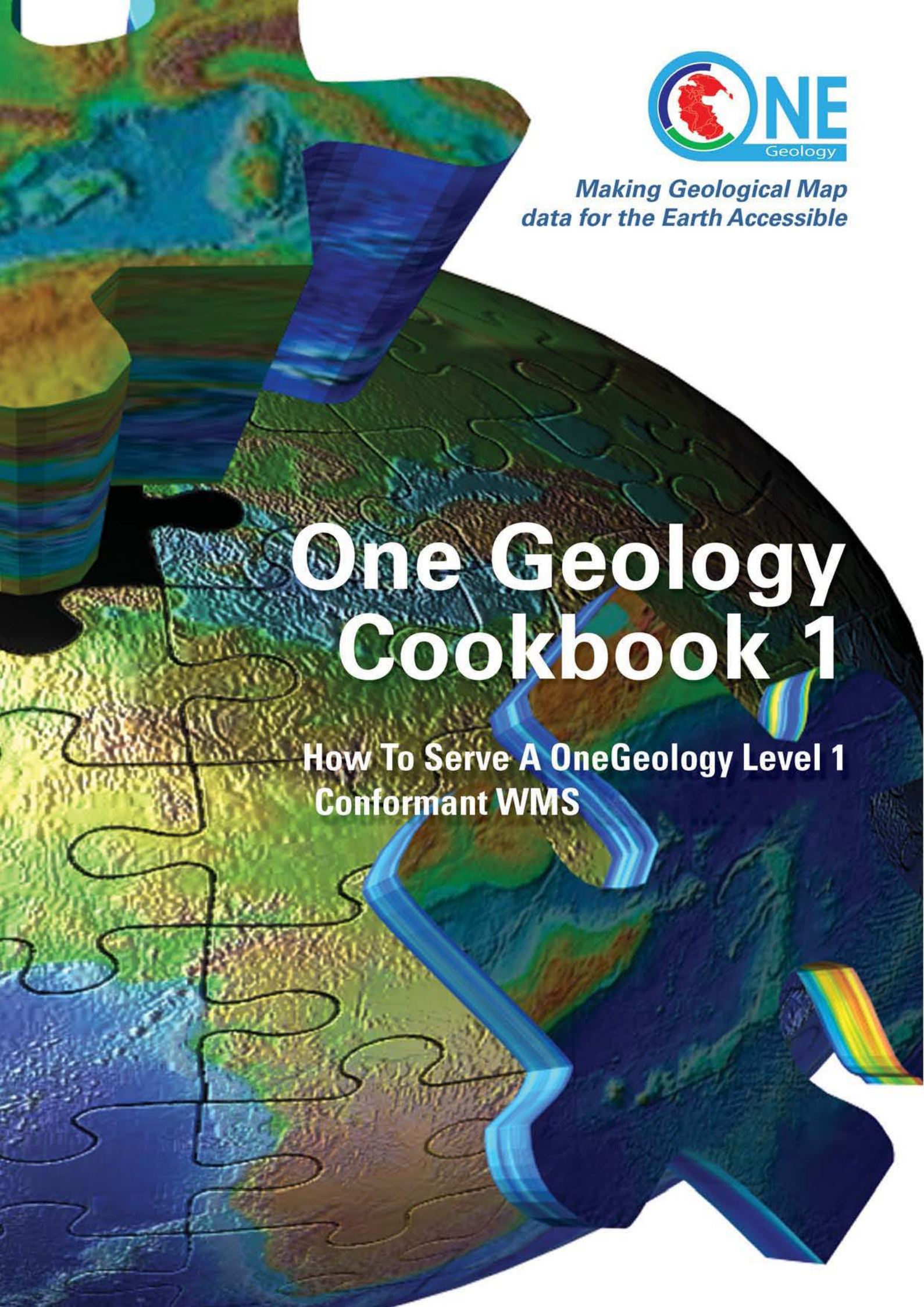

Making Geological Map data for the Earth Accessible

One Geology Cookbook 1

How To Serve A OneGeology Level 1 Conformant WMS

How to serve a OneGeology level 1 conformant Web Map Service (WMS) - Cookbook 1

PDF version of this OneGeology WMS cookbook

Summary of changes since last major update

- March 2016
- February 2016
- December 2015
- November 2015
- October 2015
- September 2014
- August 2013
- June 2013

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Appendices

Section last modified: 23 March 2016

1 Registering your WMS service with the OneGeology Portal registry

Before you can submit your service to OneGeology, you must first register your organization as a OneGeology data provider by filling out the registration form available from the OneGeology web site.

If you are willing and able to host your own data you will then need to fill in the Data Coordination form on the OneGeology website: http://www.onegeology.org/technical_progress/data_coordination.cfm

If you are unable to host your own data for any reason, then you will ALSO need to fill in the buddy form on the OneGeology website: http://www.onegeology.org/technical_progress/buddy_coordination.cfm

Next, send an email to onegeologyhelp@bgs.ac.uk with the URL of the proposed WMS service. Include in this email:

- The name of the geographical area
- the name of the data provider organization (usually this is the owner of the data)
- the name of the service provider organization

The OneGeology secretariat will check that they have written confirmation that the service provider owns the right to serve the proposed data and/or has permission from the data provider to serve that data.

You will be contacted by the OneGeology helpdesk with confirmation of receipt, plus any other feedback.

The service will then be reviewed for conformance with OneGeology requirements and, upon verification, the service URL will be forwarded to BRGM the (OneGeology Portal hosts) by the helpdesk team with a request to register the service in the OneGeology Portal and catalog (http://onegeology-catalog.brgm.fr/geonetwork/srv/en/main.home).

If BRGM have any technical issues with the proposed service they will raise these issues with the helpdesk, and the helpdesk will in turn discuss theses issues with the service provider, if required.

When the service is fit for registration BRGM will email the OneGeology secretariat, your OneGeology WMS Service will now be officially registered and its layers are now visible in the OneGeology Portal.

As the reference information stored in the OneGeology portal and catalogue comes from your service directly it is highly

recommended if you need to make major changes to information held in your WMS service, to modify your WMS service first and then ask the helpdesk to have your service updated.

If you have any queries please contact onegeologyhelp@bgs.ac.uk.

Section last modified: 13 Jan 2016

1.1 Background

The OneGeology project aims for a complete covering of the world with a target 1:1 000 000 geological map. Every country will display its own map series within the national or wider boundaries that it chooses. Further integration or international harmonization of the content is not included in the project at this stage. The maps are displayed as Web Services, so the service provider keeps full control of the national map, while it is still possible by calling all the web services to compose a full covering of the world.

These pages make up one of a series of "cookbooks" written to assist organizations contributing to OneGeology. This particular cookbook describes how to deliver images of geological maps over the Internet as an Open Geospatial Consortium (OGC) Web Mapping Service (WMS). See http://portal.opengeospatial.org/files/?artifact_id=1081&version=1&format=pdf for the WMS 1.1.1 standard and (http://portal.opengeospatial.org/files/index.php?artifact_id=14416) for the newer WMS 1.3.0/ISO standard that OneGeology currently supports.

This cookbook explains how to set up both version 1.1.1 and 1.3.0 Web Map Services simultaneously and with minimal extra effort for adding the support for a version 1.3.0 WMS service. The OneGeology Portal now supports version 1.3.0 as the default, i.e. where both versions are suppoprted 1.3.0 will be used. **Note**, version 1.3.0 is required for 3 star accreditation.

You will need to set up a WMS to conform to being a Level 1 participant in OneGeology. If you are already familiar with how to set up a WMS using software you already possess, you can read this guide (especially Section 2: WMS Profile) just to find out the standard requirements for a OneGeology conformant WMS. If you are unfamiliar with how to set up a WMS, you can use the example in this cookbook which shows in detail how to achieve this using the Open Source MapServer software (on a variety of platforms) and also provides pointers on doing this using ESRI ArcGIS and ArcIMS software. This cookbook package consists of two parts: (1) these pages, and (2) two exemplar WMS services based on British Geological Survey data,(i) an exemplar configuration using a shapefile with the BGS 625k data and, (ii) an exemplar configuration using an image file (such as might be created by scanning a paper map, when digital vector GIS data is not available for a particular country currently) using the BGS 625k bedrock age map, available for download over the Internet from a BGS FTP (file transfer protocol) server.

We provide two downloads depending on your needs:

1. ftp://ftp.bgs.ac.uk/pubload/OneGeology/1G_WMS-exemplar-data-MS6-update.zip
   This zip file contains just the data and MapServer templates for the two exemplar services, configured for a standard MS4W installation. Use this version of the zip if you already have a working copy of Windows MapServer (e.g. version 6.0.0+), or if you are compiling MapServer for Linux. This file is approximately 22Mb.
2. ftp://ftp.bgs.ac.uk/pubload/OneGeology/1G_ms4w3_MS6-with-exemplar-data.zip
   This zip file contains a copy of MS4W MapServer (v.6.0.1) allowing you to serve both a WMS 1.1.1 and WMS 1.3.0, and the exemplar services data. This version also contains a custom 'crs' file holding CRS:84 projection information, which can be used for setting up WMS 1.3.0 web services. Use this version of the zip if you are doing a fresh installation of MapServer for Windows Apache or IIS. This file is approximately 100Mb.

Section last modified: 04 Jan 2016

1.2 Who should be reading this cookbook?

This cookbook describes the viewing and use of WMS' using commonly and freely available clients including of course the OneGeology Portal in How to section 1.4 and this information is therefore of use to anyone wishing to understand what a OneGeology Level 1 WMS contribution makes available. The minimum technical capability that a Geological Survey, wishing to contribute a WMS to OneGeology, has to have is an existing web server that is visible without access restrictions to anyone internationally, and the technical staff to maintain and support that service. This web server **must be running on port 80** (if using HTTP) or **must be running on port 443** (if using HTTPS) to be accessible to the OneGeology Portal client. If you already have another web server service running on port 80 such as Tomcat, it is possible to get that server to run on another port number, and then proxy requests though to it using the MS4W Apache web server. For a quick overview of how to use the Apache-HTTP web server as such a '*reverse proxy*' see Appendix H.

If a survey does not have this capability then OneGeology has set up a system of volunteer 'buddy' organizations that may be prepared to serve your data as a WMS for you. You can request assistance through the buddy coordination form

(http://www.onegeology.org/technical_progress/buddy_coordination.cfm).

The intended audience of this cookbook is the survey's web applications developer and a geoscientist who is going to work with them to provide the digital data to be served.

A few OneGeology participants are already serving WMS' using MapServer or other similar technologies. If they are going to continue to use those technologies then they simply have to follow the naming and WMS configuration guidelines here to serve an OneGeology conformant WMS that can be registered with the OneGeology Portal and Client. The OneGeology conformant service naming conventions are described in detail in Section 2: WMS Profile.

Even if you are not going to use MapServer to serve your WMS please scan through these pages and read in full Section 2: WMS Profile and appendices F and G for example WMS GetCapabilities responses, which show how these naming conventions are used. See Appendix E for the MapServer configuration file that shows how one particular piece of software implements the ICS 2009 colour scheme that it is requested that OneGeology services try and implement for an age layer symbolization.

Section last modified: 13 Jan 2016

1.3 What type of data should be served as a contribution to OneGeology Level 1?

As cited in the brief overview of the OneGeology initiative (elsewhere on this web site ~ http://www.onegeology.org/technical_progress/home.html)

each contributor decides which maps to contribute and *it is anticipated that the majority of contributed maps will be bedrock and/or superficial maps, lithological and/or lithostratigraphical and/or chronostratigraphical where possible, but again, each contributor decides*.

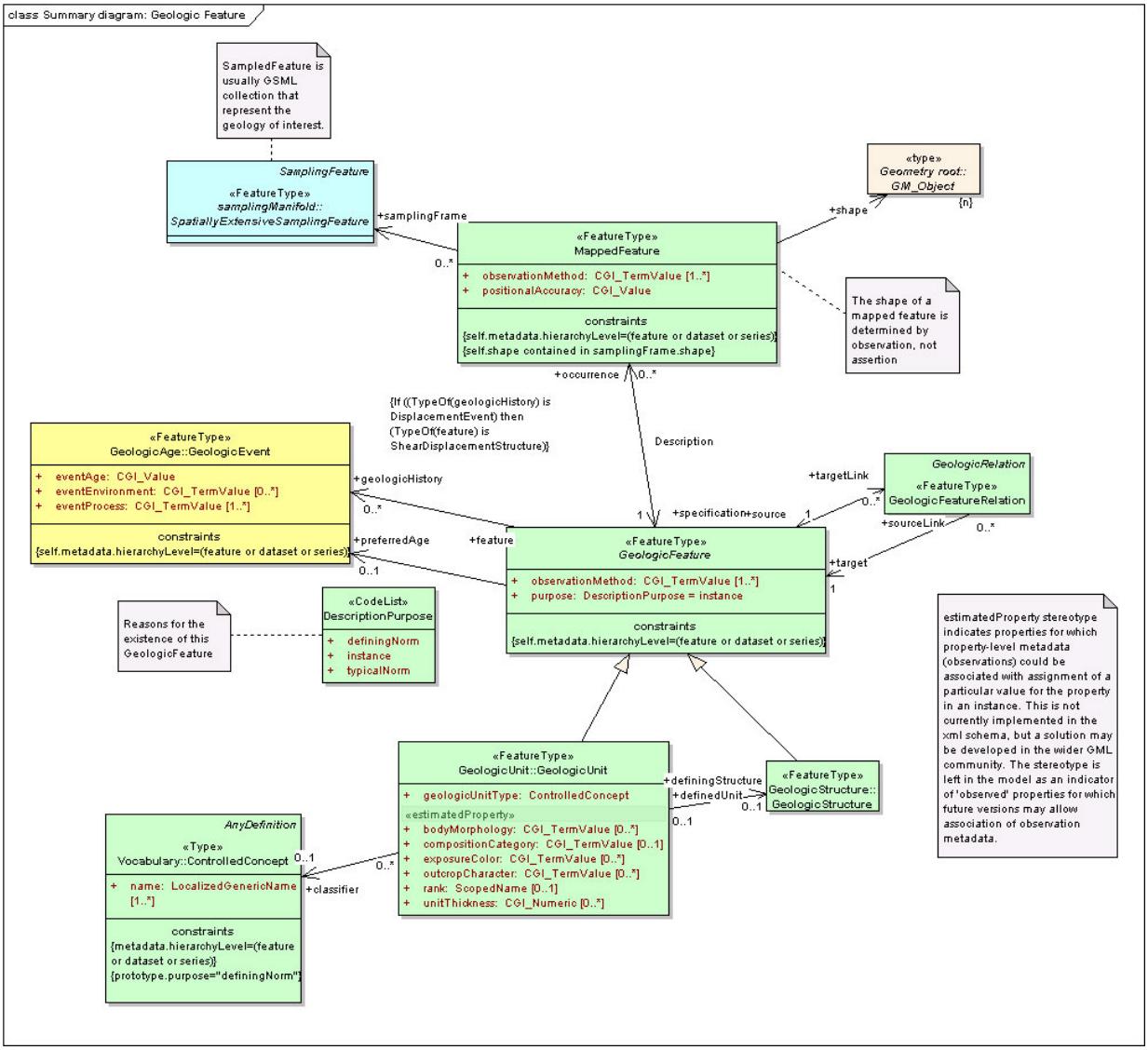
If chronostratigraphical symbolization is being offered then if possible the target scheme to use would be the IUGS 2009 colour scheme (https://www.seegrid.csiro.au/wiki/pub/CGIModel/GeologicTime/ISChart2009.pdf).

If you wish you are also encouraged to go a step further and follow the GeoSciML-Portrayal schema, which would allow your age service to be queried and re-symbolized using CGI URI codes. See (Section 7) for details on how to enable GeoSciML-Portrayal in your service.

This definition of these target ideal data contents represented by the Level 1 participants was agreed at the Brighton meeting but it also forms a small part of the GeoSciML logical model of geoscience concepts that OneGeology aspires to use to serve Level 2 Web Feature Services (WFS) in which the actual data in GML XML form is served over the web and not just a pictorial image of the map as in a WMS service.

A relevant UML (Universal Modelling Language) fragment of that GeoSciML model is shown below for those who want to understand the long term context:

Any Level 1 participant that plans in the long term to serve a Level 2 OneGeology WFS web service will want to serve this type of category of data to make it straightforward to move from a Level 1 WMS to a Level 2 WFS.



UML diagram for a fragment of the GeoSciML model (click to enlarge)

We emphasise that these geoscientific categories or feature types are only the target aim for OneGeology and if you have other data that you wish to serve and contribute then you are very much encouraged to do so. Similarly, whilst the target scale of data to be published is 1:1 000 000 OneGeology will happily accept data between the scales 1:500 000 and 1:5 000 000 with some other useful baseline datasets being of even larger scale. For example the British Geological Survey has decided to contribute its 1:625 000 scale data — and as it would take time and money to change this to a 1:1 000 000 scale it is not worth the effort to make this change.

A WMS is served from digital data and this comes in two forms; vector digital geological data in a GIS format such as ESRI's shapefile or a digitally scanned map in an image format such as GeoTIFF or JPEG. A digitally scanned map in an image format is required if the map you wish to serve is only currently available in paper map form — perhaps from a historical library source.

If you wish to serve a WMS from a paper map source then follow Section 3 (of the WMS cookbook) on scanning a paper map and then proceed to Section 4 and Section 5 on setting up a WMS using your choice of software.

Section last modified: 4 Jan 2016

2 WMS Profile

2 star accreditation requirement

For a 2 star accredited service, the service and ALL OneGeology layers must conform at least to the minimum requirements described in this profile.

For your service(s) to be accepted in the OneGeology Portal the participant protocol requires that you follow the WMS service naming conventions as agreed by the OneGeology Technical Working Group; these naming conventions (the 'profile') are described in detail with examples in this section.

The Web Map Service **must** conform to the appropriate WMS specification. The latest editions of MapServer, ArcGIS server, and ArcIMS help provide the version 1.3.0 WMS capability by default, though you may need to make some modifications to the GetCapabilities response to achieve full conformance to the specification and/or OneGeology WMS profile. ***With the latest version of MapServer you need to make no changes to the .map configuration file to achieve all versions of the WMS standards*** (that is WMS versions 1.0.0, 1.0.7, 1.1.0, 1.1.1, 1.3.0).

3 star accreditation requirement

For a 3 star accredited service, the service must support WMS version 1.3.0. Note, in line with the requirement to conform to the WMS specification (above), this means that the service must supply the highest WMS version supported (in the GetCapabilities response) when no version number is given in the GetCapabilities request.

In the profile we make a distinction between the organization that owns or has copyright to provide the data (whom we term the 'data owner') and the organization that serves that data as a WMS (whom we term the 'service provider').

The intention of the OneGeology Portal is that there will be one service (and only one service) per data owner per language; though it is understood this won't be possible in some cases, such as when you are serving different data sets from different servers. Any such service will serve one or more layers, which may be of different scale and/or of different geographical extent. The OneGeology WMS profile sets out a naming mechanism to ensure uniqueness across service names and layer names, whilst maintaining human readability.

Where a data owner serves their own data (is also the service provider) in a single language we expect a single service. Where an organization acts as a buddy to serve data for a partner geological survey organization (is the service provider) we expect one service for each organization per language served.

For example, at the time of writing The British Geological Survey is hosting its own data, and is acting as a buddy to host data for the Afghanistan Geological Survey, and for the Namibian Geological Survey, and for the Falkland Island Government, and for Geoscience Australia for Antarctica data, each of these is only available in English language versions. The British Geological Survey is also hosting a single language (French) service for Burkina Faso. The net result is that BGS, acting in the role of service provider, is serving six separate services (six separate service URLs).

Section last modified: 06 October 2015

2.1 WMS Service name

2 star accreditation requirement For a 2 star accredited service, the service must conform to these naming protocols.

The service name is defined by the OGC WMS specification as follows:

For WMS version 1.1.1 the service name MUST be: OGC:WMS

For WMS version 1.3.0 the service name MUST be: WMS

Your WMS software should automatically create the correct service name (as above), but you should double check the GetCapabilities response, and amend if required.

Section last modified: 06 September 2011.

2.2 WMS service title

2 star accreditation requirement For a 2 star accredited service, the service title must conform to these naming protocols.

The service title holds information about the service provider, the data owner (if different), the service language, and a generalized statement or short summary (we term this the theme) of the data served in all the layers. It should be noted that the service URL should be based on the service title, where the software permits — we cover this in more detail later. The service title (or URL), does not include any scale representation or any geographic area or coverage information; this information is held at the layer level. Remember that a service may provide data layers covering more than one geographic area and each layer may be at a different scale.

In the service title, URL, (and also layer titles and layer names), the organization whether data owner or service provider, is identified by the registered organization code. The data owner organization code follows the service provider organization code. The data

owner organization code does not need to be specified if the data owner is serving their own data (is also the service provider).

The language of a service is determined by the language used by the contents of the GetCapabilities response and of the legends. The code used to identify a language shall be the ISO 639-1 two-letter language code, if available; otherwise it shall be the ISO 639-2 three-letter language code. See Wikipedia for a list of most ISO-639 codes (http://en.wikipedia.org/wiki/List_of_ISO_639-1_codes).

The service language code follows the data owner organization code. The service language code does not have to be specified if either the language is the default language of the data owner organization, or if the data owner is serving only one service and that service is provided in English.

The final part of the service title is the service theme. The service theme is a generalized summary of the all the data provided in the layers of the service. The service theme is usually written in the language of the service. Using the BGS exemplar service as an example, the service provides layers on Superficial geology and other layers on Bedrock geology, a good summary of this for the service theme is therefore "Bedrock and Superficial geology", similarly, a French speaking Geological Survey might provide two services for their own data, one provided in French and the other in English; the theme for the French service might be "Formations Géologiques" whilst the theme for the English service would be "Geological Formations".

In summary then the format for a WMS service title is:

Service Provider Organization code then **Data Owner Organization code** (optional if data owner and service provider are the same) then **ISO 639 language code** (optional if service is in default language, or if one service is provided and that service is in English) then **Service Theme**.

For the BGS exemplar service this could translate as any of:

"BGS BGS EN Bedrock and Superficial Geology", or as

"BGS EN Bedrock and Superficial Geology", or as

"BGS BGS Bedrock and Superficial Geology", or as

"BGS Bedrock and Superficial Geology"

We would normally recommend using the shortest version where possible, though you may wish to add a language code if you specify the service theme in English but supply the service in your native (non-English) language.

We will run through more examples of service titles in Section 2.3 on the WMS service URL; remember that the service URL should be based on the service title.

2.2.1 Root layer name

Indicative XPATH to metadata:
/WMT_MS_Capabilities/Capability/Layer/Name **(WMS version 1.1.1)**
/WMS_Capabilities/Capability/Layer/Name **(WMS version 1.3.0)**

Some software (such as MapServer) allows you to configure the root layer name, if you are able to configure this layer name we suggest it should follow the same naming convention as the service title, but with substituting underscores for spaces.

For example, for the BGS exemplar service the root layer name is: **BGS_EN_Bedrock_and_Superficial_Geology**

INSPIRE layer naming considerations

If your INSPIRE service is only serving layers of one type, one way of applying group layering would be to use the root layer name and title (not service name and title) as the grouping layer, see section 2.5 for further details.

Section last modified: 21 October 2015

2.3 WMS service URL

2 star accreditation requirement For a 2 star accredited service, the service should conform to these URL naming protocols.

As mentioned above the WMS service URL is based on the WMS service title; in fact we really mean that the service URL should include the exact wording of the service title, but with the substitution of all spaces in the service title with underscore characters (_).

The structure of any WMS URL can generally be considered as having two parts. One part (usually the left hand side) is likely to depend on the technical architecture, the rules of the service providers, and the capabilities of the WMS software itself; the second part deals with the identification of the service itself.

The OneGeology Registry of services cannot be too strict about the first part of the URL, as the naming could be partially out of the control of OneGeology service providers. It is the second part that needs to mirror the WMS service title.

So if our service title is "BGS Bedrock and Superficial Geology" our service URL must include the string "BGS_Bedrock_and_Superficial_Geology".

We have now tested various software to check conformance against the Service URL rules and have found it to be achievable using GeoServer (2.1.1) on Apache, MapServer on Apache, MapServer on IIS, ArcIMS (9.3.1 tested) and ArcGIS server (9.3.1. and above tested) as below.

MapServer (on IIS) the exemplar service can be represented as:

http://ogc.bgs.ac.uk/cgi-bin/**BGS_Bedrock_and_Superficial_Geology**/wms/?

MapServer (on Apache) as:

http://ogc.bgs.ac.uk/cgi-bin/**BGS_Bedrock_and_Superficial_Geology**/wms?

ArcIMS as:

http://ogc.bgs.ac.uk/wmsconnector/com.esri.wms.Esrimap/**BGS_Bedrock_and_Superficial_Geology**?

ArcGIS server as:

http://ogc.bgs.ac.uk/ArcGIS/services/**BGS_Bedrock_and_Superficial_Geology**/MapServer/WMSServer?

GeoServer (on Apache) as:

http://ogc.bgs.ac.uk/**BGS_Bedrock_and_Superficial_Geology**/ows?

Below we show a few more described examples of service URLs (and titles)

1. In this example the Service provider is BGS, the data owner is BGS, the theme of the service is Bedrock and Superficial Geology, the service is in the default language of the data owner (English). The structure is therefore:
   .../**ServiceProvider_ServiceTheme**/...

   http://ogc.bgs.ac.uk/cgi-bin/**BGS_Bedrock_and_Superficial_Geology**/wms

2. In this example the Service Provider is BGS, the Data Owner is AGS, the service is in English which is not the default language of data owner, but there is no intention to publish any other language service and the theme of the service is Bedrock and Structural Geology. The structure is therefore:
   .../**ServiceProvider_DataOwner_ServiceTheme**/...

   http://ogc.bgs.ac.uk/cgi-bin/**BGS_AGS_Bedrock_and_Structural_Geology**/wms

3. In these examples the data owner and service provider is ISPRA, and theme of the service is 'Geology'. An Italian and an English service are provided. The native language is Italian so the language code for this service could be omitted, but as the service URL is written in English and not Italian adding the language code adds clarity. The structure for both service URLS is therefore:
   .../**ServiceProvider_LanguageCode_ServiceTheme**/...

   http://sgi.apat.it/wmsconnector/com.esri.wms.Esrimap/**ISPRA_EN_Geology** and

   http://sgi.apat.it/wmsconnector/com.esri.wms.Esrimap/**ISPRA_IT_Geology**

4. In this example the Service Provider is IGME, the Data Owner is SGN, the service is in English which is not the default language of the data owner, though there is a possibility that a native language service will be published in the future, and the theme of the service is simply 'Geology'. The structure is therefore:
   .../**ServiceProvider_DataOwner_LanguageCode_ServiceTheme**/...

   http://mapas.igme.es/gis/services/PSysmin/**IGME_SGN_EN_GEOLOGY**/MapServer/WMSServer

Section last modified: 13 September 2011

2.4 WMS service-level metadata

Whilst the OneGeology Portal is layer based, it is important top add as much metadata as possible in the service metadata. Some metadata may only be added explicitly at the service level.

2.4.1 Required service-level metadata

The OneGeology Portal will attempt to harvest the following information from your service, and you must therefore aim to provide this information in your GetCapabilities response document.

Note, the indicative XPATH in the below tables relates to the GetCapabilities response document

Metadata name	Indicative XPATH to metadata (WMS version is shown in brackets)
version	/WMT_MS_Capabilities@version **(1.1.1)** /WMS_Capabilities@version **(1.3.0)**

The WMS version. This will be automatically populated

title*	/WMT_MS_Capabilities/Service/Title **(1.1.1)** /WMS_Capabilities/Service/Title **(1.3.0)**

As detailed in the above section

2 star accreditation requirement For a 2 star accredited service, the service title must conform to the naming protocols.

abstract	/WMT_MS_Capabilities/Service/Abstract **(1.1.1)** /WMS_Capabilities/Service/Abstract **(1.3.0)**

Information about the service and general information about the map data served in the layers. You may also use this to field to describe the data owner organization, and its goals within OneGeology etc. You can also include in this section information about the scale layering of your service, and any other information that is not automatically extracted / viewable by the OneGeology Portal (or indeed any other client software).

2 star accreditation requirement For a 2 star accredited service, the service must supply an abstract.

access constraints	/WMT_MS_Capabilities/Service/AccessConstraints **(1.1.1)** /WMS_Capabilities/Service/AccessConstraints **(1.3.0)**

Information about who is allowed to use the data served by the WMS, and for what purpose they can use it for. Remember your WMS is available to any application that is able to access the Internet, not just through the OneGeology Portal.
For clarity to any potential users, it is recommended (within the OGC specifications) that you explicitly state when there are no access constraints on the using the service using the word "none".

Note too that there is no "AccessConstraints" metadata applicable at the layer level. If you need to define different access constraints for different layers in your service you will need to define these differences in the service level metadata.

2 star accreditation requirement For a 2 star accredited service, the service must provide information on any access constraints, or specify 'none' if there are no contraints on access.

3 star accreditation requirement For a 3 star accredited service, the service must supply a clear statement of use relating to data, including licence and charging details (where appropriate). Access to data must be transparent, simple and fair to all.

keywords	/WMT_MS_Capabilities/Service/KeywordList/Keyword **(1.1.1)** /WMS_Capabilities/Service/KeywordList/Keyword **(1.3.0)**

A list of keywords or short phrases that users of the OneGeology Portal and other catalogue services could use to search/discover your services. You **must** include the keyword *OneGeology*.

We would like you to also supply two special @ style 'Metadata keywords' (*MD_DATE@value* and *MD_LANG@value*) that will be used to populate the OneGeology catalogue of services, and which help make the GetCapabilities response ISO19115 core compliant.

MD_DATE@ is used to add a date for when the information in the GetCapabilites file for the service was last updated, (for MapServer services this would be the same as a change to the .map configuration file). For example the exemplar BGS_Bedrock_and_Superficial_Geology service has a MD_DATE@ keyword of MD_DATE@2011-06-15

MD_LANG@ is used to add the langauge (using the ISO 639-3 three letter codes) that the GetCapabilites file is populated with. This may be different from the language that the service returns its data in. For example the exemplar BGS_Bedrock_and_Superficial_Geology service has a MD_LANG@ keyword of MD_LANG@ENG

2 star accreditation requirement For a 2 star accredited service, the service must include the *OneGeology* keyword.

3 star accreditation requirement For a 3 star accredited service, the service must include the above 'Metadata keywords'.

Data (owner) provider	/WMT_MS_Capabilities/Service/ContactInformation/ContactPersonPrimary/ContactOrganization **(1.1.1)** /WMS_Capabilities/Service/ContactInformation/ContactPersonPrimary/ContactOrganization **(1.3.0)**

The full name of the data owner organization not service provider, where these are different, such as in buddied services.

2 star accreditation requirement For a 2 star accredited service, the service must supply the data owner organization name as part of the service ContactInformation (as well as in the special layer keywords).

Image Format	/WMT_MS_Capabilities/Capability/Request/GetMap/Format **(1.1.1)** /WMS_Capabilities/Capability/Request/GetMap/Format **(1.3.0)**

One or more formats that the WMS service can provide its map layers in. This information would normally be populated automatically by the web service.

Online Resource*	/WMT_MS_Capabilities/Service/OnlineResource **(1.1.1)** /WMS_Capabilities/Service/OnlineResource **(1.3.0)**

A link to the data owner organization web site, or web site with information about the data owner organization. Note this online resource is intended to provide additional information on the provider of the data and is NOT intended to be the same as the online resource attribute referenced in the Capability section of the response. i.e. NOT the same as the resource cited in, for example the below location in a 1.3.0 response, though this may be used if no other resource is available:
/WMS_Capabilities/Capability/Request/GetCapabilities/DCPType/HTTP/Get/OnlineResource

2 star accreditation requirement For a 2 star accredited service, the service must supply an appropriate online resource.

* Metadata required by the WMS specification.

Details on how to configure this metadata information in MapServer is shown in Section 4.3.1 "Step-by-step configuration for MS4W" (below).

Section last modified: 30 July 2013

2.4.2 Recommended service-level metadata

You should attempt to fill in as much service level metadata as possible, in addition to the mandated metadata (above) we recommend that as a minimum you also populate the following.

Note, the indicative XPATH in the below tables relates to the GetCapabilities response document

Metadata name	Indicative XPATH to metadata (WMS version is shown in brackets)
Contact Person	/WMT_MS_Capabilities/Service/ContactInformation/ContactPersonPrimary/ContactPerson **(1.1.1)** /WMS_Capabilities/Service/ContactInformation/ContactPersonPrimary/ContactPerson **(1.3.0)**
A named individual or named role (such as Director General) within the data owner organization to act as a contact for any enquires relating to the WMS service.	
Country	/WMT_MS_Capabilities/Service/ContactInformation/ContactAddress/Country **(1.1.1)** /WMS_Capabilities/Service/ContactInformation/ContactAddress/Country **(1.3.0)**
Country of the data owner organization	
Email Address	/WMT_MS_Capabilities/Service/ContactInformation/ContactElectronicMailAddress **(1.1.1)** /WMS_Capabilities/Service/ContactInformation/ContactElectronicMailAddress **(1.3.0)**
The email address for the named contact.	
2 star accreditation requirement	For a 2 star accredited service, the service must supply sufficient contact information to allow the data owner to be contacted by a user. This may be an email address, a phone number, or a full postal address and named contact (person or role)
Fees	/WMT_MS_Capabilities/Service/Fees **(1.1.1)** /WMS_Capabilities/Service/Fees **(1.3.0)**
Any fees required to use the WMS services and data contained within. Again if there are no fees you are recommended to explicitly state this using the word "none".	
3 star accreditation requirement	For a 3 star accredited service, the service must supply a clear statement of use relating to data, including licence and charging details (where appropriate). Access to data must be transparent, simple and fair to all. **If there are no fees for using the service this must be explicitly stated using the word "none".**

Section last modified: 09 September 2011.

2.5 Layer metadata

2 star accreditation requirement For a 2 star accredited service, ALL OneGeology layers must conform to these naming protocols.

The OneGeology Portal is layer-level based, rather than service-level based. It is the layer metadata that is shown to the users in the OneGeology Portal itself. It is therefore important to add as much metadata as possible to each of the layers. Even if most of your metadata is the same for your layers and for your service, you should replicate that data in the layer metadata.

It is worth starting this section by noting the differences between titles and names (applicable to services and layers) in the GetCapabilities response. A **name** is a short string (containing no spaces) used by computers to identify the data, whereas a **title** is a human readable phrase.

To simplify the rules for the user and to avoid name duplication in the registry, for the OneGeology Portal WMS profile, we **RECOMMEND** that layer titles and layer names are used to encapsulate exactly the same information. We **suggest** that the only difference being the style described above, and that we may shorten or abbreviate the information in the name. In the name we take any spaces that exist in the title and replace with the underscore character (_).

We recognize however that some services may require other naming conventions to fit in with other obligations for the service provider. In such cases the layer name and layer title need not follow the OneGeology layer protocols. Instead only the layer title

needs to follow the protocol described below.

The metadata information **REQUIRED** by the layer title and **RECOMMENDED** for the layer name are (in order):

[Geographical extent] of the data in the layer, then **[Data owner organization]** (not service provider), then **[Language code]** (if non-default as per service naming conventions), then **[Scale]**, then **[Theme]**.

INSPIRE layer naming considerations

If your service falls under the INSPIRE naming conventions, then both the layer name and the layer title are fixed according to the legislation. For example the D2.8.II.4 Data Specification on Geologyâ€“Technical Guidelines tell us (section 11.1 ~ Layers to be provided by INSPIRE view services) that any layer to do with lithology or age must have the name *GE.GeologicUnit* and title *Geologic Units*. See the layer-naming discussion on the INSPIRE Thematic Clusters Geology forum for fuller details.

To have a multiple layer geology service that adheres to the INSPIRE naming rules we believe the only option is for you to configure group layering. In such a situation, the layer name and title rules set out in this and the following sections relate to the grouped (or sub layers). Whereas the INSPIRE name and title relate to the group (or parent) layer.

Section last modified: 21 October 2015

2.5.1 Geographic extent

2 star accreditation requirement For a 2 star accredited service, ALL OneGeology layers must conform to these naming protocols.

The first piece of information is the Geographic extent. Geographic extent should begin wherever practically possible with the Country of the layer extent, even if the layer only covers part of a country, or if the layer covers all of one country (use that as the country code) and some of the surrounding landmass or sea area. Country information is codified using the ISO 3166-1 three-letter country codes (http://en.wikipedia.org/wiki/ISO_3166-1_alpha-3).

When the layer covers an area such as a defined region, state or province within a country, you should state the country code first and then the provincial information. Provincial information should wherever practically possible be codified using the ISO 3166-2 codes (http://en.wikipedia.org/wiki/ISO_3166-2).

For example:

- The US state of Kentucky would use US-KY
- The semi-autonomous region of Flanders (Northern Belgium) would use BE-VLG

Note, the ISO 3166-2 codes use a 2 letter country code then hyphen then provincial code.

If you are using your own provincial code (known within your county perhaps but not codified by ISO), you should use the three letter ISO country code, then a space (not a hyphen), and then your provincial code.

The OneGeology Portal divides countries and regions using the United Nations (UN) "World macro regions and components" listing. If you are serving regional data wider than country level, you should use the UN regions (http://unstats.un.org/unsd/methods/m49/m49regin.htm) where possible.

Where the layer coverage doesn't correspond to a country and/or when no ISO code or UN region exists to describe the coverage, you should use a short geographic name such as "World".

Section last modified: 28 June 2013

2.5.2 Data owner

2 star accreditation requirement For a 2 star accredited service, ALL OneGeology layers must conform to these naming protocols.

Geographic extent information is followed by the data owner organization code (not service provider), **EXACTLY** the same as used in the service title and service URL.

Section last modified: 06 September 2011

2.5.3 Language

2 star accreditation requirement For a 2 star accredited service, ALL OneGeology layers must conform to these naming protocols.

If you need to include language in your layer you should use the same ISO 639-1 two-letter language code (http://en.wikipedia.org/wiki/List_of_ISO_639-1_codes) as in the service title and include it **AFTER** the data owner organization code .

Section last modified: 06 September 2011

2.5.4 Scale

2 star accreditation requirement For a 2 star accredited service, ALL OneGeology layers must conform to these naming protocols.

Scale comes next and is shortened using SI symbols:

- "M" for Million (upper case)
- "k" for thousand (lower case)

Such that a 1:1 000 000 scale map would be represented in the layer title as 1:1M and a 1:625 000 scale map would be represented in the layer title as 1:625k. In the layer names we shorten this further by removing the "1:" portion so that a 1:1 000 000 scale map is represented as 1M and a 1:625 000 scale map is represented as 625k.

Additionally, if the map scale is represented in the layer title as 1:1.5M we can lose the decimal point in the layer name by using 1500k. **Note**, you do not have to use the 1500k format over the 1.5M format, rather we offer this format as an alternative, if your server software has an issue with dots in the layer name.

Section last modified: 12 June 2013

2.5.5 Theme

2 star accreditation requirement For a 2 star accredited service, ALL OneGeology layers should conform to these naming protocols.

The theme is the geological description of the data contained in the layer. As with the service title theme, the layer title theme should be a descriptive phrase in the service language. For English services the layers will most commonly have titles such as "Bedrock Age", "Bedrock Lithology" etc.

As mentioned above the layer names are for the consumption of the WMS software. It is important that within the OneGeology Portal the layer names are unique. The data owner is responsible to guarantee that there is no layer name duplication in all the layers they provide.

When we first started defining the rules for the OneGeology Portal we discovered that MapServer had a 20 character maximum limit on LAYER names (though this limit no longer applies), to get over this issue we defined a set of two and three letter codes to describe the most common layer themes to be used in the layer names, these are described below:

BA — Bedrock Age

BLT — Bedrock Lithology

BLS — Bedrock Lithostratigraphy

SLT — Superficial Lithology

SLS — Superficial Lithostratigraphy

MSF — Major Structural Features

This list is not exclusive, so please create your own if need be.

Note, if you decide to use ESRI ArcGIS server (versions 9.3.1 and below) you will not be able to conform to this layer naming convention, because the software auto-names the map layers 0, 1, 2... This problem will be dealt with in the OneGeology Registry through the use of auto-generated unique id's for each registered service layer, this is necessary as in a Catalogue like that for OneGeology one cannot have two layers having the same name i.e. both being named layer name 0.

This issue has been resolved in ESRI ArcGIS server 10

Section last modified: 11 June 2013

2.5.6 Layer title examples

For a 2 star accredited service, ALL OneGeology layers must conform to these naming protocols.

GBR BGS 1:625k Bedrock Age

FRA BRGM 1:1M Formations géologiques - France Continentale

FRA BRGM 1:1M Formations géologiques - Guyanne

Note, it is acceptable to replace the ISO country code with a more readable name in the layer title

Section last modified: 06 September 2011.

2.5.7 Layer name examples

For a 2 star accredited service, ALL OneGeology layers should conform to these naming protocols.

Remember that older versions of MapServer had a limit of 20 Characters for LAYER names; though this restriction no longer applies.

FRA_BRGM_1M_GeoUnits

GBR_BGS_625k_BA

World_25M_GeolUnits

Europe_BGR_5M_BLS

US-KY_KGS_24k_Faults

Section last modified: 12 June 2013

2.6 Other layer metadata

The OneGeology Portal client will harvest the following information from each WMS layer.

Note, the indicative XPATH in the below tables relates to the GetCapabilities response document

Metadata name	Indicative XPATH to metadata (WMS version is shown in brackets)
name	/WMT_MS_Capabilities/Capability/Layer/Layer/Name **(1.1.1)** /WMS_Capabilities/Capability/Layer/Layer/Name **(1.3.0)**

As already detailed above

For a 2 star accredited service, each OneGeology layer name should conform to the naming protocols.

title	/WMT_MS_Capabilities/Capability/Layer/Layer/Title **(1.1.1)** /WMS_Capabilities/Capability/Layer/Layer/Title **(1.3.0)**

As already detailed above.

For a 2 star accredited service, each OneGeology layer title must conform to the naming protocols.

abstract	/WMT_MS_Capabilities/Capability/Layer/Layer/Abstract **(1.1.1)** /WMS_Capabilities/Capability/Layer/Layer/Abstract **(1.3.0)**

You must provide a description of your layer data. You may wish to include other metadata, such as information about your organization and other data you make available. You may also wish to include a statement on access constraints.

For a 2 star accredited service, ALL OneGeology layers must provide a descriptive abstract for all their OneGeology layers.

keywords (and short phrases)	/WMT_MS_Capabilities/Capability/Layer/Layer/KeywordList/Keyword **(1.1.1)** /WMS_Capabilities/Capability/Layer/Layer/KeywordList/Keyword **(1.3.0)**

The Keyword "OneGeology" must be present to be able to search for services and layers with this keyword. OneGeologyEurope participants should also include relevant keywords chosen from the keyword list created for that project and listed in Appendix I below. The main purpose of these keywords is to make your services discoverable by a user searching in a catalogue of services, so a clearly formed but limited list of geosciences domain specific is ideal and all OneGeology global participants may also want to consider using items from this proposed OneGeology-Europe list, which has been formed by looking at many such lists available around the world including the European GEMET thesaurus found at: http://eionet.europa.eu/gemet/.

The following broad concepts are good starting points

http://eionet.europa.eu/gemet/concept?cp=2405 (earth science)

http://eionet.europa.eu/gemet/concept?cp=3648 (geological process)

Each keyword (or short phrase) must be contained within its own <keyword> element.

In addition to this we also require you to add a number of special 'Cataloguing keywords' to help the OneGeology Portal and catalogue services better index your layers. These special keywords have a term then an '@' symbol and then your value for the term, as below:

```
*Continent:                          continent@value       Required
*Subcontinent:                       subcontinent@value    Conditional
*Geographic area (usually country):  geographicarea@value  Required
*State(Region or province):          subarea@value         Conditional
*Data provider:                      dataprovider@value    Required
*Service provider:                   serviceprovider@value Required
```

The geographicarea@value represents a verbalization of the code that starts a layer name. For most layers geographicarea@value will be a country; this INCLUDES layers that only show a sub-region or state within a country.

The values for Continent, Subcontinent and Country must be taken from the United Nations (UN) list: http://unstats.un.org/unsd/methods/m49/m49regin.htm used by the OneGeology Portal.

Conditional keywords are required if they apply.
Eg. If the geographic area is a state or province then the subarea keyword is required.

2 star accreditation requirement For a 2 star accredited service, ALL OneGeology layers must include the 'OneGeology' keyword and **all** appropriate 'Cataloguing keywords'.

In addition we would like that you also supply the following two special 'Metadata keywords' for each layer. These keywords help make the GetCapabilities response ISO19115 core compliant.

```
*Layer (Data set) date:              DS_DATE@value
*Layer (Data set) topic category:    DS_TOPIC@value        (one or more as appropriate)
```

The topic category is taken from the ISO 19119 topic category listing. A good reference to the categories and what they represent is found at: http://gcmd.nasa.gov/User/difguide/iso_topics.html.
We anticipate that most layers would have a DS_TOPIC@geoscientificinformation keyword.

3 star accreditation requirement For a 3 star accredited service, ALL OneGeology layers must include all appropriate 'Metadata keywords'.

So for example, the layer "AFG AGS 1:1M Bedrock Age" would include the following keywords:

<KeywordList>
<Keyword>OneGeology</Keyword>
<Keyword>geology</Keyword>
<Keyword>Afghanistan</Keyword>
<Keyword>continent@Asia</Keyword>
<Keyword>subcontinent@South-central Asia</Keyword>
<Keyword>geographicarea@Afghanistan</Keyword>
<Keyword>serviceprovider@British Geological Survey</Keyword>
<Keyword>dataprovider@Afghanistan Geological Survey</Keyword>
<Keyword>DS_TOPIC@geoscientificinformation</Keyword>
<Keyword>DS_DATE@2008-12-03</Keyword>
</KeywordList>

Note, that we have the country twice, once as one of the OneGeology Portal special keywords, and once as the country only; this is because we recognize that the service may be consumed (and catalogued) by services other than OneGeology. We don't include a subarea@ keyword in this list because that would not be appropriate in this instance.

To help classify your service in the portal according to the thematic keyword list (as detailed in Appendix I), you should also use one or more *thematic@value keywords*.

Please note services using GeoSciML-Portrayal also require the following keyword: **Geosciml_portrayal_age_or_litho_queryable**

For those WMS layers with an associated GeoSciML WFS that you would like to query using the OneGeology Portal thematic analysis tool, you will need to add the appropriate **GeoSciML32_wfs_age_or_litho_queryable** or **GeoSciML4_wfs_age_or_litho_queryable** keyword.

Extent /WMT_MS_Capabilities/Capability/Layer/Layer/LatLonBoundingBox **(1.1.1)**
/WMS_Capabilities/Capability/Layer/Layer/EX_GeographicBoundingBox **(1.3.0)**

In WMS version 1.1.1 a list of (latitude-longitude decimal degree) coordinates defining an imaginary box that entirely encompasses the map data. It is always specified as minimum-X, minimum-Y, maximum-X, and maximum-Y. The purpose of these extent values is to facilitate geographic searches; values may be approximate.

In WMS version 1.3.0 four elements each describing a single bounding limit (always in the order: west, east, south, north)

2 star accreditation requirement For a 2 star accredited service ALL OneGeology layers must supply a LatLonBoundingBox defined using SRS EPSG:4326 WGS1984 latitude/longitude.

Reference System /WMT_MS_Capabilities/Capability/Layer/Layer/SRS **(1.1.1)**
Spatial (1.1.1) or /WMS_Capabilities/Capability/Layer/Layer/CRS **(1.3.0)**
Coordinate (1.3.0)

A list of one or more horizontal ' Spatial Reference Systems' that the layer can handle (will accept requests in and return results based upon those SRS). In WMS 1.1.1, the returned image is always projected using a pseudo-Plate Carrée projection that plots Longitude along the X-axis and Latitude along the Y-axis.

For example, the exemplar service lists the following Spatial Reference Systems:
EPSG:4326, EPSG:3857, CRS:84, EPSG:27700, EPSG:4258

The portal now supports a number of projection systems, including two suitable for INSPIRE compliance; see section 4.3.1.2 for a list of projections currently supported by the portal.

2 star accreditation requirement For a 2 star accredited service ALL OneGeology layers must support EPSG:4326.

Each layer must supply a list of the SRS it supports

We would like too if the layers also support Spherical Mercator projection (EPSG:3857), so that they can be used in various online mapping applications, such as OpenLayers and Google Maps.

BoundingBox /WMT_MS_Capabilities/Capability/Layer/Layer/BoundingBox **(1.1.1)**
/WMS_Capabilities/Capability/Layer/Layer/BoundingBox **(1.3.0)**

The BoundingBox attributes indicate the edges of the bounding box in units of the specified spatial reference system, for example, the exemplar service provides the following BoundingBox information for the GBR BGS 1:625k bedrock lithology layer:

Example WMS 1.1.1 response

```
<BoundingBox SRS="EPSG:4326" minx="-8.64846" miny="49.8638" maxx="1.76767" maxy="60.8612" />
<BoundingBox SRS="EPSG:3857" minx="-962742" miny="6.42272e+006" maxx="196776" maxy="8.59402e+006" />
<BoundingBox SRS="CRS:84" minx="-8.64846" miny="49.8638" maxx="1.76767" maxy="60.8612" />
<BoundingBox SRS="EPSG:27700" minx="-77556.4" miny="-4051.91" maxx="670851" maxy="1.23813e+006" />
<BoundingBox SRS="EPSG:4258" minx="-8.64846" miny="49.8638" maxx="1.76767" maxy="60.8612" />
```

Example WMS 1.3.0 response

```
<BoundingBox CRS="EPSG:4326" minx="49.8638" miny="-8.64846" maxx="60.8612" maxy="1.76767" />
<BoundingBox CRS="EPSG:3857" minx="-962742" miny="6.42272e+006" maxx="196776" maxy="8.59402e+006" />
<BoundingBox CRS="CRS:84" minx="-8.64846" miny="49.8638" maxx="1.76767" maxy="60.8612" />
<BoundingBox CRS="EPSG:27700" minx="-77556.4" miny="-4051.91" maxx="670851" maxy="1.23813e+006" />
<BoundingBox CRS="EPSG:4258" minx="49.8638" miny="-8.64846" maxx="60.8612" maxy="1.76767" />
```

Please note the swap in x,y axes order for the geographic coordinate systems EPSG:4258 and EPSG:4326 between WMS versions. In WMS version 1.3.0 the x-axis is the first axis in the CRS definition, and the y-axis is the second. EPSG geographic coordinate reference systems follow ISO 6709 and ALWAYS list latitude before longitude.

2 star accreditation requirement For a 2 star accredited service ALL OneGeology layers must supply an EPSG:4326 BoundingBox

DataURL (optional) /WMT_MS_Capabilities/Capability/Layer/Layer/DataURL **(1.1.1)**
/WMS_Capabilities/Capability/Layer/Layer/DataURL **(1.3.0)**

This may be used to provide further information about all the digital data offered by the data provider, though it is primarily used to provide a link to non-standards compliant metadata for the layer in question.

```
<DataURL>
<Format>text/html</Format>
<OnlineResource
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xlink:type="simple"
  xlink:href="http://www.bgs.ac.uk/discoverymetadata/13480426.html" />
</DataURL>
```

MetadataURL /WMT_MS_Capabilities/Capability/Layer/Layer/MetadataURL **(1.1.1)**
/WMS_Capabilities/Capability/Layer/Layer/MetadataURL **(1.3.0)**

You **should** supply one or more on-line resources offering detailed, standardized (either as "FGDC:1998" or "ISO 19115:2003") metadata about the layer data. If your metadata is not available in either of these standards you **MUST** instead use a DataURL.

The core ISO 19115:2003 metadata required to be compliant is shown in Section 2.7. Note, there are no formatting requirements; this information could be provided as xml or html or text or pdf etc as long as it accessible on the web.

Example WMS 1.1.1 response

```
<MetadataURL type="TC211">
<Format>application/xml; charset=UTF-8</Format>
<OnlineResource
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xlink:type="simple"
  xlink:href="http://metadata.bgs.ac.uk/geonetwork/srv/en/csw?
    service=CSW&
    version=2.0.2&
    request=GetRecordById&
    id=ac9f8250-3ae5-49e5-9818-d14264a4fda4&" />
```

</MetadataURL>

Example WMS 1.3.0 response

```
<MetadataURL type="ISO 19115:2003">
<Format>application/xml; charset=UTF-8</Format>
<OnlineResource
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xlink:type="simple"
  xlink:href="http://metadata.bgs.ac.uk/geonetwork/srv/en/csw?
    service=CSW&
    version=2.0.2&
    request=GetRecordById&
    id=ac9f8250-3ae5-49e5-9818-d14264a4fda4&" />
</MetadataURL>
```

Please note: the defined attribute value to indicate ISO 19115:2003 metadata is "ISO 19115:2003" in WMS version 1.3.0 as opposed to "TC211" in version 1.1.1. In version 1.3.0, communities may **ALSO** define their own attributes. We **RECOMMEND** that if you can change this attribute for different WMS version GetCapabilities responses you should use "ISO 19115:2003" for your WMS 1.3.0 response. If you can only configure one response type then you **MUST** use "TC211".

2 star accreditation requirement For a 2 star accredited service, any MetadataURL supplied must link to a valid metadata resource for that layer.

4 star accreditation requirement For a 4 star accredited service, ALL OneGeology layers and feature types (WMS and WFS) must supply a MetadataURL to a valid metadata resource for that layer (and feature type), which conforms at least to the OneGeology metadata profile.

Minimum Scale /WMT_MS_Capabilities/Capability/Layer/Layer/ScaleHint@min **(1.1.1)**
/WMS_Capabilities/Capability/Layer/Layer/MinScaleDenominator **(1.3.0)**

A hint to the minimum scale at which the map will not be zoomed in beyond. This is cited in units relating to the diagonal dimension of the screen in units relevant to the software providing the service, and would normally be populated automatically by the software.

Maximum Scale /WMT_MS_Capabilities/Capability/Layer/Layer/ScaleHint@max **(1.1.1)**
/WMS_Capabilities/Capability/Layer/Layer/MaxScaleDenominator **(1.3.0)**

A hint to the maximum scale at which the map will not be zoomed out beyond. This is cited in units relating to the diagonal dimension of the screen in units relevant to the software providing the service, and would normally be populated automatically by the software.

Is the layer **queryable** /WMT_MS_Capabilities/Capability/Layer/Layer@queryable **(1.1.1)**
/WMS_Capabilities/Capability/Layer/Layer/@queryable **(1.3.0)**

Parameter to indicate whether a GetFeatureInfo request is allowed on the layer

3 star accreditation requirement For a 3 star accredited service ALL OneGeology layers must provide a valid GetFeatureInfo response. At a minimum, the GetFeatureInfo response must support text/html.

Legend url /WMT_MS_Capabilities/Capability/Layer/Layer/Style/LegendURL **(1.1.1)**
/WMS_Capabilities/Capability/Layer/Layer/Style/LegendURL **(1.3.0)**

We require you to have some sort of legend to accompany your map data. If you are using the latest version of MapServer server, this will be created for you automatically using the inbuilt SLD capability. If your WMS server is not SLD capable, or if you have a complex legend, you may add the LegendURL manually in your GetCapabilities response document. See below section 2.6.1 style examples.

2 star accreditation requirement For a 2 star accredited service, ALL OneGeology layers must supply a readable legend graphic.

Style name /WMT_MS_Capabilities/Capability/Layer/Layer/Style/Name **(1.1.1)**
/WMS_Capabilities/Capability/Layer/Layer/Style/Name **(1.3.0)**

Computer readable name for the style. See below section 2.6.1 style examples.

Style title /WMT_MS_Capabilities/Capability/Layer/Layer/Style/Title **(1.1.1)**
/WMS_Capabilities/Capability/Layer/Layer/Style/Title **(1.3.0)**

Human readable title for the style. See below section 2.6.1 style examples.

Section last modified: 21 June 2016

2.6.1 Layer styling information

The examples below show the styling portion of the GetCapabilities response. The first two come from MapServer services, and show that the legend will be generated on-the-fly using an SLD GetLegendGraphic request. The third example shows a simple request to a static image, generated in advance by the map service provider.

Example style information from a MapServer version 4.10.3 WMS version 1.1.1. GetCapabilities response. The legend will be created automatically by MapServer and served using an SLD GetLegendGraphic operation.

```
<Style>
<Name>default</Name>
<Title>default</Title>
```

```
<LegendURL width="20" height="10">
<Format>image/png</Format>
<OnlineResource
 xmlns:xlink="http://www.w3.org/1999/xlink"
 xlink:type="simple"
 xlink:href="http://ogc.bgs.ac.uk/cgi-bin/BGS_Bedrock_and_Superficial_Geology/wms?

   version=1.1.1&
   service=WMS&
   request=GetLegendGraphic&
   layer=UKCoShelf_BGS_1M_SBS&
   format=image/png&" />
</LegendURL>
</Style>
```

Example style information from a MapServer version 5.6.5 WMS version 1.3.0. GetCapabilities response. The legend will be created automatically by MapServer and served using an SLD GetLegendGraphic operation. Note the OnlineResource URL now includes an sld_version parameter.

```
<Style>
<Name>default</Name>
<Title>default</Title>
<LegendURL width="328" height="3013">
<Format>image/png</Format>
<OnlineResource
 xmlns:xlink="http://www.w3.org/1999/xlink"
 xlink:type="simple"
 xlink:href="http://ogc.bgs.ac.uk/cgi-bin/BGS_GSN_Bedrock_Geology/wms?

   version=1.3.0&
   service=WMS&
   request=GetLegendGraphic&
   sld_version=1.1.0&
   layer=NAM_GSN_1M_BLS&
   format=image/png&
   STYLE=default&"/>
</LegendURL>
</Style>
```

Example style information from an ArcGIS server WMS version 1.3.0. GetCapabilities response. A detailed static legend is provided.

```
<Style>
<Name>default</Name>
<Title>US-KY KGS 1:500K Kentucky Geologic Formations</Title>
<LegendURL width="100" height="588">
<Format>image/png</Format>
<OnlineResource
 xlink:href="http://.../.../KGS_Geology_and_Faults_MapServer/wms/default2.png&"
 xlink:type="simple"
 xmlns:xlink="http://www.w3.org/1999/xlink" />
</LegendURL>
</Style>
```

Section last modified: 07 October 2015

2.7 Core TC211/ISO:19115:2003 Metadata

This section has been added to allow you to understand what metadata you need to supply, if you choose to supply additional metadata about a layer as an online resource **AND** if you want to use the MetadataURL to reference that resource. If you wish to supply an online resource to layer metadata, that doesn't conform to the minimum standard set out below (or FGDC:1998) then you cannot use the MetadataURL; we recommend that you use the DataURL. If you also wish to supply a URL to your web site, to highlight all your data products (for example), then you can use the SERVICE level online resource URL; in MapServer you do this by

specifying the WMS_ SERVICE_ONLINERESOURCE (or OWS_SERVICE_ONLINERESOURCE) keyword.

For example in our exemplar service we have:

OWS_SERVICE_ONLINERESOURCE "http://www.bgs.ac.uk/products/digitalmaps/digmapgb.html"

Note that TC211/ISO:19115:2003 is not itself a format, but a standard for defining formats and profiles. To comply with the ISO:19115:2003 metadata standard a data format (or profile) must define a core set of metadata elements as shown below. Note, for the purposes of the OneGeology Portal if you are showing your metadata (when accessed using the MetadataURL) in an HTML/text or pdf page it is sufficient to provide only Mandatory metadata, and Conditional metadata (where appropriate).

Mandatory (M): The metadata entity or metadata element shall be documented

Conditional (C): The metadata entity or metadata element shall be documented if another entity or element has been documented, or if a condition is or isn't met elsewhere.

Optional (O): Provided to allow users to document their data more fully.

