JNCC – UK Overseas Territories Report Series

Environmental data management and data flows in British Virgin Islands: Geospatial data management protocols

Summary

The Environmental data management and data flows in British Virgin Islands project was delivered in three main phases:

- **Inception and stakeholder engagement:** WSP launched the project with an all-stakeholder call and planned the in-country stakeholder engagement. In late December 2022, representatives from WSP visited the BVI and engaged with 15 to 20 governmental and non-governmental stakeholders. The output of the stakeholder engagement:

    - Led to the establishment of user requirements.
    - Agreement of six environmental indicators for inclusion in the data hub.
    - The definition of key datasets for the data hub.
    - The assessment of the existing GIS infrastructure for sharing and accessing environmental data.

- **Development of pilot data hub:** Based on the identified objectives, WSP developed a pilot data hub based on BVI's existing GIS infrastructure for sharing data – the BVI National GIS Mapping Portal. This mapping portal is an implementation of ESRI's ArcGIS cloud-based ArcGIS Online and server-based ArcGIS Enterprise system. The data hub provides functionality to load data and for users to search the platform for environmental data.

- **Knowledge sharing and data management protocols:** This final element of the project worked to provide a baseline set of protocols for creating metadata, structuring, and organising data, defining workflows for producing environmental indicators, and share knowledge on use and maintenance of the platform.

This report was produced by WSP in March 2023 and outlines a baseline set of procedures to support the management of environmental information in the British Virgin Islands. It covers three main elements:

1. **Spatial data management principles**: which covers how data is: inventoried, metadata is created and edited, data status is tracked, data stored and managed.

2. **Core indicator data workflows**: based on core indicators identified during the stakeholder engagement, we have illustrated workflows to show how these indicators are developed. It provides a high-level overview, data capture, GIS/data management processes, and where specialist input from flood modelling or other disciplines may be needed. We have also identified where there are gaps in the data availability based on our current understanding of data availability.

3. **Platform use and management**: A data hub has been setup to provide a repository to store environmental data and make it accessible to stakeholders. This section details how to search, use, and manage the data hub, how to add new data and control access to datasets.

This protocol is intended to be refined by the BVI stakeholders as technology changes and the Government of the Virgin Islands transitions its spatial data infrastructure to ArcGIS Enterprise 10.9 and ArcGIS Pro. It is hoped that the document will become part of the national geospatial data policy over time.

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1.   Introduction

1.1. Background

The Joint Nature Conservation Committee (JNCC) has received funding through the Conflict, Stability & Security Fund (CSSF) to provide technical assistance to the Overseas Territory (OT) of British Virgin Islands (BVI) to develop data management capacity (discovery, access, manage, analyse & use). The aim of the project is to provide BVI with a self-sufficient, secure data management system and geospatial data hub for environmental spatial data.

WSP UK Limited (formerly Wood Group UK Limited) was selected to deliver the 'Environmental data management and data flows in British Virgin Islands' project. The project builds on work previously done by Wood Group UK on Environmental Damage and Loss (EDLA, in publication), and the assessment of the value of natural capital in the protective service against coastal and inland flooding (see An assessment of the value of natural capital in the protective service against coastal and inland flooding in the UK Overseas Territory of the British Virgin Islands 2019).

The project kicked off in late 2022 with a virtual inception workshop, and quickly followed up with a face-to-face stakeholder engagement event. We met with fifteen (15) representatives from the Ministry of Natural Resources and Labour; Department of Disaster Management; The National Parks Trust of The Virgin Islands (NPT), Town and Country Planning Department, and the Department of Agriculture and Fisheries. The output from the engagement was:

- A list of users' requirements for the data hub, outlining what they expected it to look like, how it is accessed, and how metadata is managed.
- The prioritisation of six indicators to focus on as part of this work, identified from the 25-year Environment Plan by JNCC, Key Performance Indicators (KPIs) used for budgeting, and previous work on indicators used in disaster preparedness.
- A list of key datasets used to support the EDLA, capable of supporting the calculation of economic and environmental economic indicators and supporting environmental reporting on Multilateral Environment Agreements (MEAs).

These outputs from the stakeholder engagement were used to inform this work on geospatial data management and the implementation of the data hub, which is summarised in the Stakeholder engagement report. The data hub and data management protocols were delivered over a two-day training session covering the same stakeholder group as outlined above and will be shared with the National GIS Committee.

The following document outlines a series of protocols and guidance developed in 2023 to support the management of geospatial data and metadata for the Government of the Virgin Islands. These protocols have been designed to standardise geospatial data management by providing processes for its capture, maintenance, and use in environmental decision making, and thereby ensure that the data used are the best available and fit-for-purpose. The Ministry of Natural Resources & Labour will be responsible for the agreement and implementation of the protocols with support from other departments through the National GIS Committee. The National GIS Committee (NGIS) is composed of environmental and non-environmental stakeholders from across government and non-governmental agencies. It is a strong well-functioning community of practice who can work to collaborate and incrementally improve the protocols from this first iteration.

The document also includes a set of geospatial data management standards for future use across governmental bodies (internal version) and, where needed, shared with consultants, non-governmental organisations (NGOs) or contractors (external version), who are collecting data and producing information used for reporting, indicator, or Key Performance Indicators (KPIs).

The protocols covered in this document are:

- Development of a national spatial data register – including guidelines for appropriate data storage formats; versioning; data purchasing and licensing and data backup and archiving.
- Creation and management of metadata for all spatial datasets.
- Dataset layer naming and database schemas including:
  - The use of and updating the layer naming structure based on agreed language and structure, and
  - geodatabase schemas for storing information on version number and dataset status.
- Geospatial attribute field management.
- Coordinate and projection systems.
- Development of GIS workflows to facilitate the evaluation of core environmental indicators.
- Gaps in the data requirements for the selected indicators.
- Recommendations and next steps for managing and sustainability of the platform.

The appendices cover methods for the inclusion of metadata based on how data are added to the data hub.

1.2.   The data hub, protocols and their management

1.2.1.   The data hub

The data hub is an implementation of ESRI's ArcGIS Hub, utilising the existing infrastructure hosting the BVI NGIS Mapping Portal. It allows users to engage with the data and tools via a separate, intuitive to use, webpage. The main function of the BVI Data Hub is the search tool, which allows users to search the data catalogue. The catalogue can be searched from the main search bar below the title banner as shown in Figure 1. We have also created two main categories to explore data – terrestrial and marine. This was generated based on the marine and terrestrial tags.
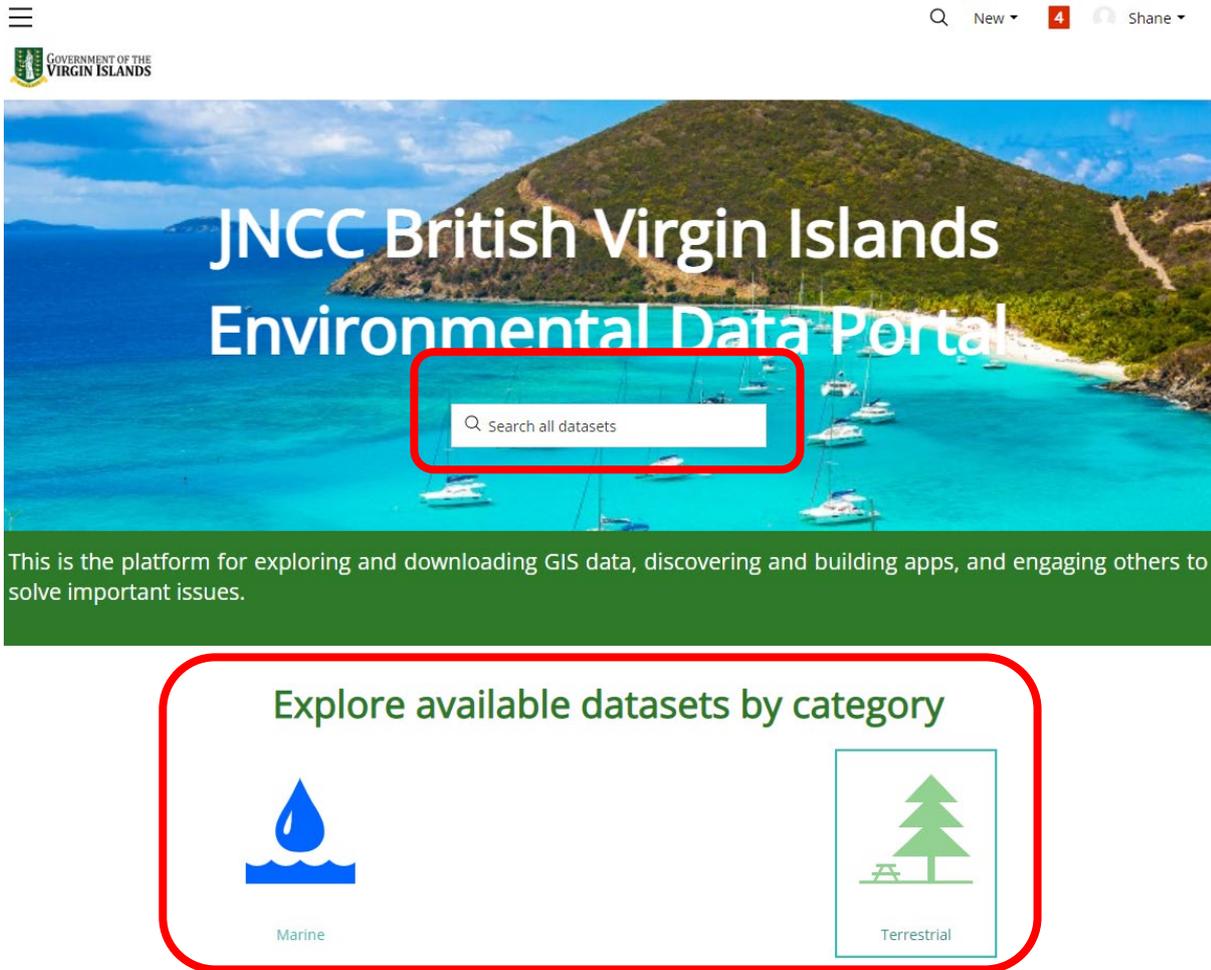
Figure 1. Screenshot of the data hub with the search function and main data categories highlighted.

The result of the search takes users to the results page which illustrates tiles of the search results. The dataset name, description and metadata characteristics are illustrated in Figure 2. Each of the result tiles link to the datasets. The results include documents, datasets, and any apps or maps. Access to download the data is based on the profile of the user. Users can further refine the search result by applying filters relating to the tags and the type of content. Applications can also be found using the search function. It is anticipated that Marine Spatial Planning and Hazard and Climate Vulnerability Assessment tools will be migrated to the platform in the future.

Figure 2. Results page for a test search for 'marine' datasets.

1.2.2. Data management protocols

These protocols have been developed to support the management of data on the data hub. The data hub will be managed by the Town & Country Planning Department (TCPD). The hub will be accessible to named users from the Government of the Virgin Islands and NGO organisations such as National Parks Trust of the Virgin Islands. Viewer access licences will be granted to stakeholders, this will allow users to search and access data. It has been recommended that each organisation should have a creator-level licence which allows them to manage data on the platform. This will allow each relevant Government Department to manage data on the hub, keep their datasets up-to-date, and work with web-maps, web-apps, and dashboards.

Guidance and technical information for the online environmental data management hub created within this project are available in the Appendix. The flowchart below (Figure 3) highlights how data, viewers, and stakeholders interact with the data hub, protocols and each other.

Additional capacity for management of the hub may be developed by the provision of appropriate training and licensing for the platform to a wider group of stakeholders (see ESRI User types overview).
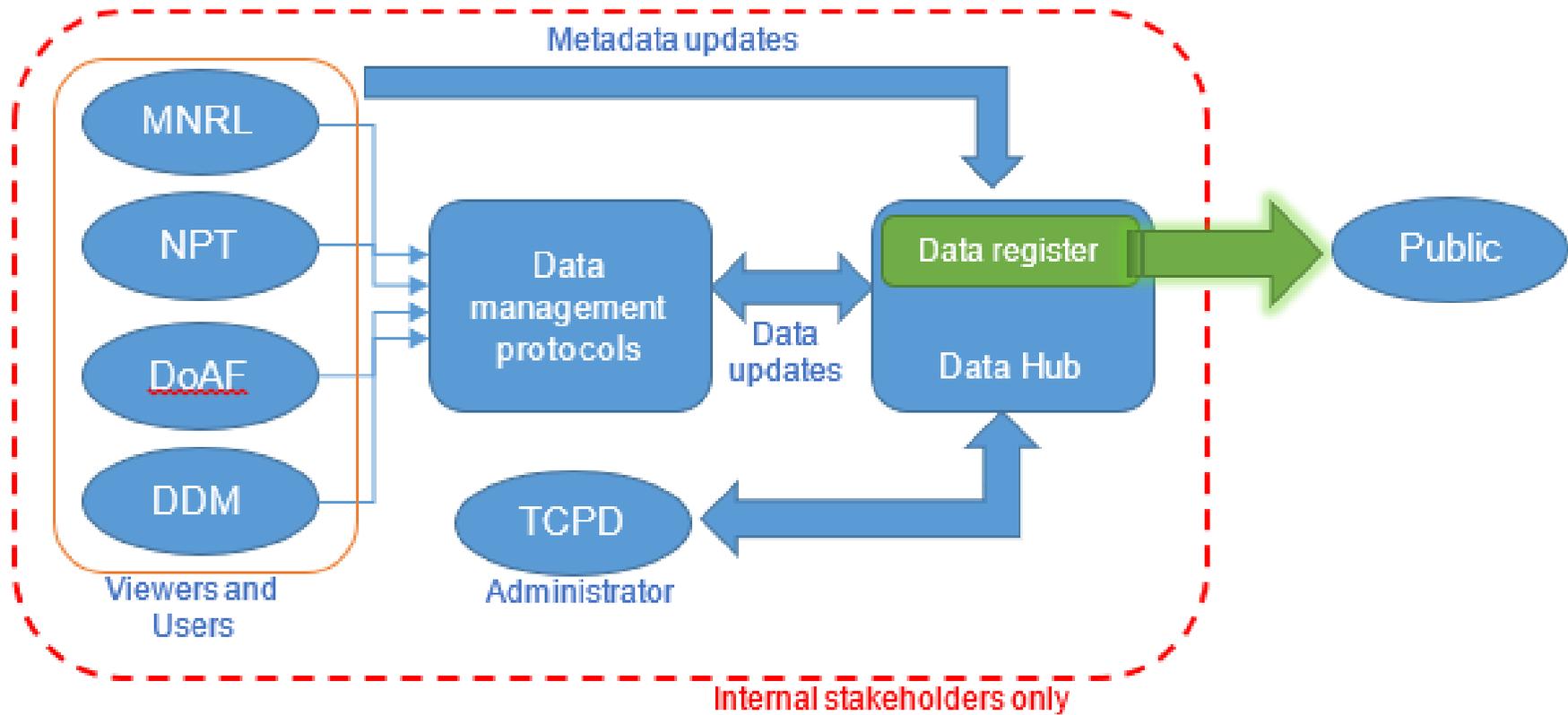
Figure 3. Conceptual layout of the interaction between users, data hub, protocols, and the public.

2. Spatial data management principles

2.1. Data register

A comprehensive data register is a key component of any Geographical Information System (GIS) / data management system, and the following section outlines recommended approaches for the ongoing development of an authoritative and accessible (online) listing of environmental datasets held by the Government of the Virgin Islands (GoVI). The key aim of the register will be to list core data created from work programmes, such as water and air quality monitoring), project outputs, and ad-hoc data collection activities.

The proposed structure of the data register will consist of three main components:

- **Open data** – data which can be freely accessed, used and re-distributed and can be obtained usually at little to no cost. These data layers may include base maps from Open Street Maps or protected areas from Protected Planet.
- **Commercially sensitive data** – data belonging to the Government of the Virgin Islands which are or could be sold for commercial benefit. An example of commercially sensitive data is updated cadastral/parcel maps.
- **Licensed data** – data which are owned by the GoVI and may be provided to other government agencies or third parties under licence. These datasets often have a restriction on their use in terms of the numbers of users and/or the length of time they can be used.

The data register will be an Excel file with a tab for each component of the register. It will be maintained by the portal administrator, and users who add, remove, or modify data, will provide register entries to the data administrator. The data registers will be available on the hub via a download link and can be made available via the main BVI Government Mapping Portal.

It is important that details of all data held are recorded in the data register in a structured format in a location accessible to all stakeholders on the data hub. This provides an opportunity to identify to stakeholders the nature of the data held and how it is to be treated. The data register will also be available to external users on request to provide a list and description of environmental data holdings.

A proposed structure for the data register is presented below in Table 1 and consists of a series of industry standard metadata fields. Further details of the requirements of the metadata fields, including consistent naming conventions and coding values, is presented in subsequent sections. The table indicates the specific fields which are mandatory and optional.

Table 1. Proposed data register structure.

Field name	Description	Catalogue where field is required	Example
Category	Description of the main thematic class the dataset belongs to.	All	Disaster risk
File name	File name based on the naming structure outlined in protocol document.	All	BVI_COAS_DDM_BVIRRRI_PLY_230113
Dataset description	Brief description of dataset.	All	Modelled Category 4 storm surge dataset tracking at 60 degrees and assuming 1 m sea-level rise created as part of BVI Regional Risk Reduction Initiative.
Data custodian	Organisation or entity responsible for maintaining the metadata and updating its status on the data hub.	All	Department of Disaster Management
Contact information	Information to contact the organisation responsible for the dataset.	All	Data Manager (mailto:datamanager@ddm.gov.vg)
Producer	Definition of the agency, organisation, or government department who collected, processed, and stored data.	All	Wood produced a set of data for the Climate Risk and Hazard Vulnerability report. Wood Group will be the producer.
Link to File	Hyperlink or URL to (view) the dataset if it is available online.	All	

Field name	Description	Catalogue where field is required	Example
Source Format	Format the data is natively available in: shapefile, feature class, database, spreadsheet	All	Feature class
Coordinate System	How is data reference to real world space.	All	UTM Zone 20 N
Original Download Date	Original download date.	All	2023/01/13 in yyyy/mm/dd format. This is where applicable.
Copyright Statement	Notice informing users of the claim of copyright for the dataset.	All	Sample text: Copyright Government of the Virgin Islands. Data available under Geodata Licence v1, subject to the following acknowledgement accompanying the reproduced VI Government materials: "Contains VI Governmental data © copyright and database right YEAR"
Licence Restrictions	Limitation or condition placed on your authority to use the data.	Licensed	Data available via Open Government Licence (OGL).
Other Details	Any other notes or attributes not covered in the other fields.	All	Example: Dataset scheduled for update in 2024.

2.2. Data storage and management

It is recommended that all primary spatial data registered in the data register is stored in ESRI file (.gdb) geodatabase(s) hosted on the TCPD site.

The use of the ESRI shapefile format should be avoided as it does not provide an effective method for data creation, editing, versioning, and archiving. Full details of the limitations of the shapefile and DBF format are available online.

2.3. Raster Data

Raster datasets must be managed and/or supplied in an ESRI compatible format with associated georeferencing world files and metadata. This may include geo-tiff and ecw with a preference for

Geo tiff. The coordinate systems and projections used for national datasets need to be used for all raster data.

2.4. Standalone tables

Additional standalone tables which are linked to the GIS layers should be supplied in an ESRI compatible format with accompanied metadata. All standalone tables should be named using the schema/naming conventions described in Section 3 and detailed in Appendix B.

