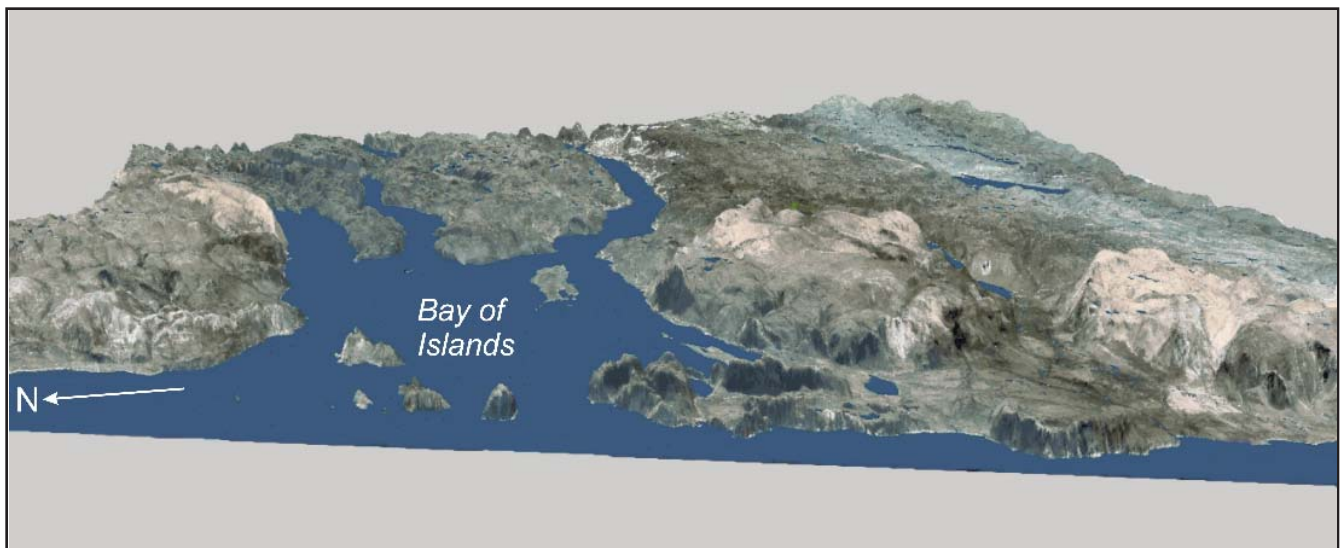


CREATING A 3D FLY-THROUGH OF THE BAY OF ISLANDS AREA, WESTERN NEWFOUNDLAND



M. Noonan, P. Honarvar, A. Hinchey and M. Walsh

Open File NFLD/3310

**St. John's
Newfoundland and Labrador
December, 2017**

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Cover: Three-dimensional model, with an airphoto overlay, of the Bay of Islands area.

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ABSTRACT

Digital elevation models (DEM) and 3-dimensional (3D) fly-throughs can provide an excellent overview of a terrain of interest. Layers of information, such as geology, trails or historical sites, can be draped on the DEM and a fly-through prepared to provide a birds-eye view of the association between terrain features and the draped information.

The area of interest for this project is the Bay of Islands and surrounding areas on the west coast of Newfoundland. It has a range in elevation from the sea shore to the highest peak in Newfoundland of 812 m at The Cabox in the Lewis Hills. The geology of the Bay of Islands area includes excellent examples of exposed ophiolitic rocks comprising mafic oceanic crust and ultramafic upper mantle rocks. These rocks stand out on the geology and geophysics maps, as well as airphotos, where the ultramafic rocks are barren of vegetation.

The procedures used to create the DEM, compile the ancillary information and prepare the 3D fly-throughs for the geology, geophysics and airphoto-drape layers are described using the Esri programs ArcGIS 10.3 and ArcScene 10.3. These procedures can then be applied to other regions in the province to highlight features of local interest.

INTRODUCTION

The Bay of Islands area, located in western Newfoundland (Figure 1), consists of the Lewis Hills, Blow-Me-Down Mountains, and North Arm Mountain. These hills and mountains are geologically significant as they consist of excellent examples of exposed ophiolitic rocks comprising mafic oceanic crust and ultramafic upper mantle rocks. The Cabot, in the Lewis Hills area, is the highest mountain on the island (812 m above mean sea level). The large range in elevation, the beauty of the area and the significance of the geology make the Bay of Islands area an excellent site for 3D computer fly-throughs.

This report describes the compilation and preparation of a digital elevation model, various overlays and subsequent computer-generated 3D fly-throughs of the Bay of Islands area as a test-case. The fly-through animations provide a good overview of the terrain, historical sites and trails in the area, as well as providing underlying geology and geophysics information. This procedure can then be applied to other regions in the province.

METHOD

BACKGROUND

The procedures described below are based on ArcGIS version 10.3. The ArcGIS tools were used to compile, digitize and crop the data layers consisting of airphotos, the boundary of the Bay of Islands area of interest (AOI), topographic information, geology, geophysics, hiking trails and points of interest.

Most of the data is available from the Newfoundland and Labrador (NL) Geological Survey's Geoscience Atlas (<http://geoatlas.gov.nl.ca/>), in latitude–longitude (geographic) coordinate system based on the NAD27 datum. This is an older datum centred in the middle of the USA. The newer NAD83 datum is an Earth-centred datum and provides more accurate location data, especially when compared with location information provided by handheld mobile devices. For this reason all the layers of information for this project will be converted to the NAD83 datum. The data will also be converted to the UTM projection, as the AOI is small and a Cartesian coordinate system in metres will provide a better local grid base than the latitude–longitude spherical coordinates.

The data layers of interest consist of the Bay of Islands AOI boundary, a digital elevation model, airphotos, topographic information such as water polygons and roads, bedrock geology, airborne residual magnetic geophysics, hiking trails and points of interest. Once all the layers are digitized or cropped and compiled, the fly-through animations can be prepared using the airphotos, the bedrock geology and the geophysics layers, with the other features (*e.g.*, topography, trails, points of interest) overlaid on top.

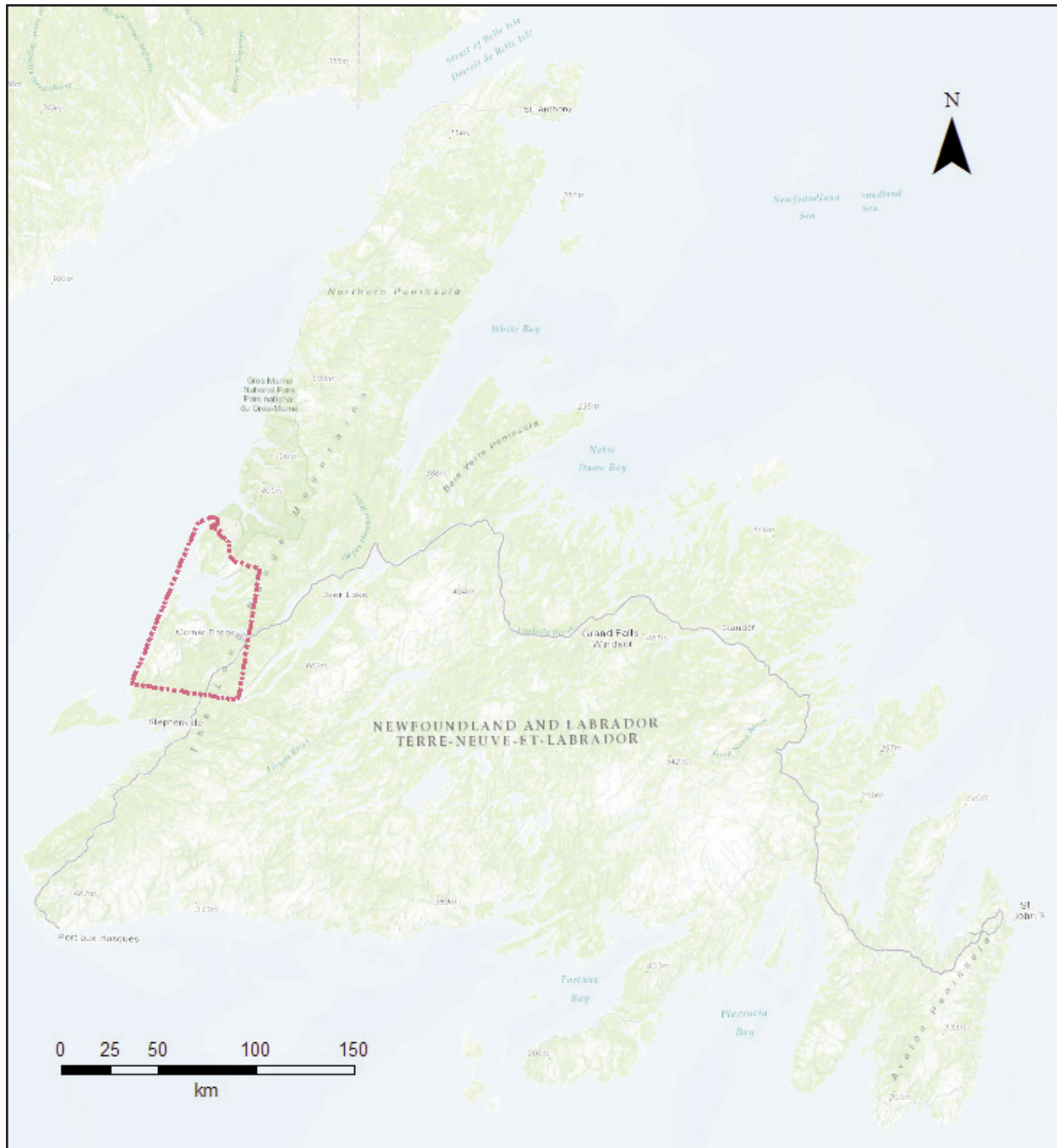


Figure 1. *The Bay of Islands area (red dashed line) on the Island of Newfoundland, Canada (base map from Esri's World Topo Map).*

CREATING THE AREA OF INTEREST (AOI) BOUNDARY

The AOI is defined for this project by the extents of the western Newfoundland ophiolites in the Bay of Islands area, south of Gros Morne National Park (Figure 1). A map delineating the AOI (Figure 2) is available to download from the International Appalachian Trail-Newfoundland and Labrador (IAT-NL) website <http://www.iatnl.com/>. Download the CanVec 1:50 000 topographic data (lakes and rivers consisting of water polygons and water lines), which is available free of

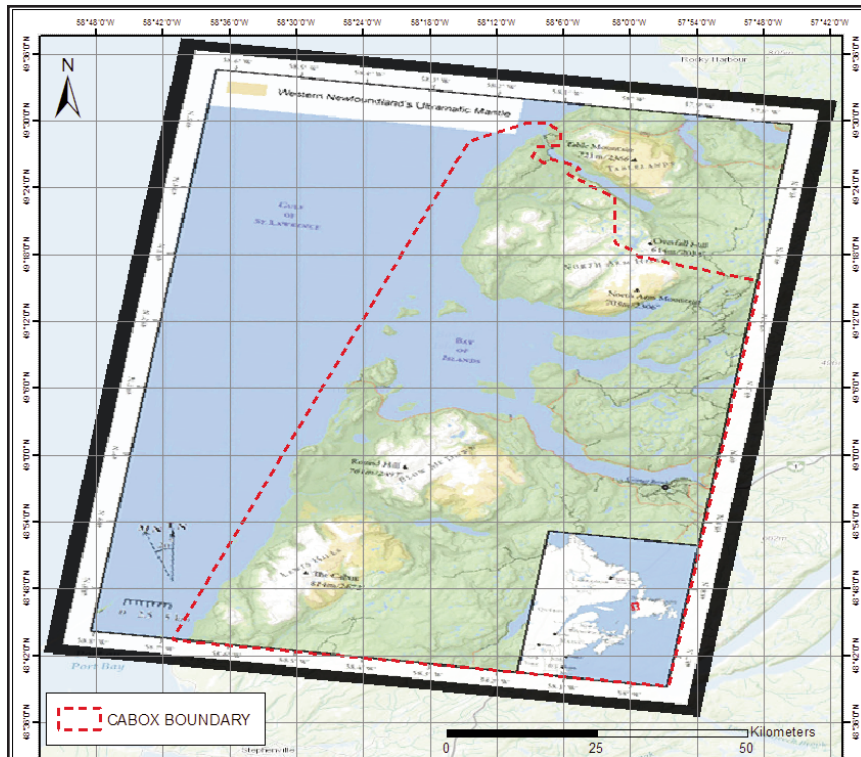


Figure 2. *Georeferenced map (from IAT NL) and AOI boundary (dashed red line), using the southern border of Gros Morne National Park as the northern border of the AOI.*

charge from the Canadian Federal Government's Geospatial Data Extraction website <http://maps.canada.ca/czs/index-en.html> (formerly the Geogratis website). Convert the data from latitude–longitude, NAD83 projection to UTM, NAD83 projection. Use this data to georeference the AOI map - an even spread of eight control points provides a good reference. Digitize the AOI boundary from the georeferenced map using the Gros Morne National Park boundary as the northern border (Figure 2). The park boundary is available in the Mineral Tenure layer on the Geoscience Atlas.

