

***GDAit* (GDA94 InTerpolation)**

User's Guide

Version 2.0

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Acknowledgements

In 1996, the Department of Geomatics at The University of Melbourne was engaged by Land Victoria to prepare a report investigating the impact of moving spatial data to the new Geocentric Datum of Australia (Collier et al. 1996). In the following year, a more detailed technical investigation was carried out to establish an optimal transformation process (Collier et al. 1997). In early 1998, the Department of Geomatics was again approached by Land Victoria to actually implement the transformation process proposed in the earlier study. The result of this most recent project, has been the development of an interactive transformation program known as *GDAit* (GDA94 InTerpolation).

Whilst specifically developed to support users of spatial data in Victoria to move to GDA, the *GDAit* software is generally applicable and can be used anywhere in Australia. The only prerequisite for successful use of the software is the existence of a valid transformation grid in the area of interest.

The *GDAit* software has been written by David Mitchell and the *GDAit* User's Guide was co-authored by David Mitchell and Dr Philip Collier.

1. Introduction

1.1 What is *GDAit*?

As users of spatial data prepare for the adoption of the new Geocentric Datum of Australia (GDA), the ability to transform coordinates to and from GDA in a simple and rigorous way is taking on increasing importance. The Department of Geomatics at the University of Melbourne, under contract to Land Victoria, has developed a PC-based application, known as *GDAit*, to meet this need.

GDAit will allow the transformation of coordinates from the current Australian Geodetic Datum (AGD66/84) to the new Geocentric Datum of Australia (GDA94) and vice versa. Users can work with either map grid (AMG or MGA) or geographical coordinates (latitude and longitude) in regard to both input to and output from the program. *GDAit* can operate in interactive mode, where coordinates are entered in the appropriate fields on the interface screen, or in file entry mode, where the coordinates to be transformed are read from a file in the required format.

Successful application of the *GDAit* software requires that a valid transformation grid file be available for the user's area of interest. A transformation grid consists of the shift components in latitude and longitude required to move from AGD to GDA at each grid node.

1.2 Why do we need to use *GDAit*?

In the transition period from AGD to GDA, when there is spatial data on both datums being used by various organisations for different purposes, it will be necessary to have the capacity to move data between datums in an efficient and rigorous way. The concepts of *uniqueness* and *reversibility* in the transformation process are critical in this context. A unique transformation process will prevent different users from getting different results when transforming the same data. A reversible transformation process will ensure that application of a forward transformation (AGD to GDA) and then a reverse transformation (GDA to AGD) to the same point will return the user to the starting coordinates.

As well as being efficient, the process implemented in *GDAit* is both reversible and unique. Universal adoption of this software by the spatial data community in Victoria is therefore strongly recommended.

1.3 Transformation Grid Availability

Since the late 1960's spatial data in Victoria has generally been related to the Australian Geodetic Datum 1966 (AGD66). With the recommendation by the Intergovernmental Committee on Surveying and Mapping (ICSM) that Australia move to a geocentric datum by the year 2000, the requirement for a software utility to transform coordinates between the two systems was recognised as a priority by the Victorian Department of Natural Resources and Environment (NRE).

The readjustment of geodetic and survey control data on the new datum was required to support the GDA94 transformation process. The staged state-wide readjustment of the survey control network has been completed by NRE and the necessary computations have been completed allowing a transformation grid for Victoria to be computed. This grid file is now available through the Victorian Government Land Channel web site (www.land.vic.gov.au). For users of *GDAit* in other States, visit the web page for your State Land Information agency to obtain a grid file for your area (see the ICSM web page for a link to your agency (www.anzlic.org.au/icsm/gda)).

2. Installing *GDAit*

2.1 System Requirements

GDAit requires Windows 3.1 or higher, and about 1 megabyte of free disk space. *GDAit* is available in both 16 and 32 bit versions. If your operating system is Windows 3.1 or 3.11, then you must install the 16 bit version. If your operating system is Windows 95/98 or NT then you should install the 32 bit version.

2.2 Installation

GDAit comes with its own installation program that will guide you through the steps required to install *GDAit* on your computer. The installation program will put *GDAit* and its associated files in the directory you specify. Select the steps to follow based on your operating system:

2.2.1 Windows 95/98 or NT 4.0

1. Insert Disk 1 into the appropriate disk drive.
2. Open the Control Panel window and double click on the Add/Remove Program icon.
3. Follow the instructions that SETUP will guide you through.

2.2.2 Windows 3.1, 3.11 or Windows NT 3.51

1. Insert Disk 1 into the appropriate disk drive.
2. Use File Manager to locate the drive containing the installation disk 1.
3. Locate the file SETUP.EXE and double click on it.

4. Follow the instructions that SETUP will guide you through.

The installation program copies the following files to the installation directory you specified (*application directory*):

- GDAit.exe: the application,
- GDAit.hlp: online help,

The installation program copies the following sample input data files to the DATA directory (a subdirectory in the *application directory*):

- UTM.dat, Dec_deg.dat, hp_dms.dat and sep_dms.dat: sample DAT format files.
- UTM.csv, Dec_deg.csv, hp_dms.csv and sep_dms.csv: sample CSV format files.

(The installation process may also install some files in your Windows System directory).

3. Overview

3.1 GDAit User Interface

The *GDAit* interface (Figure 1) is designed so that input values are entered on the left hand side of the application interface and output values appear on the right hand side. The *GDAit* interface contains four drop down menus, four button controls, three status bars, a drop list box and up to six text entry boxes.

