Technical Report Series on the 
Boreal Ecosystem-Atmosphere Study (BOREAS)

Forrest G. Hall, Editor

Volume 105

BOREAS Elevation Contours over the 
NSA and SSA in ARC/INFO Generate Format

David Knapp and Jaime Nickeson, Raytheon ITSS, 
NASA Goddard Space Flight Center, Greenbelt, Maryland
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David Knapp and Jaime Nickeson, Raytheon ITSS,
NASA Goddard Space Flight Center, Greenbelt, Maryland
BOREAS Elevation Contours over the NSA and SSA in ARC/INFO Generate Format

David Knapp, Jaime Nickeson

Summary

This data set was prepared by BORIS Staff by reformatting the original data into the ARC/INFO Generate format. The original data were received in SIF at a scale of 1:50,000. BORIS staff could not find a format document or commercial software for reading SIF; the BOREAS HYD-08 team provided some C source code that could read some of the SIF files. The data cover the BOREAS NSA and SSA. The original data were compiled from information available in the 1970s and 1980s. The data are available in ARC/INFO Generate format files.

Note that the files of this data set on the BOREAS CD-ROMs have been compressed using the Gzip program. See Section 8.2 for details.

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1. Data Set Overview

1.1 Data Set Identification
BOREAS Elevation Contours over the NSA and SSA in ARC/INFO Generate Format

1.2 Data Set Introduction
This vector contour data set was prepared by BORreal Ecosystem-Atmosphere Study (BOREAS) staff by reformatting the original data into the ARC/INFO Generate format. These data cover portions of the BOREAS Northern Study Area (NSA) and Southern Study Area (SSA) and are on a scale of 1:50,000.
1.3 Objective/Purpose
These data are provided as part of the BOREAS Staff Science Geographic Information System (GIS) Data Collection Program, which included the collection of pertinent map data in both hardcopy and digital form. The purpose of these data is to provide the user with elevation contours of the Modeling Sub-Areas (MSAs). These data can be used to create Digital Elevation Models (DEMs) of the MSAs. The original Standard Interchange Format (SIF) data were reformatted to the ARC/INFO Generate format because it was considered difficult for an average user to extract the contours from the SIF files.

1.4 Summary of Parameters
The parameters that are in the reformatted data are the elevation of the contour (meters above mean sea level) and North American Datum of 1983 (NAD83) Universal Transverse Mercator (UTM) coordinate pairs (easting and northing) along the contour.

1.5 Discussion
Based on information available to BOREAS Information System (BORIS) personnel, these data were manually digitized from the National Topographic System (NTS) map sheets at a scale of 1:50,000. The data were given to BORIS staff in SIF and K8A (the meaning of K8A is unknown) formats. C source code provided by the BOREAS Hydrology (HYD)-08 team was modified to read the contour data from various files. The input data were understood to be in a standard format, but they were not standard in terms of the software's ability to consistently read all of the data files.

1.6 Related Data Sets
BOREAS HYD-08 DEM Data over the NSA-MSA and SSA-MSA in the UTM Projection

2. Investigator(s)

2.1 Investigator(s) Name and Title
David Knapp
BORIS Staff Member

2.2 Title of Investigation
BOREAS Staff Science GIS Data Collection Program

2.3 Contact Information

Contact 1:
David Knapp
Raytheon ITSS
NASA GSFC
Code 923
Greenbelt, MD 20771
(301) 286-1424
David.Knapp@gsfc.nasa.gov

Contact 2:
Jaime Nickeson
Raytheon ITSS
NASA GSFC
Code 923
Greenbelt, MD 20771
(301) 286-3373
Jaime.Nickeson@gsfc.nasa.gov
3. Theory of Measurements

These data were not collected with any particular research in mind.

4. Equipment

4.1 Sensor/Instrument Description
Unknown.

4.1.1 Collection Environment
Unknown.

4.1.2 Source/Platform
Unknown.

4.1.3 Source/Platform Mission Objectives
The implied purpose of the NTS 1:50,000-scale map sheets was to provide users with needed location and topographic information.