DOWNLOADING AND COMPILING DIGITAL ELEVATION DATA (DEM)

The digital elevation data, at a 1:50 000 scale, is available from the Federal Government's GeoGratis site¹. The elevation data has a cell resolution of approximately 23 m by 15 m. The model elevation data was derived from scanning the National Topographic Database (NTDB) 1:50 000 map sheets (Government of Canada, 2007). Eleven, 1:50 000 National Topographic System (NTS) map areas cover the entire AOI (Figure 3). Each NTS map area consists of an east and west portion resulting in fifteen DEM files of interest (Figure 4).

Create an empty mosaic dataset file in ArcCatalog by right clicking on the Cabox geodatabase and going to *New -> Mosaic Dataset* (Figure 5). This will open the *Create Mosaic Dataset* dialogue box. Enter the mosaic dataset name (*e.g.*, DEM_MosaicDataset). Since the original raster DEM files are in the GCS_North_America_NAD83 coordinate system, set the new mosaic dataset to the same coordinate system and click *OK*.

¹At the time of this publication, the .dem formatted digital elevation data is no longer available from the GeoGratis site. Similar GeoTIFF data is available through the Federal Government's Geospatial Data Extraction site.

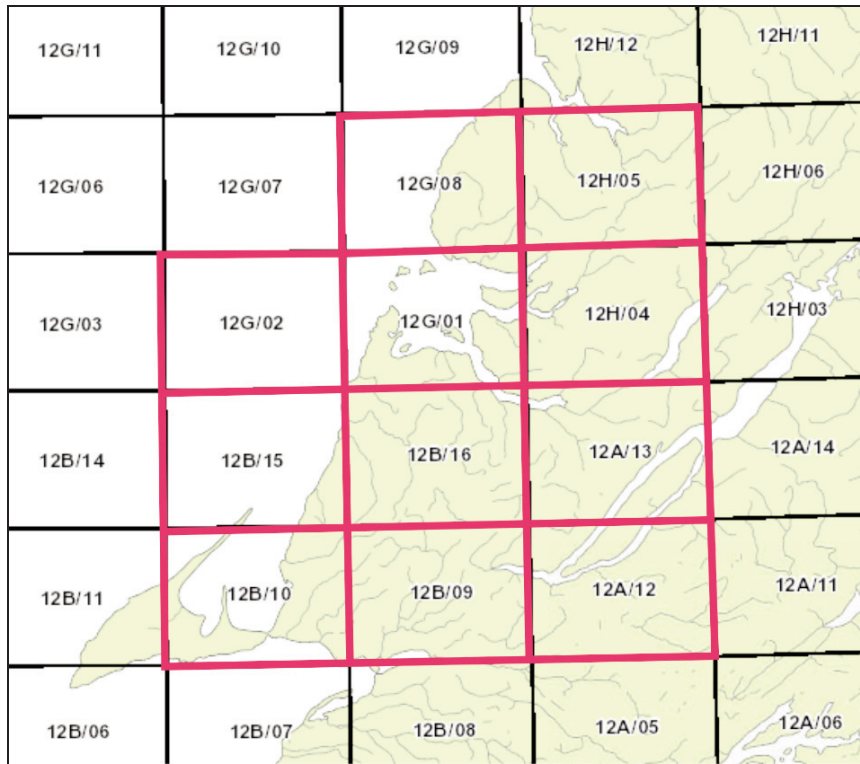


Figure 3. The National Topographic System map sheets, over the AOI, consist of portions of NTS 12A, 12B, 12G and 12H.

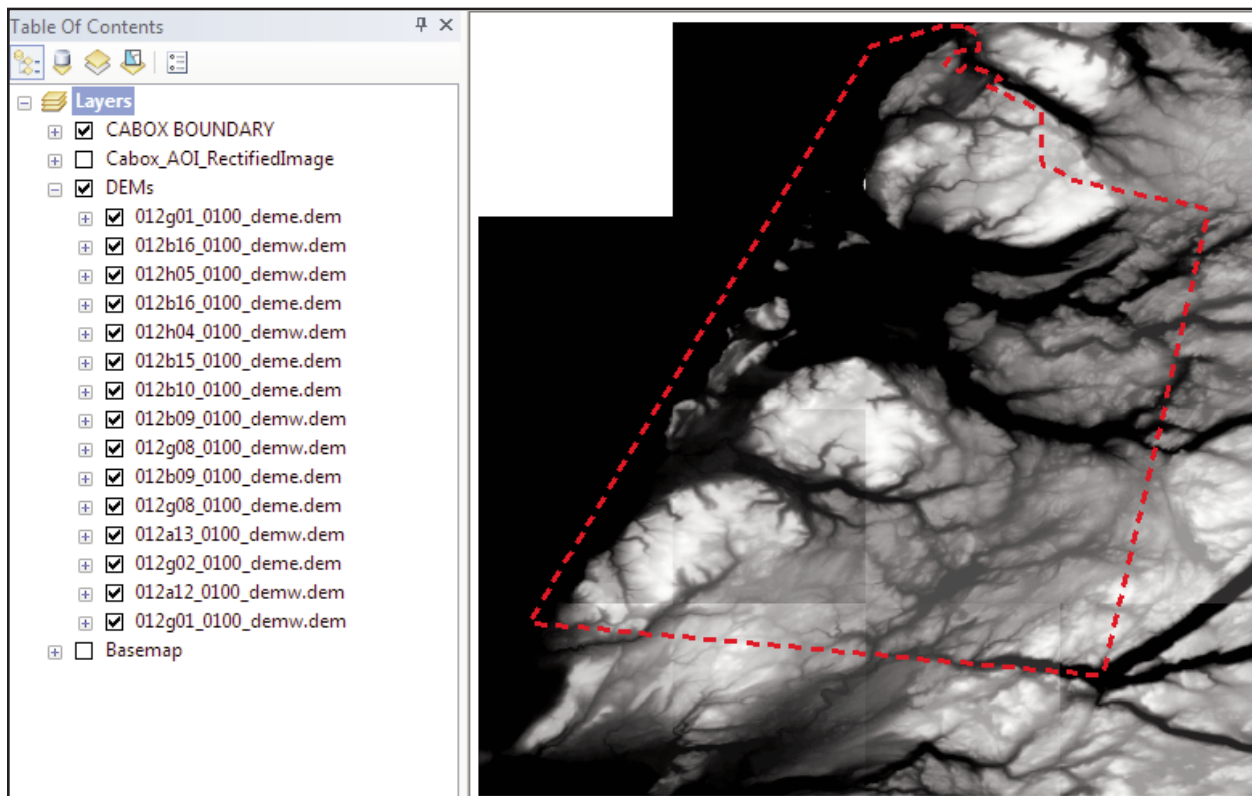


Figure 4. ArcGIS Table of Contents listing the fifteen digital elevation model files (raster tiles) that cover the AOI.

Download the separate DEM files. Add them to the empty mosaic dataset by right clicking on its filename in ArcCatalog, and choose the *Add Rasters* tool. In the *Add Rasters To Mosaic Dataset* dialogue box (Figure 6), leave the *Raster Type* as *Raster Dataset*. In the *Input Data* section drop-down list, choose *Workspace*. Browse for the *Source* folder containing the individual DEM's. Check the *Update Overview* box and click *OK* to run the tool. Clip the DEM to the AOI using the *Extract by Mask* tool (Figure 7) to provide the final AOI_DEM file.

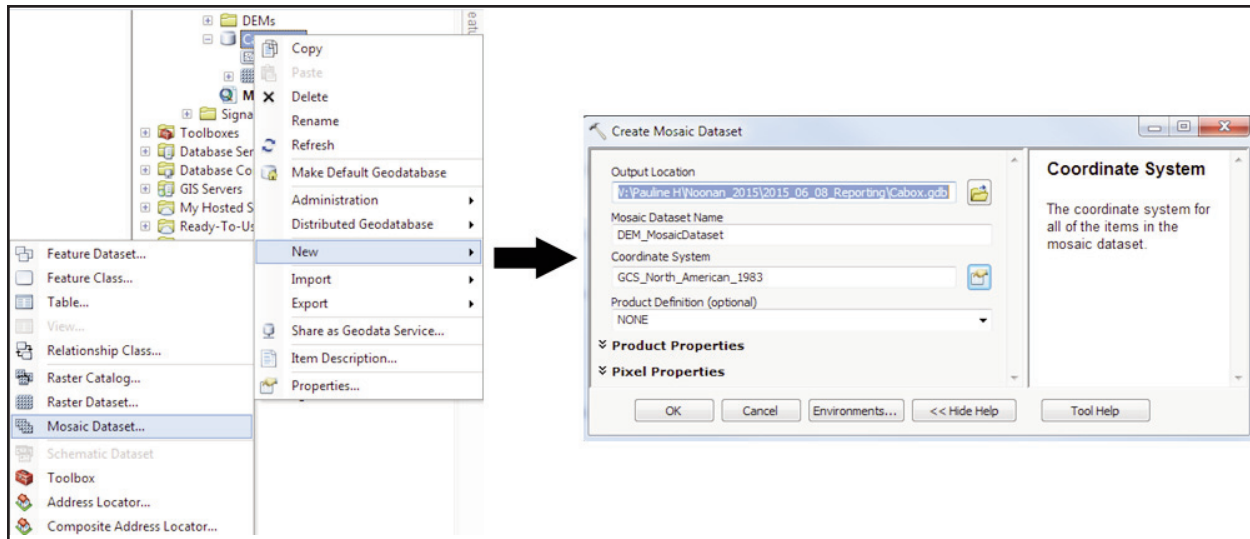


Figure 5. Procedure to create a new mosaic dataset in ArcCatalog.

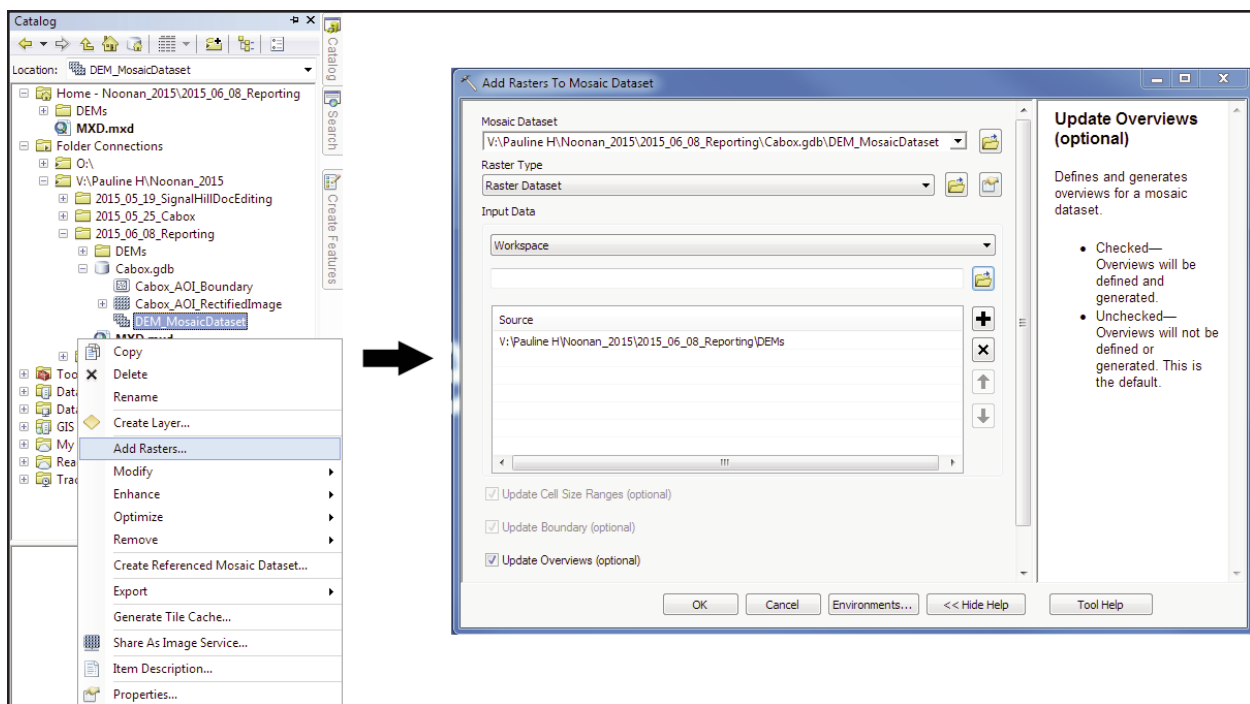


Figure 6. Add the individual DEM rasters to the DEM mosaic dataset.