2.5. Procurement of spatial data

Procurement of spatial data should start with the data requestor checking the data register to confirm that the data, or a suitable proxy, does not already exist or may be available from another department or local source. Procurement should follow any existing procurement rules or policies within government. Procurement for spatial data needs to consider the data register and where it will sit, once it is acquired, who, and how it will be accessed, and its metadata maintained.

Procured data must follow the standards for file naming, storage, projections, and access outlined in the protocols in this document.

2.6. Supply of spatial data

Data can be supplied as the output or outcome of project-based exercises or studies. Data supplied or shared with the Government of the Virgin Islands should follow the protocols outlined in this document. Data needs to be supplied using an agreed schema, in an ESRI compatible format, and fully validated for geometric and attribute integrity.

We will also encourage that all data supplied to GoVI is undertaken using a secure online collaboration technology – such as ESRI Enterprise Portal; collaboration platforms, such as SharePoint; or approved data transfer software, such as MoveIT or Dropbox. The supply of data via email will be avoided unless no other option is available.

2.7. Data archiving

Data which are no longer the current version, have been superseded by a corrected dataset, or are no longer used should be archived and removed from the data repository. It should be kept in a designated folder in an archived drive on a separate drive. Organisations such as GeoJobe (BackUpMyOrg) also offer software tools to help facilitate the backup the ArcGIS online or enterprise portal content to either local backup facilities or online cloud-based storage accounts.

3.   Metadata

3.1. Metadata records

All geospatial data must have metadata included. The following metadata must be included:

- implicitly in the file naming (see Section 4 of this document);
- explicitly in the eXtensible Markup Language (XML) data with the feature class (see Appendix 1); and
- encoded in the attributes in the dataset or in the geodatabase using coded and range domain fields (see Section 5.5).

In addition to the creation of a structured online and accessible data register, it is essential to record metadata against all shared and approved GIS data files and ensure users of spatial datasets understand the information they are viewing or analysing.

The following metadata must be captured and recorded for each spatial dataset and is based on the Inspire Metadata Directive standards:

- **Name:** Dataset name based on file naming convention.
- **Abstract (description):** Brief summary of the dataset and its content.
- **Summary (purpose):** Why the dataset was created.
- **Credits:** Copyright statement (who created or contributed to the resource).
- **Tag:** One-word (keyword) general descriptor for data to support searching. You can have multiple key words which is strongly recommended.
- **Lineage:** Description of the processing steps involved in the creation of the dataset including what source the dataset is derived from, creation date, last revision date and originator.
- **Metadata author**: Including their full contact details (Individual name, company name, team on project email address).
- **Use limitations**: Describe limitations of use of the resource. This defines the licence for use of the data.
- **Version**: Version / edition of the dataset.
- **Citation**: Contact for the organisation responsible for metadata under the metadata tab (drr Step 7 under Appendix 1).
- **Data Collector**: Person who collected the data (if applicable).
- **Status:** The status and progress of the data. This can be current, draft, or superseded.
- **Coordinate system:** Represents locations on the Earth's curved surface as two-dimensional coordinates on a flat surface. Some of the tools on the data hub may require a projected coordinate system to calculate area values or measure distances.

Additional metadata information that would be beneficial to include, if available:

- **Scale / Resolution**: Level of detail, expressed as the scale of a comparable hardcopy map.
- **Elevation Units**: Information about units used for elevation.
- **Time Period**: Time period applicable to the data, including period the data were collected and correspond to the real-world conditions.
- **Language**: Language of metadata and dataset.

Satellite Data: (Required for satellite data only)

- **Sensor:** Sensor used for image acquisition.
- **Path/Row:** Scene identifier.
- **Image ID:** Image identifier.
- **Date of Acquisition:** Date of acquisition of all images used.
- **Processing:** Orthorectified, etc., including processing steps.
- **Cloud Cover:** Percentage cloud cover.
- **Version:** Final or intermediate.

4.   File Naming Convention (FNC) & Database Schema

The following section outlines recommended naming conventions and database schemas for all datasets held in the data register and on the BVI GIS system.

4.1.   Layer naming convention

A consistent naming convention should be applied to all spatial data/layers following six main components: geography, theme, organisation, description, geometry, and date:

GEO_THEME_ORG_DESC_GEOM_DATE

- **Geography** defines where this dataset covers. Country wide (BVI), Tortola (TOR), Anegada (ANE), etc.
- Dataset **theme** e.g. terrestrial ecology (TECO), hydrology (HYDR) (THEM).
- Source **organisation** for open and licensed datasets only (ORG).
- **Description** detailing what the dataset contains (DESC).
- **Geometry** type (GEOM).
- **Date** created (DATE).

An example dataset name using this naming system would be:
BVI_TECO_ENVS_HabitatMap_20180426: This would be a terrestrial ecology dataset (terrestrial habitat).

4.1.1.   Dataset geography

Each dataset should cover a specific geography within the BVI or the entire archipelago. The initial part of the naming convention will cover the list of geographies presented below in Table 2.

Table 2. Dataset geography naming conventions.

Data Geography Code	Data Geography
BVI	Covers the entire landmass areas of the British Virgin Islands
JVD	Covers Jost Van Dyke
TOR	Covers Tortola and Beef Island
ANE	Covers Anegada
VIG	Covers Virgin Gorda
ILT	Covers smaller islet
STC	Southern Cays (South of Virgin Gorda)

4.1.2.   Dataset theme

One data theme should be applied to each dataset as part of the naming convention. The current list of datasets themes is listed below in Table 3.

Table 3. Dataset theme naming conventions.

Data Theme Code	Data Theme
AGRI	Agriculture
AIRQ	Air Quality
ARCH	Archaeology & Cultural Heritage
BASE	Base mapping
BETH	Benthic Ecology
BOUN	Boundary
AVIA	Aviation
COAS	Coastal Processes
COMF	Commercial Fisheries
ELEV	Elevation
ENVI	Environmental Designations
FSEC	Fish & Shellfish Ecology
GROU	Ground Conditions
HYDR	Hydrology
IHAB	Intertidal Habitats
MECO	Marine Ecology
NOIS	Noise Quality
SOCI	Socio-economic
SPAT	Spatial Data Management (GIS)
TECO	Terrestrial Ecology
TRAN	Transport
WTRQ	Water quality

4.1.3. Dataset organisation

This code helps to quickly identify the organisation that produced or owns a specific open or licensed dataset. An Organisation (ORG) code is applied to the dataset name. An initial list of commonly used sources is listed in the table below and will be expanded upon as and when new suppliers are identified. If an ORG code is missing, Users would need to contact the data manager or GIS Hub Administrator to get an additional code set up for your dataset. The organisation is responsible for maintaining the metadata and ensuring that it is kept up to date in the data register. The current list of organisations is listed below in Table 4 but is expected to grow as the use of the register and naming conventions becomes embedded in the future operations of the BVI government.

Table 4. Dataset organisation naming convention.

Data Organisation Code	Data Organisation
MNRL	Ministry of Natural Resources and Labour
DDM	Department of Disaster Management
TCPD	Town and Country Planning Department
AGF	Department of Agriculture and Fisheries
NPT	National Parks Trust
WOOD	Wood Group UK Limited
WSP	WSP UK Limited

4.1.4. Dataset description

A short description of the dataset is used to help users understand what the dataset is showing, noting that acronyms and abbreviations should be avoided, if possible, to ensure non subject matter experts understand the data description. The description should not be more than 40 characters, and it is recommended that you limit the name to contain only letters of the alphabet (A to Z, a to z), digits (0 to 9), underscores (_) and hyphens (-). The total path length to the dataset needs to be considered. Usually, path lengths are limited by Windows in the MAX_PATH registry key to 256 characters. When using the ESRI GRID raster format in ArcMap 10.x this restriction is even greater, for raster datasets, the following must be noted:

- The maximum number of characters is 13.
- It cannot have spaces.
- It cannot use special characters other than underscore ("_").
- The first letter of a raster name should be a character instead of a number or symbol.
- For tools that output a Grid Stack, the stack name cannot have more than 9 characters.
- The total length of the name for a Grid **and its path** cannot be more than 128 characters.

4.1.5. Dataset geometry

Geometry of a dataset is identified by a two-letter code as outlined in Table 5 below.

Table 5. Dataset geometry naming conventions.

Geometry Code	Geometry Type
AN	Annotation
LN	Line
PT	Point
PO	Polygon
RA	Raster
TB	Table

4.1.6.   Dataset date

A date should be attributed to each dataset when it is created or sourced. The format of the date should be YYYYMMDD. For example, 1 October 2020 would be written 20201001.

4.2.   Database schemas

The development and use of data schemas are an essential part of the development and implementation of a GIS and database systems and are designed to ensure consistency of approach and promote the speed and effectiveness of data capture, management and transfer tasks.

The use of database schemas can save time when updating. Schemas can be created in ArcCatalog, or even use existing schemas (as already designed by TCPD). All GIS spatial data collected and used by GoVI should be collected using a standardised database schema. A schema defines the physical structure of a geodatabase or database along with the rules, relationships, and properties of each dataset in the geodatabase. The geodatabase may contain one or many individual datasets, with the number typically determined by operational requirements and expected data volumes.

4.2.1.   Assessing the availability of existing data schemas

It is recommended that an organisation's GIS Lead is contacted before the commencement of any major spatial data collection exercises to discuss the process and data schemas to be adopted. This process should consider if there is an existing geodatabase schemes which could be used or enhanced for the data collection. All changes to an existing data schema must be logged and undertaken to not compromise or alter existing data structures. If there is any doubt, then it is recommended that a new data schema is developed.

The development of a new schema design for the future collection of the data should be undertaken by the GIS/database custodian with input from relevant technical leads.

4.2.2.   Developing a new database schema

The creation of a new geodatabase structure or alterations to an existing database schema must be undertaken using either the ESRI ArcGIS ArcCatalog or ArcGIS Pro software products. The general processes involved are shown below in Figure 4 and involves defining the naming conventions to be adopted, field structures within the geodatabase and the addition of domains (coded values) to selected fields. See Sections 5.5 to 5.8 for more details on how to create domains.
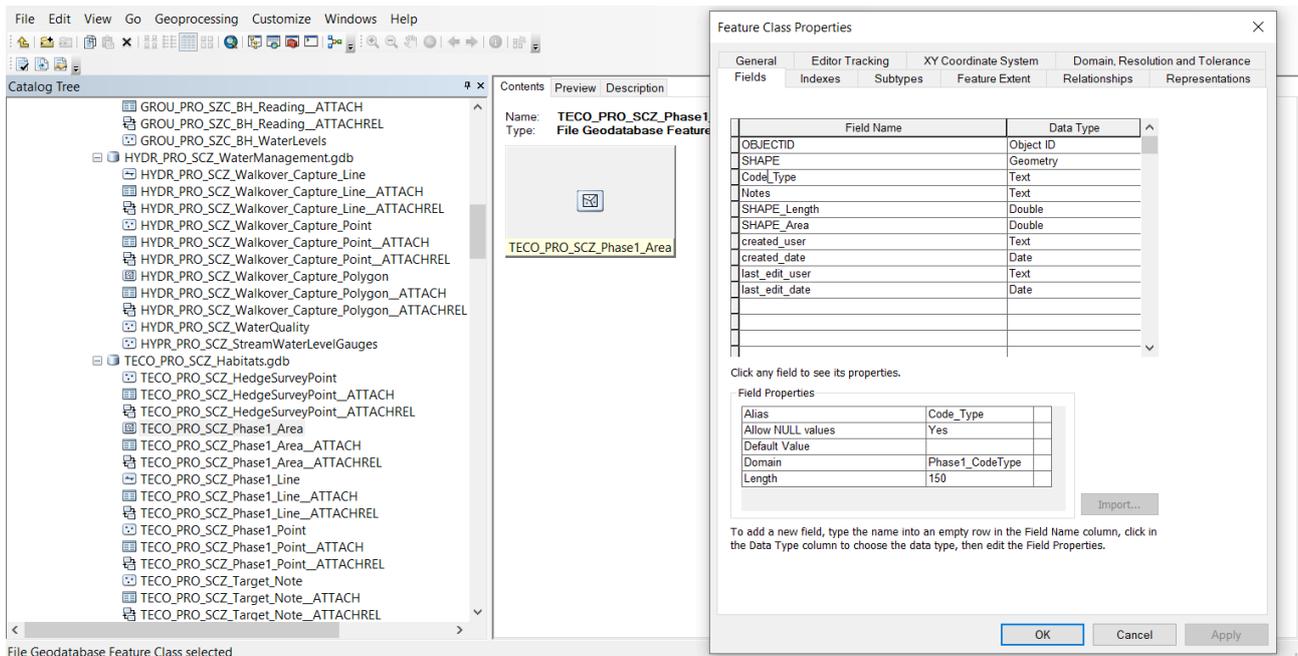
Figure 4. Creating a new database schema.

All database schemas created must include the following items:

- a zipped version of the ESRI file geodatabase in a folder.
- a new addition or revision to the SZC database schema change log.
- an ESRI XML workspace of the schema exported from ArcGIS.

The name of the schema, accompanying file geodatabase, geodatabase layer and an ESRI Map Document (MXD) defining the symbology (for maps, reviewing data and internal web mapping platform) for the schema, must also be named in line with the naming convention detailed earlier.

5.   Integrating metadata into layer attributes

5.1.   Mandatory fields to include in datasets.

Mandatory attribute fields in datasets are fields that are required to have values for every feature in a dataset. These fields are typically designated as mandatory during the process of creating the dataset and cannot be deleted or left blank for any feature. Examples of such include "OBJECTID" or "FID".

However, this portion of the report outlines a set of mandatory fields to include in every dataset in the data hub. These attributes are not automatically generated by the dataset itself but are included manually. The importance of mandatory attribute fields lies in their ability to ensure consistency and completeness in the data. By requiring certain attributes to be filled in for every feature, you can ensure that the data is as accurate and complete as possible.

Mandatory attribute fields are key for enforcing the protocol, helping to prevent errors and inconsistencies in the data. For example, should a dataset be updated, one can change the status of a dataset, marking it "current" so people using project data can then use the most updated dataset. In addition, mandatory attribute fields can help to improve the quality and usefulness of the data by making it easier to search, filter, and analyse.

Table 6 outlines a series of recommended mandatory attribute fields for future inclusion on all datasets.

Table 6. Dataset geometry naming conventions.

Field name	Alias	Description	Field type	Field length
Source	Source	Specific reference to source of data. Examples include website, document number, survey reference or file path. Should the data be made in-house please use the relevant company name.	Text	255
Revision	Revision	Numeric code demonstrating the sequence features were created in.	Long integer	NA
Status	Status	Whether the dataset is "Current" (1) or "Superseded" (0). This field is controlled by a geodatabase domain.	Text	50

5.2.   Importance of attribute data and management

Attributes are non-spatial data that describe the characteristics of the geographic features in a feature class. These can include things like the name of a city or town, flood zone levels, or the elevation of a mountain peak. You can access a feature class attribute data by right clicking on the desired layer and selecting open attribute table, see Figure 5).
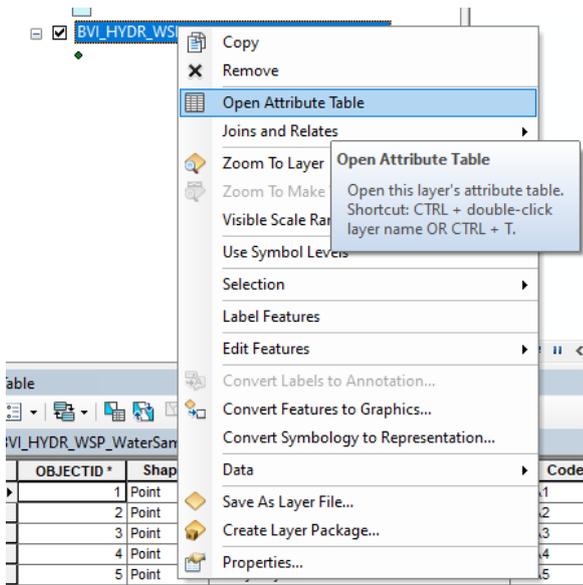
Figure 5. How to access a dataset's attribute table.

Upon clicking, users are presented with the feature class attribute table – see Figure 6.

Figure 6. ArcGIS attribute table structure example.

Attribute data are organised into fields, which define the type of data that can be stored in each attribute column. For example, a field might be defined as a text field, which would allow alphanumeric data such as names to be stored, or a numeric field, which would allow numbers to be stored for things like population counts or elevation values. Editing attribute fields involves modifying the values in the attribute table for a specific feature class. This can be done for a variety of reasons, such as correcting errors, updating information, or adding new data.

When data are obtained from external sources, there is often attribute data that are irrelevant to the project. Additionally, there will be some contextual data relevant to the project (i.e. whether the latest version of data are being used in the project) missing in the attribute table. To ensure the uniformity of the data, attribute tables must be cleaned and managed to ensure only essential data are included. The following sections detail how users can edit attribute table data and mandatory fields to be included within feature classes. This is based on ESRI ArcMap/Catalog 10.8 and 10.9. The process is expected to change with the migration to ArcGIS Pro and ArcGIS Desktop end of life.

5.3. Adding and/or editing a new ESRI based attribute field

The following section outlines the process for adding and/or editing a new ESRI based GIS attribute field.

5.3.1. Step 1: Open the attribute table

Select the layer you want to edit in the Table of Contents, right-click on it and select "Open Attribute Table."

5.3.2. Step 2: Add new field

Click on the Options button in the attribute table and select "Add Field." This will open the "Add Field" dialog box, see Figure 7.
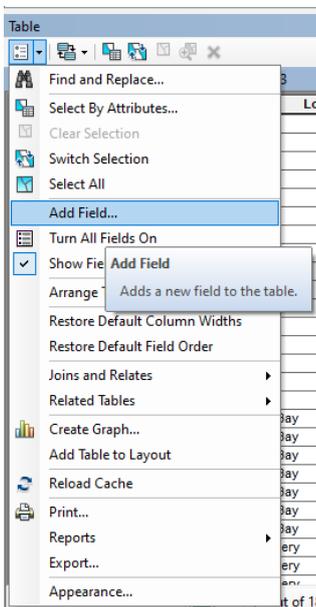
Figure 7. Adding a new attribute field.

5.3.3. Step 3: Set parameters of the new field

In the "Add Field" dialog box, specify the properties of the new field, including its name, data type, and length, see Figure 8.

You can also specify a default value for the field if needed. Default values can come in handy when setting the source of your dataset. When naming an attribute field, ensure the only special character being used is "_". Do not use any spaces when naming the attribute column either. You can, however, add spaces in the attribute's alias name.
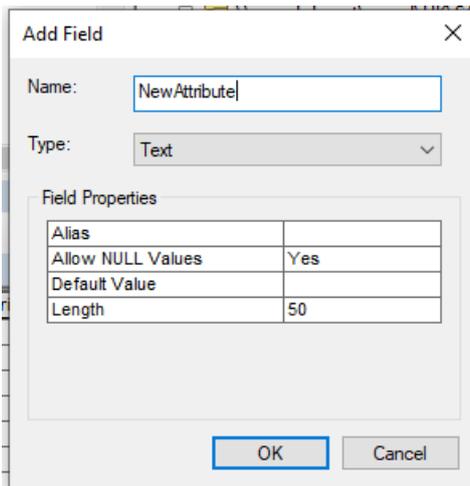
Figure 8. Defining the parameters for a new attribute field.

