Contents

Preface – how to use this guide .................................................................................................................. 6
1 DCNA Geographical Data Development Project .................................................................................... 7
2 Introduction to GIS: Key concepts, tools and resources ........................................................................... 8
  2.1 Spatial data .............................................................................................................................................. 8
  2.2 Geographical Information Systems ........................................................................................................ 8
  2.3 Spatial Data formats: Vector and Raster ................................................................................................. 8
    2.3.1 Vector data: points, lines and polygons .......................................................................................... 8
    2.3.2 Raster data: cellular .......................................................................................................................... 8
  2.4 Storing spatial data .................................................................................................................................. 8
  2.5 Shapefiles ................................................................................................................................................ 9
    2.5.1 KML files ......................................................................................................................................... 9
    2.5.2 Raster and image data ..................................................................................................................... 9
    2.5.3 Geodatabases .................................................................................................................................. 9
  2.6 Sharing data .......................................................................................................................................... 10
    2.6.1 Coordinate systems ........................................................................................................................ 10
    2.6.2 Data Management .......................................................................................................................... 10
  2.7 GIS software .......................................................................................................................................... 12
    2.7.1 ArcGIS ............................................................................................................................................ 12
    2.7.2 Google Earth ................................................................................................................................... 12
    2.7.3 Free open-source GIS ...................................................................................................................... 12
  2.8 GPS ....................................................................................................................................................... 12
  2.9 Remote sensing .................................................................................................................................... 12
  2.10 Habitat modelling ............................................................................................................................... 13
  2.11 Data sources ...................................................................................................................................... 13
  2.12 Help and support ............................................................................................................................... 13
    2.12.1 General introductions to GIS and resources ................................................................................ 13
    2.12.2 ArcGIS Help ............................................................................................................................... 13
3 Viewing and Managing DCNA Geographical Data ................................................................................. 14
  3.1 ArcGIS for Desktop .................................................................................................................................. 14
    3.1.1 ArcMap .......................................................................................................................................... 14
    3.1.2 ArcCatalog ..................................................................................................................................... 14
    3.1.3 ArcToolbox ................................................................................................................................... 14
  3.2 Viewing and managing data in ArcCatalog ........................................................................................ 15
  3.3 Adding data to ArcMap ........................................................................................................................ 16
    3.3.1 Setting the coordinate system ........................................................................................................ 16
    3.3.2 Adding data .................................................................................................................................. 16
  3.4 Displaying spatial data in ArcMap ....................................................................................................... 17
  3.5 Adding a basemap .................................................................................................................................. 18
  3.6 ArcMap navigation tools ..................................................................................................................... 18
  3.7 Attribute data ....................................................................................................................................... 19
    3.7.1 Using the identify tool .................................................................................................................... 19
    3.7.2 Displaying a complete table .......................................................................................................... 19
  3.8 Colouring and styling layers .............................................................................................................. 19
    3.8.1 Applying DCNA symbols .............................................................................................................. 19
    3.8.2 Changing a symbol ......................................................................................................................... 20
    3.8.3 Transparency ................................................................................................................................ 20
  3.9 Displaying multiple symbols .............................................................................................................. 21
    3.9.1 Symbolising categorical data ....................................................................................................... 21
    3.9.2 Symbolising quantitative data .................................................................................................... 23
  3.10 Labelling and annotation .................................................................................................................. 24
  3.11 Data frames ...................................................................................................................................... 25
  3.12 Saving ................................................................................................................................................ 25
3.13 Creating final output – the layout view ................................................................. 26
3.13.1 Printing the map .............................................................................................. 27
3.13.2 Exporting maps and data to use in other applications ................................... 27
3.13.3 Sharing on a web page .................................................................................... 28

4 Editing and Modifying DCNA Geographical Data ............................................... 29
4.1 Editor toolbar ...................................................................................................... 29
4.2 Updating attribute data ...................................................................................... 29
4.3 Adding new data fields for existing features ...................................................... 29
4.4 Adding area and perimeter data ......................................................................... 30
4.5 Updating fields using a query ............................................................................ 31
4.6 Adding fields with a database join ..................................................................... 32
4.7 Merging data layers ........................................................................................... 32
4.8 Reprojecting data layers .................................................................................... 33
4.9 Modifying features: Updating points, lines and polygons ............................... 33

5 Creating new DCNA Geographical Data ............................................................... 34
5.1 Preparation ........................................................................................................ 34
5.2 Creating a new shapefile .................................................................................... 34
5.3 Georeferencing an image ................................................................................... 35
5.3.1 Georeferencing a scanned image to a reference layer ................................. 35
5.3.2 Assigning real world coordinates to an image .............................................. 36
5.4 Digitising Points ............................................................................................... 37
5.4.1 Adding attributes .......................................................................................... 37
5.5 Digitising lines and polygons .......................................................................... 37
5.6 Other digitising procedures ............................................................................. 38
5.6.1 Snapping ....................................................................................................... 38
5.6.2 Zooming and panning while digitising ....................................................... 38
5.6.3 Selecting features ......................................................................................... 38
5.6.4 Deleting features .......................................................................................... 38
5.6.5 Saving and finishing ...................................................................................... 38
5.7 Editing lines and polygons ................................................................................ 39
5.7.1 Clipped polygon ........................................................................................... 39
5.7.2 Splitting polygons ......................................................................................... 39
5.7.3 Reshaping polygons ..................................................................................... 39
5.8 Creating points from x,y coordinates ................................................................. 40
5.8.1 Converting coordinates ................................................................................ 40
5.8.2 Creating a shapefile from x,y data .............................................................. 40
5.9 Converting points and lines to polygon and vice versa .................................... 41
5.9.1 Download ET GeoWizards ......................................................................... 41
5.9.2 Using ET GeoWizards for converting data formats .................................. 41
5.10 Importing a KML file to ArcMap ..................................................................... 42
5.11 Updating metadata ........................................................................................... 42

Appendix 1: Data layers ......................................................................................... 43
Land topography .................................................................................................... 43
Coastline ................................................................................................................ 43
Contours .................................................................................................................. 43
Inland Water ........................................................................................................... 43
Inland islands .......................................................................................................... 43
Watershed ............................................................................................................... 44
Cliffs ................................................................. 44
Seabed bathymetry ............................................................................................... 44
Land and sea tenure and jurisdiction ................................................................. 44
Geology ................................................................. 45
Vegetation ............................................................................................................. 45
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Parks</td>
<td>45</td>
</tr>
<tr>
<td>Major eco-user recreational activity sites</td>
<td>45</td>
</tr>
<tr>
<td>Moorings / Dive Sites</td>
<td>45</td>
</tr>
<tr>
<td>Trails</td>
<td>46</td>
</tr>
<tr>
<td>Eco-user activity</td>
<td>46</td>
</tr>
<tr>
<td>Basic island infrastructure</td>
<td>46</td>
</tr>
<tr>
<td>Buildings</td>
<td>46</td>
</tr>
<tr>
<td>Roads 46</td>
<td>46</td>
</tr>
<tr>
<td>Points of interest</td>
<td>47</td>
</tr>
<tr>
<td>Locations / Place Names (In process)</td>
<td>47</td>
</tr>
<tr>
<td>Important Bird Areas (IBAs)</td>
<td>48</td>
</tr>
<tr>
<td>Ramsar Sites</td>
<td>48</td>
</tr>
<tr>
<td>World Heritage and proposed World Heritage sites</td>
<td>48</td>
</tr>
<tr>
<td>SPAW (Specially Protected Areas and Wildlife)</td>
<td>48</td>
</tr>
<tr>
<td>Key species habitat</td>
<td>48</td>
</tr>
<tr>
<td>Threats</td>
<td>48</td>
</tr>
<tr>
<td>Appendix 2: Resources</td>
<td>49</td>
</tr>
<tr>
<td>General help and information</td>
<td>49</td>
</tr>
<tr>
<td>Data sources</td>
<td>49</td>
</tr>
<tr>
<td>Useful resources</td>
<td>50</td>
</tr>
<tr>
<td>GIS Software</td>
<td>50</td>
</tr>
<tr>
<td>GPS</td>
<td>51</td>
</tr>
<tr>
<td>Remote sensing</td>
<td>51</td>
</tr>
<tr>
<td>Habitat modelling</td>
<td>51</td>
</tr>
<tr>
<td>Appendix 3: DCNA Metadata standards</td>
<td>53</td>
</tr>
</tbody>
</table>
Preface – how to use this guide

The goal of this user manual is to enable park managers to efficiently and accurately work with the GIS data recently collated as part of the DCNA Geographical Data Development Project.

The software used to work with the GIS data in this manual is ArcGIS 10. A training manual also exists for working with Google Earth: Workbook_Google_EarthMaps_Training.pdf.

The manual is structured as follows:

- Chapter 1 and Appendix 1: An introduction to the DCNA Geographical Data Development project and overview of DCNA data layers, their properties and notes on application
- Chapter 2 and Appendix 2: An introduction to key GIS concepts, tools and resources
- Chapter 3: Guidelines to using DCNA geographical data layers
- Chapter 4: Guidelines to editing and modifying DCNA geographical data layers
- Chapter 5: Guidelines to creating new geographical data layers in DCNA style and format

In this document the following conventions are used:

- Buttons and tabs are indicated in a **bold font**. Where a number of buttons or tabs are clicked in sequence they are separated with a `, eg File I Open
- File names and entered text are in italics, eg BON_Coastline.shp
- A **bold font** is used to indicate named keys on the keyboard, eg Enter
- A **bold font** is also used where a technical term or command name is used
- When two keys are separated by a forward slash (as in `CTRL/C`) for example, press and hold down the first key (Ctrl), tap the second (C) and then release the first key,

Examples relating to the GIS DCNA files are in light blue boxes.

Tips and comments are in outlined boxes.
1 DCNA Geographical Data Development Project

The Dutch Caribbean Nature Alliance works to ensure the islands preserve their unique natural world through focused support and capacity building. Effective conservation requires exceptional management, and exceptional management requires objective, reliable data that can be used to measure progress and make critical decisions. Establishing and utilizing effective geographic information systems (GIS) has been flagged as a pressing need of nature managers to achieve their conservation goals. Thus, from 2010 DCNA has assisted the nature management organizations in becoming GIS-capable.

The DCNA Geographical Data Development Project seeks to build on DCNA’s initial GIS efforts by organizing, collating and where necessary modifying essential regional-wide data and ensuring their usefulness to park and nature managers. The primary objective is to produce several key geo-referenced nature data layers for the Dutch Caribbean in a standardized style and format.

Thematic areas identified by DCNA include:

A. Land topography – contoured land height
B. Seabed bathymetry – contoured sea depth
C. Land and sea tenure and jurisdiction – territorial and EEZ land and sea
D. Geology – major geological attributes of the six islands
E. Vegetation maps – translated and modified from CAR MABI
F. National parks – MPAs and TPAs, including zoning
G. Recreational activity sites – diving, kayaking, fishing, hiking, bird watching, windsurfing/sailing, sailing (moorings).
H. Basic island infrastructure – roads, airports, large industry
I. Important Bird Areas (IBAs)
J. Ramsar Sites
K. World Heritage, and proposed World Heritage sites
L. SPAW
M. Key species habitat – as points (or polygons where possible) including: sea turtle nesting beaches, mangroves, elfin-cloud forest (Saba), sea bird nesting areas and others as determined by park managers.