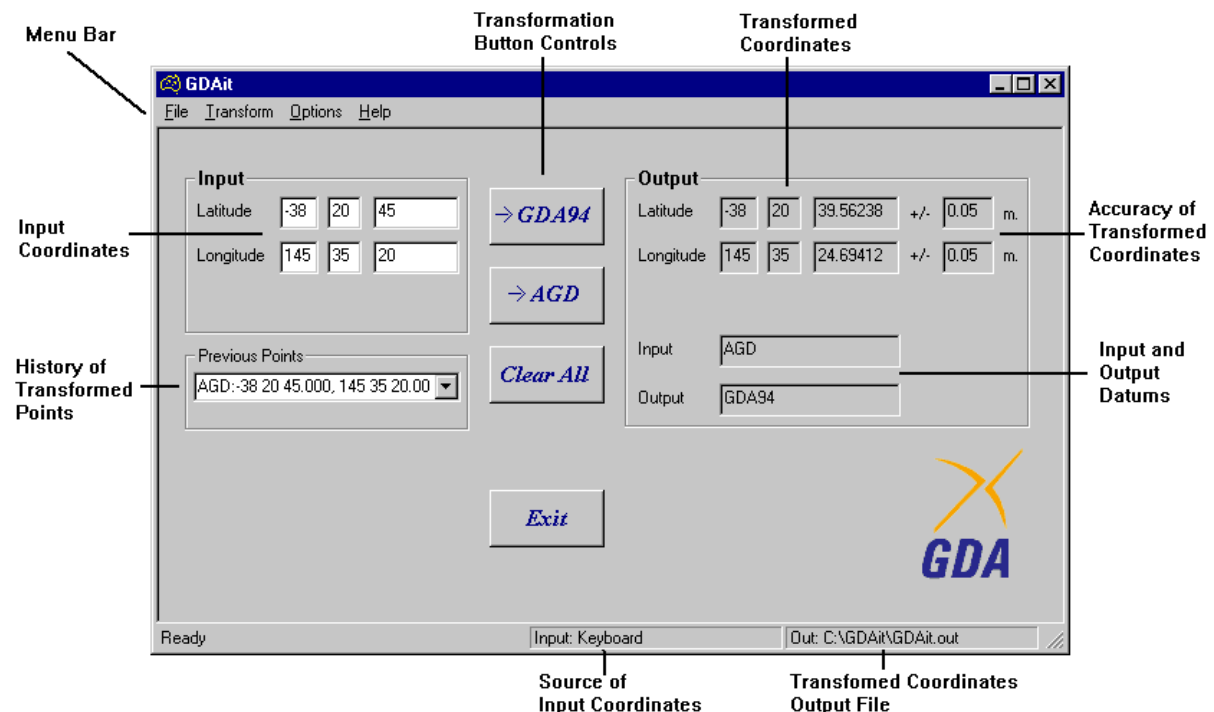


Figure 1: *GDAit* user interface

3.1.1 Menu Bar

The *GDAit* menu bar contains four drop down menus which are used to select and view files, convert the input data, change *GDAit* options, and display the help file.

3.1.2 Button Controls

The *GDAit* button controls are used to transform the current input coordinates, clear the text entry boxes or exit the application.

3.1.3 Text Entry Boxes

The text entry boxes are used to enter the coordinates of the point being transformed. The number of text boxes visible is dependent on the input coordinate type: Projection or Geographic (decimal degrees, or degrees, minutes and seconds).

3.1.4 Drop List Box

The drop list box stores the input coordinates and the datum of points that have been successfully transformed.

3.1.5 Status Bars

The status bars along the bottom of the interface display the current status of input to, and output from, *GDAit*.

3.2 How to use *GDAit*

Using *GDAit* is a relatively simple process:

- Enter the coordinates of the point to be transformed (ensuring that the point lies within the area covered by the transformation grid. Refer to Section 4.1.3),
- Click on the button to transform the coordinates to the required datum,
- View the transformed coordinates displayed.

3.3 Output

GDAit outputs the transformed coordinates for a point and an approximate measure of the accuracy of the transformed coordinates. Output generated is saved to default files, but the user can select their own output file.

3.4 File Input

GDAit will accept input from an input data file. A *GDAit* input file consists of a number of compulsory values and some optional values. The input data can be formatted as either a comma separated file or in a fixed column width file.


4. *GDAit* User Interface

The following section describes the *GDAit* user interface in more detail.

4.1 File Menu

The File drop down menu contains items to select and view files.

4.1.1 Input File

This menu item displays the Point File Transformation dialog box (Figure 2) which is used to select the input file of points to transform as well as the output file for the transformed coordinates. The **View** button opens the selected input in Notepad so that it can be viewed to check the format and/or coordinate type that it contains. The  button displays an Open File dialog box.

After clicking the **OK** button to close the dialog box, *GDAit* changes from **Interactive Mode** to **Point File Mode**. In this mode the text entry boxes on the *GDAit* interface are disabled and the **Mode** indicator (**Options** menu) is set to Point File. The other indicator that *GDAit* is in this mode is that the Input status bar changes from *Keyboard* to the name of the input file.

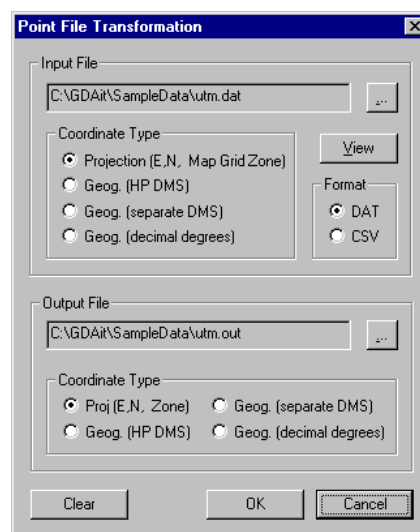


Figure 2: Point File Transformation dialog box

4.1.2 Output File

This item displays the Output File dialog box (figure 3) which is used to select an Interactive Mode output file and to specify if points written to the output file are assigned a name. **Select** displays an Open File dialog box, **Clear** clears the selected filename. The **Prompt for point name** option will display a dialog box after each point is transformed, whereas **Automatically Increment** will generate a new point name for each point. Automatic point numbering starts at one and if a default string is specified, the number is appended to the end of the string.