Click OK: Once you have set the properties of the new field, click OK to add it to the attribute table.

5.3.4.   Step 4: Edit the field.

To edit a field, right click on the desired feature in the table of contents, hover over edit features, then select and select "start editing." This is shown below in Figure 9.
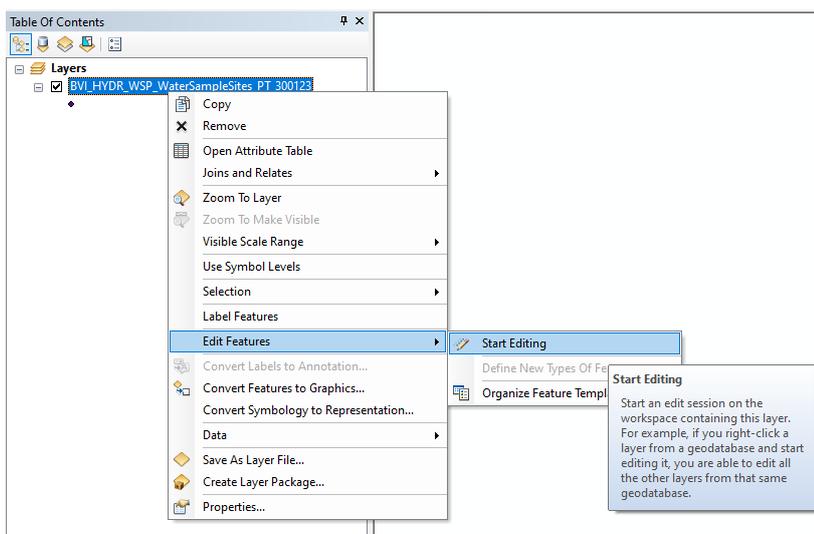
Figure 9. Editing existing attribute table data.

5.3.5.   Step 5: Save the changes and stop editing.

When you have finished adding and editing the new field, save your changes by clicking on the "Save Edits" button in the editor toolbar. Repeat and then select "stop editing." This process is shown in Figure 10.
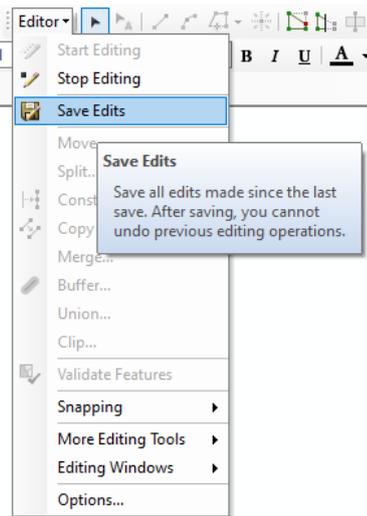
Figure 10. Saving the final attribute table data.

5.4.   How to delete an attribute field

The following section details the process for deleting an attribute field. The process is illustrated in Figure 11.

5.4.1.   Step 1: Open the attribute table.

Select the layer you want to edit in the Table of Contents, right-click on it and select "Open Attribute Table."

5.4.2.   Step 1: Select field to be deleted.

Right click on intended field to be deleted and delete field. A pop-up box will appear to confirm this action. If you are sure you wish to delete this field, select yes.
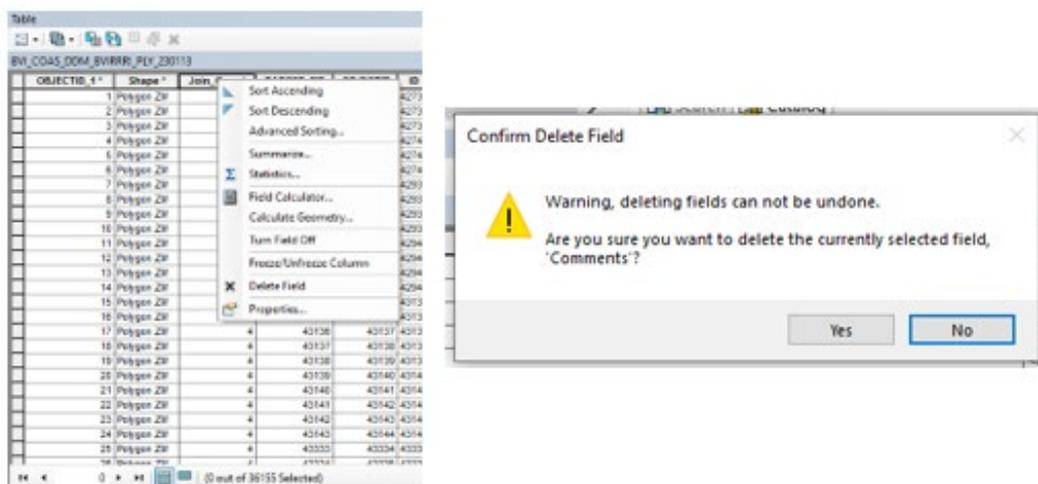
Figure 11. Deletion on an ESRI attribute field.

5.5.   Using coded and range domain fields to track metadata

A domain is a set of rules that define valid values for a specific attribute field in a feature class. A domain can be used to ensure that only specified values are entered into the attribute field. This ensures data remains accurate and consistent. There are two types of domains as shown in Figure 12.
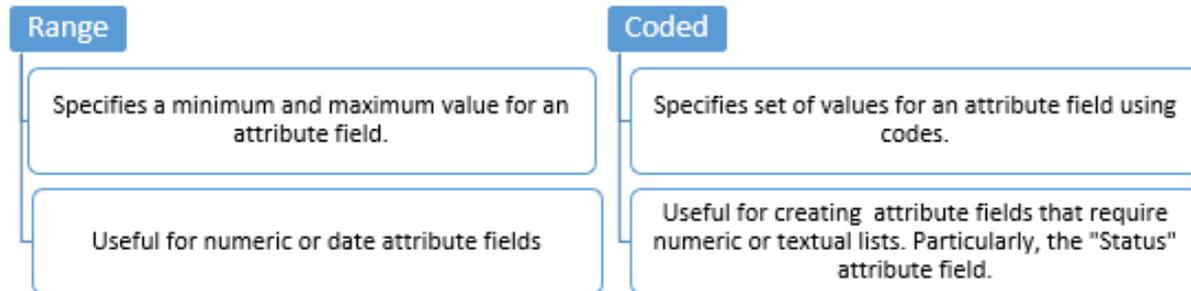
Figure 12. Different domain types.

Domains can be created and managed in a geodatabase and can be assigned to one or more attribute fields in a feature class. When a domain is assigned to an attribute field, it becomes a drop-down list or range of valid values that can be selected when entering data into that field. Domains prevent users from entering invalid values into attribute fields, ensuring data accuracy and consistency. This can be valuable when working with large datasets and when data is being shared between different users within internal and external bodies.

5.6.   How to create a coded domain

One mandatory field that should be included in every dataset is "Status", which signifies whether a dataset is "Current" (the latest version of the data, coded as "1") or "Superseded" (an outdated version of the dataset, coded as "0").

5.6.1.   Step 1: Navigate to the geodatabase properties

Select to ArcGIS "Catalogue" icon in your toolbar. This will open your catalogue pane on the left of your application.

Find the file path of the geodatabase you wish to create the domain in, expand it by either double clicking the folder or clicking the ⊞ icon. Once the desired geodatabase is found, right click it and select "Properties". This is illustrated in Figure 13.
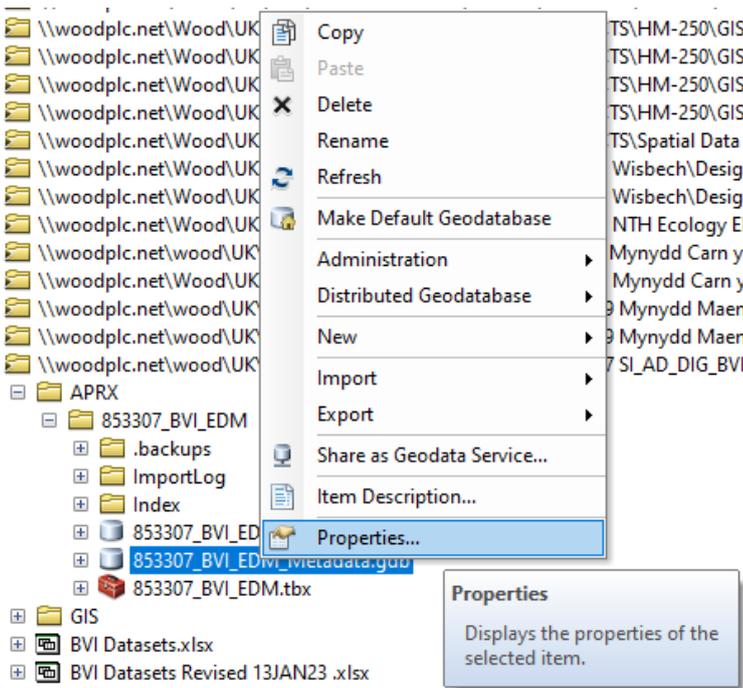
Figure 13. Reviewing ESRI geodatabase properties.

5.6.2. Step 2: Specify domain field properties

In the next step, you are required to enter your domain name ("Status") and description ("Status"). In the domain properties table, select the field type "Text" from the dropdown. Then, specify the domain type, which in this case will be coded values. Ensure split and merge policies remain as Default Value". This is shown below in Figure 14.
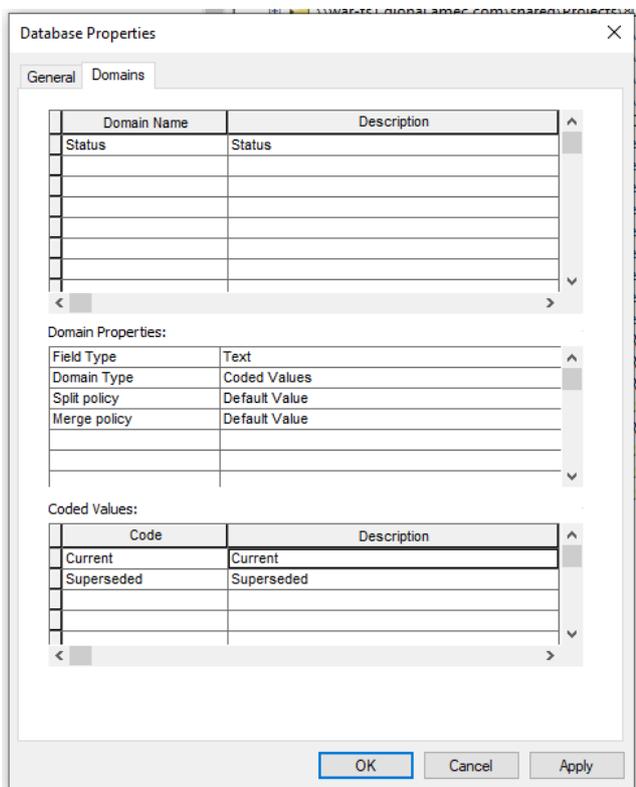
Figure 14. Specifying domain field properties (coded domain).

5.6.3.   Step 3: Define coded values for your domain

Once "Coded Values" has been selected as the domain type, populate the coded values table your valid entries. In this case, "Current" and "Superseded" will be added to the code and description columns of the table. When complete, select ok to apply the domain to the geodatabase.

5.7.   Creating a range domain

5.7.1.   Step 1: Navigate to the geodatabase properties

Select to ArcGIS "Catalog" icon in your toolbar. This will open your catalogue pane on the left of your application.

Find the file path of the geodatabase you wish to create the domain in, expand it by either double clicking the folder or clicking the ⊞ icon. Once the desired geodatabase is found, right click it and select "Properties".

5.7.2.   Step 2: Specify domain field properties.

Assign a domain name and description, however this time select "Short Integer" as the field type, and "Range" as the domain type. Enter the minimum and maximum value of the numeric range by double clicking the rows populated with "0". Select "OK" to apply.

5.8.   Assigning a domain to an attribute field

5.8.1.   Step 1: Add new field

Add new field as shown in Section 5.3, however this time ensure that the field type matches the domain you wish to add. The domain option should be present in the field properties table. Click the dropdown and select the relevant domain. Assign a "Default Value" if needed. Once you have selected your domain, select "OK" to create the new attribute.

6.   Spatial referencing systems

All data must have a coordinate reference system. In most cases it will be the projected coordinate system mentioned in Section 6.1. If data require an alternative coordinate system (for example marine or those which exceed the UTM projection limits), the appropriate projection should be noted in the layer name, attribute table and the metadata. Geographical Coordinate Systems (GCS) are allowed in circumstances where the dataset is natively in that reference system (example WGS 84), or it extends beyond the limit of the UTM Zone 20 N projection.

6.1. Detailed survey – 3D GPS positioning and reference

All new GPS survey information captured in the British Virgin Islands should be captured or transformed to the North American Datum (NAD 83) GPS coordinate system. The key parameters of the NAD 83 system are provided in Table 7 below.

Table 7. Projected coordinate system specifications of NAD 83.

Parameter	Value
Name	NAD 1983 UTM Zone 20N
Linear Unit	Metres / Meters
Metres per unit	1
Projection	Transverse Mercator
False Easting	500000
False Northing	0
Central Meridian	-63
Scale factor	0.9996
Latitude of origin	0
Geographic coordinate system	GCS North American 1983
Angular unit	Degree
Radians per unit	0.0174532925199433
Prime meridian	Greenwich
Spheroid	GRS 1980
Semimajor Axis	6378137
Semi minor Axis	6356752.31414036
Inverse flattening	298.257222101

6.2. Vertical datums

The geodetic and computational bases used are the North American Datum 1983 ("NAD 83"). Please consult the BVI Lands & Surveys Department for more information on datums.

7. Core indicator data workflows

Based on the stakeholder engagement with the Ministry of Natural Resources & Labour, Department of Disaster Management, and National Parks Trust of the Virgin Islands, conducted in December 2022, six priority indicators were identified to support environmental management by the Government of the Virgin Islands. These indicators are listed in Table 8. The table also outlines the key datasets currently available for their assessment.

This section details the process for data requirements, GIS tasking, and final production of indicators required for reporting. It also provides a summary of each process and suggestions on execution in desktop GIS.

Table 8. Core environmental indicators.

No.	Indicator	Source	Key habitats	Comment
1	Extent, health and connectivity of coral reef (bleaching/ effects of sedimentation), mangroves, sea grass.	Environmental Indicators – previous JNCC work as referenced in the introduction in Section 1 of this report.	Mangroves, sea grass, coral reef	This can be derived from the existing coastal atlas benthic habitat mapping. An update is being developed under the Darwin Plus project on Marine Spatial Planning carried out by NOC.
2	Coastal erosion: changes in beach area and coastal profile depth	Environmental Indicators – previous JNCC work as referenced in the introduction in Section 1 of this report.	Coastline/beaches	Existing subscription to satellite imagery (Sentinel 2) may be used to derive data.
3	Extent, health and connectivity of habitat (e.g. forests, wetlands, agriculture, salt ponds, wetlands)	Environmental Indicators – previous JNCC work as referenced in the introduction in Section 1 of this report.	Forest, mangroves, salt ponds, agriculture	Existing imagery access can be used to carry out image classification to derive updates to this data.
4	Communities resilient to flooding, coastal erosion, wind damage.	Environmental Indicators – previous JNCC work as referenced in the introduction in Section 1 of this report.	Coastal	This may possibly be derived with a combination of surveys and key datasets identified in Table 3.

No.	Indicator	Source	Key habitats	Comment
5	Area of coral reef under direct restoration.	2022 Budget	Coral reef	Data for this will have to be a combination of identified survey areas, validated with marine habitat data.
6	Number of days water quality at beaches exceed safety standards.	2022 Budget	Marine habitats at key locations	Data for this is being collected as part of MNRL's water quality monitoring programme and is being enhanced by the RESEMBID project.

7.1. Data gaps

Based on the key datasets identified by stakeholders and the indicators selected, we have identified gaps in the data requirements for the computation of the selected indicators (see Table 9).

Table 9. Core environmental indicators, data requirements and data gaps.

No.	Indicator	Data requirements	Data gap
1	Extent, health and connectivity of coral reef (bleaching/ effects of sedimentation), mangroves, sea grass.	Marine habitat map to identify habitats extent is available. Evaluation of health of mangrove, coral reef, and sea grass. Based on survey data and/or remotely sensed data for mangrove health. Some data on Stony coral tissue loss affected areas is available, which provides an input of coral health. National Oceanography Centre is working on a parallel project to develop a marine habitat map which will be delivered by the end of June 2023.	There is not a complete set of survey or remote sensed data evaluated for marine habitat health.
2	Coastal erosion: changes in beach area and coastal profile depth	Baseline elevation model – currently available. Measurements of changed coastal profile from beach profiles or topographic surveys.	It is unclear if there is consistent data on the changed coastal profile.

No.	Indicator	Data requirements	Data gap
3	Extent, health and connectivity of habitats (e.g. forests, wetlands, agriculture, salt ponds)	Terrestrial habitat map to identify habitats is available. Field survey data is required to develop baseline health of these habitats.	Data to assess health of these habitats is not currently available. Upcoming projects by CSSF may be in train to deliver NDVI data which may be useful in habitat health assessment. NPT has some data on forest, but it is not an overall assessment of forest health. Condition of wetlands, agriculture, and salt ponds are not assessed.
4	Communities resilient to flooding, coastal erosion, wind damage.	Buildings data – available Flood hazard data – available Wind hazard data – available Structural vulnerability (damage function)	Information on structural vulnerability which is unique to BVI is not currently available. This may be developed through research and surveys of structures in the hazard zones.
5	Area of coral reef under direct restoration.	Marine habitat map to identify coral reefs – available. Location of restoration work being conducted	Location of restoration or planned restoration work is not available.
6	Number of days water quality at beaches exceed safety standards.	Location of water quality sample sites – available. Results from tested samples at sites with small enough sample window to minimise interpolation. Standard thresholds for water quality.	There are currently no known gaps, and this is being actively worked on within MNRL under the RESEMBID project (Resilience, Sustainable Energy and Marine Biodiversity).

7.2. Workflows for indicator development

There are up to four components involved in the workflow that are required to reach the result, these are:

- **Data capture teams** – any stage of the workflow indicated as this component refers to the acquisition or production of GIS datasets that are required.

- **GIS/Data Management** – this component is best explained as any geoprocessing or alteration of datasets that are required to be performed, followed by the management, via quality assurance, and transfer of data a relevant location required for display or storage for later use.

- **Modelling** – this component involves the geoprocessing of multiple datasets to create outputs for different scenarios, for example varying storm surge levels, which can be used to inform and be used in the analysis of environmental indicator values.

- **BVI Indicator Values** – this component is the result of all analysis and involves the indicator values that are used to inform and infer in reporting.