For the first phase of this project, all existing GIS data has been reviewed, standardised and collated into data layers within the thematic areas outlined above. The data structure for each layer can be found in Appendix 1.

The role of this user manual is to help protected area and nature managers work with the available data, modify existing layers and create new data layers in the same style and format.

This project does not currently include the field collection of any new data or on site support, although these along with the creation, population and maintenance of an online data storage facility have been identified as possible “next steps” in GIS workshops in 2010 on Bonaire and 2011 on Saba. Next steps for the development of DCNA GIS and capacity building have been identified in the 2011 Bonaire GIS workshop report.
2 Introduction to GIS: Key concepts, tools and resources

2.1 Spatial data

Spatial data is any data with a location component that can be recorded and mapped. Spatial data records have x,y coordinates (‘where’) and attributes (‘what’). By adding coordinate data to an existing data set, you create a spatial database – data that can be mapped.

2.2 Geographical Information Systems

A Geographical Information System (GIS) turns spatial data into useful information through analysis and visualisation, facilitating communication, collaboration and decision-making. Elements of a GIS include outputs, data, software, hardware, procedures and people.

2.3 Spatial Data formats: Vector and Raster

2.3.1 Vector data: points, lines and polygons

Vector data are generally used for data that needs to display quickly, and for when a lot of control is required for setting feature styles and colours. Vector file sizes are generally quite small.

Point: a pair of x,y coordinates
- Dive sites
- Points of interest
- Place names, etc

Line (aka Polyline): a series of x,y coordinate pairs
- Roads
- Watersheds
- Cliffs, etc

Polygon: a closed shape defined by connected x,y coordinate pairs
- Coastline
- Water bodies
- Protected area boundaries
- Vegetation
- Geology, etc

2.3.2 Raster data: cellular

Raster data features are broken up into individual cells, or pixels. Raster files can be quite large, but offer a wide range of analysis options. Raster data is used to represent imagery, Digital Elevation Models (DEM’s) and other thematic data.

- Satellite imagery
- Aerial photography, etc

2.4 Storing spatial data

There are many different data formats you may encounter when working with GIS. Some of the most common are described below.
2.5 Shapefiles

Shapefiles are an Esri format GIS file, and used as the standard file format by many GIS software packages including free and OpenSource toolkits. A shapefile is a vector data file and can only contain one type of data – either points, lines or polygons. In a shapefile containing say 10 points representing dive sites, each point is an individual feature and has a corresponding record in the file. Each feature is described by its location (xy coordinate) and may have other information tagged to it (e.g. the depth of the dive site, the name of the dive site). This tagged information is called attribute data. Attributes are generally stored in a table, either within the shapefile, or as a separate spreadsheet which can be linked to the shapefile using a unique ID. A feature class is a collection of similar features and their attributes. The features have the same theme and the same geometry.

Shapefiles are made up of a number of files (including .dbf, .prj, .sbn, .sbx, .shp, .xml, .shx). When you look at them in Microsoft Explorer or equivalent they will show as multiple files; in ArcCatalog they display as one.

Tip: As a general principle, only open and edit a shapefile within your GIS software package. Editing data outside of specialist GIS software tools is likely to cause inconsistencies.

2.5.1 KML files

Keyhole Markup Language (KML) is the file format used in Google Earth and is now a widely recognised format. It is based on XML. When KML files are zipped with related content (like pictures) the format becomes KMZ.

2.5.2 Raster and image data

Images and scanned maps are managed as a raster such as a TIFF or JPEG format. However to be usable in a GIS, raster data layers must have linked georeferenced data.

2.5.3 Geodatabases

Although it is a general term for spatial databases, Esri Geodatabases are a specifically-defined format used in the latest versions of some GIS software, alongside or instead of shapefiles.

2.6 Sharing data

Being able to share data on and off the islands is very important. To share data you need to find a common language to describe it. This involves a shared coordinate system, naming conventions, standard methods of managing data and always providing a description of where, why, what, how and when the data was created, commonly known as metadata.
2.6.1 Coordinate systems

There are two types of coordinate system:

- **Geographic coordinate system**: Defines locations on a spherical (or spheroidal) model of the earth
- **Projected coordinate system**: Defines locations on a flat model of the earth (map) - Geographic coordinates are converted from angular units (degrees) to distance units on a map (feet or meters). A map projection defines a formula for this conversion. Every map projection causes spatial distortion (shape, area, distance or direction).

2.6.1.1 Projections used in the Dutch Caribbean

Most data these days has a geographic coordinate system of WGS 1984. This refers to the datum used and most GPS hardware collects data in this format. A common projection is the UTM. All the DCNA data to date has been saved with the following coordinate systems and projections.

**Geographic coordinate system:**
GCS_WGS_1984

**Projected coordinate system:**
- WGS_1984_UTM_Zone_19N (For ABC islands)
- WGS_1984_UTM_Zone_20N (For SSS islands)

2.6.2 Data Management

When working with several data sets across various locations it is vital to be organised and strict with data management. The DCNA GIS files have a standard simple naming convention and an organised folder structure. All DCNA files have been saved as shapefiles and Layer files. The Layer file saves the style and symbols used, defining the way data is displayed on a map. A layer is a representation of a feature class. It is not data, but points to data.

2.6.2.1 DCNA file naming conventions

ARU: Aruba
BON: Bonaire
CUR: Curacao
SAB: Saba
EUX: Statia
SXM: St Maarten
SXMFS: St Martin French Side

2.6.2.2 DCNA Geographical Data Folder Structure

The current working folder structure is described below. Files can also be saved as packages per island but it is required that all changes made are kept centrally to ensure consistency.

**DCNA GIS Vector Files** (shapefiles, layer files and KML files)

- A: Land Topography
  - Cliffs
  - Coastline
  - Contours
  - Inland Water
  - Islands - inland
  - Watersheds
B: Sea Bathymetry
C: Land and Sea Tenure and Jurisdiction
   EEZ
   Administrative Border
D: Geology
E: Vegetation
F: National Parks
G: Recreational Activity
   Dive sites and moorings
   Trails
H: Basic Island Infrastructure
   Buildings
   Industry
   Locations
   Plantation boundaries
   Points of Interest
   Roads
I: Important Bird Areas
J: Rasmar
K: World Heritage and proposed World Heritage sites
L: SPAW
M: Key species habitat
N: Threats

**DCNA GIS Raster Files** (images collated to date as well as georeferenced raster data)
   ABC
   ARU
   BON
   Caribbean
   CUR
   EUX
   NA
   SAB
   SSS
   SXM

**DCNA GIS tables** (additional data in excel table format)

**DCNA GIS style** (DCNA symbols to be loaded into your ArcGIS Style Manager)

---

The GIS files for use with this User Manual are contained in a folder package called **DCNA GIS Files UM**.
2.6.2.3 Metadata

Metadata is data about data and is essential to ensure your GIS files are considered reliable, shareable and searchable. Important metadata fields for a spatial dataset include when the data was collected, by whom, how it is projected and so on. ArcCatalog provides editable fields to record a summary, description and credits. Metadata may be held inside some file formats (e.g. the Dutch Caribbean EEZ data obtained from the Ministry of Defense) or attached separately for others (or even supplied on paper or verbally).

Tip: It is useful to know that there are several emerging standards for spatial data that enable it to be shared effectively and automatically between systems.

2.7 GIS software

2.7.1 ArcGIS

Esri’s ArcGIS is a very powerful tool for GIS editing, analysis and planning, enabling the overlay and merging of multiple data sets and different data sources, thematic mapping and analysis of clustering, correlations, trends and predictions. Through ESRI’s Grant Assistance Programme, each protected area management organisation on the islands of the Dutch Caribbean and DCNA are benefitting from ArcGIS licenses. Chapters 3 – 5 of this manual focus on the use of ArcGIS for managing the DCNA Data layers. Alternatives to ArcGIS include TatukGIS, Manifold and MapMaker.

2.7.2 Google Earth

Google Earth is a superb geographic visualiser, used as graphics for reports and presentations; as an outreach tool; for fieldwork planning; and for sharing data. Many GIS-like add-ons are appearing and the KML file format has been widely adopted as a standard. A DCNA manual and Google Earth training course is available. Section 5.10 of this manual explains how to convert KML files to Shapefiles so they can be used in ArcGIS.

2.7.3 Free open-source GIS

Free open-source GIS also exist. Quantum GIS (QGIS) and MapWindow are recommended as well as GRASS for advanced processing. The new ArcGISExplorer (which replaces ArcExplorer) is excellent for data viewing and accessing online data and can be used to display many raster and vector file formats, perform data queries and create thematic maps.

2.8 GPS

GPS (Global Positioning System) is a collection of 27 NAVSTAR satellites orbiting the earth. Signals from these satellites can be collected by GPS receivers to determine the 3D position of the receiver. The cheapest handheld receivers can collect data at better than 10m accuracy. High end receivers, combined with Differential GPS (combination of a roaming receiver and a fixed receiver at a known location) can improve accuracy to the sub-metre level. GPS are used for navigation, for mapping and to record data on location such as species records and environmental measurements. Popular models include fieldwork favourite, the Garmin GPSMAP 62 or 60x and the MagellanTriton range. Lower cost options include Etrex H (no data cable) and Etrex venture HC (with cable).

Google Earth offers direct GPS download. To download GPS data into a GIS programme, GPS Utility is very useful. GPS Utility imports and exports most data formats, including KML and Shapefile. A free version (with limited, but sufficient, functionality) is available.

2.9 Remote sensing

Remote sensing is the use of satellite imagery and aerial photography to detect and classify objects on Earth. It is used to help determine vegetation, geology, soils, geomorphology, flooding, erosion and land use and is widely used in hazard mapping to
analyse change over time. ILWIS is a very well-specified remote sensing and GIS package – and free. ER Mapper has a limited trial download and a free viewer. ERDAS IMAGINE and ENVI are also widely used in research and universities.

2.10 Habitat modelling

An area of much interest to the work of the DCNA, habitat modelling combines actual observations (of plants and animals) with environmental conditions, to describe and predict suitable habitats, using a variety of statistical techniques. This is an area outlined for attention in future DCNA GIS work. Habitat modelling generally uses generic GIS and statistics software, although some free specialist software is available, such as Domain and DMAP.

2.11 Data sources

A wide variety of data is of potential interest to protected area management in the Dutch Caribbean, from remote sensed images and base maps to administrative boundaries and human and situation data. It must be noted however that much data of use to organisations working with larger land masses is of little use to small islands. A list of useful data sources is available in Appendix 2.