4.1.4 Key Variables
Elevation above mean sea level NAD83 UTM coordinate pairs.

4.1.5 Principles of Operation
Unknown.

4.1.6 Sensor/Instrument Measurement Geometry
Unknown.

4.1.7 Manufacturer of Sensor/Instrument
Unknown.

4.2 Calibration

4.2.1 Specifications
Unknown.

4.2.1.1 Tolerance
Unknown.

4.2.2 Frequency of Calibration
Unknown.

4.2.3 Other Calibration Information
None.

5. Data Acquisition Methods

The data were acquired from the National Topographical Data Base and received from the Canadian Centre for Remote Sensing (CCRS). The original data came in SIF, digitized from 1:50,000-scale topographic maps.
6. Observations

6.1 Data Notes
None.

6.2 Field Notes
None.

7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage
The various data files cover parts of the BOREAS NSA-MSA and SSA-MSA. The two areas that are covered by these vector files include an area west of Thompson, Manitoba (NSA), and an area north of Prince Albert, Saskatchewan (SSA). Each of the following maps covers an area roughly 31.5 km x 27.8 km. The following NTS map sheets are covered by the data:

For the NSA:

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>63 O/10</td>
<td>Wuskwatim Lake</td>
</tr>
<tr>
<td>63 O/15</td>
<td>Nelson House</td>
</tr>
<tr>
<td>63 O/16</td>
<td>Noble Lake</td>
</tr>
<tr>
<td>63 O/09</td>
<td>Osawagan Lake</td>
</tr>
<tr>
<td>63 P/14</td>
<td>Begg Lake</td>
</tr>
<tr>
<td>64 A/03</td>
<td>Orr Lake</td>
</tr>
<tr>
<td>64 A/04</td>
<td>Strong Lake</td>
</tr>
<tr>
<td>64 B/01</td>
<td>Harding Lake</td>
</tr>
<tr>
<td>64 B/02</td>
<td>Leftrook Lake</td>
</tr>
</tbody>
</table>

For the SSA:

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>73 G/09</td>
<td>Halkett Lake</td>
</tr>
<tr>
<td>73 G/16</td>
<td>Waskesiu Lake</td>
</tr>
<tr>
<td>73 H/09</td>
<td>Torch River</td>
</tr>
<tr>
<td>73 H/10</td>
<td>Bedard Creek</td>
</tr>
<tr>
<td>73 H/11</td>
<td>Birchbark Lake</td>
</tr>
<tr>
<td>73 H/12</td>
<td>Emma Lake</td>
</tr>
<tr>
<td>73 H/13</td>
<td>Bittern Lake</td>
</tr>
<tr>
<td>73 H/14</td>
<td>Candle Lake</td>
</tr>
<tr>
<td>73 H/15</td>
<td>White Gull Creek</td>
</tr>
<tr>
<td>73 H/16</td>
<td>Falling Horse Creek</td>
</tr>
<tr>
<td>73 I/01</td>
<td>Scarth River</td>
</tr>
<tr>
<td>73 I/02</td>
<td>Summit Lake</td>
</tr>
<tr>
<td>73 I/03</td>
<td>Whiteswan Lake</td>
</tr>
<tr>
<td>73 I/04</td>
<td>Montreal Lake South</td>
</tr>
<tr>
<td>73 J/01</td>
<td>Crean Lake</td>
</tr>
</tbody>
</table>
The area covered by these sheets does not cover all of the area described by the following NAD83 bounding coordinates. These bounding areas are provided to give a general idea of where these map sheets fall.

### NSA-MSA

<table>
<thead>
<tr>
<th></th>
<th>Longitude</th>
<th>Latitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northwest</td>
<td>98.72W</td>
<td>56.055N</td>
</tr>
<tr>
<td>Northeast</td>
<td>98.09W</td>
<td>55.990N</td>
</tr>
<tr>
<td>Southeast</td>
<td>98.18W</td>
<td>55.726N</td>
</tr>
<tr>
<td>Southwest</td>
<td>98.81W</td>
<td>55.790N</td>
</tr>
</tbody>
</table>

### SSA-MSA

<table>
<thead>
<tr>
<th></th>
<th>Longitude</th>
<th>Latitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northwest</td>
<td>105.18W</td>
<td>54.093N</td>
</tr>
<tr>
<td>Northeast</td>
<td>104.42W</td>
<td>54.053N</td>
</tr>
<tr>
<td>Southeast</td>
<td>104.48W</td>
<td>53.695N</td>
</tr>
<tr>
<td>Southwest</td>
<td>105.23W</td>
<td>53.735N</td>
</tr>
</tbody>
</table>

7.1.2 Spatial Coverage Map
Not available.

7.1.3 Spatial Resolution
The original contour interval of the data is 25 feet (7.62 m).

7.1.4 Projection
The data are in their original UTM projection. The NSA data are in UTM zone 14, and the SSA data are in UTM zone 13.