Re-sample the DEM to a finer resolution, so the draped files in the fly-through will have a smoother appearance. Use the *Resample* tool to set the resolution to a 15 x 15 m cell size using the bilinear method of interpolation.

DEM ACCURACY CHECK

To check the accuracy of the DEM, use the survey control monuments elevation data in the *Survey Control Monuments.kmz* file from the NL Department of Fisheries and Land Resources website (http://www.flr.gov.nl.ca/lands/maps/digital_map.html). The ArcMap *KML to Layer* tool (Figure 8) only translates the locations of the survey control monuments and does not contain the elevation information.

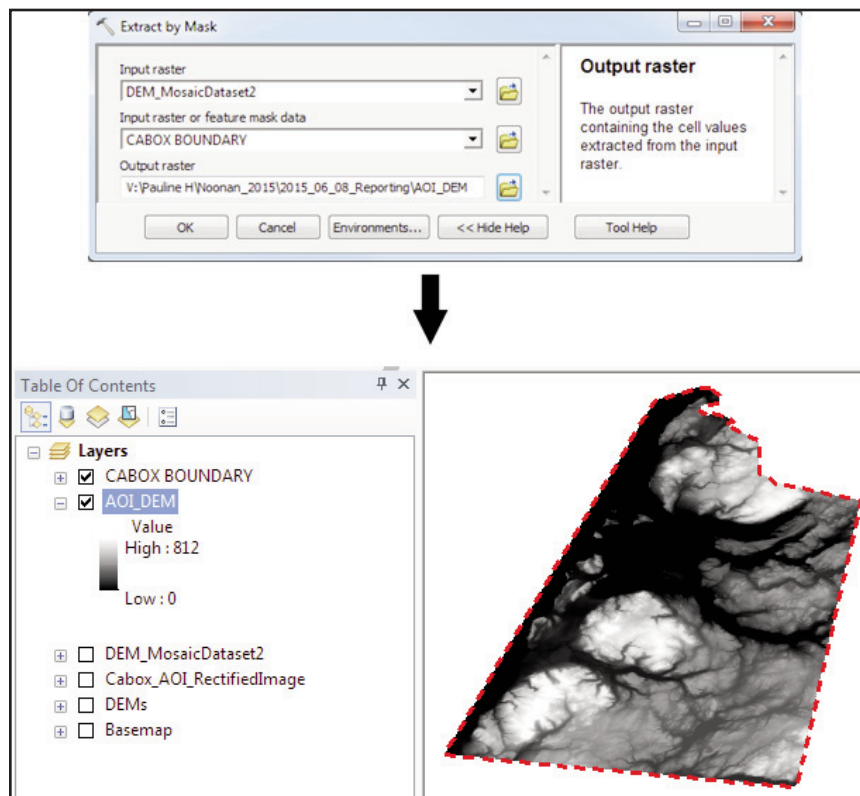


Figure 7. Use the Extract by Mask tool to clip the AOI from the mosaic DEM.

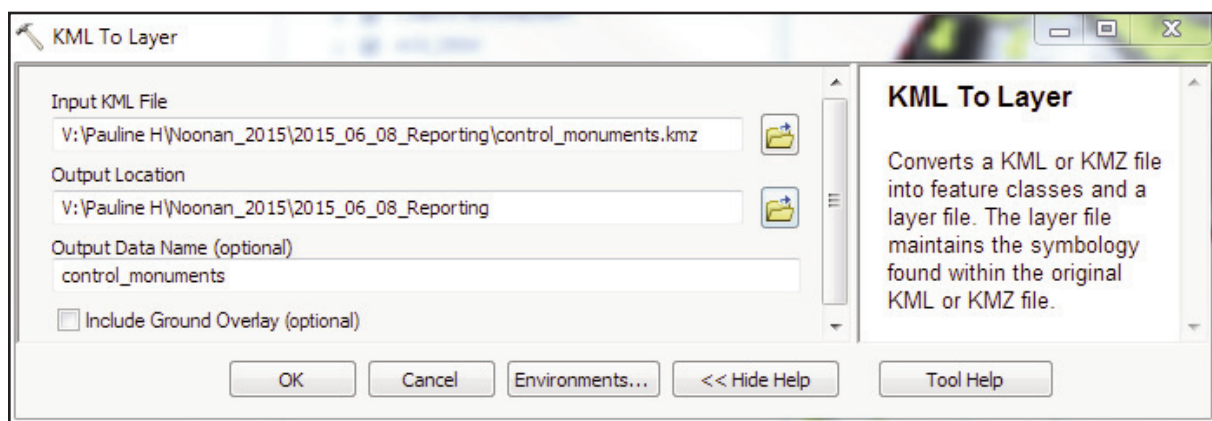


Figure 8. KML to layer tool dialogue box.

As an alternate method to check the accuracy of the DEM, in ArcMap select the survey monuments within the AOI using the *Select by Location* tool (Figure 9). Set the method to target features that ‘are completely within the source layer feature’ and export to a shapefile (e.g., SurveyPointsOfInterest.shp). Then using the *Extract Multi Values to Points* tool (Figure 10), use the SurveyPointsOfInterest file to extract the elevation data from the DEM at the site of the survey monuments.

Convert the file to a Google Earth kml file by using the *Layer to KML* tool (Figure 11). In Google Earth, randomly select a few survey monuments and compare the monument elevations in the pop-up box with the elevations extracted from the DEM (Table 1). The metadata for the orig-

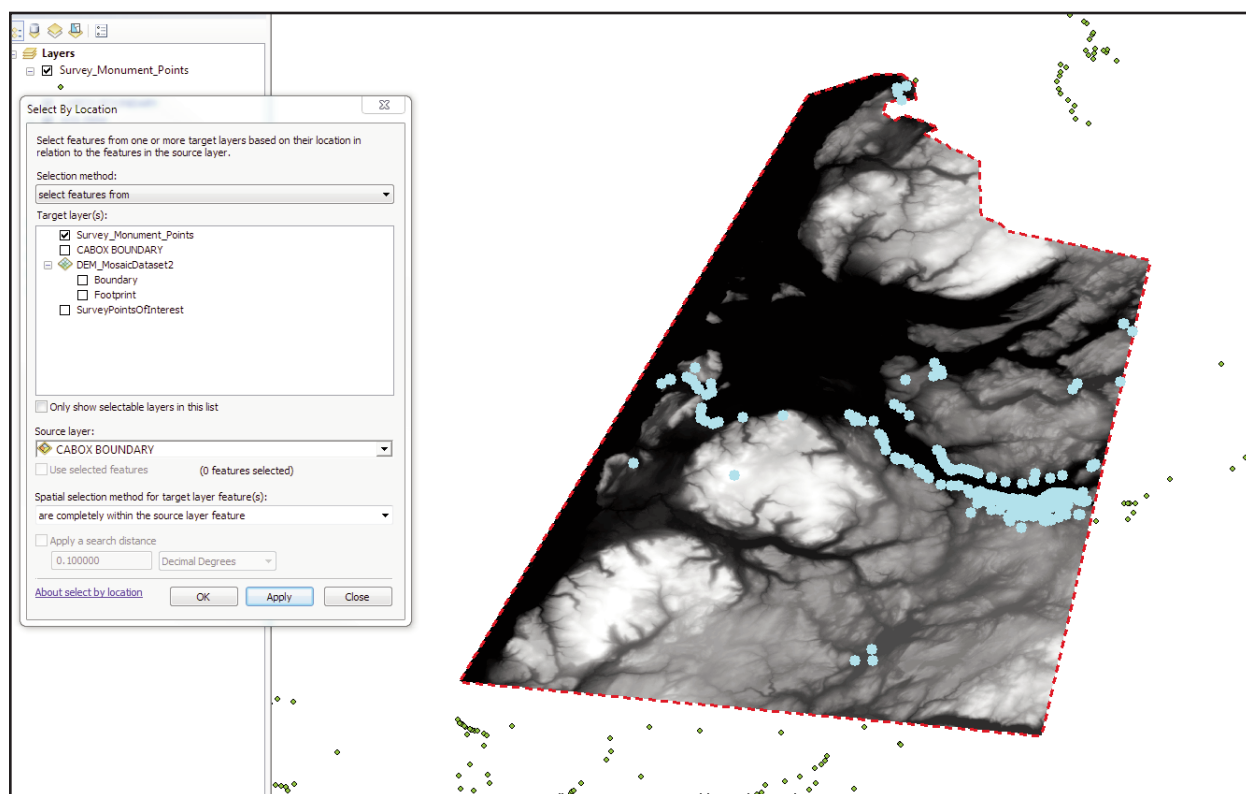


Figure 9. Select the survey monument points within the AOI boundary.

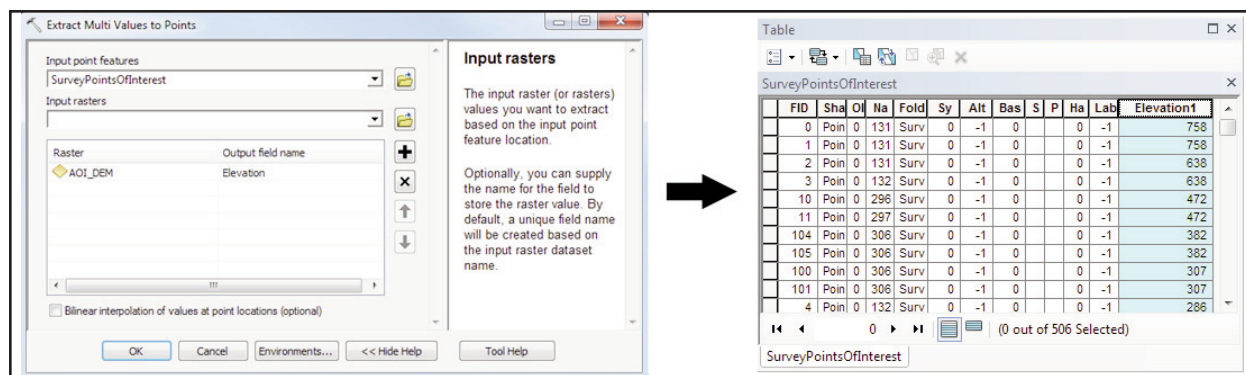


Figure 10. Extract the elevation values for each point within the AOI boundary.