Dataset title (M)	**Spatial representation type** (O)
A unique title (within your metadata records) for your data.	The method used to represent geographic information in the dataset. i.e., vector, grid, TIN etc.
Dataset reference date (M)	**Reference system** (O)
Dataset responsible party (O)	**Lineage** (O)
Geographic location of the dataset (by four coordinates or by geographic identifier) (C) If the metadata applies to a data set which is spatially referenced (such as a OneGeology WMS) this is required.	**On-line resource** (O)
Dataset language (M)	**Metadata file identifier** (O)
Language(s) used within the dataset. Required even if the resource does not include any textual information; defaults to the Metadata language.	Unique identifier for this metadata file
Dataset character set (C)	**Metadata standard name** (O)
Full name of the character encoding used for the data set. You must supply this character set if you are not using the ISO/IEC 10646-1 character set and if your character set is not defined by the document encoding.	Name of the metadata standard (including profile name) used
Dataset topic category (M)	**Metadata standard version** (O)
Main theme(s) of the data set described using the most appropriate term defined in the standard; for OneGeology services these are likely to be one or more from: '*geoscientificInformation*', '*economy*' (for layers showing mineral resources), or '*imageryBaseMapsEarthCover*'	Version (profile) of the metadata standard used
Spatial resolution of the dataset (O)	**Metadata language** (C)
Scale or factor which provides a general understanding of the density of the spatial data in the dataset.	Language used to document the metadata. You must supply the metadata language if it is not defined by the document encoding. Note for INSPIRE GEMINI metadata you must always supply the metadata language.
Abstract defining the dataset (M)	**Metadata character set** (C)
Brief narrative summary of the content of the resource.	Full name of the character encoding used for the metadata set. You must supply this character set in your metadata if you are not using the ISO/IEC 10646-1 character set (http://en.wikipedia.org/wiki/Universal_Character_Set) AND if your character set is not defined by the document encoding. Note as most XML and HTML pages provide a character set as part of their own metadata, it is likely that you will not need to explicitly state this for your own layer metadata
Distribution format (O)	**Metadata point of contact** (M) Party responsible for the metadata information
Additional extent information for the dataset (vertical and temporal) (O)	**Metadata date stamp** (M)

OneGeology Europe participants should note that conformance of an ISO 19115 metadata set to the ISO 19115 Core does not guarantee conformance to INSPIRE metadata, see the INSPIRE technical guidelines document MD_IR_and_ISO_v1_2_20100616 for further details:
(http://inspire.jrc.ec.europa.eu/documents/Metadata/MD_IR_and_ISO_20131029.pdf).

Section last modified: 12 September 2014

2.8 GetFeatureInfo response

Depending on the data you have available for each layer and depending on your WMS software, you may be able to configure what is returned in response to GetFeatureInfo requests on each layer, either to format the look of the data returned or to restrict the data attributes returned. For example both of these customizations is possible with MapServer but neither are currently possible with ESRI ArcGIS server or ESRI ArcIMS server (versions 9.3.1 and below).

Ideally the response should include a field for age/lithology/lithostratigraphy as appropriate for each layer. You may choose to include other information you consider useful but please try to exclude data fields that only have meaning internal to your organization.

Preferably it should be possible to retrieve the information in at least text/html and text/plain formats.

3 star accreditation requirement

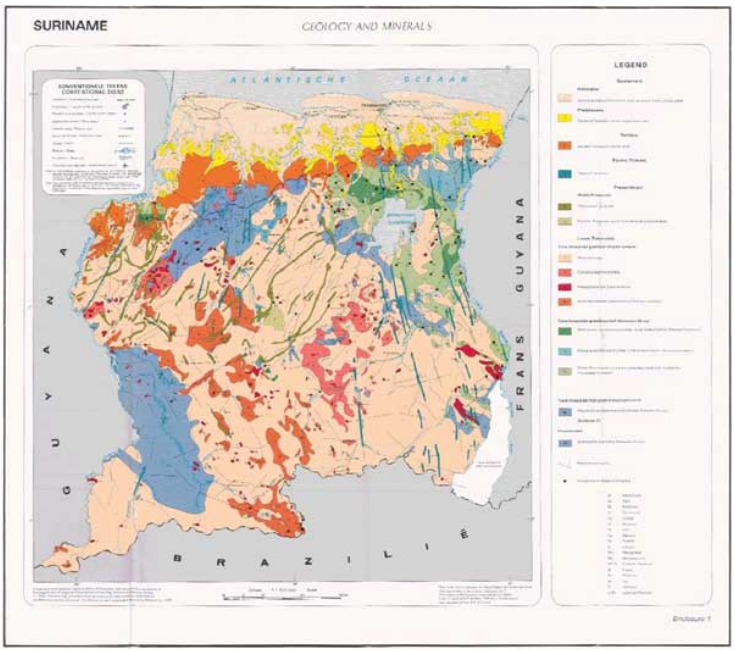
For a 3 star accredited service ALL OneGeology layers must provide a valid GetFeatureInfo response. At a minimum, the GetFeatureInfo response must support text/html.

Section last modified: 06 September 2011

3 Scanning a paper map

3.1 Scanning

Your chosen paper map may look something like this one from the Dutch Geological Survey of Dutch Guyana or Suriname:



Example geological map to scan

Step 1

It is important to find a large scanner in your city, which could cover a whole paper map. If this scanner is not available at your survey, you may try the Topographical Survey or a large bookshop or book printer.

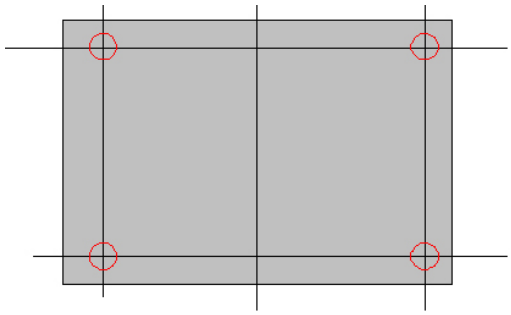
Step 2A

If you could use a large scanner, you can scan the whole map at one time. But remember to scan the geological map portion into a separate file from that for the legend i.e. you will have two files one for the map and one for the legend. Alternatively, make a copy of an original digital image of the whole map face and cut out the map from the legend. Good software to do this is IrfanView (http://www.irfanview.com/) or Adobe Photoshop (http://www.adobe.com/uk/products/photoshopfamily.html). Tip: This cropped map is now ready for geo-referencing. If you have a slow Personal Computer, you could temporarily work with a JPEG copy. The file size is than much smaller and it can be accessed and geo-referenced faster.

The preferable output format should be .TIF as this format keeps most information.

Step 2B

For larger maps, or if you have only a small scanner, the map should be scanned in parts and later stitched together.



Orientation of map for scanning

If you scan in parts always try to keep the crossings of the horizontal and vertical black lines in each of the four corners. The straight horizontal and vertical black lines on the map are the altitude and longitude. Then the stitching and geo-referencing will be much easier.

The output format should be .TIF as this format keeps most pixel information available.

Step 2C

If scanners are not available, you could use a good digital camera. Unfold the map on a well lit place without glare or light reflections. Sometimes white sheets on the side will diffuse the light and prevent ugly reflections from the sun or from the light-bulb. Take a picture right above the centre of the map.

Make several pictures with different lighting and shutter speed. Choose the best colourful result. Usually the export format is .JPG.

Step 3 ~ Stitching

For the stitching of map parts many applications or free software are available, such as such as GNU Image Manipulation Program (GIMP) (http://www.gimp.org/), or OSSIM ImageLinker (http://www.ossim.org/)

Section last modified: 12 June 2013

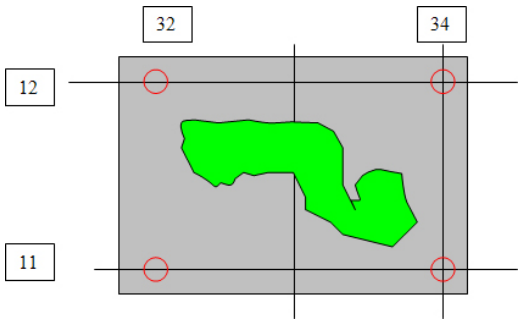
3.2 Georeferencing a scanned map

You have now a .TIF file or maybe a .JPG file, which is a representation of your paper map. This digital file should now be brought into relation with the surface of the earth. This is called geo-referencing. For this action you need GIS software.

Commercial GIS software such as ESRI ArcGIS or MapInfo is widely available and 'no-cost' GIS software, which also could perform this task, is ILWIS, (http://52north.org/downloads/llwis/) or Geothings Map Warper (http://warper.geothings.net/).

Note down the Coordinate system of the paper map, as this is necessary for the following process. Sometimes paper maps are found and we are not sure what coordinate system was being used as it has not been clearly stated on the paper copy. Some research may have to be done to estimate the original coordinate system used. For the Suriname map example it is thought probable that the coordinate system originally used was GCS North American 1927.

It is important to find four or more fixed points in the corner of the picture, from which you know exactly the position. Reliable points are church towers, railway and roads crossings, canals or bridges. Be careful with coastal features or rivers as these tend to change slowly in time. More points are desirable to prevent conical distortions, which often happen with digital cameras.



Minimum number and location of control points when georectifying a scanned image.

Usually these are crossing points of an altitude line and a longitude line.

The x and y coordinates of each crossing should be given to the program.

Be careful to use the relevant degree-minutes-seconds or decimal entries for degrees depending on the particular program's

requirements. After confirming the picture will be warped by the program so it fits now on the world surface. Please check the accuracy, preferable with a topographical map, as often even the cartographers have made mistakes, or may have deliberately introduced errors for geopolitical or security reasons. With slight alterations of the fixed points you can try to make a perfect overlap with a topographical map.

Section last modified: 11 June 2013

3.3 Image formats and transparency

Although your scanned image will be rectangular in shape, nearly all mapped geographic regions will have irregularly shaped boundaries. Thus it is preferable to make the background parts of your image transparent rather than a solid background colour which will obscure neighbouring regions. The variety of image formats that are usable with MapServer and their various advantages and disadvantages is a complex subject which we cannot be authoritative about.

We have found 32-bit TIFF (RGB plus alpha layer) or 8-bit palette PNG with a transparent background colour work; you may wish to experiment.

See MapServer raster data (http://www.mapserver.org/input/raster.html) for more information.

Section last modified: 08 September 2010

3.4 The legend for the scanned map

A WMS based on a scanned map will not have the ability to click on a symbolized polygon and see what attributes and therefore what classification it has according to the legend. A WMS based on GIS digital data polygons and attributes does have this capability and the legend is automatically created from such information by the MapServer software. However for this scanned map based WMS it is possible to associate the scanned legend file for the map — which in the case of the Suriname example looked like this — with the WMS service by including the following lines in the Metadata section of the MapServer.map configuration file which is discussed later:

METADATA

...

WMS_STYLE "default"
WMS_STYLE_DEFAULT_LEGENDURL_HEIGHT "353"
WMS_STYLE_DEFAULT_LEGENDURL_WIDTH "253"
WMS_STYLE_DEFAULT_LEGENDURL_HREF
"http://www.dinoservices.nl/TNO_Suriname_Geology/surinameLegend.png"
WMS_STYLE_DEFAULT_LEGENDURL_FORMAT "image/png"

...

It is an OneGeology target aim to provide any legends in English as well as the originating language; in this case you would have to create an image file with a relevant translation. Note that the image format should be one that can be directly displayed by a web browser, i.e. JPEG, PNG or GIF. To keep things simple we have decided that any alternative language WMS services should be completely separate language specific services e.g. the BRGM plans to serve an English service and a French one.

Section last modified: 13 July 2011

Detailed legend for scanning

4 Setting up a MapServer WMS

The first version of this cookbook ran through how to set-up a simple implementation of the MapServer for Windows (MS4W) "all-in-one" package which utilises the Apache HTTP web server. This revised cookbook section updates that original guidance, including how to update your MapServer version, (you will need to do this to serve WMS 1.3.0), and also gives information on how to setup MapServer to run on Windows IIS and Linux Apache.

Comprehensive documentation for installing on other platforms and with other web servers is available on the MapServer website (http://mapserver.org/).

We also give some guidance in subsequent sections on how to set up your WMS services using the latest versions of ESRI software.

Section last modified: 25 May 2010

4.1 Prerequisites for setting up a WMS

You may set up and configure a web map service on any PC or laptop running the appropriate software (and you may have to do this if you don't have a networked PC or internet server). To serve a WMS on the OneGeology Portal you must have an open access Internet connected machine on which the server software can be installed and kept running.

As far as source data goes, the examples will concentrate mainly on GeoTIFF format raster files and ESRI shapefiles for vector data. However, access to other formats of raster data, and many possible vector formats, including access to spatial databases are listed on the MapServer website.

See the MapServer help pages (as below) for further information:

Raster Data (http://www.mapserver.org/input/raster.html),
Vector Data (http://www.mapserver.org/input/vector/index.html) and
Information about OGR (http://www.mapserver.org/input/vector/ogr.html)

Section last modified: 12 June 2013

4.2 MS4W software installation

All versions of the MS4W software package, including the latest version are available from the MapTools (http://dl.maptools.org/dl/ms4w/) web site.

We will detail here how to set up MapServer 6.0.0 as part of the MS4W version 3 package. We will also provide information on how to update the MapServer component of your MS4W installation; to allow you for example to use the MapServer NSIS installer (which currently installs MapServer 5.6.6) and then update this to the latest 6.0.0 version of the MapServer windows binary. These sections are provided for completeness.

If you are setting up a WMS with MapServer for the first time and have downloaded the full exemplar zip (which includes the MS4W software) you should follow Section 4.2.1.

Please take the time to read the Copyright and Open Source license terms (http://maptools.org/ms4w/index.phtml?page=license.html) for the use of this no cost software.

Section last modified: 17 June 2011

4.2.1 Using the MS4W zip (or full exemplar zip)

Unzip the downloaded file to the top level of one of your web server computer drives; it will create a folder ms4w, which will contain all the required program files. You can unzip into another location and then move the ms4w folder to the top level (root directory), but if you wish to run the software from another location you will need to manually edit several configuration files (or use the NSIS installer); we do not detail how to edit the configuration files here.

You can edit the apache-install.bat (inside the newly created ms4w directory) file to change the name of the service (for example, you may wish to note which version of MapServer is being run, or you may wish to run more than one copy on different ports), but if you do so, remember to also change the apache-restart.bat and apache-uninstall.bat files at the same time. To edit the file you need to right click on the file and select edit, NOT open.

To start the installation you must first run the setenv.bat script inside the newly created ms4w directory (e.g. by double-clicking it). This should set up your server with all the correct environment variables and paths required to run your Apache/MapServer installation.

Now run the apache-install.bat script (e.g. by double-clicking it). Open your Services control panel and check that you can see a service called something like 'Apache MS4W Web Server'and that it is started.

If you get an error when trying to run the apache-install.bat script with message 'The system cannot execute the specified program', then the most likely cause is that your server has not got the Microsoft VC++ 2008 Redistributable Package (http://www.microsoft.com/downloads/details.aspx?familyid=
9B2DA534-3E03-4391-8A4D-074B9F2BC1BF&displaylang=en") installed, and you will need to install it before running apache-install.bat. The installer for this package is available from the Microsoft download center.

Open http://localhost in a web browser and check that you get a MS4W - MapServer 4 Windows welcome page. Click the link to

/cgi-bin/mapserv.exe under the Features heading and check you get an error message like 'No query information to decode. QUERY_STRING is set, but empty'.

You have successfully installed MapServer.

If you wish to check which version of MapServer you have installed, you need to open a Command Window, navigate to the mapserv.exe file (typically at this stage of the setup, C:\ms4w\Apache\cgi-bin\) and type: mapserv -v

You should get a result like:

MapServer version 6.0.0 OUTPUT=GIF OUTPUT=PNG OUTPUT=JPEG OUTPUT=KML SUPPORTS=PROJ SUPPORTS=AGG SUPPORTS=CAIRO SUPPORTS=FREETYPE SUPPORTS=ICONV SUPPORTS=FRIBIDI SUPPORTS=WMS_SERVER SUPPORTS=WMS_CLIENT SUPPORTS=WFS_SERVER SUPPORTS=WFS_CLIENT SUPPORTS=WCS_SERVER SUPPORTS=SOS_SERVER SUPPORTS=FASTCGI SUPPORTS=THREADS SUPPORTS=GEOS INPUT=JPEG INPUT=POSTGIS INPUT=OGR INPUT=GDAL INPUT=SHAPEFILE

That's it!

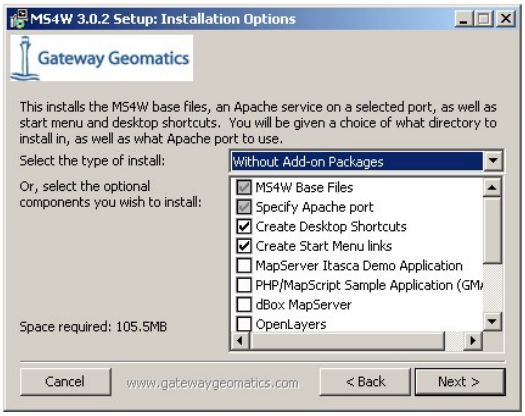
Section last modified: 11 June 2013

4.2.2 Alternative method using the MS4W 'Nullsoft Scriptable Install System' (NSIS) installer

Maptools.org provides a NSIS installer, to make it easier to install and configure MapServer and related associated Geospatial software. NSIS is used by many other FOSS4G packages, so the hope is that all communities can join together to create a single installer. The installer requires you to have an active internet connection. The installer allows you to make configuration choices that you don't get when using the zip file version, but at present it doesn't use the most up-to-date version of MS4W so you will also need to download the latest MapServer binary and do a manual update.

To run the MS4W NSIS installer, you must first download the setup.exe file (http://www.maptools.org/ms4w/index.phtml?page=downloads.html).

For our example installation you only need to use the default installation "Without Add-on Packages" option. Next, you have the option to change the location you install the MS4W files to; by default this will be the root of C:\. Finally you get to choose which port to run Apache on; you should use the default (port 80) unless you already have a web server operating on that port on your server.



NSIS installer dialogue window showing minimum options required to install MapServer and Apache

After the installer has finished running you should have a file structure exactly the same as that installed by the MS4W zip; with Apache (as "Apache MS4W Web Server") installed and running. If you changed the port or install path location, this will already be configured for you.

Section last modified: 11 June 2013

4.2.3 Updating an existing OneGeology MS4W installation

From time to time it will be necessary to update your MapServer or MS4W installation, for example when bug fixes are released, or when the software is upgraded to allow a new version of the WMS specification to be served. To update to a new version of MS4W, you should first stop and uninstall the existing Apache service by running the "apache-uninstall.bat" file found in the ms4w folder (i.e. by clicking on it). You can then just unzip the new MS4W zip file into the same location, and allow it to overwrite all existing files. Any

file or folder within the existing ms4w folder that you have created will not be deleted. You then need to run the apache-install.bat script inside the ms4w folder to install your new version of Apache. The new version of the MapServer binaries will be installed into the cgi-bin folder; if you are following the methodology set out by the exemplar WMS, you will need to copy the new binaries to each of the Application sub folders within cgi-bin, and rename the mapserv.exe to wms.

If your Apache installation is up-to-date and you only wish to update MapServer you need only get a copy of the MapServer binaries for example, from the latest MS4W zip, or sometimes as a separate MapServer zip downloadable from http://dl.maptools.org/dl/ms4w/, and copy them over the existing MapServer files in the cgi-bin folder (and sub-folders as appropriate). See section 4.3.1 for further details.

You will need to rename the copy of "mapserv.exe" inside your cgi-bin folder to "wms". Make sure there is no .exe extension, especially if you do not have file extensions visible in your Explorer windows. You may get a warning about changing the file suffix; this is OK.

Section last modified: 11 June 2013

4.2.4 If you already have an Apache installation

If you already have an installation of Apache which you want to use it is possible to copy the necessary parts of the MS4W bundle to your installation. The details will depend on exactly how you have configured your installation but the main steps you will need to follow are as follows. They are in the context of using a pristine Apache (v2.2.17) installation so, if you have done a lot of customization of your installation you may need to adapt them.

Instead of following all the above steps for installation simply unzip the ms4w.zip file to a convenient temporary location. You will then need to copy the following files over to your existing Apache installation. In the following we give directory paths from the ms4w root wherever you unzipped it.

Copy the contents of ms4w\Apache\cgi-bin to the cgi-bin directory of your Apache installation. (Strictly you may not need all these files but it is easier just to copy them all across.)

Add the following directives in an appropriate place in your httpd.conf file.

```
#---------------------------------
# Alias for MapServer tmp directory
#---------------------------------
Alias /ms_tmp/ /ms4w/tmp/ms_tmp/
<Directory "/ms4w/tmp/">
AllowOverride None
Options None
Order allow, deny
Allow from all
</Directory>
```

Replace "/ms4w/tmp/" with the path to somewhere on your machine suitable for storing the temporary image files which MapServer generates during its operation. You may also want to copy the contents of ms4w\tmp to this directory as it contains a script that can be used to delete old files from this directory and which could be set as a scheduled task.

You will also want to copy the following directories from the MS4W bundle to somewhere convenient on your machine: ms4w\proj\nad, ms4w\gdaldata and ms4w\gdalplugins. Then add the following to your httpd.conf file, replacing the path /ms4w/ with the directory you have copied the above directories to.

```
# set environment vars necessary for MapServer
SetEnv PROJ_LIB /ms4w/proj/nad/
# Replace /Apache/cgi-bin/ below with your
# Apache cgi-bin directory path
SetEnv PATH /Apache/cgi-bin/
# Set GDAL_DATA environment variable to location
# of supporting gdal files
SetEnv GDAL_DATA "/ms4w/gdaldata"
# Set GDAL_DRIVER_PATH environment variable for gdal plugins
SetEnv GDAL_DRIVER_PATH "/ms4w/gdalplugins"
# uncomment the following line to log MapServer errors to a file
#SetEnv MS_ERRORFILE "/ms4w/tmp/ms_error.txt"
```

Section last modified: 11 June 2013

4.3 Configuring your MapServer WMS

The following section takes you through the exemplar service installed as part of the full download i.e. with Apache and MapServer (as part of MS4W) included. We are assuming that you will install into the root directory of a drive as required of this installation; typically this will be c:\, with all the content created within a folder called 'ms4w' (e.g. c:\ms4w). You do not need to create a folder called 'ms4w' as it is already part of the exemplar zip. To configure your own service using this structure you will need to make changes in the following folders:

C:\ms4w\apache\cgi-bin ~ you need to make a copy of the MapServer binaries and put them in a sub-folder with an alias name that conforms to the OneGeology WMS profile. This will be your service URL.

C:\ms4w\apps ~ you need to create a sub-folder and add your data, service templates, and map file.

C:\ms4w\httpd.d ~ you need to create an Apache .conf configuration file for your service, that follows the same naming convention as your service URL, and which maps together your app data and cgi service information.

You will also probably want to make changes in the following folder:

C:\ms4w\apache\htdocs ~ html documents linking to your service

It is recommended you copy the exemplar data rather than modify it to ensure you always have a reference copy you can refer to and preview.

The first query a WMS client will send to a server is a GetCapabilities request. In the response the server will supply information necessary for the client to know how many layers it is serving and how to retrieve them. It will also supply human readable information that could be useful for humans to understand what data is being served, what limitations it has, what restrictions on use etc. The way this information is viewable is dependent on the client, here we will just describe how you can make sure that it is included in the server response. MapServer will generate much of this information automatically for you from the configuration of data layers you include but there are some extra WMS specific parameters to include filling in all the fields of a GetCapabilities response. MapServer uses text configuration files called "map files" with a MapServer specific syntax to configure its web services. The first main section is inside the <Service> element which can contain a variety of metadata, such as keywords and contact information about your WMS. These are essentially all defined by corresponding fields in the MapServer map file. The next <Capability> section contains some essentially automatically generated <Request> specifications detailing what URLs to use for requesting maps, feature information etc., and a series of <Layer> elements inside one parent <Layer> which give some automatically generated and some WMS specifically configured data on each of your layers. The example layers show exactly what parameters should be supplied for each layer; whilst Appendix G (WMS version 1.1.1) and Appendix F (WMS version 1.3.0) show how these relate to the appropriate GetCapabilities response.

Section last modified: 11 June 2013

4.3.1 Step-by-step configuration for MS4W

C:\ms4w\Apache\cgi-bin\

Create a folder inside ms4w\Apache\cgi-bin with a name including your organization initials in the same way as the example application shows for BGS (BGS_Bedrock_and_Superficial_Geology); see sections 2.2 and 2.3 for rules governing for web service titles and URLS.

It is not within the scope of OneGeology at this stage to address the problem of translating geological terms between different languages so the above service can be in the language you usually use for your data. However, if you already have your data in other languages, in particular English if that is not your default language, then we would like to encourage you to provide services in these other languages as well. These should be served from separate services with different URLs. In MapServer this means making another copy of the above directory and renaming it to use the appropriate language in the directory name.

At this stage you should have a sub-folder structure within c:\ms4w\Apache\cgi-bin like:

\BGS_Bedrock_and_Superficial_Geology
  Holds mapserver cgi libraries for the 'BGS_Bedrock_and_Superficial_Geology' shapefile-based exemplar service.
\BGS_Bedrock_Geology
  Holds mapserver cgi libraries for the 'BGS_Bedrock_Geology' raster-based exemplar service.
\Your-Organization-code_Your-Service-Theme
  EMPTY
\Your-Organization-code_Your-alternate-language(service)-code_Your-Service-Theme

EMPTY

You then need to copy the ms4w\Apache\cgi-bin\wms file and all the libraries it depends on from one of the exemplar services cgi-bin sub-folders to the newly-created folder (or folders). Rather than attempt to list exactly which libraries are necessary it is probably easier simply to copy all the files to your newly created folder(s).

Section last modified: 11 June 2013

4.3.1.1 Installing the exemplar services into an existing MS4W installation

If you have downloaded the complete MS4W with exemplar zip, you should skip this section. This section is only for people wanting to install the exemplar services into an existing version of MS4W.

Obtain the OneGeology template application in the 20Mbytes approx. sized 1G_WMS-exemplar-data-MS6-update.zip file from the BGS FTP website (ftp://ftp.bgs.ac.uk/pubload/OneGeology/).

If you are using a web browser clicking on this URL may take you directly to it without requesting a password. If you prefer to use the older DOS prompt style FTP user interface then as normal with such anonymous ftp services enter anonymous if prompted for a userid and type your email address as the password to allow the FTP manager to monitor who is using the service.

Unzip the OneGeology template application to the same drive and directory level as the MS4W resulting from the MapServer installation e.g. if you installed MS4W on C:\MS4W then point the unzip extract to C:\. It should create a number of files inside the ms4w directory. The main part of the two example applications are inside a BGS_Bedrock_and_Superficial_Geology directory (for the shapefile based example) and BGS_Bedrock_Raster_Map directory (for the image file based example) which will be created inside ms4w\apps. You should copy the appropriate one to a directory named appropriately for your service.

Section last modified: 11 June 2013

4.3.1.2 BGS exemplar service (SERVICE configuration)

The first part of this section helps you set up a new map service (with a service name appropriate to your data) which, at this stage, uses one of the exemplar datasets as the data source. The second part of the section helps you configure this new service so it can serve your own data.

C:\ms4w\apps\cookbookExemplars

Inside the \ms4w\apps\cookbookExemplars folder you will find two folders: "BGS_Bedrock_and_Superficial_Geology" and "BGS_Bedrock_Raster_Map". These folders contain the exemplar data, and map configuration files.

We will assume you are basing your service on the BGS_Bedrock_and_Superficial_Geology example; substitute with BGS_Bedrock_Raster_Map if that is closer to your requirements. When you have decided which exemplar service is most suitable for your needs, you should copy that exemplar folder to a new folder that will be your new service.

Note the names of these folders do not have to match the names of the service, but you would be advised to ensure that the folder name gives some hint as to its contents and purpose. For example we call one of our exemplar folders "BGS_Bedrock_Raster_Map" to indicate that this service application holds a raster map as datasource, rather than a shapefile.

Make more copies with appropriate names if you are also making multiple language services.

Inside this folder there is a wwwroot\index.html file. This has some example queries which will enable you to test your service when you have set it up. For these to work for your new service you will need to edit the file and change all occurrences of the string "BGS_Bedrock_and_Superficial_Geology" with the name you have created for your service.

C:\ms4w\httpd.d\

Now you will need to create an httpd conf file in the \ms4w\httpd.d\ folder that has the same name as your service; for example, the "BGS_Bedrock_and_Superficial_Geology" exemplar service has a conf file called "httpd_BGS_Bedrock_and_Superficial_Geology_Exemplar.conf" and the "BGS_Bedrock_Geology" exemplar service has a corresponding conf file called "httpd_BGS_Bedrock_Geology.conf"

You need to copy one of the exemplar .conf files and rename it to match the name of your service, you will then need to change the paths in the file to match your service name and folder configuration.

Using the raster exemplar service (as shown below), you will need to change all references to "BGS_Bedrock_Geology" to match the name of your service, and all references to "BGS_Bedrock_Raster_Map" to match the name of your app folder. Note, you do not

need to add the drive letter.

```
Alias /BGS_Bedrock_Geology/ "/ms4w/apps/cookbookExemplars/BGS_Bedrock_Raster_Map/wwwroot/"

<Directory "/ms4w/apps/cookbookExemplars/BGS_Bedrock_Raster_Map/wwwroot/">
  AllowOverride None
  Options Indexes FollowSymLinks Multiviews
  Order allow,deny
  Allow from all
</Directory>

SetEnvIf Request_URI "/cgi-bin/exemplars/BGS_Bedrock_Geology/wms"
    MS_map file=/ms4w/apps/cookbookExemplars/BGS_Bedrock_Raster_Map/onegeology.map
SetEnvIf Request_URI "/fcgi-bin/exemplars/BGS_Bedrock_Geology/wms"
    MS_map file=/ms4w/apps/cookbookExemplars/BGS_Bedrock_Raster_Map/onegeology.map
```

Again make more copies if making multiple language services.

c:\ms4w\Apache\htdocs\

Now you should edit the index.html file in the Apache web root \ms4w\Apache\htdocs\ and add a link to your new service. Note, the link you use is the value of the Alias (line one of the httpd conf file).

Test your service

Restart the Apache service using the Services control panel and then reload the http://localhost page in your browser. You should get the index.html page with the link to your new service. If you follow the link you should find a page with some test requests for some of the exemplar layer data.

Configure your new service

Next you need to configure your own data with the service. You can use the example UK geology layers as a guide to creating your own shapefile based layers. The BGS_Bedrock_Raster_Map directory provides a layer you can use as a guide for a raster file based layer. The example uses an 8-bit palette PNG with transparent background and world file for georeferencing. You could also use a 32-bit TIFF file with alpha layer transparency and world file for georeferencing or GeoTIFF file with georeferencing information incorporated inside the file. Refer to the MapServer documentation for further details on raster formats or post a question to the OneGeology help forum if you have further questions.

You should remove the examples in your own folders and all the BGS_Bedrock_and_Superficial_Geology files when you have finished i.e. make sure that you do not serve to the WWW the BGS dataset! We will soon see if more than one web server is serving it! The BGS 625k dataset and configuration is provided in the template application so that you can see everything that is required to set up a real OneGeology Level 1 WMS service including real metadata and example WMS service layer Names, Titles, Keywords etc.

First you should copy your source date (shapefiles or rasters) to your renamed version of the apps\BGS_Bedrock_and_Superficial_Geology\data directory. Next you need to edit the OneGeology map file appropriately for your server.

You can refer to the full map file for the BGS_Bedrock_and_Superficial_Geology service in Appendix E. You may also find the online MapServer documentation (http://www.mapserver.org/documentation.html) useful, to help you configure your service.

There are comments included to indicate where you need to edit values. The important sections are reproduced below with comments.

At the top of the map file you will need to edit the EXTENT and UNITS lines shown in the extract below. The below example specifies units of decimal degrees and an extent (minx miny maxx maxy) covering the whole of the United Kingdom. You should change these according to the map units in your data files and their total extent.

```
MAP
# Root layer name
  NAME BGS_EN_Bedrock_and_Superficial_Geology

  STATUS ON
  SIZE 600 600
#======================================================================#
# EXTENT
```

```
# Change to appropriate min-x,min-y,max-x,max-y coordinates for your data
#========================================================================#
  EXTENT -8.6476 49.8639 1.76943 60.8622
#========================================================================#
# Units of the map coordinates. Used for scalebar and scale computations.
# UNITS [feet|inches|kilometers|meters|miles|dd]
#========================================================================#
  UNITS dd
  SHAPEPATH "data"
  IMAGECOLOR 255 255 255
#========================================================================#
# Use the PNG8 IMAGETYPE when you need to use a 256 colour palette
# IMAGETYPE PNG8
#========================================================================#
  IMAGETYPE PNG
  OUTPUTFORMAT
    NAME png
    DRIVER "AGG/PNG"
    MIMETYPE "image/png"
#========================================================================#
# Use the 8 bit MIMETYPE when you need to use a 256 colour palette
# MIMETYPE "image/png; mode=8bit"
#========================================================================#
    IMAGEMODE RGBA
### All colours and alpha based transparency
    EXTENSION "png"
    FORMATOPTION "INTERLACE=ON"
### Slow connections will profit from this option
  END
  PROJECTION
    "init=epsg:4326"
  END
```

Note, the use of the **GD/PNG** renderer is deprecated in MapServer 6.0.0, you should switch to using the AGG renderer (as shown above). If you require a 256 color paletted image, then you can use the builtin png8 imagetype, by specifying **MIMETYPE "image/png; mode=8bit"**

The next (WEB) section of the map file (extract shown below) sets general information for your web service including a general description, contact information, etc. You can edit it according to the comments included in the example.

```
  WEB
    HEADER "templates/query_header.html"
    FOOTER "templates/query_footer.html"
    IMAGEPATH "/ms4w/tmp/ms_tmp/"
    IMAGEURL "/ms_tmp/"
```

In the following (METADATA) section(s) instead of the "WMS_" prefix you may use "OWS_" prefix. The OWS_ prefix is used by WMS, WFS, WCS, GML, and other services, so you only have to specify that metadata type once. If you have "OWS_ABSTRACT" and "WMS_ABSTRACT", the "OWS_ABSTRACT" will be used by any WFS / WCS service whilst the "WMS_ABSTRACT" will be used by the WMS.

```
    METADATA
#=============================================================================#
# OWS_ metadta applies to all available services (WMS, WFS, WCS, SOS...)
# WFS_ metadata applies to WFS services only. Values will override an OWS setting
# WMS_ metadata applies to WMS services only. Values will override an OWS setting
#=============================================================================#
      OWS_ABSTRACT "The 1:625k DiGMap data covering the whole of the United Kingdom is available
      in this OGC web service for all uses - including commercial use subject to the conditions
      in the Access Constraints section and is being served as a contribution to the OneGeology
      initiative (www.onegeology.org)."
      OWS_ACCESSCONSTRAINTS "The 1:625k DiGMap data is available for free download for your
```

```
      personal, teaching, research, or non-commercial use (as described on
      http://www.bgs.ac.uk/about/copyright/non_commercial_use.html). Your use of any information
      provided by the British Geological Survey (BGS) is at your own risk. Neither BGS nor the
      Natural Environment Research Council (NERC) gives any warranty, condition, or representation
      as to the quality, accuracy, or completeness of the information or its suitability for any
      use or purpose. All implied conditions relating to the quality or suitability of the
      information, and all liabilities arising from the supply of the information (including any
      liability arising in negligence) are excluded to the fullest extent permitted by law."
      OWS_ADDRESS "Environmental Science Centre"
      OWS_ADDRESSTYPE "postal"
      OWS_CITY "Keyworth"
      OWS_CONTACTELECTRONICMAILADDRESS "enquiries@bgs.ac.uk"
      OWS_CONTACTFACSIMILETELEPHONE "+44 (0)115 936 3200"
      OWS_CONTACTINSTRUCTIONS ""
      OWS_CONTACTORGANIZATION "British Geological Survey"
      OWS_CONTACTPERSON "Garry Baker"
      OWS_CONTACTPOSITION ""
      OWS_CONTACTVOICETELEPHONE "+44 (0)115 936 3100"
      OWS_COUNTRY "United Kingdom"
      OWS_ENABLE_REQUEST "*"
      OWS_FEES "none"
      OWS_HOURSOFSERVICE "Mon-Fri, 09:00-17:00"
#============================================================================#
# OWS_KEYWORDLIST
# Put your organisation name and any other information you want to include.
# You MUST include "OneGeology" as one of the keywords.
# Do NOT use spaces after the commas in the keyword listing.
#============================================================================#
      OWS_KEYWORDLIST "OneGeology,geology,map,United Kingdom,bedrock,superficial,lithology,
      lithostratigraphy,age,MD_LANG@ENG,MD_DATE@2011-06-15"
      #OWS_ONLINERESOURCE "http://another-service/or/some-different-path/ows?"
      OWS_POSTCODE "NG12 5GG"
      OWS_ROLE "PointOfContact"
      OWS_SERVICE_ONLINERESOURCE "http://www.bgs.ac.uk/products/digitalmaps/digmapgb.html"
      OWS_STATEORPROVINCE "Nottinghamshire"
      OWS_SRS "EPSG:27700 EPSG:3857 EPSG:4258 EPSG:4326"
      OWS_TITLE "BGS Bedrock and Superficial geology"
      WFS_ABSTRACT "The 1:625k DiGMap data covering the whole of the United Kingdom
      is available in this OGC WFS service for your personal, non-commercial use only
      and is being served as a contribution to the OneGeology initiative(www.onegeology.org).
      The contents of this WFS service are not intended for direct use but are transformed by
      a mediator layer into separate WFS services which provide data in GeoSciML. This process
      is described in Chapter 2 of the OneGeology WFS Cookbook available at www.onegeology.org.
      WMS_ABSTRACT "The 1:625k DiGMap data covering the whole of the United Kingdom
      is available in this OGC WMS service for your personal, non-commercial use only
      and is being served as a contribution to the OneGeology initiative (www.onegeology.org).
      Separate bedrock geology and superficial deposits layers are available in this service.
      Layers available for bedrock are lithostratigraphy, age, and lithology. Layers available
      for superficial deposits layer are lithostratigraphy and lithology.  For information
      about more of the British Geological Survey's maps that are available digitally please
      visit http://www.bgs.ac.uk/products/digitalmaps/digmapgb.html"
      WMS_BBOX_EXTENDED "TRUE"
      WMS_FEATURE_INFO_MIME_TYPE "text/html"
      #WMS_ONLINERESOURCE "http://another-service/or/some-different-path/wms?
"
      WMS_SRS "EPSG:4326 EPSG:3857 CRS:84 EPSG:27700 EPSG:4258"
    END
  END
```

You may use the "WMS_ONLINERESOURCE" (and "OWS_ONLINERESOURCE" etc) metadata sections to change the service

endpoint for your service. For example, you can do this to force users (clients) to always use the IP version of your service rather than the server name (or vice versa), or to force them to always use the cgi-bin version rather than the fcgi-bin version (or vice versa), or to get them to use a different server. That is, you can have an initial GetCapabilities response document that itself advertises a different service endpoint for the subsequent GetMap requests. There are several reasons why you might want to do this; one such reason is when you have an existing service that has multiple layers only some of some of which are conformant to OneGeology and in which the service metadata doesn't otherwise conform to the OneGeology WMS profile. In such an example, you can set up a service that has a GetCapabilities document that is conformant to the OneGeology WMS profile and which advertises only some of the layers of the other service through the use of the ”WMS_ONLINERESOURCE” metadata.

The SRS specifies the coordinate system that the WMS can serve data in. These are commonly specified using EPSG codes **and must include EPSG:4326** so that all services have at least one coordinate system in common. We would like if you could specify the Spherical Mercator projection (EPSG:3857) to allow your service to be used in Google Maps. You may specify other systems that are appropriate for your region if you wish; for example we would expect most European services to support either (or both of) EPSG:4258 and EPSG:3034 to ensure compliance with INSPIRE coordinate system requirements.

2 star accreditation requirement

For a 2 star accredited service ALL OneGeology layers must supply a LatLonBoundingBox defined using SRS EPSG:4326 [WGS1984 latitude/longitude].

For a 2 star accredited service ALL OneGeology layers must support EPSG:4326.

Each layer must supply a list of the SRS it supports

You can find out more information about EPSG codes (http://www.epsg.org/). The file ms4w\proj\nad\EPSG in your MS4W distribution contains a list of EPSG codes and their projection parameters in a form that the PROJ library used by MapServer can understand. Hopefully, this should cover all cases. If you do not find your system there you could try looking in some of the other files in the "nad" directory and copying the appropriate line or following some of the links given in the MapServer FAQ at where-do-i-find-my-epsg-code (http://www.mapserver.org/faq.html#where-do-i-find-my-epsg-code).

The new version of the OneGeology Portal supports the display of a number of coordinate systems, not just the default EPSG:4326 and the suggested EPSG:3857. as below:

EPSG:3031
Antarctic Polar Stereographic (WGS84) http://spatialreference.org/ref/epsg/3031/
EPSG:3034
Lambert Conformal Conic (ETRS89) http://spatialreference.org/ref/epsg/3034/ (suitable for INSPIRE compliance)
EPSG:3413
NSIDC Sea Ice Polar Stereographic North (WGS84) http://www.spatialreference.org/ref/epsg/3413/
EPSG:3857
Web Mercator (WGS84) http://spatialreference.org/ref/sr-org/7483/
EPSG:4258
2D Latitude / Longitude (ETRS89) http://www.spatialreference.org/ref/epsg/4258/ (suitable for INSPIRE compliance)
EPSG:4326
2D Latitude / Longitude (WGS84) http://spatialreference.org/ref/epsg/4326/

So you may also want to add these coordinate systems to your service, if they are applicable to your service.

You must then create "LAYER" sections for each map (e.g. Bedrock map, superficial geology map etc.) that you are going to serve. The contents of these LAYER sections will depend on whether your data is in shapefile format or a raster image. Examples are given below with comments where you will need to edit them according to your own data.

Section last modified: 21 June 2016

4.3.1.3 Raster image data exemplar (LAYER configuration)

An example of adding a PNG layer is included in the BGS_Bedrock_Raster_Map application. The relevant section is reproduced below for reference. This data was simply created as a raster from the bedrock shapefile for the purposes of serving as an example. In this case we won't be setting up a response to GetFeatureInfo or GetLegendGraphic requests; we are just returning a coloured map. There is more detailed documentation (http://www.mapserver.org/input/raster.html), in particular as regards efficient serving of large images, using 8-bit vs. 24-bit images, tiling etc.

Example extract from map file below:

```
LAYER
    NAME BGS_625k_BAR
    TYPE RASTER
    STATUS ON
```

```
    DATA bedrock625ll.png
    PROJECTION
      "init=EPSG:4326"
    END
    PROCESSING "CLOSE_CONNECTION=DEFER"
    METADATA
      WMS_TITLE "GBR BGS 1:625k Bedrock Age"
      WMS_ABSTRACT "GBR BGS 1:625k Bedrock Age"
      WMS_SRS "EPSG:4326 EPSG:3857 CRS:84 EPSG:27700 EPSG:4258"
      WMS_METADATAURL_HREF "http://.../geonetwork/srv/en/csw?SERVICE=CSW&VERSION=2.0.2
      &REQUEST=GetRecordById&ID=ac9f8250-3ae5-49e5-9818-d14264a4fda4&"
      WMS_METADATAURL_FORMAT "application/vnd.iso.19139+xml"
      WMS_METADATAURL_TYPE "TC211"
      WMS_DATAURL_HREF "http://www.bgs.ac.uk/discoverymetadata/13480426.html"
      WMS_DATAURL_FORMAT "text/html"
      WMS_KEYWORDLIST "OneGeology,bedrock,chronostratigraphy,continent@Europe,
      subcontinent@Northern Europe,geographicarea@United Kingdom,DS_DATE@2011-06-15,age,
      dataprovider@British Geological Survey,DS_TOPIC@geoscientificInformation,geology
      serviceprovider@British Geological Survey,"
      WMS_STYLE "default"
      WMS_STYLE_DEFAULT_LEGENDURL_HEIGHT "353"
      WMS_STYLE_DEFAULT_LEGENDURL_WIDTH "253"
      WMS_STYLE_DEFAULT_LEGENDURL_HREF "http://.../BGS_Bedrock_Geology/bedrockAgeLegend.png"
      # The legend URL must be accessible externally,
      # So you cannot use 'localhost' or '127.0.0.1' above.
      WMS_STYLE_DEFAULT_LEGENDURL_FORMAT "image/png"
    END
    TOLERANCE 10
    DUMP TRUE
  END #layer
```

Section last modified: 20 June 2011

4.3.1.4 Vector data exemplar (LAYER configuration)

The example file includes the following shapefile based layers:

- UK bedrock geology classified by lithology, lithostratigraphy and age
- UK superficial geology classified by lithology and lithostratigraphy.

These are typical of the sorts of layer expected for OneGeology but you may have slightly different theme layers and slightly different available classification schemes. Please consult on the OneGeology forum if you are uncertain about exactly what layers and classifications to serve.

The fields you will need to edit for each LAYER section are described below. The NAME must be unique for each layer. This is a short identifier used by WMS clients to select layers rather than being for human consumption. The OneGeology catalogue service requires that the NAMEs are unique within all the OneGeology layers we have decided some naming conventions as shown in the example. These are described explicitly in Section 2.1. (Note that MapServer does not allow more than 20 characters in a LAYER NAME.)

DATA should specify the name of your shapefile. The HEADER, TEMPLATE, and FOOTER values refer to files with snippets of HTML template which format the results of GetFeatureInfo requests when requested in text/html format. The examples have been written for the data fields in the example shapefiles; it should be straightforward for you to edit them to match the fields in your shapefiles. The PROJECTION section should specify the coordinate system that your data is actually in. This might not be EPSG:4326 if you have your data in some regional projected system. However, as most OneGeology clients will want to retrieve your data in the EPSG:4326 system we suggest it will be better for performance reasons to convert your data files to EPSG:4326 rather than have MapServer convert them on-the-fly in response to requests. See Appendix A for one way to do this with the tools bundled with MS4W.

```
LAYER
    NAME GBR_BGS_625k_BLT #Bedrock lithology
    TYPE POLYGON
```

```
STATUS ON
DATA bedrock625ll
TRANSPARENCY 100
TOLERANCE 0
TOLERANCEUNITS pixels
TRANSFORM TRUE
DUMP TRUE
PROCESSING "CLOSE_CONNECTION=DEFER"
HEADER "templates/bedrock_lithology_query_header.html"
TEMPLATE "templates/bedrock_lithology_query_body.html"
FOOTER "templates/bedrock_lithology_query_footer.html"
PROJECTION
  "init=epsg:4326"
END
```

In the METADATA section you should edit the following values:

WMS_TITLE
: the human readable layer name and must follow the conventions laid in Section 2

WMS_ABSTRACT
: expands on the title with any extra information you feel would be useful.

WMS_SRS
: These values specify which coordinate systems your WMS can supply the data in and **MUST** include at least **EPSG:4326**. Other coordinate systems are up to you; for example you may wish to include the EPSG:3857 (spherical mercator) coordinate system, which is used by several web mapping clients such as Bing Maps, Google Maps, and Yahoo maps.

GML_INCLUDE_ITEMS and WMS_INCLUDE ITEMS
: These items will depend on the data fields in your shapefile and which ones you wish to make available by a GetFeatureInfo request. Items should be a comma separated list of field names. These should be the same as the fields included in the HTML templates above.It is optional to include any information here but obviously if you have fields with geological unit names or ages they would be useful to include.

WMS_METADATAURL_HREF and WMS_DATAURL_HREF
: are supposed to contain URLs for web pages which describe the dataset used for the layer in more detail. It is possible that you may already have suitable web pages on your organization's website, or you may wish to create suitable pages to be served by this same server. These URL's give users of your WMS service quick and easy links back to your web pages that may describe your available data offerings in more detail. The differences between the metadataurl and dataurl are:

  WMS_METADATAURL_HREF
  : the metadataurl must only link to a page which describes your layer data corresponding to either the TC211/ISO:19115:2003 or FGDC-STD-001-1998 metadata standards. See Section 2.7 of this cookbook for the core metadata required to be TC211/ISO:19115:2003 compliant

  WMS_DATAURL_HREF
  : the dataurl is to be used when you have some layer metadata that doesn't conform to either of these standards.

  The UK geology layer examples point to some pre-existing web pages on the BGS website which were suitable so that you can get an idea of what you might use for your own data.

```
METADATA
  OWS_TITLE "GBR BGS 1:625k Bedrock Lithology"
  OWS_ABSTRACT "GBR BGS 1:625k scale Bedrock Lithology"
  WMS_SRS "CRS:84 EPSG:27700 EPSG:3857 EPSG:4258 EPSG:4326"
  GML_INCLUDE_ITEMS "RCS_D"
  GML_FEATUREID "ID"
  WMS_INCLUDE_ITEMS "RCS_D"
  WMS_METADATAURL_FORMAT "application/xml; charset=UTF-8"
  WMS_METADATAURL_HREF "http://.../geonetwork/srv/en/csw?SERVICE=CSW&
    VERSION=2.0.2&REQUEST=GetRecordById&ID=ac9f8250-3ae5-49e5-9818-d14264a4fda4&"
  WMS_METADATAURL_TYPE "TC211"
  OWS_DATAURL_HREF "http://www.bgs.ac.uk/discoverymetadata/13480426.html"
  OWS_DATAURL_FORMAT "text/html"
  OWS_KEYWORDLIST "OneGeology,bedrock,lithology,continent@Europe,
  subcontinent@Northern Europe,geographicarea@United Kingdom,geology,
  dataprovider@British Geological Survey,DS_TOPIC@geoscientificInformation,
```

```
    serviceprovider@British Geological Survey,DS_DATE@2011-06-15”
  END
```

The CLASS related items are the most complicated. These sections are setting up the legend and colour scheme of your map polygons so you will need a separate item for each rock type or lithology you have in your data. This will depend on your data and which field in your shapefile you are going to use for colouring the map. The example below specifies that the RCS_D field will be used for specifying which colour to use with the CLASSITEM VALUE. Then for each CLASS section the EXPRESSION specifies the value of RCS_D this colour will apply to and the COLOR and BACKGROUNDCOLOR give the respective RGB colour values. It is likely that creating a CLASS for all your values would be very time-consuming to do manually. If you already have ArcView and an ESRI .avl legend file you can automatically convert this to the MapServer format using the utility described in Appendix C or if you have ArcGIS and .mxd or .lyr files you can use the utility described in Appendix C.

```
CLASSITEM ‘RCS_D’
  CLASS
    NAME ‘ANORTHOSITE’
    EXPRESSION ‘ANORTHOSITE’
    #RASTERFILL_STYLE_SOLID
    STYLE
      COLOR 237 237 237
      BACKGROUNDCOLOR 255 255 255
    END #style
  END #class
```

#... more classes needed to assign colours

for each value of RCS_D

Colour codes for the lithostratigraphical and lithology layers are specific to the British Geological Survey, you should use the codes used by your geological survey. However, for OneGeology it has been agreed, where possible, to serve a chronostratigraphic age layer using the new IUGS 2009 colour scheme (https://www.seegrid.csiro.au/wiki/pub/CGIModel/GeologicTime/ISChart2009.pdf). This will give some form of harmonization between the different chronostratigraphic layers served by the contributing geological surveys and this is only possible where such an internationally agreed scheme exists. In this case the British Geological Survey had to refine, re-allocate, and ‘map’ its internal ages to fit the IUGS 2009 one. The file ‘ICSClasses.txt’ contains a full list of names and CLASS definitions for the appropriate colours for all the IUGS 2009 colours. In the map file we have commented out the terms that are not actually used in the BGS map; please do the same for your map.

3 star accreditation requirement

For a 3 star accredited service, where an age harmonization layer is defined, it must be based on the IUGS standards.
If you wish you are encouraged to go a step further and follow the GeoSciML-Portrayal schema, which would allow your age service to be queried and re-symbolized using CGI URI codes.

See (Section 7) for details on how to enable GeoSciML-Portrayal in your service.

You may notice that in two of our example layers we have defined some ‘DUMMY’ classes. This is a hack to work around a bug we found with Google Earth. It should only affect you if you have layers with fewer than 16 classes. If this is the case then read the comments in the map file for an explanation and add some dummy classes to your own layers so that there are at least 16.

Also note that the example CLASS definitions do not have any polygon borders (no OUTLINECOLOR directive). This is important as the different scales of viewing to be used within OneGeology mean that border lines would often obscure the polygons themselves.

You will also notice that we do not currently recommend enabling some capabilities in a WMS service such as setting Transparency (this can upset some WMS viewing clients and also other clients can allow the user to set the level of transparency interactively) and ScaleHint (this can upset several clients and make your service difficult to use in them).

Section last modified: 03 October 2014

4.3.2 Adding alternate character set support

If you are serving a non-English language service, you may need or want to change the font and character sets.

To specify a font set you need to use the FONTSET keyword which references a file that contains the mappings from the font name aliases, which you will use in your map file, to the actual font file names on your computer.

```
MAP
    NAME BGS_EN_Bedrock_and_Superficial_Geology
```

```
    # Root layer name
    STATUS ON
    SIZE 600 600
    EXTENT -8.6476 49.8639 1.76943 60.8622
    UNITS dd
    SHAPEPATH "data"
    IMAGECOLOR 255 255 255
    FONTSET "fontset.txt"
```

The path to the fontset.txt file is relative to the location of the map file. In this example (above) then, the fontset.txt file is located in the same folder as the map file.

A fontset.txt file may look like:

```
arial C:\WINDOWS\Fonts\ARIAL.TTF
msgothic C:\WINDOWS\Fonts\MSGOTHIC.TTC
msmincho C:\WINDOWS\Fonts\MSMINCHO.TTC
```

You only need one font specified in your map file but you may list as many as you like in your font set file. To get the font specified in the font file to be used by the map service you now need to modify the LABEL section of the LEGEND, as in the below example, which would allow you to display Chinese characters.

```
LEGEND
    OUTLINECOLOR 200 200 200
    KEYSPACING 10 10
    LABEL
        TYPE truetype
        FONT msgothic
        SIZE 8
        ENCODING UTF-8
    END
END
```

The important parts to note in the above example are:

- TYPE truetype (the default is TYPE bitmap)
- FONT msgothic (the font alias we set up in our fontset.txt file)
- SIZE 8 (size should be specified in points, you can't use words like "small" or "medium" which you do with bitmap fonts.)
- ENCODING UTF-8 (You must also save your map file in this character set encoding).

Section last modified: 31 August 2011.

4.3.3 Debugging common errors

This section is added to help you debug common errors in your map file.

4.3.3.1 Symbol definition error

getString(): Symbol definition error. Parsing error near (*matching text*):(line *line-number*)

This error may occur when your layer classes have a name which includes an apostrophe or other quotation mark that matches the quotation marks used to delimit the CLASS name. For example if your class name is delimited using single quotes such as below and your class name includes a word with a single quote (d'Irma), you will get this error.

NAME 'Formation d'Irma : calcaire, dolomie à tromatolites, argilite'

You can correct the error by swapping the file name delimiters to double quotes (as below), in the CLASS name causing the problem; you don't need to change all the delimiters in all the CLASS names in the map file, just the one(s) with the problem.

NAME "Formation d'Irma : calcaire, dolomie à stromatolites, argilite"

Section last modified: 19 January 2010

4.3.3.2 Unknown identifier

loadLayer(): Unknown identifier. Parsing error near (*matching text*):(line *line-number*)

This error can occur when you are missing an enclosing KEYWORD in the map file. For example in the below example, the CLASS keyword has been commented out, leaving the STYLE section uncommented; STYLE is now found in an unexpected position in the map file, resulting in an error.

```
#CLASS
  STYLE
    COLOR 161 8 0
    MINSIZE 1
    MAXSIZE 10
  END #style
#END #class
```

Section last modified: 19 January 2010

4.3.3.3 Missing magic string

When running a GetFeatureInfo request with the info_format set as text/html, you will get an error like the below, if you do not include a magic string in each of your HTML template documents.

Content-type: text/xml isValidTemplate(): Web application error. Missing magic string, *template-file* doesn't look like a MapServer template.

You need to add **<!-- MapServer Template -->** to the top of ALL templates.

Example the exemplar template query footer.html is:

<!-- MapServer Template -->
</body>
</html>

The recently updated exemplar service kits include this NEW requirement, but those updating from older services might miss this.

More information on this and related issues. (http://mapserver.org/development/rfc/ms-rfc-56.html)

Section last modified: 11 June 2013

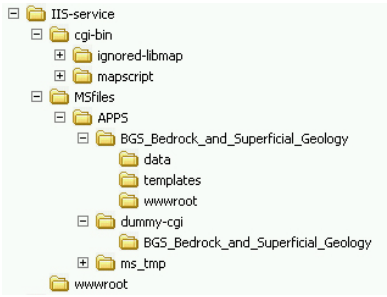
4.4 Alternative MapServer configurations

4.4.1 MapServer and IIS 6

If you have an existing Microsoft Windows server running IIS, you may use this web server instead of Apache to run the MapServer CGI. This section runs through how you may achieve this to create a service URL that almost exactly mirrors that which we have configured using Apache. The configuration allows maximum reuse of code to improve maintenance, (such as future updates to support newer WMS specifications). It is slightly convoluted and requires an advanced knowledge of IIS administration.

To achieve this we need a version of MapServer that has been compiled to run on a Windows platform, and the simplest way of getting this is to use the MapServer binaries that come with the MS4W zip file; specifically we need the contents of the ms4w\Apache\cgi-bin folder.

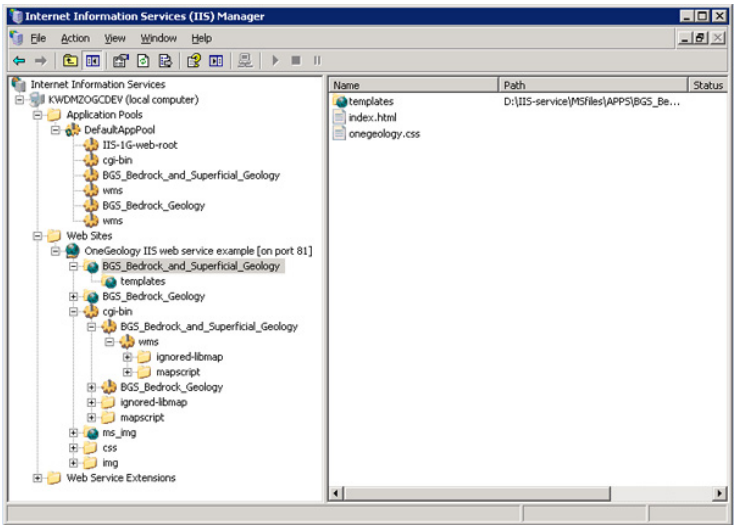
The folder structure used in the example show best practice of separating executable content from static content, you may change the folder structure, and folder naming, as appropriate to fit your server structure, but virtual directory mappings need to be retained. Folder structure and naming are shown in the below figure. In this example the "IIS-service" folder is mapped at the root of D:\, but can exist at any location on your web server or indeed on any server that can be mapped to from your web server.



IIS folder structure

Quickly running through this structure, you need to know that all the MapServer CGI files are held in the "cgi-bin" folder (and sub-folders), and all files concerning the WMS service are held in the "MSfiles" folder and (sub-folders); only the index HTML file is physically held in the "wwwroot" folder. The example shows the setup for the exemplar WMS, and the "BGS_Bedrock_and_Superficial_Geology" folder in "APPS" is a direct copy of the "c:\ms4w\apps\BGS_Bedrock_and_Superficial_Geology" folder from the example zip. Finally, there is no content in the "d:\IIS-service\MSfiles\dummy-cgi\ BGS_Bedrock_and_Superficial_Geology" folder, it exists only as a mechanism to map to the cgi-bin folder within IIS; this mapping mechanism further allows us to map to a single copy of the MapServer CGI binaries, if we need to serve more than one WMS service.

We will now show you how to map these folders in IIS to create the appropriate virtual directories (effectively, the directory structure that a user would see when they access the service). The resultant directory mappings are shown in the below figure from the IIS manager console.



IIS console showing web service configuration

Our IIS service has no other content running on it, but this may not be your starting point. We start by mapping our "Home Directory" to "D:\IIS-service\wwwroot" and copying the contents from "c:\ms4w\Apache\htdocs" to it from the exemplar zip file.

Next we map a virtual directory "cgi-bin" to the folder "D:\IIS-service\cgi-bin" and give it "Scripts and Executables" permissions. This folder does not need Read or Write permissions.

We now map a virtual directory "BGS_Bedrock_and_Superficial_Geology" within the "cgi-bin" virtual directory to the folder "D:\IIS-service\MSfiles\APPS\dummy-cgi\BGS_Bedrock_and_Superficial_Geology". Similarly to the "cgi-bin" folder this virtual directory, needs "Scripts and Executables" permissions, but doesn't need Read or Write permissions.

We now create another virtual directory "wms" within the above "BGS_Bedrock_and_Superficial_Geology" virtual directory and map it back to our physical folder "D:\IIS-service\cgi-bin". Again we set "Scripts and Executables" permissions, but deny Read and Write. We enable a default content page and set this page to be:

"mapserv.exe?map=D:\IIS-service\MSfiles\APPS\BGS_Bedrock_and_Superficial_Geology\onegeology.map"

In effect we have now created a path (as below) to our exemplar service, which hides both the structure of our server and the software we are using to serve our WMS.

http://localhost/cgi-bin/BGS_Bedrock_and_Superficial_Geology/wms/

However at this stage in the setup IIS security will not allow you to run MapServer from this (or any other) URL. To configure this we must "Add a new Web service extension" which we will call "wms", with required file "d:\IIS-service\cgi-bin\mapserv.exe" and set

status to "Allowed". If you are setting up more WMS services you do not need to repeat this stage.