7.3. Extent, health and connectivity of coral reef, mangroves and sea grass

The workflow for the extent, health and connectivity of coral reef, mangroves and sea grass is presented in Figure 15.
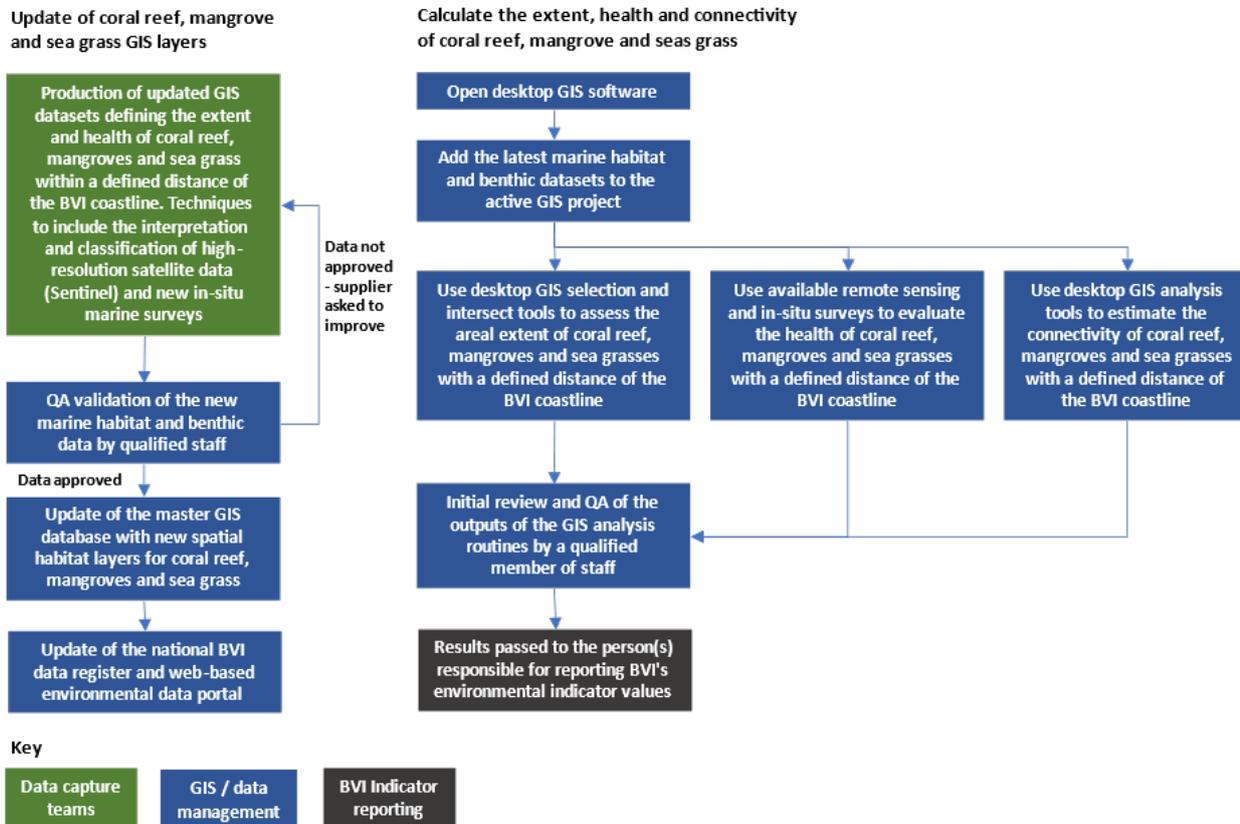
Figure 15. Extent, health and connectivity of coral reef, mangroves and sea grass workflow.

7.3.1. Summary

The workflow covers two main elements:

1. The actual collection of data and recording it in data registers and applying data management policies and recording metadata.
2. Computation of index dataset values.

Part of both processes involves a key element of quality assurance to ensure that the right processes were carried out to produce the best possible quality data.

The extent, health and connectivity of coral reef, mangroves, and seagrass can be split into three components: extent, health, and connectivity of each habitat:

*   **Extent** will first be based on selection of the correct habitat, and secondly the calculation of the area parameter.
*   **Health** will require collection of survey data and its visual evaluation.
*   **Connectivity** may be derived by use of topology tools to determine connectivity or adjacency or habitat polygons. In QGIS for example this can be the *find neighbour* polygons, or *polygon neighbours* in the analysis toolbox in ArcGIS.

7.4. Coastal erosion changes in beach area and coastal profile depth

The workflow for the extent of coastal erosion changes in beach area and coastal profile depth workflow is presented in Figure 16.
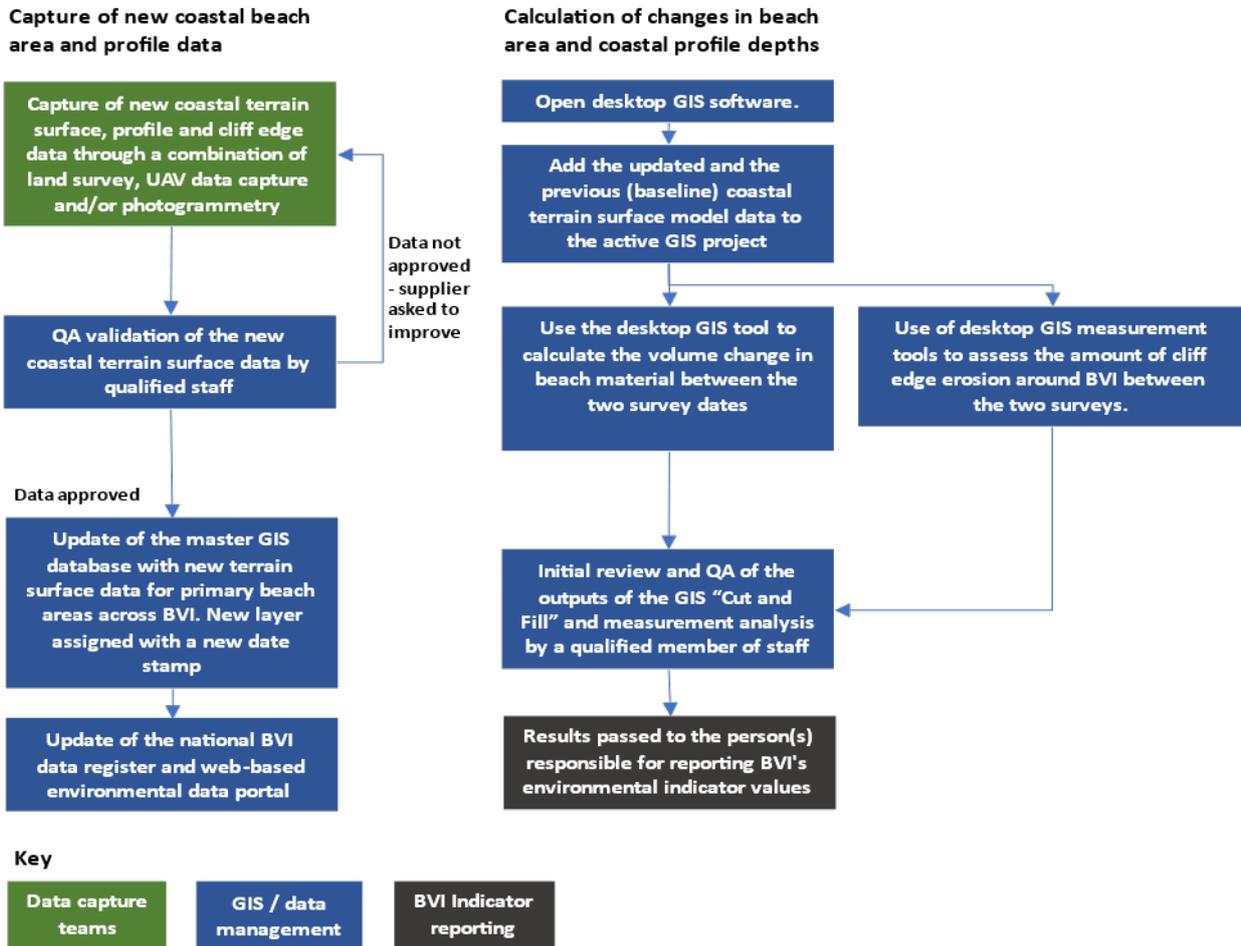
Figure 16. Coastal erosion changes in beach area and coastal profile depth workflow.

7.4.1. Summary

The workflow covers two main elements:

1. The actual collection of data and recording it in data registers and applying data management policies and recording metadata.
2. Computation of index dataset values.

Part of both processes involves a key element of quality assurance to ensure that the right processes were carried out to produce the best possible quality data.

The workflow can be split into coastal profile depth, and the change in beach area.

- Coastal profile depth can be considered as a difference between the baseline surface and the new coastal topography referred to as *'cut and fill'*. To determine a volume the cut and fill

tool can be used in most desktop GIS applications. In QGIS this can be found under the *Raster Surface Volume tool and cut and fill* under 3D Analyst toolbox.

- Individual coastal cross sections can be prepared using the cross-section tool. These should be spatially referenced from the same point and based on the national benchmark or datum.

7.5. Extent, health and connectivity of terrestrial habitats

The workflow for the extent, health and connectivity of terrestrial habitats is shown in Figure 17.
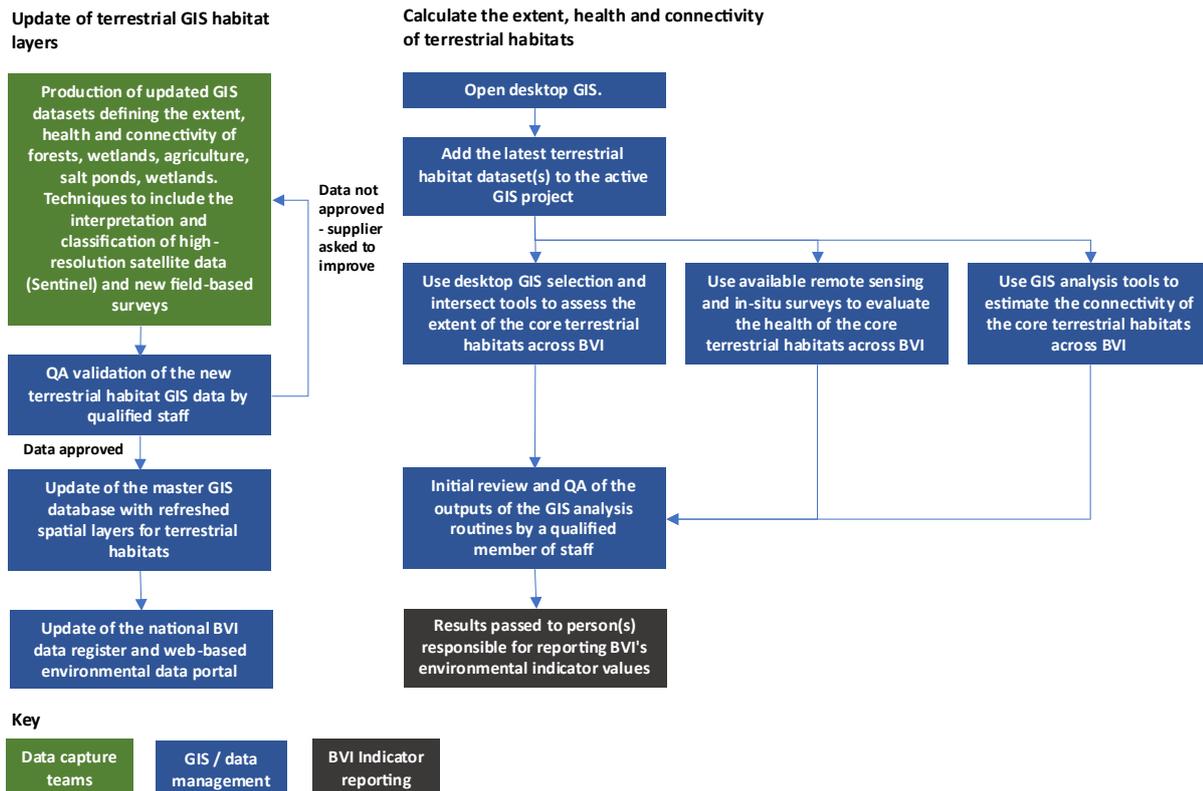
Figure 17. Extent, health and connectivity of terrestrial habitats workflow.

7.5.1. Summary

The workflow assumes that there is a baseline dataset existing to compare to the changed *state under consideration. It covers two main* elements:

1. The actual collection of updated data and recording it in data registers and applying data management policies and recording metadata.

2. Computation of index dataset values.

Part of both processes involves a key element of quality assurance to ensure that the right processes were carried out to produce the best possible quality data.

The extent, health and connectivity of terrestrial habitats can be split into three components: extent, health, and connectivity of each habitat.

- Extent will first be based on selection of the correct habitat, and secondly the calculation of the area parameter.

- Health will require collection of survey data and its visual evaluation.

- Connectivity may be derived by use of topology tools to determine connectivity or adjacency or habitat polygons. In QGIS for example this can be the *find neighbour* polygons, or *polygon neighbours* in the analysis toolbox in ArcGIS.

7.6. Communities' resilience to inland flooding

The workflow for the communities' resilience to inland flooding is shown in Figure 18.
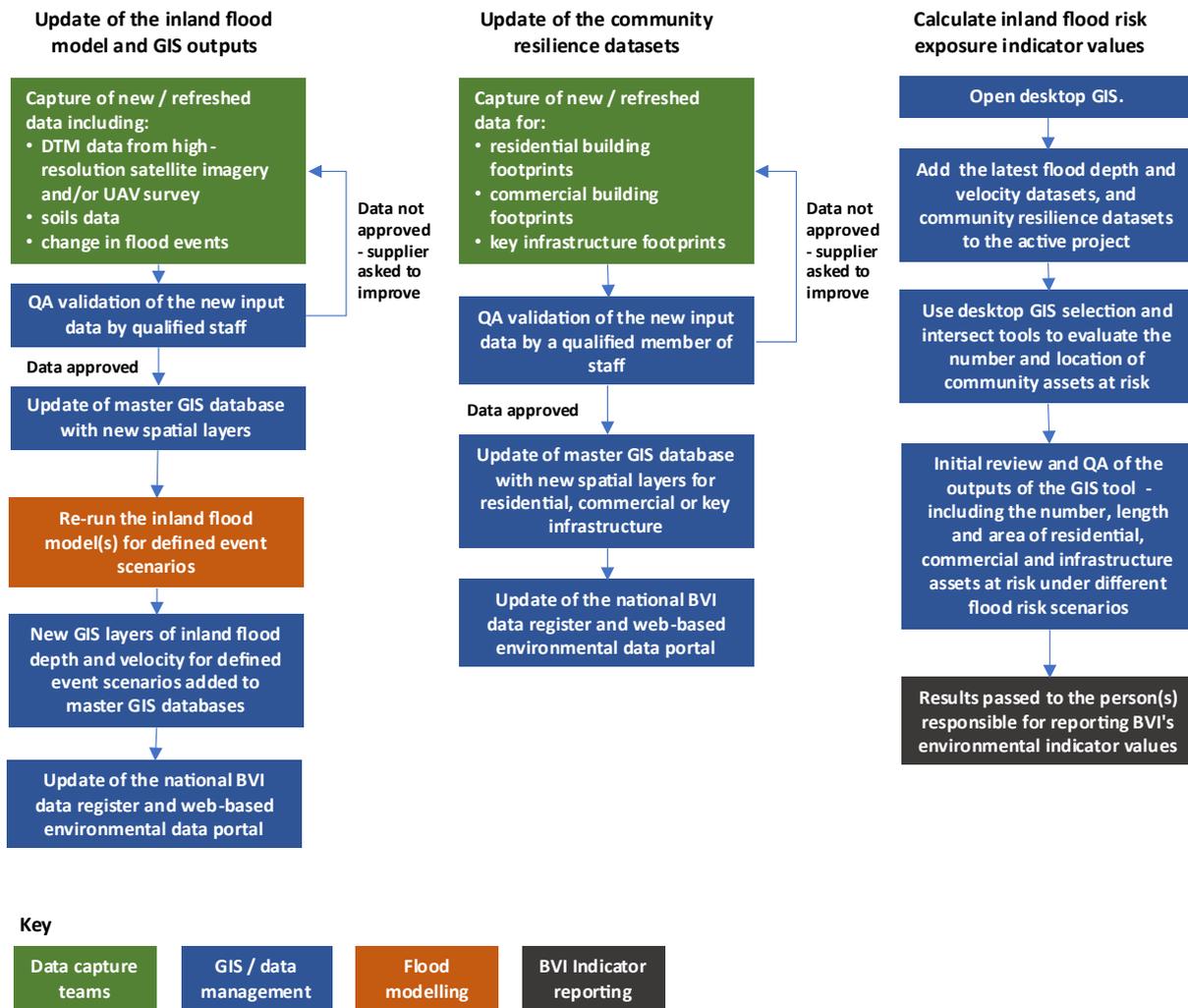
Figure 18. Communities' resilience to inland flooding workflow.

7.6.1. Summary

The workflow assumes that there is a baseline dataset existing to compare to the changed state under consideration. It covers two main elements:

1. The actual collection of updated data and recording it in data registers and applying data management policies and recording metadata.

2. Computation of index dataset values.

Part of the processes involves a key element of quality assurance to ensure that the right processes were carried out to produce the best possible quality data.

Community resilience is based on the ability of the structures to resist damage, especially in high frequency, low depth scenarios. This workflow does not consider intangible measures of resilience like community interconnectivity, or resource availability.

Additional information on structural damage functions or in-depth research on localised community damage functions would be useful and complimentary in indicating resilience in combination with the workflow defined.

7.7. Communities' resilience to coastal flooding

The workflow for the communities' resilience to coastal flooding is shown in Figure 19.

Update of the inland flood model and GIS outputs

Capture of new datasets including:
• Offshore bathymetry
• Changes in coastal flood storm events

Data not approved - supplier asked to improve

QA validation of the new input data by qualified staff

Data approved

Update of the master GIS database with new spatial layers

Re-run the coastal flood model(s) for defined event scenarios

New GIS layers of coastal flood depth and velocity for defined event scenarios added to master GIS databases

Update of the national BVI data register and web-based environmental data portal

Update of the community resilience datasets

Capture of new or altered data for:
• residential building footprints
• commercial building footprints
• key infrastructure footprints

Data not approved - supplier asked to improve

QA validation of the new input data by a qualified member of staff

Data approved

Update of the master GIS database with new spatial layers for residential, commercial or key infrastructure

Update of the national BVI data register and web-based environmental data portal

Calculate inland flood risk exposure indicator values

Open desktop GIS.