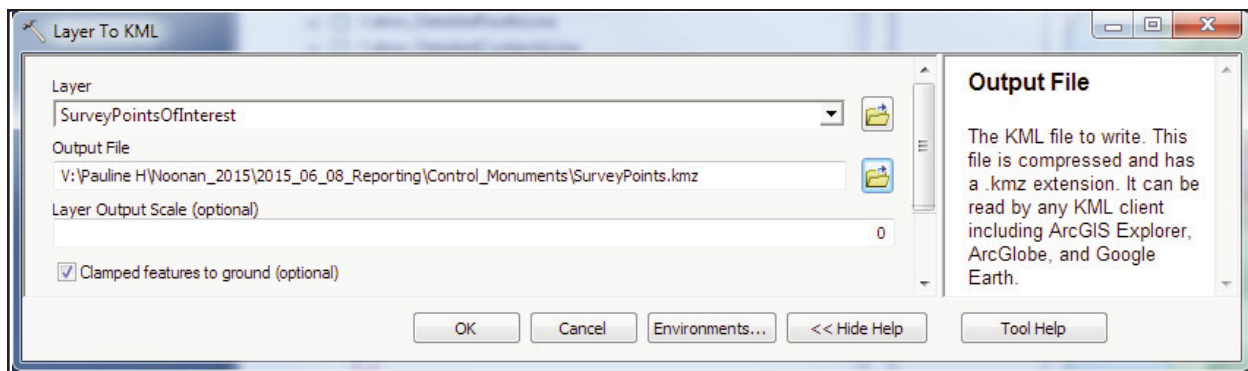


Figure 11. Layer to KML *tool dialogue box*.

Table 1. Elevation comparison between randomly selected survey monument sites and the elevation from the federal government’s Digital Elevation Model

Survey Monument Number	NTS_Maps	Elevation_m (Survey Monument)	Elevation_m (DEM)	Difference (m)
76G2459	012A/13	382	382	0
77G2495	012A/13	39	41	-2
36016	012B/16	760	758	2
98G9207	012B/16	156	149	7
76G2402	012G/01	91	87	4
94G2461	012G/01	260	252	8
87G3003	012G/08	30	26	4
98G9213	012H/04	166	161	5

inal DEM files indicates that these map sheets have a horizontal accuracy of 25 m and a vertical accuracy of 5 m. The elevation differences of 0 m to 8 m, between the survey monuments and the DEM, listed in Table 1, are within an acceptable margin of error.

PREPARING THE GEOLOGY SURFACE

Extract the detailed bedrock geology, contact lines and fault lines from the GeoScience Atlas (<http://geoatlas.gov.nl.ca>) and clip using the AOI boundary. The layer file, providing the symbols for the geology polygons and lines, is available to download from the bedrock geology help file (<http://geoatlas.gov.nl.ca/custom/help/bedgeohelp.html#layer>).

Overlay the federal government’s CanVec water polygons and water lines to provide relative location information. As mentioned above, the CanVec vector topographic data can be obtained from the Canadian federal government’s Geospatial Data Extraction site at <http://maps.canada.ca/czs/index-en.html> or the internal government folder on O:\Topo\Vector_Topo\. Clip these feature classes using the AOI boundary.

Save all the data to the Cabox.gdb file geodatabase. The projection of the GeoScience Atlas data and internal CanVec data is latitude–longitude, based on the NAD27 datum. Use the *Project* tool to re-project the data to UTM, zone 21, NAD83, making sure to use the Canadian NTV2 grid transformation file for the NAD27 to NAD83 conversion. A thumbnail of each layer is displayed in Figure 12.

PREPARING THE GEOPHYSICS SURFACE

Residual magnetic geophysics images delineate mafic and ultramafic ophiolitic rocks. The airborne geophysics grid files are available for download from the Geoscience Atlas (<http://geoatlas.gov.nl.ca>). In the Geophysics Group, the layers within the AOI are the *Corner Brook*, *Indian Head* and *Offshore Western NL - 2012* geophysical surveys. Download the gridded residual magnetic data for *Offshore Western NL - 2012* from the Geoscience Atlas. The *Corner Brook* and *Indian Head* surveys were merged by Gerry Kilfoil (NL Geological Survey), using the Geosoft program and were made available for this project. ArcMap requires a plug-in to read the .grd Geosoft grid files. Download the plug-in from the Geosoft website at <http://www.geosoft.com/support/downloads/plugin-ins/plugin-arcgis>.

In the Bay of Islands area, the merged and offshore grid files overlap with different colour value ranges (Figure 13). Use the *Mosaic to New Raster* tool to merge the rasters (Figure 14) and balance the colours of the two images in a file geodatabase raster dataset. Use the *Project* tool to

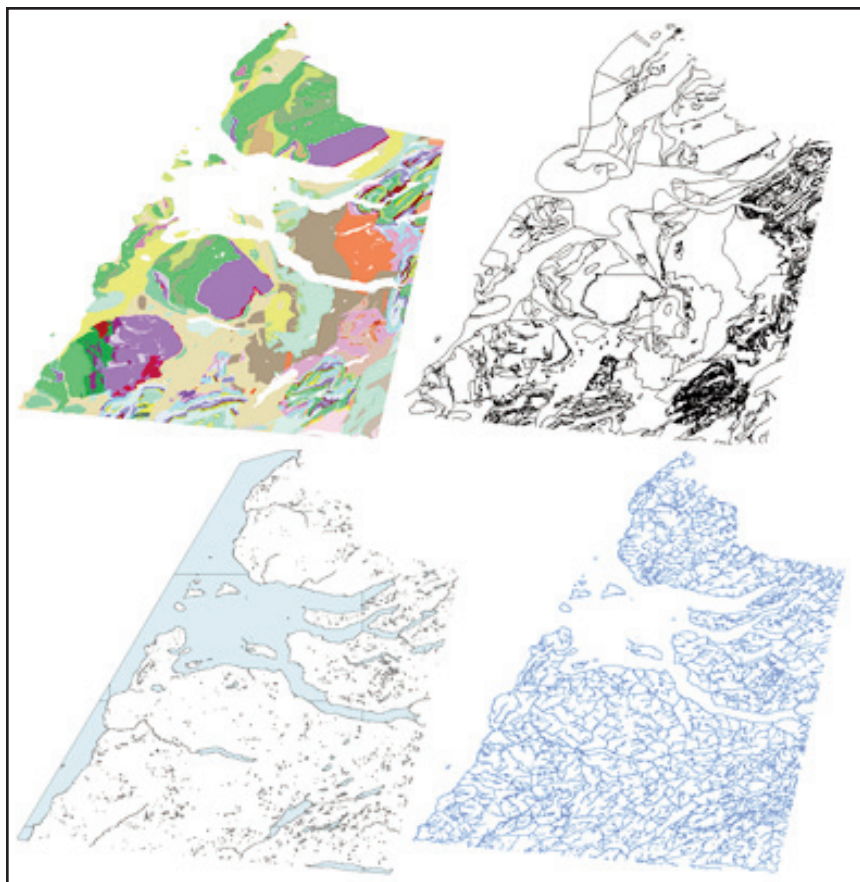


Figure 12. Layer files used for the bedrock geology drape (clockwise, from the top left, are the detailed bedrock geology, contact and fault lines, water lines and water polygons).

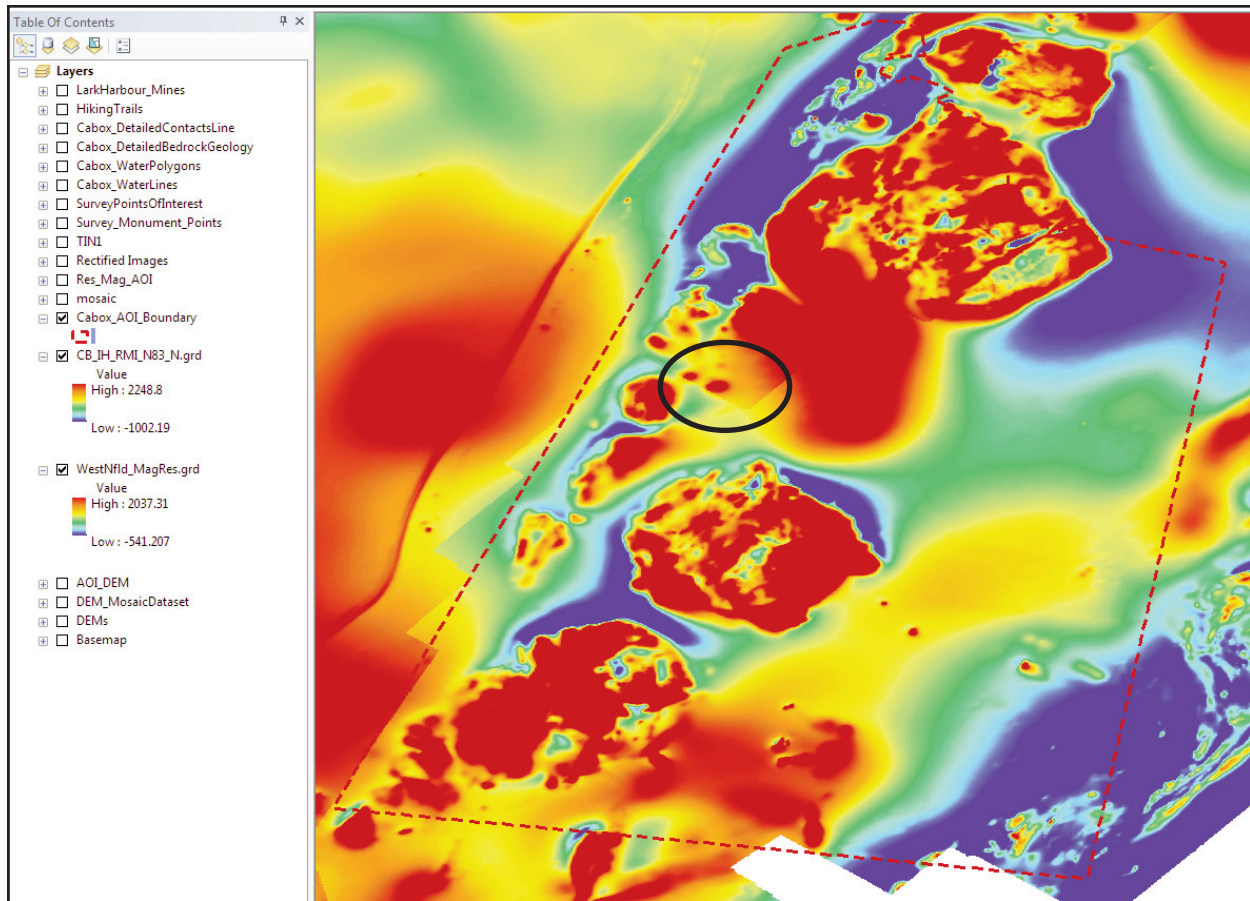


Figure 13. The two residual magnetics Geosoft grid files display different colour values where they overlap (e.g., within black ellipse).

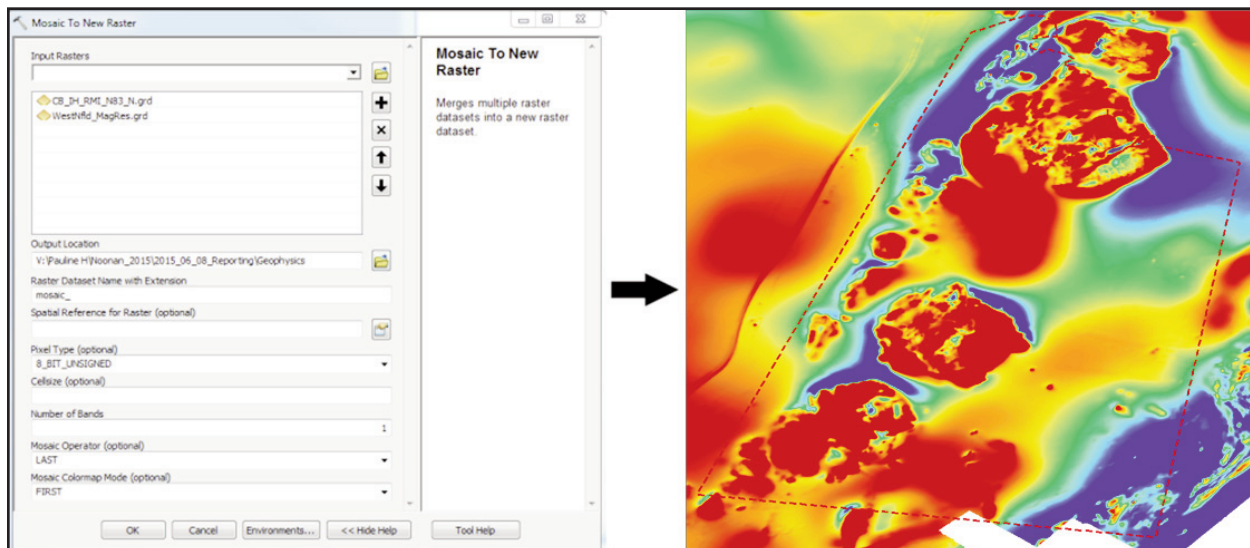


Figure 14. The geophysics grid files combined into one seamless raster grid using the 'Mosaic to New Raster' tool.

re-project the mosaic to UTM, zone 21, NAD83. Then use the *Extract by Mask* tool to extract the AOI from the grid file (Figure 15). The resolution of the geophysics gridded image is 50 m.