2.12 Help and support

2.12.1 General introductions to GIS and resources

There are many helpful references and tutorials for working with geographical information. A list of some of the better examples can be found in Appendix 2. The DCNA GIS team are also on hand to help with any issues which may crop up:

Nathaniel Miller  
email: projects@dcnanature.org  
skype: nat.miller44  
tel: +599 717 5010

Eseld Imms  
email: eseld@hotmail.com  
skype: eseldimms

Roy Huggins  
email: R.Huggins@gis4c.com  
phone: +599 461 4684

2.12.2 ArcGIS Help

The ArcGIS Help is vast and you can find answers to many questions there. There are also forums where users can post and answer questions.
3  Viewing and Managing DCNA Geographical Data

3.1  ArcGIS for Desktop

ArcGIS for Desktop has 3 main applications of note for this manual:

- ArcMap
- ArcCatalog
- ArcToolbox

ArcGIS 10 is the latest version of ArcGIS for Desktop and is significantly different to 9.3 (the previous version) and earlier releases. Various licences exist for ArcGIS for Desktop with increasing functionality from ArcView to ArcEditor to ArcInfo. DCNA park and nature managers are fortunate to have ArcInfo – the highest level of functionality.

3.1.1  ArcMap

ArcMap is used to display and present map (spatial) data. It is also used to edit, query and analyse. Most of your work will be done using ArcMap.

3.1.2  ArcCatalog

ArcCatalog is used for accessing and managing data. Specifically it can be used to move, rename and copy datasets; preview geographic and attribute data; and enter and edit metadata. In version 10 ArcCatalog can be viewed within ArcMap as well as separately.

3.1.3  ArcToolbox

ArcToolbox provides access to advanced geoprocessing functionality.

ArcToolbox
3.2 Viewing and managing data in ArcCatalog

1. Start ArcCatalog
2. Go to File I Connect Folder and browse to relevant location, click OK.
3. In the left-hand pane, expand folder and left-click on a shapefile. It will appear as highlighted.
4. In the right-hand pane, view file details:
   a. Click the Preview tab. ArcCatalog automatically shows the Geography preview. To view attributes, go to the Preview: field (located at the bottom of the screen) and select Table from the dropdown.
   b. Click the Description tab to view metadata

Locate and view GIS files for Bonaire in ArcCatalog:

i. Save files in folder DCNA GIS Files UM to a convenient place on your computer
ii. Start ArcCatalog
iii. Go to File I Connect Folder and browse to folder DCNA GIS Files UM and click OK
   a. In the left-hand pane, expand DCNA GIS Files UM and left-click on BON_Coastline shapefile (there is a shapefile .shp and an associated layer file .lyr both named BON_Coastline. Open the shapefile for now). It will appear as highlighted.
   b. Click on Preview tab. ArcCatalog automatically shows the Geography preview. To view attributes, go to the Preview: field and select Table from the dropdown.
3.3 Adding data to ArcMap

3.3.1 Setting the coordinate system

The coordinate system needs to be set for each data layer and in the data frame. Coordinate systems used in the DCNA files are described in section 2.5.1.1.

To set a coordinate system for the data frame:

1. Start ArcMap
2. View I Data Frame Properties and go to Coordinate System tab
3. Expand predefined > Geographic Coordinate Systems > World > WGS 1984 and then Projected Coordinate System > UTM > WGS 1984 > Northern Hemisphere > WGS 1984 UTM Zone 19N (for the ABC islands), or WGS 1984 UTM Zone 20N (for the SSS islands)
4. Click OK

Three key concepts with regards to the use of coordinate systems in ArcGIS:

On-the-fly projection: Every feature class has a native coordinate system. Every data frame also has a coordinate system. Defined by the first layer added, Can be changed by the user. Every subsequent layer that is added is projected to match the coordinate system of the data frame. Known as on-the-fly projection. The native coordinate system of the data is not changed.

Geographic transformation: On-the-fly projection works when all the layers added to a data frame have the same underlying geographic coordinate system. When you add a layer with a different geographic coordinate system, ArcMap may generate a warning message. ArcMap will try to project the data, but the alignment may be imperfect. You can fix this problem using geographic transformation. To perform geographic transformation, use the Project tool to convert one geographic coordinate system into another. Creates a new feature class with a new native coordinate system (the original feature class and coordinate system are preserved).

Unknown coordinate system: On-the-fly projection works when a layer’s coordinate system is known. When you add a layer with an unknown coordinate system, ArcMap cannot project it. The result may be gross misalignment. You can fix this problem by defining the coordinate system. First, determine the correct coordinate system. Second, use the Define Projection tool to identify the coordinate system. Adds information identifying the coordinate system to the existing feature class (does not create a new feature class). Used to update missing or incorrect coordinate system information.

(Esri, 2010)

3.3.2 Adding data

There are two main ways to add spatial data to ArcMap:

1. In ArcMap
   a. Click on Add Data icon 📜 , or go to File I Add Data. The Add Data dialog box will appear.
   b. Navigate to your files and click Add. If the data has not been accessed before, click on Connect to Folder 🗂. Layers can be added one at a time, or in multiples by clicking on each layer whilst holding down the Shift or Ctrl key.
2. Or
   a. Go to Catalog within ArcMap (usually situated on the right-hand side of the screen) or start ArcCatalog separately. If Catalog is not showing in ArcMap, go to Windows I Catalog
   b. Left-click and hold (highlight) the file you want to add and drag the file from Catalog to the left-hand pane in ArcMap.
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4. Click OK

### 3.3.2 Adding data

There are two main ways to add spatial data to ArcMap:

1. In ArcMap
   - Click on Add Data icon, or go to File > Add Data. The Add Data dialog box will appear.
   - Navigate to your files and click Add. If the data has not been accessed before, click on Connect to Folder. Layers can be added one at a time, or in multiples by clicking on each layer whilst holding down the Shift or Ctrl key.
2. Or
   - Go to Catalog within ArcMap (usually situated on the right-hand side of the screen) or start ArcCatalog separately. If Catalog is not showing in ArcMap, go to Windows > Catalog.
   - Left-click and hold (highlight) the file you want to add and drag the file from Catalog to the left-hand pane in ArcMap.

### 3.4 Displaying spatial data in ArcMap

Each layer is displayed in the left-hand pane. This is called the Table of Contents (TOC). There is a tick box alongside each layer which can be used to turn the display for that layer on and off.

The position of a layer in the TOC determines the drawing order. Generally point data goes at the top, lines in the middle and polygons at the bottom. To move the order of layers:

1. Left-click and hold on a layer in the TOC. The layer will be highlighted.
2. Move the mouse up the TOC - a thick black line will be displayed where the layer is to be inserted - and release the mouse button when the black line is at the required position.
3. To remove a layer completely from the TOC, right-click and Remove

You will notice you cannot see the inland water bodies as they are hidden under the Bonaire land mass. Move the Inland water file to the top.

i. Left-click and hold BON_Inland_water in the TOC and move it above BON_Coastline. The water layer will now be viewable.

---

**Add coastline and inland water data for Bonaire to ArcMap:**

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>i.</td>
<td>Start ArcMap</td>
</tr>
<tr>
<td>ii.</td>
<td>Open Catalog (separately or from within ArcMap)</td>
</tr>
<tr>
<td>iii.</td>
<td>Browse to BON_Coastline and left-click, hold and drag layer to ArcMap (Select the shapefile at this stage - identified with a box icon containing polygons - as opposed to the layer file – identified by a yellow diamond)</td>
</tr>
<tr>
<td>iv.</td>
<td>Repeat for BON_Inland_water</td>
</tr>
</tbody>
</table>

---

**ArcMap: Adding data to the TOC**

![ArcMap screenshot showing Table of Contents (TOC) with layers listed and the option to toggle between Data view and Layout view.](image-url)
3.5 Adding a basemap

It is often useful to add a basemap to your layers. In ArcGIS10 this can be done easily:

1. Go to Add data I Add Basemap
2. Select from choice of 12 styles (see below). The map you have chosen will appear for your region in the viewing pane.

![Add Basemap](image)

Tip: While the option to add a base map as reference can be very useful, it must be remembered that these layers may contain errors. Esri recently entered into a partnership with Microsoft and therefore supply Bing maps. The available layers for the Dutch Caribbean region are not of especially good quality. Open Street Map data are also included however.

You can also georeference any images you have which provide data on the region and are of high enough quality (resolution) to trace information from. Section 5.3 explains georeferencing in detail.

3.6 ArcMap navigation tools

ArcMap has a range of navigation tools located on the Tools floating toolbar. Hovering the mouse over an icon gives a brief description of its purpose. It’s a good idea to spend some time familiarising yourself with the various tools.
Another useful navigation tool is Zoom To Layer. This can be found by right-clicking on a highlighted layer and selecting Zoom To Layer from menu.

Tip: All toolbars can be turned on and off as required. To manage your toolbars, go to Customise I Toolbars and check on and off.

### 3.7 Attribute data

Individual features on a map have associated data held in tabular form. These are known as attribute data. There are two ways to access attribute data in ArcMap – using the identify tool or displaying the whole table as a layer.

#### 3.7.1 Using the identify tool

1. Left-click a layer in TOC so it is highlighted
2. Click on Identify button on the Tools toolbar , then click on a feature in the map within the highlighted layer. Attribute data on the layer will appear in the Identity Results dialog box.

#### 3.7.2 Displaying a complete table

1. Right-click layer in TOC, Open Attribute Table

#### Attribute data for Bonaire Coastline

<table>
<thead>
<tr>
<th>FID</th>
<th>Shape^</th>
<th>ID</th>
<th>CL_Type</th>
<th>CL_Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Polygon</td>
<td>BOCL2</td>
<td>Island - offshore</td>
<td>Klein Bonaire</td>
</tr>
<tr>
<td>1</td>
<td>Polygon</td>
<td>BOCL1</td>
<td>Mainland</td>
<td>bonaire</td>
</tr>
</tbody>
</table>

### 3.8 Colouring and styling layers

ArcMap automatically assigns a random colour and style to each shapefile layer. This is known as its symbol. These randomly assigned symbols are rarely suitable but can be changed using the symbol selector.

Saving information as a Layer (.lyr) file saves styling as well. A layer file does not contain the data itself but points to the shapefile holding the data. All DCNA data layers have been saved as layer files and shapefiles.

A set of symbols are being developed for DCNA and the current versions can be accessed using the Style Manager, however it is also important to understand how to create symbols.

#### 3.8.1 Applying DCNA symbols

A set of symbols for DCNA mapping projects are maintained in the DCNA.style file. To access these symbols:

1. In ArcMap, click on Customize I Style Manager I Styles I Add Style to List
2. Browse to DCNA.style (DCNA GIS Style > DCNA.style), click open and OK and Close.
When you now open the **Symbol Selecter** dialog box (see section 3.8.2), the DCNA symbols will appear as choices.

### 3.8.2 Changing a symbol

To change the colour and style of a layer:

1. In the TOC, left-click on the symbol you want to modify (the symbol appears below the layer name). The **Symbol Selector** dialog box appears.
2. Change the **Color** and **Width** as required.
3. Click **OK** when finished. The map will redraw to reflect any changes made.