7.1.5 Grid Description
Quantitative estimates were not made of the mean spacing between points along the contour lines. Visual assessment of the data showed the spacing to be appropriate for the 1:50,000 scale (i.e., there was no noticeable jaggedness or discontinuities along the contours).

7.2 Temporal Characteristics

7.2.1 Temporal Coverage
Information regarding when the original source data were collected is sketchy. Most of the maps from which these contours were digitized were made in the 1970s or 1980s.

7.2.2 Temporal Coverage Map
Not available.

7.2.3 Temporal Resolution
Although these data were likely compiled from map and aerial photograph vintages covering 10 or more years, they are considered to be a single reference data set.

7.3 Data Characteristics

7.3.1 Parameter/Variable
Elevation above mean sea level
NAD83 UTM coordinate pairs along a given elevation contour
7.3.2 Variable Description/Definition
Elevation above mean sea level - The vertical distance between a plane at mean sea level and a parallel plane intersecting this point. NAD83 UTM coordinate pairs along a given elevation contour - The NAD83-based UTM easting and northing coordinate pairs that define the geographic locations over which the given contour exists.

7.3.3 Unit of Measurement
Elevation above mean sea level - meters
NAD83 UTM coordinate pairs along a given elevation contour - UTM meters

7.3.4 Data Source
Geomatics Canada
Natural Resources Canada
615 Booth St.
Ottawa, Ontario K1A 0E9 CANADA

7.3.5 Data Range
NDA-MSA
Elevation (meters)
----------------
Minimum: 206
Maximum: 381

SSA-MSA
Elevation (meters)
----------------
Minimum: 335
Maximum: 747

7.4 Sample Data Record
442
533084.00, 5939891.00
533079.00, 5939891.00
533061.00, 5939889.00
533033.00, 5939897.00
532950.00, 5939902.00
532877.00, 5939910.00
532849.00, 5939918.00
532784.00, 5939950.00
532747.00, 5939991.00
532714.00, 5940015.00
532539.00, 5940100.00
END
8. Data Organization

8.1 Data Granularity
The smallest amount of data obtainable is the entire set of vector contour files.

8.2 Data Format(s)

8.2.1 Uncompressed Data Files
The vector contour data set consists of a set of 24 files in the following order:

File 1: Data for Map 73 G/09 (400 bytes per record) SSA
File 2: Data for Map 73 G/16 (400 bytes per record)
File 3: Data for Map 73 H/09 (400 bytes per record)
File 4: Data for Map 73 H/10 (400 bytes per record)
File 5: Data for Map 73 H/11 (400 bytes per record)
File 6: Data for Map 73 H/12 (400 bytes per record)
File 7: Data for Map 73 H/13 (400 bytes per record)
File 8: Data for Map 73 H/14 (400 bytes per record)
File 9: Data for Map 73 H/15 (400 bytes per record)
File 10: Data for Map 73 H/16 (400 bytes per record)
File 11: Data for Map 73 I/01 (400 bytes per record)
File 12: Data for Map 73 I/02 (400 bytes per record)
File 13: Data for Map 73 I/03 (400 bytes per record)
File 14: Data for Map 73 I/04 (400 bytes per record)
File 15: Data for Map 73 J/01 (400 bytes per record)

File 16: Data for Map 63 O/09 (400 bytes per record) NSA
File 17: Data for Map 63 O/10 (400 bytes per record)
File 18: Data for Map 63 O/15 (400 bytes per record)
File 19: Data for Map 63 O/16 (400 bytes per record)
File 20: Data for Map 63 P/14 (400 bytes per record)
File 21: Data for Map 64 A/03 (400 bytes per record)
File 22: Data for Map 64 A/04 (400 bytes per record)
File 23: Data for Map 64 B/01 (400 bytes per record)
File 24: Data for Map 64 B/02 (400 bytes per record)

The 24 data files each contain maximum record sizes of 400 bytes. Each physical record on tape consists of 1 to 10 logical records of 40 bytes each. As noted previously, the data in the files are stored in the ARC/INFO Generate format. Within each file, the data in the 40-byte logical records are stored as American Standard Code for Information Interchange (ASCII) characters. The records are arranged in groups that contain varying numbers of records. The first record of the group contains the value for the elevation above mean sea level. This is followed by the records containing the UTM easting and northing coordinate pairs for that elevation contour. At the end of each contour, a record containing the ASCII 'END' characters indicates the end of the contour. A second record containing the ASCII 'END' characters is given at the end of the contour groups to indicate the end of the file. The following listing illustrates this format.

```
442 533084.00, 5939891.00 <-------- This is the contour's elevation (meters)
533079.00, 5939891.00 <-------- This is the first of a series of UTM
533061.00, 5939889.00 coordinates (easting, northing) that
define the contour.
533033.00, 5939897.00
532950.00, 5939902.00
532877.00, 5939910.00
```
8.2.2 Compressed CD-ROM Files