PREPARING THE AIRPHOTO IMAGES

High resolution airphotos provide a realistic surface drape for a fly-through of the Bay of Islands area. The airphotos taken in the AOI are available through the Surveys and Mapping Division of the Provincial Department of Municipal Affairs.

The following specifications are from B. Budgell (Senior Engineer, Surveys and Mapping Division). The airphoto survey was flown in 2012 as part of the Deer Lake forest inventory and Surveys and Mapping topographic project. The cell resolution is 30 cm and has a horizontal accuracy of 2 to 5 m. The raster catalog airphoto coordinate system is Modified Transverse Mercator, zone 2, NAD83, with a false easting of 304800, a central meridian of -56° and a scale factor of 0.9999. The airphotos were photogrammetrically orthorectified by the contractor (Aeroquest International Ltd.) but not colour balanced.

Organize the airphotos into a raster catalog, similar to the procedure used to compile the DEM data. Use the *Select by Location* tool to find those tiles (the target layer) that fall within the AOI (the source layer) using the ‘*intersect the source layer feature*’ spatial selection method. With the tiles of interest selected, right click the raster catalog in the Table of Contents and go to *Data > Mosaic Raster Catalog*. Make sure the ‘*Use selected rasters*’ option is selected. Choose a cell size of 1 to significantly speed up the mosaic processing time and to create a high-resolution drape layer. To make each pixel square, choose the *Square* option. Output as a TIF format having a JPEG

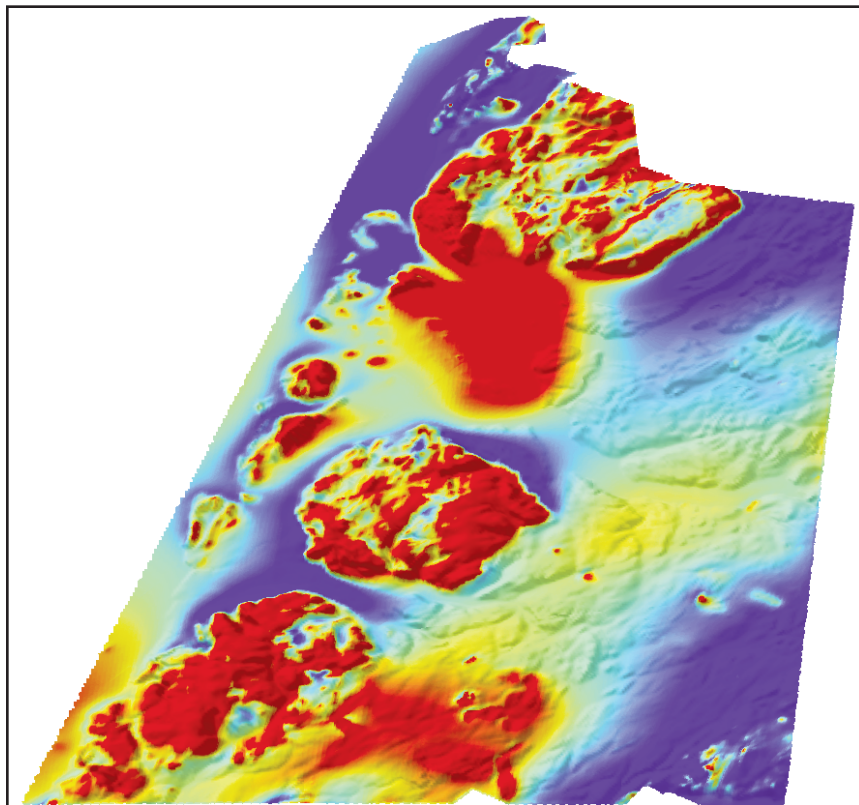


Figure 15. *The seamless geophysics grid file cropped to the AOI and draped on the DEM.*

compression quality of 75 percent; this is done to keep the image quality high while maintaining a relatively low file size. The projection of the input airphoto tiles is Modified Transverse Mercator, zone 2, NAD83, so this is retained as the output mosaic projection. Then use the *Project* tool to convert the projection to UTM, zone 21, NAD83. Clip the mosaic to the AOI. Use the *Resample* tool, with the *Nearest Neighbor* resampling technique, to re-grid the mosaic cell size to 10 x 10 m. Open the airphoto mosaic in ArcScene (Figure 16).

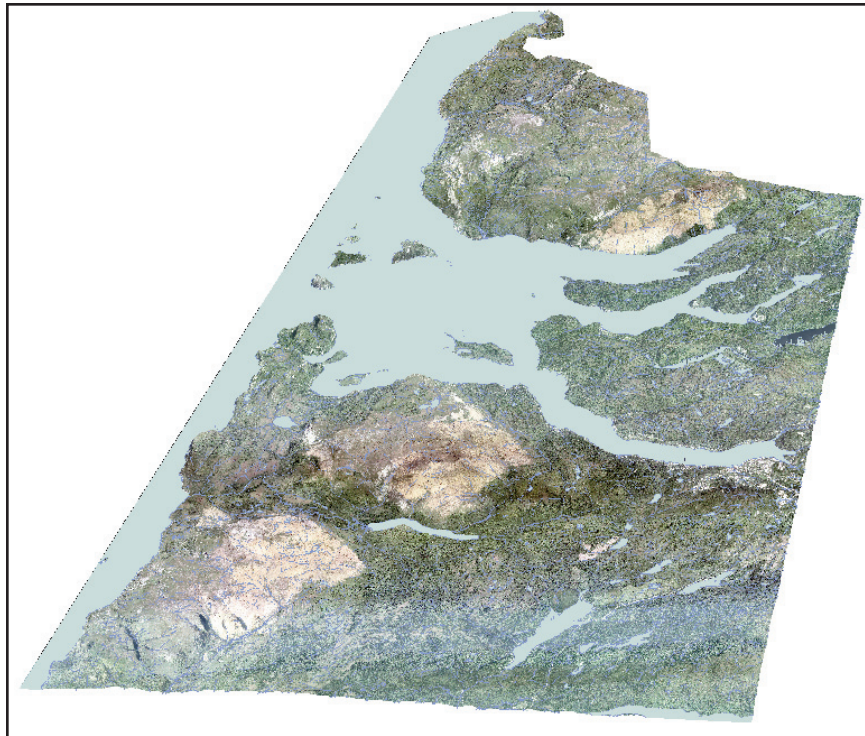


Figure 16. *Orthorectified and mosaicked airphotos with the water polygons and lines overlain on top.*

COMPILING ANCILLARY INFORMATION

Ancillary information, to add to the fly-throughs, include sites of interest (e.g., historic mines) and hiking trails. The mine sites can be extracted from the Geoscience Atlas' Mineral Occurrence layer. Use the *Custom Queries* or *Attribute Query* tool to select and download those sites where the *Status* is a *Producer*, *Past Producer (Dormant)*, or *Past Producer (Exhausted)*. There is only one mine site in the area. The York Harbour Mine site, located on the north side of Blow-Me-Down Mountain, is a past producer (dormant) of copper, with secondary zinc, silver and gold. Over 100 000 tons of high-grade copper/zinc ore was mined from this site in the late nineteenth and early twentieth centuries. To symbolize the mine site, download the York Harbour mineral occurrence and add it to the database.

Many hiking trails wind their way around these mountains and more are being developed each year. The hiking trails are available from the *IAT-NL* website, *Trails* section (<http://www.iatnl.com/index.php/Trails-2/>) and the Provincial Department of Municipal Affairs and Environment-Environmental Assessment section (http://www.mae.gov.nl.ca/env_assessment/projects/Y2008/1372/index.html). Download the maps, and register and digitize the trails (Figures 17 and 18).

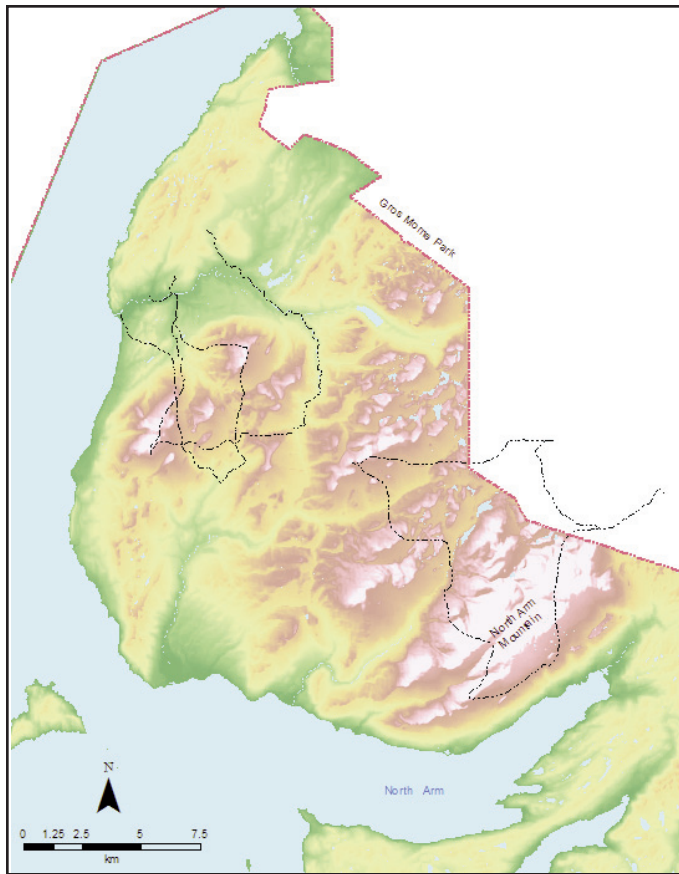


Figure 17. Hiking trails (dash-dot lines) in the North Arm Mountain area.

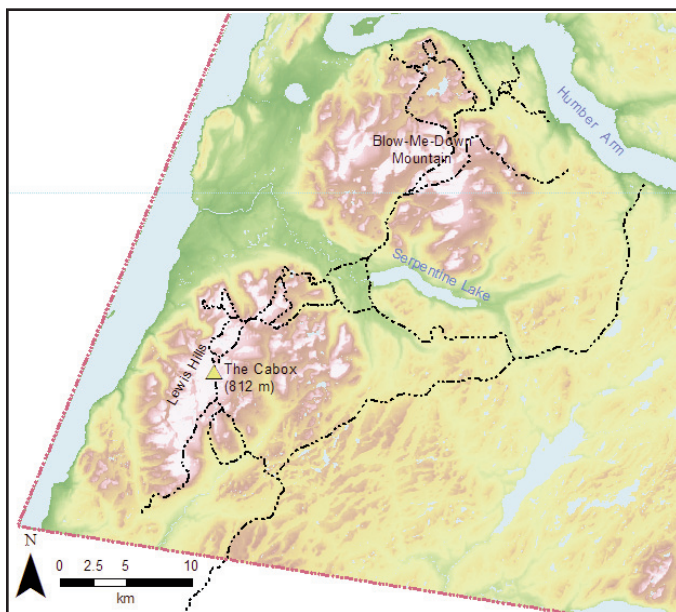


Figure 18. Hiking trails (dash-dot lines) in the Blow-Me-Down Mountain and Lewis Hills area.

DISPLAYING INFORMATION IN ARCSCE

ArcScene is Esri's 3D visualization program that displays data in three-dimensional perspective scenes. ArcScene is available with Esri's 3D Analyst Licence. Features are displayed in 3D using height information stored in the features geometry, attributes, layer properties, or a defined 3D surface.