#### Change the Bonaire coastline and inland water symbols:

i. Left-click on the symbol for **BON_Coastline**. The **Symbol Selector** dialogue box will open.

ii. Change **Outline Color**: click the drop down, go to **More colors**. The **Color Selector** dialog box will open.

iii. Make sure the color setting is RGB, type R:10, G:147, B:252 and **OK**.

iv. Change **Outline Width**: click the arrow pointing upwards once so it shows a width of 1.00.

v. Change **Fill Color**: click the drop down, go to **More colors**, type R:255, G:255, B:204 and **OK**.

vi. Repeat the above for **BON_Inland_water**, changing to blue with no border (The border can be removed by setting **Outline color**: to No color, or **Outline Width**: to 0).

### 3.8.3 Transparency

Any symbol can be made transparent to allow details in layers below to show through:

1. Double left-click the layer name or right-click **Properties**. The **Layer Properties** dialogue box will open.
2. Click on the **Display** tab. Change the % in the **Transparent** field.
When you now open the Symbol Selecter dialog box (see section 3.8.2), the DCNA symbols will appear as choices.

### 3.8.2 Changing a symbol

1. In the TOC, left-click on the symbol you want to modify (the symbol appears below the layer name). The Symbol Selector dialog box appears.
2. Change the **Color**: and **Width** as required.
3. Click **OK** when finished. The map will redraw to reflect any changes made.

#### Change the Bonaire coastline and inland water symbols:

1. Left-click on the symbol for `BON_Coastline`. The Symbol Selecter dialogue box will open.
2. Change **Outline Color**: click the drop down, go to **More colors**. The Color Selector dialog box will open.
3. Make sure the color setting is RGB, type R:10, G:147, B:252 and **OK**
4. Change **Outline Width**: click the arrow pointing upwards once so it shows a width of 1.00
5. Change **Fill Color**: click the drop down, go to **More colors**, type R:255, G:255, B:204 and **OK**
6. Repeat the above for `BON_Inland_water`, changing to blue with no border (The border can be removed by setting **Outline color:** to No color, or **Outline Width:** to 0).

### 3.8.3 Transparency

Any symbol can be made transparent to allow details in layers below to show through:

1. Double left-click the layer name or right-click **Properties**. The Layer Properties dialogue box will open.
2. Click on **Display** and change the number in the **Transparent**: field.

#### Add a relief basemap and make the Bonaire land mass transparent to allow the relief to show through:

1. Add the Shaded Relief basemap: **Add data I Add Basemap**, select **Shaded Relief** and **Add** (it may take a while to load)
2. Double left-click the layer name `BON_coastline`, opening the **Layer Properties** dialog box.
3. Click on **Display** and change the number in the **Transparent**: field to 50. Click **OK**

Add the Important Bird Areas (IBAs) and make transparent:

1. Add `BON_IBA` at the top of the TOC
2. Double left-click the layer name `BON_IBA` opening the **Layer Properties** dialog box.
3. Click on **Display** and change the number in the **Transparent**: field to 50. Click **OK**
4. Left-click on symbol and change **Fill Color**: to **light apple**, **Outline Width**: 1.00 and **Outline Color**: Gray 70%, and click **OK**

### Setting transparency display levels

![Map with transparency settings](image)

#### 3.9 Displaying multiple symbols

Most data layers will contain categories or numerical data which will need to be represented using multiple symbols.

#### 3.9.1 Symbolising categorical data

Categorical (qualitative) data can be represented with different colours or symbols:

1. Open **Layer Properties** dialogue box and go to **Symbology** tab
2. Click on **Categories I Unique Values**. Go to **Value Field** and select the field you want to symbolise in the dropdown.
3. Click on **Add Values** and select those you wish to add, or **Add All Values**
4. Double left-click each symbol and edit as required, click **OK**
The Bonaire Inland water file contains 3 distinct water types: Inland water, Salinas and Salt Pans. These are all water bodies, but need to be symbolised differently.

i. Double left-click BON_Inland_water, opening Layer Properties dialogue box. Go to Symbology tab
ii. Click on Categories I Unique Values. In the Value Field select WaterType.
iii. Click Add All Values. The three categories will appear above, along with a category called <all other values>. Change the symbols as follows:
   o Inland water: R:151, G:219, B:242, with no outline;
   o Salinas: Esri water intermittent symbol with no outline, and;
   o Salt Pans: Indicolite green, with no outline.
iv. Uncheck <all other values>. Click OK. The layer will redraw with the new colours.
v. Turn off BON_IBA and remove the Baselayer.

Add Main Roads for Bonaire:

i. Add BON_Roads as top layer in the TOC.
iii. Click on Categories I Unique Values. In the Value Field select RoadType.
iv. Click Add Values I Complete List. Select Main road and click OK
v. Uncheck <all other values> and change the symbol for Main Road to Color: R:255, G:102, B:82, Width: 1.00, and click OK
vi. Click OK. The layer will redraw with the new colours.

Add Points of Interest to the Bonaire file with different symbols:

i. Add BON_POI as top layer in the TOC.
ii. Double left-click BON_POI opening Layer Properties dialogue box. Go to Symbology tab.
iii. Click on Categories I Unique Values. In the Value Field select CATEGORY
iv. Click Add All Values
v. Uncheck <all other values> and change the order of the feature categories using the arrows to the right hand side so they are in the following order: Capital, Town, Airport, Habitat, Peak
vi. Choose different symbols for each category:
   b. Town: Circle 2, Mars Red, Size:6
   c. Airport: Airplane, Size:18
   d. Habitat: Square 1, Electron Gold, Size:12
   e. Peak: Triangle 1, R:0 G:135 B:11, Size:12
vii. Click OK. The layer will redraw with the new symbols

Tip: If you need help choosing symbols, talk to DCNA, or click on Style references and check a category, e.g. conservation. Extra symbol choices will appear in the Symbol Selector dialog box.
3.9.2 Symbolising quantitative data

Numerical (quantitative) data can be represented with different colours or symbol size. When looking at continuous data such as numerical data, category ranges need to be determined as part of the procedure. There are various classification methods:

- **Natural Breaks**: suitable in most situations; the default method
- **Equal Interval**: emphasizes differences at low and high ends of value range; legend is easy to interpret; best applied to familiar data ranges such as percentages or temperature
- **Quantile**: emphasizes differences in middle of value range
- **Manual**: emphasizes a particular range of values, such as those above or below a threshold (e.g. areas below a certain elevation level that are susceptible to flooding); useful for isolating and emphasizing ranges of data

Elevation is an example of numerical data that can be symbolised in this way:

i. Add *BON_Contours* file to the TOC. Place it below *BON_Inland_water* and above *BON_Coastline*.

i. Click on Quantities > Graduated Colors. In Fields, Value select ELEVATION. ArcGIS will automatically classify into 5 levels using natural breaks. If you click on classify you can view the data split and change the number of classes and the method of classification, as required.
ii. Select the second to bottom color ramp (graduated greens). Double left-click each symbol and change the Outline Width to 0 (to remove outline).
iii. Click OK. The layer will redraw with the new colours.
iv. Change the transparency of *BON_Coastline* back to 0%.

Bonaire with roads, points of interest and contours added
3.10 Labelling and annotation

To display labels for a layer:

1. In the TOC right-click the layer you want to label and select **Properties**
2. Click the **Labels** tab
3. Check **Label features in this layer**
4. In **Method**: select your choice of labelling
5. From **Label Field**: select the field to label
6. Click OK

Or

1. In the TOC right-click the layer and select **Label Features**

If you need to move individual labels around manually and independently, they can be converted to annotation:

1. Right-click on layer and select **Convert Labels to Annotation**
2. Change your cursor back to the black arrow

To display labels for the Points of Interest:

i. Right-click the **BON_Poi** and select **Properties**

ii. Click the **Labels** tab:
   a. Check **Label features in this layer**
   b. In **Method**: select ‘Label all features the same way’ from the dropdown
   c. In **Label Field**: select **NAME**
   d. Click **OK**, The labels will show

iii. Right-click **BON_Poi** and select **Convert Labels To Annotation**

iv. Check **In the map** and **Convert**

v. Change cursor back to the **black arrow**

vi. To remove the label for the airport, right-click on text **Flamingo International Airport** and **Delete**

vii. To highlight the capital city label in bold font, double left-click on **Kralendijk** and in the text box write **<BOL>Kralendijk</BOL>** and click **OK** or click **Change Symbol** and adjust font style in the **Symbol Selector** dialog box
3.10 Labelling and annotation

To display labels for a layer:

1. In the TOC right-click the layer you want to label and select Properties.
2. Click the Labels tab.
3. Check Label features in this layer.
4. In Method: select your choice of labelling.
5. From Label Field: select the field to label.
6. Click OK.

Or

1. In the TOC right-click the layer and select Label Features.

If you need to move individual labels around manually and independently, they can be converted to annotation:

1. Right-click on layer and select Convert Labels to Annotation.
2. Change your cursor back to the black arrow.

To display labels for the Points of Interest:

i. Right-click the BON_POI and select Properties.
ii. Click the Labels tab:
   a. Check Label features in this layer.
   b. In Method: select 'Label all features the same way' from the dropdown.
   c. In Label Field: select NAME.
   d. Click OK. The labels will show.
iii. Right-click BON_POI and select Convert Labels To Annotation.
iv. Check In the map and Convert.
v. Change cursor back to the black arrow.
vi. To remove the label for the airport, right-click on text Flamingo International Airport and Delete.
vii. To highlight the capital city label in bold font, double left-click on Kralendijk and in the text box write <BOL>Kralendijk</BOL> and click OK or click Change Symbol and adjust font style in the Symbol Selector dialog.

3.11 Data frames

As well as overlaying data in a map, we can create multiple dataframes to display data from different geographical areas or to group related datasets together. NB The default dataframe is called 'layers'. Data frames are useful if you want your final map to contain multiple maps.

To add a new dataframe:

1. Go to Insert I Data Frame. The active Data Frame is shown in bold in the TOC.
2. To make a Data Frame active, right-click the Data Frame name in the TOC and select Activate.
3. To change the name of a dataframe right-click the Data Frame name, select Properties and change Name: field.

3.12 Saving

To save the ArcMap document, save as a .mxd document:

1. File I Save As, browse to location and enter a file name.

To save style and colour settings for individual layers, save as a layer file:

1. Right-click on layer and select Save As Layer File. This will save the data with the styling in addition to the shapefile.

This has already been done for all DCNA layers.

Tip: If files are moved or the file name changed (i.e. the path changes), the layers will not be drawn automatically when you reopen ArcMap. To solve: Right-click on layer and select Data I Repair data source. Browse to locate file and double-click on it. The layer should reappear as normal.
3.13 Creating final output – the layout view

Most work in ArcMap is performed in Data View. This is where you add layers, symbolize them, label them, set layer properties, and choose a coordinate system (add, organise, symbolise, prepare). This work is usually preparation for an eventual output: a printed map, an online map, or an image of a map embedded in a report or document.

Although printing can be done directly from the Data View, for final map output the Layout View is recommended. The Layout View is used to design a complete map, arrange data frames on a virtual page, add map elements (e.g. title, legend, scale bar) and adjust map scale and extent.