Add the latest flood depth and velocity; and the community resilience datasets to the active project

Use desktop GIS selection and intersect tools to evaluate the number and location of community assets at risk

Initial review and QA of the outputs of the GIS tool - including the number, length and area of residential, commercial and infrastructure assets at risk under different flood risk scenarios

Results passed to the person(s) responsible for reporting BVI's environmental indicator values

Key

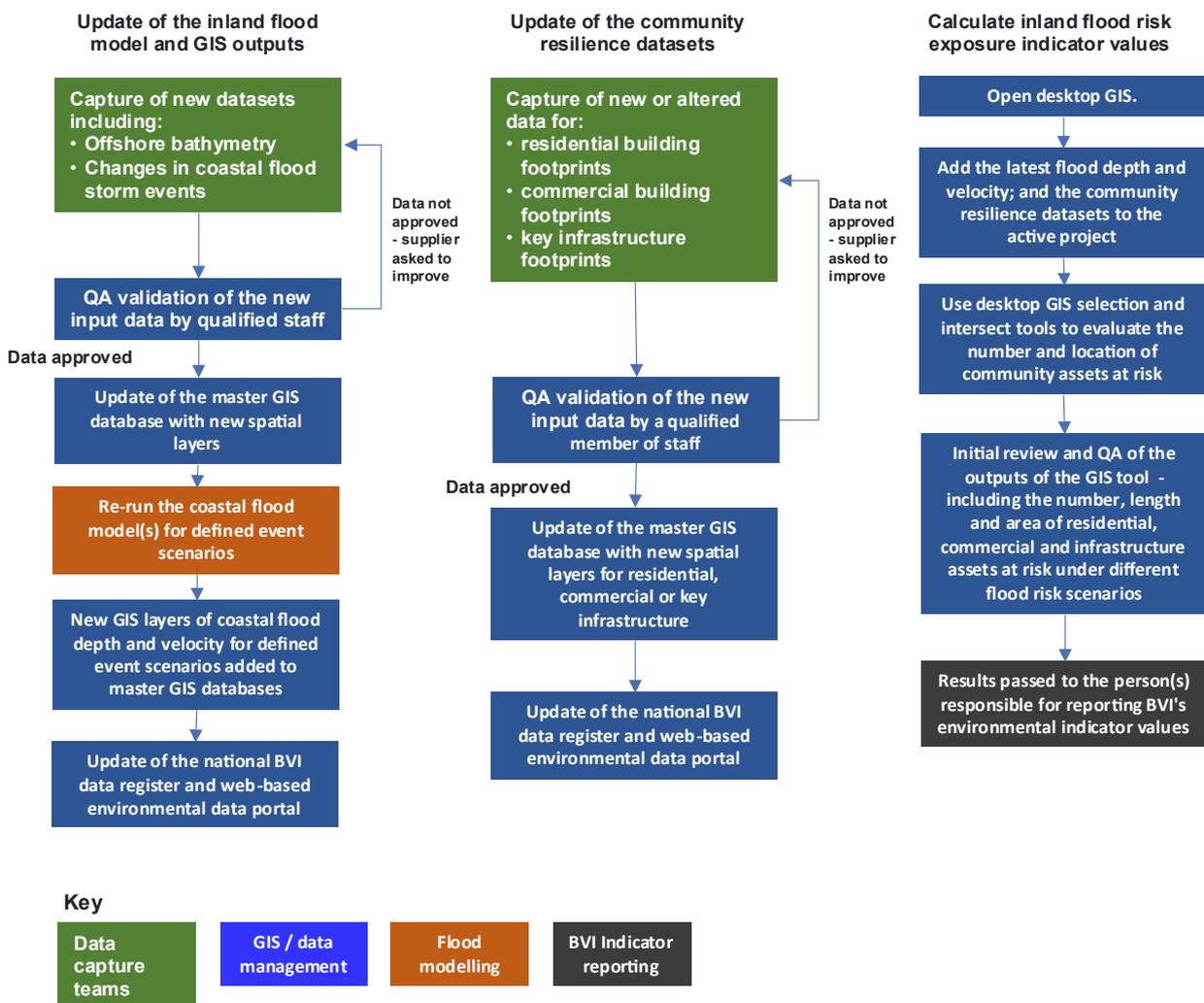| Data capture teams | GIS / data management | Flood modelling | BVI Indicator reporting |

Figure 19. Communities' resilience to coastal flooding workflow.

7.7.1. Summary

The workflow assumes that there is a baseline dataset existing to compare to the changed state under consideration. It covers two main elements:

1. The actual collection of updated data and recording it in data registers and applying data management policies and recording metadata.

2. Computation of index dataset values.

Part of the processes involves a key element of quality assurance to ensure that the right processes were carried out to produce the best possible quality data.

Community resilience is based on the ability of the structures to resist damage, especially in high-frequency, low-depth scenarios. This workflow does not consider intangible measures of resilience like community interconnectivity, or resource availability.

Additional information on structural damage functions or in-depth research on localised community damage functions *(damage vs depth)* would be useful and complimentary in indicating resilience in combination with the workflow defined.

In the coastal context, research into the extent of high velocity wave impact zones would be useful in refining the damage.

7.8. Communities' resilience to coastal erosion

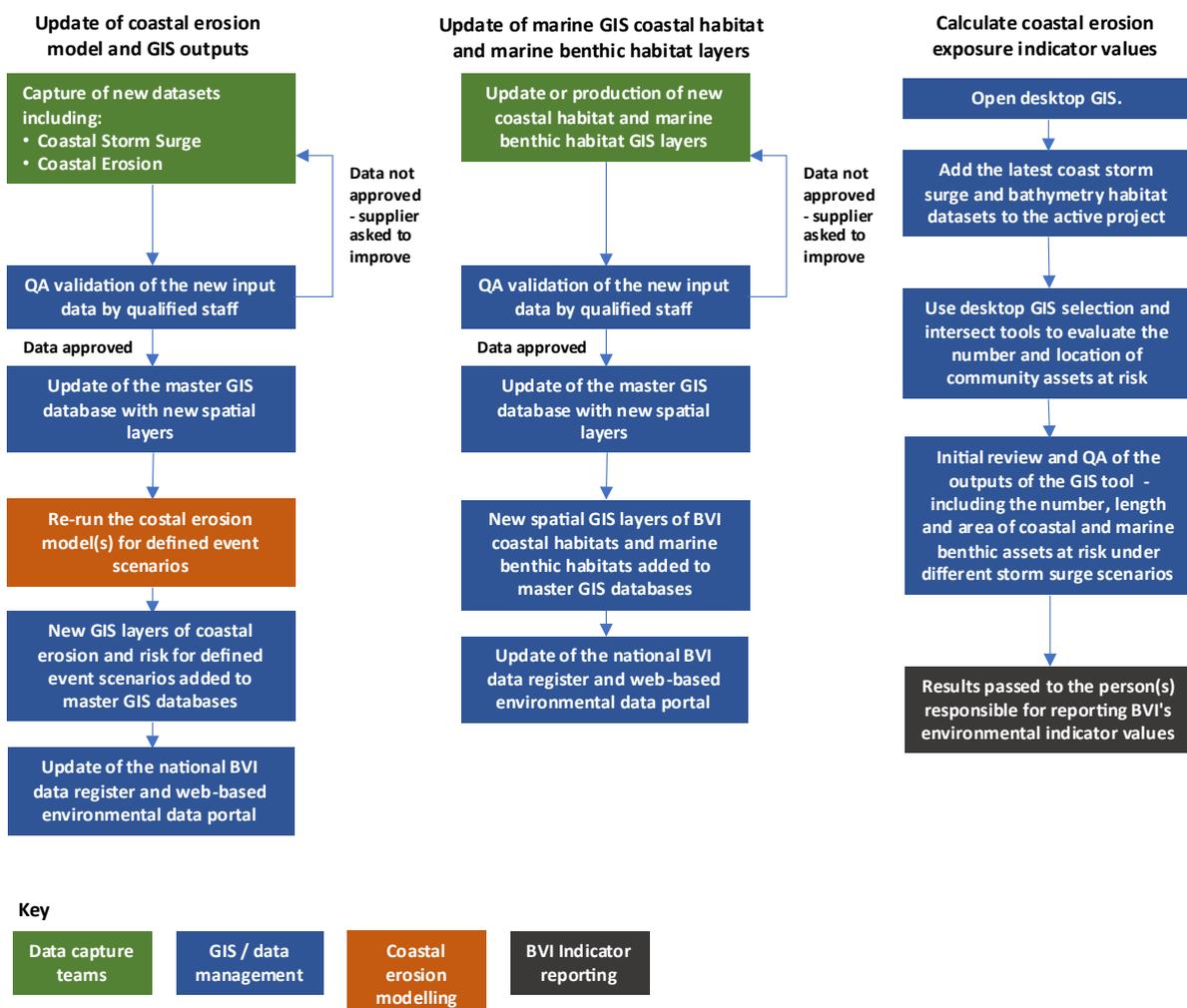The workflow for the communities' resilience to coastal erosion is shown in Figure 20.

Figure 20. Communities' resilience to coastal erosion workflow.

7.8.1. Summary

The workflow assumes that there is a baseline dataset existing to compare to the changed state under consideration. It covers two main elements:

1. The actual collection of updated data and recording it in data registers and applying data management policies and recording metadata.

2. Computation of index dataset values.

Part of the processes involves a key element of quality assurance to ensure that the right processes were carried out to produce the best possible quality data.

Community resilience is based on the ability of the structures to resist damage, especially in high-frequency, wind speed scenarios. This workflow does not consider intangible measures of resilience like community interconnectivity, or resource availability.

Additional information on structural damage functions (damage versus wind speed) or in-depth research on localised community damage functions would be useful and complimentary in indicating resilience in combination with the workflow defined.

7.9. Communities' resilience to wind damage

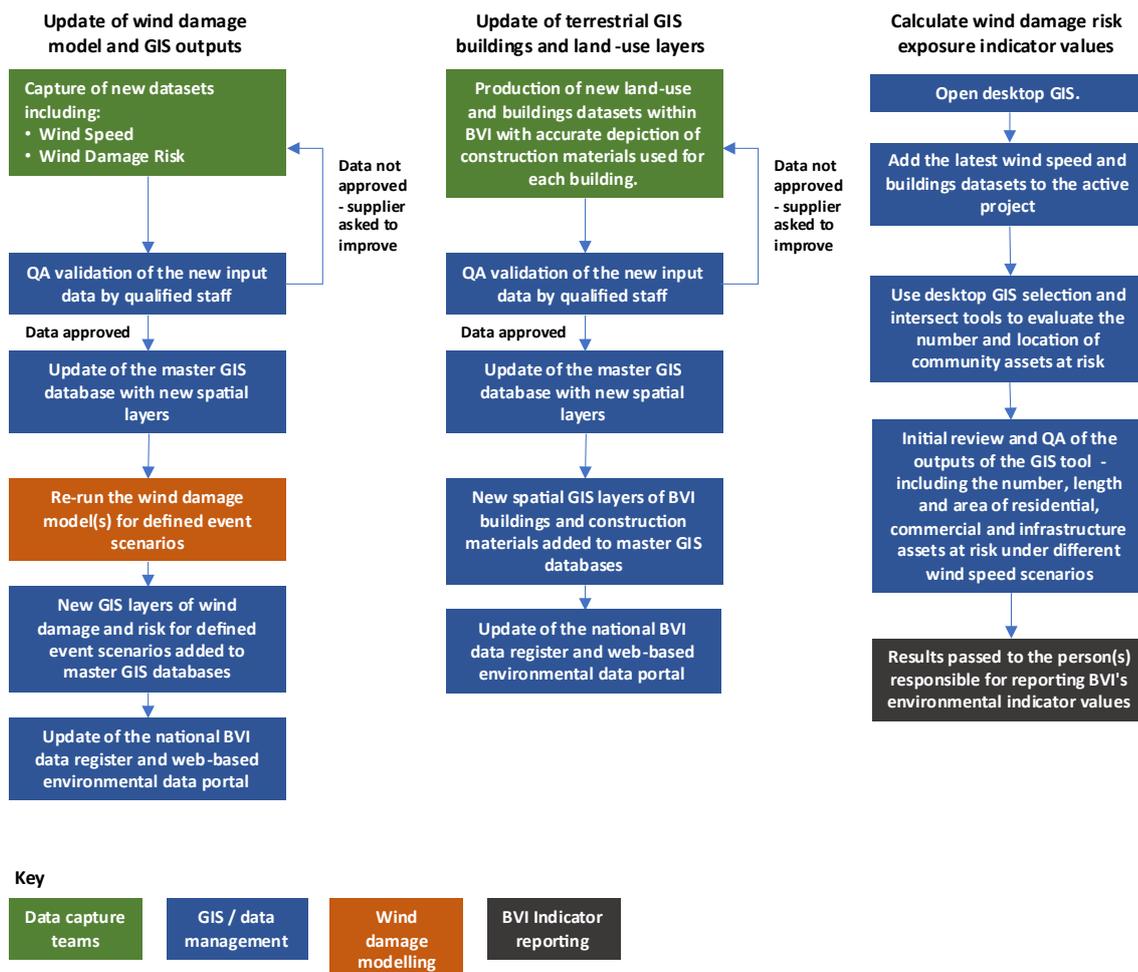The workflow for the communities' resilience to wind damage is shown in Figure 21.

Figure 21. Communities' resilience to wind damage workflow.

7.9.1. Summary

The workflow covers two main elements:

1. The actual collection of data and recording it in data registers and applying data management policies and recording metadata.

2. Computation of index dataset values.

Part of both processes involves a key element of quality assurance to ensure that the right processes were carried out to produce the best possible quality data.

Coastal erosion can be considered like *Coastal profile depth* calculated in Section 7.4. The change in depth can be considered as a difference between the baseline surface and the new coastal topography referred to as 'cut and fill'. The area of the change '*cut'*, is the **erosion area**. If there is '*fill'*, there is accretion and cannot be used in this indicator. Once the erosion area is calculated, this is combined with the buildings dataset to select structures within a defined proximity to the erosion area.

7.10. Area of coral reef under direct restoration

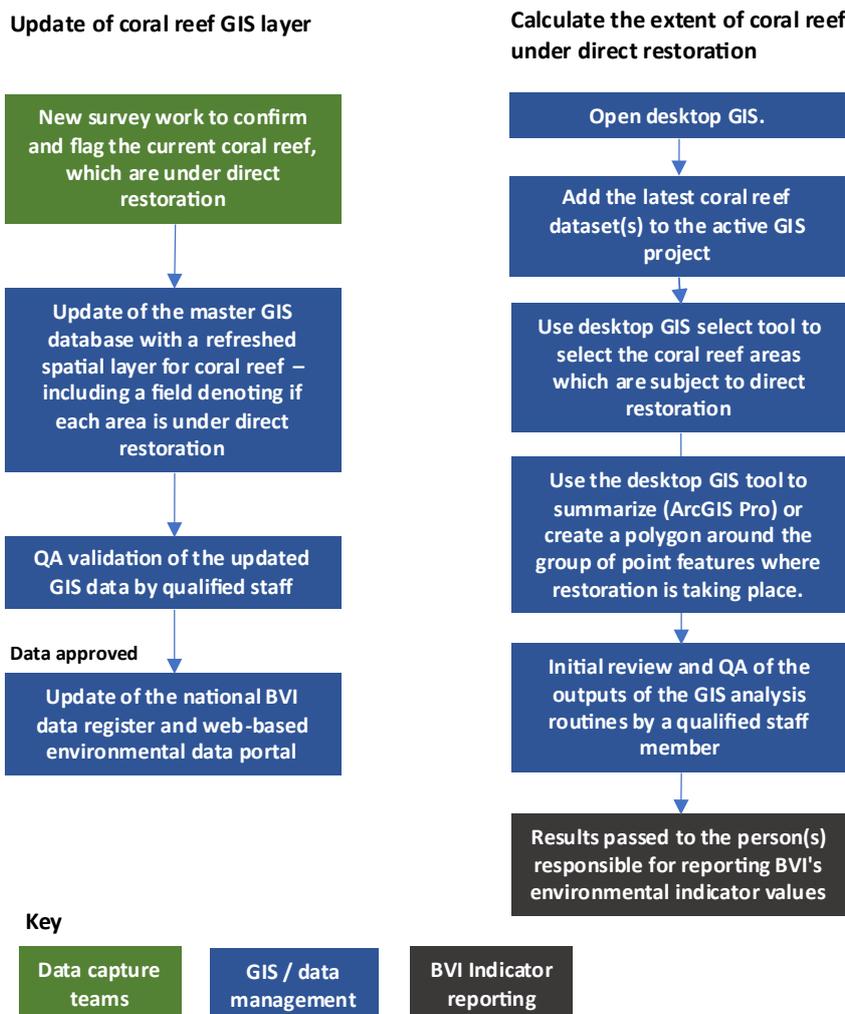The workflow for the area of coral reef under direct restoration is shown in Figure 22.

Update of coral reef GIS layer

Calculate the extent of coral reef under direct restoration

```
New survey work to confirm
and flag the current coral reef,
which are under direct
restoration
        │
        ▼
Update of the master GIS
database with a refreshed
spatial layer for coral reef –
including a field denoting if
each area is under direct
restoration
        │
        ▼
QA validation of the updated
GIS data by qualified staff
        │
Data approved
        ▼
Update of the national BVI
data register and web-based
environmental data portal
```

```
Open desktop GIS.
        │
        ▼
Add the latest coral reef
dataset(s) to the active GIS
project
        │
        ▼
Use desktop GIS select tool to
select the coral reef areas
which are subject to direct
restoration
        │
        ▼
Use the desktop GIS tool to
summarize (ArcGIS Pro) or
create a polygon around the
group of point features where
restoration is taking place.
        │
        ▼
Initial review and QA of the
outputs of the GIS analysis
routines by a qualified staff
member
        │
        ▼
Results passed to the person(s)
responsible for reporting BVI's
environmental indicator values
```

Key

Data capture teams	GIS / data management	BVI Indicator reporting

Figure 22. Area of coral reef under direct restoration workflow.
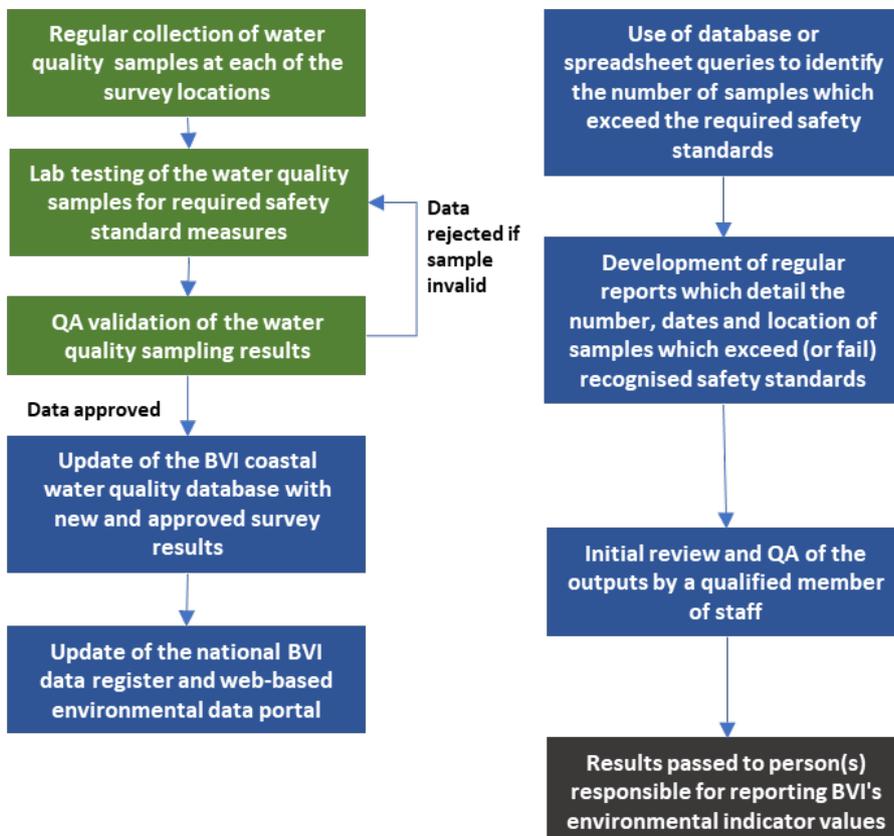
7.10.1. Summary

The workflow assumes that there is a baseline dataset existing to compare to the changed state under consideration. It covers two main elements:

1. The actual collection of updated data and recording it in data registers and applying data management policies and recording metadata.

2. Computation of index dataset values

Part of the processes involves a key element of quality assurance to ensure that the right processes were carried out to produce the best possible quality data.

The area of coral reef under direct restoration is based on a summary of the extent of work being carried out to restore coral reefs. This data may be collected as point datasets and an enclosing polygon used to define a restoration area. This restoration area cannot intersect with the coastline or have a disproportionately sparse distribution of points over a large area. This will be quite a subjective element and should be consistent across various iterations of the computation of the indicator.