Open all the project layers in ArcScene 10.3 using the *Add Data* button. The preliminary perspective image of the DEM is in greyscale (Figure 19). To view the DEM with an appropriate colour palette, in the DEM *Layer Properties*, under the *Symbology* tab, change the *Color Ramp* to a range of colours varying from light blue to greens, browns and white. This colour ramp represents water at the lowest elevations, vegetation, mountains and snow-capped peaks at the highest elevations. To enhance the 3D effect of the DEM, turn on the 'Use hillshade effect'. Under the *Stretch* section, change the *Type* to *Standard Deviations* with an *n* value of 2.5. Under the *Base Heights* tab, choose 'Floating on a custom surface' and select the *AOI_DEM* from the drop-down list. Because the elevations at The Cabox are up to 812 m, scale them down so the layer is easily viewed in ArcScene. Do this under the 'Elevation from features' section, by changing the 'Factor to convert layer elevation values to scene units' to a custom factor of 0.00003. Under the *Rendering* tab, in the *Effects* section, check the 'Shade areal features relative to the scene's light position' and 'Use smooth shading if possible'. These changes provide an enhanced appearance of the AOI (Figure 20) compared with the grey-scale image (Figure 19).

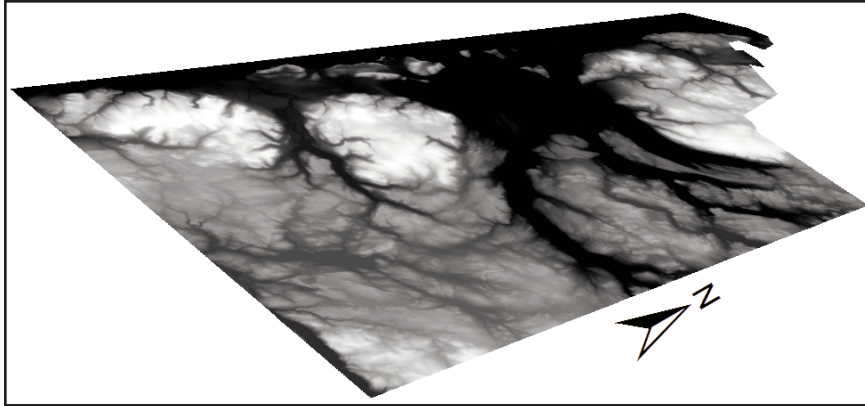


Figure 19. *The greyscale DEM of the AOI displayed in ArcScene.*

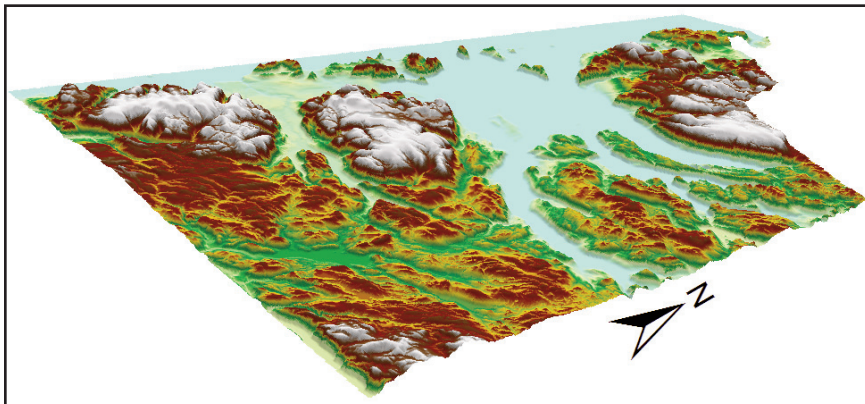


Figure 20. *The colour enhanced DEM of the AOI displayed in ArcScene.*

To drape other surfaces, such as geophysics, over the DEM, the above procedure is repeated. For example, turn off the DEM and turn on the Residual Magnetics layer. In the *Layer Properties Symbology* tab, set the *Colour ramp* to a red to blue range and click the *Invert* box so the blue shades represent low magnetic values. Under the *Stretch* section, change the *Type* to *Standard Deviations* with an *n* value of 1. Under the *Base Heights* tab, choose ‘*Floating on a custom surface*’ and select the *AOI_DEM* from the drop-down list. Scale the elevations down in the ‘*Elevation from features*’ section by changing the ‘*Factor to convert layer elevation values to scene units*’ to a custom factor of 0.00003. Under the *Rendering* tab, under the *Effects* section, check the ‘*Shade areal features relative to the scene’s light position*’ and ‘*Use smooth shading if possible*’.

Figure 21 displays the residual magnetic geophysics layer draped over the DEM and, similarly, Figure 22 displays the geology, water bodies, rivers and streams.

The geology layer does not always retain its drape over the DEM. If this happens, go back to the *Layer Properties Base Heights* tab and under the ‘*Elevation from features*’ section, reset the ‘*Factor to convert layer elevation values to scene units*’ to a custom factor of 0.00003.

In ArcScene, the point sites can be symbolized using a 3D symbol. For the mine sites, in the *Layer Properties Symbology* tab, click on the symbol and scroll down to the *3D Industrial* symbols and select the *Derrick 1* symbol. Click on the *Edit Symbol* button and set the *width* and *depth*

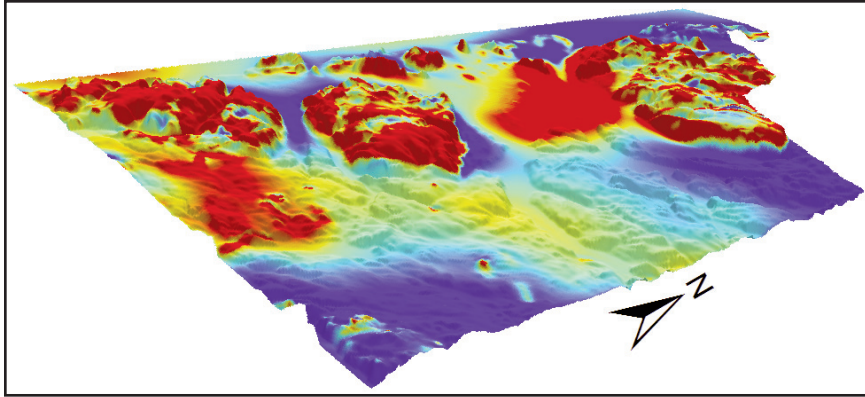


Figure 21. The residual magnetic geophysics layer draped over the DEM surface. Values range from about -400 (dark blue) to 1000 (red) nanotesla's.

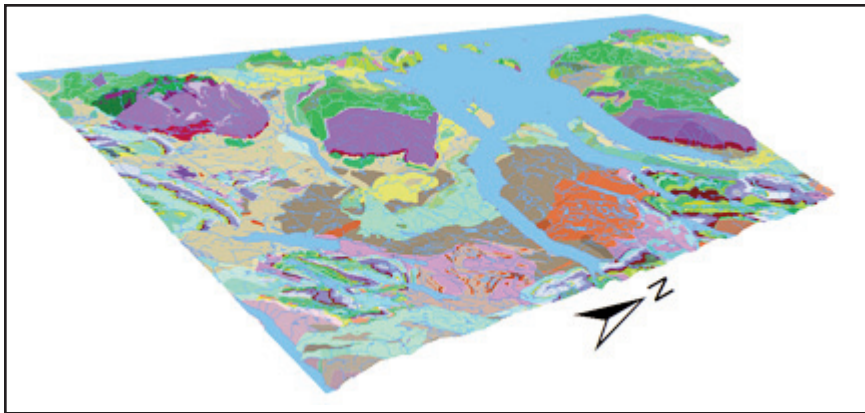


Figure 22. The geology layer overlain by the water bodies and rivers layers.

to 0.01. To size the symbol, go to the *Table of Contents*, right click on the point layer and click on *Scale 3D Symbols*. Click on the *Suggest* box. If this is not an appropriate size for the symbol then move the slider manually. Similarly, mark the top of the Cabox peak with an appropriate 3D symbol, such as *Post 1* in the *3D Street Furniture* section.

CREATE A FLY-THROUGH IN ARCSCENE USING A FLIGHT PATH

Fly-throughs can be created using two different methods – a digitized path or keyframes. To create a fly-through using the digitized path method within ArcScene, open ArcCatalog and create a new feature class in the geodatabase. In the *New Feature Class* dialogue box, provide a name for the line feature class (e.g., *Flight_Path*), set the 'Type to Line Features' and check the 'Coordinates include Z values' (i.e., elevations) box (Figure 23). Choose the geographic coordinate system UTM, zone 21, NAD83, for the X, Y and Z coordinates for the data to be created. Accept the defaults for the remaining steps and click *Finish*.

The *3D Editor* toolbar (Figure 24) is required to create and edit the 3D fly-through line. If it is not already open, right click anywhere on the ArcScene toolbar and select *3D Editor*.

Before the flight path line is created over the AOI, the DEM base heights must be turned off. If the base heights are left on, positive and negative Z values are automatically assigned to each vertex in the flight path line, which creates an oddly shaped line. To avoid this issue, open the

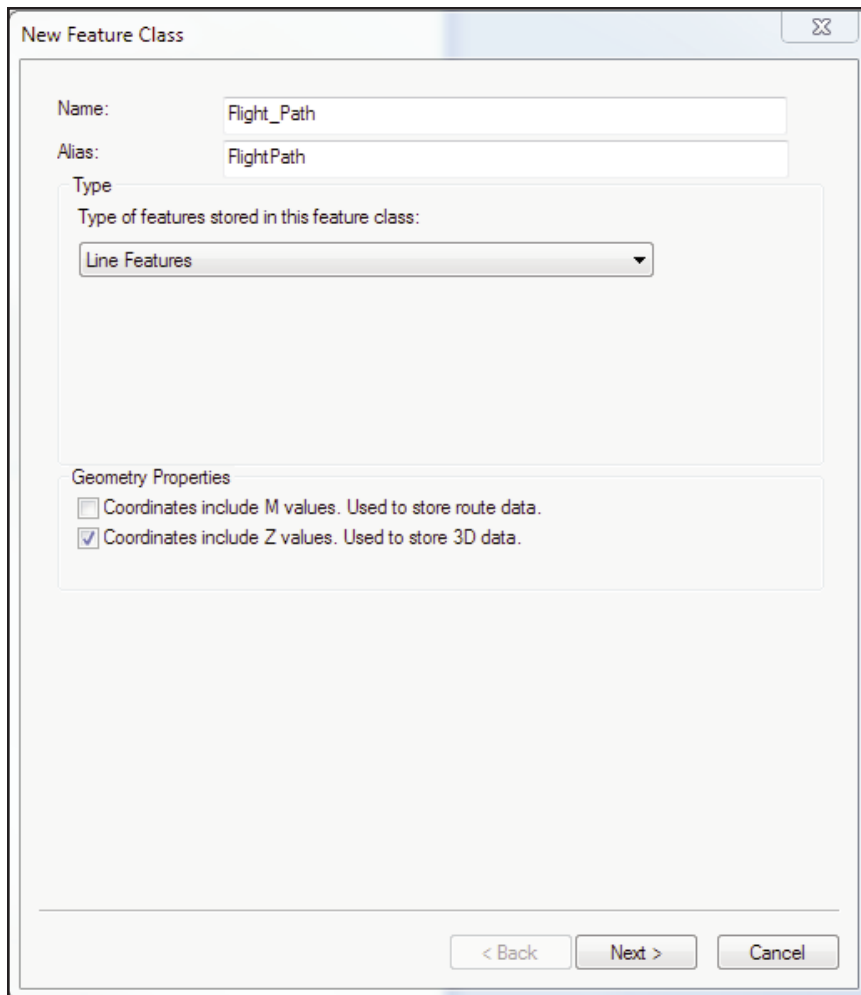


Figure 23. *New Feature Class* dialogue box to create the fly-through feature class path.



Figure 24. *The 3D Editor* toolbar.

DEM *Properties*, click the *Base Heights* tab, and choose ‘No elevation values from a surface’. The DEM surface will now appear flat (Figure 25).