When designing your final map, consider the:

- **Purpose**: The design should support map’s purpose. Unless you have thought about what you are aiming to communicate, you may struggle to include the right information.
- **Situation**: The design should support the viewing situation; the map medium (paper, computer screen, other) and map size. Review whether the most important features of the map stand out clearly. Often less is more in terms of communication so keep colours and symbols simple.
- **Audience**: Complexity and detail required depends on expertise of audience.

To create a map:

1. Select **Layout View** from the icon just below the bottom left of the map. As default, a border line is added around the map. Zoom and pan as required to position the map on the page.
2. Set the data frame units to meters so that the scale bar is correct
   a. Select the menu **View I Data Frame Properties**
   b. On the general tab under Units set both **Map** and **Display** to Metres
   c. Click **OK**
3. Select the **Insert I Scale Bar**, choose **Properties** and set **Division Units** to **Kilometres**
4. Click **OK** and **OK** again
5. Insert a Title: **Insert I Title**. Enter title for map
6. Insert a North arrow: **Insert I North Arrow**
7. Move the elements to appropriate places on the map by clicking and dragging with the mouse
8. Insert a legend: **Insert I Legend**. These rarely look good straight away, but there are many ways to change the settings. If all else fails right-click legend and select Convert To Graphics, but be aware that the data will no longer link to the data source.
9. Insert a text box and include a copyright note and any logos

Create a map of Bonaire to be used to show DCNA Protected Areas:

i. Add the layer files (the files denoted with a yellow diamond rather than the shapefile) for **BON_MPA** (at the bottom of the TOC) and **BON_TPA** (at the top of the TOC)
ii. Select **Layout View** from the icon just below the bottom left of the dataframe. As default, a border line is added around the map.
iii. Set the data frame units to meters so that the scale bar is correct
   a. Select the menu **View I Data Frame Properties**
   b. On the general tab under Units set **Display** to Metres
   c. Click **OK**
iv. Select the **Insert I Scale Bar**, choose **Properties** and set **Division Units** to **Kilometres**
v. Click **OK**, Select **Alternating Scale Bar 1** and click **OK**
vi. Move the bar to the bottom left of the page by clicking and dragging with the mouse. Double left-click and open the **Alternating Scale Bar Properties** dialog box. Click on **Numbers and Marks** tab and change **Frequency** to **divisions**. Click **OK**

vii. Insert a Title: **Insert I Title** and enter the title “Bonaire: Protected Areas”
viii. Insert a North arrow: **Insert I North Arrow**, Select **Esri North 2**.
ix. Move the elements to appropriate places on the map by clicking and dragging with the mouse
x. Insert a legend: **Insert I Legend**, In the **Legend Wizard**,
To create a map:

Most work in ArcMap is performed in the **Data View**. This is where you add layers, symbolize them, label them, set layer properties, and choose a coordinate system (add, organize, symbolize, prepare). This work is usually preparation for an eventual output: a printed map, an online map, or an image of a map embedded in a report or document.

When designing your final map, consider the:

1. **Purpose**: The design should support the viewing situation; the map medium (paper, computer screen, other) and the design should support map's purpose. Unless you have thought about what you are aiming to communicate, you may struggle to include the right information.
2. **Audience**: Decide who will be looking at the map and how they will use it.
3. **Situation**: The design should support map's purpose. Unless you have thought about what you are aiming to communicate, you may struggle to include the right information.
4. **Completion**: Make sure the map is complete and all necessary data is included.
5. **Reuse**: Consider future uses of the map and make it as versatile as possible.
6. **Quality**: Ensure the map is of high quality and meets professional standards.
7. **Functionality**: Consider how easy it is to use the map, for example, if it is interactive or not.
8. **Consistency**: Use consistent symbols, colors, and styles throughout the map.
9. **Readability**: Ensure the map is easy to read at different scales.
10. **Feedback**: Gather feedback from others to improve the map.

**Printing the map**

To print a map:

1. Select **File I Print**

**Exporting maps and data to use in other applications**

Maps are commonly placed into other applications, e.g. MS Word, MS PowerPoint, Adobe InDesign or in a web page.

**Exporting as an image file**

1. **File I Export Map**, choose JPEG or another format as the Save As Type. Enter a file name and click **Save**

---

**Layout view of Bonaire Protected Areas**

---

| a. | Choose which layers you want to include in your legend: click on `BON_Coastline` and `BON_Countours` and move to lefthand box using the arrow. Change the order of the layers here so that the `BON_MPA` and `BON_TPA` layers show at the top, followed by `BON_POI`, `BON_Roads` and `BON_Inland_water`. Leave the number of columns as 1. Click Next, Next, Next, Next, Finish. A legend will be created. |
| b. | Move legend to above the scale bar. Right-click the **Legend Box** and select Properties. In the **Legend Properties** dialog box, go to **Items I Style**. Select the legend style second down on the left, click OK and OK. Right-click the **legend box** and **Convert To Graphics** (be aware that the legend now no longer links to the data source so if you make changes in the shapefile they will not be represented in the legend). |
| c. | Right-click on **legend box** and Ungroup. Delete all the boxes containing only text (except the title legend). |
| d. | Right-click on `BON_TPA` and Ungroup to separate the symbol from the text. Change the text from `BON_MPA` to Bonaire Marine Park. Repeat for `BON_TPA`, changing the text to Washington-Slagbaai National Park. |
| e. | Regroup the POI symbols using the **black arrow** to select, right-click, **group** and move up. Move the road symbol up. Regroup the Inland water symbols and move up. Regroup the legend. |

**xi.** Insert a text box and include a copyright note, the STINAPA logo and the DCNA logo.
2. To use a JPEG file in MS Word or PowerPoint, start the appropriate programme and go to Insert > Picture > From File, select the JPEG and click on Insert.

Tip: if you export the file and save as a PDF, it is possible in the output file to turn the layers on and off.

3.13.3 Sharing on a web page

Files can also be shared online or imported into other mapping programmes and applications such as Google Earth.
4 Editing and Modifying DCNA Geographical Data

In instances where features are in the wrong location, or missing entirely, or where attribute data needs to be changed or updated, it will be necessary to modify the DCNA files. There may also be additional data related to features in the maps you would like to include. This chapter explains how to edit DCNA GIS files.

4.1 Editor toolbar

All editing requires the Editor toolbar:

1. Turn on the toolbar for editing by selecting the menu Customize Toolbars I Editor

Tip: It is good to get into the practice of saving a copy of the raw data before you start work on it. Then if any irreversible problems arise the original data source remains intact.

4.2 Updating attribute data

1. Open Attribute Table for a layer
2. From the Editor toolbar select Editor I Start editing
3. Alter data in a cell. Press Enter key to confirm changes
4. Click Editor I Save Edits I Stop Editing

4.3 Adding new data fields for existing features

Adding a new attribute column can either be done by joining database tables (see section 4.6) or adding a new column and filling in manually or semi-automatically using a query.

1. Add new field, either:
   a. Start ArcCatalog
   b. Go to Preview: Table
   c. Click the Table Options button at the bottom left of the pane and select Add field

   Or

   a. Start ArcMap:
   b. Open Attribute Table for a layer
   c. Click the Table Options button at the top left of the attribute table and select Add Field. If an ‘Add Field Failed...’ error message is given, close ArcCatalog first (you cannot make changes if you have the layer highlighted in ArcCatalog)

2. Enter field properties
   a. Add field name
   b. Select Type: (choose from short integer, long integer, text, date, float, double)
   c. Under Field Properties set Precision (i.e. length) to the maximum number of characters or digits
   d. Click OK

Tip: It is worth thinking through the fields you wish to include beforehand as once the name, field type and field length have been entered they cannot be changed, although an alias field name can be added.
There are 5 Ramsar sites on Bonaire, however there is little data in the current GIS file. Additional information is now available and can be added to the attributes table. It would be helpful for example to know which organisation is responsible for each site for management purposes. All sites are managed by STINAPA except Pekelmeer which is managed by Cargill Salt Bonaire NV.

1. Expand J Ramsar folder in ArcCatalog and add BON_Ramsar to ArcMap
2. Open Attribute Table for BON_Ramsar
3. Click on Add Field and enter field properties
   a. Add field name: Management
   b. Select Type: Text
   c. Under Field Properties set Length to 25
   d. Click OK. A new column will be displayed in the attributes table
4. Open Editor Toolbar: Customise I Toolbars I Editor
5. Click on Editor I Start Editing
6. Choose BON_Ramsar as the layer to edit by highlighting it and clicking OK and Continue. The Create Features dialog box will appear.
7. Place cursor in a cell in the Management column of the attributes table and enter STINAPA for the first 4 sites (you can copy and paste using Ctrl/C andCtrl/V). For Pekelmeer enter Cargill Salt Bonaire NV.
8. Click Editor I Save Edits and Editor I Stop Editing

4.4 Adding area and perimeter data

It is often useful to calculate the size or perimeter length of an area. This can be done using Calculate Geometry.

To calculate area:

1. Open Attribute Table
2. Add field
   a. Name: e.g. Area_km2
   b. Type: e.g. Short Integer
   c. Precision: e.g. 10
3. Click OK
4. Right-click on Area_km2 column and select Calculate Geometry (Click yes to the warning that you are about to calculate outside of an edit session)
5. In the dialog box:
   a. Property: Area
   b. Units: Square Kilometers [sq km]
6. Click OK. The area in km² will be calculated for all fields in the column.

To calculate perimeter:

1. Open Attribute Table
2. Add field
   a. Name: e.g. Perimi_m
   b. Type: e.g. Short Integer
   c. Precision: e.g. 10
3. Click OK
4. Right-click on Perimi_m column and select Calculate Geometry
5. In the dialog box:
   a. Property: Perimeter
   b. Units: meters [m]
6. Click OK. The perimeter in m will be calculated for all fields in the column.
Calculate the area of the Ramsar sites on Bonaire:

i. **Open Attribute Table** for BON_Ramsar

ii. Add field
   - Name: Area_km2
   - Type: Short Integer
   - Precision: 10

iii. Click **OK**

iv. Right-click on Area_km2 column and select **Calculate Geometry** (Click yes to the warning that you are about to calculate outside of an edit session)

v. In the dialog box:
   - Property: Area
   - Units: Square Kilometers [sq km]

vi. Click **OK**

vii. The calculated area is entered in the column.

### 4.5 Updating fields using a query

1. **Open Attribute Table**
2. Add a new field
3. Go to **Selection I Select By Attributes**. The dialog box will open.
4. Create a query. Click **Apply** and selected records will be shown highlighted.
5. To enter a certain record for these items, right-click on the title bar of a column, and choose **Field Calculator**. The dialog box will open.
6. Enter the text you would like to appear in the new column within quote marks in the lower panel and click **OK**.
7. The text will be entered into the column cells for all the selected records.
8. Close the **Select By Attributes** dialog box.