You can now test the MapServer installation with the below URL, and should get a message like "No query information to decode. QUERY_STRING is set, but empty."

http://localhost/cgi-bin/mapserv.exe

We now create a new virtual directory "BGS_Bedrock_and_Superficial_Geology" within the "wwwroot" directory and map it to "D:\IIS-service\MSfiles\APPS\BGS_Bedrock_and_Superficial_Geology\wwwroot"; we give this only "Read" permission. Then, within this directory, another virtual directory "templates" which maps to "D:\IIS-service\MSfiles\APPS\BGS_Bedrock_and_Superficial_Geology\templates"; again with only "Read" permission.

Our final virtual directory is "ms_img" which we create within "wwwroot" and map to "D:\IIS-service\MSfiles\APPS\ms_tmp\img"; we give this directory "Read" and "Write" permissions.

The final step in the configuration is to change the paths in the exemplar onegeology.map file to reflect our physical folder and virtual directory structure:

SHAPEPATH “D:\IIS-service\MSfiles\APPS\BGS_Bedrock_and_Superficial_Geology\data”
IMAGEPATH “D:\IIS-service\MSfiles\APPS\ms_tmp\img\”
IMAGEURL “/ms_img/”
LOG “D:\IIS-service\MSfiles\APPS\ms_tmp\log\bgsBEDROCK.log”

For details on configuring the remainder of the map file see the MapServer configuration section.

Section last modified: 19 January 2010

4.4.2 Installing MapServer on a LAMP server

Installation

This installation guide will give you simple step-by-step instructions of installing a MapServer, with PHP/MapScript and OneGeology level 1 compliant, WMS onto a computer with a LINUX OS with an Apache http web server already running.

This guide includes instructions on the installation of the compulsory libraries to run MapServer 5.6.5 and OneGeology level 1 WMS, all libraries required to serve the BGS exemplar services, and other libraries required to serve Arabic, and Hebrew fonts. The net result of this installation is something similar to that achievable with the MS4W installation. You may opt to install less or more libraries to give less or more functionality, depending on your requirements. More detailed information about a linux MapServer installation is available from the MapServer site (http://mapserver.org/installation/unix.html)

Though we haven’t yet updated this section for the latest version of MapServer (6.0.0) the process will be very similar. Users of Ubuntu/Debian systems may now find that they are able to get the latest version of MapServer by adding the following Personal Package Archives to their system’s software sources:

ppa:ubuntugis/ppa
Official stable UbuntuGIS packages
ppa:ubuntugis/ubuntugis-unstable
Unstable releases of Ubuntu GIS packages

Before starting the installation process, it would be convenient if you log in as root in your Linux machine. Throughout this guide, we would be using the Linux console to run and install the software and the needed libraries. In this document, we assume that the Root Linux prompt is #. Each command would be executed after pressing <ENTER>.

MapServer ~ download the latest source code from the OSGEO MapServer repository (http://download.osgeo.org/mapserver/). You must install all supporting libraries (as below) before compiling MapServer.

Required external libraries (you must have these libraries to install MapServer). We shall try to update the cookbook to show the current releases of these libraries, please let us know if we are showing older versions. Please note the versions we show in the examples are the ones we used to build our Linux MapServer solution and may not be the latest version.

zlib (http://www.zlib.net)
zlib should be on your system by default. 1.2.5 is the current release with security patches. If this doesn’t exist on your system, you must install it before libpng.
libpng (http://www.libpng.org/pub/png/libpng.html)
libpng should be on your system by default. 1.2.44 is the current release with security patches, although versions all the way back to 1.2.7 should work.
freetype (http://www.freetype.org/index2.html)

Version 2.x or above is required by GD. Current release is 2.4.2.

GD (http://libgd.org/Main_Page)
libgd is used by MapServer for rendering images. Version 2.0.28 or greater required. Version 2.0.29 or later is required to use curved (following) labels, and version 2.0.34 is required for antialiasing (1 pixel wide lines/outlines). Current release is 2.0.36.

Other libraries we will use in this installation

libproj (http://trac.osgeo.org/proj/)
libproj provides projection support for MapServer. Version 4.4.6 or greater is required. Current version is version 4.7.0

libcurl (http://curl.haxx.se/libcurl
libcurl is the foundation of OGC (WFS/WMS/WCS) client and server support. Version 7.10 or greater is required. Current version is 7.21.1.

GDAL (http://www.gdal.org/)
GDAL is a translator library for raster geospatial data formats and provides access to at least 42 different raster formats. Current version is 1.7.

OGR (http://www.gdal.org/ogr/)
OGR is a library (and command-line tools) providing read (and sometimes write) access to at least 18 different vector file formats including ESRI Shapefiles, PostGIS, and Oracle Spatial. OGR is a part of the GDAL library.

libjpeg (http://www.ijg.org/)
libjpeg allows MapServer to render images in JPEG format. A sufficient version should be installed by default on your system. Version 8b is the current stable version.

GEOS (http://trac.osgeo.org/geos/)
GEOS allows MapServer to do spatial predicate and algebra operations (within, touches, etc & union, difference, intersection). Requires MapServer version 4.10 or greater, current version is 3.2.2.

libxml2 (http://xmlsoft.org/)
libxml2 is required to use OGC SOS support in MapServer (versions 4.10 and greater). Current version is 2.7.7.

libxslt (http://xmlsoft.org/XSLT/)
required for PostGIS. Current version is 1.1.26.

libpq (http://www.postgresql.org/docs/8.4/interactive/libpq.html)
libpq is required to support the use of PostGIS geometries within the PostgreSQL database. Ideally, your client library matches the database you are querying from.

FriBidi (http://www.fribidi.org/)
FriBidi is an implementation of the Unicode Bidirectional Algorithm, and is used to provide support for languages with characters that flow from right to left. Current release is 0.10.9.

We will download all the required libraries into the /usr/local/src directory using the ‘wget’ program. It is recommended that you browse to the home page for each library to ensure you obtain the format that is best suited to your system, to check there are no known issues that might affect your install, and to ensure you have the most up-to-date library for your system.

```
#cd /usr/local/src
#wget http://download.osgeo.org/mapserver/mapserver-5.6.5.tar.gz
#wget http://www.gzip.org/zlib/zlib-1.2.3.tar.gz
#wget http://prdownloads.sourceforge.net/libpng/libpng-1.2.40.tar.gz?download
#wget http://sourceforge.net/projects/freetype/files/freetype2/2.3.11/freetype-2.3.11.tar.gz/download
```

Etc...

After successfully downloading the compressed files using the ‘wget’ program, we will need to uncompress using the ‘tar’ program.

The following steps would uncompress the downloaded files:

```
#tar -xzvf mapserver-5.6.5.tar.gz
#tar -xzvf zlib-1.2.3.tar.gz
#tar -xzvf libpng-1.2.40.tar.gz
#tar -xzvf freetype-2.3.11.tar.gz
#tar -xzvf gd-2.0.36.tar.gz
#tar -xzvf proj-4.7.0.tar.gz
```

Etc...

Uncompressing the .tar.gz files will create a sub-directory, with a name corresponding to the root name of the compressed file, within the /usr/local/src/ directory, containing the files needed to build the library on your system.

Before continuing with building the supporting libraries and MapServer, it is worth ensuring all other system libraries and components are up-to-date. In Ubuntu (as per this install) you do this by:

```
#apt-get update
#apt-get upgrade
#apt-get install build-essential
```

Now we need to change to each sub-directory in turn to compile and install the libraries on our system using the following sequence of commands:

```
#./configure
#make
#make install
```

Note you may review any configuration options by using the help option (in this example we direct the output to the 'less' program) as:

```
#./configure --help | less
```

Use q to quit from less.

E.g.

```
#cd zlib-1.2.3
#./configure
#make
#make install
#cd ..
```

By default the libraries created will be installed in the /usr/local/lib directory.

Check there are no errors cited after running both the 'configure' and 'make' programs. If there are errors you will need to fix these first before continuing. For example you might get a warning that you are missing a dependant library, or an existing library is too old, or the make program found more than one copy of a library. You might be able to fix the issues by specifying non-default configure options (see the configure help), or editing the PATH environment variable.

You should clean up any files before re-running configure and make. This might be possible using the 'make clean' command, but if the errors happen when you are trying to compile MapServer (for example) you may need to delete the sub-folder and start again.

Example of recompiling, if you get a compilation error:

```
#cd /usr/local/src/zlib-1.2.3
#./configure
#make
```

But you get errors here so then (when you have fixed the issues) you could try:

```
#make clean
#./configure
#make
```

If you get the same (or similar) error then:

```
#cd /usr/local/src/
#rm -r zlib-1.2.3
#tar -xzvf zlib-1.2.3.tar.gz
#cd zlib-1.2.3
#./configure
#make
#make install
```

Once you have installed all the dependent libraries you can now install MapServer.

We will install onto a Ubuntu server (9.10) with Apache, PHP, Perl, Python, and PostgreSQL with PostGIS already installed and running.

We will force some configuration options, other options are picked up by default (for example AGG support).

```
#cd /usr/local/src/mapserver-5.6.5
#./configure --with-ogr --with-gdal --with-wfsclient --with-wmsclient --with-proj --with-wcs --with-postgis --with-geos --with-sos
--with-experimental-png --with-fribidi-config --with-threads --enable-debug
#make
```

Note for MapServer you don't need to run 'make install', you just need to move (or copy) the mapserv file to an appropriate cgi-bin

executable directory accessible by your Apache web server. This location will vary depending on your version of Linux; in Ubuntu 9.10 the default location for cgi-bin files is **/usr/lib/cgi-bin**

#cp mapserv /usr/lib/cgi-bin/mapserv

The mapserv binary created needs to have —rwxr-xr-x permissions to be able to execute

You can check permissions using:

#ls —l mapserv

If needed you can change permissions using:

#chmod 755 mapserv

To test you have compiled mapserv with all appropriate options you can check the version:

#./mapserv —v

You should get an output like:

MapServer version 5.6.5 OUTPUT=GIF OUTPUT=PNG OUTPUT=JPEG OUTPUT=WBMP OUTPUT=PDF OUTPUT=SVG SUPPORTS=PROJ SUPPORTS=AGG SUPPORTS=FREETYPE SUPPORTS=ICONV SUPPORTS=FRIBIDI SUPPORTS=WMS_SERVER SUPPORTS=WMS_CLIENT SUPPORTS=WFS_SERVER SUPPORTS=WFS_CLIENT SUPPORTS=WCS_SERVER SUPPORTS=SOS_SERVER SUPPORTS=THREADS SUPPORTS=GEOS SUPPORTS=RGBA_PNG INPUT=EPPL7 INPUT=POSTGIS INPUT=OGR INPUT=GDAL INPUT=SHAPEFILE

To test you have mapserv accessible through your web server you can use the 'lynx' text browser package (available through apt-get):

#apt-get install lynx
#lynx http://127.0.0.1/cgi-bin/mapserv

Or you could simply use the wget program (which will retrieve the output as a text file):

#cd /tmp
#wget http://127.0.0.1/cgi-bin/mapserv
#less mapserv

You should get the message "No query information to decode. QUERY_STRING is set but empty"

Congratulations! You have now got MapServer installed and configured to run in your web server.

Section last modified: 24 June 2011.

4.4.2.1 Configuring MapServer exemplar services on a LAMP server

We shall now configure the two BGS exemplar services (a shapefile version and a raster version) available from the BGS FTP server.

#cd /usr/local/src
#wget ftp://ftp.bgs.ac.uk/pubload/OneGeology/1G_WMS-exemplar-data-MS6-update.zip
#unzip 1G_WMS-exemplar-data-MS6-update.zip

We now need to move the contents of the zip file to the correct locations on our server.

First we move our index pages to the root directory of the web server (/var/www/ on Ubuntu).

#mv ms4w/Apache/htdocs/* /var/www/

Create Alias configuration files

Next we need to create an alias to our data files and MapServer html templates. The way you do this varies considerably depending on your Linux version. In older versions of Ubuntu these aliases are created in the ***alias*** file located in the **/etc/apache2/conf.d/** directory. In recent versions you should add these aliases to the ***httpd.conf*** file in **/etc/apache2/**

We need to create information in the style of the contents of the .conf files (found in our unzipped contents ../ms4w/httpd.d/ directory). We will combine the contents of both .conf files (that deal with the html templates and data content) into our 'alias' configuration file.

You may choose any text editor, but probably the easiest to use is nano.

#cd /etc/apache2
#nano httpd.conf

Alias /BGS_Bedrock_Geology
/usr/local/src/ms4w/apps/cookbookExemplars/BGS_Bedrock_Raster_Map/wwwroot/

<Directory /usr/local/src/ms4w/apps/cookbookExemplars/BGS_Bedrock_Raster_Map/wwwroot/>
AllowOverride None
Options Indexes FollowSymLinks Multiviews
Order allow,deny
Allow from all
</Directory>

Alias /BGS_Bedrock_and_Superficial_Geology
/usr/local/src/ms4w/apps/cookbookExemplars/BGS_Bedrock_and_Superficial_Geology/wwwroot/

<Directory /usr/local/src/ms4w/apps/cookbookExemplars/BGS_Bedrock_and_Superficial_Geology/wwwroot/>
AllowOverride None
Options Indexes FollowSymLinks Multiviews
Order allow,deny
Allow from all
</Directory>

^O (to save changes)

ENTER

^X (to exit)

You will probably need to restart the Apache web server at this point:

#/etc/init.d/apache2 restart

We can test these using the lynx browser

#lynx http://127.0.0.1/BGS_Bedrock_and_Superficial_Geology/index.html

or using wget:

#cd /tmp
#wget http://127.0.0.1/BGS_Bedrock_Geology/index.html
#less index.html

Create a wms shell script

Next we need to create a 'wms' shell script for each of our Map Services; which we need to place in an associated directory.

#cd /usr/lib/cgi-bin
#mkdir --parents exemplars/BGS_Bedrock_Geology
#nano exemplars/BGS_Bedrock_Geology/wms

#!/bin/sh
MS_map file=/usr/local/src/ms4w/apps/cookbookExemplars/BGS_Bedrock_Raster_Map/onegeology.map
export MS_map file
exec /usr/lib/cgi-bin/mapserv
exit 0

^O (to save changes)

ENTER

^X (to exit)

#chmod 755 exemplars/BGS_Bedrock_Geology_Raster/wms

and similarly for our shapefile based service

#mkdir --parents exemplars/BGS_Bedrock_and_Superficial_Geology
#nano exemplars/BGS_Bedrock_and_Superficial_Geology/wms

#!/bin/sh
MS_map file=/usr/local/src/ms4w/apps/cookbookExemplars/BGS_Bedrock_and_Superficial_Geology/onegeology.map
export MS_map file
exec /usr/lib/cgi-bin/mapserv
exit 0

^O (to save changes)

ENTER

^X (to exit)

#chmod 755 exemplars/BGS_Bedrock_and_Superficial_Geology/wms

Modify paths in the map file

The final step is to modify the WEB > IMAGEPATH path (to "/var/tmp/") and the WEB > IMAGEURL path (to "/tmp/") in each of our onegeology.map files

That's it!

Section last modified: 12 June 2013

4.4.3 Using the GISInternals packages for Windows

The most recent versions of the GISInternals GDAL and MapServer packages are available online at:
http://www.gisinternals.com/sdk/

In most instances we would recommend using the MS4W packages to install Apache and MapServer to give youself a Windows implementation of MapServer, but in some instances, for example if you want the latest version of MapServer or if you want to use 64-bit software, you can alternatively use one of the GISinternals packages for your MapServer service.

In this section we will assume you are familiar with configuring a MS4W service and just provide some notes to assist you configure this alternative MapServer on Windows service using Apache-HTTP as your web server.

First install your web server

The first thing to note is that you will need to install your server software (such as Apache-HTTP) separately, as it is not included with GISInternals.

You may get the previous versions (that is, up to version 2.2.n) of Apache-HTTP for Windows (32 bit), from the Apache HTTP server project site: http://httpd.apache.org/.

If instead you want to use the latest stable release of Apache-HTTP, that is the version 2.4.n releases (latest is currently 2.4.4), you must instead go to the Apache Lounge site: http://www.apachelounge.com/download/. There are several options here both in server architecture (32 bit and 64 bit), and server functionality, for you to choose from to fit your needs.

For the purposes of this example we have selected a 64 bit package from Apache Lounge and installed it to our C:\ drive as C:\Apache24\ .

Installing a GISInternals package

Once you have a working web service installed, you now need to obtain the corresponding GISInternals binaries, for example in this case we downloaded the zip file **release-1600-x64-gdal-1-9-2-mapserver-6-2-0.zip**, and unzipped onto our C:\ drive as C:\apps\gisinternals\ .

Now we must run the SDKShell.bat batch file to set up some environment variables, for example it adds the following locations to the system PATH:

- C:\apps\gisinternals\bin;
- C:\apps\gisinternals\bin\gdal\python\osgeo;
- C:\apps\gisinternals\bin\proj\apps;
- C:\apps\gisinternals\bin\gdal\apps;
- C:\apps\gisinternals\bin\ms\apps;
- C:\apps\gisinternals\bin\gdal\csharp;
- C:\apps\gisinternals\bin\ms\csharp;
- C:\apps\gisinternals\bin\curl;

The MapServer executable file (mapserv.exe) is found in the C:\apps\gisinternals\bin\ms\apps folder. As ever, you can check the version by using the -v option in a command window like:

```
c:\apps\gisinternals\bin\ms\apps>mapserv.exe -v
MapServer version 6.2.0 OUTPUT=GIF OUTPUT=PNG OUTPUT=JPEG OUTPUT=PDF SUPPORTS=PROJ SUPPORTS=GD
```

```
SUPPORTS=AGG SUPPORTS=FREETYPE SUPPORTS=CAIRO SUPPORTS=OPENGL SUPPORTS=ICONV SUPPORTS=FRIBIDI
SUPPORTS=WMS_SERVER SUPPORTS=WMS_CLIENT SUPPORTS=WFS_SERVER SUPPORTS=WFS_CLIENT SUPPORTS=WCS_SERVER
SUPPORTS=SOS_SERVER SUPPORTS=FASTCGI SUPPORTS=THREADS SUPPORTS=GEOS INPUT=JPEG INPUT=POSTGIS
INPUT=OGR INPUT=GDAL INPUT=SHAPEFILE
```

Configuring your service

Data

You may put your OneGeology data for your service (and the map file etc) anywhere on your server, but here we will follow the same pattern as we have for used for the MS4W services. In this case we have extracted the exemplar shapefile data to a location on our D:\ drive as:

- D:\WxS\ms\apps\cookbookExemplars\BGS_Bedrock_and_Superficial_Geology
  - data (folder)
  - templates (folder)
  - wwwroot (folder)
  - onegeology.map (file)
  - ICSClasses.txt (file)

You will need to make a few change to the map file from the downloaded exemplar file. For example you will need to tell MapServer where to find the proj files so that you can reproject your data. You do this by adding a CONFIG statement at the top of the map file like:

```
MAP
    CONFIG "PROJ_LIB" "C:/apps/gisinternals/bin/proj/SHARE"
```

You will also need to change the IMAGEPATH statement to point at your chosen temporary file location (within the WEB section of the map file) like:

```
#========================================================================#
# Start of WEB interface definition (including WMS enabling metadata)
#========================================================================#
    WEB
        HEADER "templates/query_header.html"
        FOOTER "templates/query_footer.html"
        IMAGEPATH "D:/WxS/ms/out/tmp/"
        IMAGEURL "/ms_tmp/"
```

MapServer cgi-bin

For this installation we will now create some folders in the Apache-HTTP cgi-bin folder to hold our copy of the mapserv.exe executable (which we will rename as 'wms') as:

- C:\Apache24\cgi-bin (folder)
  - exemplars (folder)
    - BGS_Bedrock_and_Superficial_Geology (folder)
      - wms (file)

At this stage you will have a working MapServer service such that a request like the below (where we also specify the 'map' variable explicitly) will give you a GetCapabilities reponse document.

```
http://[your-server-name]/cgi-bin/exemplars/BGS_Bedrock_and_Superficial_Geology/wms?

  service=WMS&
  request=GetCapabilities&
  map=D:/WxS/ms/apps/cookbookExemplars/BGS_Bedrock_and_Superficial_Geology/onegeology.map&
```

httpd.d configuration files

For this installation we will now create a httpd.d folder on our D:\ drive, to hold our OneGeology service configuration files, as: D:\WxS\ms\httpd.d\ , and create an http_ file (i.e. 'httpd_BGS_Bedrock_and_Superficial_Geology_Exemplar.conf') for our exemplar service as below.

```
#============================================================================================#
# Note: Alias is one line in the file, but split here to make the page easier to read...
#============================================================================================#
Alias /BGS_Bedrock_and_Superficial_Geology_Exemplar/
  "D:/WxS/ms/apps/cookbookExemplars/BGS_Bedrock_and_Superficial_Geology/wwwroot/"

<Directory "D:/WxS/ms/apps/cookbookExemplars/BGS_Bedrock_and_Superficial_Geology/wwwroot/">
    AllowOverride None
    Options FollowSymLinks Multiviews
    Require all granted
</Directory>
#============================================================================================#
# Note: SetEnvIf is one line in the file, but split here to make the page easier to read...
#============================================================================================#
SetEnvIf Request_URI "/cgi-bin/exemplars/BGS_Bedrock_and_Superficial_Geology/wms"
  MS_map file=D:/WxS/ms/apps/cookbookExemplars/BGS_Bedrock_and_Superficial_Geology/onegeology.map
```

Note, that there is a change in the way access permissions are handled between versions 2.2.n and 2.4.n of Apache, so if you are copying the existing MS4W httpd_ conf files you will need to change your <Directory> information; that is, you will need to replace the '*Order allow,deny*' and '*Allow from all*' directives with '*Require all granted*'

apache.conf

Finally you will need to add some information to the Apache-HTTP server configuration file (C:\Apache24\conf\httpd.conf) as per the below snippets.

```
...
<IfModule alias_module>
  ...
  # Alias: Maps web paths into filesystem paths and is used to
  # access content that does not live under the DocumentRoot.

  Alias /ms_tmp "D:/WxS/ms/out/tmp"

  # ScriptAlias: This controls which directories contain server scripts.
  # ScriptAliases are essentially the same as Aliases, except that
  # documents in the target directory are treated as applications and
  # run by the server when requested rather than as documents sent to the
  # client.

  ScriptAlias /cgi-bin/ "C:/Apache24/cgi-bin/"
  ...
</IfModule>
...
<Directory "C:/Apache24/cgi-bin">
    AllowOverride None
    Options None
    Require all granted
</Directory>
...
# Parse our MapServer Apache conf files
Include D:/WxS/ms/httpd.d/httpd_*.conf
```

Section last modified: 27 June 2013

4.5 Configuring group layering

In some situations, for example when you have too many individual layers, or if you have to comply with some strict naming conventions (such as INSPIRE) you may need to consider configuring group layering. In group layering you nest one set of layers inside another (group) layer, you can still call (e.g. make a GetMap request on) any of the individual grouped layers or you can call all

the grouped layers at the same time using the grouping layer. For example in the below MapServer GetCapabilities response on a service with group layers you could make a GetMap request on the group layer called GE.GeologicFault and would get a map comprising both the grouped layers (GE.GeologicFault_GBR_BGS_EN_1M_Surface and GE.GeologicFault_GBR_BGS_EN_1M_Bedrock), or you could perform a GetMap request on either of the individual layers.

Layer (2 rows)	Name	Title	Abstract	...	Layer
1	GE.GeologicFault	Geologic Faults	MappedFeature (spatial objects whose specification property is of type ShearDisplacementStructure)		Layer (2 rows)
2	GE.GeologicUnit	Geologic Units	MappedFeature (spatial objects whose specification property is of type GeologicUnit)		Layer (4 rows)

Layer (2 rows):

	@q...	@...	@...	Name
1	1	0	0	GE.GeologicFault_GBR_BGS_EN_1M_Surface
2	1	0	0	GE.GeologicFault_GBR_BGS_EN_1M_Bedrock

Layer (4 rows):

	@q...	@...	@...	Name
1	1	0	0	GE.GeologicUnit_GBR_BGS_EN_1M_Surface_Lithology
2	1	0	0	GE.GeologicUnit_GBR_BGS_EN_1M_Surface_Age
3	1	0	0	GE.GeologicUnit_GBR_BGS_EN_1M_Bedrock_Lithology
4	1	0	0	GE.GeologicUnit_GBR_BGS_EN_1M_Bedrock_Age

Group layering in a GetCapabilities response

To configure group layering in MapServer first you need to configure a service with all the layers that need to be grouped. The next step is to add a GROUP keyword (with the name of the group layer) into the LAYER section of all the layers you want to be grouped together. Finally, in ONE of the METADATA sections of the layers you want to group you need to add a WMS_GROUP_TITLE and a WMS_GROUP_ABSTRACT value. For example in the MapServer service configuration file for the above GetCapabilities response we have the following configuration:

```
LAYER
    GROUP "GE.GeologicFault"
    NAME GE.GeologicFault_GBR_BGS_EN_1M_Surface
    TYPE LINE
    STATUS ON
    EXTENT -8.01697 49.9678 0.715821 60.8368
    MAXSCALEDENOM 3000000
    CONNECTIONTYPE ogr
    CONNECTION "data2/OGE.mdb"
    DATA "V5_625k_ONEGEOLOGY_FAULTS_AT_SURFACE"
    PROCESSING "CLOSE_CONNECTION=DEFER"
    OPACITY 100
    TOLERANCE 10
    TOLERANCEUNITS pixels
    TRANSFORM TRUE
    # Same template OK for surface and bedrock faults
    HEADER "templ/OGE_1M_bedrock_GeologicStructure_headerGSMLP.html"
    TEMPLATE "templ/OGE_1M_bedrock_GeologicStructure_bodyGSMLP.html"
    FOOTER "templ/OGE_1M_bedrock_GeologicStructure_footerGSMLP.html"
    PROJECTION
        "init=epsg:4326"
    END
    METADATA
        INCLUDE "../DefaultMapIncludes/BGS-Attribution.map"
        "OWS_TITLE" "BGS 1:1 Million surface geologic structure"
        "OWS_ABSTRACT" "BGS surface fault geology originally created for OneGeology Europe"
        "OWS_EXTENT" "-8.01697 49.9678 0.715821 60.8368"
        "OWS_SRS" "CRS:84 EPSG:27700 EPSG:3034 EPSG:4258 EPSG:4326"
        "GML_INCLUDE_ITEMS" "all"
        "GML_FEATUREID" "OBJECTID"
        "OWS_METADATAURL_HREF" "http://www.bgs.ac.uk/discoverymetadata/13480426.html"
        "OWS_METADATAURL_FORMAT" "text/html"
        "OWS_METADATAURL_TYPE" "TC211"
        "OWS_DATAURL_HREF" "http://www.bgs.ac.uk/products/digitalmaps/digmapgb_625.html"
        "OWS_DATAURL_FORMAT" "text/html"
```

```
        "OWS_KEYWORDLIST" "OneGeology,continent@Europe,subcontinent@Northern Europe,geographica
        serviceprovider@British Geological Survey,dataprovider@British Geological Survey,themat
        thematic@Surface geology,DS_TOPIC@geoscientificinformation,DS_DATE@2010,thematic@Struct
        "WFS_SRS" "EPSG:4326 EPSG:27700 EPSG:3034 EPSG:4258"
        "WMS_GROUP_TITLE" "Geologic Faults"
        "WMS_GROUP_ABSTRACT" "MappedFeature (spatial objects whose specification property is of
    END
    INCLUDE "FaultTypeClassesIn3.map"
END
LAYER
    GROUP "GE.GeologicFault"
    NAME GE.GeologicFault_GBR_BGS_EN_1M_Bedrock
    EXTENT -8.09708 49.9678 0.781767 60.8368
    TYPE LINE
    STATUS ON
    MAXSCALEDENOM 3000000
    CONNECTIONTYPE ogr
    CONNECTION "data2/OGE.mdb"
    DATA V5_625k_ONEGEOLOGY_FAULTS
    PROCESSING "CLOSE_CONNECTION=DEFER"
    OPACITY 100
    TOLERANCE 10
    TOLERANCEUNITS pixels
    TRANSFORM TRUE
    HEADER "templ/OGE_1M_bedrock_GeologicStructure_headerGSMLP.html"
    TEMPLATE "templ/OGE_1M_bedrock_GeologicStructure_bodyGSMLP.html"
    FOOTER "templ/OGE_1M_bedrock_GeologicStructure_footerGSMLP.html"
    PROJECTION
        "init=epsg:4326"
    END
    METADATA
        INCLUDE "../DefaultMapIncludes/BGS-Attribution.map"
        "OWS_TITLE" "BGS 1:1 Million bedrock geologic structure"
        "OWS_ABSTRACT" "BGS bedrock fault geology  originally created for OneGeology Europe.
        The bedrock fault layer shows faults with superficial deposits (Quaternary and Recent)
        "OWS_EXTENT" "-8.09708 49.9678 0.781767 60.8368"
        "OWS_SRS" "CRS:84 EPSG:27700 EPSG:3034 EPSG:4258 EPSG:4326"
        "GML_INCLUDE_ITEMS" "all"
        "GML_FEATUREID" "OBJECTID"
        "OWS_METADATAURL_HREF" "http://www.bgs.ac.uk/discoverymetadata/13480426.html"
        "OWS_METADATAURL_FORMAT" "text/html"
        "OWS_METADATAURL_TYPE" "TC211"
        "OWS_DATAURL_HREF" "http://www.bgs.ac.uk/products/digitalmaps/digmapgb_625.html"
        "OWS_DATAURL_FORMAT" "text/html"
        "OWS_KEYWORDLIST" "OneGeology,continent@Europe,subcontinent@Northern Europe,geographica
        serviceprovider@British Geological Survey,dataprovider@British Geological Survey,
        thematic@Harmonized structure,thematic@Bedrock,DS_TOPIC@geoscientificinformation,
        DS_DATE@2010,thematic@Structure,thematic@Fault"
        "WFS_SRS" "EPSG:4326 EPSG:27700 EPSG:3034 EPSG:4258"
    END
    INCLUDE "FaultTypeClassesIn3.map"
END
```

Section last modified: 19 October 2015

5 Using ESRI software to serve OneGeology web services

A number of organizations have set up WMS' for OneGeology using ESRI software rather than the MapServer setup described and supplied in the original WMS Cookbook. This is understandable as many of the world's geological surveys have ESRI software as the

corporate standard and they would like if possible to use the same software suite to serve OGC WMS' and WFS'.

However the quite basic OGC conformant functionality required for OneGeology purposes is limited in current versions of ESRI ArcIMS and ESRI ArcGIS Server. ESRI-USA inform us that there will be no further significant development in the OGC WMS capabilities of ArcIMS - all further OGC focussed improvements, including feedback from the OneGeology initiative, will take place in future version of ArcGIS Server as we understand it. Several OneGeology participants have worked with the OneGeology secretariat and the OneGeology Portal staff to try and get this software to contribute usefully to OneGeology goals and we now have some useful implementation notes from those organizations to share with others who need to use this route. See the ArcGIS server or ArcIMS server sections below for notes on the respective platforms.

Unless otherwise noted, the following notes are based on ESRI ArcIMS version 9.3.1 and ESRI ArcGIS server version 10 (SP1)

Section last modified: 12 June 2013

5.1 Setting up an ArcIMS WMS

5.1.1 Create and modify the AXL

You may use the MXD2WMS tool (described in Appendix C) to create the AXL required for the service. The AXL created using this method will take the .mxd layer name and use it to populate values for both the LAYER name attribute, and the LAYER id attribute. The LAYER id attribute value is used by the WMS GetCapabilities response for the WMS layer name. The LAYER name attribute value is used by the GetCapabilities response for the WMS layer title. If you have set up any scale layering in your .mxd file these will be translated into LAYER maxscale and minscale attributes in the AXL; and in turn into ScaleHint min and max attributes (WMS version 1.1.1 GetCapabilities response) or into <MinScaleDenominator> and <MaxScaleDenominator> elements (WMS version 1.3.0 GetCapabilities response).

Section last modified: 19 January 2010

5.1.2 Create your ArcIMS service

When you set up your service you must give it a service name that matches the WMS service title (see Section 2 of this cookbook).

For example:

If the service name is:

"BGS_AGS_Bedrock_and_Structural_Geology"

The Service URL will become:

http://[hostname]/wmsconnector/com.esri.wms.Esrimap/BGS_AGS_Bedrock_and_Structural_Geology?

Section last modified: 19 January 2010

5.1.3 Allow WMS services and create your WMS

You now need to user the WMS Connector Administrator tool to permit WMS services to be run on your server in general, and then explicitly create a WMS service from your ArcIMS service. Note, your service must be running when you do the second part of this configuration.

The Administrator would normally be accessed as: http://[hostname]/wmsconnector/index.htm

If this is the first time you have run the WMS Connector Administrator tool, you will first need to set up a username and password.

Again if this is the first time you have run the Administrator, the first step is to configure the WMS Connector properties, using the dialog form (example shown below). These properties will be common for all WMS services run from the server. The options are well described in the ESRI help page normally found at: C:\Program Files\ArcGIS\ArcIMS\Help\mergedProjects\wms_connect\wms_admin\wms_administrator.htm; and we will deal here with a few key points.

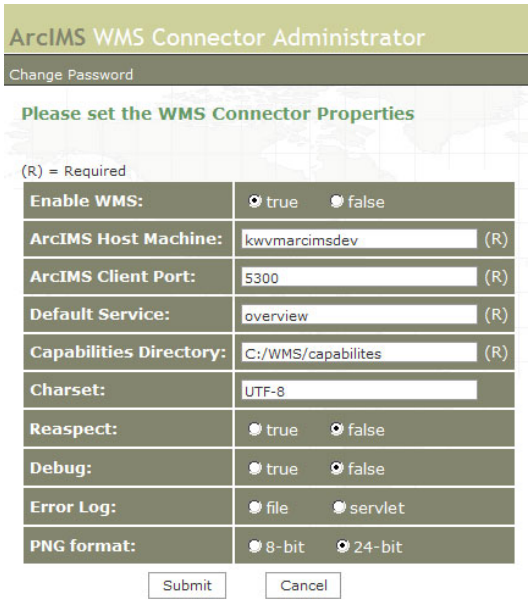
The enable WMS option enables/disables all WMS services. If this option is off, you will not be able to configure your OneGeology WMS services, or view them.

The WMS specification requires the reaspect option to be FALSE, and this is the default. Although you have the option to set reaspect to TRUE, it is recommended that you keep reaspect set to FALSE. A GetMap request is the only operation that has been

designed to work with a reaspect value of TRUE. GetFeatureInfo requests may not work properly when reaspect is set to TRUE. You should keep this value FALSE if you want your service to be consumed correctly by "Google Earth".

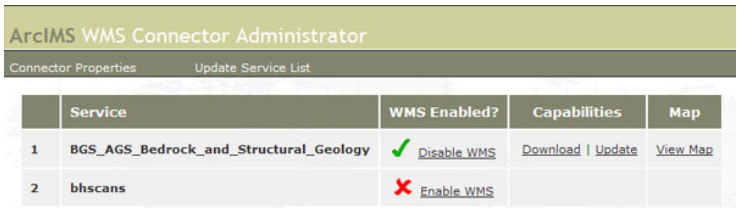
The capabilities directory is the root stem for the capabilities folders. The connector will create additional folders inside this folder based on the name of the host and the name of the ArcIMS service.

If you need to show any transparency in your layers you will need to use the 24bit PNG output format.



ArcIMS WMS connector properties dialogue window

Once you click Submit, or if you the connector properties have already been set up, you will then be able to access the connector service list. This page displays a list of all ArcIMS services. To create your OneGeology WMS you simply need to click the "Enable WMS" link next to your service; if there are no problems you will get a green tick.



ArcIMS WMS connector administrator

The connector will create four GetCapabilities xml response documents in the service capability folder, that is, one GetCapabilities xml response document per supported WMS specification.

In this example, in folder C:\WMS\capabilites\wms\kwvmarcimsdev-5300\BGS_AGS_Bedrock_and_Structural_Geology the connector creates these documents:

- capabilities_1_0_0.xml
- capabilities_1_1_0.xml
- capabilities_1_1_1.xml
- capabilities_1_3_0.xml

These capabilities documents are valid, but contain no useful metadata about your service, layers, and data, and do not conform to the OneGeology naming conventions; you will therefore need to edit them before your WMS service can be accepted in the OneGeology Portal.

Explicitly, you will need to change the Service Title, Service Abstract, add to the Service Keywords (to include OneGeology), and complete as many fields as possible within the Service Contact Information section. On the individual layers within your service you should add one or more Metadata URL elements that offer detailed standardized metadata about the data; you may also wish to add Keywords Abstracts as appropriate, (see the WMS:profile section for more detailed requirements information).

As the OneGeology Portal currently supports WMS version 1.1.1, the document you need to edit is "capabilities_1_1_1.xml ". As the OneGeology Portal is moving to towards supporting WMS version 1.3.0 (and if you wish your service to be used by others outside of the OneGeology Portal), you should also edit the capabilities_1_3_0.xml document.

It is advised that once you have edited your response documents you make copies of them, this is because if you use the 'upload' option in the Administrator (which you might do if you change the service/AXL) you will overwrite your edits.

Section last modified: 28 June 2013

5.1.4 ArcIMS issues

In ArcIMS 9.3.1 you cannot edit the GetFeatureInfo request template(s), either to filter out data attributes or change the format and styling. With the WMS Connector for ArcIMS 10, it is possible to edit the formating. We have not been able to test whether you can also restrict the values returned. For information on how to do this, see the ESRI help page: http://help.arcgis.com/en/arcims/10.0/mainhelp/mergedProjects/wms_connect/wms_connector/get_featureinfo.htm

A GetCapabilities request with no version specified returns the 1.1.1 version response, even if you have a version 1.3.0; this is currently fine for OneGeology, but is not conformant to the WMS specification, which requires the highest version supported to be returned.

ArcIMS is not a Styled Layer Descriptor (SLD) http://www.opengeospatial.org/standards/sld) capable WMS and cannot dynamically create a legend for WMS. However, you can save a static image PNG or JPEG file to a web accessible location on your server and edit the capabilities documents (as below). Create a Style element in the Layer you are assigning the legend to with contents similar to those below:

```
<Style>
 <Name>default</Name>
 <Title>default</Title>
 <LegendURL width="20" height="10">
  <!-- Edit width and height for your image -->
  <Format>image/png</Format>
  <!-- or image/jpeg if appropriate -->
  <OnlineResource
    xlink:type="simple"
    xlink:href="http://hostname/path/to/legendImage.png"/>
  <!-- URL for the static legend file you have created -->
 </LegendURL>
</Style>
```

Section last modified: 28 September 2011

5.2 Setting up an ArcGIS Server WMS

Initial set up of WMS services is relatively straightforward with the ArcGIS Server Manager, usually located at an address like: **http://[hostname]/ArcGIS/Manager/Default.aspx**.

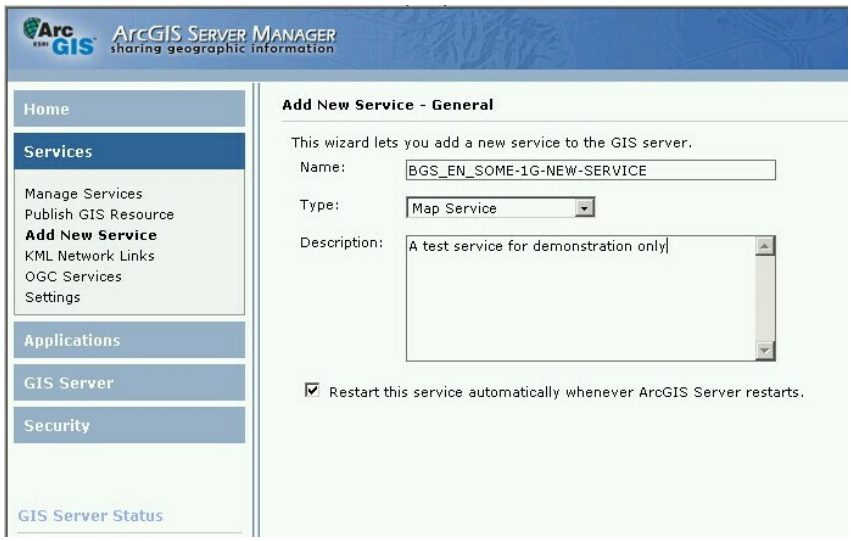
Once you have logged onto the manager, you should navigate to the 'Services' option in the left hand menu where you are given two options for creating your service. Here we will describe how to use the 'Add New Service' option, which allows you to change the ESRI server default values for the service properties, if required.

ArcGIS Server Manager console

5.2.1 Add New Service

After selecting *'Add New Service'* You will get a window like below.

Give your new *'map service'* an appropriate name - this is used in the URL and the Service Title. You may optionally add any comment (in the description box) to help you distinguish the purpose of the service; this is for internal purposes only.

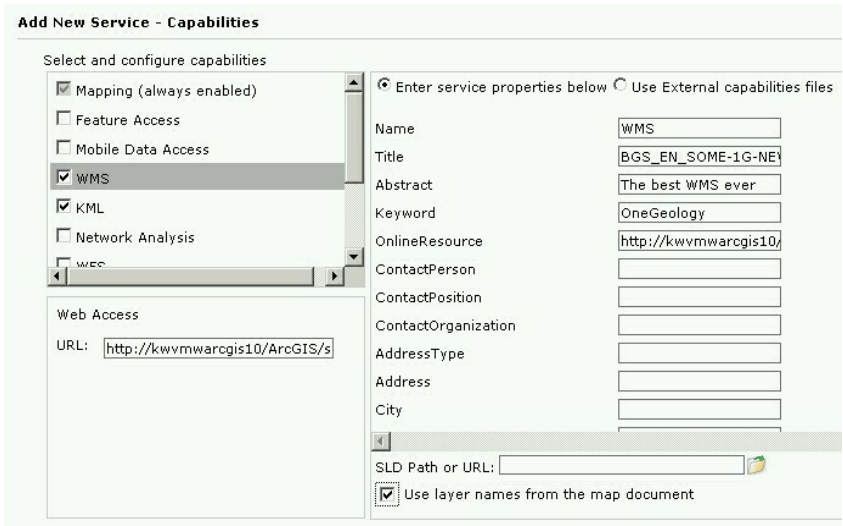


Adding a new service

Click Next to take you to the *'Add New Service - Parameters'* section; now in the *'Map Document'* text box you need to put the full network path to (and including) your .mxd file; this can be on the web server or at any location accessible by the server. Accept all the default parameters.

We note that in theory it is possible to create a service from a map service definition (.msd) file, but in our general experience, due in one instance to complex server and network configurations and in another to complex symbology, this is not always true. We therefore recommend you use an .mxd file.

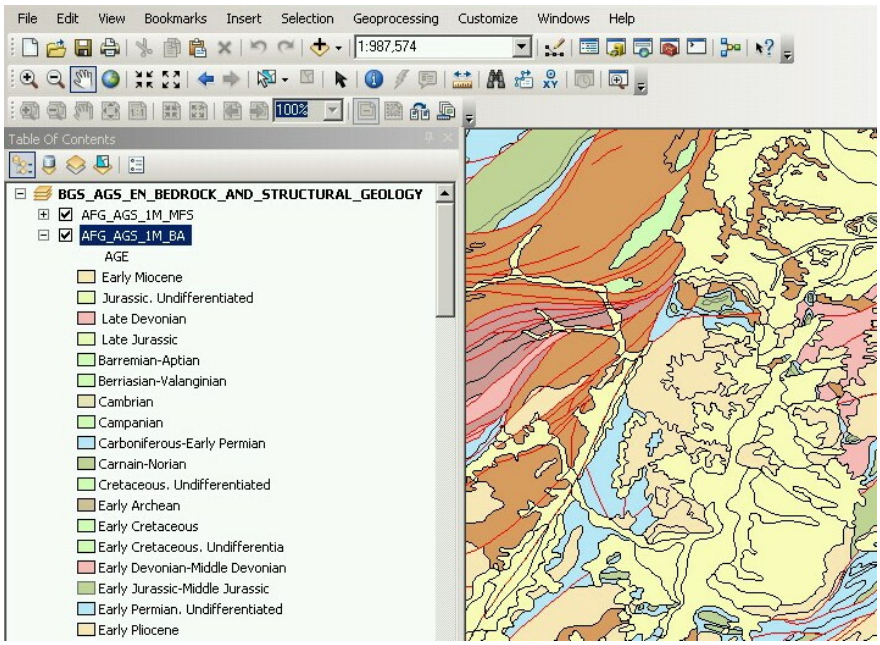
Click Next; you will then need to select "WMS" in the capabilities section. After you have made this selection you will be presented with a form to edit your service level metadata (as below) or you may opt to use external capabilities. We suggest at this stage that you should use the form to fill in as much detail as possible, though you should note that you will eventually need to use external files to enter any layer level metadata and add missing service level metadata parameters; we can use the data you enter initially as the basis for these external static files.



Adding a new WMS service in ArcGIS

If you want to make your service INSPIRE compliant, you will need to configure the name of your layer&#39s style (e.g. GE.GeologicUnit.Lithology). ArcGIS Server creates only one style named &#34default" for every layer, but allows you to do include additional styles for each layer using a SLD file.

You also need to tick the "Use layer names from the map document" option otherwise the layer names will be given numbers instead, *(this functionality was introduced in version 10 of ArcGIS server software)*. You will need to ensure that the ArcMap layer names follow the naming guidelines.



Using ArcMap layer names in the service

Note, when you select the "Use layer names from the map document" option, the service will use the Data frame name as the root layer name. The individual service layer names will use the ArcMap layer names. The service will also use the ArcMap layer names for the respective layer titles and layer abstracts.
Eg. an unmodified GetCapabilities (version 1.3.0) response for the above example would look like:

```
<Layer>
<Title><![CDATA[BGS_AGS_EN_BEDROCK_AND_STRUCTURAL_GEOLOGY]]></Title>
<CRS>CRS:84</CRS>
<CRS>EPSG:4326</CRS>
...
<Layer queryable="1">
    <Name>AFG_AGS_1M_BLS</Name>
    <Title><![CDATA[AFG_AGS_1M_BLS]]></Title>
    <Abstract><![CDATA[AFG_AGS_1M_BLS]]></Abstract>
    <CRS>CRS:84</CRS>
    <CRS>EPSG:4326</CRS>
   ...
    <Style>
        <Name>default</Name>
        <Title>AFG_AGS_1M_BLS</Title>
        <LegendURL width="68" height="2048">
            <Format>image/png</Format>
            <OnlineResource xlink:href="..." xlink:type="simple"
            xmlns:xlink="http://www.w3.org/1999/xlink" />
        </LegendURL>
    </Style>
    <MaxScaleDenominator>9449404.761905</MaxScaleDenominator>
    <MinScaleDenominator>9449.404762</MinScaleDenominator>
</Layer>
<Layer queryable="1">
    <Name>AFG_AGS_1M_BA</Name>
    <Title><![CDATA[AFG_AGS_1M_BA]]></Title>
   <Abstract><![CDATA[AFG_AGS_1M_BA]]></Abstract>
...
```

The manager will now enable your service and use your form entries and .mxd layer information to create the capabilities response

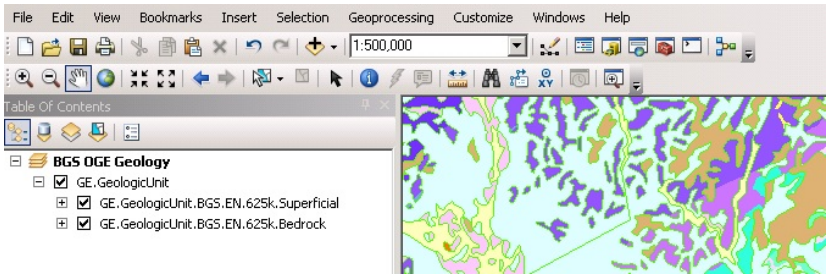
documents on request.

Your new service will have a URL like:

http://[hostname]/ArcGIS/services/[map service title]/MapServer/WMSServer

In some situations it is desirable to create a group layer, for example you may want to do this to comply with INSPIRE layer naming regulations to create a layer called GE.GeologicUnit to group all of your layers that are spatial objects of type GeologicUnit.

To **add group layers to a new service** simply add a group layer to the map document that will create your service, rename it and place your layers inside. The WMS service published form this map document will keep the same group layer structure.



Adding group layers to the service

If you want **add group layers to an existing service**, open the map document that created the service, modify it as described above and publish it again as a WMS service; however, when publishing the service, make sure that you select the option &#34Overwrite an existing service&#34. This will save you having to delete the original service as well as having to type again all service properties.

Note that ArcGIS Server will generate only the *&#60Title>* tag of group layers in the GetCapabilities document. The content of this tag will be the same that you wrote in the map document. In order to comply with INSPIRE layer naming regulations for group layers, you will need to manually add the *&#60Name>* tag, filling it in with the adequate group layer name, by editing the GetCapabilities document using an external capabilities file.

Group layers created in ArcGIS Server will not have a style associated to them and the group layer itself will not display a map.

Section last modified: 19 February 2016

5.2.2 Edit the GetCapabilities documents

ArcGIS server doesn't create any static GetCapabilities xml documents, but does allow you to use external files. You will need to use such external files if you want to add any additional spatial reference systems, correct the keywords listing, change the LegendURL images, add better abstracts and layer titles, or add an INSPIRE extended capabilities section. We think to provide a fully compliant WMS it is highly likely that you will need to use a set of static files.

The first step to editing your files is to create them!

The quickest way to do this is to use the response documents from your initial service. You will need to have a file for all the WMS versions that you want your service to support. We would recommend that you have at least a version 1.3.0 document and a version 1.1.1 document; for completeness you could also have a 1.1.0 and 1.0.0 response.

Your WMS version 1.1.1 GetCapabilities document is generated using a request like:

http://[hostname]/ArcGIS/services/[map service title]/MapServer/WMSServer?service=WMS&request=GetCapabilities&version=1.1.1&

Save this as [short service name]111.xml

Your WMS version 1.3.0 GetCapabilities document is generated using a request like:

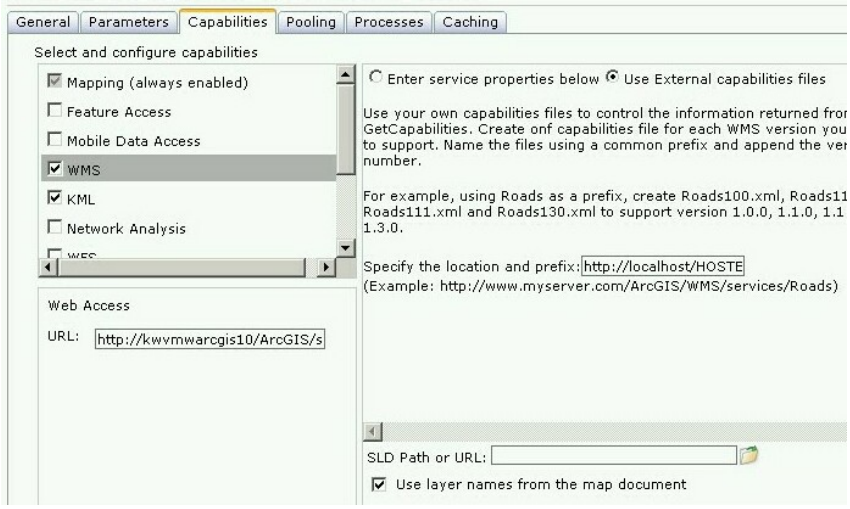
http://[hostname]/ArcGIS/services/[map service title]/MapServer/WMSServer?service=WMS&request=GetCapabilities&version=1.3.0&

Save this as [short service name]130.xml

It doesn't really matter what name you give these files, as long as you use the same name prefix for all files that belong to the same service.

You need to put these files on the server (or at a location available to your server), and make them browseable. These files only need to be browseable internally by the ArcGIS server.

Now go back to the ArcGIS Server Manager and edit your service. Select "WMS", then select the "Use External capabilities files" option and in the 'Specify the location and prefix' dialog add the web address to the folder containing the capabilities response documents plus your [short service name] prefix.



Using external capabilities files

For example:
For a service called BGS_EN_MARS_GEOLOGY, we may save our initial GetCapabilities response documents using a prefix "MARS-", giving us a file called MARS-130.xml for our version 1.3.0 GetCapabilities response document, MARS-111.xml for our version 1.1.1 GetCapabilities response document, MARS-110.xml for our version 1.1.0 GetCapabilities response document, and MARS-100.XML for our version 1.0.0 GetCapabilities response document. We might then save these to a location on our web server such as *C:\Inetpub\wwwroot\ONEGEOLOGY_WMS\BGS_EN_MARS_GEOLOGY* which would be browseable locally as *http://localhost/ONEGEOLOGY_WMS/BGS_EN_MARS_GEOLOGY/*. When we select the "Use External capabilities files" option, we then provide the web address and **prefix** as *http://localhost/ONEGEOLOGY_WMS/BGS_EN_MARS_GEOLOGY/MARS-*

Having created your files, you may then edit them as required. We would recommend you make a second copy of the files in case you make an error whilst editing.

INSPIRE extended capabilities

The extended capabilites section is inserted into your external GetCapabilities section, between the Exception element block and the first Layer element.

For example to add a scenario 1 INSPIRE extended capabilities section (where you have an external XML document or service that provides such an XML document containing metadata for your WMS service) you would insert a section like below:

```
</Exception>
<inspire_vs:ExtendedCapabilities xmlns:inspire_vs="http://inspire.ec.europa.eu/schemas/inspire_vs/1
    <inspire_common:MetadataUrl xsi:type="inspire_common:resourceLocatorType">
        <inspire_common:URL>http://metadata.bgs.ac.uk/geonetwork/srv/en/csw?SERVICE=CSW
        &REQUEST=GetRecordById&ID=7822e848-822d-45a5-8584-56d352fd2170&elementSetName=full&OutputSc
        </inspire_common:URL>
        <inspire_common:MediaType>application/xml</inspire_common:MediaType>
    </inspire_common:MetadataUrl>
    <inspire_common:SupportedLanguages>
        <inspire_common:DefaultLanguage>
            <inspire_common:Language>eng</inspire_common:Language>
        </inspire_common:DefaultLanguage>
    </inspire_common:SupportedLanguages>
    <inspire_common:ResponseLanguage>
        <inspire_common:Language>eng</inspire_common:Language>
    </inspire_common:ResponseLanguage>
</inspire_vs:ExtendedCapabilities>
<Layer>
```

Alternatively to add a scenario 2 INSPIRE extended capabilities section (where you have no external metadata document for your WMS service) you would insert a section like below:

```
</Exception>
```

```
<inspire_vs:ExtendedCapabilities xmlns:inspire_vs="http://inspire.ec.europa.eu/schemas/inspire_vs/1
    <inspire_common:ResourceLocator>
        <inspire_common:URL>http://ogc2.bgs.ac.uk/cgi-bin/BGS_OGE_Bedrock_and_Surface_Geology_in3/o
    </inspire_common:ResourceLocator>
    <inspire_common:ResourceType>service</inspire_common:ResourceType>
    <inspire_common:TemporalReference>
        <inspire_common:DateOfLastRevision>2015-10-23</inspire_common:DateOfLastRevision>
    </inspire_common:TemporalReference>
    <inspire_common:Conformity>
        <inspire_common:Specification>
            <inspire_common:Title>-</inspire_common:Title>
            <inspire_common:DateOfLastRevision>2015-10-23</inspire_common:DateOfLastRevision>
        </inspire_common:Specification>
        <inspire_common:Degree>notEvaluated</inspire_common:Degree>
    </inspire_common:Conformity>
    <inspire_common:MetadataPointOfContact>
        <inspire_common:OrganisationName>Mr Matthew Harrison</inspire_common:OrganisationName>
        <inspire_common:EmailAddress>enqiries@bgs.ac.uk</inspire_common:EmailAddress>
    </inspire_common:MetadataPointOfContact>
    <inspire_common:MetadataDate>2015-10-23</inspire_common:MetadataDate>
    <inspire_common:SpatialDataServiceType>view</inspire_common:SpatialDataServiceType>
    <inspire_common:MandatoryKeyword xsi:type='inspire_common:classificationOfSpatialDataService'>
        <inspire_common:KeywordValue>infoMapAccessService</inspire_common:KeywordValue>
    </inspire_common:MandatoryKeyword>
    <inspire_common:SupportedLanguages>
        <inspire_common:DefaultLanguage>
            <inspire_common:Language>eng</inspire_common:Language>
        </inspire_common:DefaultLanguage>
    </inspire_common:SupportedLanguages>
    <inspire_common:ResponseLanguage>
        <inspire_common:Language>eng</inspire_common:Language>
    </inspire_common:ResponseLanguage>
</inspire_vs:ExtendedCapabilities>
<Layer>
```

In addition (for both scenarios) you will need to reference the inspire_common schema and namespace in your root element, so it will become something like:

```
<WMS_Capabilities
    xmlns:inspire_common="http://inspire.ec.europa.eu/schemas/common/1.0"
    xmlns="http://www.opengis.net/wms" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:esri_wms="http://www.esri.com/wms"
    version="1.3.0"
    xsi:schemaLocation="http://www.opengis.net/wms http://schemas.opengis.net/wms/1.3.0/capabilitie
    http://inspire.ec.europa.eu/schemas/inspire_vs/1.0 http://inspire.ec.europa.eu/schemas/inspire_
    http://www.esri.com/wms http://../arcgis/services/.../MapServer/WmsServer?version=1.3.0%26servi
```

Section last modified: 23 March 2016

5.2.3 ArcGIS server issues

- If you have set up scale layering in your .mxd map file these will be translated into the appropriate Scale Hint (version 1.1.1), or Scale Denominator (version 1.3.0) elements in the GetCapabilities documents; whilst the values are correct, the order the MaxScaleDenominator and MinScaleDenominator elements are specified is invalid. A bug report has been submitted to ESRI concerning this issue. It is understood this will be fixed in version 10 service pack 2.
- In ArcGIS Server (version 9.3.1) you cannot edit the GetFeatureInfo request template(s), either to filter out data attributes or change the format and styling. In ArcGIS Server version 10 you can customize the response style. We have not yet checked to see if it is possible to restrict which data fields are returned. For information on how to do this, see the ESRI help page (http://help.arcgis.com/en/arcgisserver/10.0/help/arcgis_server_dotnet_help/index.html) section: #/Customizing_a_WMS_GetFeatureInfo_response/009300001663000000/

- ArcGIS Server (version 9.3.1) can only produce service layer names with the values 0, 1, 2... so cannot conform to the layer naming conventions that are specified in the OneGeology WMS profile. The OneGeology Portal has been modified to cope with this situation but this should be considered a temporary fix that should be avoided if possible in the long term. **This has been resolved in version 10.**
- Though ArcGIS Server 9.3.1 will create a dynamic legend, the legend that is created is generally of poor quality and only really of use for simple data layers. You are recommended to create your own legend or legends and edit the GetCapabilities response to reflect this.
- Though "application/vnd.ogc.gml" is cited as an available output format of the GetFeatureInfo request, the response in ArcGIS server 9.3.1 is in fact not GML but simply XML.
  For example, the following request to the Spanish service:

  http://mapas.igme.es/gis/services/oneGeology/IGME_EN_Geology/MapServer/WMSServer?
  transparent=true&
  format=image/png&
  version=1.1.1&
  service=WMS&
  request=GetFeatureInfo&
  styles=default,default,default,default&
  exceptions=application%2Fvnd.ogc.se_inimage&
  layers=3,2,1,0&
  bgcolor=0xFFFFFF&
  srs=EPSG%3A4258&
  info_format=application/vnd.ogc.gml&
  query_layers=3&
  feature_count=100&
  width=931&
  height=712&
  bbox=-17.952776,27.3616,3.565876,43.8184&
  x=652&
  y=134&

  Returns the following GetFeatureInfo XML response:

  ```
  <FeatureInfoResponse>
    <FIELDS
      OBJECTID="3"
      SHAPE="NULL"
      Erathem="Cenozoic"
      System="Neogene"
      SHAPE_Length="70250444,2884521"
      SHAPE_Area="110573853611,653" />
  </FeatureInfoResponse>
  ```

  A bug report has been submitted to ESRI regarding this issue. Our latest understanding from ESRI is that application/vnd.ogc.gml will NOT be supported in 10, though you will be able to create non-geometry GML by creating a template.