On the BOREAS CD-ROMs, all the files listed in Section 8.2.1 have been compressed with the Gzip compression program (file name *.gz). These data have been compressed using gzip version 1.2.4 and the high compression (-9) option (Copyright (C) 1992-1993 Jean-loup Gailly). Gzip (GNU zip) uses the Lempel-Ziv algorithm (Welch, 1994) used in the zip and PKZIP programs. The compressed files may be uncompressed using gzip (-d option) or gunzip. Gzip is available from many Web sites (for example, ftp site prep.ai.mit.edu/pub/gnu/gzip-*.*) for a variety of operating systems in both executable and source code form. Versions of the decompression software for various systems are included on the CD-ROMs.

9. Data Manipulations

9.1 Formulae

The only data value conversion performed by BORIS staff was to convert the elevation measurements in feet in some (not all) of the files to meters. This was done by dividing the elevation values of feet by 3.28 and then rounding the result.

9.2 Data Processing Sequence

9.2.1 Processing Steps

BORIS staff processed the original data to the current product by:

• Attempting to read a file with the provided software
• Modifying the C source code and updating the file header to read the specific file
• Running the program to extract contours from the file and create output files
• Writing the output files to tape
• Copying the ASCII and compressing the binary files for release on CD-ROM

9.2.2 Processing Changes

None.
9.3 Calculations

9.3.1 Special Corrections/Adjustments

There appeared to be two types of files in the original set. In many cases, the header information in each file had to be modified in order for the modified software to extract the contours successfully.

9.3.2 Calculated Variables

See Section 9.1.

9.4 Graphs and Plots

None.

10. Errors

10.1 Sources of Error

One source of error is the digitizing process used to create the contours from the map sheets. It is not known whether the maps were hand digitized or if software was used to digitize the contours. In either case, the error is probably negligible.

10.2 Quality Assessment

10.2.1 Data Validation by Source

Unknown.

10.2.2 Confidence Level/Accuracy Judgment

Unknown.

10.2.3 Measurement Error for Parameters

Unknown.

10.2.4 Additional Quality Assessments

None.

10.2.5 Data Verification by Data Center

After extracting the data into the ARC/INFO Generate files, BORIS staff plotted the contour data and visually reviewed the data with the 1:50,000-scale hardcopy maps. No anomalies or errors were detected in this review.

11. Notes

11.1 Limitations of the Data

Because the data have a 25-foot contour interval, variations in the terrain that are smaller than 25 feet may not be detectable. The user should not expect to see terrain detail such as small berms or other minor topographic relief.

11.2 Known Problems with the Data

The NSA maps from which these data were derived were found to be in disagreement with BOREAS-gathered and differentially corrected Global Positioning System (GPS) coordinates by about 150 meters. The error did not appear to be systematic. The SSA maps have a higher degree of accuracy (about 45 meters) when compared to GPS.
11.3 Usage Guidance
If these data are going to be used to create a DEM, the various vector files should be edge-matched to create seamless contours that do not have discontinuities at the map boundaries.
Before uncompressing the Gzip files on CD-ROM, be sure that you have enough disk space to hold the uncompressed data files. Then use the appropriate decompression program provided on the CD-ROM for your specific system.

11.4 Other Relevant Information
None.

12. Application of the Data Set
These data can be used to create a gridded DEM of the area of interest as well as for graphical purposes, as an overlay along with other vector layers.

13. Future Modifications and Plans
None.

14. Software

14.1 Software Description
C source code from HYD-08 was used for converting from SIF or K8A format. The software to read the SIF and K8A was originally produced by an unknown source, although it was obtained from HYD-08. The software reads the input file and extracts certain features based on feature codes that are supplied by the user.
Gzip (GNU zip) uses the Lempel-Ziv algorithm (Welch, 1994) used in the zip and PKZIP commands.

14.2 Software Access
The software is written in C and is operational on UNIX workstations at GSFC. The software is available by contacting the ORNL DAAC or BOREAS staff.
Gzip is available from many Web sites across the Internet (for example, ftp site prep.ai.mit.edu/pub/gnu/gzip-*.*) for a variety of operating systems in both executable and source code form. Versions of the decompression software for various systems are included on the CD-ROMs.