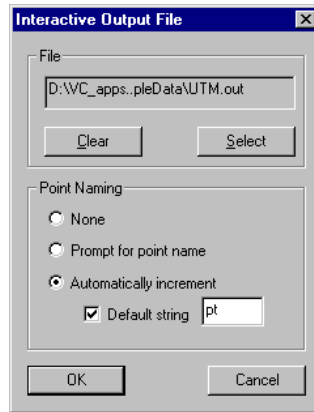


Figure 3: Interactive Output File dialog box

4.1.3 Import Grid File

A grid file is used by *GDAit* to compute transformed coordinates. The grid file selected defines the extents (upper and lower limit of latitude and longitude) within which *GDAit* can transform coordinates. A point outside the extents of the selected grid file can not be transformed. This menu item allows a different or updated grid file to be selected so that *GDAit* can be used to transform coordinate values in a different area. (The extents of the currently selected grid file can be viewed in the *GDAit* log file).

After selecting a Grid File, a message box will be displayed that asks: "Do you wish to make *selected file name* the default grid file?". Answering "Yes" to this prompt forces *GDAit* to use the selected grid file each time *GDAit* is used. Answering "No" means that the selected grid file will only be used for the current session, i.e. when *GDAit* is started next time it will use the original grid file.

(**Note:** To obtain the latest grid shift file for the area visit the web page for the Land Information agency in your State. In Victoria this is the Land Channel web site (www.land.vic.gov.au), users in others States should select the appropriate link from the ICSM web page (www.anzlic.org.au/icsm/gda)).

4.1.4 Export Grid File

This menu item allows the currently selected grid file to be saved in either ASCII or binary using the Canadian National Transformation Version 2 (NTv2) format so the grid file can be imported into another application. If the current grid file is in ASCII format, this option will create the binary version. If the current grid file is in binary format, this option will create the ASCII version. Details regarding the NTv2 format can be found in Appendix C.

4.1.5 View

This popup menu item contains a list of the output files that can be viewed. When a file is selected, it is opened up in Notepad.

..Log File

The log file (**GDAit.log**) is a file that is created in the directory in which *GDAit* is installed. This file records general information about the operation of *GDAit*:

- The names of the input and output file selected, and the number of points that were transformed.
- The name of grid shift file selected and the extents of the grid (the latitude and longitude values which define the area in which points can be transformed).
- Error messages such as the identification of points which could not be transformed and errors that occurs while processing an input file. (Error messages displayed on the screen are also written to the log file).

(**Note:** The log file is overwritten each time *GDAit* runs. If the file contains information you wish to keep, you should copy the file or rename it to prevent it being overwritten the next time *GDAit* is run).

..Default Output File

The default output file (**GDAit.out**) is a file that is created in the directory in which *GDAit* is installed. This file records all points that are transformed interactively (coordinates entered via the keyboard).

(**Note:** The default output file is overwritten each time *GDAit* runs. If the file contains information you wish to keep, you should copy the file or rename it to prevent it being overwritten the next time *GDAit* is run).

..Point File Output

This opens the file that is created when an input file is transformed.

..Interactive Output

This opens the file created for the output of coordinates that are transformed Interactively (entered via the keyboard).

4.2 Transform Menu

This drop down menu contains items to transform the current input coordinates to a destination datum. Current input can be either coordinates entered from the keyboard or coordinates read from an input file.

4.2.1 to GDA94

Transforms the input coordinates from AGD66/84 to their equivalent GDA94 values.

4.2.2 to AGD

Transforms the input coordinates from GDA94 to their equivalent AGD66/84 values.

4.3 Options Menu

This drop down menu contains menu items for changing *GDAit* settings.

4.3.1 Coordinate Display

Displays a dialog box that enables the displayed input and output coordinate type to be changed. The available options are :

- Projection (Universal Transverse Mercator coordinates i.e. AMG or MGA)
- Geographic coordinates in degrees, minutes and seconds (DMS)
- Geographic coordinates in decimal degrees



The values set also determine the format of coordinates written to the Interactive Output file. (When a file of points is transformed (Point File Mode), the format of the output coordinates is specified when the file is selected).

4.3.2 Mode





This item allows *GDAit* to be changed from **Point File Mode** to **Interactive Mode** without transforming the currently selected input file. (The only way to change *GDAit* from **Interactive Mode** into **Point File Mode** is to select an input file).

5. How to Use *GDAit*

5.1 Transforming a single point

1. If the *GDAit* interface does not match the type of coordinate (e.g. Projection or Geographic) that you wish to input and output, select **Coordinate Display** from the **Options** drop down menu. Select the appropriate radio buttons in the dialog box which is displayed, then click **OK**.
2. Enter the coordinates of the point to be transformed.
3. Select the transformation required:
 - Click  to transform AGD66/84 coordinates to their GDA94 equivalent.
 - Click  to transform GDA94 coordinates to their AGD66/84 equivalent.
4. View the file containing the input and transformed coordinates by selecting **View.. Default Output** from the **File** menu.