- ArcGIS server 9.3.1 does not support the SLD_BODY parameter in WMS requests. A bug report was submitted to ESRI regarding this issue. ArcGIS server 10 now supports this method of sending SLD styles to the server. For information on how to do this, see the ESRI help page (http://help.arcgis.com/en/arcgisserver/10.0/help/arcgis_server_dotnet_help/index.html) section: #/Using_Styled_Layer_Descriptors_with_WMS_services/00930000005n000000/
- When using the SLD parameter to get an external SLD file, ArcGIS 10.0 expects the layer name and styles parameter to be to be sent as part of a GetMap request, even though this is not required by the WMS+SLD specification. A bug has been raised with ESRI on this issue (NIM095568).

Section last modified: 12 OCtober 2015

6 Using GeoServer software to serve OneGeology web services

GeoServer is an free and open sourced Java-based server for providing OGC web services. GeoServer runs on top of a Java web server, such as Jetty or (recommneded for a production environment) Tomcat. GeoServer can be downloaded from http://geoserver.org/download/, the latest stable build is version 2.8.0. A number of modules and extentions exist for adding functionality, such as the INSPIRE plugin geoserver-2.8.0-inspire-plugin.zip (for adding INSPIRE extended capabilities to your

services), and the Application Schema plugin geoserver-2.8.0-app-schema-plugin.zip.

GeoServer is a good choice if you wish to set up both a GeoSciML-Portrayal WMS and WFS. When considering using GeoServer for a GeoSciML-Portrayal service you are limited to using a vector data source, by default you would use either an ESRI shape file or a PostGIS database, but you can use any number of other databases (ArcSDE, DB2, H2, MySQL, Oracle, SQL Server, Teradata) by adding the appropriate extention. Element names in the output XML are determined by the field names in the data source. Shapefiles use dBase tables to contain thematic property data, and the field names in a shape file are limited to 10 characters in length. Because some of the fields in the GeoSciML-Portrayal schema are longer than 10 characters, ESRI shapefiles are not suitable as a datastore for GeoSciML-Portrayal services that utilize the simple configuration approach in GeoServer. A more complicated configuration schema utilizing an 'application schema' is also available to GeoServer users, but to avoid this complication, it is recommended to use PostGIS as the data store for GeoServer GeoSciML-Portrayal implementation.

This procedure assumes that you have a working GeoServer implementation with PostGIS, and that you have administrative privileges necessary to create workspaces, stores, and layers accessible to GeoServer. In order for services to be publicly accessible, the host and port of the GeoServer instance must be configured to allow remote access to the GeoServer instance.

Section last modified: 21 October 2015

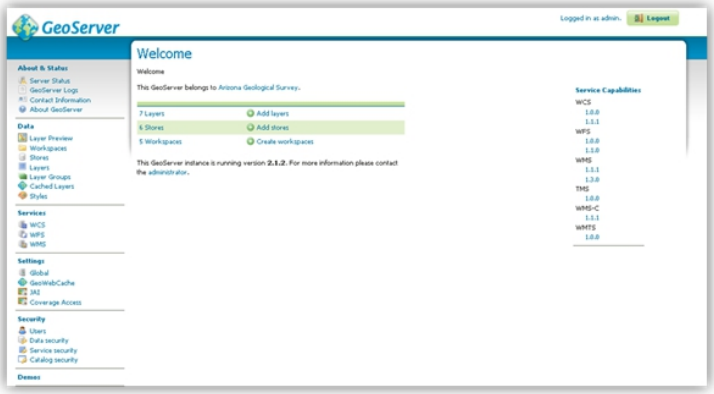
6.1 Logging in

The Web Administration Interface is a browser-based tool for administering the server software remotely. To deploy a web service in the GeoServer environment, log in to the Web Administration Interface for the GeoServer instance you will be using to deploy your data as a web service. To access this tool, open a web browser and enter the web address into the navigation bar. GeoServer is usually installed such that the administrative interface can be accessed at a URL with the following address pattern:

http://<host>:<port>/geoserver/web/, **<port>** is usually **8080**, and <host> is the name or IP address of the server.

The default account settings for GeoServer are as follows:
Username: admin
Password: geoserver

For security reasons, it is recommended that you change your password to something more secure as soon as possible.



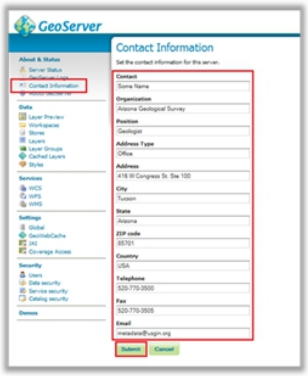
GeoServer administration interface web page.

Section last modified: 06 October 2015

6.2 Editing contact information metadata

Within the GeoServer Web Administration Interface, click **Contact Information**, under About & Status. This brings you to a Contact Information form in which you can provide contact information for your GeoServer instance. The information entered here becomes part of service-level metadata for the web service that is accessed by the OGC GetCapabilities request. Consequently, Contact Information entered here should be as precise and comprehensive as possible.

See http://onegeology.org/wmsCookbook/2_4_1.html for details of required service level metadata

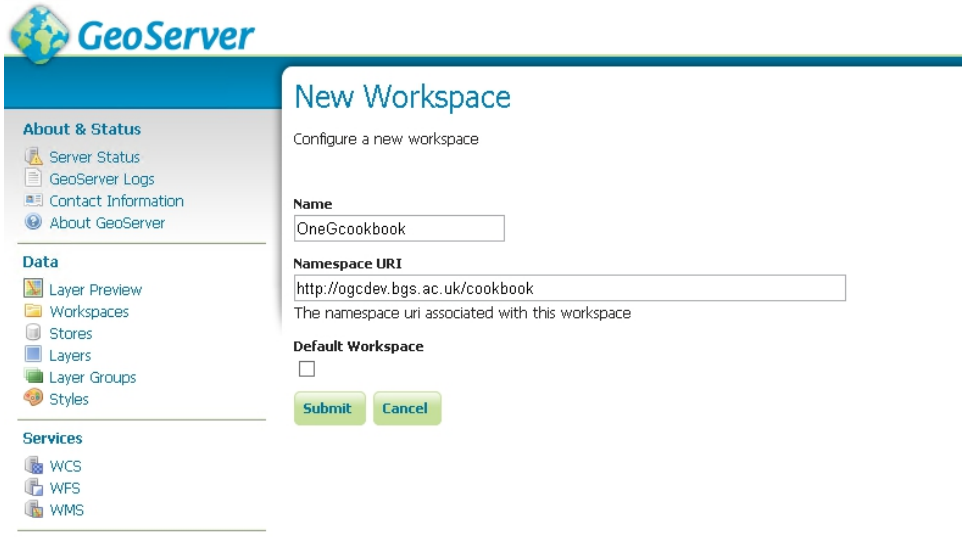


GeoServer contact information

Section last modified: 07 October 2015

6.3 Creating a workspace (and editing service metadata)

1. After entering contact information for your GeoServer instance, you will need to create a workspace for your web service.
2. On the left side of the GeoServer **Web Administration Interface**, under **Data**, click **Workspaces**. This will bring you to the **Workspaces** page, wherein you can manage existing workspaces and create new workspaces.
3. Click **Add New Workspace**. This will bring you to the Edit Workspace page for your new workspace.
4. Two fields are present on the Edit Workspace page:
   - **Name**: The service title; may contain spaces or special characters, see notes below for further details.
   - **Namespace URI**: A URI associated with your project; this can be any URI (and doesnâ€™t have to resolve).
5. When you are finished, click **Save**.

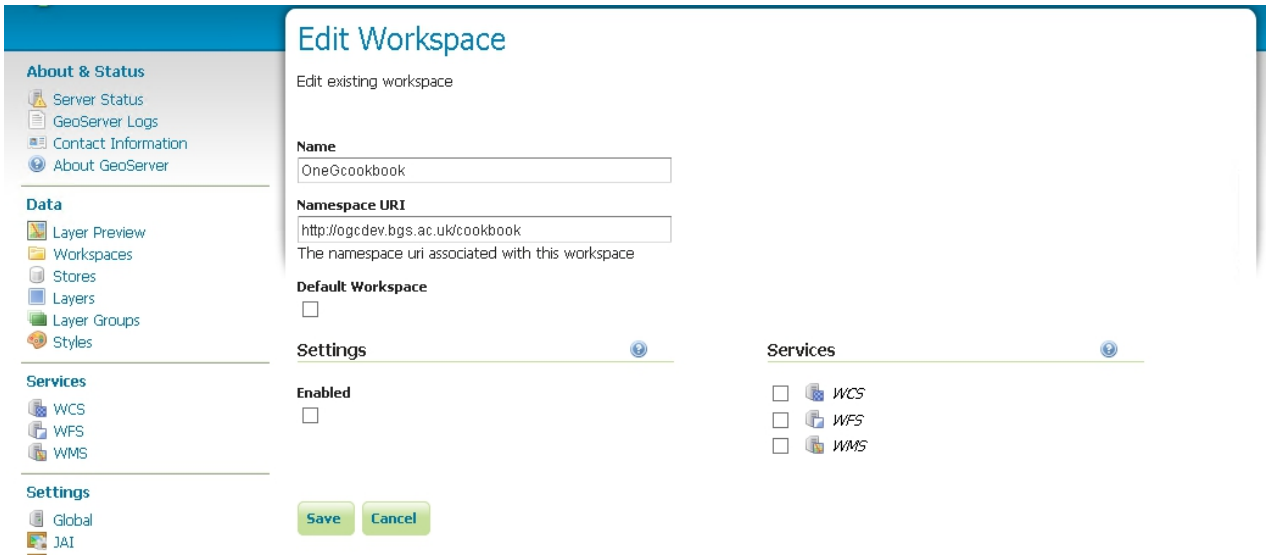


Create a GeoServer Workspace

Give the workspace a memorable name; we suggest that this name is kept as short as possible because the workspace name is used throughout the service and is appended to all layer identifiers. The workspace name will also make up part of the URL for the service, for example:
http://127.0.0.1:8080/geoserver/OneGcookbook/wcs?

Note you can set up a proxy and configure Proxy URL base to achieve the desired OneGeology WMS profile URL name if required.

When you have created your workspace you can edit its properties. You will need to click the enabled box and also the WMS services option

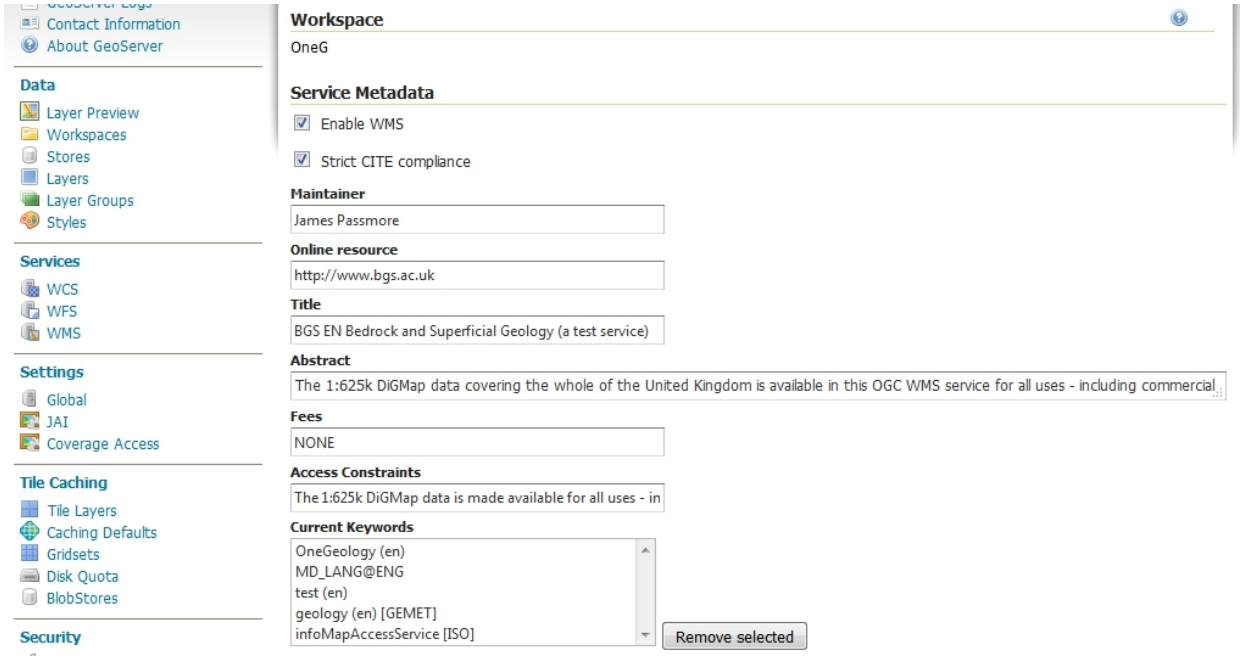


Edit a GeoServer Workspace

Once you have **Enabled** the service, you will be able to edit the contact details for your service. By default you will have the standard metadata populated into this form. These metadata will be provided as part of the service GetCapabilities response.

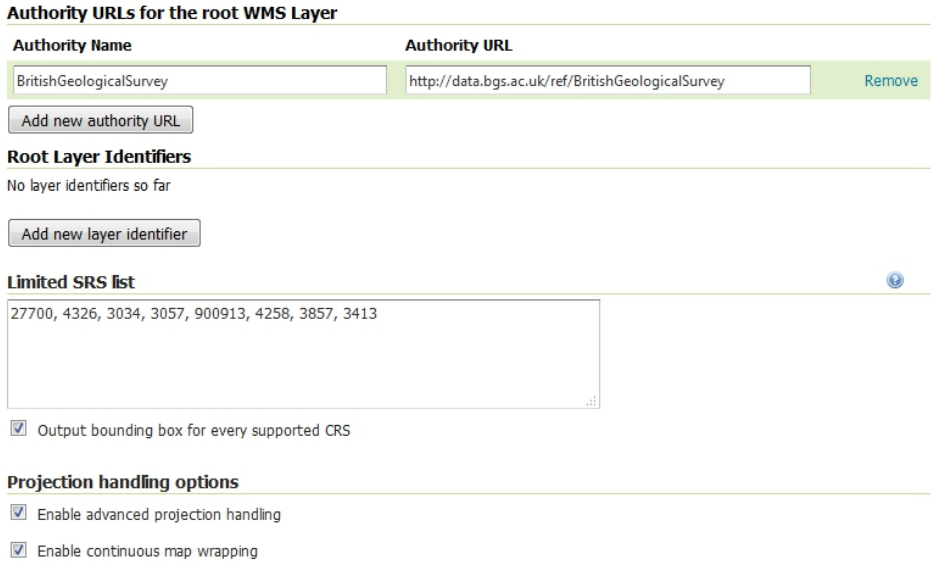
See http://onegeology.org/wmsCookbook/2_4_1.html for details of required service level metadata

At the top of the page you need to add the service title and abstract, plus any constaints on use of the service and any access constraints. We recommned that you also select the strict CITE compliance option. The Online resource url listed in this section is not intended to be the URL of the service, but instead a URL to obtain further information on the service provider.



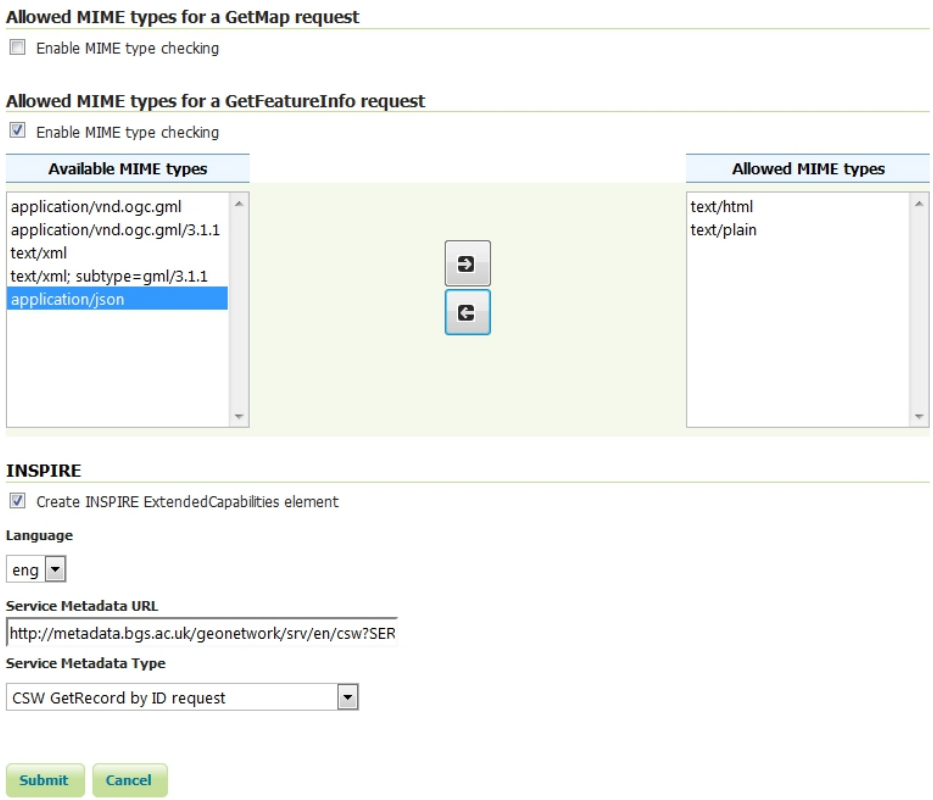
Editing GeoServer WMS service properties (1)

In the middle of the page you can configure a limited list of SRS for the service; it is recommended that you use this option otherwise you will get the full list of GeoServer supported coordinate reference systems (about 4100), which makes the **capabilities** document slow to parse. Remember you must support EPSG:4326 for the portal.



Editing GeoServer WMS service properties (2)

If you have added the INSPIRE extension plugin, at the bottom of the page you will be able to configure a scenario 1 style extended capabilities section. See the GeoServer documentation (http://docs.geoserver.org/stable/en/user/extensions/inspire/index.html) for further details.



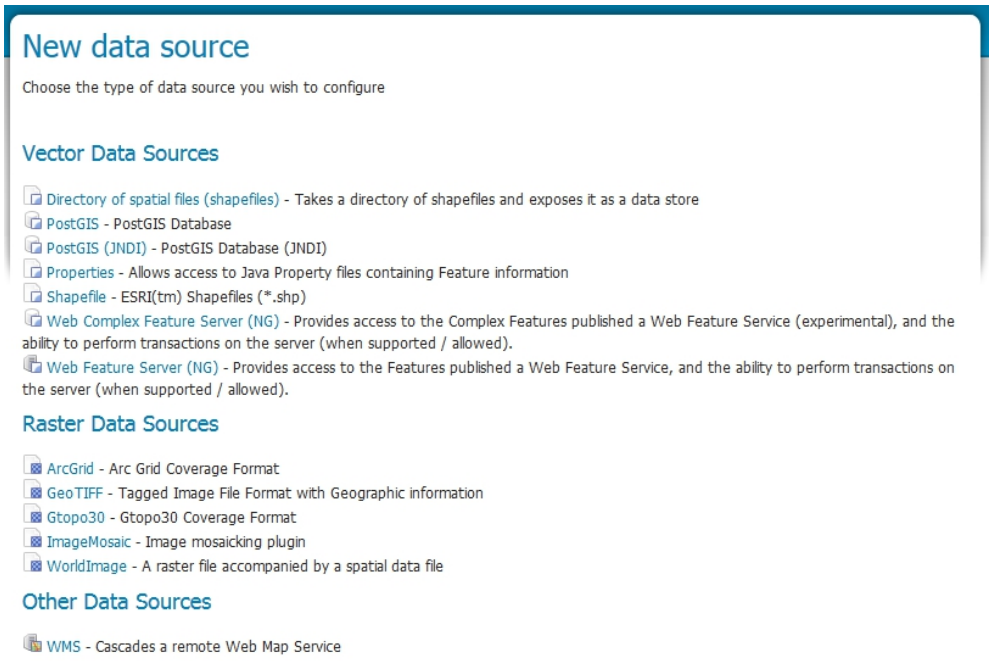
Editing GeoServer WMS service properties (3)

Section last modified: 07 October 2015

6.4 Configuring a data store

The next step is to use the Stores menu option to set up any sources of data for our service.

On the left side of the GeoServer **Web Administration Interface**, under **Data**, click **Stores**. This will bring you to the **Stores** page. On the **Stores** page, click **Add New Store**, then choose the type of data source you wish to configure from the list of options.



GeoServer data store options (version 2.8-beta)

In the following sections we take you through how to configure a PostGIS data source (section 6.4.1) and a Shapefile (section 6.4.2). If you have a raster data source take a look at the stores section of the OneGeology WCS cookbook.

Section last modified: 6 October 2015

6.4.1 Connecting to a PostGIS database

On the **New Data Source** page, choose **PostGIS** as the data source by clicking **PostGIS**. This will bring you to a **New Vector Data Source** page. Complete the following steps:

1. Select a **Service Title** from the **Workspace** drop down menu. Select the workspace you created in the 'Creating a Workspace' section
2. Type a name for your data store in the **Data Source Name field** (spaces are acceptable here); add a description if desired
3. Make sure that the **Enabled** checkbox is checked
4. Set the **Connection Parameters** for your PostGIS data source; if the PostGIS data source is located on a remote server, you will need to provide the appropriate host, port, database name, user name, and password to access it:
   - **Host:** use 'localhost' if the PostGIS data source is on the same machine as your GeoServer instance; more specific host information will be necessary if your PostGIS data source is on a remote server
   - **Port:** default is 5432
   - **Database name:** this information will depend on the PostGIS data source
   - **Schema:** this information will depend on the PostGIS data source
   - **User name:** this information will depend on the PostGIS data source
   - **Password:** this information will depend on the PostGIS data source
5. When finished, click **Save**.

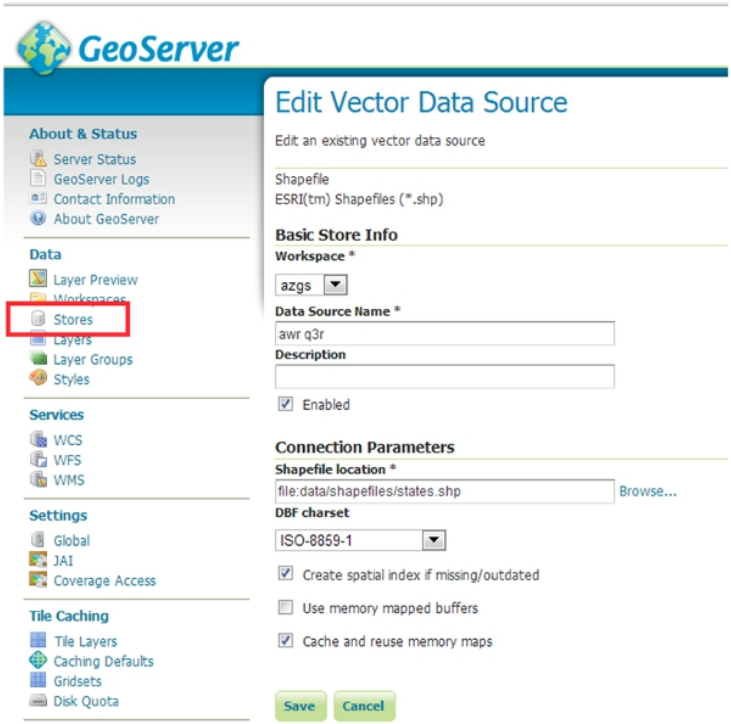
At this stage you have configured a store of data (a postgis database connection) that is available to your workspace, but you have no actual layers; see section 6.5 for details of how to configure your layers.

Section last modified: 7 October 2015

6.4.2 Connecting to a shapefile data source

1. First, place the shapefile of the intended data source in a file location that can be accessed by your GeoServer instance. For the following example file location, a folder named 'shapefiles' was created to house shapefiles in the geoserver installation directory:
   %installLocation%\geoserver\data\shapefiles
2. On the New Data Source page, choose Shapefile as the source by clicking Shapefile. This will bring you to a New Vector Data

Source page.



Edit Vector Data Source in GeoServer

3. In the Workspace drop down menu, select the workspace you created in the last step
4. Type a name for your data store in the Data Source Name field.
5. Add a description for the store, if desired. This description is for internal use only.
6. Make sure that the Enabled checkbox is checked.
7. Under Connection Parameters, click Browse... and navigate to the saved shapefile. The file will have to be accessible in the file system on the server that is hosting GeoServer.
8. When finished, click **Save**.

At this stage you have configured a store of data (a shapefile) that is available to your workspace, but you have no actual layers; see section 6.5 for details of how to configure your layers.

Section last modified: 7 October 2015

6.4.2.1 Using application schemas extension

If you wish to configure a GeoSciML-Portrayal cabaility in any layers in your service and you are using shapefiles as the data source for those layers then you will need to use the application schemas extension.

Shapefiles use dBase tables to contain thematic property data, and the field names in a shapefile are limited to 10 characters in length. Because some of the fields in the GeoSciML-Portrayal schema are longer than 10 characters a more complicated configuration utilizing the GeoServer Application Schema extension must be used for GeoServer GeoSciML-Portrayal implementation based on a shapefile. This extension allows data sources to be configured with a mapping from field names in the data source to XML element names in the representation of that data returned by a WMS GetFeatureInfo request. This field name mapping is essential for enabling user-defined map legend schemes based on OGC Styled Layer Descriptor (SLD) files that expect GeoSciML-Portrayal field names

The application scheme extension must be downloaded and installed separately, as it is not part of the standard GeoServer installation. Once the extension is installed, you will need to create a mapping file, and restart GeoServer to enable the new configuration.

6.4.2.1.1 Install application schema .jar files

See the Geoserver extensions page on Sourceforge http://sourceforge.net/projects/geoserver/files/GeoServer%20Extensions/ to get the application schema extension appropriate to uyour version of GeoServer

1. Go to the above Sourceforge page and click the link for the version of GeoServer that you have installed. For example if you have

Geoserver 2.3.5 installed click on the 2.3.5 link.

2. Download the app-schema plugin zip file for the same version of your GeoServer instance. So for Geoserver 2.3.5 you would download the geoserver-2.3.5-app-schema-plugin.zip file
3. Unzip the app-schema plugin zip file to obtain the jar files inside. Do not unzip the jar files.
4. Place the jar files in the WEB-INF/lib directory of your GeoServer installation.
5. Restart GeoServer to load the extension

6.4.2.1.2 Create mapping file

The mapping file is an XML file that maps fields from the data source into the fields of the XML output schema. For this example, the data source is a shapefile; this could be used as a workflow with continuation from Section 7.1.2. The example mapping file, below, uses field names in a shapefile that are the automatically truncated names generated by ESRI software mapping from the long field names to the valid Shapefile field names. If other field names are used in the shapefile (e.g. the recommended abbreviations in Appendix K), the strings in the sourceExpression/OCQL elements should be modified appropriately.

```
<?xml version="1.0" encoding="UTF-8"?>
 <as:AppSchemaDataAccess
 xmlns:as="http://www.geotools.org/app-schema"
 xmlns:ogc="http://www.opengis.net/ogc"
 xmlns:xs="http://www.w3.org/2001/XMLSchema"
 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
 xsi:schemaLocation="http://www.geotools.org/app-schema
 http://ogc.bgs.ac.uk/mapping/AppSchemaDataAccess.xsd">
 <namespaces>
  <Namespace>
   <prefix>gsmlp</prefix>
   <uri>http://xmlns.geosciml.org/geosciml-portrayal/2.0</uri>
  </Namespace>
  <Namespace>
   <prefix>gml</prefix>
   <uri>http://www.opengis.net/gml</uri>
  </Namespace>
 </namespaces>
 <sourceDataStores>
  <DataStore>
   <id>shapefile</id>
   <parameters>
    <Parameter>
     <name>url</name>
     <value>
      file:/home/geoserver/downloads/shapefiles/GeologicUnitView.shp
     </value>
    </Parameter>
    <Parameter>
     <name>memory mapped buffer</name>
     <value>false</value>
    </Parameter>
    <Parameter>
     <name>create spatial index</name>
     <value>true</value>
    </Parameter>
    <Parameter>
     <name>charset</name>
     <value>ISO-8859-1</value>
    </Parameter>
   </parameters>
  </DataStore>
 </sourceDataStores>
 <targetTypes>
  <FeatureType>
   <schemaUri>
```

```
      http://schemas.usgin.org/files/geologic-units/2.0/GeoSciML.xsd
    </schemaUri>
  </FeatureType>
</targetTypes>
<typeMappings>
  <FeatureTypeMapping>
    <sourceDataStore>shapefile</sourceDataStore>
    <sourceType>GeologicUnitView</sourceType>
    <targetElement>gsmlp:GeologicUnitView</targetElement>
    <attributeMappings>
      <AttributeMapping>
        <targetAttribute>gsmlp:GeologicUnitView</targetAttribute>
        <idExpression>
          <OCQL>getId()</OCQL>
        </idExpression>
      </AttributeMapping>
      <AttributeMapping>
        <targetAttribute>gsmlp:identifier</targetAttribute>
        <sourceExpression>
          <OCQL>identifier</OCQL>
        </sourceExpression>
      </AttributeMapping>
      <AttributeMapping>
        <targetAttribute>gsmlp:name</targetAttribute>
        <sourceExpression>
          <OCQL>name</OCQL>
        </sourceExpression>
      </AttributeMapping>
      <AttributeMapping>
        <targetAttribute>gsmlp:description</targetAttribute>
        <sourceExpression>
          <OCQL>descriptio</OCQL>
        </sourceExpression>
      </AttributeMapping>
      <AttributeMapping>
        <targetAttribute>gsmlp:geologicUnitType</targetAttribute>
        <sourceExpression>
          <OCQL>geologicUn</OCQL>
        </sourceExpression>
      </AttributeMapping>
      <AttributeMapping>
        <targetAttribute>gsmlp:rank</targetAttribute>
        <sourceExpression>
          <OCQL>rank</OCQL>
        </sourceExpression>
      </AttributeMapping>
      <AttributeMapping>
        <targetAttribute>gsmlp:lithology</targetAttribute>
        <sourceExpression>
          <OCQL>lithology</OCQL>
        </sourceExpression>
      </AttributeMapping>
      <AttributeMapping>
        <targetAttribute>gsmlp:geologicHistory</targetAttribute>
        <sourceExpression>
          <OCQL>geologicHi</OCQL>
        </sourceExpression>
      </AttributeMapping>
      <AttributeMapping>
        <targetAttribute>gsmlp:observationMethod</targetAttribute>
```

```
  <sourceExpression>
    <OCQL>observatio</OCQL>
  </sourceExpression>
</AttributeMapping>
<AttributeMapping>
  <targetAttribute>gsmlp:positionalAccuracy</targetAttribute>
  <sourceExpression>
    <OCQL>positional</OCQL>
  </sourceExpression>
</AttributeMapping>
<AttributeMapping>
  <targetAttribute>gsmlp:source</targetAttribute>
  <sourceExpression>
    <OCQL>source</OCQL>
  </sourceExpression>
</AttributeMapping>
<AttributeMapping>
  <targetAttribute>gsmlp:geologicUnitType_uri</targetAttribute>
  <sourceExpression>
    <OCQL>geologic_1</OCQL>
  </sourceExpression>
</AttributeMapping>
<AttributeMapping>
  <targetAttribute>gsmlp:representativeLithology_uri</targetAttribute>
  <sourceExpression>
    <OCQL>representa</OCQL>
  </sourceExpression>
</AttributeMapping>
<AttributeMapping>
  <targetAttribute>gsmlp:representativeAge_uri</targetAttribute>
  <sourceExpression>
    <OCQL>represen_1</OCQL>
  </sourceExpression>
</AttributeMapping>
<AttributeMapping>
  <targetAttribute>gsmlp:representativeOlderAge_uri</targetAttribute>
  <sourceExpression>
    <OCQL>represen_2</OCQL>
  </sourceExpression>
</AttributeMapping>
<AttributeMapping>
  <targetAttribute>gsmlp:representativeYoungerAge_uri</targetAttribute>
  <sourceExpression>
    <OCQL>represen_3</OCQL>
  </sourceExpression>
</AttributeMapping>
<AttributeMapping>
  <targetAttribute>gsmlp:specification_uri</targetAttribute>
  <sourceExpression>
    <OCQL>specificat</OCQL>
  </sourceExpression>
</AttributeMapping>
<AttributeMapping>
  <targetAttribute>gsmlp:metadata_uri</targetAttribute>
  <sourceExpression>
    <OCQL>metadata_u</OCQL>
  </sourceExpression>
</AttributeMapping>
<AttributeMapping>
  <targetAttribute>gsmlp:genericSymbolizer</targetAttribute>
```

```
      <sourceExpression>
        <OCQL>genericSym</OCQL>
      </sourceExpression>
    </AttributeMapping>
    <AttributeMapping>
      <targetAttribute>gsmlp:shape</targetAttribute>
      <sourceExpression>
        <OCQL>the_geom</OCQL>
      </sourceExpression>
    </AttributeMapping>
  </attributeMappings>
 </FeatureTypeMapping>
</typeMappings>
</as:AppSchemaDataAccess>
```

Create this mapping file with the prefix and namespace binding, the connection parameters (data source here is a shapefile), the online location of the schema (XSD), and the field mapping.

See helpful GeoServer documentation at the following locations:
http://docs.geoserver.org/stable/en/user/data/app-schema/mapping-file.html
http://docs.geoserver.org/stable/en/user/data/app-schema/data-stores.html#shapefile

Place the file in the GeoServer file location of the datastore. An example file location might be:
C:\Program Files (x86)\OpenGeo\OpenGeo Suite\webapps\geoserver\data\workspaces\gsmlp\Lithostratigraphy\
Where **gsmlp** is the name of your Workspace, and Lithostratigraphy is the Data Store name.

6.4.2.1.3 Edit datastore.xml file

This file is located in the same Data Store directory. To enable application-schemas, this file must indicate that the shapefile is no longer used for field names, but the mapping file instead. Example datastore.xml, after editing:

```
<dataStore>
 <id>DataStoreInfoImpl--49e58162:140a6f913de:-8000</id>
 <name>ShearDisplacementStructureView</name>
 <enabled>true</enabled>
 <workspace>
  <id>WorkspaceInfoImpl--1739a454:14097568969:-7fe9</id>
 </workspace>
 <connectionParameters>
  <entry key="dbtype">app-schema</entry>
  <entry key="url">
  file:workspaces/gsmlp/ShearDisplacementStructureView/ShearDisplacementStructureViewAZGS.xml
  </entry>
  <entry key="namespace">http://xmlns.geosciml.org/geosciml-portrayal/2.0</entry>
 </connectionParameters>
 <__default>false</__default>
</dataStore>
```

6.4.2.1.4 Restart GeoServer

After restarting GeoServer, the datastore for the desired layer will now read the field names from the mapping file, while still pulling the data from the indicated shapefile. The same can be done with data connections to PostGIS or any other type of data store.

Section last modified: 07 October 2015

6.5 Adding layers to a workspace

Having created a workspace and specified one or more data sources for your service, you will now associated data with layers offered by the service in your workspace.

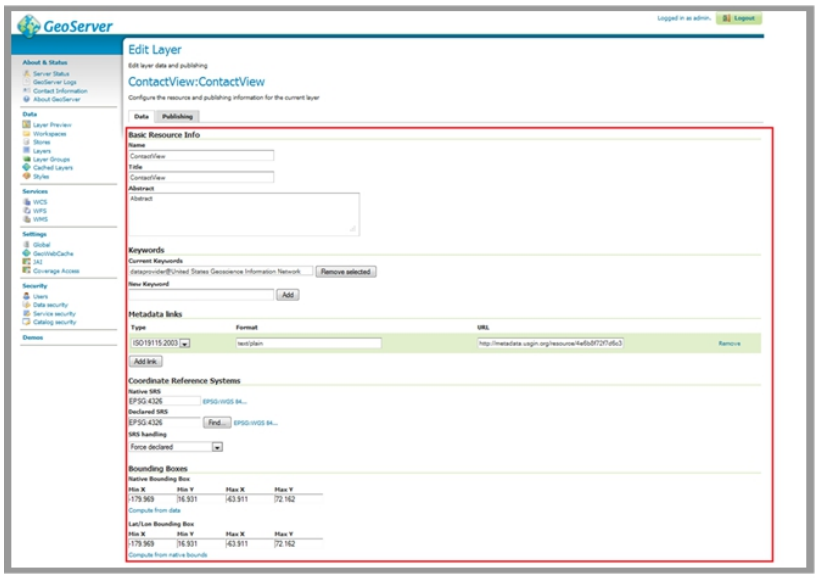
On the left side of the GeoServer **Web Administration Interface**, under **Data**, click **Layers**. This will bring up the **Layers** page.

On the **Layers** page, click **Add a new resource**. This will take you to the **New Layer** page.

On the **New Layer** page, use the pull down menu at the top of the page to select a workspace:data source combination that you previous specified. Doing so will populate the **New Layer** page with a list of layers that may be published; click **Publish** to make the associated layer publicly accessible to anyone who connects to your web service.

Note: You may publish the same layer multiple times. To do so, click **Publish again.

After clicking **Publish**, the **Edit Layer** page for the corresponding layer automatically appears. The **Edit Layer** page contains two tabs, **Data** and **Publishing**



Edit Layer Page

6.5.1 The Data tab of the Edit Layer page

The **Data** tab contains fields within which you may specify the name, title, abstract, bounding box, spatial reference system, keywords, and metadata links for each layer in your web service. This information will be present within the **Capabilities document** produced by your web service in response to a **GetCapabilities** request, so it is very important to enter this information carefully for each layer in your web service.

It is recommended to enter the bounding boxes for your service manually, as doing so permits you to provide a more useful bounding box for your web service.

Note: GeoServer occasionally hangs up. To fix this, try restarting the service on Apache-Tomcat.

6.5.2 The Publishing tab of the Edit Layer page

After populating the fields in the **Data** tab, click the **Publishing** tab.

The **Publishing** tab contains **Layer Style** settings for the corresponding layer of your web service. **Layer Style** settings are dependent on the geometry of the layer (point, line, or polygon). See the 'styling' section of this document for more details.

Generally, it is faster and more precise to import **Layer Style** settings from an existing style than it is to manually specify values for each field in the **Publishing tab**. To import **Layer Style** settings from an existing style, select the desired style from the **Available Styles** list.

To populate the Available Styles list, you might need to import layer styles from an SLD file. For further instructions, see the 'Importing Layer Styles from an SLD File' section.

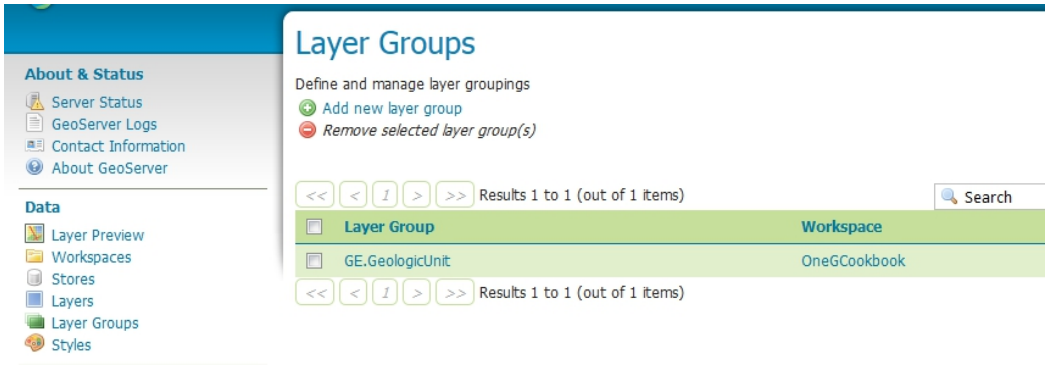
When you have populated the fields in the **Publishing** tab, click **Save**.

Section last modified: 7 October 2015

6.5.3 Creating group layers

In some situations it is desireable to create a group layer, for example you may want to do this to comply with INSPIRE layer naming regulations to create a layer called GE.GeologicUnit to group all of your layers that are spatial objects of type GeologicUnit.

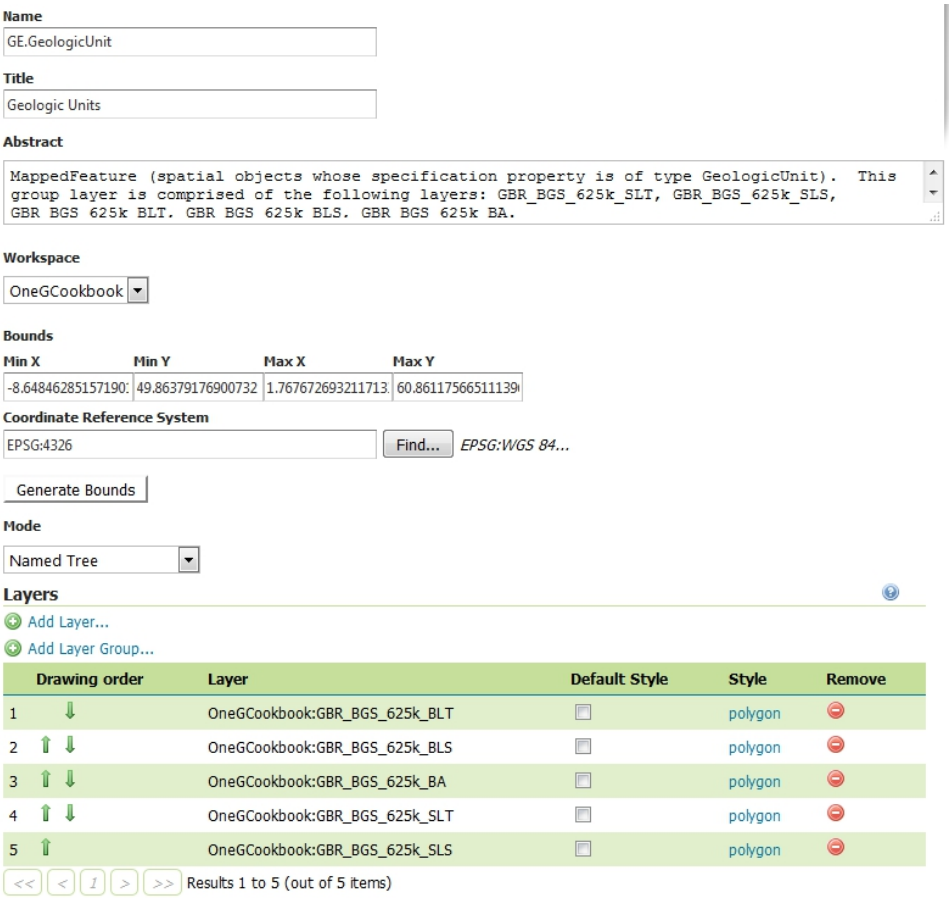
On the left side of the GeoServer **Web Administration Interface**, under **Data**, click **Layer Groups**. This will bring up the **Layer Groups** page. Click the add new layer group link to add a new group layer; this opens a New Layer Group page.



Create or edit a Group layer

Add the name, title, and abstract. If you are following INSPIRE regulations note the name and title must be EXACTLY as in the technical guidelines. You may enter anything in the abstract, though we suggest you provide as much information about the grouping as possible. Select the workspace you want to use and enter the layers that you want to group; the layers must already be available in the workspace. The layers will display on top of each other so when adding layers you may wish to chose a layer order, for example if you want to group layers that are point features on top of polygon features. Note the drawing order is the inverse of what will appear, that is the first drawn layer will appear at the bottom of the resultant map image.

Now select the default projection system for the group and then click the Generate Bounds button, this will generate a bounding box based on the extents of all your listed layers, though you may add the bounding box manually if you wish. To ensure that a user can see which layers are included in the group, you will also need to choose the *Named Tree* Mode (and not use the default Single mode).



Group layer properties

The output of a grouped layer is shown below (excerpt from a GetCapabilities response).

Name	GE.GeologicUnit
Title	Geologic Units
Abstract	MappedFeature (spatial objects whose specification property is of type GeologicUnit). This group layer is comp GBR_BGS_625k_BLT, GBR_BGS_625k_BLS, GBR_BGS_625k_BA.
CRS	EPSG:4326
EX_GeographicBoundingBox	
BoundingBox	
AuthorityURL	

Layer (5 rows)		@q...	...	Name	Title	Abstract
	1	1	0	OneGCookbook:GBR_BGS_625k_BLT	GBR BGS 1:625k Bedrock Lithology	GBR BGS 1:625k scale Bedrock Lithology
	2	1	0	OneGCookbook:GBR_BGS_625k_BLS	GBR BGS 1:625k Bedrock Lithostratigraphy	GBR BGS 1:625k scale Bedrock Lithostratigraphy (including Lithogenic units)
	3	1	0	OneGCookbook:GBR_BGS_625k_BA	GBR BGS 1:625k Bedrock Age	GBR BGS 1:625k scale Bedrock Age
	4	1	0	OneGCookbook:GBR_BGS_625k_SLT	GBR BGS 1:625k Superficial Lithology	GBR BGS 1:625k scale Superficial Deposits Lithology
	5	1	0	OneGCookbook:GBR_BGS_625k_SLS	GBR BGS 1:625k Superficial Lithostratigraphy	GBR BGS 1:625k scale Superficial Deposits Lithostratigraphy (including Lithomorphogenetic units)

Text | Grid | Author

./OneGCookbook/ows?service=wms&version=1.3.0&request=GetCapabilities | Format and Indent successful

Group layer output

Section last modified: 21 October 2015

6.6 Importing layer styles from an SLD file

On the left side of the GeoServer **Web Administration Interface**, under **Data**, click Styles. This will open the Styles page.

If the Style you want is not listed on the Styles page, you will need to add it to the list by clicking **Add a New Style**. This brings you to the **Style Editor** page.

On the Style Editor page, you have the choice to copy/paste an SLD or upload a .sld XML document. The **Validate** button may be used to validate the SLD file against the OGC XML schema before using it. Click **Submit** to add the SLD to the list on the **Styles** page.

Section last modified: 11 June 2013

6.7 GeoServer troubleshooting

Q: I made a change in the database on my server and now the service is not working
A: Try clearing the cache and reloading GeoServer on the Server Status page. If that doesn't work, try hard restarting the service through Apache Tomcat.
Q: Can I use a replicated Feature Class to create a service on GeoServer?
A: No.
Q: I set up my services under three separate workspaces. When I connected to the WMS in ArcCatalog, all the layers appeared as one bundle. Is there a way to separate them out so I can add them individually?
A: Yes.

Though setting up your services under different workspaces seems to imply that they can be accessed as discrete services, GeoServer defaults to providing one capabilities document containing the information for all of the services set up on your instance of GeoServer. To access workspaces individually, you will need customize your Get request to specify the desired workspace.

For example: a Geological Survey might run three services on GeoServer:

- GeologicUnitView
- FaultView
- ContactView

To perform a GetCapabilities request for GeologicUnitView, your GetCapabilities request will appear as follows:

http://services.a.survey.gov/geoserver/GeologicUnitView/ows?service=WMS&request=GetCapabilities&

This URL opens the WMS **capabilities document** for the GeologicUnitView workspace only. A generic form of the service endpoint for the request is as follows:

http://[host server]/geoserver/[Workspace Name]/ows?

Q: Is it possible to configure GeoServer so that I do not need to use PostGIS?
A: Try installing the ArcSDE plug-in for GeoServer. To do this, you will need to download the extension from GeoServer's website. Make sure to match the versions of the extension and GeoServer. If you can get it to work, you should be able to connect to other SDE databases running on, for instance, MS SQL or Oracle.
Q: All of my data are in Shapefiles. Can I deploy a shapefile as a GeoSciML-Portrayal service?
A: The problem you will run into is the truncation of field names that occurs in shapefiles. Ideally you will have a full version of the data in PostGIS. As mentioned in the above document, to be compliant with GeoSciML-Portrayal, you will need to make sure there is no truncation in field names; they must be an exact match for the GeoSciML-Portrayal schema. To map table fields to XML elements with different names you will have to use the Application Schema extension for GeoServer (http://docs.geoserver.org/stable/en/user/data/app-schema/index.html)

Section last modified: 9 November 2015

7.1 Introduction to GeoSciML-Portrayal

GeoSciML-Portrayal is an XML markup language for encoding geoscience information. It was developed to provide a simple schema to deliver geologic map unit, contact, and shear displacement structure (fault and ductile shear zone) descriptions in web map services. The intention is to support interoperable map services, for which interoperability is based on a shared data schema and the use of standard vocabulary terms for basic type classification of contacts and faults, age of geologic units and faults, and lithology of geologic units. Use of standard vocabulary enables map display using a shared legend (symbolization scheme) to achieve visual harmonization of maps provided by different services. In addition the GeoSciML-Portrayal data structure includes text fields with information for human users browsing a geologic map, a link to a full GeoSciML feature element if available, and a symbol identifier field to enable a user-defined symbolization scheme in each map service. By linking the simple feature WMS with a GeoSciML WFS, clients can acquire geologic feature descriptions that can be used in web-mapping applications to construct custom legends. Linking to full GeoSciML features allows the portrayal schema to be used in a map browsing and query interface to identify and select features for further processing that can be acquired as highly structured, information-rich GML features.

As of version 4.0, the GeoSciML-Portrayal schema is part of GeoSciML 4.0. GeoSciML is an XML markup language developed as a GML v3.2 application for encoding a wide variety of geoscientific information (See Richard et al., 2007), and defines a collection of GML features for describing various geoscience entities. The GeoSciML-Portrayal schema is a simplified view of GeoSciML data that merges complex property values into single, human-readable text, and assigns single, representative identifiers from controlled vocabularies for lithology and age that can be used for standardized map legends.

GeoSciML-Portrayal conforms to the level 0 of the Simple Features Profile for GML (OGC 10-100r3 - van den Brink et al., 2011; OGC 06-049). The simple features profile supports only a limited subset of possible GML geometry types that may be used to describe feature geographic location and shape. For the purposes of GeoSciML simple features, these include gml:Point, gml:LineString, gml:Curve, gml:Polygon, gml:Surface, gml:MultiPoint, gml:MultiCurve, gml:MultiSurface and multi-geometry types consisting of collections of these base types. For a useful discussion of GML simple vs. complex features, see this GeoServer documentation page.

GeoSciML-Portrayal features are analogous to GeoSciML mapped features, with additional text attributes for human consumption, a flatted-relation view of the age, and assignment to a single lithology. The portrayal schema consists of 'free-text' fields and identifier fields. In robust services the free-text fields will contain well-structured summaries of data in a format suitable for reading by the intended users. Identifier fields should contain identifiers for concepts in a controlled vocabulary (for example CGI Simple Lithology) that specify representative thematic properties. Inclusion of these standardized identifiers enables interoperability across services. Ideally these should be URIs that can be dereferenced to obtain machine-processable or human-readable representations of the identified concepts.

In addition, each feature includes an (optional) identifier for a specification, which is a resource containing a description of that particular feature. In many cases, the descriptions will be the same for all polygons assigned to the same map unit or classified as the same kind of contact or structure. If more complete information is available, different descriptions may be associated with subsets of features of the same type that are portrayed with the same symbol. In the most extreme case, each feature might have a unique description that captures the full spatial variability of a geologic unit or structure. Following the standard patterns of web architecture, the specification_uri should be dereferenceable to obtain one or more representations of that description. For maximum interoperability, one of these representations should be a GeoSciML encoded description of the feature, but other encodings might also be available, for example HTML web pages, other XML schema, or JSON. For those familiar with full GeoSciML, the

specification_uri property is equivalent to the specification association from MappedFeature to GeologicFeature.

Deployment of an interoperable dataset requires first that the interchange format used for interoperability is well understood. The following sections are intended to provide the necessary background understanding of GeoSciML-Portrayal, and should be studied carefully. The deployment process consists of determining how the information in the dataset to be published can best be represented using the elements in the GeoSciML-Portrayal model, populating the feature collections that will be served, and configuring a WMS server to display the data.

Section last modified: 10 December 2015

7.1.2 Cookbook workflow

Setting up a geologic data web map service involves the following steps:

1. Map your source data from its original schema to the GeoSciML-Portrayal schema; this step can be further broken down into the following sub-steps
   1. Map existing content fields to corresponding GeoSciML-Portrayal schema elements
   2. Determine controlled vocabulary terms for lithology and age to assign for each map unit
   3. Load data from the original database format to tables or files required by the server software used to deploy the web service
2. Establish symbology for lithostratigraphic polygon portrayal that can be used by the map server
3. Deploy your web service, create metadata for dataset and service.

Section last modified: 11 June 2013

7.2 Integration of web map services

The key to interoperable map services is the ability to portray adjacent maps using the same symbolization scheme such that when the maps are displayed, the visual discontinuity at the boundary is minimized. Because of the discrepancies in mapping interpretation and intention, there are commonly differences in the definition of map units between geologic maps produced by different authors or at different times. Resolving such differences is a compilation process that often requires additional field work; this is outside the scope of service deployment. What can be avoided is visual discontinuity due to portrayal schemes that assign different colors to similar units on adjacent maps. GeoSciML-Portrayal addresses this issue by requesting that geologic unit mapped features be categorized using the CGI Simple Lithology vocabulary (representativeLithology_uri) and the ICS stratigraphic time scale (representativeAge_uri) using registered identifiers. The use of community portrayal schemes associated with these categorization schemes provides a basis for first order lithologic and age harmonization between maps provided by different services. The genericSymbolizer property is intended to enable preservation of the original legend units and portrayal from the source map.

Section last modified: 07 February 2013

7.3 GeoSciML-Portrayal feature types

Three feature types are defined. ContactView contains features that represent the mapped traces of boundaries between two geologic units. ShearDisplacementStructureView is used to represent the mapped trace of any kind of fault or shear zone that is treated as a single surface for map portrayal. GeologicUnitView contains polygon features that represent the outcrop of a geologic unit mapped on some outcrop surface called the '*map horizon*'. Example map horizons include '*Earth surface*' (the most common map horizon for a geologic map), '*Top of basement*', and '*Mission-Pima pit, 6/20/1990*'. Since the map horizon is not specified in each feature's properties, it must be described in the metadata for the feature collection. Overlapping polygons representing outcrops on different horizons (e.g. '*Earth surface*' and '*bedrock surface*') will be represented as distinct features in different GeoSciML-Portrayal services. Each GeoSciML-Portrayal service provides geologic unit outcrop polygons, associated contacts between the units, and fault traces on a single map horizon at any particular location in the extent of the feature collection.

Section last modified: 14 June 2015

7.3.1 ContactView features

These features provide a simplified view of GeoSciML Contact Features. In GeoSciML terms this will be an instance of a MappedFeature with key property values from the associated ContactFeature summarized in text (data type xs:string) fields, and properties suffixed with '*_uri*' that contain URIs referring to other resources, for example controlled concepts in published vocabularies.

Elements in ContactView mapped feature scheme

Missing values should be specified using OGC nil values http://www.opengis.net/def/nil/ogc/0/ as below:

above detection range (AboveDetectionRange)
Value was above the detection range of the instrument used to estimate it.
below detection range (BelowDetectionRange)
Value was below the detection range of the instrument used to estimate it.
inapplicable
There is no value
missing
The correct value is not readily available to the sender of this data. Furthermore, a correct value may not exist
template
The value will be available later
unknown
The correct value is not known to, and not computable by, the sender of this data. However, a correct value probably exists
withheld
The value is not divulged

Alternatively you could use INSPIRE defined void reaons http://inspire.ec.europa.eu/codelist/VoidReasonValue/

Bold property names indicate required properties.

Whilst properties of type _uri are defined as xs:string in the GeoSciML-Portrayal 4.0 schema, to be conformant with GML SF-0, the intention is that these strings SHALL BE absolute URI's.

Name	Implementation data type	Notes
identifier	xs:string	Globally unique identifier for the individual feature. Recommended practice is that this identifier be derived from the primary key for the spatial objects in the source data in case information needs to be transferred from the interchange format back to the source database. This identifier is analogous to the identifier for a GeoSciML MappedFeature.
name	xs:string	Display name for the Contact. Examples: '*depositional contact*', '*unconformity*', '*Martin-Escabrosa contact*'
description	xs:string	Text description of the contact, may be a generic description of a contact type taken from an entry on a geological map legend, or a more specific description of the particular contact.
contactType	xs:string	Text label specifying the kind of surface separating two geologic units including primary boundaries such as depositional contacts, all kinds of unconformities, intrusive contacts, and gradational contacts, as well as faults that separate geologic units. Ideally this would be the preferred label for the concept identified by contactType_uri
observationMethod	xs:string	Metadata snippet indicating how the spatial extent of the feature was determined. ObservationMethod is a convenience property that provides a quick and dirty approach to observation metadata.
positionalAccuracy	xs:string	Preferred use is a quantitative value defining the radius of an uncertainty buffer around a MappedFeature, e.g. a positionAccuracy of 100 m for a line feature defines a buffer polygon of total width 200 m centered on the line. Some other text description that quantifies position accuracy may be provided, e.g. a term from a controlled vocabulary. Vocabulary used should be described in the dataset metadata.
source	xs:string	Text describing feature specific details and citations to source materials, and if available providing URLs to reference material and publications describing the geologic feature. This could be a short text synopsis of key information that would also be in the metadata record referenced by metadata_uri.
contactType_uri	xs:string	URI referring to a controlled concept from a vocabulary defining the Contact types. Mandatory property - if no value is provided then a URI referring to a controlled concept explaining why the value is nil must be provided.
The current CGI controlled vocabulary is: http://resource.geosciml.org/classifier/cgi/contacttype/ There is no INSPIRE specific controlled vocabulary for contact type. OneGeology-Europe services applied one of the following CGI vocabulary terms: impact_structure_boundary, volcanic_subsicence_zone_boundary, glacial_stationary_line		
specification_uri	xs:string	URI referring to the GeoSciML Contact feature that describes the instance in detail. Mandatory property - if no value is provided then a URI referring to a controlled concept explaining why the value is nil must be provided.
metadata_uri	xs:string	URI referring to a formal metadata record describing the provenance of data.
genericSymbolizer	xs:string	Identifier for a symbol from standard (locally or community defined) symbolization scheme for portrayal. There should be an SLD file available defining the symbol associated with each genericSymbolizer value.

shape	GM_Object	Geometry defining the extent of the feature of interest. This is the only element with complex content, and must contain a GML geometry that is valid for the Geography Markup Language (GML) simple features profile (OGC 06-049r1.). The shape value will generally be provided by GIS software, and will need no user input.
Other attribute(s)		A placeholder allowing any user-defined attributes to be delivered in addition to those specified above.

Section last modified: 9 December 2015

7.3.2 ShearDisplacementStructureView features

These features represent faults and ductile shear zones. In GeoSciML terms they are instances of MappedFeature with key property values from the associated ShearDisplacementStructure feature summarized in text fields (data type xs:string) and fields containing identifiers (URI) for fault type, deformation style, movement type, geologic age, and a formally-encoded (ideally in GeoSciML) specification for interoperability. The latter are the properties suffixed with '*_uri*' and will contain URIs referring to other resources, for example controlled concepts in published vocabularies.

The concept of 'Shear displacement structure' includes all brittle to ductile style faults or ductile shear zones along which displacement has occurred, from a simple, single 'planar' brittle or ductile surface to a fault system comprising multiple strands of both brittle and ductile nature. Because this feature class is constrained to have a linear geometry, it is limited to representing shear displacement structures that are considered single surfaces at the scale of portrayal.

Elements in Shear Displacement Structure View feature

Missing values should be specified using OGC nil values (see section 7.3.1 for allowed values) alternatively you could use INSPIRE defined void reaons http://inspire.ec.europa.eu/codelist/VoidReasonValue/

Bold property names indicate required properties.

Whilst properties of type _uri are defined as xs:string in the GeoSciML-Portrayal 4.0 schema, to be conformant with GML SF-0, the intention is that these strings SHALL BE absolute URI's.