Next, right click the *FlightPath* feature class in ArcScene and begin editing. In the 3D Editor toolbar, select *Create Features* (Figure 24). This will open a *Create Features* panel on the right. Select the *FlightPath* feature class and under *Construction Tools* (bottom of the panel), select the *Line* tool (Figure 26). Create the line by clicking along a path that the fly-through will follow. Once the line is finished, it will appear flush with the flat DEM surface (Figure 27).

The newly created line can be elevated by editing the Z value of each vertex. Select the *Edit Vertex* tool and click the line – this may take a few seconds to activate (Figure 28). Click on the *Sketch Properties* icon to see the panel list of the vertices X, Y and Z values. Change all the Z val-

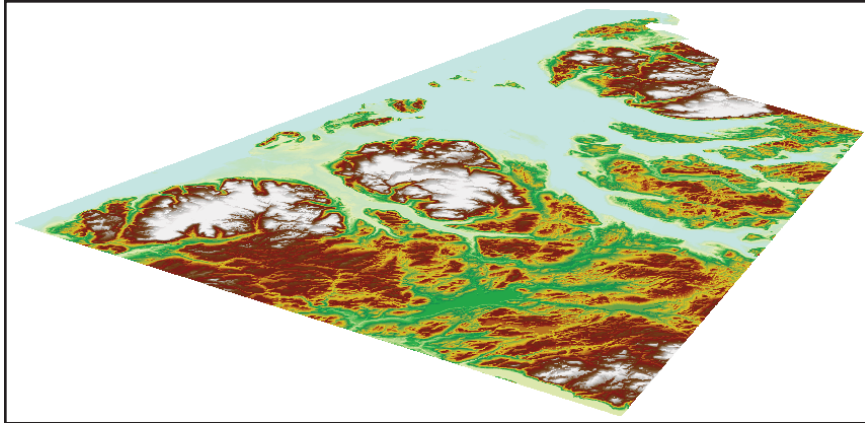


Figure 25. *The AOI DEM displayed as a 2D flat image.*

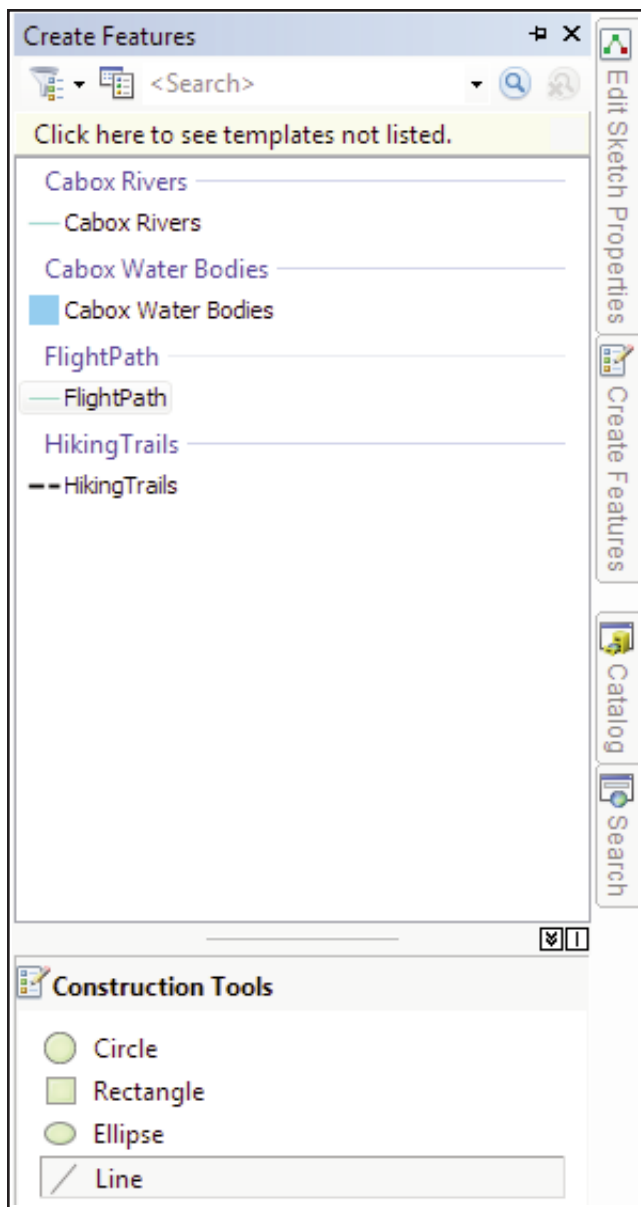


Figure 26. *Setup to create a path for the FlightPath feature class.*

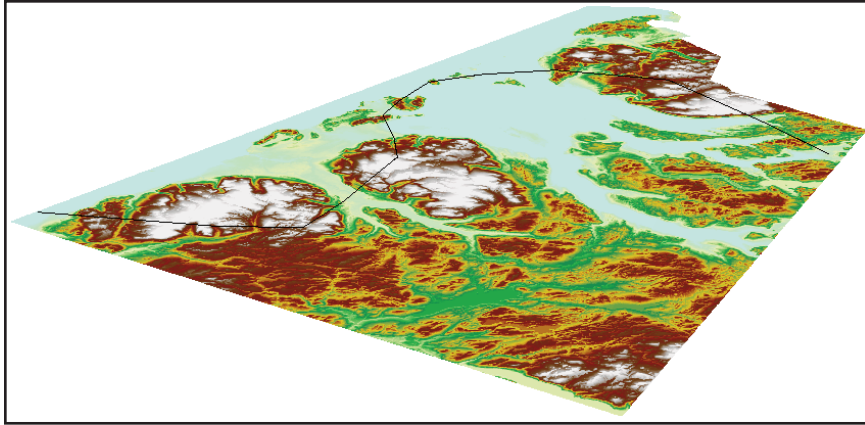


Figure 27. The digitized flight path on the 2D surface.

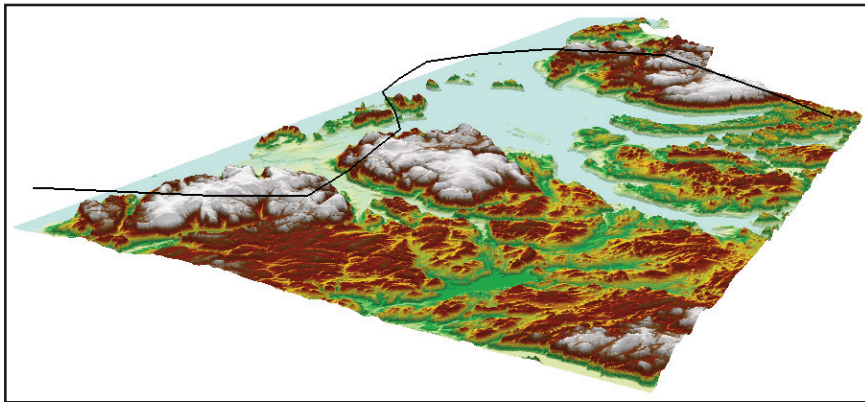


Figure 28. The AOI DEM displaying the flight path above the 3D surface

ues to 0.060 decimal degrees. Click on the *3D Editor* drop down list to *Save* the edits and *Stop Editing*.

Reopen the *Base Heights* tab in the DEM properties. Set the layer to *Float* on a custom surface and choose the AOI DEM. All settings should be the same as when originally displaying the DEM in 3D. The resulting layers are displayed in Figure 28.

Open the *Animation* toolbar (Figure 29) by right-clicking anywhere on the toolbar and selecting *Animation*. Select the line from the *FlightPath* feature class to be used for the fly-through. On the *Animation* tool drop-down, choose *Create Flyby from Path* to open up the dialogue box (Figure 30). The *Path source* is the *Selected line feature*. The *Simplification Factor* defines how closely the flight will follow the flight path line – set this to approximately 50%. Set the *Path destination* to ‘*Move both observer and target along path*’. Click on the *Orientation Settings* button

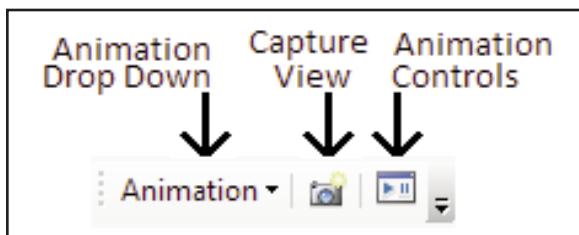


Figure 29. The Animation toolbar, consisting of the drop down list, the Capture View icon and the Animation Control options.

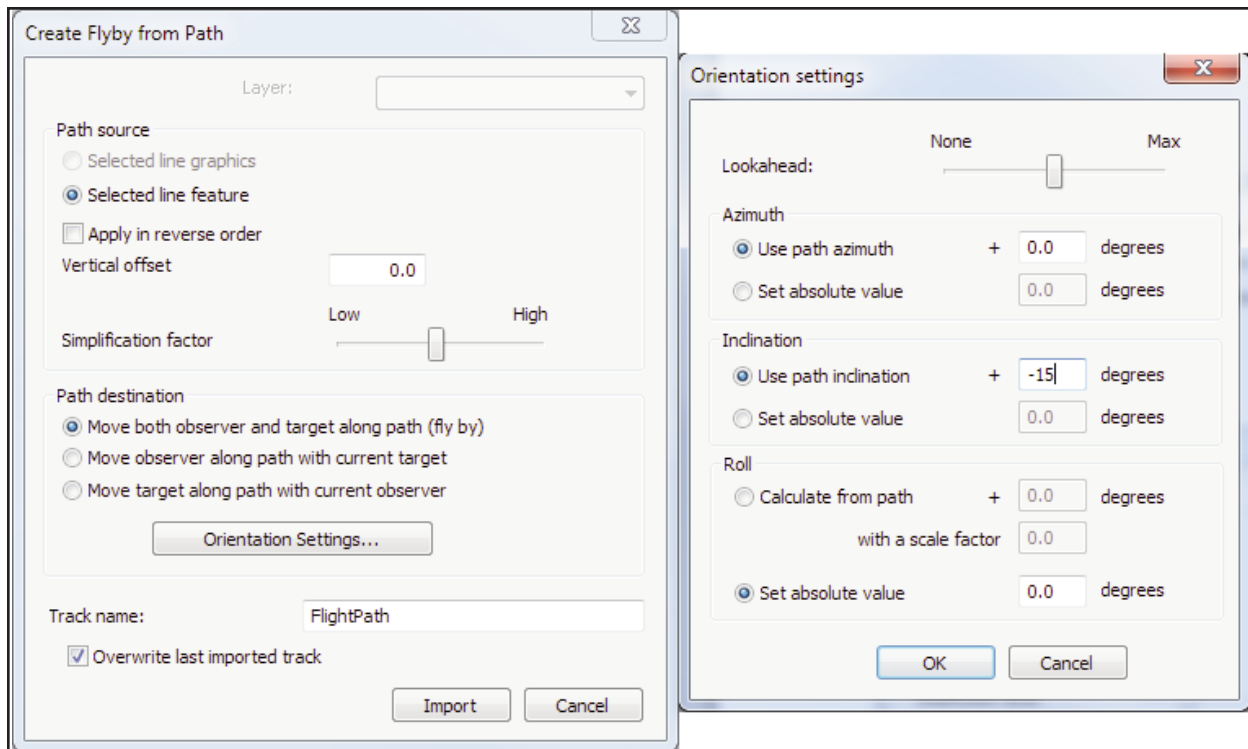


Figure 30. Settings to create a fly-through from a digitized path.

to open that dialogue box. *Lookahead* is a ratio between the position of the observer and the position they are being directed toward – set this to approximately 50% (midway between None and Max). The higher the *lookahead* ratio, the smoother the animation will progress around bends in the flight path. Set the *Inclination path* to -15 degrees, which will orient the fly-through looking down toward the ground. Click *OK* in the *Orientation settings* box and the *Import* button to close the *Create Flyby from Path* dialogue box.

To create an animation (*i.e.*, a video) in the *Animation* toolbar, click the *Animation* drop down and select *Export Animation*. Select a location to save the video and click the *Export* button to open the *Video Compression* dialogue box. Set the compression to *Cinepak Codec by Radius* to produce a high-quality video and click *OK*. ArcScene will then construct the fly-through animation and save it as an .avi formatted file. A 100-km flight path over the DEM image will produce an .avi file over 200 MB in size.