15. Data Access
The elevation contour data over the NSA and SSA in ARC/INFO Generate format are available from the Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).
15.1 Contact Information
For BOREAS data and documentation please contact:

ORNL DAAC User Services
Oak Ridge National Laboratory
P.O. Box 2008 MS-6407
Oak Ridge, TN 37831-6407
Phone: (423) 241-3952
Fax: (423) 574-4665
E-mail: ornldaac@ornl.gov or ornl@eos.nasa.gov

15.2 Data Center Identification
Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC) for Biogeochemical Dynamics http://www-eosdis.ornl.gov/.

15.3 Procedures for Obtaining Data
Users may obtain data directly through the ORNL DAAC online search and order system [http://www-eosdis.ornl.gov/] and the anonymous FTP site [ftp://www-eosdis.ornl.gov/data/] or by contacting User Services by electronic mail, telephone, fax, letter, or personal visit using the contact information in Section 15.1.

15.4 Data Center Status/Plans
The ORNL DAAC is the primary source for BOREAS field measurement, image, GIS, and hardcopy data products. The BOREAS CD-ROM and data referenced or listed in inventories on the CD-ROM are available from the ORNL DAAC.

16. Output Products and Availability

16.1 Tape Products
The vector contour data can be made available on 8-mm, Digital Archive Tape (DAT), or 9-track tapes at 1600 or 6250 Bytes Per Inch (BPI).

16.2 Film Products
None.

16.3 Other Products
These data are available on the BOREAS CD-ROM series.

17. References

17.1 Platform/Sensor/Instrument/Data Processing Documentation

17.2 Journal Articles and Study Reports


17.3 Archive/DBMS Usage Documentation
None.

18. Glossary of Terms
None.

19. List of Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASCII</td>
<td>American Standard Code for Information Interchange</td>
</tr>
<tr>
<td>BOREAS</td>
<td>Boreal Ecosystem-Atmosphere Study</td>
</tr>
<tr>
<td>BORIS</td>
<td>BOREAS Information System</td>
</tr>
<tr>
<td>BPI</td>
<td>Bytes Per Inch</td>
</tr>
<tr>
<td>CCRS</td>
<td>Canadian Centre for Remote Sensing</td>
</tr>
<tr>
<td>CD-ROM</td>
<td>Compact Disk-Read-Only-Memory</td>
</tr>
<tr>
<td>DAAC</td>
<td>Distributed Active Archive Center</td>
</tr>
<tr>
<td>DAT</td>
<td>Digital Audio Tape</td>
</tr>
<tr>
<td>DEM</td>
<td>Digital Elevation Model</td>
</tr>
<tr>
<td>EOS</td>
<td>Earth Observing System</td>
</tr>
<tr>
<td>EOSDIS</td>
<td>EOS Data and Information System</td>
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<tr>
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<td>Geographic Information System</td>
</tr>
<tr>
<td>GMT</td>
<td>Greenwich Mean Time</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Positioning System</td>
</tr>
<tr>
<td>GSFC</td>
<td>Goddard Space Flight Center</td>
</tr>
<tr>
<td>MSA</td>
<td>Modeling Sub-Area</td>
</tr>
<tr>
<td>NAD27</td>
<td>North American Datum of 1927</td>
</tr>
<tr>
<td>NAD83</td>
<td>North American Datum of 1983</td>
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<tr>
<td>NASA</td>
<td>National Aeronautics and Space Administration</td>
</tr>
<tr>
<td>NSA</td>
<td>Northern Study Area</td>
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20. Document Information

20.1 Document Revision Date(s)
Written: 09-Jun-1995
Last Updated: 05-Feb-1999

20.2 Document Review Date(s)
BORIS Review: 06-Jun-1997
Science Review:

20.3 Document ID

20.4 Citation
When using these data, please include the following acknowledgement as well as citations of relevant papers in Section 17.2:

These data originated as vector data that were provided to BORIS staff through CCRS by Geomatics Canada. The contribution of the data by CCRS and Geomatics Canada and processing of the data by BORIS staff are greatly appreciated.

If using data from the BOREAS CD-ROM series, also reference the data as:

Also, cite the BOREAS CD-ROM set as:

20.5 Document Curator

20.6 Document URL
This data set was prepared by BORIS Staff by reformatting the original data into the ARC/INFO Generate format. The original data were received in SIF at a scale of 1:50,000. BORIS staff could not find a format document or commercial software for reading SIF; the BOREAS HYD-08 team provided some C source code that could read some of the SIF files. The data cover the BOREAS NSA and SSA. The original data were compiled from information available in the 1970s and 1980s. The data are available in ARC/INFO Generate format files.