Name	Type	Notes
identifier	xs:string	Globally unique identifier for the individual feature. Recommended practice is that this identifier be derived from the primary key for the spatial objects in the source data in case information needs to be transferred from the interchange format back to the source database. This identifier is analogous to the identifier for a GeoSciML MappedFeature.
name	xs:string	Display name for the ShearDisplacementStructure. This may be a generic fault type, e.g. '*thrust fault*', 'strike-slip fault', or a particular fault name, e.g. '*Moine thrust*', 'san Andreas Fault'.
description	xs:string	Text description of the ShearDisplacementStructure, typically taken from an entry on a geological map legend.
faultType	xs:string	Type of ShearDisplacementStructure (as defined in GeoSciML).
movementType	xs:string	Summary of the type of movement (e.g. dip-slip, strike-slip) on the ShearDisplacementStructure.
deformationStyle	xs:string	Description of the style of deformation (e.g. brittle, ductile etc) for the ShearDisplacementStructure.
displacement	xs:string	Text summary of displacement across the ShearDisplacementStructure.
geologicHistory	xs:string	Text (possibly formatted with formal syntax) description of the sequence of events that formed and have affected the ShearDisplacementStructure. Events include process and optional environment information.
observationMethod	xs:string	Metadata snippet indicating how the spatial extent of the feature was determined. ObservationMethod is a convenience property that provides a quick and dirty approach to observation metadata when data are reported using a feature view (as opposed to observation view).
positionalAccuracy	xs:string	Preferred use is a quantitative value defining the radius of an uncertainty buffer around a MappedFeature, e.g. a positionAccuracy of 100 m for a line feature defines a buffer polygon of total width 200 m centered on the line. Some other text description that quantifies position accuracy may be provided, e.g. a term from a controlled vocabulary. Vocabulary used should be described in the dataset metadata.
source	xs:string	Text describing feature specific details and citations to source materials, and if available providing URLs to reference material and publications describing the geologic feature. This could be a short text synopsis of key information that would also be in the metadata record referenced by metadata_uri.
faultType_uri	xs:string	URI referring to a controlled concept from a vocabulary defining the fault (ShearDisplacementStructure) type. Mandatory property - if no value is provided then a URI referring to a controlled concept explaining why the value is nil must be provided.

Current CGI controlled vocabulary is: http://resource.geosciml.org/classifier/cgi/faulttype/

The current INSPIRE specific controlled vocabulary is: http://inspire.ec.europa.eu/codelist/FaultTypeValue/		
movementType_uri	xs:string	URI referring to a controlled concept from a vocabulary defining the ShearDisplacementStructure movement type. Mandatory property - if no value is provided then a URI referring to a controlled concept explaining why the value is nil must be provided.
Current CGI controlled vocabulary is: http://resource.geosciml.org/classifier/cgi/faultmovementtype/		
There is no INSPIRE specific controlled vocabulary for movement type.		
deformationStyle_uri	xs:string	URI referring to a controlled concept from a vocabulary defining the ShearDisplacementStructure deformation style. Mandatory property - if no value is provided then a URI referring to a controlled concept explaining why the value is nil must be provided.
Current CGI controlled vocabulary URI stem is: http://resource.geosciml.org/classifier/cgi/deformationstyle/ for concepts see: http://resource.geosciml.org/vocabulary/cgi/201211/deformationstyle.html		
There is no INSPIRE specific controlled vocabulary for deformation style		
representativeAge_uri	xs:string	URI referring to a controlled concept specifying the most representative stratigraphic age interval for the GeologicUnit. This will be defined entirely at the discretion of the data provider and may be a single event selected from the geologic feature's geological history or a value summarizing the all or part of the feature's history.
representativeOlderAge_uri	xs:string	URI referring to a controlled concept specifying the most representative older value in a range of stratigraphic age intervals for the GeologicUnit. This will be defined entirely at the discretion of the data provider and may be a single event selected from the geologic feature's geological history or a value summarizing the all or part of the feature's history.
representativeYoungerAge_uri	xs:string	URI referring to a controlled concept specifying the most representative younger value in a range of stratigraphic age intervals for the GeologicUnit. This will be defined entirely at the discretion of the data provider and may be a single event selected from the geologic feature's geological history or a value summarizing the all or part of the feature's history.
Current CGI controlled vocabulary are: http://resource.geosciml.org/classifier/ics/ischart/ and http://resource.geosciml.org/classifier/cgi/stratchart/ (for OneGeology-Europe Precambrian Epoch definitions for the Fenno-Scandian Shield)		
The current INSPIRE specific controlled vocabulary is: http://inspire.ec.europa.eu/codelist/GeochronologicEraValue/		
numericOlderAge	xs:double	Older age in numerical representation in Ma.
numericYoungerAge	xs:double	Younger age in numerical representation in Ma.
specification_uri	xs:string	URI referring to the GeoSciML ShearDisplacementStructure feature that describes the instance in detail. Mandatory property - if no value is provided then a URI referring to a controlled concept explaining why the value is nil must be provided.
metadata_uri	xs:string	URI referring to a metadata record describing the provenance of data.
genericSymbolizer	xs:string	Identifier for a symbol from standard (locally or community defined) symbolization scheme for portrayal.
shape	GM_Object (GM_curve)	Geometry defining the extent of the feature of interest.
Other attribute(s)		A placeholder allowing any user-defined attributes to be delivered in addition to those specified above.

Section last modified: 9 December 2015

7.3.3 GeologicUnitView features

GeologicUnitView features represent outcrops of a particular geologic unit, typically with polygon geometry. The properties of these features provide a simplified view of information associated with GeoSciML GeologicUnit features. A geologic unit in this context is an identifiable body of material within the Earth. GeologicUnitView features are instances of GeoSciML MappedFeature with property values from the associated GeologicUnit specifier summarized in text fields for human data consumers, and with fields containing standard identifiers for geologic unit type, representative lithology, and geologic age. The specification_uri property identifies a description resource specific to the geologic unit cropping out in the extent of the polygon (or other) geometry of the feature. The specification_uri should dereference to yield a formally-encoded representation of the geologic unit, ideally in GeoSciML for interoperability. Properties populated by identifiers are suffixed with '_uri' and contain URIs referring to other resources, for example controlled concepts in published vocabularies.

Elements in GeologicUnitView feature class

Missing values should be specified using OGC nil values (see section 7.3.1 for allowed values) alternatively you could use INSPIRE defined void reaons http://inspire.ec.europa.eu/codelist/VoidReasonValue/

Bold property names indicate required properties.

Whilst properties of type _uri are defined as xs:string in the GeoSciML-Portrayal 4.0 schema, to be conformant with GML SF-0, the

intention is that these strings SHALL BE absolute URI's.

Name	Type	Notes
identifier	xs:string	Globally unique identifier for the individual feature. Recommended practice is that this identifier be derived from the primary key for the spatial objects in the source data in case information needs to be transferred from the interchange format back to the source database. This identifier is analogous to the identifier for a GeoSciML MappedFeature.
name	xs:string	Display name for the GeologicUnit; this can be used to put in a geologic unit name, or more likely an abbreviation used to label outcrops of the unit in a map display.
description	xs:string	Text description of the GeologicUnit, typically taken from an entry on a geological map legend.
geologicUnitType	xs:string	Type of GeologicUnit (as defined in GeoSciML).
rank	xs:string	Stratigraphic rank of GeologicUnit (as defined in GeoSciML). Examples: formation, member, group, supergroup.
lithology	xs:string	Text (possibly formatted with formal syntax) description of the GeologicUnit's lithology.
geologicHistory	xs:string	Text (possibly formatted with formal syntax) description of the age of the GeologicUnit (where age is a sequence of events and may include process and environment information).
numericOlderAge	xs:double	Older age in numerical representation in Ma.
numericYoungerAge	xs:double	Younger age in numerical representation in Ma.
observationMethod	xs:string	ObservationMethod is a convenience property to provide observation metadata. Example values might include '*field observation by author*', '*compilation from published maps*', '*air photo interpretation*'. Recommend using the CGI Feature Observation Method vocabulary (http://resource.geosciml.org/classifier/cgi/featureobservationmethod/)
positionalAccuracy	xs:string	Preferred use is a quantitative value defining the radius of an uncertainty buffer around a MappedFeature, e.g. a positionAccuracy of 100 m for a line feature defines a buffer polygon of total width 200 m centered on the line. Some other text description that quantifies position accuracy may be provided, e.g. a term from a controlled vocabulary. Vocabulary used should be described in the dataset metadata. For polygon mapped features this is intended for use to indicate the position uncertainty of the contact and fault features bounding the outcrop polygon, which is only necessary if the associated line features are not included with the polygons.
source	xs:string	Text describing feature specific details and citations to source materials, and if available providing URLs to reference material and publications describing the geologic feature. This could be a short text synopsis of key information that would also be in the metadata record referenced by metadata_uri.
geologicUnitType_uri	xs:string	URI referring to a controlled concept from a vocabulary defining the GeologicUnit types. Mandatory property - if no value is provided then a URI referring to a controlled concept explaining why the value is nil must be provided.
The current CGI controlled vocabulary is: http://resource.geosciml.org/classifier/cgi/geologicunittype/		
The current INSPIRE specific controlled vocabulary is: http://inspire.ec.europa.eu/codelist/GeologicUnitTypeValue/		
representativeLithology_uri	xs:string	URI referring to a controlled concept specifying the characteristic or representative lithology of the unit. This may be a concept that defines the supertype of all lithology values present within a GeologicUnit or a concept defining the lithology of the dominant CompositionPart (as defined in GeoSciML) of the unit. This identifier is intended for use as the symbol key for a lithologic map portrayal of the geologic unit features.
The current CGI controlled vocabulary is: http://resource.geosciml.org/classifier/cgi/lithology/		
The current INSPIRE specific controlled vocabulary is: http://inspire.ec.europa.eu/codelist/LithologyValue/		
representativeAge_uri	xs:string	URI referring to a controlled concept specifying the most representative stratigraphic age interval for the GeologicUnit. This will be defined entirely at the discretion of the data provider and may be a single event selected from the geologic feature's geological history or a value summarizing all or part of the feature's history. This identifier is intended for use as a symbol key for a geologic-age-based portrayal of the geologic unit features.
representativeOlderAge_uri	xs:string	URI referring to a controlled concept specifying the most representative older value in a range of stratigraphic age intervals for the GeologicUnit. This will be defined entirely at the discretion of the data provider and may be a single event selected from the geologic feature's geological history or a value summarizing all or part of the feature's history.
representativeYoungerAge_uri	xs:string	URI referring to a controlled concept specifying the most representative younger value in a range of stratigraphic age intervals for the GeologicUnit. This will be defined entirely at the discretion of the data provider and may be a single event selected from the geologic feature's geological history or a value summarizing all or part of the feature's history.
Current CGI controlled vocabulary are: http://resource.geosciml.org/classifier/ics/ischart/ and http://resource.geosciml.org/classifier/cgi/stratchart/ (for OneGeology-Europe Precambrian Epoch definitions for the Fenno-Scandian Shield)		
The current INSPIRE specific controlled vocabulary is: http://inspire.ec.europa.eu/codelist/GeochronologicEraValue/		

specification_uri	xs:string	URI for a complete description of the geologic unit cropping out within the extent of the feature's geometry. Preferred representation is a GeoSciML GeologicUnit feature instance. Mandatory property - if no value is provided then a nil reason URI explaining why the value is nil must be provided.
metadata_uri	xs:string	URI referring to a metadata record describing the provenance of data.
genericSymbolizer	xs:string	Identifier for a symbol from standard (locally or community defined) symbolization scheme for portrayal.
shape	GM_Object (GM_polygon)	Geometry defining the extent of the feature of interest.
Other attribute(s)		A placeholder allowing any user-defined attributes to be delivered in addition to those specified above.

Section last modified: 9 December 2015

7.4 Deployment

Once geologic map data is automated into a structured digital form, publication of the data for access as an OGC WMS/WFS is a process of **Extracting** data from the source data set, **Transforming** it to the GeoSciML-Portrayal schema, and **Loading** the transformed data into whatever sort of data store is most convenient for the server implementation of the OGC WMS and WFS. This process is commonly called '**ETL**'. There exists a broad spectrum of approaches to the ETL process. We focus in this tutorial on what we deem to be a common situation in which the source data is in a database feature class (possibly in an ESRI geodatabase, shapefile, or PostGIS table) with one record for each geometric feature (line or polygon), and each feature either includes fields specifying the age and lithology of the unit, or has a link to a map unit description table that contains the information. Source information for the map data and unit descriptions is also required.

The most difficult part of the process is typically determining what representative lithology, age, younger age, and older age categories from a standard vocabulary to assign to each unit using URIs. OneGeology conformance prescribes that these vocabularies should be either the CGI SimpleLithology vocabulary for lithology and the CGI2011 time scale (see listing in portrayal template workbook, CGI2011 tab), or their INSPIRE vocabulary equivalents. This time scale includes the International Stratigraphic Commission Geologic Time Scale 2009 for age, and Fennoscandian age additions (Asch, Kristine, Klicker, Marco, and Schubert, Chris, 2009-11, Draft Portrayal Rules for OneGeology Europe, OneGeology-Europe WP3 Data Portrayal, Downloaded from http://onegeology-europe.brgm.fr/how_to201002/OneGeologyWP3-DataSpec_Portrayal_v%201%205KA.doc 2011-11-30). Mapping data structure from the source data tables into a GIS feature class (a table with the GeoSciML-Portrayal data structure with a geometry column for the line or polygon location) is described in the next section.

Once the GeoSciML-Portrayal feature class is ready, set up the configuration for the WMS server. This procedure will be specific to the particular server implementation that is being used. To support the use of SLD for user defined map portrayals, it is important to provide WMS layers with standard layer names as discussed in the section on Styling, below.

The final step is to create metadata for the dataset and its service distribution. This includes checking the WMS GetCapabilities response document that the service will present to describe itself, as well as loading a metadata record into a catalog server to make the serviced discoverable. The OneGeology catalog is populated automatically using the WMS capabilities document, so the catalog registration does not require an extra step on the part of the service provider.

Section last modified: 21 October 2015

7.4.1 Mapping from source data

The following outline describes the basic ETL workflow:

1. Determine which fields in the source data contain the information that is to be delivered in the interchange format fields. Multiple source fields may be combined into single interchange fields, and a single source field may impact values in multiple interchange fields.
2. Determine what steps are necessary to get the content into the interchange format. This may involve some calculation, such as concatenating text from multiple fields to populate the text fields in interchange format. Use of the standard vocabularies for interoperability will likely require mapping vocabulary terms in the source data to identifiers for concepts in the controlled vocabularies for the fields that require URI's (see next section).
3. Set up a query to generate a table with field names exactly matching the field names in the interchange schema. In some cases it may be convenient to generate the interchange schema table in several steps, populating subsets of the fields each time. It may be useful to generate a table with unique combinations of contact, fault, or geologic unit properties from the source data, and map each combination to corresponding properties in the interchange format. Depending on individual situations, the unique descriptions can be identified using the specification_uri, name, or generic-Symbolizer field; identifiers in this field can then be used

to join the interchange format properties with individual features.

4. The table of unique descriptions can then be joined with the geometry elements to generate the final feature classes for the portrayal view service. ESRI Shapefiles and PostGIS tables are useful representations for the final feature class that the WMS server will use. Shapefiles will truncate field names longer that 10 characters, so in order to use them, the map server must support defining XML element names distinct from data table field names that are longer than 10 characters. Note that this requires installing an extension for GeoServer.

Section last modified: 21 October 2015

7.4.1.1 Schema mapping in ESRI ArcGIS

This section provides an example of schema mapping using ESRI ArcGIS software, including ArcMap, ArcCatalog, and ArcToolbox. The procedure requires connecting to the spatial data container (file geodatabase, shapefile, or SDE database), creating a new feature class using the GeoSciML-Portrayal schema if an empty template is not available, and loading data from the source dataset into the GeoSciML-Portrayal schema feature class.

Prepare feature class

1. Open ArcCatalog
2. Locate or create the **geodatabase** that will host the data for your GeoSciML-Portrayal web services. To start, it is probably a good idea to work in a new geodatabase, but in the long run the organization of feature classes and geodatabases for production services should be determined by local data management policies.
3. Connect to the desired spatial database
   1. If you are using a shapefile or file or personal geodatabase, navigate to it in the file system tree in ArcCatalog.

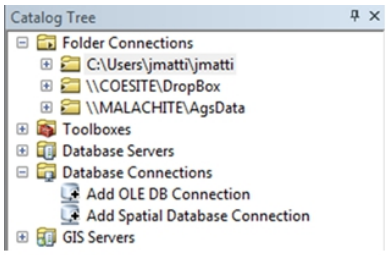


Figure 1: Adding a Spatial Database Connection in ArcCatalog

   2. If you are using and SDE geodatabase, you will need to connect to the database using Database Connections (Figure 1). In the Spatial Database Connection window, specify the location and (if necessary) the credentials needed to access the desired spatial database. Click OK when finished.
4. If you are starting with a new geodatabase or shapefile, you need to create a feature class with the fields required by the appropriate GeoSciML-Portrayal feature class (geologicUnitView, contactView or shearDisplacementStructureView). It is useful to create a set of empty feature class templates in one geodatabase and copy these to create new instances. To create a new feature class, right-click the desired database and in the context menu that appears, click New > Feature Class... This will bring up the New Feature Class dialogue box.
   1. In the New Feature Class dialogue box, type the name for your feature class (this is not the name of the web service). Use the pull down menu to select the appropriate Type of feature geometry for the data you are going to publish. When you are finished filling out the form, click Next. Note that if you are loading into a shapefile, field names longer than 10 characters will be truncated; aliases assigned to the fields must contain the complete GeoSciML-Portrayal field name; see the 'ESRI shapefile implementation' section (below) for recommended aliases.
   2. Choose the coordinate system for your feature class. OneGeology requires that all services are available in the WGS 1984 coordinate reference system, so this is the easiest to use for feature classes for OneGeology services. To select the WGS 1984 coordinate system, navigate to the Geographic Coordinate System > World directory and click the WGS 1984 coordinate system. When you have located and selected the desired coordi-nate system, click Next.

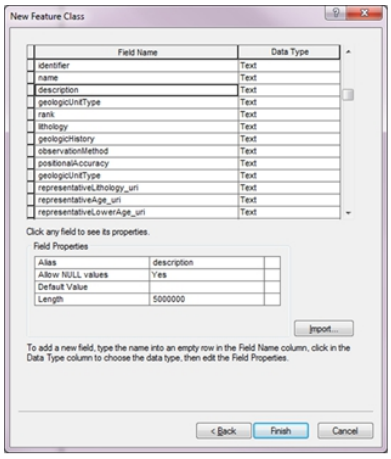


Figure 2: Step 5E - Entering GeoSciML-Portrayal schema field names and parameters

3. Specify the resolution for your feature class. The XY tolerance defaults to 0.000000008983153, which is fine for most applications, but may be changed if necessary by entering an appropriate value into the XY Tolerance field. When finished, click Next.
4. Specify the Configuration keywords for your feature class if you are using any. The default is fine for most database storage architectures. When finished, click Next.
5. Enter appropriate field names under the Field Name column; All field names (or field aliases if you are using shape files) and associated parameters must conform exactly to the GeoSciML-Portrayal schema for the feature class you are implementing (see Table 1, Table 2, or Table 3). This includes capitalization, spacing, underscores in names, data types, field lengths, and cardinality.
6. Specify the parameters for each field by entering appropriate values in the Data Type column and in the Field Properties section (Figure 2).
7. When done, click Finish.

Your new feature class will appear in the spatial database you selected or created above.

Load data into feature class

Next, you will use ArcToolbox to import and map your existing data into the new feature class you just selected or created above.

1. Open ArcCatalog
2. On the menu bar of ArcCatalog, click the ArcToolbox button

ArcToolbox button

3. In ArcToolbox, click Data Management Tools > General > Append

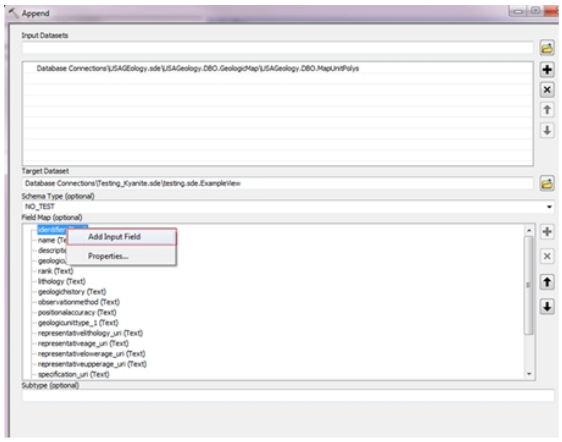


Figure 3: The Append window

4. In the Append window (Figure 3), you need to perform a number of tasks:
   1. Specify the Input Dataset. This will be your source data that does not conform to the GeoSciML-Portrayal schema
   2. Specify the Target Dataset. This will be a feature class that conforms to the GeoSciML-Portrayal schema, e.g. the feature class

you created above. Data from the input dataset

3. Change the default Schema Type to NO_TEST. This last instruction is very important; it allows you to perform the schema mapping
4. Using the Field Map (optional) table, match each field in the Input Dataset to the appropriate GeoSciML-Portrayal field in the Target Dataset:
    1. Right-click a target field in the Field Map (optional) table
    2. In the context menu that appears, click Add Input Field
    3. In the dialog box that appears, select the corresponding field from your Input Dataset
5. Repeat steps i-iii for every field in the Target Dataset
6. When finished, click OK

5. Repeat Step 4 in this list for each dataset you wish to deploy as a web service

The feature classes are now ready to deploy your services. Double check the feature class content to make sure that all content is in order. In many cases you may need to update some fields with additional information.

Section last modified: 11 June 2013

7.4.1.2 Schema mapping in SQL

If your data is in a relational database with multiple tables that must be joined to generate the GeoSciML-Portrayal fields, it may be easier to write an SQL query to do the mapping. The following example demonstrates a schema mapping query. The source schema is the USGS/AASG National Cooperative Geologic Mapping Program NCGMP09 database schema (NCGMP, 2010), and the target is a GeoSciML-Portrayal GeologicUnitView. This is meant as an illustrative example of the kind of processing that may be required. The level of difficulty in the schema mapping is largely determined by how similar the source relational database data model is to the GeoSciML conceptual model, and how much content the data provider wishes to make available in the portrayal view.

The below code example provides an SQL query that creates a table with fields conforming to the GeologicUnitView for the GeoSciML-Portrayal schema. The SQL is PostGIS dialect; notes on the query construction are at the end of the code example, and details for each field follow. This example is meant to be illustrative of the kind of processing that may be required. The level of difficulty in the schema mapping is largely determined by how similar the internal data model schema is to the GeoSciML conceptual model, and how much content there is that the data provider wishes to make available in the portrayal view.

```
1  CREATE TABLE sde.geologicunitview As
2  SELECT
3  mup.mup_id AS identifier,
4  dmu.description AS name,
5  mup.notes AS description,
6  'Geologic Unit'::text AS "geologicUnitType",
7  'Not Specified'::text AS rank,
8  polyextattr.lith6name AS lithology,
9  dmu.age AS "geologicHistory",
10 (datasources.source::text || ' '::text) || datasources.notes AS source,
11 'http://…/cgi/geologicunittype/0008'::text AS "geologicUnitType_uri",
12 polyextattr.lithuri AS "representativeLithology_uri",
13 polyextattr.ageuri AS "representativeAge_uri",
14 mapunitages.ageoldererterm AS "representativeLowerAge_uri",
15 mapunitages.agyoungerterm AS "representativeUpperAge_uri",
16 'http://www.opengis.net/def/nil/OGC/0/missing'::text AS
   specification_uri,
17 'http://catalog.usgin.org/geoportal/…'::text AS metadata_uri,
18 mup.mapunit AS "genericSymbolizer",
19 shape::geometry as shape
20 mup.objectid as objectid,
21 FROM mapunitpolys AS mup
22 LEFT JOIN polyextattr ON mup.mapunitpolys_id = polyextattr.ownerid
23 LEFT JOIN datasources ON mup.datasourceid = datasources.datasources_id
24 LEFT JOIN descriptionofmapunits as dmu ON mup.mapunit = dmu.mapunit
25 LEFT JOIN mapunitages ON mup.mapunit = mapunitages.mapunit;
```

This example SQL query creates a table that has fields conforming to the GeologicUnitView for the GeoSciML-portrayal scheme. The SQL is PostGIS dialect, so field names that are not all lower case are enclosed in quotes, and constant values are explicitly typed (e.g. '::text'). 'mapunitpolys' (abbreviated mup),' datasources', and 'descriptionofmapunits' (dmu) are tables from the source NCGMP09 database, abbreviated as indicated in the query. 'polyextattr' and 'mapunitages' are Postgres views that aggregate lithology and age properties correlated with polygons or map units respectively. The source data is a regional dataset that correlates lithology and age categories at the polygon level to document lithologic and age variation within the map units. This information is contained in the 'extendedattributes' and 'geologicevent' tables in the source dataset (See NCGMP (2010) or http://ngmdb.usgs.gov/Info/standards/NCGMP09/ for details on the input data structure).

Code example 1. PostGIS SQL query to produce GeoSciML-Portrayal view for map unit polygons. Notes explaining the query follow.

Notes on schema mapping example

Line numbers refer to numbered lines of text in Code example 1. The Target table is in an ESRI Spatial Database Engine (SDE) geodatabase implemented in PostGIS.

Line 1
Result table is placed in PostGIS schema named sde (this is an ESRI geodatabase).

Line 3
User-defined unique polygon identifiers from the source dataset are carried into the interchange format view.

Line 6
Source data map units are not categorized into specific unit types (e.g. lithostratigraphic, chronostratigraphic, geophysical, etc.), so this field gets a constant value 'Geologic Unit', which is the preferred label for the corresponding concept in the CGI Geologic Unit Type vocabulary

Line 7
Rank is not assigned for the regional geologic units in the source dataset, so this is a constant that is the preferred label ('Not Specified') for the corresponding concept in the CGI Stratigraphic Rank vocabulary.

Line 8
Text descriptions of lithology and the age of the unit are derived from corresponding fields in the source data. The lithology description is mapped at the individual polygon level (via the polyextattr Postgres view), note the JOIN in line 22 that uses the .mapunitpolys_id as the foreign key

Line 9
The age text description is mapped at the map unit level, note the JOIN in line 24 that uses the .mapunit field as the foreign key.

Line 10
The text for the source field in the portrayal schema is calculated by concatenating two fields (.source and .notes) from the datasources table in the input dataset.

Line 11
Since all of the map units are classified simply as 'Geologic Unit', this URI is also a constant value from the CGI Geologic Unit Type vocabulary. Note that the URL in the example text has been abbreviated (...) to save space.

Lines 12, 13
Representative lithology and age categories are assigned on a polygon by polygon basis, thus the polyextattr table is the source of these URIs. Note the JOIN in line 22 that uses the .mapunitpolys_id as the foreign key

Lines 14, 15
Younger and older age bounds are assigned by map unit (not at the individual polygon level), so these fields are sourced from the mapunitages aggregation query in the database; this query uses the extendedattributes table to join map units with geologicevent records that contain the lower and upper age bounds for the unit. Note that GeoSciML-Portrayal v1 uses the XML element names 'representativeUpperAge_uri' and 'representativeLowerAge_uri'; these are changed to 'representativeOlderAge_uri' and 'representativeYoungerAge_uri' respectively in GeoSciML-Portrayal v.2 used here to avoid ambiguity in the interpretation of 'upper' and 'lower'.

Line 16
specification_uri is a link to a more complete description of the geologic unit that crops out in the polygon's extent. This description can be viewed as a resource in the context of web architecture. The intention of the GeoSciML design team was that this URI should dereference to return a full GeoSciML GeologicUnit element instance. With the use of content negotiation on the web, this description might also have representations as a web page or other structured description (rdf, owl...). In the example instance, a more complete description is not available, so an OGC nil URI is used to indicate that the resource is missing (does not exist).

Line 17
metadata_uri identifies a metadata resource that contains more complete information on the provenance of the information in the feature element. This may be a metadata record that is scoped to the individual feature, or may identify a metadata record describing some collection of polygons that have similar enough provenance to document together. The text in the source field (Line 11) should be a succinct summary of the information in this metadata record pertinent to the containing feature.

Line 18
The genericSymbolizer field should contain an identifier for the symbol used to display this polygon in the default portrayal (legend) chosen by the data provider for the GeologicUnitView instance in the containing feature collection. This field can be used to capture the map unit assignment and legend color scheme from the original data from which the GeologicUnitView polygon was digitized. The legend may be encoded in an accompanying Styled Layer Descriptor (SLD) file, and if such an SLD exists it should be recorded as a related resource in the metadata record specified by metadata_uri.

Line 19
The shape field contains a representation of the geometry of the outcrop area described by the GeologicUnitView instance. The content of this field will be managed by the GIS and web map service server, and generally will not need to be manipulated by users outside the GIS environment. The shape field may need to be cast into a recognized geometry field in order to get PostGIS and ESRI SDE to recognize the output as a feature class. In our configuration at AZGS, we ended up using this: **'st_geometryfromtext(ST_AsText(shape)::text, 4326)::geometry as shape'**. More expert PostGIS users may have a better solution for this problem.

Line 20
In order for ArcGIS server to recognize this as a feature class that may be used to source a service an integer unique value field must be present. Note that the GeoSciML-Portrayal v.2 schema allows any xml elements to follow the shape field. Since the ObjectID field is not present in the GeoSciML-Portrayal model, but must be present to deploy the service using ArcGIS server, it is placed here in the instance document. Other server or client application required fields can be placed following this element. In the example, the field from the source dataset is used because it serves as an ESRI feature class unique integer identifier there. This field does not need to be set up as an autoincrement field because the resulting table is a read-only view of the data.

Section last modified: 8 October 2015

7.4.2 Vocabulary mapping

There are many possible approaches to mapping terms from one vocabulary to another. One situation in which a standard process can be defined is that a controlled vocabulary is used to populate a field in the source data, and that field maps directly to a field in the interchange format. For example, consider a source dataset that contains a 'dominantLithology' field with the information used to populate the 'representativeLithology_uri' for a GeologicUnitView feature. The recommended procedure in this case is:

1. Produce a table of the unique 'dominantLithology' values in the source data
2. Add columns to this table for the corresponding term name and URI from the CGI standard lithology vocabulary (required for GeoSciML-Portrayal OneGeology services).
3. Determine the best matching value from the CGI standard lithology vocabulary for each unique lithology term.
4. Use an SQL query like that in Code example 1, joining the 'dominantLithology' field to the corresponding field in the lookup table to update the 'representativeLithology_uri' field to the correct standard lithology term URI.

In general, the most specific term from the interchange vocabulary that completely subsumes (encompasses) the meaning of the term in the source vocabulary should be used. If the source vocabulary has terms that are more specific than the controlled vocabulary, there will be some information lost in this process, but the original source terminology should be preserved in the text description, lithology, and geologicHistory fields in the interchange document as appropriate. Remember, the primary purpose of the controlled vocabulary fields is for data integration, search criteria, and standardized map legends.

In some cases, unique values for a combination of fields from the source data may be necessary to define mapping to interchange concepts, particularly for representativeAge_uri, representativeLithology_uri, and genericSymbolizer fields. The procedure is the same, but the unique values query will involve more than one source field and multiple-field joins will be necessary to construct queries generating the output schema content.

Standard vocabularies are listed in the accompanying Microsoft Excel workbook (http://www.onegeology.org/docs/technical/GeoSciMLPortrayalTemplate.xlsx).

Section last modified: 08 October 2015

7.4.3 Excel workbook template

The accompanying Microsoft Excel workbook (http://www.onegeology.org/docs/technical/GeoSciMLPortrayalTemplate.xlsx) provides spreadsheets with the content models for the description properties associated with geologic contacts, faults or shear zones, and geologic units in the GeoSciML-Portrayal schema. These spreadsheets do not include geometry fields that are necessary for an actual GIS feature class for the corresponding **ContactView**, **ShearDisplacementStructureView**, and **GeologicUnitView** features. Rather, they provide a template for compiling the necessary descriptions (combinations of attributes) that can then be joined with a GIS feature class to produce the dataset for feature web service deployment.

The specification_uri in each feature class provides a link to structured representation of the geologic feature that is intended to be a GeoSciML feature. The metadata_uri provides a link to a structured metadata record recording complete provenance information for features. See the notes tab in the workbook for additional information describing the GeoSciML-Portrayal feature classes and the worksheets included in this document.

Section last modified: 03 October 2014

7.4.4 Configuring OGC services

GeoSciML-Portrayal is intended to support map services for online viewing and exploration of geologic data, and the creation of mash-ups integrating data from different servers and possibly different the-matic domains. The OGC WMS specification includes a 'GetFeatureInfo' operation that returns a description of a map feature at a user identified point on the map. Typically this is

implemented by a mouse click in an on-screen map display. The operation returns a document determined by the server configuration. A variety of different formats may be offered, and specified by a request parameter. For OneGeology GeoSciML-Portrayal services, an XML document conforming to the GeoSciML-Portrayal XML schema should be provided when 'outputFormat=application/xml' is specified in the request. Other GetFeatureInfo response formats may also be offered.

Section last modified: 8 October 2015

7.4.5 Styling (SLDs)

Part of the process of deploying a web map service includes defining the map legend or portrayal. The use of GeoSciML-Portrayal and standardized vocabularies for representative lithology and age enables legends to be applied uniformly using OGC Styled Layer Descriptor (Lupp, 2007) (SLD) files that can be shared on the World Wide Web. An SLD is an XML document that defines a collection of rules using feature property values to select features assigned a particular graphical element for map display. The selection criteria use OGC Filter (Vretanos, 2010) encoding for logic, and XPaths relative to the feature type XML schema to specify the properties used in the selection. The collection of rules used to portray feature constitutes a map legend.

Services deployed using ESRI ArcGIS Server can use the legend associated with a layer in the ArcMap project file from which the service is deployed. If you are using GeoServer to deploy the web map service, an OGC Styled Layer Descriptor (SLD) file is used to define the map legend. SLD files can also be used to define the symbolization scheme for services deployed with ArcGIS server. OGC WMS 1.3.0 services allow a web accessible SLD file to be specified in a GetMap request, enabling users to define custom symbolization schemes for maps returned by the service.

SLD files are available for standardized portrayal schemes using either the CGI or INSPIRE simple lithology:

- Colours creatively adapted from Moyer, Hasting, and Raines (2005) (http://ogc.bgs.ac.uk/sld/CGI-inspire-lithologyTextURI.sld)
- INSPIRE recommended colours (http://ogc.bgs.ac.uk/sld/CGI-INSPIRE-lithologyTextURI-INSPIREcols.sld)

and the CGI/INSPIRE 2012 time scale:

- Colour code of the IGME 5000 (http://ogc.bgs.ac.uk/sld/CGI-inspire-AgeTextURI.sld)
- CGMW colours, as used by ICS charts, and recommended by INSPIRE (http://ogc.bgs.ac.uk/sld/CGI-inspire-AgeTextURI-CGMW.sld)

These files define a standardized portrayal scheme for symbolizing geologic unit outcrop polygons, and recommended practice is to provide WMS layers using these portrayal schemes for any OneGeology GeoSciML-Portrayal service.

Some other test SLD's are also posted at http://schemas.usgin.org/schemas/slds/.

One *suggested* methodology to enable user-defined, custom symbolization by specifying a web-accessible SLD file in a WMS GetMap request, is that OneGeology-Portrayal services should also include WMS layers with names corresponding to the GeoSciML-Portrayal feature type exposed by that layer (though layer titles must still follow the OneGeology WMS profile naming conventions). With this methodology the recommended layer names are prefixed with 'gsmlp' and the schema version. Thus services based on GeoSciML-Portrayal version 2.0 would have layers named:

- gsmlp2.0:geologicunitview
- gsmlp2.0:sheardisplacementstructureview
- gsmlp2.0:contactview

Similarly (using this suggested methodology), services based on GeoSciML-Portrayal version 4.0 would have layers named:

- gsmlp4.0:geologicunitview
- gsmlp4.0:sheardisplacementstructureview
- gsmlp4.0:contactview

The actual names of the layers though are not important to the OneGeology thematic tool which creates custom SLD stylesheets on demand using the names of the layers registered in the portal. Services configured using the previous GeoSciML-Portrayal 2.0 schema will continue to work in the portal, because the two schemas share the same property names and demand concepts from the same controlled vocabularies; moreover GeoSciML-Portrayal version 4.0 is less restrictive than version 2.0 (has fewer mandatory properties), so anything that conformed to the former will conform to the latter version.

SLD's intended to be used with OneGeology GeoSciML-Portrayal services would specify an **sld:NamedLayer** with of these values (depending on the feature type offered by the layer). If an **sld:UserStyle** is specified in the SLD, then the style name must be specified in the WMS GetMap request; otherwise the STYLE parameter in the request is empty.

It is possible to manually create an SLD using a text editor or one of the standard XML editor tools, but instructions for creating an SLD file manually are out of the scope of this document. The GeoServer online documentation provides some guidance for creating

SLD's manually. Appendix J: How to create a Styled Layer Descriptor (SLD) using Arc2Earth describes software for creating an SLD file based on symbology in an ArcMap project layer.

Code example 2 is a snippet of an SLD file that assigns colors to gsmlp2.0:geologicunitview layer polygons with representativeAge URIs for Holocene and Quaternary.

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<StyledLayerDescriptor
  xmlns:gml="http://www.opengis.net/gml"
  xmlns:gsmlp="http://geosciml.org/xmlns/GeoSciML-Portrayal/2.0"
  xmlns:ogc="http://www.opengis.net/ogc"
  xmlns:sld="http://www.opengis.net/sld"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  version="1.0.0">
  <NamedLayer>
    <Name>gsmlp2.0:geologicunitview</Name>
    <UserStyle>
      <FeatureTypeStyle>
        <Rule>
          <Name>Holocene</Name>
          <Title>Holocene</Title>
          <ogc:Filter>
            <ogc:PropertyIsEqualTo>
              <ogc:PropertyName>representativeAge_uri</ogc:PropertyName>
              <ogc:Literal>
                <http://resource.geosciml.org/classifier/ics/ischart/Holocene>
              </ogc:Literal>
            </ogc:PropertyIsEqualTo>
          </ogc:Filter>
          <PolygonSymbolizer>
            <Fill>
              <CssParameter name='fill'>#9FFF02</CssParameter>
            </Fill>
          </PolygonSymbolizer>
        </Rule>
        <Rule>
          <Name>Quaternary</Name>
          <Title>Quaternary</Title>
          <ogc:Filter>
            <ogc:PropertyIsEqualTo>
              <ogc:PropertyName>representativeAge_uri</ogc:PropertyName>
              <ogc:Literal>
                <http://resource.geosciml.org/classifier/ics/ischart/Quaternary>
              </ogc:Literal>
            </ogc:PropertyIsEqualTo>
          </ogc:Filter>
          <PolygonSymbolizer>
            <Fill>
              <CssParameter name='fill'>#FF9F22</CssParameter>
            </Fill>
          </PolygonSymbolizer>
        </Rule>
      </FeatureTypeStyle>
    </UserStyle>
  </NamedLayer>
</StyledLayerDescriptor>
```

Code example 2. Fragment of a Styled Layer Descriptor XML file with SLD rules for age portrayal of Holocene or Quaternary geologicUnitView polygons.

Note that the LAYERS parameter value in the request must match the (XPath) NamedLayer/Name element value in the SLD file, and

this must also match one of the layer names in the capabilities for the WMS service.

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<StyledLayerDescriptor
  xmlns:gml="http://www.opengis.net/gml"
  xmlns:gsmlp="http://geosciml.org/xmlns/GeoSciML-Portrayal/2.0"
  xmlns:ogc="http://www.opengis.net/ogc"
  xmlns="http://www.opengis.net/sld"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  version="1.0.0">
  <NamedLayer>
    <Name>gsmlp2.0:geologicunitview</Name>
      <UserStyle>
        <FeatureTypeStyle>
        <Rule>
          <Name>sediment</Name>
          <Abstract>(description of unit)</Abstract>
          <ogc:Filter>
            <ogc:Or>
              <ogc:PropertyIsEqualTo>
                <ogc:PropertyName>representativeLithology_uri</ogc:PropertyName>
                <ogc:Literal>
                  http://resource.geosciml.org/classifier/cgi/lithology/0232
                </ogc:Literal>
              </ogc:PropertyIsEqualTo>
              <ogc:PropertyIsEqualTo>
                <ogc:PropertyName>representativeLithology_uri</ogc:PropertyName>
                <ogc:Literal>
                  http://resource.geosciml.org/classifier/cgi/lithology/sediment
                </ogc:Literal>
              </ogc:PropertyIsEqualTo>
            </ogc:Or>
          </ogc:Filter>
          <PolygonSymbolizer>
            <Fill>
              <CssParameter name="fill">#FFFF00</CssParameter>
            </Fill>
          </PolygonSymbolizer>
        </Rule>
      </FeatureTypeStyle>
    </UserStyle>
  </NamedLayer>
</StyledLayerDescriptor>
```

Note that the LAYERS parameter value in the request must match the (XPath) NamedLayer/Name element value in the SLD file, and this must also match one of the layer names in the capabilities for the WMS service.

Section last modified: 9 May 2016

7.5 GeoSciML-Portrayal issues

7.5.1 GML geometry

Note that the GeoSciML-Portrayal XML schema (http://schemas.geosciml.org/) allows any abstract GML geometry in the feature shape element, but the simple feature profile mandates that the geometry is one of gml:Point, gml:LineString, gml:Curve, gml:Polygon, gml:Surface, gml:MultiPoint, gml:MultiCurve, or gml:MultiSurface. For typical GeoSciML-Portrayal services, it is likely that ContactView and ShearDisplacementView features will have gml:Curve (possibly gml:MultiCurve) geometry, and GeologicUnitView features will have gml:Polygon features. The more restrictive data typing for the shape element has not been used to allow greater flexibility in utilization of GeoSciML-Portrayal, but bear in mind that the schema allows features with different

geometries to be mixed in the same feature collection, and point, line, polygon or surface geometry to be associated with any feature.

7.5.2 Optional GML header elements

The GeoSciML-Portrayal XML schema (http://schemas.geosciml.org/) have been generated using the FullMoon tool. This tool generates full GML features, which include a number of elements inherited from the GML abstract feature type. In GeoSciML-Portrayal these optional gml elements (gml:name, gml:description, gml:metadata, etc.) should not be included in instance documents, but the equivalent elements in the GeoSciML-Portrayal namespace should be used. This is because some WMS and simple feature WFS clients cannot process documents with thematic elements from more than one namespace.

7.5.3 ESRI ArcGIS server ObjectID

The ObjectID field should be placed at the last column in the table for better interoperability with systems that do not require such a field.

7.5.4 Schema location

ArcGIS server and GeoServer report the schema location for the GeoSciML-Portrayal content using a WFS DescribeFeatureType request.

Section last modified: 19 October 2015

7.6 References

Lupp, Markus, ed., 2007-06-29, Styled Layer Descriptor profile of the Web Map Service Implementation Specification version 1.1.0v4: Open Geospatial Consortium, Inc., Document OGC 05-078r4, accessed at http://portal.opengeospatial.org/files/?artifact_id=22364 2012-09-10.

National Cooperative Geologic Mapping Program, USGS (NCGMP), 2010, NCGMP09â€"Draft Standard Format for Digital Publication of Geologic Maps, Version 1.1, in Soller, D.R., Digital Mapping Techniques '09 -- Workshop Proceedings: USGS Open-File Report 2010-1335. (Accessed at http://pubs.usgs.gov/of/2010/1335/pdf/usgs_of2010-1335_NCGMP09.pdf, 2012-03-25).

Richard, S. M., and CGI Interoperability Working Group, 2007, GeoSciML â€" A GML Application for Geoscience Information Interchange, in Soller, D.R., Editor, Digital Mapping Techniques '06--Workshop Proceedings: USGS Open File Report 2007-1285. (Accessed at http://pubs.usgs.gov/of/2007/1285/pdf/Richard.pdf, 2012-02-24)

Van den Brink, Linda, Portele, Clemens, Vretanos, P.A., 2011, Geography Markup Language simple features profile (with technical note): Open Geospatial Consortium Implementation Specification Profile, OGC 10-100r3, dated 2011-05-11.

Vretanos, Peter, 2010-11-22, OpenGIS Filter Encoding 2.0 Encoding Standard, version 2.0.0: Open Geospatial Consortium, Inc., Document OGC 05-078r4 (equivalent to ISO 19143:2010), accessed at http://portal.opengeospatial.org/files/?artifact_id=39968 2012-09-10.

Section last modified: 12 February 2013

Appendix A: Converting coordinate system in data files

As mentioned in the documentation on setting up the WMS, the OneGeology project requires that your WMS can serve data in latitude-longitude coordinates with the WGS84 ellipsoid and datum (EPSG:4326). If your data files are stored in a different coordinate reference system, MapServer can convert the coordinates to EPSG:4326 or other client requested coordinate reference systems on-the-fly. However, to reduce the load on your server, as we can expect that a substantial proportion of requests to OneGeology servers will be for EPSG:4326 then we suggest that you convert your underlying data sets to this coordinate reference system so that the conversion won't have to be carried out on every request. The same tools that MapServer uses internally are available with command line programs bundled in the MS4W package and can be used to convert your underlying data sets as follows.

For shapefiles the main program you will want to use is ogr2ogr.exe which is located in ms4w\tools\gdal-ogr where ms4w is the top-level folder of your MS4W installation. The easiest way to use the programs is to run the batch file ms4w\setenv.bat from a DOS window which will set up your path. (You may need to edit the setenv.bat file to reflect the location where you have installed MS4W.) Next you need to find out whether your current data set has a coordinate reference system assigned to it. If you have, for example, a dataset in a shapefile called datafile.shp you would issue a command like:

:\ > ogrinfo -so datafile.shp datafile

(The first datafile.shp refers to the file name; the datafile afterwards is a layer name which is redundant in the case of shapefiles which only have one layer but is the way ogrinfo works.) You should get some information including something like that below:

```
Layer SRS WKT:
PROJCS["British_National_Grid",
 GEOGCS["GCS_OSGB_1936",
 DATUM["OSGB_1936",
 SPHEROID["Airy_1830",6377563.396,299.3249646]],
 PRIMEM["Greenwich",0.0],
 UNIT["Degree",0.0174532925199433]],
 PROJECTION["Transverse_Mercator"],
 PARAMETER["False_Easting",400000.0],
 PARAMETER["False_Northing",-100000.0],
 PARAMETER["Central_Meridian",-2.0],
 PARAMETER["Scale_Factor",0.  999601272],
 PARAMETER["Latitude_Of_Origin",49.0],
 UNIT["Meter",1.0]]
```

The details do not matter as long as you don't get the below:

Layer SRS WKT:
(unknown)

In this situation you will need to find out what coordinate system your data is in. If the data has a coordinate system assigned you can issue a command like that below to convert the data (note that the destination file is specified before the source file):

:\ > ogr2ogr -t_srs EPSG:4326 new_datafile.shp datafile.shp

If your data set does not have a coordinate system assigned to it but you have found out what it is you can specify the source coordinate system on the command line with the parameter -s_srs, for example:

:\ > ogr2ogr -s_srs EPSG:27700 -t_srs EPSG:4326 new_datafile.shp datafile.shp

For GeoTIFF files the utilities you will want to use are gdalinfo.exe and gdalwarp.exe. Issuing a command like: gdalinfo imagefile.tif will result in some information including projection information like that below:

```
Driver: GTiff/GeoTIFF
Size is 522, 252
Coordinate System is:
GEOGCS["WGS 84",
 DATUM["WGS_1984",
 SPHEROID["WGS 84",6378137,298.2572235630016,
 AUTHORITY["EPSG","7030"]],
 AUTHORITY["EPSG","6326"]],
 PRIMEM["Greenwich",0],
 UNIT["degree",0.0174532925199433],
 AUTHORITY["EPSG","4326"]]
Origin = (-180.,000000000000000,83.879999999999995)
Pixel Size = (0.690000000000000,-0.690000000000000)
Metadata:
```

You can transform an image in a similar way to the ogr2ogr utility for shapefiles but unlike ogr2ogr the source and destination files are specified in the more common source then destination file order so typical command lines would be:

:\ > gdalwarp —t_srs EPSG:4326 imagefile.tif new_imagefile.tif

or

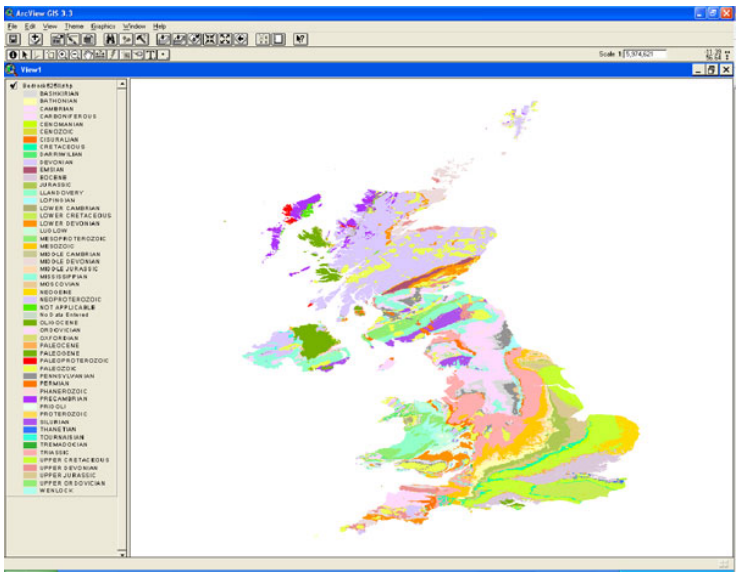
:\ > gdalwarp -s_srs EPSG:27700 -t_srs EPSG:4326 imagefile.tif new_imagefile.tif

Section last modified: 19 January 2010

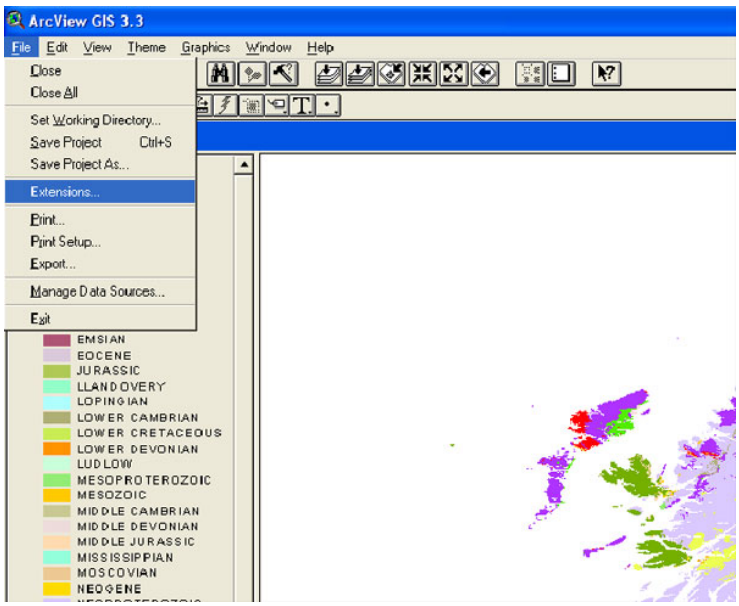
Appendix B: Creating MapServer CLASS definitions from ArcView legends

The Gix Export Tool can help you create the CLASS sections of your map file from an ESRI ArcView 3.x .apr file. This tool converts

ESRI ArcView 3.x (NOT ArcMap) projects to common open source alternatives including a MapServer map file. (Please note that this tool has only been used to convert simple symbology e.g. geology polygons symbolized by a solid colour according to its lithology value. Its ability to convert more complex symbology has not been tested.) Download the Gix Export Tool (http://gix.sourceforge.net/). Run the executable and follow the instructions to install the tool as an ArcView 3.x extension. Having installed the Gix Export Tool, create or open an ArcView project containing your symbolized data.

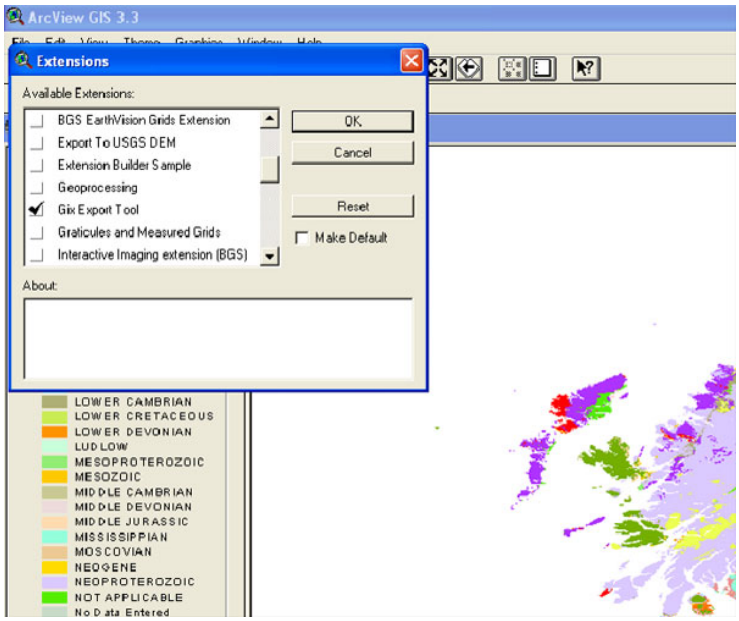


ArcView map view showing symbolized data



Loading the Gix ArcView extension

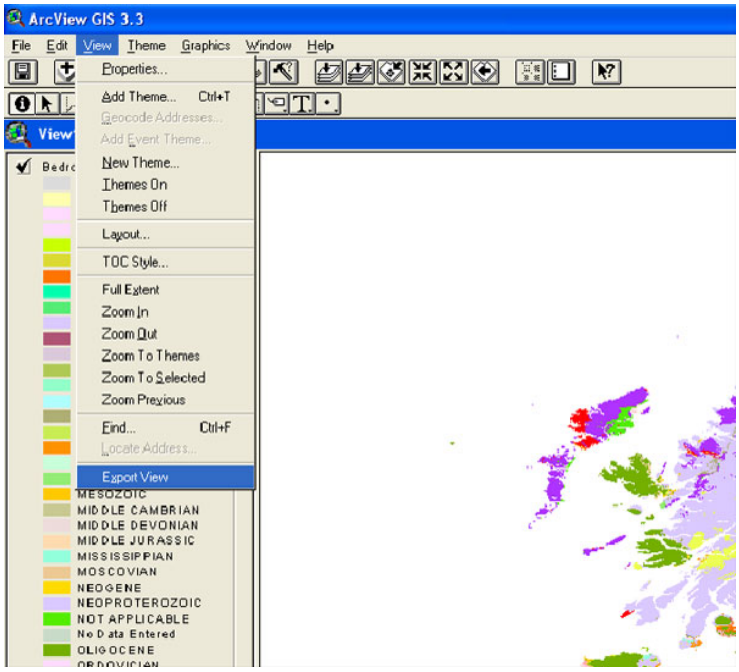
Load the Gix Export Tool Extension (File — Extensions, tick required extension, click OK).



Loading the Gix ArcView extension

Complete the following steps to convert your project to a MapServer map file.

1. Select View — Export View.



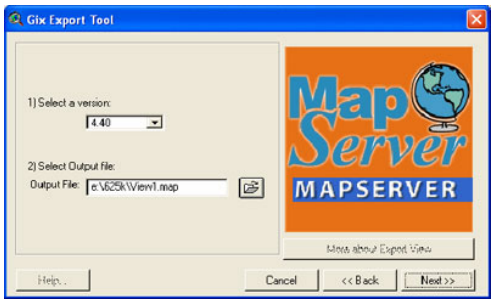
ArcView, Exporting your View

2. The first screen asks you to select your output file format — choose MapServer map file (.map) and click next.

Gix export tool, selecting output format

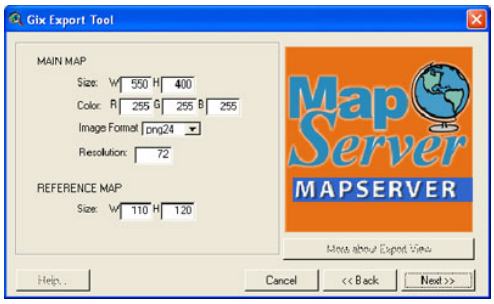
3. The next screen asks you to select a version (choose default) and output file. The output file generated will be a temporary file from which you will cut the CLASS components and paste them into the master map file you have been creating elsewhere. Select a

location for your output file and click next.



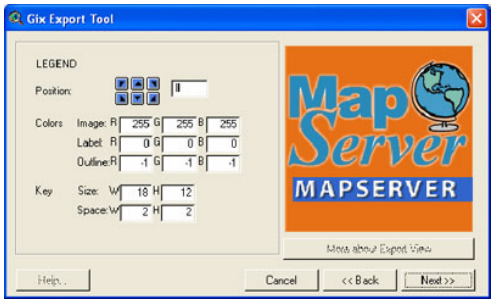
Gix export tool, selecting output file

4. The next screen asks for details of the main and reference map. You won't use these sections so accept the defaults and click next.



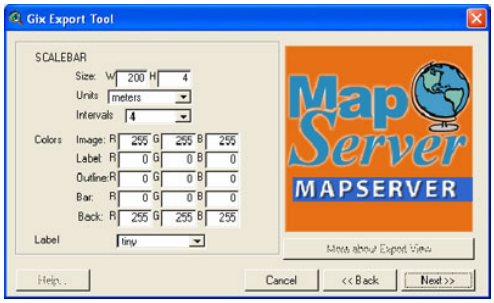
Gix export tool, details for the main, and reference maps

5. The next screen asks for details of the legend. Again, you won't use these sections so accept the defaults and click next.



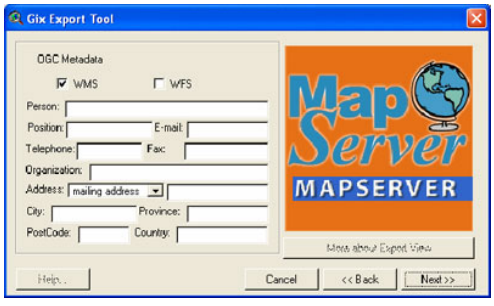
Gix export tool, details for the legend

6. The next screen asks for details of the scale bar. Again, you won't use these sections so accept the defaults and click next.



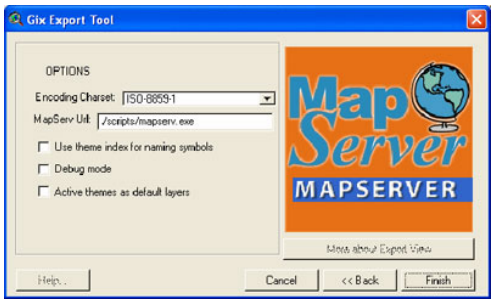
Gix export tool, details for the scale bar

7. The next screen asks for details of the OGC metadata. Again, you won't use these sections so accept the defaults and click next.



Gix export tool, OGC metadata details

8. The next screen asks for details of final options. Again, you won't use these sections so accept the defaults.



Gix export tool, character set encoding and symbology options

9. Click Finish to create your map file.

Open up the map file you created in a text editor and complete the following steps for each layer in your map file:

1. Navigate to the line beginning CLASSITEM
2. Highlight from here down to the END #CLASS line associated with that layer
3. Copy and paste the selected lines to an empty text file
4. Delete all TEMPLATE ' template.html' lines (one for each class)
5. Paste the remaining content into your master map file within the section for the layer you are dealing with. A good position is after the END line which closes the METADATA for that layer.

If your symbolization in ArcView had polygon boundaries you will need to remove these from the MapServer symbolization. This may be easier to do by deleting all the 'OUTLINECOLOR' lines from the generated map file than by altering your ArcView symbolization.

Section last modified: 19 January 2010

Appendix C: Creating MapServer CLASS definitions from ARCGIS legends

The MXDtoWMS tool can help you create the complete MapServer map file including CLASS sections from an ESRI ArcMap . mxd file. There are versions for ArcGIS 8 and ArcGIS 9 supplied in the same download but only the version for ArcGIS 9 is described here.

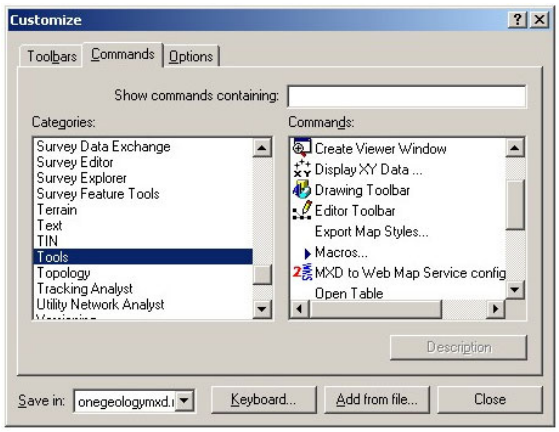
The tool produces complete map files and allows customization of the produced map files. However, we have not used this functionality and, for the purposes of this cookbook, we are only interested in the generation of the CLASS definitions, the other parts of the map file should be edited according to the instructions elsewhere in these cookbook pages.

This tool is free and open source software released under the LGPL license. It can be obtained from the ESRI support center (http://arcscripts.esri.com/details.asp?dbid=12766), the author would like an email if you use it and like it.