7.11. Number of days water quality at beaches exceed safety standards.

The workflow for beach water quality is shown in Figure 23.

Figure 23. Beach water quality workflow.

7.11.1. Summary

The workflow assumes that there is a baseline dataset existing to compare to the changed state under consideration. It covers two main elements:

1. The actual collection of updated data and recording it in data registers and applying data management policies and recording metadata.

2. Computation of index dataset values.

Part of the processes involves a key element of quality assurance to ensure that the right processes were carried out to produce the best possible quality data.

The indicator workflow can be split into the evaluation of the number of samples which exceed the safety standard, then the count of the days these samples cover.

8. Recommendations and next steps

The following section outlines the challenges and limitations in the current environmental data governance and provides recommendations on how these may be managed.

1. The data hub developed in this project covers environmental datasets only, and a subset of them. There are likely to be other fundamental national datasets covering infrastructure, aerial photography, and security, for example. The infrastructure, guidance and protocols developed to help manage this data can be extended to national datasets of other nature, adapted, and eventually formally adopted. As there is a regularly meeting and well-functioning National GIS Committee, this can be used to build consensus on protocol adoption, changes, and extension of protocols to national scale. The NGIS Committee is an excellent tool for stakeholders to take ownership of the data hub and protocols. We suggest developing a program to review protocols – using analysis tools such as Strengths Weakness Opportunities and Threats (SWOT) or Political, Economic, Sociological, Technological, Legal and Environmental (PESTLE) analysis, and evaluating their success, efficacy and effectiveness at least annually.

2. The data register is the only element of the data hub which is publicly available. There needs to be an automated method to update this register based on the datasets held in the data hub. This is important to manage versioning of the register, less error in updates, and to ensure that the register version is authoritative whenever it is accessed, and users can rely on what it says. We recommend the development of a custom tool to automate the updating of the data register and linking to a notification system for stakeholders to be made aware of new datasets.

3. Utilise the web-enabled environment to integrate the Hazard and Climate Vulnerability and the upcoming Marine Spatial Planning tools into the web platform to provide a centralised place for physical planning and environmental decision making.

4. Stakeholders **must** insist that consultants, NGOs, and in fact all parties who create data, use the protocols to provide metadata with their data deliverables, and maintain the data catalogue with each new dataset and value-added dataset. This can be integrated into a data policy to support compliance.

5. Metadata will be everyone's responsibility. New key data or existing data which you significantly change the value should be added to the data register and the data hub.

6. Currently, the administration of the NGIS platform sits with Town and Country Planning Department. This management structure creates a vulnerability with a single individual. If that individual, is no longer able to carry out those duties due to illness or change in career, it may leave a gap to be filled. Extending this responsibility to individuals in other departments, such as the Ministry of Natural Resources & Labour, the Department of Disaster Management, and National Parks Trust of the Virgin Islands, would provide more resilience.

7. A clear data sharing policy and data licence is key to driving more open data. We have included a draft template of possible text which may be useful as a starting point for developing a data sharing agreement in Appendix 4.

Appendix 1: Updating ESRI metadata

The following section outlines the processes required to create metadata for each dataset involved in this project. The only mandatory entries required are all mentioned in this guide and any additional information filled in is either optional, for example if there is already existing metadata, or is not required to be filled in.

Step 1: Selecting the metadata style. The first step in this process is the selection of the metadata format to be used. This process is illustrated in Figure 24.
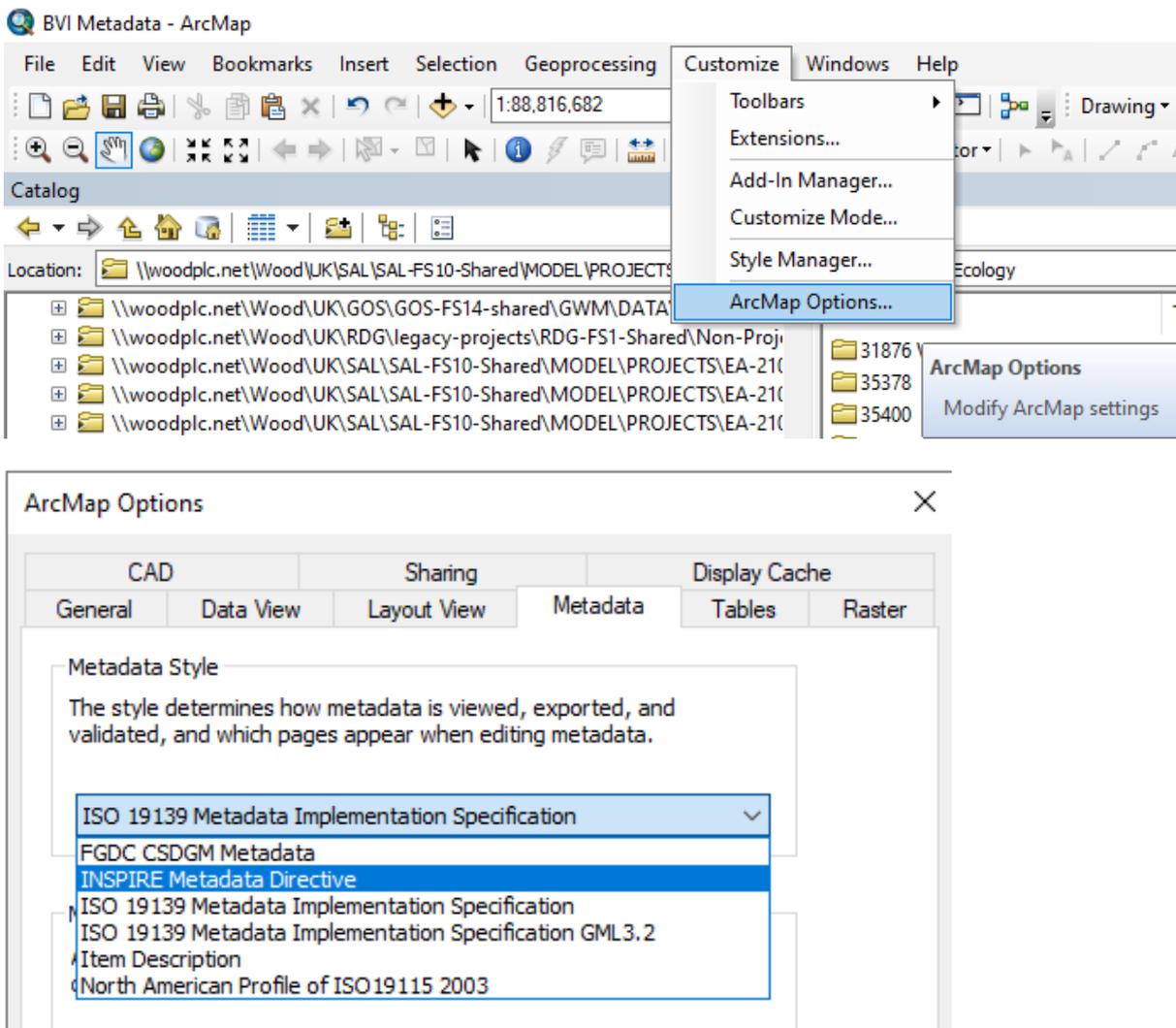
Figure 24. Selecting the metadata style under ArcMap options.

Step 2: Navigate to the dataset you want to edit the metadata of and select 'Item Description' (see Figure 25).
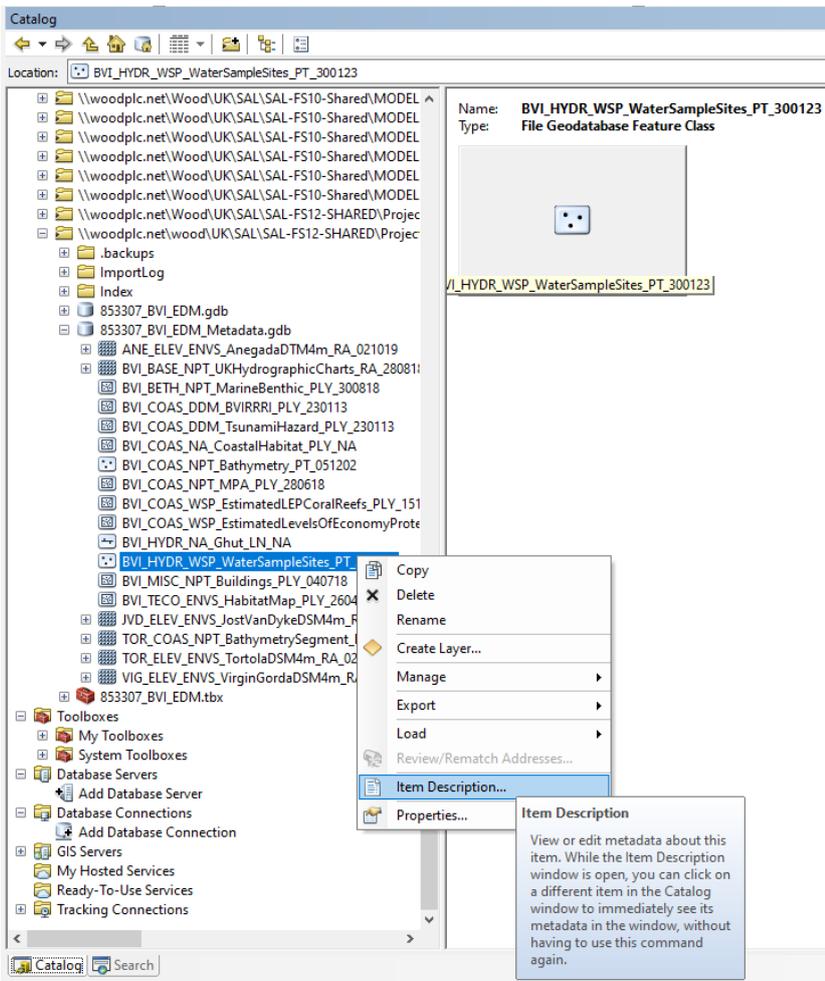
Figure 25. Location of Item Description.

Step 3: In the pop-up window that appears select the 'Edit' button to begin editing the metadata (see Figure 26).

Figure 26. Editing metadata.

Step 4: As shown in Figure 27, the data can now be edited with a variety of sections to complete in the lefthand column that features Overview, Metadata and Resource sections. In the 'Overview' section, only the 'Item Description' section has mandatory attributes that must be completed.
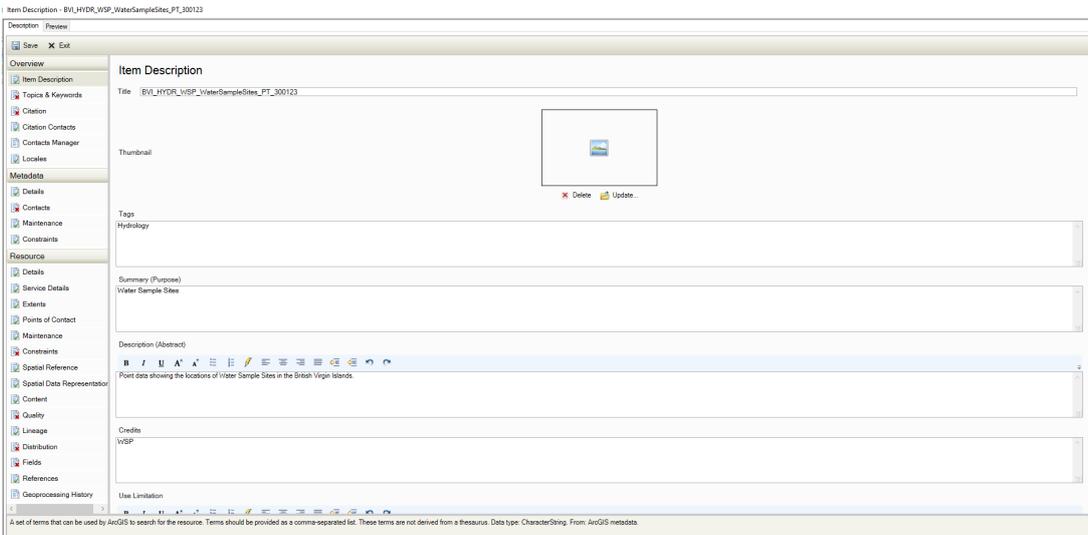
Figure 27. Item description.

Step 5: Within the Item Description Section (see Figure 28), make sure to include at least one appropriate '**Tag**' and fill in the '**Summary**' with the purpose of the dataset. Provide a more expanded '**Description**' detailing the type of data it is, where the dataset is based, its purpose and when it was last updated. Make sure to include '**Credits**' highlighting the source of the data and any 'Use **Limitations**' that may apply to the data, for example whether the data will be available for public or private use. Your dataset may or may not come with a 'Bounding Box' already filled in, but this data is superfluous to requirements, so is not necessary to complete if it isn't present.
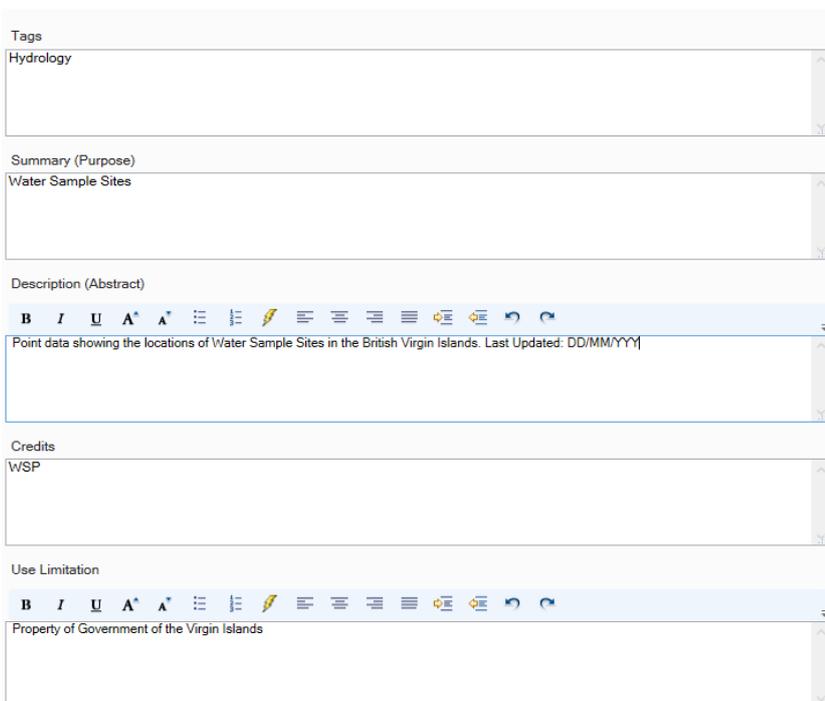
Figure 28. Completing the Item Description section.

Step 6: Within the 'Metadata' section, you will only need to complete the subsections '**Contacts**' and 'Maintenance'. In the '**Contacts**' section you will need to add a contact, including contact details, for the organisation responsible for the dataset. If you have not done this before, you will need to select the 'New Contact' option to create contact details. An example of what details are required when creating a contact is included in Figure 29.
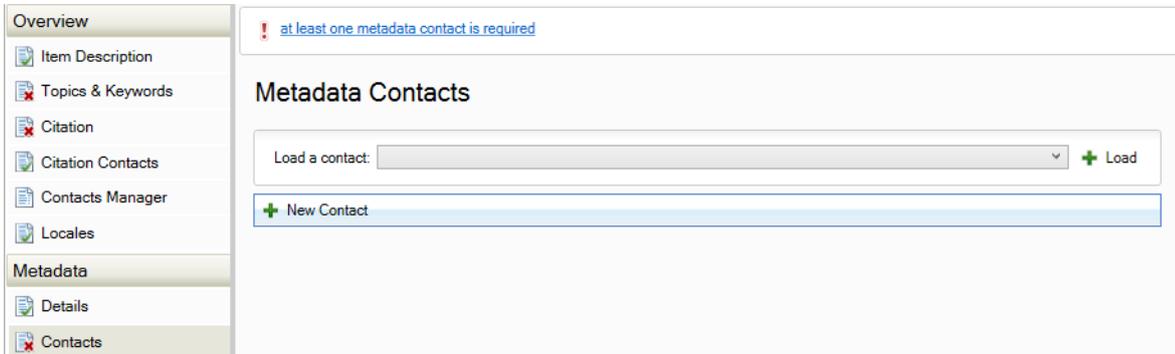
Figure 29. Contacts under Metadata.

Step 7 The process for completion of the 'metadata contacts' section is shown below in Figure 30.
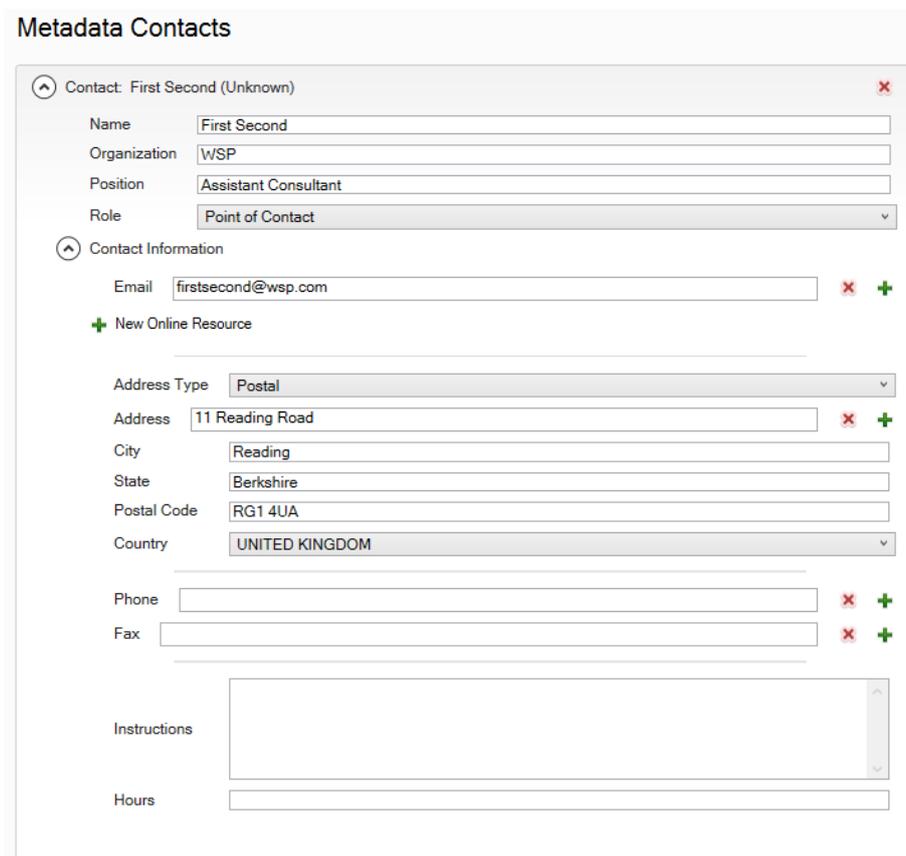
Figure 30. Completion of the 'metadata contacts' section.