If you were for instance to create a protected area of the region of Bonaire at 50m above sea level and above you could identify the area by adding a new column to determine the region:

i. **Open Attribute Table** for BON_Contours

ii. **Add Field** called testing, text, length 25

iii. Click on **Select By Attribute**

iv. Create a query:
   - Method: Create a new selection
   - Double click on Elevation to paste to query white box.
   - Select >=
   - Get Unique Values. Double left-click on 50.
   - "ELEVATION" >= 50 should show in the box
   - Click **Apply**

v. Right-click on header of new column and select **Field Calculator**

vi. Type "potential protected area" in testing= box (remember the quote marks). Click **OK**

vii. The selected fields will fill with the text

viii. Delete the testing field again, right-click on column header and select **Delete**. Click **OK** when warning message appears.

ix. Go to **Selection I Clear Selected Features**

---

Version 1.0  -  Updated 19 Oct 2011
4.6 Adding fields with a database join

A database containing additional attribute data can be appended to a layer using a common field.

Tip: There must be a common field to use for linking the tables/data.

1. View the tabular data in excel
2. Add to ArcMap (you will need to expand to show all sheets)
3. Right-click layer and select Joins and Relates I Join
4. In the Join Data dialog box, make sure the top box is set to Join attributes from a table
5. Set drop-down box 1.
6. Click on the open button beside drop-down box 2 and navigate to file you wish to join data from.
7. Set drop-down box 3. This is the join, or common field.
8. Click OK.
9. The additional fields from the excel spreadsheet will now be displayed in the original layer.

4.7 Merging data layers

You will sometimes find information in various layers which could be combined for ease of use. For example, in the original DCNA data there is a point file for dive sites and a point file for Klein Bonaire dive sites. These can be combined and attributes added later.

Create a point file for all dive sites for Bonaire:

i. You will need ArcToolbox for this exercise. To open ArcToolbox click on the ArcToolbox button or go to Geoprocessing I ArcToolbox
ii. Add BON_Dive_sites and BON_Dive_sites_Klein_Bonaire
iii. In the Toolbox, expand Data Management Tools I General and double left-click Merge
iv. In the Input Datasets field select BON_Dive_sites from the dropdown. It will appear in the box below. Click + and select BON_Dive_sites_Klein_Bonaire from the dropdown.
v. The output dataset will have been named BON_Dive_sites_Merge or similar
vi. Click OK. A new file will be added to the TOC (and in Catalog).
4.8 Reprojecting data layers

You will sometimes need to reproject a layer for it to show correctly in ArcMap. If you look for example at the new merged layer created in 4.7, it has taken on the coordinate system of the data frame but has no coordinate system set.

To set a projection for BON_dive_sites_merge:

1. If ArcToolbox is not showing, open it by clicking on the ArcToolbox button or go to Geoprocessing I ArcToolbox
2. In the Toolbox, expand Data Management Tools I Projections and Transformations and double left-click Define Projection.
3. In Input Datasets field, select BON_Dive_sites_Merge from the dropdown.
4. The Coordinate System field says Unknown. Click on the button to the right of the Coordinate System field and Select > Geographic Coordinate Systems > World > WGS 1984 and Select Projected Coordinate System > UTM > WGS 1984 > Northern Hemisphere > WGS 1984 UTM Zone 19N (for the ABC islands), or WGS 1984 UTM Zone 20N (for the SSS islands).
5. Click OK and OK again. The file will be reprojected.

Dive site data merged and reprojected

4.9 Modifying features: Updating points, lines and polygons

If you need to move point features which have been placed incorrectly or have moved, or to change the length or direction of a line, or the shape of a polygon, this can be done using digitising functionality in the Editor toolbar. Follow instructions in section 5.7.
5 Creating new DCNA Geographical Data

You may want to create new layers altogether. These must be created in the DCNA style and format.

5.1 Preparation

Preparation is key to creating an efficient, effective GIS system and investing thought into this step of the process will invariably save time later on:

1. List the shapefiles to be created, one for each theme to be digitised. Make a note of:
   a. Names (with a short description)
   b. Whether the features are best captured with a point, line or polygon
   c. Fields required (ie attributes / columns)
   d. The data source

5.2 Creating a new shapefile

1. Start ArcCatalog
2. Navigate to where you want to save your data and create a new shapefile: *File I New I Shapefile*.
3. In the dialogue box that appears:
   a. **Name**: type the name (eg footpaths, trees)
   b. **Feature type**: choose point / polyline / polygon (must be one of these, not a mixture)
   c. **Spatial reference**: Edit I Select *Projected coordinate systems > UTM I WGS 1984 > Northern Hemisphere* > WGS 1984 UTM Zone 19N (for ABC islands) or *WGS 1984 UTM Zone 20N* (for SSS islands). Click **OK**
4. Add columns (fields) for attribute information
   a. Right-click on the new shapefile and click **Properties I Fields**
   b. Three fields are created automatically for all new Shapefiles. Below these, you can add new fields: type in the Field Name and appropriate Data Type from the drop down list. Example field names might be species, height, date etc
   c. Click **OK**
5. Close ArcCatalog

Create new shapefile to record recreational (eco-user) activity:

i. Think about the information you want to store for eco-user activity (refer to the suggested data structure in Appendix 1).
ii. Check the projection of the paper based map you are planning to use as reference
iii. Start ArcCatalog
iv. Navigate to folder: *DCNA GIS Files UM* and create a new shapefile: *File I New I Shapefile*.
v. In the dialogue box that appears:
   a. **Name**: BON_recreational_activity
   b. **Feature type**: point
   c. **Spatial reference**: Edit I Select *Projected coordinate systems > UTM I WGS 1984 > Northern Hemisphere* > WGS 1984 UTM Zone 19N > **OK**
vi. Click on file in ArcCatalog and **Preview**: Table. At the moment there are three columns: FID, Shape and ID
vii. Add columns (fields) for attribute information:
   a. Right-click on the new Shapefile and click **Properties I Fields**
   b. Type in the Field Name
      i. Activity, Text, Precision 20
      ii. Name, Text, Precision 35
   c. Click **OK**
viii. Close ArcCatalog
5.3 Georeferencing an image

Data from paper maps can be input into a GIS by a process of digitising; either digitising from paper maps laid on a digitising table where features are traced manually or by a heads up digitising process where a paper map is first scanned and features are then traced from this image on-screen with the mouse. We will discuss the latter.

There are two ways of georeferencing an image using ArcGIS:

- with a control layer (i.e. you already have a georeferenced dataset in your GIS which you use to match identifiable points from your image to) and;
- without a control layer (i.e. you know the coordinates of certain points on the map which you can associate to your image)

Both cases involve assigning real world coordinates to a number of reference points on an image. This is done using the tools available in the georeferencing toolbar.

5.3.1 Georeferencing a scanned image to a reference layer

1. Start ArcMap
2. Add the Georeferencing toolbar: Go to Customize I Toolbars I Georeferencing
3. Add a vector shapefile
4. Add the image you wish to georeference against (a message may appear asking if you want to build pyramids. Click Yes. This shortens the time the image takes to display)
5. Zoom to image layer
6. Click on add control points button
7. Click on an obvious point
8. Zoom to shapefile layer
9. Click on same point
10. Repeat steps 5 to 8 on 4 different points. Add as many control points as you want until you have your desired result. If you make a mistake, press View link table button, highlight the point you have added and press delete.
11. Once you have the desired result go to Georeferencing I Rectify. In the next window, make sure the output file is in your personal folder, name the file and save as a .JPG (other formats are available if you prefer). Keep the options as they are and press Save. When the rectification process is finished you have a spatially referenced image which should open in the correct location in future.

Tip: When georeferencing using a reference layer make sure you have at least 4 points and that they are evenly spread across the image. On a larger scale, it is best to use road junctions or building corners; things that are unlikely to change position. Physical features such as river bends or the perimeter of woodlands can alter in position.

Georeference the Bonaire map:

i. Start ArcMap and add BON_Coastline shapefile. Change the symbol so it has no fill and a yellow outline
ii. Add BonaireIslandMap_enlarged_2009.jpg to ArcMap. It may not show automatically as has no georeference. To view the image, right-click and select Zoom To Layer
iii. Zoom in to the most northerly point
iv. Click on Add Control Points button and left-click the image at a recognisable point on the coastline.
vi. The image will look very small compared to the coastline. You need zoom back to the image layer and repeat this process on 4 points on the island, preferably as far away from each other as possible. You will see the image start to
fit to the coastline with each control point added.

vii. Once satisfied, save the image: click Georeferencing I Rectify. Browse to output location DCNA GIS Files UM and select .jpeg image format. Click Save.

viii. The image will always appear in the right place from now on. Remove image layer and add the rectified version.

5.3.2 Assigning real world coordinates to an image

Useful when you have a map or image with real world coordinates for which you are sure of the projection used.

If the image has a reference grid on top of it, the reference points can be used as control points.

1. Start ArcMap
2. Add the Georeferencing toolbar: Go to Customize I Toolbars I Georeferencing.
3. Add the image you wish to georeference
4. Change/Set the coordinate system:
   a. Go to View I Data Frame Properties.
   b. Click on the Coordinate System tab. Select the appropriate coordinate system: Predefined > Projected Coordinate system > WGS1984 > UTM Zone 19N (for ABC) or UTM Zone 20N (for SSS)
5. Add control points:
   a. From the Georeferencing toolbar choose the Add Control Point button.
   b. Using the grid position your first control point at what would be 0,0 on the scanned map. Click the mouse once – a green cross will appear, click the mouse a second time and a red cross will appear. These are the referencing points.
   c. Open View Link Table (button next to the Add Control points). The green point is referred to as the source, or X and Y source in the link table. The red point is referred to as the target, X and Y map in the link table.

Tip: Check the symbol of the target layer. This is shown in the layer list. Dark colours do not usually show clearly against aerial photographs, so click on the symbol to change the settings: yellow typically contrasts with remotely sensed images.
d. Change the X Map and Y Map values to reflect the real-world values read from the map. Click X map value for link 1 until it is highlighted and change.
e. Perform the same procedure for all 4 corners.
f. Click OK
6. Go to Georeferencing I Rectify and Save

5.4 Digitising Points

1. Turn on the toolbar for editing by selecting the menu Customize I Toolbars I Editor, and from this toolbar select Editor I Start editing
2. The Create New Feature dialog box will appear
3. Click on the 'Target' layer (the layer you will be working on) and click on the Construction Tool you wish to use.
4. Zoom in to the area you will digitise
5. Click once where you would like to create a point. Repeat this for each new feature.

5.4.1 Adding attributes

You can add and edit attributes either while digitising features, or afterwards; it is a question of convenience. Either way:

1. Right-click on the layer name and Open Attribute Table
2. Re-size and re-position this window to a suitable place.
3. Type the new attribute values into the table

Create point features for recreational (eco-user) activity areas on Bonaire:

i. Add BON_recreational_activity to ArcMap
ii. Open Editor I Start Editing
iii. Click on BON_recreational_activity, OK. The Create New Feature dialog box will appear
iv. Click on BON_recreational_activity - the 'Target' layer. This will expand the Construction Tools you wish to use.
v. Click on Construction Tools. Select Point by clicking on it.
vi. Click on each location where the following activities take place: kayaking, surfing, cycling, hiking, bird watching, windsurfing, sailing etc
vii. Right-click on layer and Open Attribute Table. Re-size and re-position this window to a suitable place, then type
the attribute values (Activity and Name) into the table.
ix. Click Editor I Save Edits and Editor I Stop Editing

Tip: Always check as you work that you have the correct target layer chosen: it is easy to use the wrong one if several layers are open.