Section last modified: 19 January 2010

C.1 Installation

The tool requires msxml3.dll to be pre-installed (usually located on Microsoft Windows systems in the system32 folder). First unzip the file somewhere on your system, (e.g. C:\arcgis\customtools\MXD2WMS) Make sure the resources folder and its content are in the same directory as the MXD2WMS.dll file. You may want to check if the file regtool5.dll is already somewhere on your system. Register both of the dll files, MXD2WMS.dll and regtool5.dll, using the regsvr32.exe command line DOS utility. (e.g. 'regsvr32 regtool5.dll'). Go to the Customize window in ArcMap (right-click on the tool bar in ArcMap, or Tools-Customize in the menu). Select 'Add from file...' and point to the MXDtoWMS.dll file. This should add a tool 'MXD to Web Map Service configuration file' in the Commands-Tools category (second tab in the customize window).



Adding the MXD2WMS tool to ArcMap

Use the left mouse button to drag the tool to a tool bar of your choice.

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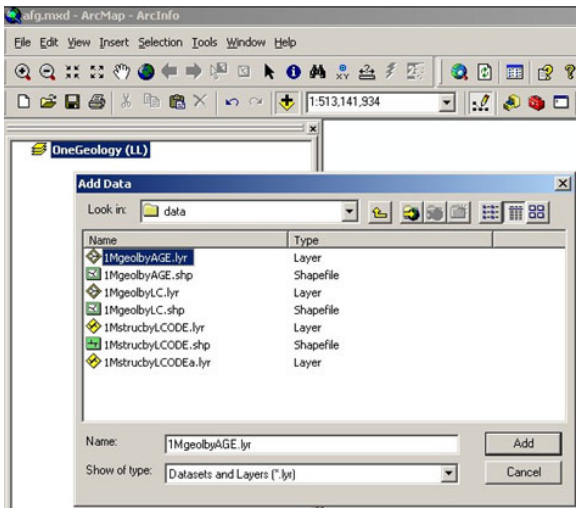
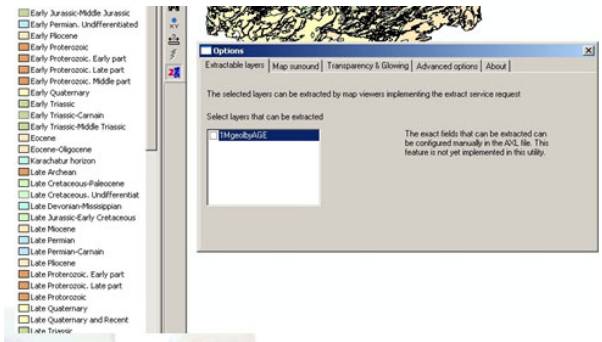
C.2 Creating map files

Having installed the MXD2WMS tool, create or open an ArcMap file containing your symbolized data.



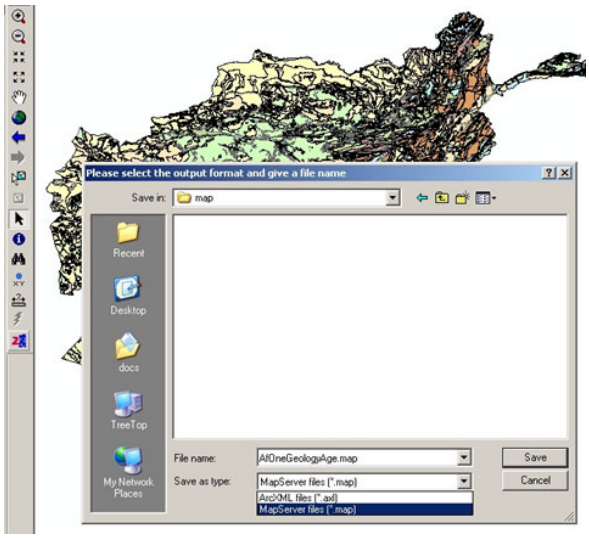
Adding a layer file to ArcMap

Click on the MXD2WMS tool icon  and then close the pop-up window.



Launching the MXD2WMS tool

Closing the pop-up window opens a save as dialogue window. The default data type to export to from this tool is AXL, so you will need select MapServer files (*.map) type from the drop down menu.



Saving output from the MXD2WMS tool

Please note, that though there are a number of tabbed options in the pop-up, they may not actually change the resultant map file. For example the tool will create a map file (and classify) any layer file or shape file in the ArcMap layer irrespectively of whether it is selected in the options dialogue, or whether it is selected in the map file.

This will create a complete map file. However, you should simply copy the CLASS definitions from this map file to the appropriate LAYER section of the map file you have been creating according to the instructions in the body of this cookbook.

If your symbolization in ArcMap had polygon boundaries you will need to remove these from the MapServer symbolization. This may be easier to do by deleting all the 'OUTLINECOLOR' lines from the generated map file than by altering your ArcMap symbolization.

Section last modified: 19 January 2010.

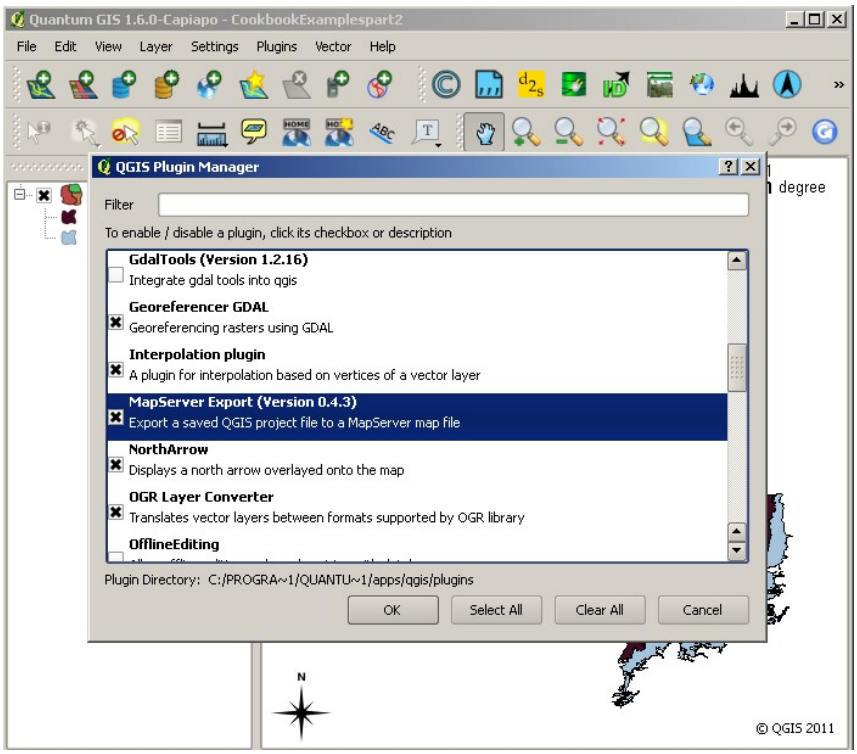
Appendix D: Creating MapServer CLASS definitions using Quantum GIS

Quantum GIS (QGIS) is a user friendly Open Source Geographic Information System (GIS) licensed under the GNU General Public License (http://www.gnu.org/copyleft/gpl.html). QGIS is an official project of the Open Source Geospatial Foundation (OSGeo) (http://www.osgeo.org/). It runs on Linux, Unix, Mac OSX, and Windows and supports numerous vector, raster, and database formats and functionalities.

The current stable version of QGIS (QGIS 2.12) is available for download from https://www.qgis.org/en/site/forusers/download.html

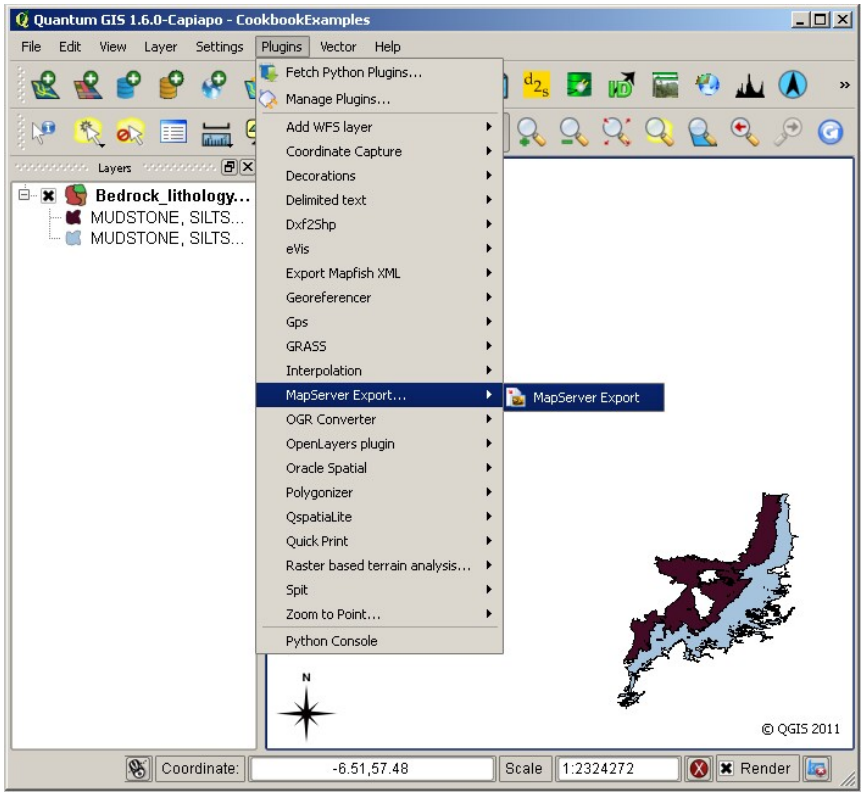
For information on how to use QGIS to view WMS and WFS services see the 'how to' section 1.4.7

You can use the MapServer Export QGIS plugin to create a .map configuration file. You will first need to enable the plugin, which comes bundled as part of the standard installation, through the Plugins menu. Select *Manage plugins* then select *MapServer Export* from the *QGIS Plugin Manager*.



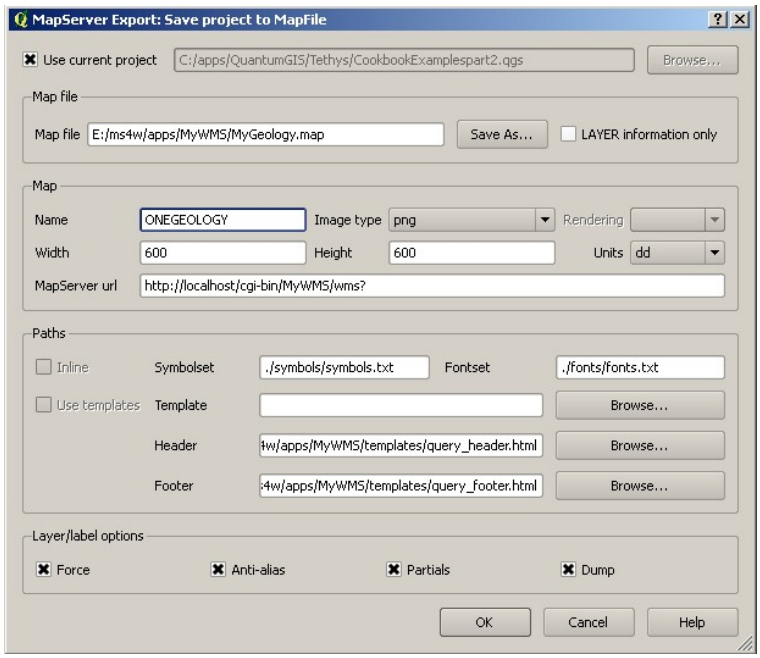
QGIS Enabling the MapServer Export plugin

With the map data you wish to serve as a WMS open in QGIS, select *Plugins* and then *MapServer Export* to start the conversion process.



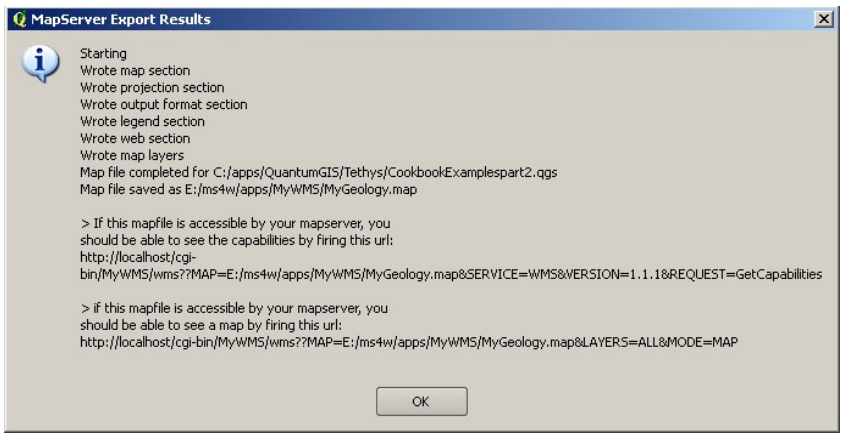
QGIS Running the MapServer Export plugin

You are given some options when you run the plugin (as below). You may use the defaults or add your own (as we have here). It isn't important if you don't know what to enter at this stage as you can edit the values in the .map file in any text editor. It may help though if add some dummy values, just so you get the correct structure.



QGIS MapServer Export: Save project to map file

When you have made all the edits you want to add, click ok. If there are no errors, you will get a results summary window (as below).



QGIS MapServer Export results summary

Note the URLs shown in the results summary will not work in the OneGeology exemplar service set-up (as detailed in this cookbook); you will need to follow the instructions in Section 4.3 to complete the set-up process.

