minutes, 15.000 Seconds will be given as:

-231415 - for JPARAM(10) = 0,
-2314150 - for JPARAM(10) = 1,
-23141500 - for JPARAM(10) = 2,
-231415000 - for JPARAM(10) = 3,

7) COMMENTS: This format should be used for all Latitude/Longitude references in other projections, since Fields JLATLL to JLATUL of the Master Header Record are in Latitude/Longitude for all projections.

TABLE C-3

1) PROJECTION NAME: UNIVERSAL TRANSVERSE MERCATOR (UTM)

2) DATE: 01-DEC-1979

3) SPECIFICATION PREPARED BY: Spatial Data Transfer Committee.

4) MAP PROJECTION IDENTIFIERS

4.1) BMPCTN (20 CHARACTERS): "UNIVERSAL TRANS MERC"

4.2) BMPCOD (4 CHARACTERS): "0200"

5) MAP PROJECTION PARAMETERS

5.1) DESCRIPTION: The following parameters define the UTM zone, central meridian, and the scale factor. Some of these are fixed for UTM, but are included so that this format can be used for other Transverse Mercator Projections.

5.2) DETAILS: JPARAM(7) is in ASCII. All other subfields of JPARAM are INTEGERS.

JPARAM(1) - The integer giving the Longitude of the Central Meridian. The Longitude is given in degrees, minutes and seconds with no decimal places for the seconds. Example: West 81 degrees is stored as the integer 810000.

JPARAM(2) - This integer gives the Zone Width in degrees, minutes and seconds. For UTM, the zones are 6 degrees wide, so this field will contain the integer 060000. This field has the same format as JPARAM(1).

JPARAM(3) - This is the scale factor given in millionths. For UTM, the scale factor is 0.9996. Therefore, this subfield will contain the integer 999600.

JPARAM(4) - This gives the dimensions of the Easting and Northing co-ordinates. Current values are:

-1 - for feet,
0 - for metres,
1 - for tenths of metres, and
2 - for hundredths of metres (centimetres).

JPARAM(5) - False Easting. The co-ordinate value for the Central Meridian. For UTM, this is set to 500000 metres. The format is the same as the Easting format in 6.1.2.

JPARAM(6) - False Northing. For UTM, this is the co-ordinate value of the equator. This value is 0 if the area of interest is in the Northern Hemisphere. If the area is in the Southern Hemisphere, this is 1000000 metres. This follows the same format as for Eastings (6.1.2).

JPARAM(7) - Zone number in ASCII. This subfield will contain 4 characters; i.e., for zone 17, this will contain "17".

JPARAM(8) - Unused. Contains integer 0.

JPARAM(9) - Unused. Contains integer 0.

JPARAM(10) The format code for the Latitude/Longitude co-ordinates in fields 11 to 16 of the Master Header Record. These are the same codes as in the Latitude/Longitude projection; i.e., this value gives the number of decimal places in the seconds of the latitude and longitude measurements.

6) CO-ORDINATES

6.1) FIRST CO-ORDINATE (X)

6.1.1) NAME: Easting

6.1.2) FORMAT: An integer, always positive, with the Easting co-ordinate in the units specified by JPARAM(4).

6.1.3) EXAMPLE: An Easting of 470295 metres is stored as 470295 if JPARAM(4) = 0.

6.2) SECOND CO-ORDINATE (Y)

6.2.1) NAME: Northing

6.2.2) FORMAT: Same as in 6.1.2.

6.2.3) EXAMPLE: A northing of 5112345.0 metres will be stored as 51123450 if JPARAM(4) = 1.

7) COMMENTS: The parameters described above are sufficient to uniquely define all Transverse Mercator Projections. Other Mercator projections should be able to use the above general layout, so that all Mercator projections will have a common field structure for their parameters.

APPENDIX D

REFERENCES

1) "The CCT Family of Tape Formats", LANDSAT Ground Station Operators Working Group, Configuration Control Board. Document number: CCB-CCT-0002, Revision number: A

2) "Recorded Magnetic Tape for Information Exchange (1600 CPI, PE)", ANSI document number: X3.39 - 1973.

3) Cornell, Kevin. MAPLIB: Map Projection Transformations, Ottawa: Department of Energy, Mines and Resources, Surveys and Mapping Branch, 1977, 50 pp.

4) Harris, L.J. Elements of Topographical Mapping in Canada, Technical Report No. 70-5, Ottawa: Department of Energy, Mines and Resources, Surveys and Mapping Branch, 1970, 17 pp.

5) Lee, L.P. "The Nomenclature and Classification of Map Projections", Empire Survey Review, Vol. 7, No. 51, 1934, pp. 190-200.

6) Richardus, Peter and Adler, Ron K. Map Projections for Geodesists, Cartographers, and Geographers, New York: American Elsevier Publishing Co., 1972, 174 pp.

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8) Weiss, C.C., "MAPLIB: an Examination of a Projection Transformation Program", Statistics Canada 1978. 76 p.

APPENDIX D

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1) "The CCT Family of Tape Formats", LANDSAT Ground Station Operators Working Group, Configuration Control Board. Document number: CCB-CCT-0002, Revision number: A

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