Step 8: In the 'Maintenance' section, you will only need to select an appropriate option for how often the metadata for the dataset will be updated and load your previously created contact into this section as well. Should the data be obtained externally, check to see if the item description provides details on how frequently the data is updated, please note that such information is not always given. This process is illustrated below in Figure 31.
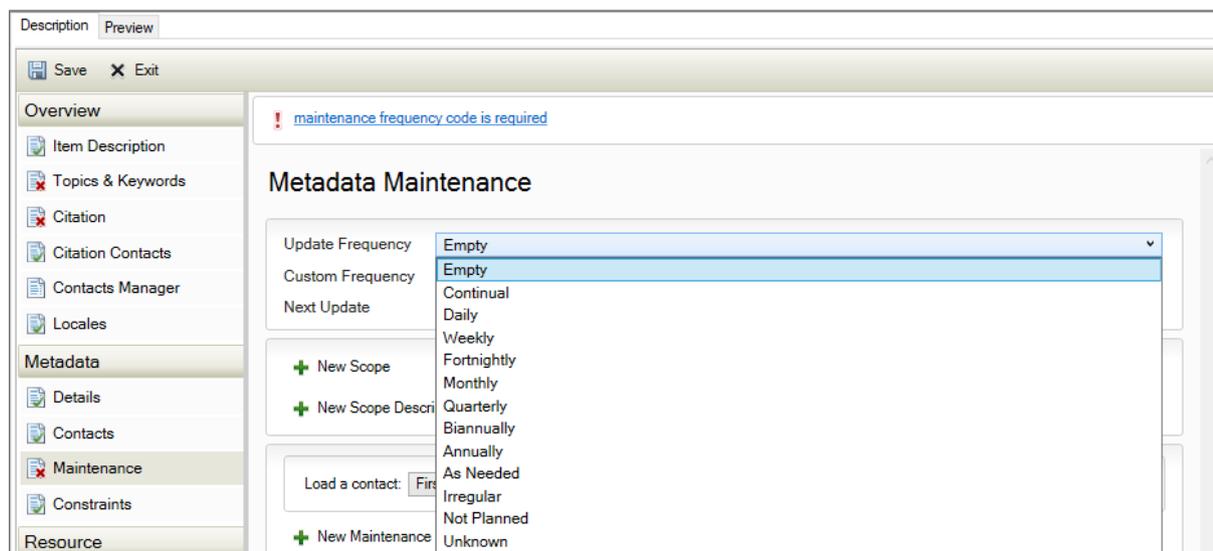
Figure 31. Update frequency under Metadata Maintenance.

Step 9: In the Resource section, you will need to fill out several sections: 'Details', 'Points of Contact', 'Maintenance', 'Spatial Reference', 'Lineage' and 'Fields'. Firstly, in the 'Details' section you will need to again fill in the 'Credits' box with the same details from Step 6. All other information in this section is optional to complete or can be left blank. This process is shown below in Figure 32.
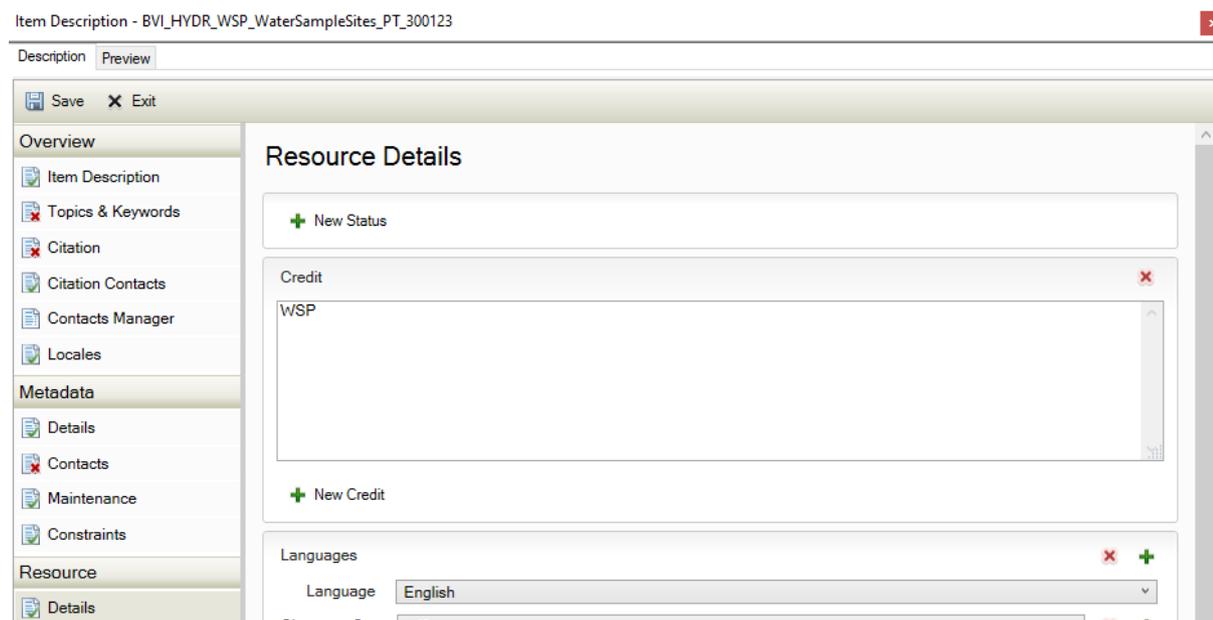
Figure 32. Resource Details.

Step 10: For 'Points of Contact', like Step 7, you should also provide contact details, as shown in Figure 33. However, this time, the contact details listed should be for the person or organisation that created the dataset. This will need to either be loaded in or created from scratch if the contact has not been used previously. Generally, this information from the website you obtained the data from. If no point of contact is provided, use the general contact details of the source's webpage.
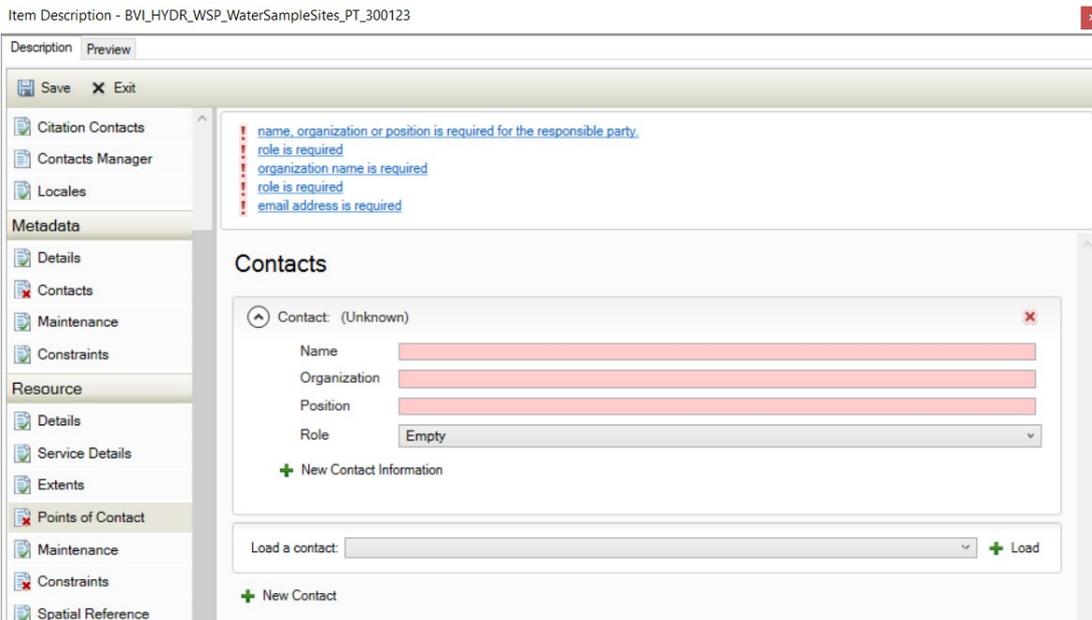
Figure 33. Points of Contact under Resource.

Step 11: In the 'Spatial Reference' section, if the coordinate reference system (CRS) for the dataset is not automatically applied here, you will need to select 'New Reference System' and enter the details for the CRS that the dataset uses. All digital data recorded, presented or communicated must have the capture date, units, datum/projection and conventions clearly stated in all outputs within the layer's metadata. This process is illustrated in Figure 34.
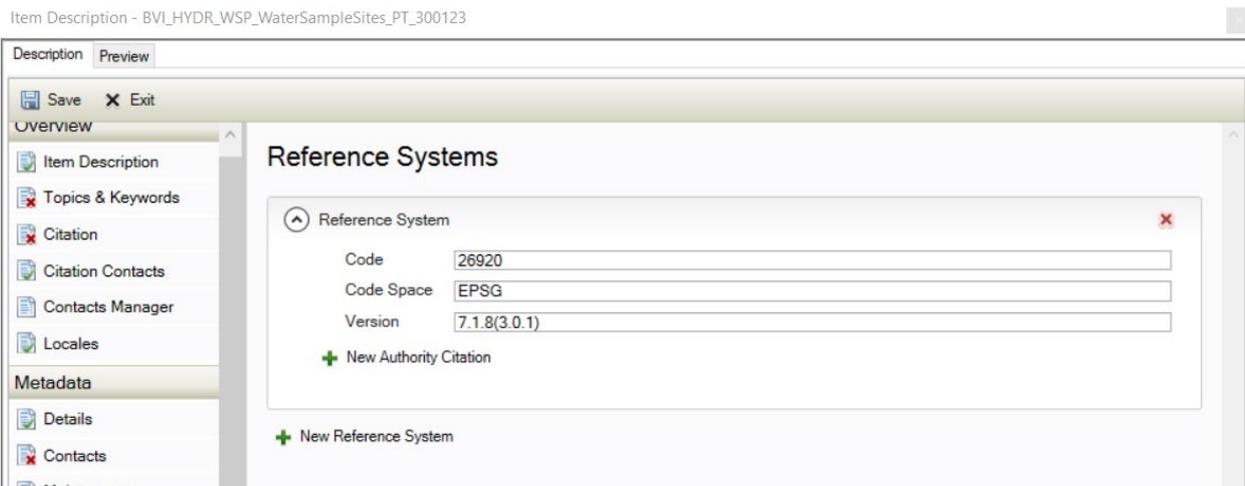
Figure 34. Reference Systems.

Step 12: In the 'Lineage' section, you will need to describe the processing steps involved in the creation of the dataset. This includes what source the dataset is derived from, when the data was altered for the purposes of the project (i.e. if the data got clipped to a site boundary, specify when this occurred), last revision date and originator. This process is illustrated in Figure 35.
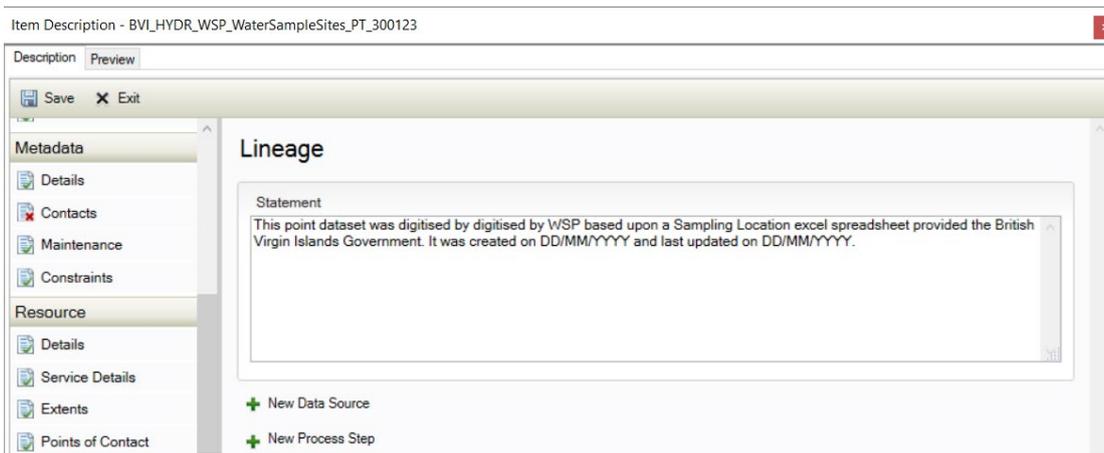
Figure 35. Completion of lineage metadata.

Step 13: The '**Fields**' section is not mandatory but recommended that it be completed. To complete the '**Fields**' section, if the dataset already has existing information for the dataset's fields, you will need to remove any information relating to fields that have been removed from the dataset.

It is important to note, that the only fields that are usually required within a dataset, will be the 'OBJECTID', symbology or labelling related fields, and the mandatory fields specified in Section 4. All other existing fields in a dataset are optional to maintain if they are considered important but will also need to be entered as an 'Attribute', if not already, when filling in this section.

The mandatory sections of each attribute that need to be completed in this section are the 'Label', 'Alias', 'Definition', 'Definition Source', 'Type', and 'Width'. The label is simply the name of the attribute, and the alias is usually the same as the label but occasionally may be different and need to be reflected as such in this section. The definition is the description of the type of attribute that is present, in this case the 'OBJECTID' which definition is 'Internal feature number', this definition has a source as it has been taken from ESRI, but it is possible that some attributes you create will have no set definition or source, so you will need to provide these yourself. The 'Type' in this case is 'OID', but it could be 'Text', 'Numeric', 'Float', 'Double', etc., and refers to the type of attribute that is present. The 'Width' simply refers to the character limit of the attribute.

Figure 36 illustrates the structure of this metadata element.
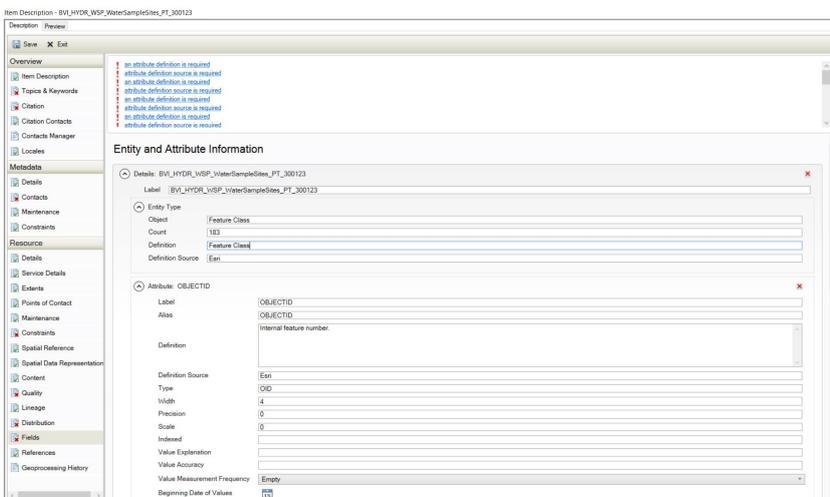
Figure 36. 'Fields' sub-section under Resource.

Appendix 2: Quick reference updating data register using data lists and controlled domains

The data register (see Figure 37) is a place for any digitised or acquired data to be registered that is used in the project, this is mandatory.

Figure 37. Data register.

The first tab relates to all the fields that need to be completed for each dataset to be properly registered and the second tab, 'Domains', contains the information this first page calls from to create the drop-down boxes.

Controlled domains (see Figure 38) are used to create dropdown boxes to fill in fields in the data register quickly and whenever there is a dataset that features information that a controlled domain field doesn't have existing information for, you can add that information to the respective domain at the bottom of the list.

Figure 38. Controlled domains.

Firstly, select and empty field and the drop-down box arrow should appear, then you will need to categorise your data into a particular theme that is suitable, for example, a habitat map would be categorised into the Terrestrial ecology theme (see Figure 39).

Figure 39. Selecting a category.

Both the dataset itself and the file name in the data register need to be the same and contain: 'Site'_'Theme'_'Source Organisation'_'Dataset Name'_'Date Last Downloaded' (see Figure 40).

Figure 40. File naming.

The 'Description' needs to be manually filled and contain information relating to the dataset itself and what it shows, how it was created and any specific relevant information to its symbolisation (see Figure 41).
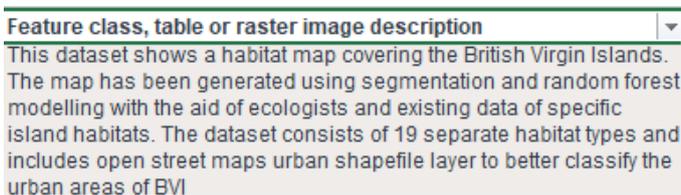

Figure 41. Description.

The 'Data Owner' field has a controlled domain (see Figure 42). You should select the owner of data you are using from the drop-down box. If the data owner is not in the drop-down box, it will need to be added to the list of data owners that the controlled domain sources its information from.

Figure 42. Data Owner.

The 'Contact Organisation' section (see Figure 43) is optional to complete dependant on whether the dataset has a contact available to fill, as not all datasets will have this information available, so it's not a mandatory field but should still be completed if you do have the information.

Figure 43. Contact Information.

The 'Producer' section should be completed with the name of the person who created the final dataset that needs to be registered, since not all datasets acquired remain in their original form, it is important to know the person who made any edits to it (see Figure 44).

Figure 44. Producer.

The 'Link to Source' section (see Figure 45) should either contain a direct web link to the source the data was acquired from or if the dataset was created internally, it should just contain the internal organisation's name.

Figure 45. Link to source.

The 'Source Format' section (see Figure 46) is a controlled domain field that should contain what format the data is in, so in this case it is a feature class, but could be in numerous different formats.
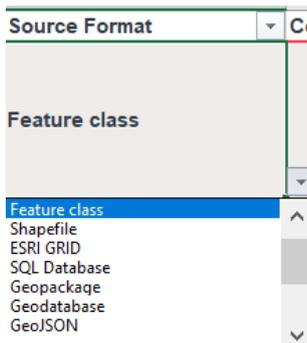
Figure 46. Source format.

The 'Coordinate System' section (see Figure 47) contains the final coordinate reference system that the data is presented in. It is also a controlled domain field so select the correct option from the drop-down box.
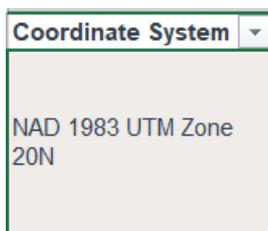

Figure 47. Coordinate system.

The 'Original Download Date' section (see Figure 48) should contain the date that the data was downloaded for the first time.
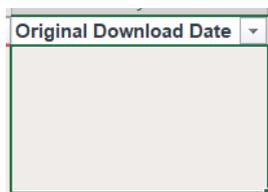

Figure 48. Original Download Date.

The 'Copyright Statement' section (see Figure 49) should contain any relevant copyright information that relates to the dataset, for example if it is publicly available it will likely not have this, but if the data has been purchased it is likely to come with information that needs to be filled in here.
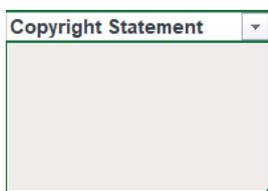

Figure 49. Copyright Statement.

The 'Licence [License] Restrictions' section (see Figure 50) comprises of information relating to restrictions that are placed upon the data in terms of licensing agreements from the purchase or source of data. Datasets will not always have licence restrictions, such as publicly available data.

Figure 50. Licence [License] Restrictions.

The 'Other Details' section (see Figure 51) is for any additional information you feel is necessary to provide to anyone accessing the data register about the dataset, which cannot be attributed to any of the prior sections.
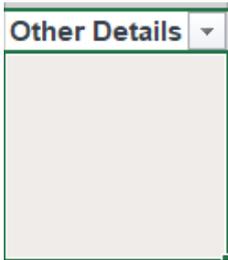

Figure 51. Other details.