5.2 Transforming a file of points

1. Display the Point File Transformation dialog box (Figure 2) by selecting **Input** from the **File** menu.
2. Select the name of the input file by clicking on .
3. Select the radio button that matches the type of coordinates in the file. (Click on the **View** button to open the selected file in Notepad if you are unsure of the coordinate type or file format).
4. Select the name of the output file by clicking on .
5. Select the radio button that matches the type of coordinates to be output.
6. Click on the **OK** button.
7. Select the transformation required:
 - Click  to transform AGD66/84 coordinates to their GDA94 equivalent.
 - Click  to transform GDA94 coordinates to their AGD66/84 equivalent.
8. A dialog box will be displayed (see Figure 4) that states how many were transformed, and how many could not be.
9. View the file containing the transformed coordinates by selecting **View.. Point File Output** from the **File** menu

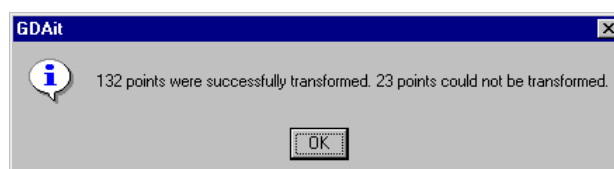


Figure 4: Transformation Information dialog box

6. Output

GDAit produces the coordinates of a point transformed into the selected datum and an approximate accuracy for these transformed values. The transformed coordinates, their accuracy and the datum to which they refer (GDA94 or AGD66/84) are all written to an output file. If the point being transformed is outside the extents of the selected grid shift file, *GDAit* is unable to transform the point. For more information see section 4.1.3 *Import Grid File*.

6.1 Accuracy

When using *GDAit*, accuracy values are assigned to the transformed coordinates. It is important to understand how to interpret these values. Strictly speaking, the accuracy figures (rounded to the nearest 0.05 m) represent the quality of the transformation grid used in the transformation process. When the grid is reliable, the accuracy values will be small (≤ 0.1 m). When the gridded data is less reliable, the accuracy values will increase. The intention of showing users these accuracy values is to allow an assessment of the accuracy of the transformation rather than the accuracy of the transformed coordinates as such.

Users should take note that *GDAit* does not magically turn inaccurate coordinates into accurate coordinates via the transformation process. For example, if input coordinates are known only to the nearest 100 m and the accuracy of the transformation is 0.05 m, users should not assume that they have improved their coordinate quality. The *GDAit* accuracy figures simply indicate that in this case the transformation is reliable and has not significantly downgraded the quality of the original data.

On the other hand, a user may enter very accurate coordinates, known to the nearest 0.01 m. If *GDAit* returns accuracy values for the transformation of 0.5 m, the user should be aware that the transformation process in this case is inaccurate and coordinate quality will suffer accordingly.

Note : If the accuracy values for the transformed coordinates appear as *** rather than numeric values, this means that the point is in an area where the transformation components are only known approximately (no distortion model is available).

6.2 File

The transformed coordinates, their accuracy and the datum to which they refer (GDA94 or AGD66/84) are written to an output file. The coordinate type, file format and file to which the output is written, are all dependent on which mode the points were transformed in (Interactive or Point File).

6.2.1 Interactive Mode

In Interactive Mode, transformed coordinates are displayed on the screen and written to the Default Output File (**GDAit.out**). The output file contains the input coordinates, the transformed coordinates, the accuracy of the transformed values and the datums of the input and output coordinates. The coordinate type written to file is the same as that specified for the display (see section 4.3.1 *Coordinate Display*). If a point cannot be transformed then the coordinates of the point are written to the Default Output File.

The Default Output File is overwritten each time *GDAit* runs. If the file contains information you wish to keep, you should copy the file or rename it to prevent it being overwritten the next time *GDAit* is run. An alternative is to specify an Interactive Output File before transforming the points by selecting **Output** from the **File** menu (see section 4.1.2). This file is similar to the Default Output File except that an optional point description is added to the start of the line.

6.2.2 Point File Mode Output

In Point File Mode, the name of the output file and output coordinate type are specified when the input file is selected using the Point File Transformation dialog box (Figure 2). The format of the output file is the same as that of the input file, i.e. DAT or CSV (comma separated variables). The only difference is that accuracy values are appended after the point description.

If a point in the input file cannot be transformed then the name of the point is written to the log file (**GDAit.log**), it does not appear in the output file.

7. File Input

GDAit has an input data specification which consists of a number of compulsory values and some optional input values. The input data can be formatted as either a comma separated file, or as a fixed column width file.

7.1 Coordinate Types

GDAit input files can contain either Geographic or Projection coordinates. Geographic coordinates can be specified as: decimal degrees, degrees, minutes and seconds in HP notation, or degrees, minutes and seconds separated by a space. All the coordinates in an input file must be the same type. An example of the different ways of specifying geographical coordinates is shown in the following table.

Format	Latitude (-37° 48' 08.4532")	Longitude (144° 55' 59.6854")
Space separated (DMS)	-37 48 8.4532	144 55 59.6854
HP notation	-37.48084532	144.55596854
Decimal degrees	-37.802348111	144.933245944

7.2 Input Values

The input values accepted by *GDAit* have been designed to include values that are most likely to be associated with coordinate data. The following lists the input values accepted by *GDAit* with **compulsory** input values shown in bold:

- Point ID (up to 10 characters including: numbers, letters and spaces)
- **Latitude / Easting**
- **Longitude / Northing**
- Height (AHD)
- **UTM zone (compulsory only if projection coordinates are used)**
- Datum (AGD for AGD66/84 coordinates, G94 for GDA94 coordinates)
- Description

7.3 File Formats

The input data values listed can be formatted in one of two ways: DAT or CSV. DAT is a fixed field width format, while CSV (Comma Separated Variable) is a more flexible format that can be generated using a program such as Excel.

7.3.1 DAT

Extension : DAT

Header line/s: No limit, just require a blank line before the start of the coordinates.