5.5 Digitising lines and polygons

The procedures for digitising lines and polygons are similar:

1. In the Editor toolbar, choose the desired Target layer
2. Use the Construction Tool. Click once at the start of the line, and click again at each change in direction along its course eg following a footpath. Each time you click you create a vertex. Similarly, to create a polygon, Click once to start and click once to add each vertex.
3. To finish a line or polygon, either: double-click at the end point; or right-click > finish sketch; or press F2
4. If you made a mistake and want to delete just the last vertex, press Ctrl-Z (undo)
5.6 Other digitising procedures

5.6.1 Snapping

A useful tool where, for example, two paths meet, is snapping: this ensures that features ‘snap’ to exactly the same point. To use this:

1. To activate the snapping toolbar: Customize I Toolbars I Snapping

![Snapping toolbar]

2. Turn on vertex, edge, end and point. These settings ensure that coincident features ‘snap’ together correctly, as if magnetic.

5.6.2 Zooming and panning while digitising

You can use these tools at any time to move to another part of the image. To resume digitising, just select the sketch tool again.

5.6.3 Selecting features

The following two selection methods are useful in adding and editing attributes:

1. To select a record in the attribute table (which also highlights as a feature on the map), simply click the grey square to the left of the record in the attribute table.
2. Conversely, to select a feature on the map and highlight its record in the attribute table, use the Select Features button in the standard toolbar.

5.6.4 Deleting features

1. Select the feature and press Delete on the keyboard, or
2. Select the row in the Attribute Table and delete.

5.6.5 Saving and finishing

1. Periodically save your work: Editor I Save edits
2. When you have finished working on a layer: Editor I Stop editing

Create a file of cycle trails in the Washington-Slagbaai National Park on Bonaire from the Island Map.

i. Create a new shapefile to record the cycle trails
   a. Start ArcCatalog
   b. Navigate to folder: DCNA GIS Files UM and create a new shapefile: File I New I Shapefile.
   c. In the dialogue box that appears:
      i. Name: BON_cycle_trails
      ii. Feature type: polyline
   ii. Turn on snapping toolbar Customize I Toolbars I Snapping
   iii. Open Editor I Start Editing and click on BON_cycle_trails, OK
   iv. The Create New Feature dialog box will appear
   v. Click on BON_cycle_trails - the ‘Target’ layer. This will expand the Construction Tools you wish to use. In
5.7 Editing lines and polygons

1. Use the Edit tools in the Editor toolbar.
2. Double-click on the feature to be edited: notice that all vertices are displayed as green squares; also, the Task in the editor toolbar changes to Modify Feature.
3. Now, if you hold the cursor over a vertex, notice that the cursor changes to a box with arrows. You can then click and drag the vertex to the desired new location. Notice that the original and modified lines are both shown.
4. Once you have finished editing, double left-click to finish the sketch, then Editor I Save Edits.

5.7.1 Clipped polygon

To complete tasks such as creating inland water files with inland islands cut out of them, or for the Bonaire, Saba and St Eustatius Marine Parks, it is necessary to create a donut polygon. This can be done using the clip command. When using this method, keep in mind that all editable features underneath the feature you are using to clip with will be clipped.

1. Select the inner polygon.
2. Click Editor I Clip.
3. Set the buffer distance to 0 and choose to discard the area that intersects.
4. Click OK.
5. Delete the inner polygon.

5.7.2 Splitting polygons

It is often handy to be able to split a polygon, for instance when creating zones within marine and terrestrial parks or dividing up the islands into vegetation types. To split a polygon, use the Cut Polygons tool, then draw a line across the polygon. The cut operation updates the shape of the existing feature and creates one or more new features using the default attribute values for the feature class. When you are splitting polygons, make sure your sketch cuts completely through the selected polygon. Edge snapping often helps ensure that the cut operation is completed successfully.

1. Click the Edit tool on the Editor toolbar.
2. Click the polygon you want to split.
3. Click the Cut Polygons tool on the Editor toolbar.
4. Click the map to create a line that cuts completely through the original polygon as desired.
5. Right-click anywhere on the map and click Finish Sketch.

Tip: To change the shape of the sketch segment, click a construction method type on the Editor toolbar or on the Feature Construction mini toolbar. Segments can be created using a variety of methods—for example, as straight lines, with curves, or traced from the shapes of other features. You can also use keyboard shortcuts or right-click to access a menu of commands to help you place vertices in the sketch.

5.7.3 Reshaping polygons

The Reshape Feature tool lets you reshape a polygon by constructing a sketch over a selected feature. The feature takes the shape of the sketch from the first place the sketch intersects the feature to the last. When you reshape a polygon, if both endpoints of the sketch are within the polygon, the shape is added to the feature. If the endpoints are outside the polygon, the feature is cut away.

1. Click the Edit tool on the Editor toolbar.
2. Click the feature you want to reshape.
3. Click the **Reshape Feature** tool on the **Editor** toolbar.

6. Click the map to create a line according to the way you want the feature reshaped. You can snap the sketch to the selected edge or cross it to indicate where to start and stop reshaping. The sketch must cross (or touch the edge) two or more times for it to be reshaped.

7. Right-click anywhere on the map and click **Finish Sketch**.

### 5.8 Creating points from x,y coordinates

#### 5.8.1 Converting coordinates

Latitude and Longitude are commonly stored as Degrees Minutes Seconds or Degrees Decimal Minutes. When working with ArcMap, it is easier to work with coordinates formatted as Decimal Degrees.

There are 60 Minutes in a Degree and 60 Seconds in a Minute. The lat/long in Decimal Degrees is calculated by dividing the Minutes by 60 and the Seconds by 3600 and adding the results of both calculations to the Degrees.

An excel spreadsheet called ‘Coordinate Conversion Formula’ has been provided with the DCNA data, detailing the process of converting coordinates to Decimal Degrees.

Convert the coordinates for the 60m depth from Degrees Minutes Seconds to Decimal Degrees

i. Open *60 meterlijn - Bonaire.xls*. The coordinates are written as Degrees Decimal Minutes

ii. Convert the coordinates to decimal degrees using the formula above (using the Coordinate Conversion spreadsheet if it helps). The final version should look like the BON_60m_depth.xls file.

#### 5.8.2 Creating a shapefile from x,y data

Once you have x,y data in decimal degrees format, it is easy to add the data to ArcGIS

Create a file showing the 60m depth for Bonaire

i. Expand the BON_60m_depth excel file and add Bathymetry$ worksheet to the ArcMap TOC. (Alternatively, you can use the file you created in exercise 5.8.1)

ii. Right-click, **Display XY Data**

iii. Set **X field**: to X and **Y field**: to Y

iv. Click **Edit** to set the Coordinate system: Geographic Coordinate Systems > World > WGS1984.prj. Click **OK** and **OK** again.

v. Each 60m depth point recorded is drawn into the shapefile.
3. Click the Reshape Feature tool on the Editor toolbar.

6. Click the map to create a line according to the way you want the feature reshaped. You can snap the sketch to the selected edge or cross it to indicate where to start and stop reshaping. The sketch must cross (or touch the edge) two or more times for it to be reshaped.

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ii. Right-click, Display XY Data.

iii. Set X field: to X and Y field: to Y

iv. Click Edit to set the Coordinate system: Geographic Coordinate Systems > World > WGS1984.prj. Click OK and OK again.

v. Each 60m depth point recorded is drawn into the shapefile.

5.9 Converting points and lines to polygon and vice versa

It is not obvious how to convert point, line and polygon files easily in ArcGIS. There are however handy - and free - tools available on the internet which can add valuable additional functionality to your ArcGIS software. One such tool is ET GeoWizards

5.9.1 Download ET GeoWizards

1. Go to www.ian-ko.com
2. Click on downloads
3. Select ETGW 10.0 (server 1) and save to your hard drive
4. Unzip the files (Extract all files)
5. Click on Windows Installer package to install and follow the setup wizard, clicking Next, I agree, Next. Install in program files.
6. Activate the ET GeoWizards toolbar Customize I Toolbars I ETGeoWizards

5.9.2 Using ET GeoWizards for converting data formats

Using ET GeoWizards you can now convert the 60m depth point data to a polyline layer (to represent the 60m depth contour which can then be merged with other bathymetric data) or polygon file (to define the boundary of the Bonaire Marine Park, as specified in the Marine Ordinance):

i. Double left-click on ETGeoWizards I Convert I Point to polygon I Go

ii. In Select Point Layer choose Bathymetry$ Events

iii. Browse to the location you wish to save the file (with the other Bathymetry files, named BON_60m_depth)

iv. Click Next

v. In Select Polygon ID field, select Depth_m

vi. Click Finish. The transformation will run. Click OK once complete. Close ETGeoWizards
The polygon file will be drawn.

The polygon clip and polygon split editing tools explained in section 5.7.1 and 5.7.2 can now be used to clip the land mass out of the marine park boundary and split the polygon to create the various zones.

5.10 Importing a KML file to ArcMap

ET GeoWizards can also be used to convert a KML file from Google Earth into a shapefile for use in ArcGIS.

i. Click on **ETGeoWizards I Import/Export I Import from Google Earth I Go**
ii. Browse to KML or KMZ file to be imported to ArcMap
iii. Choose the output location
iv. Click **Finish**. The transformation will run. Click **OK** once complete. Close ETGeoWizards
v. Add the layer to the TOC

5.11 Updating metadata

It is essential to include metadata (data about data) with any file created. There are various metadata formats which can be seen in **Customize I ArcCatalog Options I Metadata**

1. Open ArcCatalog
2. Click on **Description**
3. Enter details:
   a. **Tags**: A set of terms that can be used by ArcGIS to search for the resource
   b. **Summary**: A summary of the intentions with which the resource was developed; the purpose:
   c. **Description**: A brief narrative summary of the resource's content
   d. **Credits**: A recognition of those who created or contributed to the resource

Create metadata for **BON_60m_depth**:

i. Start ArcCatalog and go to **BON_60m_depth**
ii. Click on **Description** tab and **Edit**
iii. Make the following changes:
   a. **Title**: Leave as is
   b. **Summary**: Developed for the DCNA Geographical Data Development Project September 2011
   c. **Description**: Bonaire 60m depth contour, created from field data collected on site by STINAPA
   d. **Credits**: Source data provided by Ramon de Leon, STINAPA. File modified by <your name> for DCNA <date>.
## Appendix 1: Data layers

All symbols are provided in a Style package: DCNA.style

### Land topography

#### Coasline

<table>
<thead>
<tr>
<th>Field name</th>
<th>Options</th>
<th>Style</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>FID</td>
<td>0, 1, 2, ...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shape</td>
<td>Polygon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID</td>
<td>Unique ID</td>
<td>ARCL1, ARCL2 etc</td>
<td>To identify polygon for linking information.</td>
</tr>
<tr>
<td>CL_Type</td>
<td>Mainland Island – offshore</td>
<td>Fill: R:255 G:255, B:204 Outline: R:10, G:147, B:252. Width 1.00</td>
<td>- As definitive outline of island - To track change in coastline over time - To calculate geometry (area, perimeter)</td>
</tr>
<tr>
<td>CL_Name</td>
<td>Open text field</td>
<td></td>
<td>To label islands</td>
</tr>
</tbody>
</table>