Appendix 3: Publishing to the data hub

Before publishing the data to the portal, the layers need to be added and then prepared in ArcMap.

Firstly, the data needs to be added in the Arc Map document. This is done by creating a folder location to the geodatabase which contains the source information (see Figure 52).
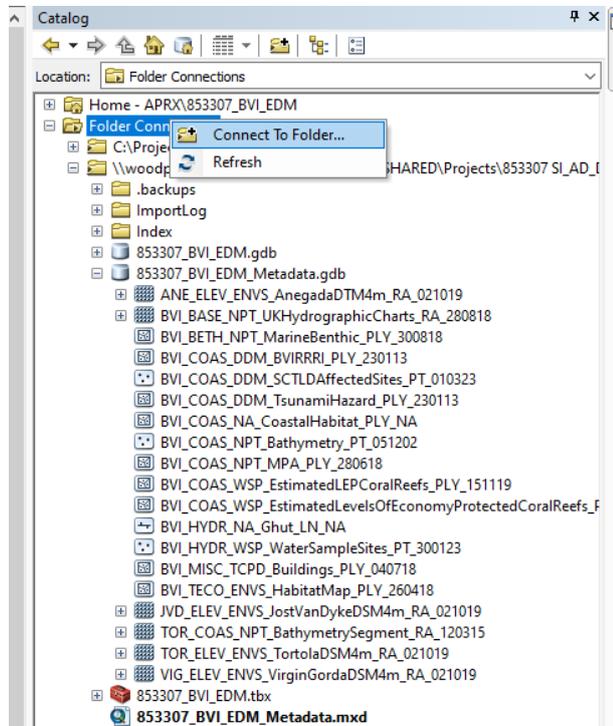

Figure 52. Prerequisite – Connecting to the geodatabase.

Navigate to the catalogue tab, (if it does not appear go to the *Windows* tab and select *Catalogue*). Right click on *Folder Connections* and then navigate to the folder containing the Geodatabase and click *okay*. The Geodatabase should now appear in the catalogue pane.

Within the catalogue pane expand the Geodatabase tab, you will then see all the layers saved within that Geodatabase. To add a table onto the map just click and drag it onto the map (see Figure 53).
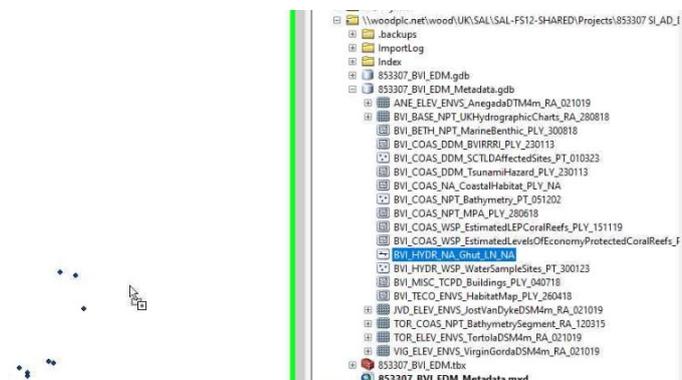

Figure 53. Adding data to map.

The layer should now appear on the map.

If the style of the layer needs to be changed this can be done by right clicking on the layer with the table of contents, then click the *properties* button and then navigate to the *Symbology* tab (see Figure 54).
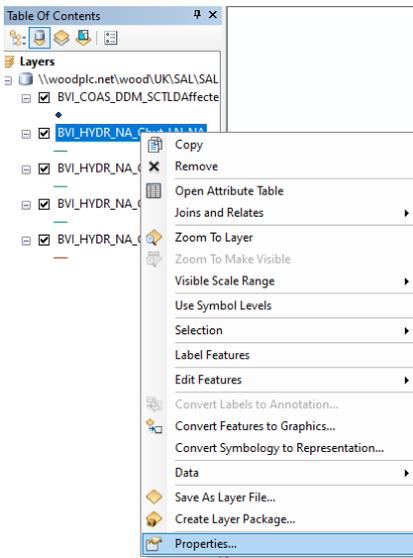

Figure 54. Change layer symbology (Part 1).

From this tab you can set how the layer will look (see Figure 55). *Single symbol* will set a universal style for the whole layer, while *Categories* will allow you to set styling using unique values in one field. Click the *Add all Values* or *Add Values* buttons to add values in.
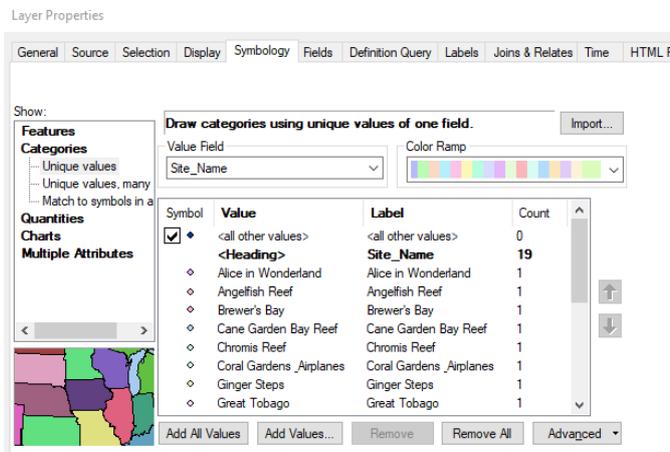

Figure 55. Change layer symbology (Part 2).

Before you can publish you need to add the portal connection, you can do this by starting ArcGIS administrator. Then select *Advanced* and then *Manage Portal Connections* (see Figure 56).
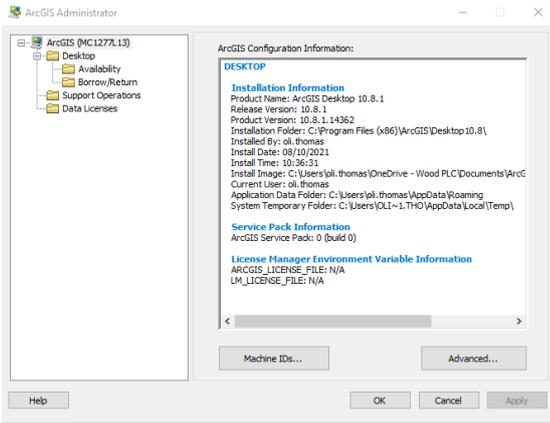
Figure 56. Connecting to ArcGIS Enterprise Portal (Part 1).

From the Manage Portal for ArcGIS Connections window click add, from here you can add the portal URL (https://www.bvimapping.gov.vg/portal/). You can then click connect to test the connection is valid (see Figure 57).
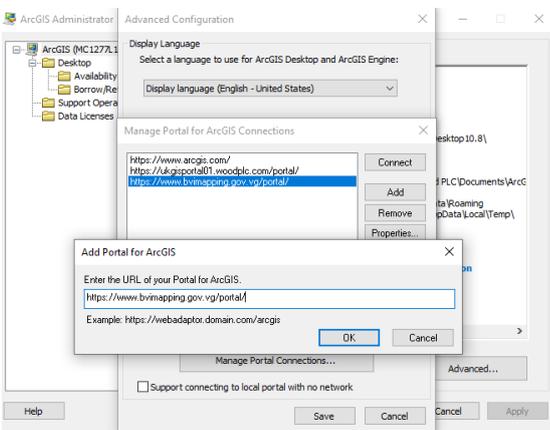

Figure 57. Connecting to ArcGIS Enterprise Portal (Part 2).

Now go back to ArcMap, click the *file* tab, and select Sign in (see Figure 58). You should not get a login page, use your ArcGIS enterprise login and password to connect. This will establish a connection between ArcMap and ArcGIS Enterprise Portal.
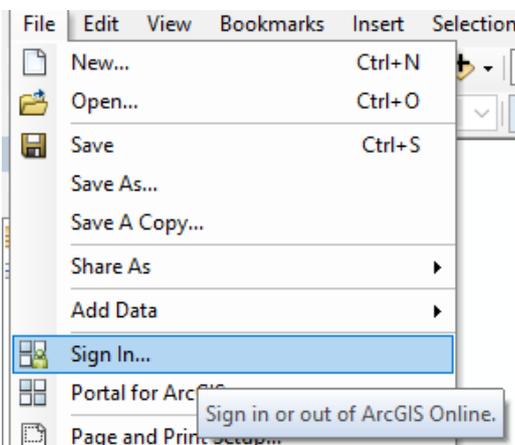

Figure 58. Connecting to ArcGIS Enterprise Portal (Part 3).

We are now in a position to publish the layer, go to *File, Share As*, *Service* and then *Publish a Service* and select next (see Figure 59).
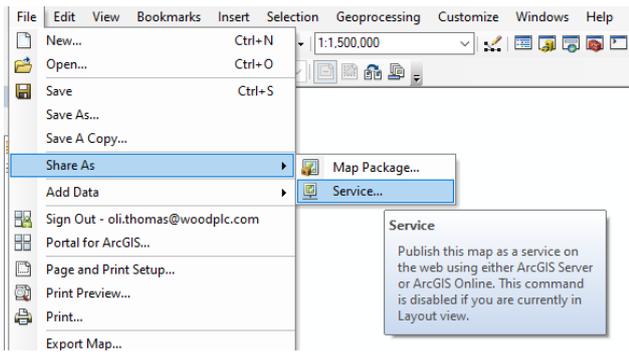
Figure 59. Publishing (Part 1).

Choose *My Hosted Service* from the *Choose a connection* drop-down menu (see Figure 60). Then type in a name for the service, this will not be the name the users see so the metadata naming convention should be followed. You can then click continue and this will take you through to the Service Editor page.

Figure 60. Publishing (Part 2).

Within the *Capabilities* and *Features Access* you can specify how you want the layer to be published and what operations you would like to allow on the layer (see Figure 61). A detailed breakdown of the differences is available from the ArcGIS website.

Figure 61. Publishing (Part 3).

Select *Item Description* and check that the metadata and tags are showing as you would expect

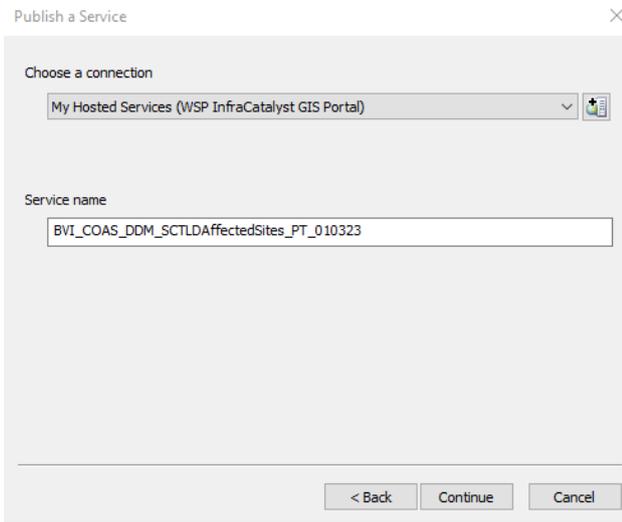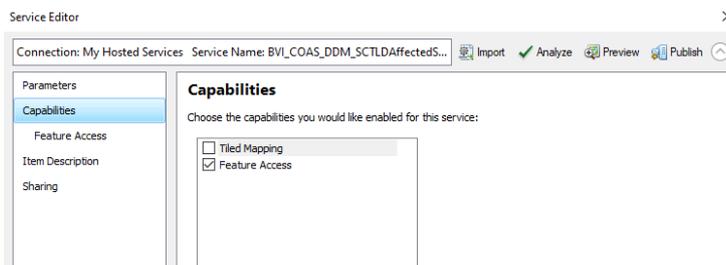Select sharing and share it with the project group (name of group unknown at time of writing) and also the project Catalogue Content group.

Before publishing it is worth first selecting *analyze*. This will check if there are any issues with upload and if so will list out ways of resolving them. If there are no issues you are then able to publish

Once published the web layer you can then open the enterprise portal itself. If you navigate to the *My Content* tab (see Figure 62) you should be able to see the layer that was just published.
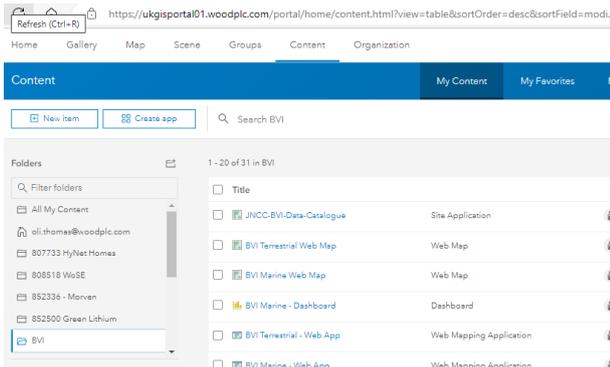
Figure 62. Navigating to published layer.

If you click on the layer just published the item page will show. At the top of the page you will be able to rename the layer, in order to give it a more user-friendly name (see Figure 63).
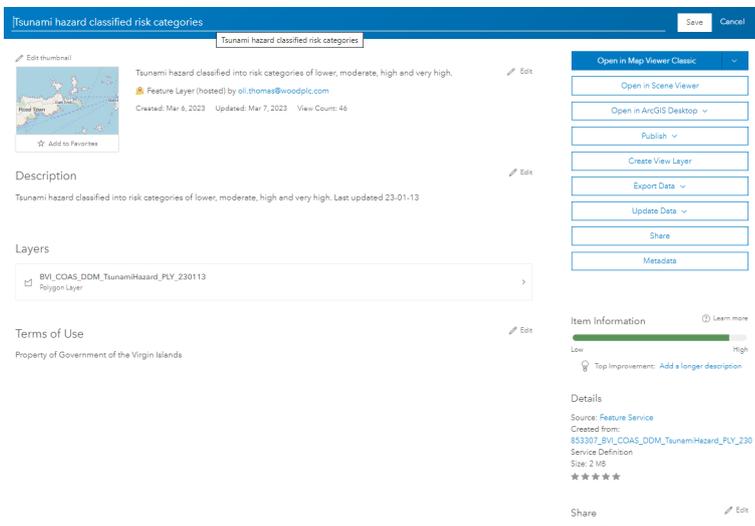
Figure 63. Renaming and quality checks.

On this item page you can check the spatial element of the data through the *Open In Map Viewer* button. You can check the data contained in the layer by going to the data tab.

The layer has been successfully published and we have checked the data.

Appendix 4: Draft data sharing agreement – Template

DATA SHARING AGREEMENT BETWEEN THE MINISTRY OF XXXXXX,

GOVERNMENT OF THE BRITISH VIRGIN ISLANDS

AND DATA REQUESTOR

This Data Sharing Agreement (hereinafter referred to as the "Agreement") is entered into on the XXXXX 2023 by and between:

(1) The Government of the British Virgin Islands, represented by the XXXX (the "Country")

And

(2) XXXXX (the "User"), a company organised under the laws of the XXXX with registered number XXXX and whose registered head office is XXXXX.

WHEREAS:

1. The Government of the British Virgin Islands has engaged **XXXXX** to provide consulting services for **XXXX** under the **XXXX Project**

2. The Government of the British Virgin Islands intends to release digital data to **XXXXX** for the specific tasks under this project. The requested datasets are as follows:

- **XXXXX**

3. **XXXXX** is to use this data exclusively for the purposes of fulfilling its obligations in line with the requirements of its contract.

Terms of Agreement

The **XXXX data** provided by **XXXXX** (hereinafter referred to as the Data provider) is provided by the Country are subject to the following conditions, restrictions and limitations:

A. Conditions and Restrictions for Data Provided

1. The data provided by the Country are solely for the User's internal use in the conduct of the services for which it is contracted.

2. None of the data provided may be reproduced or redistributed without the Country's prior written permission. This limitation, however, is not intended to restrict the User's distribution of printed map information created from the data.

3. Access to the data provided by the Country shall be exclusively for the User and employees of the User. The term "employee" shall mean any person directly employed on a full-time or part-time basis by the User. The term "employee" shall also be construed to mean any contractor, consultant or any similar person or entity hired by the User for a limited purpose.

4. The User shall require any third-party contractor hired to perform work that utilises the subject data to agree not to use, reproduce or redistribute the data for any purpose other than indicated in the applicable contract. All copies of the data used by a third-party contractor must be returned to the User upon contract work completion. The provisions of this paragraph shall apply in equal force to any independent contractor the User may choose to employ. The User shall provide any third-party contractor with a copy of this signed agreement.

B. Liabilities and Limitations for the Accuracy of Data Provided:

1. By signing this Agreement, the User shall become contractually bound to all provisions stated in this Agreement.

2. Although the *'Country'* has verified the digital data to the best of its ability, *the 'Country '*makes no representations of any kind as to its complete accuracy; nor does it guarantee the complete accuracy of any digital data furnished. *The 'Country'* additionally makes no warranty regarding fitness for purpose, nor is such warranty to be implied, with respect to the data provided under this Agreement.

3. The User is responsible for understanding the accuracy limitations of the data provided. In particular, alterations and/or manipulation of the original data may adversely affect their accuracy, meaning and design integrity.

4. To assist in the proper utilisation of the data, metadata files are provided, if available. The User, however, assumes all responsibility for the correct use of the data provided and for their interpretation.

5. The User agrees that the Country, their employees and agents will not be held liable for any damages resulting from any claim, suit or proceeding arising out of the use of the data in accordance with this agreement, including indemnification of the County and the State of Grenada for reasonable expenses incurred in defending such claims.

C. Production of Printed or Digital Maps/Reports/Publication Products Using the Data Provided

1. The User may reproduce the data in the form of printed products, provided the User abides by this agreement.

2. Any printed maps, reports or publications created using the data provided by the Country shall give credit to the Country by using the following statement/disclaimer:

"This [map/report/publication] was created using data provided by the Government of Grenada. This is a secondary product and has not been verified and is not sanctioned by Government of Grenada."

3. The User may not publish the data on any website without written permission from the Country.

D. Sharing of the Provided Digital Data with Other Persons or Entities

If at any time during the course of this Agreement, the User determines that it is necessary to share portions of the data with a person or entity not employed by the User as a consultant, contractor or any similar person or entity for a limited purpose, the User shall first request permission from the Country before sharing any portion of the data, unless otherwise committed by this Agreement or as required by law. Any such request shall be in writing to the Country and shall specify the persons or entities the User wishes to share the data with and the reasons why such sharing of the information is necessary. Permission for the User to share the data provided with other parties shall not be unreasonably withheld if such sharing of the information is necessary to further legitimate governmental purposes. Commercial or revenue-generating uses of the data shall not be considered a legitimate purpose.

The undersigned hereby accepts and agrees to be bound by the terms and conditions set forth in this agreement. It is fully understood that pursuant to this agreement, the undersigned is permitted to utilise digital information provided by the Government of the British Virgin Islands, solely for the purposes of fulfilling its obligations in line with the requirements of its contract. Any other use, unless with prior written permission from the Ministry of XXXX, shall be deemed unauthorised and punishable by law.

The Ministry of XXXXX makes no representations of any kind, including but not limited to, fitness for purpose, nor are any such warranty to be implied, with respect to data furnished hereunder. The Ministry of Agriculture and Lands, assumes no responsibility to maintain them in any manner or form.

I have the authority to legally obligate the User to the terms of this agreement.

NAME **TITLE**

SIGNED **DATE**

Countersigned by

NAME **TITLE**

SIGNED **DATE**

For further information please contact:
Joint Nature Conservation Committee
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Peterborough PE2 8YY
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facebook.com/JNCCUK

youtube.com/JNCC_UKvideo