CREATE A FLY-THROUGH IN ARCSCE using KEYFRAMES

Another method to produce a fly-through is by using camera keyframes, as described in the Esri document: <http://www.esri.com/news/arcuser/0103/files/animation.pdf>. A keyframe is a still shot of the current display in ArcScene. Multiple keyframes can be created and ArcScene will interpolate the flight path between each position, on-the-fly.

To construct a fly-through using camera keyframes, use the *Animation* toolbar (Figure 29). Set up the initial viewing position in ArcScene's map view window and in the *Animation* toolbar click

the *Capture View* icon. This will create the first camera keyframe. To view the keyframe, click the *Animation* drop down list (Figure 29) and select *Animation Manager*. The *Animation Manager* dialogue box (Figure 31) provides editing capabilities of the keyframe properties.

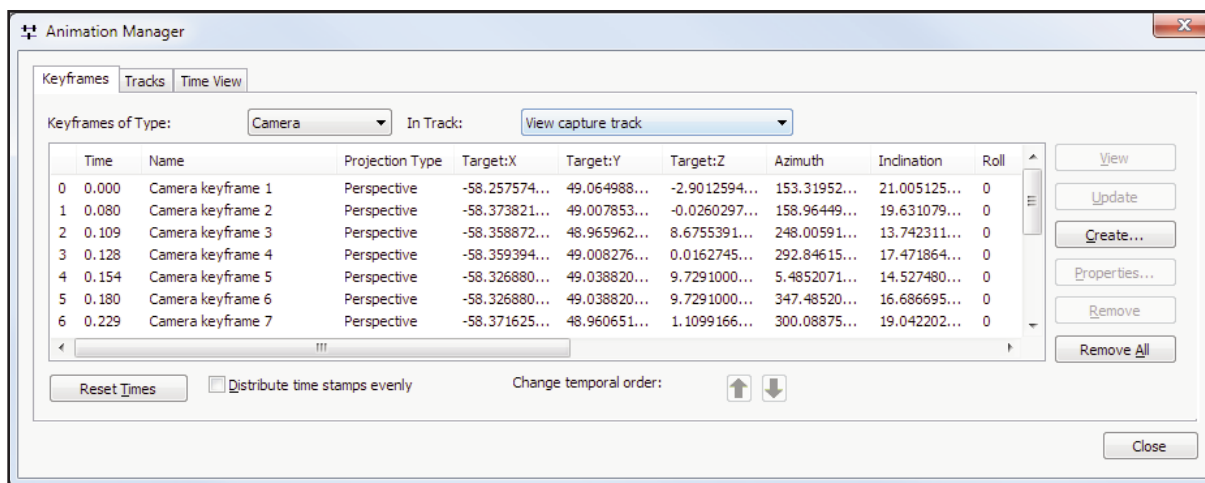


Figure 31. The *Animation Manager* dialogue box provides the list of keyframes.

Next, navigate to the second viewing position and click the *Capture View* button again. The second camera keyframe will automatically populate in the *Animation Manager's* *Keyframes* tab. Continue this process until all keyframes are created. To view the fly-through, on the *Animation* toolbar (Figure 29) click on the *Animation Controls* icon (Figure 32). Run the animation by clicking on the arrow. The control options provide the ability to change the duration of the animation by speeding up or slowing down the fly-through across the keyframes. Exporting the animation to produce an .avi file follows the same *Export Animation* procedure as in the previous section.

Once the keyframes have been selected, fly-throughs with various drape layers can be made using the same keyframes. For example, turn on the geophysics residual magnetics drape layer with the York Harbour Mine site and the Cabox Peak site. Click on *Animation > Export Animation*, provide a file name and click OK to start the animation export. A fly-through taking 1.3 minutes will export as an .avi file of between 200 to 400 MB (Appendix A).

SUMMARY WORKFLOW

In summary, the workflow for producing a fly-through is as follows:

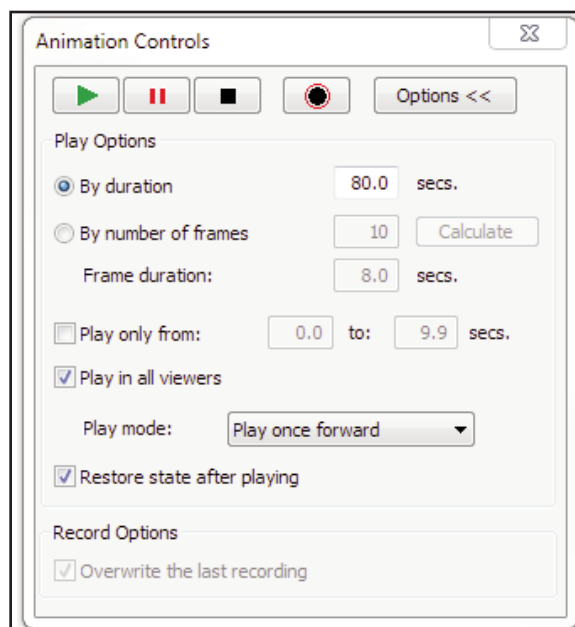


Figure 32. *Animation Controls* provide settings to view and alter the fly-through.

- Digitize the AOI boundary
- Compile the digital elevation model mosaic dataset and clip to the AOI
- Compile the raster or polygonal drape layers, such as geology, geophysics or airphotos and clip each one to the AOI
- Compile the vector drape layers, such as the water bodies, rivers, roads and points of interest and clip to the AOI
- Prepare a keyframe flight path for the fly-through
- Drape each of the raster/polygonal layers with the vector layers of interest on the DEM and export the fly-through animation producing an .avi file for each set

REFERENCES

Esri Canada

2003: Animation in ArcScene. <http://www.esri.com/news/arcuser/0103/files/animation.pdf>.

2012: Flyby Animation in ArcScene. <http://esri.ca/en/content/flyby-animation-arcsene>.

Government of Canada, Natural Resources Canada, Centre for Topographic Information

2007: Canadian Digital Elevation Data, Level 1 Project Specifications. Edition 3.0. http://ftp2.cits.rncan.gc.ca/pub/geobase/official/cded/doc/GeoBase_product_specs_CDED1_en.pdf².

Government of Canada, Natural Resources Canada, Geospatial Data Extraction

2017: <http://maps.canada.ca/czs/index-en.html>.

International Appalachian Trail Newfoundland and Labrador (IATNL)

2014: Cabox Geopark Meeting Held at Grenfell. <http://www.iatnl.com/index.php/news/141/26/Cabox-Geopark-Meeting-Held-at-Grenfell/>.

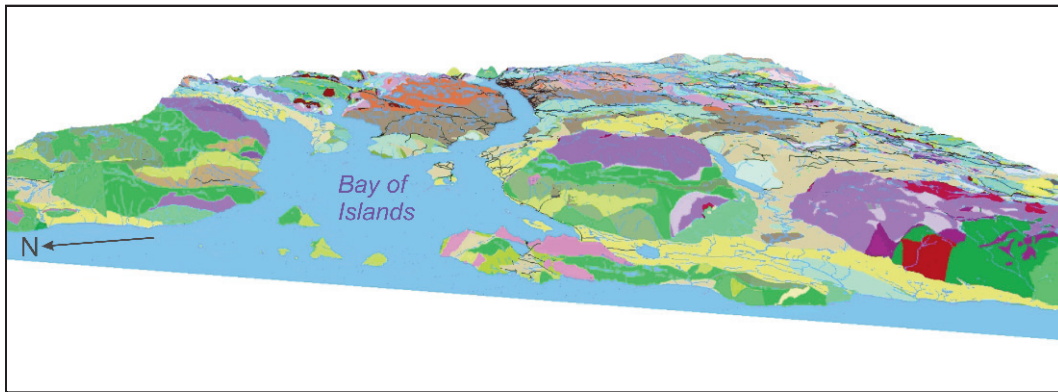
²At the time of publication, the site has been changed to Geospatial Data Extraction: <http://maps.canada.ca/czs/index-en.html>

APPENDIX A:

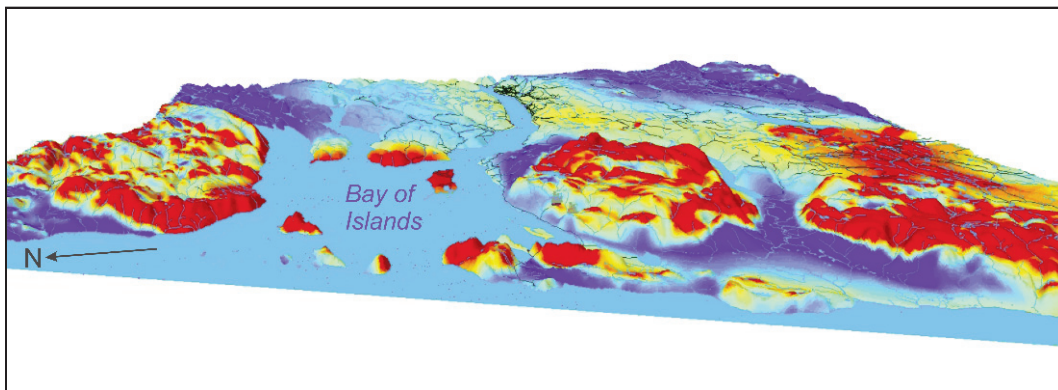
Bay of Islands Fly-throughs and Ancillary Shapefiles

The avi-formatted 80 second video fly-throughs are available upon request from the Geological Survey's Publications and Information Section (contact pub@gov.nl.ca).

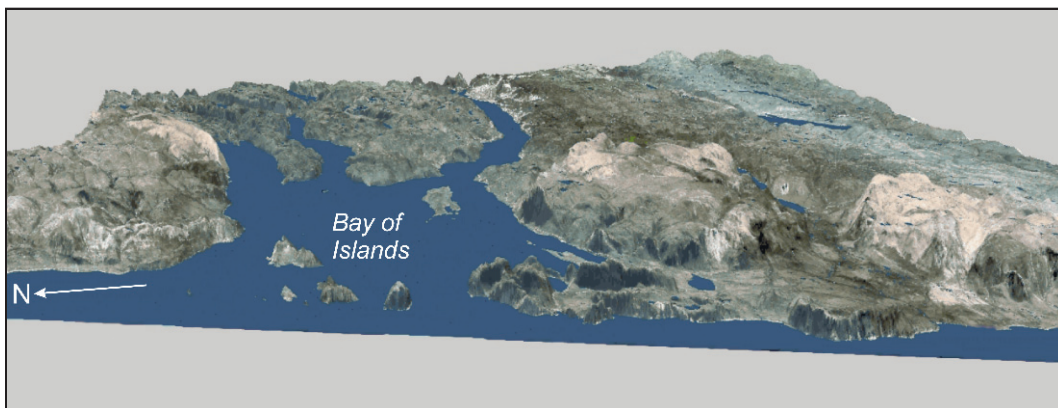
BOI Geology Fly-through (132 mb):



BOI Geophysics Fly-through (203 mb):



BOI Airphoto Fly-through (233 mb):



The following ancillary shapefiles are available upon request from the Geological Survey's Publications and Information Section (contact pub@gov.nl.ca).

Esri Shapefiles: in BOI_shapefiles.zip (4 mb)

- Cabox_AOI_Boundary
- Cabox_DetailedBedrockGeology
- Cabox_DetailedContactsLine
- Cabox_DetailedFaultsLine
- Cabox_Peak
- Cabox_Transportation
- Hiking_Trails
- York_Harbour_Mine

Water lines and polygons are available from the federal government's Geospatial Data Extraction site (<http://maps.canada.ca/czs/index-en.html>).

Image files: in BOI.gdb.zip (179 mb)

- AOI_DEM: digital elevation model, 15 x 15m cell size
- Res_Mag_AOI2: residual magnetics, 20 x 20m cell size
- DeerLake_2012_Forestry_10m_clip_NAD83: mosaicked airphotos, 10 x 10m cell size

Layer Files for symbology: in Layer_files.zip (1 mb)

- Detailed_Bedrock_Geology.lyr
- AOI_DEM.lyr
- RES Mag.lyr