Input value column positions:

Point ID	: columns 1 to 11
Latitude/Easting	: columns 12 to 27
Longitude/Northing	: columns 28 to 43
Height (AHD)	: columns 44 to 52
UTM zone	: columns 53 to 55
Datum (AGD or G94)	: columns 56 to 59
Description	: columns 60 to 85

7.3.2 CSV

Extension : CSV

Header line/s: No limit, just require a blank line before the start of the coordinates.

Input value order:

Point ID
Latitude/Easting
Longitude/Northing
Height (AHD)
UTM zone
Datum (AGD or G94)
Description

7.4 How to Create an Input File

To assist in creating input files in either format, a number of sample data files are installed in the **data** subdirectory where *GDAIt* was installed. There are a number of ways to create an input file for *GDAIt*:

7.4.1 Text Editor

A text editor such as Notepad or Word can be used to create a DAT or CSV file. If a DAT file is created this way, the important thing to note is that the values must be contained entirely within the columns specified in the format. If this method is used to create a CSV file, all fields must be specified with either a value or an empty field (i.e. two commas with nothing between them: ,,).

7.4.2 Spreadsheet

Generating a Comma Separated Value (CSV) file in a spreadsheet program such as Excel is probably the simplest way to create an input file for *GDAIt*. It is also

probably the safest as it minimises the chance of inserting a value into the wrong position in the line of a file. The following guide specifies the columns in which each value must appear (**note:** leave columns blank if you don't wish to specify the value):

Projection coordinates or geographic coordinates in decimal degrees:

Column A: Point ID
Column B: Latitude or Easting
Column C: Longitude or Northing
Column D: Height (AHD)
Column E: UTM zone
Column F: Datum
Column G: Description

Geographic coordinates given in degrees, minutes and seconds:

Column A: Point ID
Column B: Latitude degrees
Column C: Latitude minutes
Column D: Latitude seconds
Column E: Longitude degrees
Column F: Longitude minutes
Column G: Longitude seconds
Column H: Height (AHD)
Column I: UTM zone
Column J: Datum
Column K: Description

8. Short Cut Keys

A number of key combinations are available to simplify the number of keystrokes and/or mouse actions to perform a task:

Ctrl + I: displays the Point File Transformation dialog box (select an Interactive file).

Ctrl + P: displays the Point File Mode output file.

Ctrl + O: displays the Interactive Output File dialog box.

Ctrl + D: displays the Default Interactive output file if one has been specified.

Ctrl + N: displays the Interactive Mode output file if one has been specified.

Ctrl + G: transforms the current input coordinates from AGD to GDA94.

Ctrl + A: transforms the current input coordinates from GDA94 to AGD.

9. GDAit Messages

When a message is generated by *GDAit*, additional information is sometimes written to the log file (*GDAit.log*) which may help identify the reason.

9.1 Grid Shift File Errors

"The Grid Shift file could not be found. Do you wish to select a new file?"

This error occurs when the file containing the Grid Shift values has been deleted or moved from the location that is stored in the registry settings for *GDAit*. When this error occurs, *GDAit* gives the user an opportunity to specify the location of the Grid Shift file. If the offer is declined, coordinates can't be transformed until the user specifies a valid Grid Shift file. If the file has been deleted a new Grid Shift file must be obtained. This can be done by either reinstalling *GDAit* or downloading a new Grid Shift file from the Land Channel web site then importing the new file. Refer to section 4.1.3 for more information.

"Grid Shift file is invalid. Coordinates can't be transformed."

This error message will occur when the selected Grid Shift file is invalid. There are a number of reasons why the file may be invalid, refer to the log file for the likely cause. This error is solved by using the Import Grid File menu item to select a new Grid Shift file. If an alternative Grid Shift file is unavailable, a new file can be downloaded from the Land Channel web site (refer to section 4.1.3 for more information). Alternatively, reinstalling *GDAit* will overwrite the invalid Grid File with a valid copy.

"A valid Grid Shift file is not selected. Coordinates can't be transformed."

This error message will appear if the Grid Shift file could not be read when *GDAit* is started. An error message prior to this message should have identified the cause of this error, which prevents coordinates from being transformed.

"Invalid extension: file format unknown."

This error occurs when the file extension of the selected Grid Shift file is not recognised. The file extensions must be either .ASC if the file is in NTV2 ASCII format, or .GSB if the file is in NTV2 binary format. To solve this problem, confirm that the file is in fact a valid NTV2 format file and if so, modify the file extension using the operating system's file management utility. Refer to section 4.1.4 for more information about file formats.

9.2 File Input/Output Errors

"Could not open output file."

"Could not open input file: filename"

"Could not create results file: filename"

"Could not create file for the output of the transformed points: filename"

"An error occurred opening the files. Coordinates can't be transformed."

These errors are generated when a file can not be opened or created. The cause of the error will probably be due to an access violation if the file is open in another application. The log file may give further information as to the cause of the error. To solve this problem determine the file which could not be opened (see the log file), confirm that it is not being used by another application and if applicable, that the file does exist. Select the file/s again before continuing.

"End of file encountered while reading input file header. Input file may be empty or there may not be a blank line after the file header. "

This error occurs when the format of the input file is invalid because a blank line was not encountered. To solve this problem confirm that the file is not empty and that the file header and coordinates are separated by a blank line. Refer to section 7.3 for information on file formats.

"File conversion failed."

This error occurs when the Grid Shift file can not be exported to another format. The most likely cause of this error is that the Grid Shift file being used is invalid. This can be solved by replacing the Grid Shift file by either reinstalling *GDAit* or by downloading a new Grid Shift file from the Land Channel web site then importing the new file. Refer to section 4.1.3 for more information.