Section last modified: 19 June 2011

Appendix E: BGS example service map file

Below is the map file included in the example BGS shapefile based bedrock and superficial geology service. This single map file will create GetCapabilities responses (and services) for all WMS versions supported by MapServer (1.0.0, 1.1.0, 1.1.1, 1.3.0). The GetCapabilities version 1.1.1 xml document created by this map file is shown in Appendix G, and the version 1.3.0 xml document is shown in Appendix F.

```
# ================================================================================
# map file generated by MXD2WMS
# Created by Jeroen Ticheler
# With contributions from Brock Anderson, Patrizia Monteduro, Lorenzo Becchi
# Date: February 2007
# License: GNU-LGPL v2.1
# ================================================================================
# Start of map file
# ================================================================================
```

```
MAP
  NAME BGS_EN_Bedrock_and_Superficial_Geology
# Root layer name
  STATUS ON
  SIZE 600 600
  EXTENT -8.6476 49.8639 1.76943 60.8622
# Change to appropriate coordinates for your data
  UNITS dd
# UNITS [feet|inches|kilometers|meters|miles|dd] Units of the map coordinates.
# Used for scalebar and scale computations.
  SHAPEPATH "data"
  IMAGECOLOR 255 255 255
  OUTPUTFORMAT
    NAME png
    DRIVER "AGG/PNG"
    MIMETYPE "image/png"
### MIMETYPE "image/png; mode=8bit"
### Use the 8 bit MIMETYPE when you need to use a 256 colour palette
    IMAGEMODE RGBA
### All colours and alpha based transparency
    EXTENSION "png"
    FORMATOPTION "INTERLACE=ON"
### Slow connections will profit from this option
  END
  IMAGETYPE PNG
# IMAGETYPE PNG8
# Use the PNG8 IMAGETYPE when you need to use a 256 colour palette
  PROJECTION
    "init=epsg:4326"
  END
  # ######################################################################
  # Start of web interface definition (including WMS enabling metadata)
  # ######################################################################
  WEB
    HEADER "templates/query_header.html"
    FOOTER "templates/query_footer.html"
    IMAGEPATH "/ms4w/tmp/ms_tmp/"
    IMAGEURL "/ms_tmp/"
    METADATA
      WMS_BBOX_EXTENDED "TRUE"
      OWS_ENABLE_REQUEST "*"
      OWS_TITLE "BGS Bedrock and Superficial geology"
      WMS_ABSTRACT "The 1:625k DiGMap data covering the whole of the United Kingdom is available
      in this OGC WMS service for your personal, non-commercial use only and is being served as a
      contribution to the OneGeology initiative (www.onegeology.org). Separate bedrock geology and
      superficial deposits layers are available in this service. Layers available for bedrock are
      lithostratigraphy, age, and lithology. Layers available for superficial deposits layer are
      lithostratigraphy and lithology. For information about more of the British Geological
      Survey's maps that are available digitally please visit
      http://www.bgs.ac.uk/products/digitalmaps/digmapgb.html"
##### Put your organisation name and any other information you want to include.
      WFS_ABSTRACT "The 1:625k DiGMap data covering the whole of the United Kingdom is available
      in this OGC WFS service for your personal, non-commercial use only and is being served as a
      contribution to the OneGeology initiative (www.onegeology.org).  The contents of this WFS
      service are not intended for direct use but are transformed by a mediator layer into separate
      WFS services which provide data in GeoSciML. This process is described in Chapter 2 of the
      OneGeology WFS Cookbook available at www.onegeology.org. Links to the transformed WFS service
      can be found at http://ogc.bgs.ac.uk/cocoon/geosciml/page/testbed3.html.  For information
      about more of the British Geological Survey's maps that are available digitally please visit
      http://www.bgs.ac.uk/products/digitalmaps/digmapgb.html"
```

```
##### Put your organisation name and any other information you want to include.
##### You must include "OneGeology" as one of the keywords.
      OWS_KEYWORDLIST "OneGeology,geology,map,United Kingdom,bedrock,superficial,lithology,
      lithostratigraphy,age,MD_LANG@ENG,MD_DATE@2011-06-15"
      OWS_SERVICE_ONLINERESOURCE "http://www.bgs.ac.uk/products/digitalmaps/digmapgb.html"
      OWS_CONTACTPERSON "Keith Westhead"
      OWS_CONTACTORGANIZATION "British Geological Survey"
      OWS_CONTACTPOSITION "Head of Information Delivery"
      OWS_ADDRESSTYPE "postal"
      OWS_ADDRESS "Murchison House"
      OWS_CITY "Edinburgh"
      OWS_STATEORPROVINCE "West Lothian"
      OWS_POSTCODE "EH9 3LA"
      OWS_COUNTRY "UK"
      OWS_CONTACTVOICETELEPHONE "+44 (0)131 667 1000"
      OWS_CONTACTFACSIMILETELEPHONE "+44 (0)131 668 2683"
      OWS_CONTACTELECTRONICMAILADDRESS "enquiries@bgs.ac.uk"
      OWS_FEES "none"
      OWS_ACCESSCONSTRAINTS "The 1:625k DiGMap data is available for free download for your
      personal, teaching, research, or non-commercial use (as described on
      http://www.bgs.ac.uk/about/copyright/non_commercial_use.html).  Your use of any
      information provided by the British Geological Survey (BGS) is at your own risk. Neither BGS
      nor the Natural Environment Research Council (NERC) gives any warranty, condition, or
      representation as to the quality, accuracy, or completeness of the information or its suitabi
      for any use or purpose. All implied conditions relating to the quality or suitability of the
      information, and all liabilities arising from the supply of the information (including any
      liability arising in negligence) are excluded to the fullest extent permitted by law."
      WMS_FEATURE_INFO_MIME_TYPE  "text/html"
      WMS_SRS "EPSG:4326 EPSG:3857 CRS:84 EPSG:27700 EPSG:4258"
    END
  END
  LEGEND
    OUTLINECOLOR 200 200 200
    KEYSPACING 10 10
    LABEL
      TYPE bitmap
      SIZE small
    END
  END
  LAYER
### GROUP BEDROCKGEOL
### Group layer NAME, (can't include spaces)
    NAME GBR_BGS_625k_BLT ### Bedrock lithology
    TYPE POLYGON
    STATUS ON
    DATA bedrock625ll
    TRANSPARENCY 100
    TOLERANCE 0
    TOLERANCEUNITS pixels
    TRANSFORM TRUE
    DUMP TRUE
    PROCESSING "CLOSE_CONNECTION=DEFER"
    HEADER "templates/bedrock_lithology_query_header.html"
    TEMPLATE "templates/bedrock_lithology_query_body.html"
    FOOTER "templates/bedrock_lithology_query_footer.html"
    PROJECTION
      "init=epsg:4326"
    END
    METADATA
##### WMS_GROUP_TITLE "Bedrock geology layers"
```

```
##### WMS_GROUP_ABSTRACT "A grouping of bedrock geology layers.  See individual layer abstracts for
      fuller details about the layers themselves"
##### GROUP title and abstract only need to be added to one of the group layer metadata sections
      OWS_TITLE "GBR BGS 1:625k Bedrock Lithology"
      OWS_ABSTRACT "GBR BGS 1:625k scale Bedrock Lithology"
      WMS_SRS "EPSG:4326 EPSG:3857 CRS:84 EPSG:27700 EPSG:4258"
      GML_INCLUDE_ITEMS "RCS_D"
      GML_FEATUREID "ID"
      WMS_INCLUDE_ITEMS "RCS_D"
      WMS_METADATAURL_HREF "http://metadata.bgs.ac.uk/geonetwork/srv/en/csw?SERVICE=CSW&
      VERSION=2.0.2&REQUEST=GetRecordById&ID=ac9f8250-3ae5-49e5-9818-d14264a4fda4&"
      WMS_METADATAURL_FORMAT "application/xml;charset=UTF-8"
      WMS_METADATAURL_TYPE "TC211"
      OWS_DATAURL_HREF "http://www.bgs.ac.uk/discoverymetadata/13480426.html"
      OWS_DATAURL_FORMAT "text/html"
      OWS_KEYWORDLIST "OneGeology,geology,bedrock,lithology,continent@Europe,
      subcontinent@Northern Europe,geographicarea@United Kingdom,DS_DATE@2011-06-15,
      dataprovider@British Geological Survey,serviceprovider@British Geological Survey,
      DS_TOPIC@geoscientificInformation"
    END
    CLASSITEM 'RCS_D'
    CLASS
      NAME 'ANORTHOSITE'
      EXPRESSION 'ANORTHOSITE'
      STYLE
        COLOR 237 237 237
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
      NAME 'BRECCIA AND METABRECCIA'
      EXPRESSION 'BRECCIA AND METABRECCIA'
      STYLE
        COLOR 219 117 117
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
      NAME 'BRECCIA, CONGLOMERATE AND SANDSTONE'
      EXPRESSION 'BRECCIA, CONGLOMERATE AND SANDSTONE'
      STYLE
        COLOR 201 84 51
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
      NAME 'CHALK'
      EXPRESSION 'CHALK'
      STYLE
        COLOR 201 255 175
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
      NAME 'CHALK AND SANDSTONE'
      EXPRESSION 'CHALK AND SANDSTONE'
      STYLE
        COLOR 175 255 117
        BACKGROUNDCOLOR 255 255 255
      END #style
```

```
END #class
CLASS
  NAME 'CLAY AND LIGNITE'
  EXPRESSION 'CLAY AND LIGNITE'
  STYLE
    COLOR 201 201 117
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'CLAY, SILT AND SAND'
  EXPRESSION 'CLAY, SILT AND SAND'
  STYLE
    COLOR 255 201 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'CLAY, SILT, SAND AND GRAVEL'
  EXPRESSION 'CLAY, SILT, SAND AND GRAVEL'
  STYLE
    COLOR 219 147 117
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'CONGLOMERATE AND [SUBEQUAL/SUBORDINATE] SANDSTONE, INTERBEDDED'
  EXPRESSION 'CONGLOMERATE AND [SUBEQUAL/SUBORDINATE] SANDSTONE, INTERBEDDED'
  STYLE
    COLOR 175 147 84
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'CONGLOMERATE, SANDSTONE, SILTSTONE AND MUDSTONE'
  EXPRESSION 'CONGLOMERATE, SANDSTONE, SILTSTONE AND MUDSTONE'
  STYLE
    COLOR 255 219 219
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'DIAMICTITE'
  EXPRESSION 'DIAMICTITE'
  STYLE
    COLOR 147 201 201
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'DOLERITE AND THOLEIITIC BASALT'
  EXPRESSION 'DOLERITE AND THOLEIITIC BASALT'
  STYLE
    COLOR 255 51 201
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'DOLOMITIZED LIMESTONE AND DOLOMITE'
  EXPRESSION 'DOLOMITIZED LIMESTONE AND DOLOMITE'
```

```
  STYLE
    COLOR 147 255 147
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'DOLOSTONE'
  EXPRESSION 'DOLOSTONE'
  STYLE
    COLOR 175 255 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'FELSIC LAVA'
  EXPRESSION 'FELSIC LAVA'
  STYLE
    COLOR 255 175 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'FELSIC LAVA AND FELSIC TUFF'
  EXPRESSION 'FELSIC LAVA AND FELSIC TUFF'
  STYLE
    COLOR 255 175 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'FELSIC TUFF'
  EXPRESSION 'FELSIC TUFF'
  STYLE
    COLOR 255 175 84
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'FELSIC-ROCK'
  EXPRESSION 'FELSIC-ROCK'
  STYLE
    COLOR 255 0 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'GNEISS'
  EXPRESSION 'GNEISS'
  STYLE
    COLOR 201 201 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'GNEISSOSE PSAMMITE AND GNEISSOSE SEMIPELITE'
  EXPRESSION 'GNEISSOSE PSAMMITE AND GNEISSOSE SEMIPELITE'
  STYLE
    COLOR 255 201 147
    BACKGROUNDCOLOR 255 255 255
  END #style
```

```
END #class
CLASS
  NAME 'GNEISSOSE SEMIPELITE AND GNEISSOSE PSAMMITE'
  EXPRESSION 'GNEISSOSE SEMIPELITE AND GNEISSOSE PSAMMITE'
  STYLE
    COLOR 255 219 219
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'GRAPHITIC PELITE, CALCAREOUS PELITE, CALCSILICATE-ROCK AND PSAMMITE'
  EXPRESSION 'GRAPHITIC PELITE, CALCAREOUS PELITE, CALCSILICATE-ROCK AND PSAMMITE'
  STYLE
    COLOR 201 255 117
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'GRAVEL, SAND, SILT AND CLAY'
  EXPRESSION 'GRAVEL, SAND, SILT AND CLAY'
  STYLE
    COLOR 255 255 237
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'HORNBLENDE SCHIST'
  EXPRESSION 'HORNBLENDE SCHIST'
  STYLE
    COLOR 84 255 84
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'LAVA AND TUFF'
  EXPRESSION 'LAVA AND TUFF'
  STYLE
    COLOR 175 255 147
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'LAVA, TUFF, VOLCANICLASTIC ROCK AND SEDIMENTARY ROCK'
  EXPRESSION 'LAVA, TUFF, VOLCANICLASTIC ROCK AND SEDIMENTARY ROCK'
  STYLE
    COLOR 219 175 219
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'LIMESTONE'
  EXPRESSION 'LIMESTONE'
  STYLE
    COLOR 147 237 237
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'LIMESTONE AND CALCAREOUS SANDSTONE'
  EXPRESSION 'LIMESTONE AND CALCAREOUS SANDSTONE'
```

```
  STYLE
    COLOR 255 201 147
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'LIMESTONE AND MUDSTONE, INTERBEDDED'
  EXPRESSION 'LIMESTONE AND MUDSTONE, INTERBEDDED'
  STYLE
    COLOR 175 201 201
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'LIMESTONE WITH SUBORDINATE SANDSTONE AND ARGILLACEOUS ROCKS'
  EXPRESSION 'LIMESTONE WITH SUBORDINATE SANDSTONE AND ARGILLACEOUS ROCKS'
  STYLE
    COLOR 147 255 237
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'LIMESTONE, ARGILLACEOUS ROCKS AND SUBORDINATE SANDSTONE, INTERBEDDED'
  EXPRESSION 'LIMESTONE, ARGILLACEOUS ROCKS AND SUBORDINATE SANDSTONE, INTERBEDDED'
  STYLE
    COLOR 84 219 219
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'LIMESTONE, MUDSTONE AND CALCAREOUS MUDSTONE'
  EXPRESSION 'LIMESTONE, MUDSTONE AND CALCAREOUS MUDSTONE'
  STYLE
    COLOR 117 255 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'LIMESTONE, MUDSTONE, SANDSTONE AND SILTSTONE, WITH SUBORDINATE CHERT, COAL AND... '
  EXPRESSION 'LIMESTONE, MUDSTONE, SANDSTONE AND SILTSTONE, WITH SUBORDINATE CHERT, COAL... '
  STYLE
    COLOR 175 175 117
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'LIMESTONE, SANDSTONE, SILTSTONE AND MUDSTONE'
  EXPRESSION 'LIMESTONE, SANDSTONE, SILTSTONE AND MUDSTONE'
  STYLE
    COLOR 255 219 147
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'MAFIC GNEISS'
  EXPRESSION 'MAFIC GNEISS'
  STYLE
    COLOR 175 51 255
    BACKGROUNDCOLOR 255 255 255
  END #style
```

```
END #class
CLASS
  NAME 'MAFIC IGNEOUS-ROCK'
  EXPRESSION 'MAFIC IGNEOUS-ROCK'
  STYLE
    COLOR 84 201 84
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'MAFIC LAVA'
  EXPRESSION 'MAFIC LAVA'
  STYLE
    COLOR 255 219 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'MAFIC LAVA AND MAFIC TUFF'
  EXPRESSION 'MAFIC LAVA AND MAFIC TUFF'
  STYLE
    COLOR 255 219 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'MAFIC TUFF'
  EXPRESSION 'MAFIC TUFF'
  STYLE
    COLOR 255 219 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'MAFITE'
  EXPRESSION 'MAFITE'
  STYLE
    COLOR 117 255 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'METALIMESTONE'
  EXPRESSION 'METALIMESTONE'
  STYLE
    COLOR 84 255 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'METASEDIMENTARY ROCK'
  EXPRESSION 'METASEDIMENTARY ROCK'
  STYLE
    COLOR 175 201 84
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'METAVOLCANICLASTIC IGNEOUS-ROCK AND METAVOLCANICLASTIC SEDIMENTARY-ROCK'
  EXPRESSION 'METAVOLCANICLASTIC IGNEOUS-ROCK AND METAVOLCANICLASTIC SEDIMENTARY-ROCK'
```

```
  STYLE
    COLOR 117 255 147
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'MICA SCHIST'
  EXPRESSION 'MICA SCHIST'
  STYLE
    COLOR 175 237 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'MIGMATITIC ROCK'
  EXPRESSION 'MIGMATITIC  ROCK'
  STYLE
    COLOR 201 175 201
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'MUDSTONE, CHERT AND SMECTITE-CLAYSTONE'
  EXPRESSION 'MUDSTONE, CHERT AND SMECTITE-CLAYSTONE'
  STYLE
    COLOR 117 175 219
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'MUDSTONE, SANDSTONE AND CONGLOMERATE'
  EXPRESSION 'MUDSTONE, SANDSTONE AND CONGLOMERATE'
  STYLE
    COLOR 147 255 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'MUDSTONE, SANDSTONE AND LIMESTONE'
  EXPRESSION 'MUDSTONE, SANDSTONE AND LIMESTONE'
  STYLE
    COLOR 255 201 51
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'MUDSTONE, SILTSTONE AND SANDSTONE'
  EXPRESSION 'MUDSTONE, SILTSTONE AND SANDSTONE'
  STYLE
    COLOR 201 201 117
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'MUDSTONE, SILTSTONE, LIMESTONE AND SANDSTONE'
  EXPRESSION 'MUDSTONE, SILTSTONE, LIMESTONE AND SANDSTONE'
  STYLE
    COLOR 84 117 201
    BACKGROUNDCOLOR 255 255 255
  END #style
```

```
END #class
CLASS
  NAME 'MUDSTONE, SILTSTONE, SANDSTONE, COAL, IRONSTONE AND FERRICRETE'
  EXPRESSION 'MUDSTONE, SILTSTONE, SANDSTONE, COAL, IRONSTONE AND FERRICRETE'
  STYLE
    COLOR 237 201 84
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'MYLONITIC-ROCK AND FAULT-BRECCIA'
  EXPRESSION 'MYLONITIC-ROCK AND FAULT-BRECCIA'
  STYLE
    COLOR 147 175 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'PELITE'
  EXPRESSION 'PELITE'
  STYLE
    COLOR 175 237 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'PSAMMITE'
  EXPRESSION 'PSAMMITE'
  STYLE
    COLOR 255 237 117
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'PSAMMITE AND PELITE'
  EXPRESSION 'PSAMMITE AND PELITE'
  STYLE
    COLOR 237 237 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'PSAMMITE AND SEMIPELITE'
  EXPRESSION 'PSAMMITE AND SEMIPELITE'
  STYLE
    COLOR 201 175 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'PSAMMITE, PELITE, SEMIPELITE AND CALCSILICATE-ROCK'
  EXPRESSION 'PSAMMITE, PELITE, SEMIPELITE AND CALCSILICATE-ROCK'
  STYLE
    COLOR 255 237 219
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'PSAMMITE, SEMIPELITE AND PELITE'
  EXPRESSION 'PSAMMITE, SEMIPELITE AND PELITE'
```

```
  STYLE
    COLOR 255 147 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'PYROCLASTIC-ROCK'
  EXPRESSION 'PYROCLASTIC-ROCK'
  STYLE
    COLOR 255 255 84
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'QUARTZ-ARENITE'
  EXPRESSION 'QUARTZ-ARENITE'
  STYLE
    COLOR 147 237 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'QUARTZITE'
  EXPRESSION 'QUARTZITE'
  STYLE
    COLOR 237 219 51
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'SAND, SILT AND CLAY'
  EXPRESSION 'SAND, SILT AND CLAY'
  STYLE
    COLOR 51 117 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'SANDSTONE AND CONGLOMERATE, INTERBEDDED'
  EXPRESSION 'SANDSTONE AND CONGLOMERATE, INTERBEDDED'
  STYLE
    COLOR 201 255 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'SANDSTONE AND MUDSTONE'
  EXPRESSION 'SANDSTONE AND MUDSTONE'
  STYLE
    COLOR 201 219 147
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'SANDSTONE AND SILTSTONE, INTERBEDDED'
  EXPRESSION 'SANDSTONE AND SILTSTONE, INTERBEDDED'
  STYLE
    COLOR 201 237 84
    BACKGROUNDCOLOR 255 255 255
  END #style
```

```
END #class
CLASS
  NAME 'SANDSTONE AND SUBORDINATE BRECCIA'
  EXPRESSION 'SANDSTONE AND SUBORDINATE BRECCIA'
  STYLE
    COLOR 255 147 84
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'SANDSTONE AND [SUBEQUAL/SUBORDINATE] ARGILLACEOUS ROCKS, INTERBEDDED'
  EXPRESSION 'SANDSTONE AND [SUBEQUAL/SUBORDINATE] ARGILLACEOUS ROCKS, INTERBEDDED'
  STYLE
    COLOR 237 175 147
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'SANDSTONE AND [SUBEQUAL/SUBORDINATE] LIMESTONE, INTERBEDDED'
  EXPRESSION 'SANDSTONE AND [SUBEQUAL/SUBORDINATE] LIMESTONE, INTERBEDDED'
  STYLE
    COLOR 255 175 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'SANDSTONE WITH SUBORDINATE ARGILLACEOUS ROCKS AND LIMESTONE'
  EXPRESSION 'SANDSTONE WITH SUBORDINATE ARGILLACEOUS ROCKS AND LIMESTONE'
  STYLE
    COLOR 255 147 147
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'SANDSTONE WITH SUBORDINATE CONGLOMERATE AND SILTSTONE'
  EXPRESSION 'SANDSTONE WITH SUBORDINATE CONGLOMERATE AND SILTSTONE'
  STYLE
    COLOR 237 147 51
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'SANDSTONE WITH SUBORDINATE CONGLOMERATE, SILTSTONE AND MUDSTONE'
  EXPRESSION 'SANDSTONE WITH SUBORDINATE CONGLOMERATE, SILTSTONE AND MUDSTONE'
  STYLE
    COLOR 237 147 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'SANDSTONE, BRECCIA AND CONGLOMERATE'
  EXPRESSION 'SANDSTONE, BRECCIA AND CONGLOMERATE'
  STYLE
    COLOR 237 117 84
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'SANDSTONE, CONGLOMERATE AND [SUBORDINATE] ARGILLACEOUS ROCKS'
  EXPRESSION 'SANDSTONE, CONGLOMERATE AND [SUBORDINATE] ARGILLACEOUS ROCKS'
```

```
  STYLE
    COLOR 201 175 117
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'SANDSTONE, LIMESTONE AND ARGILLACEOUS ROCKS'
  EXPRESSION 'SANDSTONE, LIMESTONE AND ARGILLACEOUS ROCKS'
  STYLE
    COLOR 175 51 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'SANDSTONE, MUDSTONE, SILTSTONE AND CONGLOMERATE'
  EXPRESSION 'SANDSTONE, MUDSTONE, SILTSTONE AND CONGLOMERATE'
  STYLE
    COLOR 219 255 117
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'SANDSTONE, SILTSTONE AND MUDSTONE'
  EXPRESSION 'SANDSTONE, SILTSTONE AND MUDSTONE'
  STYLE
    COLOR 237 175 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'SCHIST'
  EXPRESSION 'SCHIST'
  STYLE
    COLOR 237 237 219
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'SEDIMENTARY ROCK CYCLES, CLACKMANNAN GROUP TYPE'
  EXPRESSION 'SEDIMENTARY ROCK CYCLES, CLACKMANNAN GROUP TYPE'
  STYLE
    COLOR 175 175 117
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'SEDIMENTARY ROCK CYCLES, STRATHCLYDE GROUP TYPE'
  EXPRESSION 'SEDIMENTARY ROCK CYCLES, STRATHCLYDE GROUP TYPE'
  STYLE
    COLOR 175 175 117
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
  NAME 'SEMIPELITE'
  EXPRESSION 'SEMIPELITE'
  STYLE
    COLOR 219 219 255
    BACKGROUNDCOLOR 255 255 255
  END #style
```

```
    END #class
    CLASS
      NAME 'SEMIPELITE AND PELITE'
      EXPRESSION 'SEMIPELITE AND PELITE'
      STYLE
        COLOR 219 219 255
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
      NAME 'SERPENTINITE, METABASALT, METALIMESTONE AND PSAMMITE'
      EXPRESSION 'SERPENTINITE, METABASALT, METALIMESTONE AND PSAMMITE'
      STYLE
        COLOR 51 117 201
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
      NAME 'SILTSTONE AND SANDSTONE WITH SUBORDINATE MUDSTONE'
      EXPRESSION 'SILTSTONE AND SANDSTONE WITH SUBORDINATE MUDSTONE'
      STYLE
        COLOR 201 175 0
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
      NAME 'SYENITIC-ROCK'
      EXPRESSION 'SYENITIC-ROCK'
      STYLE
        COLOR 237 117 84
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
      NAME 'ULTRAMAFITITE'
      EXPRESSION 'ULTRAMAFITITE'
      STYLE
        COLOR 147 51 255
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
      NAME 'WACKE'
      EXPRESSION 'WACKE'
      STYLE
        COLOR 201 237 255
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
  END #layer

  LAYER
### GROUP BEDROCKGEOL
    NAME GBR_BGS_625k_BLS
    TYPE POLYGON
    STATUS ON
    DATA bedrock625ll
    TRANSPARENCY 100
    TOLERANCE 0
    TOLERANCEUNITS pixels
```

```
TRANSFORM TRUE
DUMP TRUE
PROCESSING "CLOSE_CONNECTION=DEFER"
HEADER "templates/bedrock_lithostratigraphy_query_header.html"
TEMPLATE "templates/bedrock_lithostratigraphy_query_body.html"
FOOTER "templates/bedrock_lithostratigraphy_query_footer.html"
PROJECTION
  "init=epsg:4326"
END
METADATA
  OWS_TITLE "GBR BGS 1:625k Bedrock Lithostratigraphy"
  OWS_ABSTRACT "GBR BGS 1:625k scale Bedrock Lithostratigraphy (including Lithogenic units)"
  WMS_SRS "EPSG:4326 EPSG:3857 CRS:84 EPSG:27700 EPSG:4258"
  GML_INCLUDE_ITEMS "LEX_D,AGE_ONEGL,RCS_D" # Note: must be comma separated list of fields
  with *no* spaces between field names
  GML_FEATUREID "ID"
  WMS_INCLUDE_ITEMS "LEX_D,AGE_ONEGL,RCS_D" # Note: must be comma separated list of fields
  with *no* spaces between field names
  WMS_METADATAURL_HREF "http://metadata.bgs.ac.uk/geonetwork/srv/en/csw?SERVICE=CSW&
  VERSION=2.0.2&REQUEST=GetRecordById&ID=ac9f8250-3ae5-49e5-9818-d14264a4fda4&"
  WMS_METADATAURL_FORMAT "application/xml;charset=UTF-8"
  WMS_METADATAURL_TYPE "TC211"
  OWS_DATAURL_HREF "http://www.bgs.ac.uk/discoverymetadata/13480426.html"
  OWS_DATAURL_FORMAT "text/html"
  OWS_KEYWORDLIST "OneGeology,geology,bedrock,lithostratigraphy,continent@Europe,
  subcontinent@Northern Europe,geographicarea@United Kingdom,DS_DATE@2011-06-15,
  dataprovider@British Geological Survey,serviceprovider@British Geological Survey,
  DS_TOPIC@geoscientificInformation"
END
 CLASSITEM 'LEX_D'
 CLASS
  NAME 'APPIN GROUP'
  EXPRESSION 'APPIN GROUP'
    STYLE
     COLOR 147 175 117
     BACKGROUNDCOLOR 255 255 255
   END #style
 END #class
 CLASS
  NAME 'APPIN GROUP AND ARGYLL GROUP (UNDIFFERENTIATED)'
  EXPRESSION 'APPIN GROUP AND ARGYLL GROUP (UNDIFFERENTIATED)'
    STYLE
     COLOR 0 255 255
     BACKGROUNDCOLOR 255 255 255
   END #style
 END #class
 CLASS
  NAME 'APPLEBY GROUP'
  EXPRESSION 'APPLEBY GROUP'
    STYLE
     COLOR 255 117 0
     BACKGROUNDCOLOR 255 255 255
   END #style
 END #class
 CLASS
  NAME 'ARBUTHNOTT-GARVOCK GROUP'
  EXPRESSION 'ARBUTHNOTT-GARVOCK GROUP'
    STYLE
     COLOR 147 84 84
     BACKGROUNDCOLOR 255 255 255
```

```
  END #style
END #class
CLASS
 NAME 'ARDVRECK GROUP'
 EXPRESSION 'ARDVRECK GROUP'
   STYLE
    COLOR 201 255 147
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'ARENIG ROCKS (UNDIFFERENTIATED)'
 EXPRESSION 'ARENIG ROCKS (UNDIFFERENTIATED)'
   STYLE
    COLOR 175 117 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'ARGYLL GROUP'
 EXPRESSION 'ARGYLL GROUP'
   STYLE
    COLOR 237 219 51
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'ARMAGH GROUP'
 EXPRESSION 'ARMAGH GROUP'
   STYLE
    COLOR 147 255 219
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'ASHGILL ROCKS (UNDIFFERENTIATED)'
 EXPRESSION 'ASHGILL ROCKS (UNDIFFERENTIATED)'
   STYLE
    COLOR 147 147 237
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'BELFAST GROUP'
 EXPRESSION 'BELFAST GROUP'
   STYLE
    COLOR 237 201 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'BLACKCRAIG FORMATION AND GALDENOCH FORMATION (UNDIFFERENTIATED)'
 EXPRESSION 'BLACKCRAIG FORMATION AND GALDENOCH FORMATION (UNDIFFERENTIATED)'
   STYLE
    COLOR 201 237 237
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'BORDER GROUP'
```

```
 EXPRESSION 'BORDER GROUP'
   STYLE
    COLOR 51 255 219
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'BOUNDARY ZONE COMPLEX'
 EXPRESSION 'BOUNDARY ZONE COMPLEX'
   STYLE
    COLOR 255 0 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'BOWLAND HIGH GROUP AND CRAVEN GROUP (UNDIFFERENTIATED)'
 EXPRESSION 'BOWLAND HIGH GROUP AND CRAVEN GROUP (UNDIFFERENTIATED)'
   STYLE
    COLOR 237 255 84
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'BRACKLESHAM GROUP AND BARTON GROUP (UNDIFFERENTIATED)'
 EXPRESSION 'BRACKLESHAM GROUP AND BARTON GROUP (UNDIFFERENTIATED)'
   STYLE
    COLOR 255 147 51
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'CAMBRIAN AND ORDOVICIAN ROCKS (UNDIFFERENTIATED)'
 EXPRESSION 'CAMBRIAN AND ORDOVICIAN ROCKS (UNDIFFERENTIATED)'
   STYLE
    COLOR 255 219 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'CARADOC ROCKS (UNDIFFERENTIATED)'
 EXPRESSION 'CARADOC ROCKS (UNDIFFERENTIATED)'
   STYLE
    COLOR 117 175 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'CLACKMANNAN GROUP'
 EXPRESSION 'CLACKMANNAN GROUP'
   STYLE
    COLOR 255 51 201
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'COAL MEASURES GROUP [OBSOLETE  EXCEPT IN NORTHERN IRELAND: USE PCM, SWCM, CMSC]'
 EXPRESSION 'COAL MEASURES GROUP [OBSOLETE  EXCEPT IN NORTHERN IRELAND: USE PCM, SWCM, CMSC]'
   STYLE
    COLOR 147 147 147
    BACKGROUNDCOLOR 255 255 255
```

```
  END #style
END #class
CLASS
 NAME 'CORALLIAN GROUP'
 EXPRESSION 'CORALLIAN GROUP'
   STYLE
    COLOR 255 147 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'CRAWFORD GROUP AND MOFFAT SHALE GROUP (UNDIFFERENTIATED)'
 EXPRESSION 'CRAWFORD GROUP AND MOFFAT SHALE GROUP (UNDIFFERENTIATED)'
   STYLE
    COLOR 117 175 219
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'CROSS SLIEVE GROUP'
 EXPRESSION 'CROSS SLIEVE GROUP'
   STYLE
    COLOR 147 84 51
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'DEVONIAN ROCKS (UNDIFFERENTIATED)'
 EXPRESSION 'DEVONIAN ROCKS (UNDIFFERENTIATED)'
   STYLE
    COLOR 237 117 147
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'DINANTIAN ROCKS (UNDIFFERENTIATED)'
 EXPRESSION 'DINANTIAN ROCKS (UNDIFFERENTIATED)'
   STYLE
    COLOR 175 255 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'DUNNOTTAR-CRAWTON GROUP'
 EXPRESSION 'DUNNOTTAR-CRAWTON GROUP'
   STYLE
    COLOR 255 219 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'DURNESS GROUP'
 EXPRESSION 'DURNESS GROUP'
   STYLE
    COLOR 147 237 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #c lass
CLASS
 NAME 'ENLER GROUP'
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 EXPRESSION 'ENLER GROUP'
   STYLE
    COLOR 255 84 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'EOCENE TO MIOCENE ROCKS (UNDIFFERENTIATED)'
 EXPRESSION 'EOCENE TO MIOCENE ROCKS (UNDIFFERENTIATED)'
   STYLE
    COLOR 219 219 51
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'FAULT ZONE ROCKS, UNASSIGNED'
 EXPRESSION 'FAULT ZONE ROCKS, UNASSIGNED'
   STYLE
    COLOR 84 255 84
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'FINTONA GROUP'
 EXPRESSION 'FINTONA GROUP'
   STYLE
    COLOR 237 117 147
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'GALA GROUP'
 EXPRESSION 'GALA GROUP'
   STYLE
    COLOR 175 237 219
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'GAULT FORMATION AND UPPER GREENSAND FORMATION (UNDIFFERENTIATED)'
 EXPRESSION 'GAULT FORMATION AND UPPER GREENSAND FORMATION (UNDIFFERENTIATED)'
   STYLE
    COLOR 51 255 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'GLENFINNAN GROUP'
 EXPRESSION 'GLENFINNAN GROUP'
   STYLE
    COLOR 201 175 219
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'GRAMPIAN GROUP'
 EXPRESSION 'GRAMPIAN GROUP'
   STYLE
    COLOR 255 175 117
    BACKGROUNDCOLOR 255 255 255
```

```
  END #style
END #class
CLASS
 NAME 'GREAT OOLITE GROUP'
 EXPRESSION 'GREAT OOLITE GROUP'
   STYLE
    COLOR 175 201 84
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'GREY CHALK SUBGROUP'
 EXPRESSION 'GREY CHALK SUBGROUP'
   STYLE
    COLOR 201 255 51
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'HAWICK GROUP'
 EXPRESSION 'HAWICK GROUP'
   STYLE
    COLOR 147 84 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'HIBERNIAN GREENSANDS FORMATION AND ULSTER WHITE LIMESTONE FORMATION (UNDIFFERENTIATED)'
 EXPRESSION 'HIBERNIAN GREENSANDS FORMATION AND ULSTER WHITE LIMESTONE FORMATION (UNDIF...)'
   STYLE
    COLOR 175 255 147
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'HIGHLAND BORDER COMPLEX [UNDER REVIEW; POSSIBLY OBSOLETE]'
 EXPRESSION 'HIGHLAND BORDER COMPLEX [UNDER REVIEW; POSSIBLY OBSOLETE]'
   STYLE
    COLOR 0 255 117
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'HOLSWORTHY GROUP'
 EXPRESSION 'HOLSWORTHY GROUP'
   STYLE
    COLOR 219 219 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'HOLYWOOD GROUP'
 EXPRESSION 'HOLYWOOD GROUP'
   STYLE
    COLOR 201 237 201
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'INFERIOR OOLITE GROUP'
```

```
 EXPRESSION 'INFERIOR OOLITE GROUP'
   STYLE
    COLOR 255 147 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'INVERCLYDE GROUP'
 EXPRESSION 'INVERCLYDE GROUP'
   STYLE
    COLOR 175 255 117
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'KELLAWAYS FORMATION AND OXFORD CLAY FORMATION (UNDIFFERENTIATED)'
 EXPRESSION 'KELLAWAYS FORMATION AND OXFORD CLAY FORMATION (UNDIFFERENTIATED)'
   STYLE
    COLOR 117 147 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'KILSKEERY GROUP'
 EXPRESSION 'KILSKEERY GROUP'
   STYLE
    COLOR 219 219 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'KIRKCOLM FORMATION'
 EXPRESSION 'KIRKCOLM FORMATION'
   STYLE
    COLOR 175 219 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'LAMBETH GROUP'
 EXPRESSION 'LAMBETH GROUP'
   STYLE
    COLOR 219 147 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'LANARK GROUP'
 EXPRESSION 'LANARK GROUP'
   STYLE
    COLOR 237 117 117
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'LEADHILLS SUPERGROUP'
 EXPRESSION 'LEADHILLS SUPERGROUP'
   STYLE
    COLOR 117 117 147
    BACKGROUNDCOLOR 255 255 255
```

```
  END #style
END #class
CLASS
 NAME 'LEITRIM GROUP'
 EXPRESSION 'LEITRIM GROUP'
   STYLE
    COLOR 219 255 117
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'LEWISIAN COMPLEX'
 EXPRESSION 'LEWISIAN COMPLEX'
   STYLE
    COLOR 237 147 237
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'LIAS GROUP'
 EXPRESSION 'LIAS GROUP'
   STYLE
    COLOR 0 84 201
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'LLANDOVERY ROCKS (UNDIFFERENTIATED)'
 EXPRESSION 'LLANDOVERY ROCKS (UNDIFFERENTIATED)'
   STYLE
    COLOR 147 51 219
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'LLANVIRN ROCKS (UNDIFFERENTIATED)'
 EXPRESSION 'LLANVIRN ROCKS (UNDIFFERENTIATED)'
   STYLE
    COLOR 117 175 219
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'LOCH EIL GROUP'
 EXPRESSION 'LOCH EIL GROUP'
   STYLE
    COLOR 237 219 51
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'LOCH MAREE GROUP'
 EXPRESSION 'LOCH MAREE GROUP'
   STYLE
    COLOR 255 219 84
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'LOUGH NEAGH CLAYS GROUP'
```

```
 EXPRESSION 'LOUGH NEAGH CLAYS GROUP'
   STYLE
    COLOR 219 219 117
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'LOWER CAMBRIAN ROCKS (UNDIFFERENTIATED)'
 EXPRESSION 'LOWER CAMBRIAN ROCKS (UNDIFFERENTIATED)'
   STYLE
    COLOR 201 175 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'LOWER DEVONIAN ROCKS (UNDIFFERENTIATED)'
 EXPRESSION 'LOWER DEVONIAN ROCKS (UNDIFFERENTIATED)'
   STYLE
    COLOR 175 84 147
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'LOWER GREENSAND GROUP'
 EXPRESSION 'LOWER GREENSAND GROUP'
   STYLE
    COLOR 201 255 219
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'LOWER OLD RED SANDSTONE'
 EXPRESSION 'LOWER OLD RED SANDSTONE'
   STYLE
    COLOR 219 175 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'LUDLOW ROCKS (UNDIFFERENTIATED)'
 EXPRESSION 'LUDLOW ROCKS (UNDIFFERENTIATED)'
   STYLE
    COLOR 201 201 237
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'MERCIA MUDSTONE GROUP'
 EXPRESSION 'MERCIA MUDSTONE GROUP'
   STYLE
    COLOR 255 175 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'MESOPROTEROZOIC ROCKS (UNDIFFERENTIATED)'
 EXPRESSION 'MESOPROTEROZOIC ROCKS (UNDIFFERENTIATED)'
   STYLE
    COLOR 255 147 175
    BACKGROUNDCOLOR 255 255 255
```

```
  END #style
END #class
CLASS
 NAME 'MIDDLE CAMBRIAN'
 EXPRESSION 'MIDDLE CAMBRIAN'
   STYLE
    COLOR 219 201 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'MIDDLE DEVONIAN (UNDIFFERENTIATED)'
 EXPRESSION 'MIDDLE DEVONIAN (UNDIFFERENTIATED)'
   STYLE
    COLOR 255 201 84
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'MIDDLE JURASSIC ROCKS (UNDIFFERENTIATED)'
 EXPRESSION 'MIDDLE JURASSIC ROCKS (UNDIFFERENTIATED)'
   STYLE
    COLOR 237 219 117
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'MIDDLE OLD RED SANDSTONE (UNDIFFERENTIATED)'
 EXPRESSION 'MIDDLE OLD RED SANDSTONE (UNDIFFERENTIATED)'
   STYLE
    COLOR 147 51 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'MILLSTONE GRIT GROUP [SEE ALSO MIGR]'
 EXPRESSION 'MILLSTONE GRIT GROUP [SEE ALSO MIGR]'
   STYLE
    COLOR 237 175 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'MOINE SUPERGROUP'
 EXPRESSION 'MOINE SUPERGROUP'
   STYLE
    COLOR 0 255 219
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'MORAR GROUP'
 EXPRESSION 'MORAR GROUP'
   STYLE
    COLOR 237 219 219
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'NEOGENE ROCKS (UNDIFFERENTIATED)'
```

```
 EXPRESSION 'NEOGENE ROCKS (UNDIFFERENTIATED)'
   STYLE
    COLOR 255 219 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'NEOGENE TO QUATERNARY ROCKS (UNDIFFERENTIATED)'
 EXPRESSION 'NEOGENE TO QUATERNARY ROCKS (UNDIFFERENTIATED)'
   STYLE
    COLOR 219 175 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'NEW RED SANDSTONE SUPERGROUP'
 EXPRESSION 'NEW RED SANDSTONE SUPERGROUP'
   STYLE
    COLOR 255 201 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'OLD RED SANDSTONE SUPERGROUP'
 EXPRESSION 'OLD RED SANDSTONE SUPERGROUP'
   STYLE
    COLOR 201 117 51
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'OMAGH SANDSTONE GROUP'
 EXPRESSION 'OMAGH SANDSTONE GROUP'
   STYLE
    COLOR 117 219 219
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'ORDOVICIAN ROCKS (UNDIFFERENTIATED)'
 EXPRESSION 'ORDOVICIAN ROCKS (UNDIFFERENTIATED)'
   STYLE
    COLOR 117 175 237
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'OWENKILLEW SANDSTONE GROUP'
 EXPRESSION 'OWENKILLEW SANDSTONE GROUP'
   STYLE
    COLOR 117 219 219
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'PENNINE COAL MEASURES GROUP'
 EXPRESSION 'PENNINE COAL MEASURES GROUP'
   STYLE
    COLOR 175 219 51
    BACKGROUNDCOLOR 255 255 255
```

```
  END #style
END #class
CLASS
 NAME 'PENNINE LOWER COAL MEASURES FORMATION AND SOUTH WALES LOWER COAL MEASURES FORMAT... '
 EXPRESSION 'PENNINE LOWER COAL MEASURES FORMATION AND SOUTH WALES LOWER COAL MEASURES... '
   STYLE
    COLOR 147 147 147
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'PENNINE MIDDLE COAL MEASURES FORMATION AND SOUTH WALES MIDDLE COAL MEASURES FORMAT... '
 EXPRESSION 'PENNINE MIDDLE COAL MEASURES FORMATION AND SOUTH WALES MIDDLE COAL MEASURES... '
   STYLE
    COLOR 201 201 201
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'PENNINE UPPER COAL MEASURES FORMATION'
 EXPRESSION 'PENNINE UPPER COAL MEASURES FORMATION'
   STYLE
    COLOR 237 201 147
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'PERMIAN ROCKS (UNDIFFERENTIATED)'
 EXPRESSION 'PERMIAN ROCKS (UNDIFFERENTIATED)'
   STYLE
    COLOR 255 175 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'PORTLAND GROUP'
 EXPRESSION 'PORTLAND GROUP'
   STYLE
    COLOR 255 175 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'PORTPATRICK FORMATION AND GLENWHARGEN FORMATION (UNDIFFERENTIATED)'
 EXPRESSION 'PORTPATRICK FORMATION AND GLENWHARGEN FORMATION (UNDIFFERENTIATED)'
   STYLE
    COLOR 201 237 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'PRIDOLI ROCKS (UNDIFFERENTIATED)'
 EXPRESSION 'PRIDOLI ROCKS (UNDIFFERENTIATED)'
   STYLE
    COLOR 237 117 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'PURBECK LIMESTONE GROUP'
```

```
 EXPRESSION 'PURBECK LIMESTONE GROUP'
   STYLE
    COLOR 219 255 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'QUEYFIRTH GROUP'
 EXPRESSION 'QUEYFIRTH GROUP'
   STYLE
    COLOR 175 175 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'RAVENSCAR GROUP'
 EXPRESSION 'RAVENSCAR GROUP'
   STYLE
    COLOR 219 175 84
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'RED BAY FORMATION'
 EXPRESSION 'RED BAY FORMATION'
   STYLE
    COLOR 219 117 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'RESTON GROUP'
 EXPRESSION 'RESTON GROUP'
   STYLE
    COLOR 219 117 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'RICCARTON GROUP'
 EXPRESSION 'RICCARTON GROUP'
   STYLE
    COLOR 117 175 201
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'ROE VALLEY GROUP'
 EXPRESSION 'ROE VALLEY GROUP'
   STYLE
    COLOR 147 175 117
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'SCOTTISH COAL MEASURES GROUP'
 EXPRESSION 'SCOTTISH COAL MEASURES GROUP'
   STYLE
    COLOR 255 219 219
    BACKGROUNDCOLOR 255 255 255
```

```
  END #style
END #class
CLASS
 NAME 'SHANMULLAGH FORMATION'
 EXPRESSION 'SHANMULLAGH FORMATION'
   STYLE
    COLOR 201 175 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'SHERWOOD SANDSTONE GROUP'
 EXPRESSION 'SHERWOOD SANDSTONE GROUP'
   STYLE
    COLOR 255 175 201
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'SHINNEL FORMATION AND GLENLEE FORMATION (UNDIFFERENTIATED)'
 EXPRESSION 'SHINNEL FORMATION AND GLENLEE FORMATION (UNDIFFERENTIATED)'
   STYLE
    COLOR 237 219 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'SILURIAN ROCKS (UNDIFFERENTIATED)'
 EXPRESSION 'SILURIAN ROCKS (UNDIFFERENTIATED)'
   STYLE
    COLOR 175 147 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'SLEAT GROUP'
 EXPRESSION 'SLEAT GROUP'
   STYLE
    COLOR 201 147 147
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'SLIEVEBANE GROUP'
 EXPRESSION 'SLIEVEBANE GROUP'
   STYLE
    COLOR 237 201 147
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'SOLENT GROUP'
 EXPRESSION 'SOLENT GROUP'
   STYLE
    COLOR 255 175 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'SOUTH WALES UPPER COAL MEASURES FORMATION'
```

```
 EXPRESSION 'SOUTH WALES UPPER COAL MEASURES FORMATION'
   STYLE
    COLOR 84 84 84
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'SOUTHERN HIGHLAND GROUP'
 EXPRESSION 'SOUTHERN HIGHLAND GROUP'
   STYLE
    COLOR 147 255 117
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'STEWARTRY GROUP'
 EXPRESSION 'STEWARTRY GROUP'
   STYLE
    COLOR 201 84 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'STOER GROUP'
 EXPRESSION 'STOER GROUP'
   STYLE
    COLOR 175 117 117
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'STONEHAVEN GROUP'
 EXPRESSION 'STONEHAVEN GROUP'
   STYLE
    COLOR 201 84 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'STRATHCLYDE GROUP'
 EXPRESSION 'STRATHCLYDE GROUP'
   STYLE
    COLOR 84 84 84
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'STRATHEDEN GROUP'
 EXPRESSION 'STRATHEDEN GROUP'
   STYLE
    COLOR 51 84 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'STRATHMORE GROUP'
 EXPRESSION 'STRATHMORE GROUP'
   STYLE
    COLOR 237 147 84
    BACKGROUNDCOLOR 255 255 255
```

```
  END #style
END #class
CLASS
 NAME 'STRATHY COMPLEX'
 EXPRESSION 'STRATHY COMPLEX'
   STYLE
    COLOR 84 255 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'TAPPINS GROUP'
 EXPRESSION 'TAPPINS GROUP'
   STYLE
    COLOR 175 175 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'TEIGN VALLEY GROUP'
 EXPRESSION 'TEIGN VALLEY GROUP'
   STYLE
    COLOR 147 117 147
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'THAMES GROUP'
 EXPRESSION 'THAMES GROUP'
   STYLE
    COLOR 175 147 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'THANET SAND FORMATION'
 EXPRESSION 'THANET SAND FORMATION'
   STYLE
    COLOR 51 117 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'TORRIDON GROUP'
 EXPRESSION 'TORRIDON GROUP'
   STYLE
    COLOR 219 175 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'TREMADOC ROCKS (UNDIFFERENTIATED)'
 EXPRESSION 'TREMADOC ROCKS (UNDIFFERENTIATED)'
   STYLE
    COLOR 117 201 201
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'TRIASSIC ROCKS (UNDIFFERENTIATED)'
```

```
 EXPRESSION 'TRIASSIC ROCKS (UNDIFFERENTIATED)'
   STYLE
    COLOR 255 175 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'TYRONE GROUP'
 EXPRESSION 'TYRONE GROUP'
   STYLE
    COLOR 117 255 201
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'UNNAMED EXTRUSIVE ROCKS, CAMBRIAN'
 EXPRESSION 'UNNAMED EXTRUSIVE ROCKS, CAMBRIAN'
   STYLE
    COLOR 255 219 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'UNNAMED EXTRUSIVE ROCKS, CARBONIFEROUS'
 EXPRESSION 'UNNAMED EXTRUSIVE ROCKS, CARBONIFEROUS'
   STYLE
    COLOR 255 201 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'UNNAMED EXTRUSIVE ROCKS, DEVONIAN'
 EXPRESSION 'UNNAMED EXTRUSIVE ROCKS, DEVONIAN'
   STYLE
    COLOR 255 219 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'UNNAMED EXTRUSIVE ROCKS, DINANTIAN'
 EXPRESSION 'UNNAMED EXTRUSIVE ROCKS, DINANTIAN'
   STYLE
    COLOR 255 175 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'UNNAMED EXTRUSIVE ROCKS, NEOPROTEROZOIC'
 EXPRESSION 'UNNAMED EXTRUSIVE ROCKS, NEOPROTEROZOIC'
   STYLE
    COLOR 219 117 237
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'UNNAMED EXTRUSIVE ROCKS, ORDOVICIAN'
 EXPRESSION 'UNNAMED EXTRUSIVE ROCKS, ORDOVICIAN'
   STYLE
    COLOR 255 175 0
    BACKGROUNDCOLOR 255 255 255
```

```
  END #style
END #class
CLASS
 NAME 'UNNAMED EXTRUSIVE ROCKS, PALAEOGENE'
 EXPRESSION 'UNNAMED EXTRUSIVE ROCKS, PALAEOGENE'
   STYLE
    COLOR 255 219 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'UNNAMED EXTRUSIVE ROCKS, PALAEOPROTEROZOIC'
 EXPRESSION 'UNNAMED EXTRUSIVE ROCKS, PALAEOPROTEROZOIC'
   STYLE
    COLOR 255 219 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'UNNAMED EXTRUSIVE ROCKS, PERMIAN'
 EXPRESSION 'UNNAMED EXTRUSIVE ROCKS, PERMIAN'
   STYLE
    COLOR 255 219 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'UNNAMED EXTRUSIVE ROCKS, SILESIAN'
 EXPRESSION 'UNNAMED EXTRUSIVE ROCKS, SILESIAN'
   STYLE
    COLOR 255 219 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'UNNAMED EXTRUSIVE ROCKS, SILURIAN'
 EXPRESSION 'UNNAMED EXTRUSIVE ROCKS, SILURIAN'
   STYLE
    COLOR 255 175 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'UNNAMED EXTRUSIVE ROCKS, SILURIAN TO DEVONIAN'
 EXPRESSION 'UNNAMED EXTRUSIVE ROCKS, SILURIAN TO DEVONIAN'
   STYLE
    COLOR 255 175 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'UNNAMED IGNEOUS INTRUSION, CAMBRIAN TO ORDOVICIAN'
 EXPRESSION 'UNNAMED IGNEOUS INTRUSION, CAMBRIAN TO ORDOVICIAN'
   STYLE
    COLOR 255 0 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'UNNAMED IGNEOUS INTRUSION, CARBONIFEROUS TO PERMIAN'
```

```
 EXPRESSION 'UNNAMED IGNEOUS INTRUSION, CARBONIFEROUS TO PERMIAN'
   STYLE
    COLOR 117 117 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'UNNAMED IGNEOUS INTRUSION, DEVONIAN'
 EXPRESSION 'UNNAMED IGNEOUS INTRUSION, DEVONIAN'
   STYLE
    COLOR 175 0 237
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'UNNAMED IGNEOUS INTRUSION, LATE SILURIAN TO EARLY DEVONIAN'
 EXPRESSION 'UNNAMED IGNEOUS INTRUSION, LATE SILURIAN TO EARLY DEVONIAN'
   STYLE
    COLOR 84 201 84
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'UNNAMED IGNEOUS INTRUSION, NEOPROTEROZOIC'
 EXPRESSION 'UNNAMED IGNEOUS INTRUSION, NEOPROTEROZOIC'
   STYLE
    COLOR 147 237 84
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'UNNAMED IGNEOUS INTRUSION, ORDOVICIAN TO SILURIAN'
 EXPRESSION 'UNNAMED IGNEOUS INTRUSION, ORDOVICIAN TO SILURIAN'
   STYLE
    COLOR 255 0 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'UNNAMED IGNEOUS INTRUSION, PALAEOGENE'
 EXPRESSION 'UNNAMED IGNEOUS INTRUSION, PALAEOGENE'
   STYLE
    COLOR 255 0 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'UNNAMED IGNEOUS INTRUSION, PALAEOPROTEROZOIC'
 EXPRESSION 'UNNAMED IGNEOUS INTRUSION, PALAEOPROTEROZOIC'
   STYLE
    COLOR 0 237 147
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'UNNAMED METAMORPHIC ROCKS, NEOPROTEROZOIC'
 EXPRESSION 'UNNAMED METAMORPHIC ROCKS, NEOPROTEROZOIC'
   STYLE
    COLOR 0 255 147
    BACKGROUNDCOLOR 255 255 255
```

```
  END #style
END #class
CLASS
 NAME 'UNNAMED METAMORPHIC ROCKS, PRE-CALEDONIAN TO CALEDONIAN'
 EXPRESSION 'UNNAMED METAMORPHIC ROCKS, PRE-CALEDONIAN TO CALEDONIAN'
   STYLE
    COLOR 84 255 84
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'UNNAMED METASEDIMENTARY ROCKS, NEOPROTEROZOIC'
 EXPRESSION 'UNNAMED METASEDIMENTARY ROCKS, NEOPROTEROZOIC'
   STYLE
    COLOR 147 255 219
    BACKGROUNDCO LOR 255 255 255
  END #style
END #class
CLASS
 NAME 'UNST PHYLLITE GROUP'
 EXPRESSION 'UNST PHYLLITE GROUP'
   STYLE
    COLOR 175 219 219
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'UPPER CAMBRIAN, INCLUDING TREMADOC'
 EXPRESSION 'UPPER CAMBRIAN, INCLUDING TREMADOC'
   STYLE
    COLOR 255 255 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'UPPER CRETACEOUS TO PALAEOGENE ROCKS (UNDIFFERENTIATED)'
 EXPRESSION 'UPPER CRETACEOUS TO PALAEOGENE ROCKS (UNDIFFERENTIATED)'
   STYLE
    COLOR 219 255 201
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'UPPER DEVONIAN ROCKS (UNDIFFERENTIATED)'
 EXPRESSION 'UPPER DEVONIAN ROCKS (UNDIFFERENTIATED)'
   STYLE
    COLOR 237 147 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'UPPER JURASSIC ROCKS (UNDIFFERENTIATED)'
 EXPRESSION 'UPPER JURASSIC ROCKS (UNDIFFERENTIATED)'
   STYLE
    COLOR 219 201 147
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'UPPER OLD RED SANDSTONE'
```

```
 EXPRESSION 'UPPER OLD RED SANDSTONE'
   STYLE
    COLOR 237 201 219
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'WARWICKSHIRE GROUP'
 EXPRESSION 'WARWICKSHIRE GROUP'
   STYLE
    COLOR 147 201 147
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'WEALDEN GROUP'
 EXPRESSION 'WEALDEN GROUP'
   STYLE
    COLOR 201 219 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'WENLOCK ROCKS (UNDIFFERENTIATED)'
 EXPRESSION 'WENLOCK ROCKS (UNDIFFERENTIATED)'
   STYLE
    COLOR 175 51 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'WEST WALTON FORMATION, AMPTHILL CLAY FORMATION AND KIMMERIDGE CLAY FORMAT... '
 EXPRESSION 'WEST WALTON FORMATION, AMPTHILL CLAY FORMATION AND KIMMERIDGE CLAY... '
   STYLE
    COLOR 237 201 219
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'WHITE CHALK SUBGROUP'
 EXPRESSION 'WHITE CHALK SUBGROUP'
   STYLE
    COLOR 219 255 84
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'YOREDALE GROUP'
 EXPRESSION 'YOREDALE GROUP'
   STYLE
    COLOR 147 255 219
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'ZECHSTEIN GROUP'
 EXPRESSION 'ZECHSTEIN GROUP'
   STYLE
    COLOR 255 147 84
    BACKGROUNDCOLOR 255 255 255
```

```
      END #style
    END #class
  END #layer
  LAYER
### GROUP BEDROCKGEOL
    NAME GBR_BGS_625k_BA
    TYPE POLYGON
    STATUS ON
    DATA bedrock625ll
    TRANSPARENCY 100
    TOLERANCE 0
    TOLERANCEUNITS pixels
    TRANSFORM TRUE
    DUMP TRUE
    PROCESSING "CLOSE_CONNECTION=DEFER"
    HEADER "templates/bedrock_age_query_header.html"
    TEMPLATE "templates/bedrock_age_query_body.html"
    FOOTER "templates/bedrock_age_query_footer.html"
    PROJECTION
      "init=epsg:4326"
    END
    METADATA
      OWS_TITLE "GBR BGS 1:625k Bedrock Age"
      OWS_ABSTRACT "GBR BGS 1:625k scale Bedrock Age"
      WMS_SRS "EPSG:4326 EPSG:3857 CRS:84 EPSG:27700 EPSG:4258"
      GML_INCLUDE_ITEMS "AGE_ONEGL"
      GML_FEATUREID "ID"
      WMS_INCLUDE_ITEMS "AGE_ONEGL"
      WMS_METADATAURL_HREF "http://.../geonetwork/srv/en/csw?REQUEST=GetRecordById&
      SERVICE=CSW&VERSION=2.0.2&ID=ac9f8250-3ae5-49e5-9818-d14264a4fda4&"
      WMS_METADATAURL_FORMAT "application/xml;charset=UTF-8"
      WMS_METADATAURL_TYPE "TC211"
      OWS_DATAURL_HREF "http://www.bgs.ac.uk/discoverymetadata/13480426.html"
      OWS_DATAURL_FORMAT "text/html"
      OWS_KEYWORDLIST "OneGeology,geology,bedrock,chronostratigraphycontinent@Europe,
      subcontinent@Northern Europe,geographicarea@United Kingdom,DS_DATE@2011-06-15
      dataprovider@British Geological Survey,serviceprovider@British Geological Survey,
      age,DS_TOPIC@geoscientificInformation,"
    END
    #CLASSITEM 'AGE_ONEGL'
    CLASS
      #NAME 'AELENIAN'
      EXPRESSION ('[AGE_ONEGL]' eq 'AELENIAN')
      STYLE
        ANTIALIAS false
        COLOR 152 254 241
        BACKGROUNDCOLOR 152 254 241
      END #style
    END #class
    CLASS
      #NAME 'AERONIAN'
      EXPRESSION ('[AGE_ONEGL]' eq 'AERONIAN')
      STYLE
        ANTIALIAS false
        COLOR 178 254 203
        BACKGROUNDCOLOR 178 254 203
      END #style
    END #class
    CLASS
      #NAME 'ALBIAN'
```

```
  EXPRESSION ('[AGE_ONEGL]' eq 'ALBIAN')
  STYLE
    ANTIALIAS false
    COLOR 203 254 152
    BACKGROUNDCOLOR 203 254 152
  END #style
END #class
CLASS
  #NAME 'ANISIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'ANISIAN')
  STYLE
    ANTIALIAS false
    COLOR 190 127 254
    BACKGROUNDCOLOR 190 127 254
  END #style
END #class
CLASS
  #NAME 'APTIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'APTIAN')
  STYLE
    ANTIALIAS false
    COLOR 190 254 139
    BACKGROUNDCOLOR 190 254 139
  END #style
END #class
CLASS
  #NAME 'AQUITANIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'AQUITANIAN')
  STYLE
    ANTIALIAS false
    COLOR 254 254 50
    BACKGROUNDCOLOR 254 254 50
  END #style
END #class
CLASS
  #NAME 'ARCHEAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'ARCHEAN')
  STYLE
    ANTIALIAS false
    COLOR 254 0 254
    BACKGROUNDCOLOR 254 0 254
  END #style
END #class
CLASS
  #NAME 'ARTINSKIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'ARTINSKIAN')
  STYLE
    ANTIALIAS false
    COLOR 229 127 139
    BACKGROUNDCOLOR 229 127 139
  END #style
END #class
CLASS
  #NAME 'ASSELIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'ASSELIAN')
  STYLE
    ANTIALIAS false
    COLOR 229 101 114
    BACKGROUNDCOLOR 229 101 114
  END #style
```

```
END #class
CLASS
  #NAME 'BAJOCIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'BAJOCIAN')
  STYLE
    ANTIALIAS false
    COLOR 165 254 241
    BACKGROUNDCOLOR 165 254 241
  END #style
END #class
CLASS
  #NAME 'BARREMIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'BARREMIAN')
  STYLE
    ANTIALIAS false
    COLOR 178 254 127
    BACKGROUNDCOLOR 178 254 127
  END #style
END #class
CLASS
  #NAME 'BARTONIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'BARTONIAN')
  STYLE
    ANTIALIAS false
    COLOR 254 190 165
    BACKGROUNDCOLOR 254 190 165
  END #style
END #class
CLASS
  NAME 'BASHKIRIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'BASHKIRIAN')
  STYLE
    ANTIALIAS false
    COLOR 152 229 203
    BACKGROUNDCOLOR 152 229 203
  END #style
END #class
CLASS
  NAME 'BATHONIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'BATHONIAN')
  STYLE
    ANTIALIAS false
    COLOR 178 254 241
    BACKGROUNDCOLOR 178 254 241
  END #style
END #class
CLASS
  #NAME 'BERRIASIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'BERRIASIAN')
  STYLE
    ANTIALIAS false
    COLOR 139 254 88
    BACKGROUNDCOLOR 139 254 88
  END #style
END #class
CLASS
  #NAME 'BURDIGALIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'BURDIGALIAN')
  STYLE
    ANTIALIAS false
```

```
    COLOR 254 254 63
    BACKGROUNDCOLOR 254 254 63
  END #style
END #class
CLASS
  #NAME 'CALLOVIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'CALLOVIAN')
  STYLE
    ANTIALIAS false
    COLOR 190 254 241
    BACKGROUNDCOLOR 190 254 241
  END #style
END #class
CLASS
  #NAME 'CALYMMIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'CALYMMIAN')
  STYLE
    ANTIALIAS false
    COLOR 254 190 139
    BACKGROUNDCOLOR 254 190 139
  END #style
END #class
CLASS
  NAME 'CAMBRIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'CAMBRIAN')
   STYLE
    ANTIALIAS false
    COLOR 127 203 88
    BACKGROUNDCOLOR 127 203 88
  END #style
END #class
CLASS
  #NAME 'CAMBRIAN SERIES 2'
  EXPRESSION ('[AGE_ONEGL]' eq 'CAMBRIAN SERIES 2')
  STYLE
    ANTIALIAS false
    COLOR 152 229 127
    BACKGROUNDCOLOR 152 229 127
  END #style
END #class
CLASS
  #NAME 'CAMBRIAN SERIES 3'
  EXPRESSION ('[AGE_ONEGL]' eq 'CAMBRIAN SERIES 3')
  STYLE
    ANTIALIAS false
    COLOR 165 241 139
    BACKGROUNDCOLOR 165 241 139
  END #style
END #class
CLASS
  #NAME 'CAMBRIAN STAGE 10'
  EXPRESSION ('[AGE_ONEGL]' eq 'CAMBRIAN STAGE 10')
  STYLE
    ANTIALIAS false
    COLOR 229 254 203
    BACKGROUNDCOLOR 229 254 203
  END #style
END #class
CLASS
  #NAME 'CAMBRIAN STAGE 2'
```

```
  EXPRESSION ('[AGE_ONEGL]' eq 'CAMBRIAN STAGE 2')
  STYLE
    ANTIALIAS false
    COLOR 165 216 139
    BACKGROUNDCOLOR 165 216 139
  END #style
END #class
CLASS
  #NAME 'CAMBRIAN STAGE 3'
  EXPRESSION ('[AGE_ONEGL]' eq 'CAMBRIAN STAGE 3')
  STYLE
    ANTIALIAS false
    COLOR 165 229 139
    BACKGROUNDCOLOR 165 229 139
  END #style
END #class
CLASS
  #NAME 'CAMBRIAN STAGE 4'
  EXPRESSION ('[AGE_ONEGL]' eq 'CAMBRIAN STAGE 4')
  STYLE
    ANTIALIAS false
    COLOR 178 229 152
    BACKGROUNDCOLOR 178 229 152
  END #style
END #class
CLASS
  #NAME 'CAMBRIAN STAGE 5'
  EXPRESSION ('[AGE_ONEGL]' eq 'CAMBRIAN STAGE 5')
  STYLE
    ANTIALIAS false
    COLOR 178 241 152
    BACKGROUNDCOLOR 178 241 152
  END #style
END #class
CLASS
  #NAME 'CAMBRIAN STAGE 9'
  EXPRESSION ('[AGE_ONEGL]' eq 'CAMBRIAN STAGE 9')
  STYLE
    ANTIALIAS false
    COLOR 216 254 190
    BACKGROUNDCOLOR 216 254 190
  END #style
END #class
CLASS
  #NAME 'CAMPANIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'CAMPANIAN')
  STYLE
    ANTIALIAS false
    COLOR 229 254 127
    BACKGROUNDCOLOR 229 254 127
  END #style
END #class
CLASS
  #NAME 'CAPITANIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'CAPITANIAN')
  STYLE
    ANTIALIAS false
    COLOR 254 152 165
    BACKGROUNDCOLOR 254 152 165
  END #style
```

```
END #class
CLASS
  NAME 'CARBONIFEROUS'
  EXPRESSION ('[AGE_ONEGL]' eq 'CARBONIFEROUS')
  STYLE
    ANTIALIAS false
    COLOR 101 216 178
    BACKGROUNDCOLOR 101 216 178
  END #style
END #class
CLASS
  #NAME 'CARNIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'CARNIAN')
  STYLE
    ANTIALIAS false
    COLOR 203 165 254
    BACKGROUNDCOLOR 203 165 254
  END #style
END #class
CLASS
  NAME 'CENOMANIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'CENOMANIAN')
  STYLE
    ANTIALIAS false
    COLOR 178 254 76
    BACKGROUNDCOLOR 178 254 76
  END #style
END #class
CLASS
  NAME 'CENOZOIC'
  EXPRESSION ('[AGE_ONEGL]' eq 'CENOZOIC')
  STYLE
    ANTIALIAS false
    COLOR 241 254 0
    BACKGROUNDCOLOR 241 254 0
  END #style
END #class
CLASS
  #NAME 'CHANGHSINGIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'CHANGHSINGIAN')
  STYLE
    ANTIALIAS false
    COLOR 254 190 203
    BACKGROUNDCOLOR 254 190 203
  END #style
END #class
CLASS
  #NAME 'CHATTIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'CHATTIAN')
  STYLE
    ANTIALIAS false
    COLOR 254 229 178
    BACKGROUNDCOLOR 254 229 178
  END #style
END #class
CLASS
  NAME 'CISURALIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'CISURALIAN')
  STYLE
    ANTIALIAS false
```

```
    COLOR 241 88 101
    BACKGROUNDCOLOR 241 88 101
  END #style
END #class
CLASS
  #NAME 'CONIACIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'CONIACIAN')
  STYLE
    ANTIALIAS false
    COLOR 203 254 101
    BACKGROUNDCOLOR 203 254 101
  END #style
END #class
CLASS
  NAME 'CRETACEOUS'
  EXPRESSION ('[AGE_ONEGL]' eq 'CRETACEOUS')
  STYLE
    ANTIALIAS false
    COLOR 127 254 63
    BACKGROUNDCOLOR 127 254 63
  END #style
END #class
CLASS
  #NAME 'CRYOGENIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'CRYOGENIAN')
  STYLE
    ANTIALIAS false
    COLOR 254 203 101
    BACKGROUNDCOLOR 254 203 101
  END #style
END #class
CLASS
  #NAME 'DANIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'DANIAN')
  STYLE
    ANTIALIAS false
    COLOR 254 178 114
    BACKGROUNDCOLOR 254 178 114
  END #style
END #class
CLASS
  #NAME 'DARPINGIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'DARPINGIAN')
  STYLE
    ANTIALIAS false
    COLOR 101 254 152
    BACKGROUNDCOLOR 101 254 152
  END #style
END #class
CLASS
  NAME 'DARRIWILIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'DARRIWILIAN')
  STYLE
    ANTIALIAS false
    COLOR 114 254 165
    BACKGROUNDCOLOR 114 254 165
  END #style
END #class
CLASS
  NAME 'DEVONIAN'
```

```
  EXPRESSION ('[AGE_ONEGL]' eq 'DEVONIAN')
  STYLE
    ANTIALIAS false
    COLOR 203 152 63
    BACKGROUNDCOLOR 203 152 63
  END #style
END #class
CLASS
  #NAME 'DRUMIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'DRUMIAN')
  STYLE
    ANTIALIAS false
    COLOR 190 241 165
    BACKGROUNDCOLOR 190 241 165
  END #style
END #class
CLASS
  #NAME 'EAOARCHEAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'EAOARCHEAN')
  STYLE
    ANTIALIAS false
    COLOR 229 0 254
    BACKGROUNDCOLOR 229 0 254
  END #style
END #class
CLASS
  #NAME 'ECTASIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'ECTASIAN')
  STYLE
    ANTIALIAS false
    COLOR 254 203 152
    BACKGROUNDCOLOR 254 203 152
  END #style
END #class
CLASS
  #NAME 'EDICARIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'EDICARIAN')
  STYLE
    ANTIALIAS false
    COLOR 254 216 114
    BACKGROUNDCOLOR 254 216 114
  END #style
END #class
CLASS
  #NAME 'EIFELIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'EIFELIAN')
  STYLE
    ANTIALIAS false
    COLOR 241 216 127
    BACKGROUNDCOLOR 241 216 127
  END #style
END #class
CLASS
  NAME 'EMSIAN'

  EXPRESSION ('[AGE_ONEGL]' eq 'EMSIAN')
  STYLE
    ANTIALIAS false
    COLOR 229 216 127
    BACKGROUNDCOLOR 229 216 127
```

```
    END #style
  END #class
  CLASS
    NAME 'EOCENE'
    EXPRESSION ('[AGE_ONEGL]' eq 'EOCENE')
    STYLE
      ANTIALIAS false
      COLOR 254 178 127
      BACKGROUNDCOLOR 254 178 127
    END #style
  END #class
  CLASS
    NAME 'FAMENNIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'FAMENNIAN')
    STYLE
      ANTIALIAS false
      COLOR 241 241 203
      BACKGROUNDCOLOR 241 241 203
    END #style
  END #class
  CLASS
    #NAME 'FLOIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'FLOIAN')
    STYLE
      ANTIALIAS false
      COLOR 63 254 139
      BACKGROUNDCOLOR 63 254 139
    END #style
  END #class
  CLASS
    #NAME 'FORTUNIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'FORTUNIAN')
    STYLE
      ANTIALIAS false
      COLOR 152 216 127
      BACKGROUNDCOLOR 152 216 127
    END #style
  END #class
  CLASS
    #NAME 'FRASNIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'FRASNIAN')
    STYLE
      ANTIALIAS false
      COLOR 241 241 178
      BACKGROUNDCOLOR 241 241 178
    END #style
  END #class
  CLASS
    #NAME 'FURONGIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'FURONGIAN')
    STYLE
      ANTIALIAS false
      COLOR 178 254 152
      BACKGROUNDCOLOR 178 254 152
    END #style
  END #class
  CLASS
    #NAME 'GELASIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'GELASIAN')
    STYLE
```

```
    ANTIALIAS false
    COLOR 254 254 203
    BACKGROUNDCOLOR 254 254 203
  END #style
END #class
CLASS
  #NAME 'GHZELIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'GHZELIAN')
  STYLE
    ANTIALIAS false
    COLOR 203 229 216
    BACKGROUNDCOLOR 203 229 216
  END #style
END #class
CLASS
  #NAME 'GIVETIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'GIVETIAN')
  STYLE
    ANTIALIAS false
    COLOR 241 229 139
    BACKGROUNDCOLOR 241 229 139
  END #style
END #class
CLASS
  #NAME 'GORSTIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'GORSTIAN')
  STYLE
    ANTIALIAS false
    COLOR 203 254 229
    BACKGROUNDCOLOR 203 254 229
  END #style
END #class
CLASS
  #NAME 'GUADALUPIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'GUADALUPIAN')
  STYLE
    ANTIALIAS false
    COLOR 254 114 127
    BACKGROUNDCOLOR 254 114 127
  END #style
END #class
CLASS
  #NAME 'GUZHANGIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'GUZHANGIAN')
  STYLE
    ANTIALIAS false
    COLOR 203 241 178
    BACKGROUNDCOLOR 203 241 178
  END #style
END #class
CLASS
  #NAME 'HADEAN (INFORMAL)'
  EXPRESSION ('[AGE_ONEGL]' eq 'HADEAN (INFORMAL)')
  STYLE
    ANTIALIAS false
    COLOR 254 76 190
    BACKGROUNDCOLOR 254 76 190
  END #style
END #class
CLASS
```

```
  #NAME 'HAUTERIVIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'HAUTERIVIAN')
  STYLE
    ANTIALIAS false
    COLOR 165 254 114
    BACKGROUNDCOLOR 165 254 114
  END #style
END #class
CLASS
  #NAME 'HETTANGIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'HETTANGIAN')
  STYLE
    ANTIALIAS false
    COLOR 76 241 254
    BACKGROUNDCOLOR 76 241 254
  END #style
END #class
CLASS
  #NAME 'HIRNANTIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'HIRNANTIAN')
  STYLE
    ANTIALIAS false
    COLOR 165 254 178
    BACKGROUNDCOLOR 165 254 178
  END #style
END #class
CLASS
  #NAME 'HOLOCENE'
  EXPRESSION ('[AGE_ONEGL]' eq 'HOLOCENE')
  STYLE
    ANTIALIAS false
    COLOR 254 241 241
    BACKGROUNDCOLOR 254 241 241
  END #style
END #class
CLASS
  #NAME 'HOMERIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'HOMERIAN')
  STYLE
    ANTIALIAS false
    COLOR 203 254 216
    BACKGROUNDCOLOR 203 254 216
  END #style
END #class
CLASS
  #NAME 'INDUAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'INDUAN')
  STYLE
    ANTIALIAS false
    COLOR 165 76 254
    BACKGROUNDCOLOR 165 76 254
  END #style
END #class
CLASS
  NAME 'JURASSIC'
  EXPRESSION ('[AGE_ONEGL]' eq 'JURASSIC')
  STYLE
    ANTIALIAS false
    COLOR 50 241 254
    BACKGROUNDCOLOR 50 241 254
```

```
    END #style
  END #class
  CLASS
    #NAME 'KASIMOVIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'KASIMOVIAN')
    STYLE
      ANTIALIAS false
      COLOR 190 229 216
      BACKGROUNDCOLOR 190 229 216
    END #style
  END #class
  CLASS
    #NAME 'KATIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'KATIAN')
    STYLE
      ANTIALIAS false
      COLOR 152 254 165
      BACKGROUNDCOLOR 152 254 165
    END #style
  END #class
  CLASS
    #NAME 'KIMMERIDGIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'KIMMERIDGIAN')
    STYLE
      ANTIALIAS false
      COLOR 203 254 254
      BACKGROUNDCOLOR 203 254 254
    END #style
  END #class
  CLASS
    #NAME 'KUNGURIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'KUNGURIAN')
    STYLE
      ANTIALIAS false
      COLOR 229 139 152
      BACKGROUNDCOLOR 229 139 152
    END #style
  END #class
  CLASS
    #NAME 'LADINIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'LADINIAN')
    STYLE
      ANTIALIAS false
      COLOR 203 139 254
      BACKGROUNDCOLOR 203 139 254
    END #style
  END #class
  CLASS
    #NAME 'LANGHIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'LANGHIAN')
    STYLE
      ANTIALIAS false
      COLOR 254 254 76
      BACKGROUNDCOLOR 254 254 76
    END #style
  END #class
  CLASS
    NAME 'LLANDOVERY'
    EXPRESSION ('[AGE_ONEGL]' eq 'LLANDOVERY')
    STYLE
```

```
    ANTIALIAS false
    COLOR 152 254 190
    BACKGROUNDCOLOR 152 254 190
  END #style
END #class
CLASS
  #NAME 'LOCHKOVIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'LOCHKOVIAN')
  STYLE
    ANTIALIAS false
    COLOR 229 190 101
    BACKGROUNDCOLOR 229 190 101
  END #style
END #class
CLASS
  NAME 'LOPINGIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'LOPINGIAN')
  STYLE
    ANTIALIAS false
    COLOR 254 165 178
    BACKGROUNDCOLOR 254 165 178
  END #style
END #class
CLASS
  NAME 'LOWER CAMBRIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'LOWER CAMBRIAN')
  STYLE
    ANTIALIAS false
    COLOR 139 216 114
    BACKGROUNDCOLOR 139 216 114
  END #style
END #class
CLASS
  NAME 'LOWER CRETACEOUS'
  EXPRESSION ('[AGE_ONEGL]' eq 'LOWER CRETACEOUS')
  STYLE
    ANTIALIAS false
    COLOR 139 254 76
    BACKGROUNDCOLOR 139 254 76
  END #style
END #class
CLASS
  NAME 'LOWER DEVONIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'LOWER DEVONIAN')
  STYLE
    ANTIALIAS false
    COLOR 229 178 88
    BACKGROUNDCOLOR 229 178 88
  END #style
END #class
CLASS
  #NAME 'LOWER JURASSIC'
  EXPRESSION ('[AGE_ONEGL]' eq 'LOWER JURASSIC')
  STYLE
    ANTIALIAS false
    COLOR 63 241 254
    BACKGROUNDCOLOR 63 241 254
  END #style
END #class
CLASS
```

```
  #NAME 'LOWER MISSISSIPPIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'LOWER MISSISSIPPIAN')
  STYLE
    ANTIALIAS false
    COLOR 127 216 114
    BACKGROUNDCOLOR 127 216 114
  END #style
END #class
CLASS
  #NAME 'LOWER ORDOVICIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'LOWER ORDOVICIAN')
  STYLE
    ANTIALIAS false
    COLOR 25 254 101
    BACKGROUNDCOLOR 25 254 101
  END #style
END #class
CLASS
  #NAME 'LOWER PENNSYLVANIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'LOWER PENNSYLVANIAN')
  STYLE
    ANTIALIAS false
    COLOR 139 229 203
    BACKGROUNDCOLOR 139 229 203
  END #style
END #class
CLASS
  #NAME 'LOWER PLEISTOCENE'
  EXPRESSION ('[AGE_ONEGL]' eq 'LOWER PLEISTOCENE')
  STYLE
    ANTIALIAS false
    COLOR 254 241 190
    BACKGROUNDCOLOR 254 241 190
  END #style
END #class
CLASS
  #NAME 'LOWER TRIASSIC'
  EXPRESSION ('[AGE_ONEGL]' eq 'LOWER TRIASSIC')
  STYLE
    ANTIALIAS false
    COLOR 152 63 254
    BACKGROUNDCOLOR 152 63 254
  END #style
END #class
CLASS
  #NAME 'LUDFORDIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'LUDFORDIAN')
  STYLE
    ANTIALIAS false
    COLOR 216 254 229
    BACKGROUNDCOLOR 216 254 229
  END #style
END #class
CLASS
  NAME 'LUDLOW'
  EXPRESSION ('[AGE_ONEGL]' eq 'LUDLOW')
  STYLE
    ANTIALIAS false
    COLOR 190 254 216
    BACKGROUNDCOLOR 190 254 216
```

```
    END #style
  END #class
  CLASS
    #NAME 'LUTETIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'LUTETIAN')
    STYLE
      ANTIALIAS false
      COLOR 254 178 152
      BACKGROUNDCOLOR 254 178 152
    END #style
  END #class
  CLASS
    #NAME 'MAASTRICHTIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'MAASTRICHTIAN')
    STYLE
      ANTIALIAS false
      COLOR 241 254 139
      BACKGROUNDCOLOR 241 254 139
    END #style
  END #class
  CLASS
    #NAME 'MESOARCHEAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'MESOARCHEAN')
    STYLE
      ANTIALIAS false
      COLOR 254 101 241
      BACKGROUNDCOLOR 254 101 241
    END #style
  END #class
  CLASS
    NAME 'MESOPROTEROZOIC'
    EXPRESSION ('[AGE_ONEGL]' eq 'MESOPROTEROZOIC')
    STYLE
      ANTIALIAS false
      COLOR 254 178 114
      BACKGROUNDCOLOR 254 178 114
    END #style
  END #class
  CLASS
    NAME 'MESOZOIC'
    EXPRESSION ('[AGE_ONEGL]' eq 'MESOZOIC')
    STYLE
      ANTIALIAS false
      COLOR 101 254 229
      BACKGROUNDCOLOR 101 254 229
    END #style
  END #class
  CLASS
    #NAME 'MESSINIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'MESSINIAN')
    STYLE
      ANTIALIAS false
      COLOR 254 254 114
      BACKG ROUNDCOLOR 254 254 114
    END #style
  END #class
  CLASS
    NAME 'MIDDLE CAMBRIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'MIDDLE CAMBRIAN')
    STYLE
```

```
    ANTIALIAS false
    COLOR 165 241 139
    BACKGROUNDCOLOR 165 241 139
  END #style
END #class
CLASS
  NAME 'MIDDLE DEVONIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'MIDDLE DEVONIAN')
  STYLE
    ANTIALIAS false
    COLOR 241 203 114
    BACKGROUNDCOLOR 241 203 114
  END #style
END #class
CLASS
  NAME 'MIDDLE JURASSIC'
  EXPRESSION ('[AGE_ONEGL]' eq 'MIDDLE JURASSIC')
  STYLE
    ANTIALIAS false
    COLOR 127 254 241
    BACKGROUNDCOLOR 127 254 241
  END #style
END #class
CLASS
  #NAME 'MIDDLE MISSISSIPPIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'MIDDLE MISSISSIPPIAN')
  STYLE
    ANTIALIAS false
    COLOR 152 216 114
    BACKGROUNDCOLOR 152 216 114
  END #style
END #class
CLASS
  #NAME 'MIDDLE ORDOVICIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'MIDDLE ORDOVICIAN')
  STYLE
    ANTIALIAS false
    COLOR 76 254 127
    BACKGROUNDCOLOR 76 254 127
  END #style
END #class
CLASS
  #NAME 'MIDDLE PENNSYLVANIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'MIDDLE PENNSYLVANIAN')
  STYLE
    ANTIALIAS false
    COLOR 165 229 203
    BACKGROUNDCOLOR 165 229 203
  END #style
END #class
CLASS
  #NAME 'MIDDLE PLEISTOCENE'
  EXPRESSION ('[AGE_ONEGL]' eq 'MIDDLE PLEISTOCENE')
  STYLE
    ANTIALIAS false
    COLOR 254 241 203
    BACKGROUNDCOLOR 254 241 203
  END #style
END #class
CLASS
```

```
  #NAME 'MIDDLE TRIASSIC'
  EXPRESSION ('[AGE_ONEGL]' eq 'MIDDLE TRIASSIC')
  STYLE
    ANTIALIAS false
    COLOR 178 114 254
    BACKGROUNDCOLOR 178 114 254
  END #style
END #class
CLASS
  #NAME 'MIOCENE'
  EXPRESSION ('[AGE_ONEGL]' eq 'MIOCENE')
  STYLE
    ANTIALIAS false
    COLOR 254 254 0
    BACKGROUNDCOLOR 254 254 0
  END #style
END #class
CLASS
  NAME 'MISSISSIPPIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'MISSISSIPPIAN')
  STYLE
    ANTIALIAS false
    COLOR 101 190 114
    BACKGROUNDCOLOR 101 190 114
  END #style
END #class
CLASS
  NAME 'MOSCOVIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'MOSCOVIAN')
  STYLE
    ANTIALIAS false
    COLOR 178 229 203
    BACKGROUNDCOLOR 178 229 203
  END #style
END #class
CLASS
  #NAME 'NEOARCHEAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'NEOARCHEAN')
  STYLE
    ANTIALIAS false
    COLOR 254 152 241
    BACKGROUNDCOLOR 254 152 241
  END #style
END #class
CLASS
  NAME 'NEOGENE'
  EXPRESSION ('[AGE_ONEGL]' eq 'NEOGENE')
  STYLE
    ANTIALIAS false
    COLOR 254 229 0
    BACKGROUNDCOLOR 254 229 0
  END #style
END #class
CLASS
  NAME 'NEOPROTEROZOIC'
  EXPRESSION ('[AGE_ONEGL]' eq 'NEOPROTEROZOIC')
  STYLE
    ANTIALIAS false
    COLOR 254 178 76
    BACKGROUNDCOLOR 254 178 76
```

```
    END #style
  END #class
  CLASS
    #NAME 'NORIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'NORIAN')
    STYLE
      ANTIALIAS false
      COLOR 216 178 254
      BACKGROUNDCOLOR 216 178 254
    END #style
  END #class
  CLASS
    NAME 'NOT APPLICABLE'
    EXPRESSION ('[AGE_ONEGL]' eq 'NOT APPLICABLE')
    STYLE
      ANTIALIAS false
      COLOR 178 178 178
      BACKGROUNDCOLOR 178 178 178
    END #style
  END #class
  CLASS
    NAME 'No Data Entered'
    EXPRESSION ('[AGE_ONEGL]' eq 'No Data Entered')
    STYLE
      ANTIALIAS false
      COLOR 178 178 178
      BACKGROUNDCOLOR 178 178 178
    END #style
  END #class
  CLASS
    #NAME 'OLENEKIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'OLENEKIAN')
    STYLE
      ANTIALIAS false
      COLOR 178 88 254
      BACKGROUNDCOLOR 178 88 254
    END #style
  END #class
  CLASS
    NAME 'OLIGOCENE'
    EXPRESSION ('[AGE_ONEGL]' eq 'OLIGOCENE')
    STYLE
      ANTIALIAS false
      COLOR 254 190 139
      BACKGROUNDCOLOR 254 190 139
    END #style
  END #class
  CLASS
    NAME 'ORDOVICIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'ORDOVICIAN')
    STYLE
      ANTIALIAS false
      COLOR 0 254 101
      BACKGROUNDCOLOR 0 254 101
    END #style
  END #class
  CLASS
    #NAME 'OROSIRIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'OROSIRIAN')
    STYLE
```

```
    ANTIALIAS false
    COLOR 254 101 216
    BACKGROUNDCOLOR 254 101 216
  END #style
END #class
CLASS
  NAME 'OXFORDIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'OXFORDIAN')
  STYLE
    ANTIALIAS false
    COLOR 190 254 254
    BACKGROUNDCOLOR 190 254 254
  END #style
END #class
CLASS
  #NAME 'PAIBIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'PAIBIAN')
  STYLE
    ANTIALIAS false
    COLOR 203 254 178
    BACKGROUNDCOLOR 203 254 178
  END #style
END #class
CLASS
  #NAME 'PALEOARCHEAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'PALEOARCHEAN')
  STYLE
    ANTIALIAS false
    COLOR 254 63 254
    BACKGROUNDCOLOR 254 63 254
  END #style
END #class
CLASS
  NAME 'PALEOCENE'
  EXPRESSION ('[AGE_ONEGL]' eq 'PALEOCENE')
  STYLE
    ANTIALIAS false
    COLOR 254 165 114
    BACKGROUNDCOLOR 254 165 114
  END #style
END #class
CLASS
  NAME 'PALEOGENE'
  EXPRESSION ('[AGE_ONEGL]' eq 'PALEOGENE')
  STYLE
    ANTIALIAS false
    COLOR 254 152 101
    BACKGROUNDCOLOR 254 152 101
  END #style
END #class
CLASS
  NAME 'PALEOPROTEROZOIC'
  EXPRESSION ('[AGE_ONEGL]' eq 'PALEOPROTEROZOIC')
  STYLE
    ANTIALIAS false
    COLOR 254 63 178
    BACKGROUNDCOLOR 254 63 178
  END #style
END #class
CLASS
```

```
  NAME 'PALEOZOIC'
  EXPRESSION ('[AGE_ONEGL]' eq 'PALEOZOIC')
  STYLE
    ANTIALIAS false
    COLOR 152 229 152
    BACKGROUNDCOLOR 152 229 152
  END #style
END #class
CLASS
  NAME 'PENNSYLVANIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'PENNSYLVANIAN')
  STYLE
    ANTIALIAS false
    COLOR 152 229 203
    BACKGROUNDCOLOR 152 229 203
  END #style
END #class
CLASS
  NAME 'PERMIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'PERMIAN')
  STYLE
    ANTIALIAS false
    COLOR 241 63 63
    BACKGROUNDCOLOR 241 63 63
  END #style
END #class
CLASS
  NAME 'PHANEROZOIC'
  EXPRESSION ('[AGE_ONEGL]' eq 'PHANEROZOIC')
  STYLE
    ANTIALIAS false
    COLOR 152 254 241
    BACKGROUNDCOLOR 152 254 241
  END #style
END #class
CLASS
  #NAME 'PIACENZIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'PIACENZIAN')
  STYLE
    ANTIALIAS false
    COLOR 254 254 190
    BACKGROUNDCOLOR 254 254 190
  END #style
END #class
CLASS
  #NAME 'PLEISTOCENE'
  EXPRESSION ('[AGE_ONEGL]' eq 'PLEISTOCENE')
  STYLE
    ANTIALIAS false
    COLOR 254 241 178
    BACKGROUNDCOLOR 254 241 178
  END #style
END #class
CLASS
  #NAME 'PLIENSBACHIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'PLIENSBACHIAN')
  STYLE
    ANTIALIAS false
    COLOR 127 241 254
    BACKGROUNDCOLOR 127 241 254
```

```
    END #style
  END #class
  CLASS
    #NAME 'PLIOCENE'
    EXPRESSION ('[AGE_ONEGL]' eq 'PLIOCENE')
    STYLE
      ANTIALIAS false
      COLOR 254 254 152
      BACKGROUNDCOLOR 254 254 152
    END #style
  END #class
  CLASS
    #NAME 'PRAGIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'PRAGIAN')
    STYLE
      ANTIALIAS false
      COLOR 229 203 114
      BACKGROUNDCOLOR 229 203 114
    END #style
  END #class
  CLASS
    NAME 'PRECAMBRIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'PRECAMBRIAN')
    STYLE
      ANTIALIAS false
      COLOR 254 63 178
      BACKGROUNDCOLOR 254 63 178
    END #style
  END #class
  CLASS
    #NAME 'PRIABONIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'PRIABONIAN')
    STYLE
      ANTIALIAS false
      COLOR 254 203 178
      BACKGROUNDCOLOR 254 203 178
    END #style
  END #class
  CLASS
    NAME 'PRIDOLI'
    EXPRESSION ('[AGE_ONEGL]' eq 'PRIDOLI')
    STYLE
      ANTIALIAS false
      COLOR 229 254 229
      BACKGROUNDCOLOR 229 254 229
    END #style
  END #class
  CLASS
    NAME 'PROTEROZOIC'
    EXPRESSION ('[AGE_ONEGL]' eq 'PROTEROZOIC')
    STYLE
      ANTIALIAS false
      COLOR 254 50 165
      BACKGROUNDCOLOR 254 50 165
    END #style
  END #class
  CLASS
    #NAME 'QUATERNARY'
    EXPRESSION ('[AGE_ONEGL]' eq 'QUATERNARY')
    STYLE
```

```
    ANTIALIAS false
    COLOR 254 254 127
    BACKGROUNDCOLOR 254 254 127
  END #style
END #class
CLASS
  #NAME 'RHAETIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'RHAETIAN')
  STYLE
    ANTIALIAS false
    COLOR 229 190 254
    BACKGROUNDCOLOR 229 190 254
  END #style
END #class
CLASS
  #NAME 'RHUDDANIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'RHUDDANIAN')
  STYLE
    ANTIALIAS false
    COLOR 190 254 190
    BACKGROUNDCOLOR 190 254 190
  END #style
END #class
CLASS
  #NAME 'RHYACIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'RHYACIAN')
  STYLE
    ANTIALIAS false
    COLOR 254 88 203
    BACKGROUNDCOLOR 254 88 203
  END #style
END #class
CLASS
  #NAME 'ROADIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'ROADIAN')
  STYLE
    ANTIALIAS false
    COLOR 254 127 139
    BACKGROUNDCOLOR 254 127 139
  END #style
END #class
CLASS
  #NAME 'RUPELIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'RUPELIAN')
  STYLE
    ANTIALIAS false
    COLOR 254 216 165
    BACKGROUNDCOLOR 254 216 165
  END #style
END #class
CLASS
  #NAME 'SAKMARIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'SAKMARIAN')
  STYLE
    ANTIALIAS false
    COLOR 229 114 127
    BACKGROUNDCOLOR 229 114 127
  END #style
END #class
CLASS
```

```
  #NAME 'SANDBIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'SANDBIAN')
  STYLE
    ANTIALIAS false
    COLOR 139 254 152
    BACKGROUNDCOLOR 139 254 152
  END #style
END #class
CLASS
  #NAME 'SANTONIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'SANTONIAN')
  STYLE
    ANTIALIAS false
    COLOR 216 254 114
    BACKGROUNDCOLOR 216 254 114
  END #style
END #class
CLASS
  #NAME 'SELANDIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'SELANDIAN')
  STYLE
    ANTIALIAS false
    COLOR 254 190 114
    BACKGROUNDCOLOR 254 190 114
  END #style
END #class
CLASS
  #NAME 'SERPUKHOVIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'SERPUKHOVIAN')
  STYLE
    ANTIALIAS false
    COLOR 190 216 114
    BACKGROUNDCOLOR 190 216 114
  END #style
END #class
CLASS
  #NAME 'SERRAVALIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'SERRAVALIAN')
  STYLE
    ANTIALIAS false
    COLOR 254 254 88
    BACKGROUNDCOLOR 254 254 88
  END #style
END #class
CLASS
  #NAME 'SHEINWOODIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'SHEINWOODIAN')
  STYLE
    ANTIALIAS false
    COLOR 190 254 203
    BACKGROUNDCOLOR 190 254 203
  END #style
END #class
CLASS
  #NAME 'SIDERIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'SIDERIAN')
  STYLE
    ANTIALIAS false
    COLOR 254 76 190
    BACKGROUNDCOLOR 254 76 190
```

```
    END #style
  END #class
  CLASS
    NAME 'SILURIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'SILURIAN')
    STYLE
      ANTIALIAS false
      COLOR 178 254 190
      BACKGROUNDCOLOR 178 254 190
    END #style
  END #class
  CLASS
    #NAME 'SINEMURIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'SINEMURIAN')
    STYLE
      ANTIALIAS false
      COLOR 101 241 254
      BACKGROUNDCOLOR 101 241 254
    END #style
  END #class
  CLASS
    #NAME 'STATHERIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'STATHERIAN')
    STYLE
      ANTIALIAS false
      COLOR 254 114 229
      BACKGROUNDCOLOR 254 114 229
    END #style
  END #class
  CLASS
    #NAME 'STENIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'STENIAN')
    STYLE
      ANTIALIAS false
      COLOR 254 216 165
      BACKGROUNDCOLOR 254 216 165
    END #style
  END #class
  CLASS
    #NAME 'TELYCHIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'TELYCHIAN')
    STYLE
      ANTIALIAS false
      COLOR 190 254 216
      BACKGROUNDCOLOR 190 254 216
    END #style
  END #class
  CLASS
    #NAME 'TERRENEUVIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'TERRENEUVIAN')
    STYLE
      ANTIALIAS false
      COLOR 139 216 114
      BACKGROUNDCOLOR 139 216 114
    END #style
  END #class
  CLASS
    NAME 'THANETIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'THANETIAN')
    STYLE
```

```
    ANTIALIAS false
    COLOR 254 190 127
    BACKGROUNDCOLOR 254 190 127
  END #style
END #class
CLASS
  #NAME 'TITHONIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'TITHONIAN')
  STYLE
    ANTIALIAS false
    COLOR 216 254 254
    BACKGROUNDCOLOR 216 254 254
  END #style
END #class
CLASS
  #NAME 'TOARCIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'TOARCIAN')
  STYLE
    ANTIALIAS false
    COLOR 152 241 254
    BACKGROUNDCOLOR 152 241 254
  END #style
END #class
CLASS
  #NAME 'TONIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'TONIAN')
  STYLE
    ANTIALIAS false
    COLOR 254 190 88
    BACKGROUNDCOLOR 254 190 88
  END #style
END #class
CLASS
  #NAME 'TORTONIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'TORTONIAN')
  STYLE
    ANTIALIAS false
    COLOR 254 254 101
    BACKGROUNDCOLOR 254 254 101
  END #style
END #class
CLASS
  NAME 'TOURNAISIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'TOURNAISIAN')
  STYLE
    ANTIALIAS false
    COLOR 139 216 114
    BACKGROUNDCOLOR 139 216 114
  END #style
END #class
CLASS
  NAME 'TREMADOCIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'TREMADOCIAN')
  STYLE
    ANTIALIAS false
    COLOR 50 254 127
    BACKGROUNDCOLOR 50 254 127
  END #style
END #class
CLASS
```

```
  NAME 'TRIASSIC'
  EXPRESSION ('[AGE_ONEGL]' eq 'TRIASSIC')
  STYLE
    ANTIALIAS false
    COLOR 127 50 254
    BACKGROUNDCOLOR 127 50 254
  END #style
END #class
CLASS
  #NAME 'TURONIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'TURONIAN')
  STYLE
    ANTIALIAS false
    COLOR 190 254 88
    BACKGROUNDCOLOR 190 254 88
  END #style
END #class
CLASS
  #NAME 'UNKNOWN'
  EXPRESSION ('[AGE_ONEGL]' eq 'UNKNOWN')
  STYLE
    ANTIALIAS false
    COLOR 254 254 254
    BACKGROUNDCOLOR 254 254 254
  END #style
END #class
CLASS
  NAME 'UPPER CRETACEOUS'
  EXPRESSION ('[AGE_ONEGL]' eq 'UPPER CRETACEOUS')
  STYLE
    ANTIALIAS false
    COLOR 165 254 63
    BACKGROUNDCOLOR 165 254 63
  END #style
END #class
CLASS
  NAME 'UPPER DEVONIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'UPPER DEVONIAN')
  STYLE
    ANTIALIAS false
    COLOR 241 229 165
    BACKGROUNDCOLOR 241 229 165
  END #style
END #class
CLASS
  NAME 'UPPER JURASSIC'
  EXPRESSION ('[AGE_ONEGL]' eq 'UPPER JURASSIC')
  STYLE
    ANTIALIAS false
    COLOR 178 254 254
    BACKGROUNDCOLOR 178 254 254
  END #style
END #class
CLASS
  #NAME 'UPPER MISSISSIPPIAN'
  EXPRESSION ('[AGE_ONEGL]' eq 'UPPER MISSISSIPPIAN')
  STYLE
    ANTIALIAS false
    COLOR 178 216 114
    BACKGROUNDCOLOR 178 216 114
```

```
    END #style
  END #class
  CLASS
    NAME 'UPPER ORDOVICIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'UPPER ORDOVICIAN')
    STYLE
      ANTIALIAS false
      COLOR 127 254 152
      BACKGROUNDCOLOR 127 254 152
    END #style
  END #class
  CLASS
    #NAME 'UPPER PENNSYLVANIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'UPPER PENNSYLVANIAN')
    STYLE
      ANTIALIAS false
      COLOR 190 229 203
      BACKGROUNDCOLOR 190 229 203
    END #style
  END #class
  CLASS
    #NAME 'UPPER PLEISTOCENE'
    EXPRESSION ('[AGE_ONEGL]' eq 'UPPER PLEISTOCENE')
    STYLE
      ANTIALIAS false
      COLOR 254 241 216
      BACKGROUNDCOLOR 254 241 216
    END #style
  END #class
  CLASS
    #NAME 'UPPER TRIASSIC'
    EXPRESSION ('[AGE_ONEGL]' eq 'UPPER TRIASSIC')
    STYLE
      ANTIALIAS false
      COLOR 190 152 254
      BACKGROUNDCOLOR 190 152 254
    END #style
  END #class
  CLASS
    #NAME 'VALANGINIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'VALANGINIAN')
    STYLE
      ANTIALIAS false
      COLOR 152 254 101
      BACKGROUNDCOLOR 152 254 101
    END #style
  END #class
  CLASS
    #NAME 'VISEAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'VISEAN')
    STYLE
      ANTIALIAS false
      COLOR 165 216 114
      BACKGROUNDCOLOR 165 216 114
    END #style
  END #class
  CLASS
    NAME 'WENLOCK'
    EXPRESSION ('[AGE_ONEGL]' eq 'WENLOCK')
    STYLE
```

```
      ANTIALIAS false
      COLOR 178 254 203
      BACKGROUNDCOLOR 178 254 203
    END #style
  END #class
  CLASS
    #NAME 'WORDIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'WORDIAN')
    STYLE
      ANTIALIAS false
      COLOR 254 139 152
      BACKGROUNDCOLOR 254 139 152
    END #style
  END #class
  CLASS
    #NAME 'WUCHIAPINGIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'WUCHIAPINGIAN')
    STYLE
      ANTIALIAS false
      COLOR 254 178 190
      BACKGROUNDCOLOR 254 178 190
    END #style
  END #class
  CLASS
    #NAME 'YPRESIAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'YPRESIAN')
    STYLE
      ANTIALIAS false
      COLOR 254 165 139
      BACKGROUNDCOLOR 254 165 139
    END #style
  END #class
  CLASS
    #NAME 'ZANCLEAN'
    EXPRESSION ('[AGE_ONEGL]' eq 'ZANCLEAN')
    STYLE
      ANTIALIAS false
      COLOR 254 254 178
      BACKGROUNDCOLOR 254 254 178
    END #style
  END #class
END #layer
LAYER
### GROUP SUPERFGEOL
  NAME GBR_BGS_625k_SLT
  TYPE POLYGON
  STATUS ON
  DATA superficial625ll
  TRANSPARENCY 100
  TOLERANCE 0
  TOLERANCEUNITS pixels
  TRANSFORM TRUE
  DUMP TRUE
  PROCESSING "CLOSE_CONNECTION=DEFER"
  HEADER "templates/superficial_lithology_query_header.html"
  TEMPLATE "templates/superficial_lithology_query_body.html"
  FOOTER "templates/superficial_lithology_query_footer.html"
  PROJECTION
    "init=epsg:4326"
  END
```

```
    METADATA
##### WMS_GROUP_TITLE "Superficial geology layers"
##### WMS_GROUP_ABSTRACT "Group abstract for superficial geology layers, see individual
      layer abstracts for details about the individual layers"
      OWS_TITLE "GBR BGS 1:625k Superficial Lithology"
      OWS_ABSTRACT "GBR BGS 1:625k scale Superficial Deposits Lithology"
      WMS_SRS "EPSG:4326 EPSG:3857 CRS:84 EPSG:27700 EPSG:4258"
      GML_INCLUDE_ITEMS "ROCK_D"
      GML_FEATUREID "ID"
      WMS_INCLUDE_ITEMS "ROCK_D"
      WMS_METADATAURL_HREF "http://.../geonetwork/srv/en/csw?SERVICE=CSW&VERSION=2.0.2&
      REQUEST=GetRecordById&ID=2d759ad4-c547-4705-96c6-d5847c530ddd&"
      WMS_METADATAURL_FORMAT "application/xml;charset=UTF-8"
      WMS_METADATAURL_TYPE "TC211"
      OWS_DATAURL_HREF "http://www.bgs.ac.uk/discoverymetadata/13480426.html"
      OWS_DATAURL_FORMAT "text/html"
      OWS_KEYWORDLIST "OneGeology,superficial,lithology,continent@Europe,
      subcontinent@Northern Europe,geographicarea@United Kingdom,geology,
      dataprovider@British Geological Survey,serviceprovider@British Geological Survey,
      DS_TOPIC@geoscientificInformation,DS_DATE@2011-06-15"
    END
    CLASSITEM 'ROCK_D'
    CLASS
      NAME 'CLAY'
      EXPRESSION 'CLAY'
      STYLE
        COLOR 219 237 201
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
      NAME 'CLAY, SILT AND SAND'
      EXPRESSION 'CLAY, SILT AND SAND'
      STYLE
        COLOR 255 201 147
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
      NAME 'DIAMICTON'
      EXPRESSION 'DIAMICTON'
      STYLE
        COLOR 219 175 175
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
      NAME 'PEAT'
      EXPRESSION 'PEAT'
      STYLE
        COLOR 219 175 117
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
      NAME 'SAND'
      EXPRESSION 'SAND'
      STYLE
        COLOR 255 201 147
        BACKGROUNDCOLOR 255 255 255
```

```
      END #style
    END #class
    CLASS
      NAME 'SAND AND GRAVEL'
      EXPRESSION 'SAND AND GRAVEL'
      STYLE
        COLOR 255 201 255
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
      NAME 'SILT'
      EXPRESSION 'SILT'
      STYLE
        COLOR 255 255 175
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
      NAME 'UNKNOWN LITHOLOGY'
      EXPRESSION 'UNKNOWN LITHOLOGY'
      STYLE
        COLOR 175 201 237
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
#~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
# Note: The following DUMMY CLASSes have been added as a
# quick hack to get around a bug we found in Google Earth
# WMS visualization. It should not affect you unless you
# have 16 or fewer classes in one of your layers.
#
# If you have fewer than 16 classes Mapserver may send the
# image as a 4-bit PNG file. It seems that Google Earth
# doesn't (as of Jan 2008) handle transparent areas properly
# with 4-bit images so we have added the extra classes to
# force sending an 8-bit image. (Not necessarily the best
# way of achieving this.)
#~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
    CLASS
      EXPRESSION 'DUMMY CLASS 1'
      STYLE
        COLOR 1 1 1
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
    EXPRESSION 'DUMMY CLASS 2'
      STYLE
        COLOR 2 2 2
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
    EXPRESSION 'DUMMY CLASS 3'
      STYLE
        COLOR 3 3 3
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
```

```
    CLASS
      EXPRESSION 'DUMMY CLASS 4'
      STYLE
        COLOR 4 4 4
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
    EXPRESSION 'DUMMY CLASS 5'
      STYLE
        COLOR 5 5 5
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
    EXPRESSION 'DUMMY CLASS 6'
      STYLE
        COLOR 6 6 6
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
    EXPRESSION 'DUMMY CLASS 7'
      STYLE
        COLOR 7 7 7
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
      EXPRESSION 'DUMMY CLASS 8'
      STYLE
        COLOR 8 8 8
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
      EXPRESSION 'DUMMY CLASS 9'
      STYLE
        COLOR 9 9 9
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
      EXPRESSION 'DUMMY CLASS 10'
      STYLE
        COLOR 10 10 10
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
  END #layer
  LAYER
#### GROUP SUPERFGEOL
     NAME GBR_BGS_625k_SLS
     TYPE POLYGON
     STATUS ON
     DATA superficial625ll
     TRANSPARENCY 100
     TOLERANCE 0
     TOLERANCEUNITS pixels
     TRANSFORM TRUE
```

```
DUMP TRUE
PROCESSING "CLOSE_CONNECTION=DEFER"
HEADER "templates/superficial_lithostratigraphy_query_header.html"
TEMPLATE "templates/superficial_lithostratigraphy_query_body.html"
FOOTER "templates/superficial_lithostratigraphy_query_footer.html"
PROJECTION
  "init=epsg:4326"
END
METADATA
  OWS_TITLE "GBR BGS 1:625k Superficial Lithostratigraphy"
  OWS_ABSTRACT "GBR BGS 1:625k scale Superficial Deposits Lithostratigraphy
  (including Lithomorphogenetic units)"
  WMS_SRS "EPSG:4326 EPSG:3857 CRS:84 EPSG:27700 EPSG:4258"
  GML_INCLUDE_ITEMS "LEX_ROCK_D"
  GML_FEATUREID "ID"
  WMS_INCLUDE_ITEMS "LEX_ROCK_D"
  WMS_METADATAURL_HREF "http://.../geonetwork/srv/en/csw?SERVICE=CSW&VERSION=2.0.2&
  REQUEST=GetRecordById&ID=2d759ad4-c547-4705-96c6-d5847c530ddd&"
  WMS_METADATAURL_FORMAT "application/xml;charset=UTF-8"
  WMS_METADATAURL_TYPE "TC211"
  OWS_DATAURL_HREF "http://www.bgs.ac.uk/products/digitalmaps/digmapgb_625.html"
  OWS_DATAURL_FORMAT "text/html"
  OWS_KEYWORDLIST "OneGeology,superficial,lithostratigraphy,continent@Europe,
  subcontinent@Northern Europe,geographicarea@United Kingdom,geology,
  dataprovider@British Geological Survey,serviceprovider@British Geological Survey,
  DS_TOPIC@geoscientificInformation,DS_DATE@2011-06-15"
END
CLASSITEM 'LEX_ROCK_D'
CLASS
 NAME 'ALLUVIUM (CLAY, SILT AND SAND)'
 EXPRESSION 'ALLUVIUM (CLAY, SILT AND SAND)'
   STYLE
    COLOR 255 255 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'BLOWN SAND'
 EXPRESSION 'BLOWN SAND'
   STYLE
    COLOR 255 255 237
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'BRICKEARTH (SILT)'
 EXPRESSION 'BRICKEARTH (SILT)'
   STYLE
    COLOR 255 147 0
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'CLAY-WITH-FLINTS (DIAMICTON)'
 EXPRESSION 'CLAY-WITH-FLINTS (DIAMICTON)'
   STYLE
    COLOR 201 147 84
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
```

```
CLASS
 NAME 'CRAG GROUP (SAND AND GRAVEL)'
 EXPRESSION 'CRAG GROUP (SAND AND GRAVEL)'
   STYLE
    COLOR 255 84 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'GLACIAL SAND AND GRAVEL'
 EXPRESSION 'GLACIAL SAND AND GRAVEL'
   STYLE
    COLOR 255 175 255
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'LACUSTRINE DEPOSITS - UNDIFFERENTIATED (CLAY)'
  EXPRESSION 'LACUSTRINE DEPOSITS - UNDIFFERENTIATED (CLAY)'
   STYLE
    COLOR 237 201 147
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'LANDSLIP'
 EXPRESSION 'LANDSLIP'
   STYLE
    COLOR 255 255 237
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'PEAT'
  EXPRESSION 'PEAT'
   STYLE
    COLOR 219 175 117
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'RAIZED MARINE DEPOSITS - UNDIFFERENTIATED (SAND AND GRAVEL)'
 EXPRESSION 'RAIZED MARINE DEPOSITS - UNDIFFERENTIATED (SAND AND GRAVEL)'
   STYLE
    COLOR 255 201 175
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'RIVER TERRACE DEPOSITS - UNDIFFERENTIATED (SAND AND GRAVEL)'
 EXPRESSION 'RIVER TERRACE DEPOSITS - UNDIFFERENTIATED (SAND AND GRAVEL)'
   STYLE
    COLOR 255 201 147
    BACKGROUNDCOLOR 255 255 255
  END #style
END #class
CLASS
 NAME 'SAND AND GRAVEL OF UNCERTAIN AGE AND ORIGIN'
 EXPRESSION 'SAND AND GRAVEL OF UNCERTAIN AGE AND ORIGIN'
   STYLE
```

```
        COLOR 255 201 255
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
     NAME 'SUPERFICIAL DEPOSITS NOT MAPPED'
     EXPRESSION 'SUPERFICIAL DEPOSITS NOT MAPPED'
       STYLE
        COLOR 255 255 237
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
     NAME 'TILL (DIAMICTON)'
     EXPRESSION 'TILL (DIAMICTON)'
       STYLE
        COLOR 219 255 255
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
#============================================================
# Note: The following DUMMY CLASSes have been added as a
# quick hack to get around a bug we found in Google Earth
# WMS visualization. It should not affect you unless you
# have 16 or fewer classes in one of your layers.
#
# If you have fewer than 16 classes Mapserver may send the
# image as a 4-bit PNG file. It seems that Google Earth
# doesn't (as of Jan 2008) handle transparent areas properly
# with 4-bit images so we have added the extra classes to
# force sending an 8-bit image. (Not necessarily the best
# way of achieving this.)
#============================================================
    CLASS
      EXPRESSION 'DUMMY CLASS 1'
      STYLE
        COLOR 1 1 1
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
      EXPRESSION 'DUMMY CLASS 2'
      STYLE
        COLOR 2 2 2
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
      EXPRESSION 'DUMMY CLASS 3'
      STYLE
        COLOR 3 3 3
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
    CLASS
      EXPRESSION 'DUMMY CLASS 4'
      STYLE
        COLOR 4 4 4
        BACKGROUNDCOLOR 255 255 255
      END #style
```

```
    END #class
    CLASS
      EXPRESSION 'DUMMY CLASS 5'
      STYLE
        COLOR 5 5 5
        BACKGROUNDCOLOR 255 255 255
      END #style
    END #class
  END #layer
END #Map File
```