#### Contours

<table>
<thead>
<tr>
<th>Field name</th>
<th>Options</th>
<th>Style</th>
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</tr>
</thead>
<tbody>
<tr>
<td>FID</td>
<td>0, 1, 2, ...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shape</td>
<td>Polyline (Polygon for Bonaire)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elevation (numeric)</td>
<td>Numbers in metres – multiples of 5 or 10</td>
<td>Contours graded with 5 levels using natural breaks. Green colour ramp.</td>
<td>- Visual representation of relief (through (i) relative frequency of contours (ii) colour of contours)</td>
</tr>
</tbody>
</table>

#### Inland Water

<table>
<thead>
<tr>
<th>Field name</th>
<th>Options</th>
<th>Style</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>FID</td>
<td>0, 1, 2, ...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shape</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>WaterType (text, 15)</td>
<td>Inland water Salinas Freshwater pond Salt pans</td>
<td>R:151 G:219 B:242. No outline Water intermittent symbol with outline removed. Beryl green: R:115 G:255 B:223. No outline. Indicolite green: R:190 G:255 B:232. No outline.</td>
<td>- To represent water bodies. Initially these need to be checked, modified and labelled as necessary. Inland water currently represents undefined water bodies NB – The term Salinas is used to describe any water body containing salt water</td>
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<tr>
<td>WaterName (text, 30)</td>
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#### Inland islands

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<tr>
<td>CL_Type</td>
<td>Island - inland</td>
<td>As for coastline</td>
<td>- To represent islands inland</td>
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<td>CL_Name</td>
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### Watershed

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<tr>
<td>WaterType</td>
<td>Watershed Navigable river River Stream or creek Intermittent stream or creek Canal Aqueduct</td>
<td>R:10 G:147 B:252. Width 1.00.</td>
<td>- Visualisation - Hydrological analysis and modeling - NB – At the moment, all watersheds are unclassified and the WaterType field does not exist. Suggested categories to be approved.</td>
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<td>RiverName</td>
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### Cliffs

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<tr>
<td>CliffType</td>
<td>Cliff Spruce green R:76 G:115 B:0.</td>
<td>Spruce green R:76 G:115 B:0.</td>
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### Seabed bathymetry

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### Land and sea tenure and jurisdiction

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<tr>
<td>12m / 24m</td>
<td>AZ TZ EEZ Base land line Boundary Equid boundary Boundary NA</td>
<td>R:207 G:51 B:194 width 1.00 Gray 40%. No outline Violet Dust. No outline Gray 20%. No outline Ultra Blue Width 1.00 Gray 50% Width 1.50 Gray 50% dotted line Width 1.00 Quetzal green Width 1.50</td>
<td>- To visualise EEZ and TZ zones on a - regional scale - To calculate areas</td>
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## Geology

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<td>Limestones</td>
<td>Solar yellow, No outline</td>
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<td>Limestone/marl</td>
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<td>Rincon form.</td>
<td>R:227 G:191 B:168, No outline</td>
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<td>Washikemba form.</td>
<td>R:69 G:179 B:105, No outline</td>
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## Vegetation

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## National Parks

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<tr>
<td>PAZone</td>
<td>Conservation Traffic Industrial Anchoring Etc</td>
<td>TPA: Fill: Light apple Outline: Peacock Green, W: 2.00 Transparent: 40% MPA: Fill: Sodalite Blue Outline: Ultra blue, W: 1.00</td>
<td>- Visualisation of park boundary - Calculation of area - Planning and management</td>
</tr>
<tr>
<td>PAName</td>
<td>Text</td>
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<td>PARules</td>
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<tr>
<td>Area_m2</td>
<td>Size of protected area in squared metres</td>
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## Major eco-user recreational activity sites

### Moorings / Dive Sites

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</tr>
<tr>
<td>ID</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>Standard White Yellow</td>
<td>Circle2, Dark Amethyst, Size 5</td>
<td>- Planning and management</td>
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NB – At the moment, all watersheds are unclassified and the WaterType field does not exist. Suggested categories to be approved.

Visualisation

Hydrological analysis and modeling

Visualisation of park boundary

Calculation of area

Planning and management
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<td>Y-coord</td>
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**Trails**

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</tr>
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<td>Standard</td>
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<td>Name</td>
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<td>Time</td>
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**Eco-user activity**

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<tr>
<td>Activity</td>
<td>Diving, Kayaking, Fishing, Hiking, Bird watching, Windsurfing, Surfing, Sailing, Cycle trails</td>
<td>Symbols to be confirmed</td>
<td>Planning and management, Visualisation</td>
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**Basic island infrastructure**

**Buildings**

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<tr>
<td>Zone</td>
<td>House, Construction, Village, City</td>
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**Roads**

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<tr>
<td>RoadType</td>
<td>Main, Secondary, Tertiary, Service</td>
<td>Mars Red 1.50, Mars Red 0.40, Medium coral light 0.40</td>
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### Points of interest

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<td>Peak (hilltop)</td>
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<td>Information</td>
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<td>Park offices and other NGOs</td>
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<td>Star 3, Poinsetta Red, Size:14</td>
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<td>Square 1, Electron Gold, Size:12</td>
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### Locations / Place Names (In process)

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### Important Bird Areas (IBAs)

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### Ramsar Sites

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### World Heritage and proposed World Heritage sites

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<td>ID</td>
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<tr>
<td>Name</td>
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### SPAW (Specially Protected Areas and Wildlife)

#### Key species habitat

#### Threats
Appendix 2: Resources

General help and information

• Free Geography Tools website with many handy GIS tips and tricks covering a wide range of software and data packages: http://freegeographytools.com/

• Where are we in the world – one of the clearest guides to map datums and co-ordinate systems: http://www.linz.govt.nz/docs/topography/projects-and-programmes/newsletter/witwaw.pdf

• Introducing GIS worksheets: Top recommendation for introducing key technical GIS concepts, with tutorials and data for open source Quantum GIS: http://linfiniti.com/dla/

Data sources

General

• Open Street Map (OSM): Probably now the most up to date and accurate freely-available road and street mapping available, based on a wiki style online database: www.openstreetmap.org. To download OSM files for the Dutch Caribbean go to: http://downloads.cloudmade.com/americas/caribbean#downloads_breadcrumbs

• Google Earth: http://www.google.co.uk/intl/en_uk/earth/index.html


• Earth Explorer: US Government portals to huge archives of remotely sensed and other data: http://edcms17.cr.usgs.gov/NewEarthExplorer

• Global Land Cover Facility (GLCF): Portal to free image data from several satellites, as well as derived products including landcover classifications. www.landcover.org/data/

• Land Cover: GlobeCover European Space Agency MERIS (300m) based http://ionia1.esrin.esa.int/ or http://postel.mediasfrance.org/breve.php3?id_breve=21

• Natural Earth: Free global basemap http://www.naturalearthdata.com/downloads/

• KCL environmental geodata portal: A huge range of environmental datasets visualised and downloadable via Google Earth: rainfall to volcanoes to deforestation: https://sites.google.com/site/consmapping/home

• Compilation of interesting and useful natural resource KML compilations http://david.tryse.net/googleearth/

• FAO GeoNetwork: A searchable meta-data catalogue of many raster and vector geodatasets, many directly downloadable www.fao.org/geonetwork


• Global Satellite, Data & Observation Systems: http://www.earthobservations.org/

• Comparing countries, globally, by CIA Fact Book statistics, using visual cues: http://www.kmifactbook.org/
Useful resources

Marine

- Ocean Currents: [http://hycom.rsmas.miami.edu/basin_sim.html](http://hycom.rsmas.miami.edu/basin_sim.html)
- NOAA NowCoast: [http://nowcoast.noaa.gov/](http://nowcoast.noaa.gov/)

Conservation

- Center for Biodiversity and Conservation: Excellent collection of guides, tutorials and resources, with a biological slant: [http://biodiversityinformatics.amnh.org/](http://biodiversityinformatics.amnh.org/)

Climate Change

- [http://www.servir.net/en/catalogo_de_datos_de_servir](http://www.servir.net/en/catalogo_de_datos_de_servir) (great deal of climate change data, free to download)

Geology

- Geology: [http://www.geology.sdsu.edu/localgeology](http://www.geology.sdsu.edu/localgeology)

GIS Software

- GE (as above). Follow GEBlog, OgleEarth, Free Geography Tools. A similar non commercial product is NASA World Wind, compatible with GE files.
• OpenSource Geo: enables you to try various software from one portal: http://live.osgeo.org/en/index.html
• Quantum GIS (QGIS): http://www.qgis.org
• GRASS: Free GIS software used for geospatial data management and analysis, image processing, graphics/maps production, spatial modeling, and visualization http://grass.osgeo.org/

**GPS**

• How GPS works: tutorial from Trimble www.trimble.com/gps/index.shtml
• Geodesy: http://www.squidoo.com/GPS-coordinate-systems-datums
• Articles, reviews and links at GPS Information (http://gpsinformation.net) and GPSTracklog (http://www.pocketgpsworld.com/howgpsworks.php).
• GPSUtility (basic version is free): www.gpsu.co.uk (1.5MB).

**Remote sensing**

• General information: http://rst.gsfc.nasa.gov/ and/or http://www.rspsoc.org
• ILWIS: http://www.iti.nl/Pub/Home/Research/Research_output/ILWIS_-_Remote_Sensing_and_GIS_software.html
• ERDAS ViewFinder: Free image viewing tool with basic map manipulation features; of particular interest is that it can re-project imagery. ERDAS. Free: http://www.erdas.com/Products/ERDASProductInformation/tabid/84/currentid/2537/default.aspx
• 3DEM: neat utility to import, visualise and export DEM data, including SRTM files. Free. No longer supported by the Author. Now only available via http://freegeographytools.com/category/3dem
• Multispec: image processor with several useful features: contrast stretching, classification (choice of algorithms) and image-Stacking. Free. http://cobweb.ecn.purdue.edu/~biehl/MultiSpec/

**Habitat modelling**

• DMAP: http://www.dmap.co.uk

**Field Survey Methods**


**Regional Programs and Contacts**
• Global Island Partnerships (CBD): http://www.cbd.int/island/glispa.shtml


• SERVIR: http://www.servir.net/en/americas-latina-caribe

• WCMC, IUCN, TNC: http://protectedplanet.net/
Appendix 3: DCNA Metadata standards

Example of metadata completed in DCNA style:

**Summary**
Developed for the DCNA Geographical Data Development Project September 2011

**Description**
Bathymetry for the seas surrounding Aruba, Bonaire and Curacao, adapted from ABC_bathy_chartextract_uw84.shp

**Credits**
Source data provided by CARMABI/WWF/DCNA. File modified by Eseld Imms for DCNA September 2011.
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