9.3 Miscellaneous Errors

"Point is outside all grid files. A value can't be interpolated."

This occurs when the coordinates of the point entered are outside the limits of the Grid Shift file being used. To transform the coordinates of the point a Grid Shift file that covers the area that the point is in must be obtained. Refer to section 4.1.3 for more information.

"Interpolation function failed."

This error is generated by the interpolation function if it is unable to read the shift values from the Grid Shift file. The most probable cause of this error is that the Grid Shift file has been corrupted. This error may be solved by replacing the Grid Shift file. This can be done by reinstalling *GDAit* or by downloading a new Grid Shift file from the Land Channel web site then importing the new file. Refer to section 4.1.3 for more information.

"Geographic to Map Grid failed."

This error denotes that the conversion between coordinate systems failed. This is most likely caused by entering inappropriate coordinates.

9.4 Information Messages

"Do you wish to make filename the default grid file?"

This message is displayed if a new Grid Shift file is selected using the Import Grid File menu item. The default Grid Shift file is loaded when *GDAit* is started up. If you wish to make *GDAit* startup with a Grid Shift file that is different to the one that is installed, answer Yes to this prompt and *GDAit's* registry settings will be updated.

"This grid file is in an obsolete file format and should be updated (see "NTv2 Binary Files" in the Online Help for more information). Do you wish to continue?"

This message is displayed if the selected Grid Shift File is in a format known as "Australian" NTv2 binary. For compatibility reasons, this file format has been replaced by the "Canadian" version of the NTv2 file standard. Version 2 of *GDAit* can read files in either format, prior to this version only "Australian" binary files could be read. However it is advisable to visit the appropriate web page for your state to obtain the latest version of the Grid Shift File in "Canadian" format. Refer to Appendix C for more information on NTv2.

10. Frequently Asked Questions

Q. Do I have to enter Latitudes as negative ?

If you are using an input file Yes. If you are entering coordinates in Interactive Mode then the negative sign is optional.

Q. Why do the text entry boxes become disabled after selecting an input file ?

GDAit is in **Point File Mode**. To return *GDAit* to **Interactive Mode**, process the input file by selecting a transformation button, or change the mode by selecting the Mode menu item in the Options drop down menu.

Q. How do I force transformed projection coordinates to be in a particular UTM zone ?

If the input coordinates are projection then they must be in the UTM zone you require.

If the input coordinates are geographic, you must use an input file:

- Insert the geographic coordinates and desired zone into a data file.
- Select Projection as the coordinate output type. The output coordinates will be forced into the zone specified, if no zone is specified, the best zone will be used.

Q. How do I find out the extents of the grid file that GDAit is using ?

The extents of the currently selected grid file can be viewed in the *GDAit* log file.

References

Junkins, D.R. and Farley, S.A., 1995, *NTv2 Developer's Guide*. Geodetic Survey Division, Geomatics Canada, 27pp.

Collier, P.A. and Mitchell, D.J., 1998, *GDAit Software Documentation*. Department of Geomatics, University of Melbourne, 17 pp.

Appendix A. *GDAit Software License Agreement*



Natural Resources and Environment

AGRICULTURE • RESOURCES • CONSERVATION • LAND MANAGEMENT

LAND Victoria

GDAit Software LICENCE AGREEMENT

1. Definitions

In this Agreement the following terms shall have the meanings set out below, unless the context requires otherwise:

"Data" means the transformation grid file and source code

"Licence" is the Licence granted pursuant to this Agreement by the Supplier to the Licensee for the use of the Data;

"Licensee" is the user of the Data;

"Supplier" means the State of Victoria

2. Acceptance

2.1 Use of this software indicates the Licensee's acceptance of this license agreement and warranty.

3. Licence

3.1 The Supplier warrants it has the right and authority to grant the licence to the Licensee.

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7. Waiver

7.1 Failure or neglect by either party to enforce at any time any of the provisions of this Agreement shall not be construed or deemed to be a waiver of that party's rights under this Licence.

8. Errors and Omissions

8.1 If the licensee discovers any errors or omissions in the Data they are requested to inform the Supplier by contacting the Geodetic Survey on Ph 03 9603 9000.

9. Governing Law

9.1 This Agreement shall be governed by and construed in accordance with the laws of the State of Victoria.

Appendix B. Sample Data Files

B.1 Sample Input Format

DAT File

(note: You can't mix coordinate types like this sample file does).

```
1          2          3          4          5          6          7          8
123456789 123456789 123456789 123456789 123456789 123456789 123456789 123456789 12345
.
Pt          Lat/East      Long/North    Height  ZO DAT Description
Pt1DMS      -37 48 05.10098 144 57 35.79567 1057.075 55 A66 separate D M S
Pt1HP       -37.480510098 144.573579567 1057.075 55 HP notation
Pt1DEC      -37.801416939 144.959943242 1057.075 A66 Decimal degrees
Pt1Proj     3203896.111 5814242.111 1057.075 55 A66 Projection coordinates
```

CSV File

```
GDAit: Sample Comma Separated Variable Input File
*
POINT,Easting,Northing,Height,Zo,Dat,Description
PM1001,320396.123,5814240.123,10,55,A66,PM 1001
```

B.2 Sample Output Files

Default Output File (GDAit.out)

```
          Input          |          Output
Datum  Lat / East  Long / North | Datum  Lat / East  Long / North  Zone Accuracy m.
-----|-----
A66 -39 20 45.00000 140 35 20.00000 | G94 -39 20 39.56508 140 35 24.69337 0.15 0.20
```

Interactive Output File

```
          Input          |          Output
Point  Datum  Lat / East  Long / North | Datum  Lat / East  Long / North  Zone Accuracy m.
-----|-----
Pt_abc12  A66 -39 20 45.00000 140 35 20.00000 | G94 -39 20 39.56508 140 35 24.69337 0.15 0.10
```

Point File Transformation Output File

```
PM101      -38.010715642 144.335301515 10.000 55 G94 PM 101      0.05 0.05
```

Appendix C. Technical Details

C.1 NTV2 Grid Format

Underlying the application of *GDAit* is the need for a grid of transformation shifts in the user's area of interest. A number of options were investigated with regard to an appropriate format for the gridded transformation data. Ultimately it was decided that the Canadian National Transformation Version 2 (*NTv2*) format should be adopted. There were three main reasons for this decision :

- *NTv2* is a widely accepted format for transformation data in North America (especially Canada) and as such some of the major GIS packages are able to read and use transformation grids supplied in this format.
- *NTv2* allows for the accuracy of the transformation as well as the transformation itself to be provided on the grid. The ability for users to get some quantitative measure on the quality of the transformation was regarded as a desirable feature.
- *NTv2* permits the use of sub-grids of different density. For example, it may be preferable that the transformation grid in an urban area be more dense than that required for a rural area. The *NTv2* format can routinely accommodate this requirement.

The *NTv2* grid format and transformation software has been developed by the Geodetic Survey Division of *Geomatics Canada*. A lot of information about *NTv2* can be obtained from the *Geomatics Canada* home page (<http://www/geod.emr.ca:80/>). The *NTv2* software, documentation (including User's Guide and Developer's Guide) and the transformation grid for Canada can be purchased on a CD-ROM from *Geomatics Canada*. On-line transformations are also possible on the *Geomatics Canada* home page.

The document, *GDAit Software Documentation*, also contains a description of the *NTv2* format. Contact Land Victoria for more information about this document.

A sample of the *NTv2* grid file format (in ASCII form) is shown below :

```

SUB_NAME MELB
PARENT NONE
CREATED 7/1998
UPDATED 7/1998
S_LAT -138780.000000
N_LAT -134406.000000
E_LONG -526104.000000
W_LONG -519354.000000
LAT_INC 54.000000
LONG_INC 54.000000
GS_COUNT 10332
5.414650 -4.727520 0.002171 0.000617
5.413610 -4.728820 0.001615 0.000235
5.413050 -4.729720 0.001563 0.000233
5.413010 -4.730170 0.002045 0.000383
.....
.....
.....

```

Figure C.1 – *NTv2* data in ASCII format

The basic contents of the grid file are as follows :

```

Sub grid name
Parent grid name
Creation date
Revision date
 $\phi_{min}$  South latitude limit (in seconds)
 $\phi_{max}$  North latitude limit (in seconds)
 $\lambda_{min}$  East longitude limit (in seconds)
 $\lambda_{max}$  West longitude limit (in seconds)
 $\Delta\phi$  Latitude grid interval (in seconds) => rows = 1+(( $\phi_{max}$ - $\phi_{min}$ )/ $\Delta\phi$ )
 $\Delta\lambda$  Longitude grid interval (in seconds) => columns = 1+(( $\lambda_{max}$ - $\lambda_{min}$ )/ $\Delta\lambda$ )
Number of grid shift values (rows x columns)
 $\delta\phi$   $\delta\lambda$   $\sigma_\phi$   $\sigma_\lambda$  in seconds (row 1, column 1)
 $\delta\phi$   $\delta\lambda$   $\sigma_\phi$   $\sigma_\lambda$  in seconds (row 1, column 2)
.....
.....
.....
 $\delta\phi$   $\delta\lambda$   $\sigma_\phi$   $\sigma_\lambda$  in seconds (rows, columns)

```

Figure C.2 – Contents of the *NTv2* grid file

Application of the *NTv2* format to the Australian situation is straightforward, requiring only that the Canadian convention for treating west longitudes as positive be taken into account. In Australia longitudes are regarded as positive to the east. This issue is discussed in the document, *GDAit Software Documentation*, which can be obtained by contacting Land Victoria.

C.2 Difference between Australian and Canadian binary files

NTv2 Grid Shift Files can exist in two forms, binary and ASCII. In the initial implementation of NTv2 in Australia, the only version of a Grid Shift File that strictly adhered to the NTv2 file format was the ASCII version (States only distribute the binary form, but the ASCII equivalent is easily obtained from utilities such as *GDAit*). The differences in the binary form are minor but the consequence is that there are two binary forms of an NTv2 file that aren't compatible: an *Australian* version and a *Canadian* version. Only the *Canadian* version is a true NTv2 file. To eliminate confusion, use of *Australian* binary is being phased out, and *Canadian* binary will become the standard for Grid Shift File distribution in Australia. The following explains the difference between the two binary forms and outlines the reason why it occurred.

(**Note:** Prior to version 2.0 of *GDAit*, only NTv2 files in ASCII and *Australian* binary could be read. Version 2.0 is capable of reading NTv2 files in both *Australian* and *Canadian* binary format).

C.2.1 What is the difference?

The simple answer is that any integer value in a *Canadian* NTv2 binary file must be read as a 4 byte number followed by 4 bytes of padding. *Australian* binary files DON'T contain this padding, *Canadian* binary files do. This affects three records in the Overview Header (NUM_OREC, NUM_SREC and NUM_FILE), and one record in each of the Sub-grid Headers (GS_COUNT).

Considering this in more detail, an NTv2 file is comprised of an Overview Header and is followed by one or more Sub-grids. This is represented in Figure C.3:

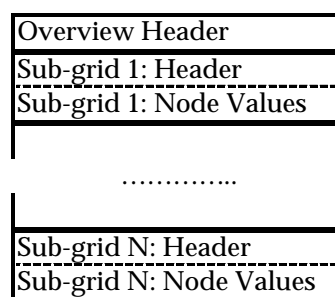


Figure C.3 - NTv2 file structure

The Overview Header and each Sub-grid Header consist of 11 records of 16 bytes, i.e. each header is 176 bytes long. The first 8 bytes of each record is a string identifier, the last 8 bytes contain the value of the identifier. The value can be one of three data types: an integer, a double or a string. A representation of how each data

type is stored in an NTV2 header record is shown in Figure C.4 with the number of bytes required being given in brackets.

Double:	Identifier (8)	Value (8)	
String:	Identifier (8)	Value (8)	
Integer:	Identifier (8)	Value (4)	Padding(4)

Figure C.4 – Data storage in a Header record

The padding used for integer values is 4 NULL characters (ASCII character 0). The only purpose of the padding is to make a record with an integer value 16 bytes long, all other data types will automatically have records 16 bytes long. The records affected in the Overview Header (see Table C.2 of *GDAIt Software Documentation*) are NUM_OREC, NUM_SREC and NUM_FILE. The record affected in the Sub-grid Header (see Table C.3 of *GDAIt Software Documentation*) is GS_COUNT.

The format of the “Node Values” in a Sub-grid is identical for both *Australian* and *Canadian* binary files, i.e. no padding is used. For more information about the NTV2 file format refer to Appendix C of the of *GDAIt Software Documentation*.

C.2.2 Why did the difference occur?

Australian binary came into existence because it was believed that NTV2 binary was compiler dependent. The Canadians had implemented it with FORTRAN and information at the time suggested that the use of records within a FORTRAN binary file would create a file that other development environments would have difficulty reading and writing. Given that most software development today is done in a language other than FORTRAN, the decision was made to format the file as specified in Appendix B of the *NTv2 Developer’s Guide* (Junkins and Farley, 1995), but to ignore any auxiliary record identifiers that FORTRAN used. At the time this was not considered to be a major issue. A FORTRAN version of the grid file could easily be created for those who required it by using a FORTRAN utility to convert an ASCII version of the grid file to the binary form.

However it has now become apparent that NTV2 binary is not compiler dependent. The justification for having an Australian version of the binary is no longer valid and retaining it will lead to further confusion in the future. Ultimately, the best option is to abandon this version and adopt the Canadian implementation.

C.3 Bi-Linear Interpolation

Bi-linear interpolation is the technique used in *GDAit* to determine the transformation and accuracy components at a non-grid point from the nearest four grid nodes. The procedure is illustrated in Figure C.5 where the transformation components at the interpolation point (p) are required. These are computed from the known transformation components at the four grid nodes (1, 2, 3 and 4).

To compute the latitude transformation component at p, the equation is :

$$\delta\phi_p = a_0 + a_1X + a_2Y + a_3XY \quad \dots(c.1)$$

where $a_0 = \delta\phi_1 \quad \dots(c.2)$

$$a_1 = \delta\phi_2 - \delta\phi_1 \quad \dots(c.3)$$

$$a_2 = \delta\phi_4 - \delta\phi_1 \quad \dots(c.4)$$

$$a_3 = \delta\phi_1 + \delta\phi_3 - \delta\phi_2 - \delta\phi_4 \quad \dots(c.5)$$

$$X = (\lambda_p - \lambda_1) / (\lambda_2 - \lambda_1) \quad \dots(c.6)$$

$$Y = (\phi_p - \phi_1) / (\phi_4 - \phi_1) \quad \dots(c.7)$$

$\delta\phi_1, \delta\phi_2, \delta\phi_3$ and $\delta\phi_4$ are the latitude transformation components at points 1 to 4 respectively.

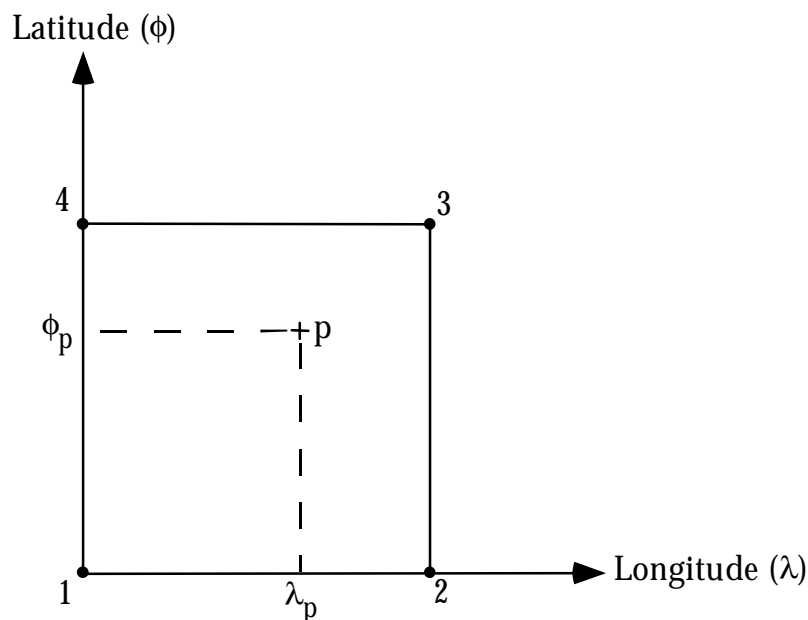


Figure C.5 – Bi-Linear Interpolation

By substituting $\delta\lambda$ for $\delta\phi$ in equations (c.1) to (c.5) the longitude transformation component at p can also be computed. Identical equations can also be used to interpolate the accuracy of the transformation in both dimensions.