Section last modified: 27 June 2013

Appendix F: WMS 1.3.0 GetCapabilities response from the BGS OneGeology exemplar service

Below is the GetCapabilities response returned by the BGS OneGeology service as configured by the MapServer map file shown in Appendix E. This response document may be obtained using the following requests, that is, either as a request without version parameter like:

```
http://ogc.bgs.ac.uk/cgi-bin/exemplars/BGS_Bedrock_and_Superficial_Geology/ows?
  service=WMS&
  request=GetCapabilities&
```

or as a request with version parameter like:

```
http://ogc.bgs.ac.uk/cgi-bin/exemplars/BGS_Bedrock_and_Superficial_Geology/ows?
  service=WMS&
  request=GetCapabilities&
  version=1.3.0&
```

That is, the version parameter is omittable because the default service is always the highest version supported by the WMS server. The response is shown below:

```
 <?xml version='1.0' encoding="ISO-8859-1" standalone="no" ?>
<WMS_Capabilities version="1.3.0" xmlns="http://www.opengis.net/wms"
 xmlns:sld="http://www.opengis.net/sld"
 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
 xmlns:ms="http://mapserver.gis.umn.edu/mapserver"
 xmlns:inspire_common="http://inspire.ec.europa.eu/schemas/common/1.0"
 xmlns:inspire_vs="http://inspire.ec.europa.eu/schemas/inspire_vs/1.0"
 xsi:schemaLocation="http://www.opengis.net/wms
 http://schemas.opengis.net/wms/1.3.0/capabilities_1_3_0.xsd
 http://www.opengis.net/sld
 http://schemas.opengis.net/sld/1.1.0/sld_capabilities.xsd
 http://inspire.ec.europa.eu/schemas/inspire_vs/1.0
 http://inspire.ec.europa.eu/schemas/inspire_vs/1.0/inspire_vs.xsd
 http://mapserver.gis.umn.edu/mapserver
 http://ogc.bgs.ac.uk/cgi-bin/exemplars/BGS_Bedrock_and_Superficial_Geology/wms?
language=eng&service=WMS&version=1.3.0&
request=GetSchemaExtension">

  <!-- MapServer version 6.2.0 OUTPUT=GIF OUTPUT=PNG OUTPUT=JPEG OUTPUT=PDF
SUPPORTS=PROJ SUPPORTS=GD
SUPPORTS=AGG SUPPORTS=FREETYPE SUPPORTS=CAIRO SUPPORTS=OPENGL SUPPORTS=ICONV
SUPPORTS=FRIBIDI SUPPORTS=WMS_SERVER SUPPORTS=WMS_CLIENT SUPPORTS=WFS_SERVER
SUPPORTS=WFS_CLIENT SUPPORTS=WCS_SERVER SUPPORTS=SOS_SERVER SUPPORTS=FASTCGI
SUPPORTS=THREADS SUPPORTS=GEOS INPUT=JPEG INPUT=POSTGIS INPUT=OGR
INPUT=GDAL INPUT=SHAPEFILE -->

  <Service>
```

```
    <Name>WMS</Name>
    <Title>BGS Bedrock and Superficial geology</Title>
    <Abstract>
The 1:625k DiGMap data covering the whole of the United Kingdom is available in this
      OGC WMS service for all uses - including commercial use subject to the conditions in the
      Access Constraints section and is being served as a contribution to the OneGeology initiative
(www.onegeology.org). Separate bedrock geology and superficial deposits layers are available
      in this service. Layers available for bedrock are lithostratigraphy, age, and lithology.
      Layers available for superficial deposits layer are lithostratigraphy and lithology. For
      information about more of the British Geological Survey's maps that are available
      digitally please visit
 http://www.bgs.ac.uk/products/digitalmaps/digmapgb.html
</Abstract>
    <KeywordList>
      <Keyword>OneGeology</Keyword>
      <Keyword>geology</Keyword>
      <Keyword>map</Keyword>
      <Keyword>United Kingdom</Keyword>
      <Keyword>bedrock</Keyword>
      <Keyword>superficial</Keyword>
      <Keyword>lithology</Keyword>
      <Keyword>lithostratigraphy</Keyword>
      <Keyword>age</Keyword>
      <Keyword>MD_LANG@ENG</Keyword>
      <Keyword>MD_DATE@2013-05-23</Keyword>
      <Keyword vocabulary="GEMET">Geology</Keyword>
      <Keyword vocabulary="ISO">infoMapAccessService</Keyword>
    </KeywordList>
    <OnlineResource
 xmlns:xlink="http://www.w3.org/1999/xlink"
xlink:href="http://www.bgs.ac.uk/"/>
    <ContactInformation>
      <ContactPersonPrimary>
        <ContactPerson>Garry Baker</ContactPerson>
        <ContactOrganization>British Geological Survey</ContactOrganization>
      </ContactPersonPrimary>
      <ContactPosition/>
      <ContactAddress>
        <AddressType>postal</AddressType>
        <Address>Environmental Science Centre</Address>
        <City>Keyworth</City>
        <StateOrProvince>Nottinghamshire</StateOrProvince>
        <PostCode>NG12 5GG</PostCode>
        <Country>United Kingdom</Country>
      </ContactAddress>
      <ContactVoiceTelephone>+44 (0)115 936 3100</ContactVoiceTelephone>
      <ContactFacsimileTelephone>+44 (0)115 936 3200</ContactFacsimileTelephone>
      <ContactElectronicMailAddress>enquiries@bgs.ac.uk</ContactElectronicMailAddress>
    </ContactInformation>
    <Fees>none</Fees>
    <AccessConstraints>The 1:625k DiGMap data is available for free download for your personal,
      teaching, research, or non-commercial use (as described on
 http://www.bgs.ac.uk/about/copyright/non_commercial_use.html). Your use of any information
      provided by the British
Geological Survey (BGS) is at your own risk. Neither BGS nor the
      Natural Environment Research Council (NERC)
gives any warranty, condition, or representation
      as to the quality, accuracy, or completeness
of the information or its suitability for any use
      or purpose. All implied conditions relating to the quality or suitability
```

```
of the information,
      and all liabilities arising from the supply
of the information (including any liability
      arising in negligence) are excluded to the fullest extent permitted by
      law.</AccessConstraints>
    <MaxWidth>2048</MaxWidth>
    <MaxHeight>2048</MaxHeight>
  </Service>

  <Capability>
    <Request>
      <GetCapabilities>
        <Format>text/xml</Format>
        <DCPType>
          <HTTP>
            <Get>
              <OnlineResource
 xmlns:xlink="http://www.w3.org/1999/xlink"
xlink:href="http://ogc.bgs.ac.uk/cgi-bin/exemplars/BGS_Bedrock_and_Superficial_Geology/wms?
language=eng&"
              />
</Get>
            <Post>
              <OnlineResource
 xmlns:xlink="http://www.w3.org/1999/xlink"
xlink:href="http://ogc.bgs.ac.uk/cgi-bin/exemplars/BGS_Bedrock_and_Superficial_Geology/wms?
language=eng&"
              />
</Post>
          </HTTP>
        </DCPType>
      </GetCapabilities>
      <GetMap>
        <Format>image/png</Format>
        <Format>image/jpeg</Format>
        <Format>image/gif</Format>
        <Format>image/png; mode=8bit</Format>
        <Format>application/x-pdf</Format>
        <Format>image/svg+xml</Format>
        <Format>image/tiff</Format>
        <DCPType>
          <HTTP>
            <Get>
              <OnlineResource
 xmlns:xlink="http://www.w3.org/1999/xlink"
xlink:href="http://ogc.bgs.ac.uk/cgi-bin/exemplars/BGS_Bedrock_and_Superficial_Geology/wms?
language=eng&"
              />
</Get>
            <Post>
              <OnlineResource
 xmlns:xlink="http://www.w3.org/1999/xlink"
xlink:href="http://ogc.bgs.ac.uk/cgi-bin/exemplars/BGS_Bedrock_and_Superficial_Geology/wms?
language=eng&"
              />
</Post>
          </HTTP>
        </DCPType>
      </GetMap>
      <GetFeatureInfo>
```

```
        <Format>text/html</Format>
        <Format>application/vnd.ogc.gml</Format>
        <Format>text/plain</Format>
        <DCPType>
          <HTTP>
            <Get>
              <OnlineResource
 xmlns:xlink="http://www.w3.org/1999/xlink"
xlink:href="http://ogc.bgs.ac.uk/cgi-bin/exemplars/BGS_Bedrock_and_Superficial_Geology/wms?
language=eng&"
              />
</Get>
            <Post>
              <OnlineResource
 xmlns:xlink="http://www.w3.org/1999/xlink"
xlink:href="http://ogc.bgs.ac.uk/cgi-bin/exemplars/BGS_Bedrock_and_Superficial_Geology/wms?
language=eng&"
              />
</Post>
          </HTTP>
        </DCPType>
      </GetFeatureInfo>
      <sld:DescribeLayer>
        <Format>text/xml</Format>
        <DCPType>
          <HTTP>
            <Get>
              <OnlineResource
 xmlns:xlink="http://www.w3.org/1999/xlink"
xlink:href="http://ogc.bgs.ac.uk/cgi-bin/exemplars/BGS_Bedrock_and_Superficial_Geology/wms?
language=eng&"
              />
</Get>
            <Post>
              <OnlineResource
 xmlns:xlink="http://www.w3.org/1999/xlink"
xlink:href="http://ogc.bgs.ac.uk/cgi-bin/exemplars/BGS_Bedrock_and_Superficial_Geology/wms?
language=eng&"
              />
</Post>
          </HTTP>
        </DCPType>
      </sld:DescribeLayer>
      <sld:GetLegendGraphic>
        <Format>image/png</Format>
        <Format>image/jpeg</Format>
        <Format>image/gif</Format>
        <Format>image/png; mode=8bit</Format>
        <DCPType>
          <HTTP>
            <Get>
              <OnlineResource
 xmlns:xlink="http://www.w3.org/1999/xlink"
xlink:href="http://ogc.bgs.ac.uk/cgi-bin/exemplars/BGS_Bedrock_and_Superficial_Geology/wms?
language=eng&"
              />
</Get>
            <Post>
              <OnlineResource
 xmlns:xlink="http://www.w3.org/1999/xlink"
```

```
xlink:href="http://ogc.bgs.ac.uk/cgi-bin/exemplars/BGS_Bedrock_and_Superficial_Geology/wms?
language=eng&"
              />
</Post>
          </HTTP>
        </DCPType>
      </sld:GetLegendGraphic>
      <ms:GetStyles>
        <Format>text/xml</Format>
        <DCPType>
          <HTTP>
            <Get>
              <OnlineResource
 xmlns:xlink="http://www.w3.org/1999/xlink"
xlink:href="http://ogc.bgs.ac.uk/cgi-bin/exemplars/BGS_Bedrock_and_Superficial_Geology/wms?
language=eng&"
              />
</Get>
            <Post>
              <OnlineResource
 xmlns:xlink="http://www.w3.org/1999/xlink"
xlink:href="http://ogc.bgs.ac.uk/cgi-bin/exemplars/BGS_Bedrock_and_Superficial_Geology/wms?
language=eng&"
              />
</Post>
          </HTTP>
        </DCPType>
      </ms:GetStyles>
    </Request>
    <Exception>
      <Format>XML</Format>
      <Format>INIMAGE</Format>
      <Format>BLANK</Format>
    </Exception>
    <sld:UserDefinedSymbolization SupportSLD="1" UserLayer="0" UserStyle="1" RemoteWFS="0"
InlineFeature="0" RemoteWCS="0"/>
    <inspire_vs:ExtendedCapabilities>
      <inspire_common:ResourceLocator>
        <inspire_common:URL>http://ogc.bgs.ac.uk/cgi-bin/exemplars/BGS_Bedrock_and_Superficial_Geol
      </inspire_common:ResourceLocator>
      <inspire_common:ResourceType>service</inspire_common:ResourceType>
      <inspire_common:TemporalReference>
        <inspire_common:DateOfLastRevision>2013-04-15</inspire_common:DateOfLastRevision>
      </inspire_common:TemporalReference>
      <inspire_common:Conformity>
        <inspire_common:Specification>
          <inspire_common:Title>-</inspire_common:Title>
          <inspire_common:DateOfLastRevision>2013-04-15</inspire_common:DateOfLastRevision>
        </inspire_common:Specification>
        <inspire_common:Degree>notEvaluated</inspire_common:Degree>
      </inspire_common:Conformity>
      <inspire_common:MetadataPointOfContact>
        <inspire_common:OrganisationName>Garry Baker</inspire_common:OrganisationName>
        <inspire_common:EmailAddress>enqiries@bgs.ac.uk</inspire_common:EmailAddress>
      </inspire_common:MetadataPointOfContact>
      <inspire_common:MetadataDate>2013-04-15</inspire_common:MetadataDate>
      <inspire_common:SpatialDataServiceType>view</inspire_common:SpatialDataServiceType>
      <inspire_common:MandatoryKeyword
 xsi:type="inspire_common:classificationOfSpatialDataService">
        <inspire_common:KeywordValue>infoMapAccessService</inspire_common:KeywordValue>
```

```
      </inspire_common:MandatoryKeyword>
      <inspire_common:SupportedLanguages>
        <inspire_common:DefaultLanguage>
          <inspire_common:Language>eng</inspire_common:Language>
        </inspire_common:DefaultLanguage>
      </inspire_common:SupportedLanguages>
      <inspire_common:ResponseLanguage>
        <inspire_common:Language>eng</inspire_common:Language>
      </inspire_common:ResponseLanguage>
    </inspire_vs:ExtendedCapabilities>
    <Layer>
      <Name>BGS_EN_Bedrock_and_Superficial_Geology</Name>
      <Title>BGS bedrock and superficial geology</Title>
      <Abstract>
The 1:625k DiGMap data covering the whole of the United Kingdom is available in this
        OGC WMS service for all uses - including commercial use subject to the conditions in the
        Access Constraints section and is being served as a contribution to the OneGeology
        initiative
(www.onegeology.org). Separate bedrock geology and superficial deposits layers
        are available in this service. Layers available for bedrock are lithostratigraphy, age, and
        lithology. Layers available for superficial deposits layer are lithostratigraphy and
        lithology. For information about more of the British Geological Survey's maps that are
        available digitally please visit
 http://www.bgs.ac.uk/products/digitalmaps/digmapgb.html
</Abstract>
      <KeywordList>
        <Keyword>OneGeology</Keyword>
        <Keyword>geology</Keyword>
        <Keyword>map</Keyword>
        <Keyword>United Kingdom</Keyword>
        <Keyword>bedrock</Keyword>
        <Keyword>superficial</Keyword>
        <Keyword>lithology</Keyword>
        <Keyword>lithostratigraphy</Keyword>
        <Keyword>age</Keyword>
        <Keyword>MD_LANG@ENG</Keyword>
        <Keyword>MD_DATE@2013-05-23</Keyword>
        <Keyword vocabulary="GEMET">Geology</Keyword>
        <Keyword vocabulary="ISO">infoMapAccessService</Keyword>
      </KeywordList>
      <CRS>EPSG:27700</CRS>
      <CRS>EPSG:3031</CRS>
      <CRS>EPSG:3034</CRS>
      <CRS>EPSG:3413</CRS>
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      <CRS>EPSG:4258</CRS>
      <CRS>EPSG:4326</CRS>
      <CRS>EPSG:900913</CRS>
      <EX_GeographicBoundingBox>
        <westBoundLongitude>-8.6476</westBoundLongitude>
        <eastBoundLongitude>1.76943</eastBoundLongitude>
        <southBoundLatitude>49.8639</southBoundLatitude>
        <northBoundLatitude>60.8622</northBoundLatitude>
      </EX_GeographicBoundingBox>
      <BoundingBox CRS="EPSG:27700" minx="-77493.4" miny="-4039.86" maxx="670977"
        maxy="1.23824e+006"/>
      <BoundingBox CRS="EPSG:3031" minx="-7.11295e+006" miny="3.3298e+007" maxx="1.46072e+006"
        maxy="4.73071e+007"/>
      <BoundingBox CRS="EPSG:3034" minx="2.60232e+006" miny="2.71888e+006" maxx="3.88362e+006"
        maxy="3.56176e+006"/>
```

```
      <BoundingBox CRS="EPSG:3413" minx="1.91073e+006" miny="-3.64649e+006" maxx="3.29885e+006"
        maxy="-2.20789e+006"/>
      <BoundingBox CRS="EPSG:3857" minx="-962646" miny="6.42274e+006" maxx="196972"
        maxy="8.59425e+006"/>
      <BoundingBox CRS="EPSG:4258" minx="49.8639" miny="-8.6476" maxx="60.8622" maxy="1.76943"/>
      <BoundingBox CRS="EPSG:4326" minx="49.8639" miny="-8.6476" maxx="60.8622" maxy="1.76943"/>
      <BoundingBox CRS="EPSG:900913" minx="-962646" miny="6.42274e+006" maxx="196972"
        maxy="8.59425e+006"/>
      <Attribution>
        <Title>British Geological Survey (BGS)</Title>
        <OnlineResource
 xmlns:xlink="http://www.w3.org/1999/xlink"
xlink:href="http://www.bgs.ac.uk/"/>
        <LogoURL width="275" height="60">
          <Format>image/gif</Format>
          <OnlineResource
 xmlns:xlink="http://www.w3.org/1999/xlink"
xlink:type="simple"
xlink:href="http://ogc.bgs.ac.uk/BGS_Bedrock_and_Superficial_Geology/bgs_c_t_275x60.gif"
          />
        </LogoURL>
      </Attribution>
      <Style>
        <Name>default</Name>
        <Title>default</Title>
        <LegendURL width="560" height="6636">
          <Format>image/png</Format>
          <OnlineResource
 xmlns:xlink="http://www.w3.org/1999/xlink"
xlink:type="simple"
xlink:href="http://ogc.bgs.ac.uk/cgi-bin/exemplars/BGS_Bedrock_and_Superficial_Geology/wms?
language=eng&version=1.3.0&service=WMS&
request=GetLegendGraphic&sld_version=1.1.0&layer=BGS_EN_Bedrock_and_Superficial_Geology&
format=image/png&STYLE=default"
          />
        </LegendURL>
      </Style>
      <Layer queryable="1" opaque="0" cascaded="0">
        <Name>GBR_BGS_625k_BLT</Name>
        <Title>GBR BGS 1:625k Bedrock Lithology</Title>
        <Abstract>
GBR BGS 1:625k scale Bedrock Lithology
</Abstract>
        <KeywordList>
          <Keyword>OneGeology</Keyword>
          <Keyword>geology</Keyword>
          <Keyword>bedrock</Keyword>
          <Keyword>lithology</Keyword>
          <Keyword>continent@Europe</Keyword>
          <Keyword>subcontinent@Northern Europe</Keyword>
          <Keyword>geographicarea@United Kingdom</Keyword>
          <Keyword>dataprovider@British Geological Survey</Keyword>
          <Keyword>serviceprovider@British Geological Survey</Keyword>
          <Keyword>DS_TOPIC@geoscientificInformation</Keyword>
          <Keyword>DS_DATE@2011-06-15</Keyword>
        </KeywordList>
        <CRS>EPSG:27700</CRS>
        <CRS>EPSG:3031</CRS>
        <CRS>EPSG:3034</CRS>
        <CRS>EPSG:3413</CRS>
```

```
        <CRS>EPSG:3857</CRS>
        <CRS>EPSG:4258</CRS>
        <CRS>EPSG:4326</CRS>
        <CRS>EPSG:900913</CRS>
        <EX_GeographicBoundingBox>
          <westBoundLongitude>-8.64846</westBoundLongitude>
          <eastBoundLongitude>1.76767</eastBoundLongitude>
          <southBoundLatitude>49.8638</southBoundLatitude>
          <northBoundLatitude>60.8612</northBoundLatitude>
        </EX_GeographicBoundingBox>
        <BoundingBox CRS="EPSG:27700" minx="-77556.4" miny="-4051.91" maxx="670851"
          maxy="1.23813e+006"/>
        <BoundingBox CRS="EPSG:3031" minx="-7.11339e+006" miny="3.32979e+007" maxx="1.45922e+006"
          maxy="4.73054e+007"/>
        <BoundingBox CRS="EPSG:3034" minx="2.60232e+006" miny="2.71882e+006" maxx="3.88352e+006"
          maxy="3.56165e+006"/>
        <BoundingBox CRS="EPSG:3413" minx="1.91076e+006" miny="-3.64654e+006" maxx="3.29876e+006"
          maxy="-2.20805e+006"/>
        <BoundingBox CRS="EPSG:3857" minx="-962742" miny="6.42272e+006" maxx="196776"
          maxy="8.59402e+006"/>
        <BoundingBox CRS="EPSG:4258" minx="49.8638" miny="-8.64846" maxx="60.8612" maxy="1.76767"/>
        <BoundingBox CRS="EPSG:4326" minx="49.8638" miny="-8.64846" maxx="60.8612" maxy="1.76767"/>
        <BoundingBox CRS="EPSG:900913" minx="-962742" miny="6.42272e+006" maxx="196776"
          maxy="8.59402e+006"/>
        <MetadataURL type="TC211">
          <Format>application/xml;charset=UTF-8</Format>
          <OnlineResource
 xmlns:xlink="http://www.w3.org/1999/xlink"
xlink:type="simple"
xlink:href="http://metadata.bgs.ac.uk/geonetwork/srv/en/csw?SERVICE=CSW&VERSION=2.0.2&
REQUEST=GetRecordById&ID=ac9f8250-3ae5-49e5-9818-d14264a4fda4&"
          />
        </MetadataURL>
        <DataURL>
          <Format>text/html</Format>
          <OnlineResource
 xmlns:xlink="http://www.w3.org/1999/xlink"
xlink:type="simple"
xlink:href="http://www.bgs.ac.uk/discoverymetadata/13480426.html"/>
        </DataURL>
        <Style>
          <Name>default</Name>
          <Title>default</Title>
          <LegendURL width="495" height="1806">
            <Format>image/png</Format>
            <OnlineResource
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xlink:type="simple"
xlink:href="http://ogc.bgs.ac.uk/cgi-bin/exemplars/BGS_Bedrock_and_Superficial_Geology/wms?
language=eng&version=1.3.0&service=WMS&
request=GetLegendGraphic&sld_version=1.1.0&layer=GBR_BGS_625k_BLT&
format=image/png&STYLE=default"
            />
          </LegendURL>
        </Style>
      </Layer>
      <Layer queryable="1" opaque="0" cascaded="0">
        <Name>GBR_BGS_625k_BLS</Name>
        <Title>GBR BGS 1:625k Bedrock Lithostratigraphy</Title>
        <Abstract>
```

```
GBR BGS 1:625k scale Bedrock Lithostratigraphy (including Lithogenic
          units)
</Abstract>
        <KeywordList>
          <Keyword>OneGeology</Keyword>
          <Keyword>geology</Keyword>
          <Keyword>bedrock</Keyword>
          <Keyword>lithostratigraphy</Keyword>
          <Keyword>continent@Europe</Keyword>
          <Keyword>subcontinent@Northern Europe</Keyword>
          <Keyword>geographicarea@United Kingdom</Keyword>
          <Keyword>dataprovider@British Geological Survey</Keyword>
          <Keyword>serviceprovider@British Geological Survey</Keyword>
          <Keyword>DS_TOPIC@geoscientificInformation</Keyword>
          <Keyword>DS_DATE@2011-06-15</Keyword>
        </KeywordList>
        <CRS>EPSG:27700</CRS>
        <CRS>EPSG:3031</CRS>
        <CRS>EPSG:3034</CRS>
        <CRS>EPSG:3413</CRS>
        <CRS>EPSG:3857</CRS>
        <CRS>EPSG:4258</CRS>
        <CRS>EPSG:4326</CRS>
        <CRS>EPSG:900913</CRS>
        <EX_GeographicBoundingBox>
          <westBoundLongitude>-8.64846</westBoundLongitude>
          <eastBoundLongitude>1.76767</eastBoundLongitude>
          <southBoundLatitude>49.8638</southBoundLatitude>
          <northBoundLatitude>60.8612</northBoundLatitude>
        </EX_GeographicBoundingBox>
        <BoundingBox CRS="EPSG:27700" minx="-77556.4" miny="-4051.91" maxx="670851"
          maxy="1.23813e+006"/>
        <BoundingBox CRS="EPSG:3031" minx="-7.11339e+006" miny="3.32979e+007" maxx="1.45922e+006"
          maxy="4.73054e+007"/>
        <BoundingBox CRS="EPSG:3034" minx="2.60232e+006" miny="2.71882e+006" maxx="3.88352e+006"
          maxy="3.56165e+006"/>
        <BoundingBox CRS="EPSG:3413" minx="1.91076e+006" miny="-3.64654e+006" maxx="3.29876e+006"
          maxy="-2.20805e+006"/>
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REQUEST=GetRecordById&ID=ac9f8250-3ae5-49e5-9818-d14264a4fda4&"
          />
        </MetadataURL>
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 xmlns:xlink="http://www.w3.org/1999/xlink"
xlink:type="simple"
xlink:href="http://www.bgs.ac.uk/discoverymetadata/13480426.html"/>
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```

```
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xlink:type="simple"
xlink:href="http://ogc.bgs.ac.uk/cgi-bin/exemplars/BGS_Bedrock_and_Superficial_Geology/wms?
language=eng&version=1.3.0&service=WMS&
request=GetLegendGraphic&sld_version=1.1.0&layer=GBR_BGS_625k_BLS&
format=image/png&STYLE=default"
            />
          </LegendURL>
        </Style>
      </Layer>
      <Layer queryable="1" opaque="0" cascaded="0">
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        <Abstract>
GBR BGS 1:625k scale Bedrock Age
</Abstract>
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          <Keyword>bedrock</Keyword>
          <Keyword>age</Keyword>
          <Keyword>chronostratigraphycontinent@Europe</Keyword>
          <Keyword>subcontinent@Northern Europe</Keyword>
          <Keyword>geographicarea@United Kingdom</Keyword>
          <Keyword>dataprovider@British Geological Survey</Keyword>
          <Keyword>serviceprovider@British Geological Survey</Keyword>
          <Keyword>DS_TOPIC@geoscientificInformation</Keyword>
          <Keyword>DS_DATE@2011-06-15</Keyword>
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        <CRS>EPSG:4258</CRS>
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```

```
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REQUEST=GetRecordById&ID=ac9f8250-3ae5-49e5-9818-d14264a4fda4&"
          />
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language=eng&version=1.3.0&service=WMS&
request=GetLegendGraphic&sld_version=1.1.0&layer=GBR_BGS_625k_BA&
format=image/png&STYLE=default"
            />
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      </Layer>
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        <Abstract>
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</Abstract>
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          <Keyword>superficial</Keyword>
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          <Keyword>subcontinent@Northern Europe</Keyword>
          <Keyword>geographicarea@United Kingdom</Keyword>
          <Keyword>dataprovider@British Geological Survey</Keyword>
          <Keyword>serviceprovider@British Geological Survey</Keyword>
          <Keyword>DS_TOPIC@geoscientificInformation</Keyword>
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```

```
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REQUEST=GetRecordById&ID=2d759ad4-c547-4705-96c6-d5847c530ddd&"
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language=eng&version=1.3.0&service=WMS&
request=GetLegendGraphic&sld_version=1.1.0&layer=GBR_BGS_625k_SLT&
format=image/png&STYLE=default"
            />
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        </Style>
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GBR BGS 1:625k scale Superficial Deposits Lithostratigraphy (including
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```

```
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          maxy="-2.20915e+006"/>
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          maxy="8.59121e+006"/>
        <BoundingBox CRS="EPSG:4258" minx="49.8902" miny="-7.62927" maxx="60.8489" maxy="1.7645"/>
        <BoundingBox CRS="EPSG:4326" minx="49.8902" miny="-7.62927" maxx="60.8489" maxy="1.7645"/>
        <BoundingBox CRS="EPSG:900913" minx="-849286" miny="6.42728e+006" maxx="196424"
          maxy="8.59121e+006"/>
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xlink:type="simple"
xlink:href="http://metadata.bgs.ac.uk/geonetwork/srv/en/csw?SERVICE=CSW&VERSION=2.0.2&
REQUEST=GetRecordById&ID=2d759ad4-c547-4705-96c6-d5847c530ddd&"
          />
        </MetadataURL>
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          <OnlineResource
 xmlns:xlink="http://www.w3.org/1999/xlink"
xlink:type="simple"
xlink:href="http://www.bgs.ac.uk/discoverymetadata/13480426.html"/>
        </DataURL>
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```

```
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language=eng&version=1.3.0&service=WMS&
request=GetLegendGraphic&sld_version=1.1.0&layer=GBR_BGS_625k_SLS&
format=image/png&STYLE=default"
            />
          </LegendURL>
        </Style>
      </Layer>
    </Layer>
  </Capability>
</WMS_Capabilities>
```

Section last modified: 27 June 2013

Appendix G: WMS 1.1.1 GetCapabilities response from the BGS OneGeology exemplars service

Below is the GetCapabilities response returned by the BGS OneGeology service as configured by the MapServer map file shown in Appendix E. This response document may be obtained using the following GetCapabilities request like:

```
http://ogc.bgs.ac.uk/cgi-bin/exemplars/BGS_Bedrock_and_Superficial_Geology/ows?
 service=WMS&
 request=GetCapabilities&
 version=1.1.1&
```

Note you must specify the version here in this request because there is a higher WMS version available on the server.

- View the generated XML

Section last modified: 27 June 2013

Appendix H: Using the MS4W Apache http server as a reverse proxy to Tomcat

To serve a OneGeology WMS through the OneGeology Portal that service must be served using port 80; the default port for any http web service. If you are already serving another web service on port 80 on the same server (such as a GeoNetwork spatial data metadata catalogue for example), then you will need to use a different port number for the existing service. In itself this shouldn't be too difficult to do, however this might cause problems for your customers due to restrictive firewall rules that prevent them consuming any web service not served on the standard web port number. One way around this is to merge the services together; another possibility (as detailed below) is to use the Apache HTTP web server as a reverse proxy, that is, to handle all requests to the second service as if that service was coming from the MS4W Apache service. The user is thus unaware that there is more than one web service. Each service proxied in this way runs on a separate port number, and may still be accessed directly on that port (depending on your configuration), but it is also available as if it were running on port 80.

Comprehensive information on configuring Apache (http://httpd.apache.org/docs/2.2/urlmapping.html).

The first step is to change the port numbers (http://www.iana.org/assignments/port-numbers) on which your other web servers work; in this example we have two other web services (a Tomcat based web service which we will run on port 8080, and a jetty based web service which we will run on port 8008). Note that both these ports are recognized alternate ports for http traffic but they may not be open to such traffic in your corporate firewall.

Now we need to edit the Apache HTTP server httpd.conf file. If you have installed the MS4W apache http server as part of the ms4w-and-exemplar-data.zip download this would be located at: c:\ms4w\Apache\conf\httpd.conf.

Check that the following modules are uncommented (by removing the # sign from the line start).

Change

#LoadModule proxy_module modules/mod_proxy.so
#LoadModule proxy_ajp_module modules/mod_proxy_ajp.so
#LoadModule proxy_http_module modules/mod_proxy_http.so

To:

LoadModule proxy_module modules/mod_proxy.so
LoadModule proxy_ajp_module modules/mod_proxy_ajp.so
LoadModule proxy_http_module modules/mod_proxy_http.so

Note, we have used mod_proxy here as it is included with the Apache HTTP Server binaries, but you could use other proxy modules such as mod_jk if desired.

Now you need to add or uncomment the following directives (as appropriate for your configuration file); we suggest adding these directives at the end of the file for clarity.

TraceEnable off
#Important for security!!

ProxyRequests Off
#This sets up the reverse proxy, if ' ProxyRequests On' is set you have a forward proxy.

ProxyPreserveHost On

Now for each service (or set of pages within a service) that you wish to proxy you need to add the following set of directives:

A <Proxy> or a <ProxyMatch> block to restrict access to your resources, a ProxyPass directive (to map that web service into the local server URL space), and a ProxyPassReverse directive (which lets Apache adjust the URL in the Location, Content-Location and URI headers on HTTP redirect responses).

Examples:

1. Adding a reverse proxy to the BRGM OneGeology Europe connector for WP6 WMS. This connector runs on the Tomcat server running on port 8080, but will appear to be running as part of the Apache http service running on port 80.
   <Proxy /1GEconnector>
   Order deny,allow
   Allow from all
   </Proxy>

   ProxyPass /1GEconnector http://localhost:8080/1GEconnector

   ProxyPassReverse /1GEconnector http://localhost:8080/1GEconnector

2. Adding a reverse proxy to our Jetty web service which is running a GeoNetwork catalogue. The Jetty service is running on port 8008 but will appear to be running as part of the Apache http service running on port 80. You would normally be able to use ' localhost' or ' 127.0.0.1' to specify a web service running on the same physical server as your Apache web server, but in this instance Jetty has been configured to only accept requests from the server IP (194.66.252.156).
   <Proxy /geonetwork>
   Order deny,allow
   Allow from all
   </Proxy>

   ProxyPass /geonetwork http://194.66.252.156:8008/geonetwork

   ProxyPassReverse /geonetwork http://194.66.252.156:8008/geonetwork

3. Adding a reverse proxy to our Jetty web service which is running an Intermap mapping client (used by the GeoNetwork catalogue). The Jetty service is running on port 8008 but will appear to be running as part of the Apache http service running on port 80.
   <Proxy /intermap>
   Order deny,allow
   Allow from all
   </Proxy>

   ProxyPass /intermap http://194.66.252.156:8008/intermap

   ProxyPassReverse /intermap http://194.66.252.156:8008/intermap

4. Adding a reverse proxy to our cocoon service, which we need to run our WFS. The cocoon service runs on the Tomcat server running on port 8080, but will appear to be running as part of the Apache http service running on port 80. In this example we are using a ProxyMatch block, which allows us to use a regular expression to map the allowable paths to cocoon.
   <ProxyMatch http://[^/]*/cocoon/*>
   Order deny,allow
   Allow from 127.0.0.1
   </ProxyMatch>

   ProxyPass /cocoon http://127.0.0.1:8080/cocoon/

   ProxyPassReverse /cocoon http://127.0.0.1:8080/cocoon/

That's it as far as the Apache http server is concerned, but you may also wish to configure your other web servers so that they always proxy their http content through Apache

To do this in Tomcat, you need to modify a Connector block in the server.xml configuration file as below:

Change:

<Connector
port="8080"
protocol="HTTP/1.1"
connectionTimeout="20000"
redirectPort="8443" />

To:

<Connector
port="8080"
protocol="HTTP/1.1"
connectionTimeout="20000"
redirectPort="8443"
proxyName="yourserver.org"
proxyPort="80" />

ProxyName: is the domain name or IP of the standard (Apache HTTP Server) web service and can be omitted if you are running your Tomcat service on the same server as the http service.

To do this in Jetty you need to make a similar change in the jetty.xml file

Section last modified: 19 June 2011

Appendix I: OneGeology English keyword dictionary picklist

To help classify your service in the portal with respect these thematic keywords you can use one or more of the optional *thematic@value* style keywords in your layer metadata.

Note, terms like Geology shown in bold help to classify the terms for ease of reading, but don't imply any hierarchy. These terms are also part of the picklist of terms.

Term	Definition
Geology	**Earth's history and its life as recorded in the rocks; includes the study of geologic features of an area, such as the geometry of rock formations, weathering and erosion, and sedimentation.**
Bedrock	Consolidated rock
Superficial deposits	Unconsolidated/quaternary geological deposits
Surface geology	Superficial deposits and bedrock which occurs at the Earth's surface
Borehole	Boreholes or data surveyed in boreholes
Geochronology	Absolute ages of rocks, fossils, and sediments, within a certain degree of uncertainty inherent to the method used
Radiometry	In optics, radiometry is a set of techniques for measuring electromagnetic radiation, including visible light.
Absolute age	The geologic age of a fossil, or a geologic event or structure expressed in units of time, usually years.
Stratigraphy	Rock and sediment layers and layering (stratification)
Biostratigraphy	The branch of stratigraphy which focuses on correlating and assigning relative ages of rock strata by using the fossil assemblages contained within them
Chronostratigraphy	The branch of stratigraphy that studies the age of rock strata in relation to time
Structural geology	Three-dimensional distribution of rock units with respect to their deformational histories
Tectonics	

Neotectonics	
Structure	
Fault	
Fold	
Petrology	Origin, occurrence, structure, and history of rocks
Lithology	
Igneous rock	
Metamorphic rock	
Sedimentary rock	
Mineralogy	
Geochemistry	Distribution and amounts of the chemical elements in minerals, ores, rocks, soils, and water
Hydrogeochemistry	
Lithogeochemistry	
Organic geochemistry	
Pedology	Soil morphology, genesis, and classification
Soil	
Permafrost	
Sedimentology	Description, classification, origin, and interpretation of sediments and sedimentary rocks
Deposition	
Erosion	
Marine submersion	
Mudflow	
Geomorphology	Landforms on the Earth's surface and the processes that shape them
Geoheritage	Geological sites of scientific, cultural or aesthetic value, including geotourism
Conservation	
Geological trail	
Geopark	
Geosite	
Geotourism	
Preservation	
Artificial ground	Man-made deposits, mineral workings, re-modelled or altered ground
Marine Geology	Investigations of the ocean floor and coastal margins
Seafloor type	
Shallow gas	
Bathymetry	
Miscellaneous	
Education	
Mathematical geology	
Popular geology	
Harmonized geology	
Harmonized age	
Harmonized genesis	
Harmonized data	
Harmonized structure	
Geophysics	**Measurements and interpolations of geophysical parameters**
Gravimetry	Measurement of the strength of a gravitational field
Geomagnetism	Measurements of the Earth's magnetic field
Paleomagnetism	The record of the Earth's magnetic field preserved in various magnetic minerals through time
Geoelectricity	measurements of the Earth's natural electric fields and phenomena
Radioactivity	Measurements of the Earth's radioactive elements
Seismology	earthquakes and the propagation of elastic waves through the Earth
Geothermics	Study of the thermal state of the interior of the solid Earth and of the thermal properties of Earth materials
Economic geology	**Geologic bodies and materials that can be utilized profitably by man**
Exploration	
Mining	
Metals	Metal resources
Minerals	Mineral resources
Energy	Energy resources
Coal	
Peat	
Oil	
Oil shale	
Gas	
Ore	
Metallic ore	

Engineering geology	**Geologic factors affecting the location, design, construction, operation, and maintenance of engineering works**
Geotechnics	
Rock mechanics	
Soil mechanics	
Land heave	
Land subsidence	
Environmental geology	**Human interactions with the geological environment**
Geologic hazards	Geological conditions capable of causing damage or loss of property and life
Avalanche	
Cavity caving	
Collapse of metastable sediments	
Earthquake	
Flood	
Landslide	
Mud and debris flow	
Off-shore landslides and collapses	
Quick clay	
Rockfall	
Tsunami	
Volcanism	
Pollution	Human pollution (contamination) of the geological environment
Acid drainage	
Groundwater pollution	
Diffuse pollution	
Point-source pollution	
Reclamation	
Soil pollution	
Climate change	Geological conditions as they effect climate change
Emission of climate gas	
Global warming	
Methane exhalation	
Sea level rise	
Carbon capture and storage	
Waste	Unwanted or unusable materials
Medical geology	Geological conditions as they effect human, animal, and plant health
Airborne dust exposure	
Arsenic exposure	
Asbestos exposure	
Heavy metal exposure	
Radon exposure	
Hydrogeology	**Distribution and movement of groundwater in the soil and rocks of the Earth's crust**
Aquifer	
Groundwater	
Groundwater abstraction	
Groundwater level	
Infiltration	
Spring	
Water quality	
Water well	
Groundwater body	Principal reporting unit with hydraulically coherent entities

Section last modified: 13 November 2015

Appendix J: How to create a Styled Layer Descriptor (SLD) using Arc2Earth

Arc2Earth is a plugin for ArcGIS that is available in several different editions. The **Community** edition is free and provides access to the SLD generator. Arc2Earth is available at http://www.arc2earth.com/.

1. Install the Arc2Earth plugin
2. Open ArcMap
3. Open the ArcMap project containing the layer or layers to export as SLDs

4. Select the desired layer in the catalog tree
5. In the Arc2Earth toolbar, click Export > Export Layer Style to SLD
6. Navigate to the appropriate location
7. Click **Export**

After your SLD has been exported, open the .sld in any XML or text editor. Note that the Arc2Earth plug-in adds an outline (stroke) to polygon layers. If you are working with polygon layers, the stroke may need to be tailored or removed manually. Also, it may be necessary to customize the heading for your SLD, or change the schema location.

Note: though .sld files, like any XML document, may be edited by a generic text editor, such as the **Notepad** or **Wordpad** text editors included with Windows operating systems, some text editors are better suited to working with XML documents than others. One example of a free-and-open-source text editor designed with XML support is Notepad++ (be sure to get the XML tools plugin).

Section last modified: 15 February 2013

Recommend ESRI shapefile definitions for GeoSciML-Portrayal

Because the field names in GeoSciML-Portrayal are longer than 10 characters, you will not be able to have the full attribute (column) name for many of the properties if your portrayal data is loaded into an ESRI shapefile, which can be an issue in some WMS server software. To prevent truncated names, we are providing a recommended shapefile implementation with shorter field names. Field names are abbreviated to try and leave characters that convey the full name of the field; lower camel case typographic has been used, except that fields that contain URI's end with '_uri'.

Table 4. Recommend shapefile definition for ContactView

XML field Name	Shapefile field name	Shapefile data type
identifier	identifier	String
name	name	String
description	descriptio	String
contactType	contactTyp	String
observationMethod	obsvMethod	String
positionalAccuracy	posAccur	String
source	source	String
contactType_uri	conTyp_uri	String
specification_uri	spec_uri	String
metadata_uri	metada_uri	String
genericSymbolizer	genericSym	String
shape	SHAPE	ESRI geometry

Table 5. Recommended shapefile definition for ShearDisplacementStructureView

XML field Name	Shapefile field name	Shapefile data type
identifier	identifier	String
name	name	String
description	descriptio	String
faultType	faultType	String
movementType	movmntType	String
deformationStyle	defrmStyle	String
displacement	displacmnt	String
geologicHistory	geolHistry	String
observationMethod	obsvMethod	String
positionalAccuracy	posAccur	String
source	source	String
faultType_uri	fltTyp_uri	String
movementType_uri	movTyp_uri	String
deformationStyle_uri	defStl_uri	String
representativeAge_uri	repAge_uri	String
representativeOlderAge_uri	oldAge_uri	String

representativeYoungerAge_uri	yngAge_uri	String
specification_uri	spec_uri	String
metadata_uri	metada_uri	String
genericSymbolizer	genericSym	String
shape	SHAPE	ESRI geometry

Table 6. Recommended shapefile definition for GeologicUnitView

XML field Name	Shapefile field name	Shapefile data type
identifier	identifier	String
name	name	String
description	descriptio	String
geologicUnitType	geoUnitTyp	String
rank	rank	String
lithology	lithology	String
geologicHistory	geolHistry	String
observationMethod	obsvMethod	String
positionalAccuracy	posAccur	String
source	source	String
geologicUnitType_uri	uniTyp_uri	String
representativeLithology_uri	repLth_uri	String
representativeAge_uri	repAge_uri	String
representativeOlderAge_uri	oldAge_uri	String
representativeYoungerAge_uri	yngAge_uri	String
specification_uri	spec_uri	String
metadata_uri	metada_uri	String
genericSymbolizer	genericSym	String
shape	SHAPE	ESRI geometry

Section last modified: 12 October 2015

Mapping OneGeology-Europe data model to GeoSciML-Portrayal 4.0

The following table is derived from the OneGeology-Europe WP5 and WP6 guidelines for preparing the datasets. **The table is provided to assist those organizations that already have data mapped to the OneGeology-Europe data model and wish to update their services to use the same data for a GeoSciML-Portrayal 4.0 WMS service that will be INSPIRE conformant.**

When reading the table you should generally (such as excluding headers) consider pairs of rows, where the first row refers to the OneGeology-Europe data mapping (label, required status, and description) and the second row is the corresponding mapping in a GeoSciML-Portayal record. Descriptions that have a line through them are regarded as obsolete (that is, refer to the OneGeology-Europe data mapping that is either replaced or not required in GeoSciML-Portrayal).

Generally you should note that URNs are deprecated and replaced by HTTP-URIs, whether they be INSPIRE URIs, or CGI URIs.

We also provide some Excel spreadsheets (below) that map the OneGeology-Europe URNs to their equivalent HTTP-URIs for both the INSPIRE and CGI controlled vobabularies, that is:

Mapping from OneGeology-Europe Lithology URNs (<< link to Excel mapping spreadsheet)
For example for mapping:
Lithology_1 to *representativeLithology_uri*
Mapping from OneGeology-Europe Age URNs (<< link to Excel mapping spreadsheet)
For example for mapping:
AgeMax or *EventAgeMax* to *representativeOlderAge_uri*, or
AgeMin or *EventAgeMin* to *representativeYoungerAge_uri*, or
AgeMax to *representativeAge_uri* (as BGS do in OGE portal)
Mapping from OneGeology-Europe GeologicUnitType URNs (<< link to Excel mapping spreadsheet)
For example for mapping:
GeologicUnitType to *geologicUnitType_uri*
Mapping from OneGeology-Europe FaultType URNs (<< link to Excel mapping spreadsheet)
For example for mapping:
FaultType to *faultType_uri*

Mapping from OneGeology-Europe EventEnvironment URNs (<< link to Excel mapping spreadsheet)

Note:

Not required for GeoSciML-Portrayal 4.0 conversions

Mapping from OneGeology-Europe EventProcess URNs (<< link to Excel mapping spreadsheet)

Note:

Not required for GeoSciML-Portrayal 4.0 conversions

Mapping OneGeology-Europe GEOLOGIC UNITS to GeoSciML-Portrayal GeologicUnitView features

Note that whilst many of the properties required for the OneGeology-Europe GEOLOGIC UNITS mapping are optional, or not specified by GeoSciML-Portrayal GeologicUnitView features, GeoSciML-Portrayal mandates other properties (that is properties not found in OneGeology-Europe) are defined, such as representativeAge_uri. Please refer to the GeoSciML-Portrayal GeologicUnitView features page of the cookboook for more information.

Mapping OneGeology-Europe GEOLOGIC UNITS to GeoSciML-Portrayal GeologicUnitView features

GEOLOGIC UNITS. Each feature (polygon) should have at least the following attributes		
featureMember/MappedFeature for each MappedFeature (for each polygon)		
A unique feature ID	M	The unique ID of the polygon is often named “fid” within a shapefile
identifier	M	Globally unique identifier for the individual feature. Recommended practice is that this the primary key for the spatial objects in the source data in case information needs to interchange format back to the source database. This identifier is analogous to the ide MappedFeature.
Observation method [urn] MappedFeature/observationMethod	M	Always **urn:cgi:classifier:CGI:MappedFeatureObservationMethod:201001:compil**
observationMethod [string]	O	ObservationMethod is a convenience property to provide observation metadata. Exam ‘field observation by author’, ‘compilation from published maps’, ‘air photo interpretati the CGI Feature Observation Method vocabulary.
The positional accurancy [numerical value] MappedFeature/positionalAccuracy	M	It is recommended that the same, approximate, value be given for all MappedFeature
positionalAccuracy [string]	O	accuracy may be provided, e.g. a term from a controlled vocabulary. Vocabulary used the dataset metadata. For polygon mapped features this is intended for use to indicate of the contact and fault features bounding the outcrop polygon, which is only necessar features are not included with the polygons.
The sampling frame [urn] MappedFeature/samplingFrame	M	This property should be set to **urn:cgi:feature:CGI:EarthNaturalSurface** for the surfa **urn:cgi:feature:CGI:BedrockSurface** for the bedrock map
The sampling frame	-	There is no corresponding value in GeoSciML-Portrayal
The geometry MappedFeature/shape	M	
shape [GM_Object (GM_polygon)]	M	Geometry defining the extent of the feature of interest.
featureMember/MappedFeature/specification/GeologicUnit The following data are the attributes of the geologic unit which the current mappedFeature is a part of		
A unique Geologic Unit ID [Any type] GeologicUnit id	M	Each GeologicUnit should be given a unique identifier
geologicUnitType [string]	O	Type of GeologicUnit (as defined in GeoSciML).
The name of the geologic Unit GeologicUnit/name	M	Could be a simple name (text) or a urn (see the WP3 explanatory notes)
name [string]	O	Display name for the GeologicUnit; this can be used to put in a geologic unit name, or abbreviation used to label outcrops of the unit in a map display.
The “free text” description GeologicUnit/description	O	
description [string]	O	Text description of the GeologicUnit, typically taken from an entry on a geological map
The geologic unit type [urn] GeologicUnit/geologicUnitType	M	Use the 1GE vocabulary “ GeologicUnitType”
geologicUnitType_uri [string]	M	URI referring to a controlled concept from a vocabulary defining the GeologicUnit type no value is provided then a URI referring to a controlled concept explaining why the va provided.
The observation method [urn] GeologicUnit/observationMethod	M	either **urn:cgi:classifier:CGI:FeatureObservationMethod:201001:data_from_singl** where the property values are derived from a single source document, or **urn:cgi:classifier:CGI:FeatureObservationMethod:201001:synthesis_of_multiple** where they are derived from multiple source documents.
observationMethod [string]	O	ObservationMethod is a convenience property to provide observation metadata. Exam ‘field observation by author’, ‘compilation from published maps’, ‘air photo interpretati the CGI Feature Observation Method vocabulary.
The purpose GeologicUnit/purpose	M	For OneGeology-Europe the Purpose property should be set to: **typical_norm**.
The purpose	-	There is no corresponding property in GeoSciML-Portrayal

Body Morphology [urn] GeologicUnit/bodyMorphology	O	For dykes the GeologicUnit bodyMorphology property should always be set to**urn:cgi:classifier:CGI:GeologicUnitMorphology:201001:dike** In any other case,
Body Morphology	-	There is no corresponding property in GeoSciML-Portrayal
GeologicUnit/preferredAge/GeologicEvent The following attributes describe the age of formation of the geologic unit		
The name (Orogenic Event) [urn] GeologicEvent/name	O	Only given where the Geologic Unit was formed by the orogenic event. Use the 1GE v " OrogenicEvents".
The name (Orogenic Event)	-	There is no corresponding property in GeoSciML-Portrayal
The event Age - Lower [urn] GeologicEvent/eventAge/.../lower	M	Use the 1GE vocabulary " Ages"
representativeOlderAge_uri [string]	M	URI referring to a controlled concept specifying the most rep-resentative older value ir age intervals for the GeologicUnit. This will be defined entirely at the discretion of the a single event selected from the geologic feature's geological history or a value summ feature's history.
The event Age - Upper [urn] GeologicEvent/eventAge/.../upper	M	Use the 1GE vocabulary " Ages"
representativeYoungerAge_uri [string]	M	URI referring to a controlled concept specifying the most representative younger value stratigraphic age intervals for the GeologicUnit. This will be defined entirely at the disc and may be a single event selected from the geologic feature's geological history or a part of the feature's history.
The event process [urn] GeologicEvent/eventProcess	M	Record the process that formed the Geologic Unit. Use the 1GE vocabulary " EventPr
The event process	-	There is no corresponding property in GeoSciML-Portrayal
The event environment [urn] GeologicEvent/eventEnvironment	O	Can be used to describe the environment which the Geologic Unit was formed. Use th " EventEnvironment".
The event environment	-	There is no corresponding property in GeoSciML-Portrayal
GeologicUnit/geologicHistory/GeologicEvent The following attributes describe a serie of geologic events that led to the formation of the geologic unit. To describe such a geologic h But for each geologic history / geologic event described, one event age and at least one event process should be described. The rules the preferred age. It is up to each data provider to describe 0 or n geologic events of the geologic history.		
The name (for Orogenic Event) [urn] GeologicEvent/name	O	Use the vocabulary " OrogenicEvents"
The name (for Orogenic Event)	-	There is no corresponding property in GeoSciML-Portrayal
The event Age GeologicEvent/eventAge	M	Can be defined as a range of urn [lower_age, upper_age], as a range of numerical val numerical value, or as a single urn. In the case of urns, use the 1GE vocabulary "Ages
The event Age	-	There is no corresponding property in GeoSciML-Portrayal
The event process [urn] GeologicEvent/eventProcess	M	It is up to each data provider to present several event process (therefore, several attrib for describing the current geologic event of the geologic history. Use the 1GE vocabul
...	O	
The event process [urn]	O	
geologicHistory [string]	O	Text (possibly formatted with formal syntax) description of the age of the GeologicUnit sequence of events and may include process and environment information).
The event environment [urn] GeologicEvent/eventEnvironment	O	It is up to each data provider to present several event environment (therefore, several names) for describing the current geologic event of the geologic history. Use the 1GE
...	O	" EventEnvironment"
The event environment [urn]	O	
The event environment	-	There is no corresponding property in GeoSciML-Portrayal
GeologicUnit/composition/CompositionPart The following attributes describe the lithology of the geologic unit. Some GeologicUnits will have a single CompositionPart, but others CompositionParts, such as interbedded layers, each of which can be described with a distinct CompositionPart. Each CompositionPar the lithology; the role of the CompositionPart in the GeologicUnit as a whole; and the proportion of the CompositionPart in the Geologi *example, if the geologic units of a given dataset have in some cases 5 distincts lithology, but not more, then the database (or shapefile lithology, role and proportion.* the main lithology (proportion=all or predominant) attibute will always have a value (at least one lithology others will be often empty.		
Lithology [urn] CompositionPart/lithology	M	Use the 1GE " Lithology" vocabulary
representativeLithology_uri [string]	M	URI referring to a controlled concept specifying the characteristic or representative lith be a concept that defines the super-type of all lithology values present within a Geolog defining the lithology of the dominant CompositionPart (as defined in GeoSciML) of the intended for use as the symbol key for a lithologic map portrayal of the geologic unit fe
Lithology [urn] CompositionPart/lithology	M	Use the 1GE " Lithology" vocabulary
Lithology [string]	O	Text (possibly formatted with formal syntax) description of the GeologicUnit's lithology
Role [urn] CompositionPart/role	M	• Where the CompositionPart is the only one in the GeologicUnit the role property sho **urn:cgi:classifier:CGI:GeologicUnitPartRole:200811:only_part** • Where the CompositionPart is one of several in the GeologicUnit the role property s **urn:cgi:classifier:CGI:GeologicUnitPartRole:200811:unspecified_part_role** • See also the detailed explanation in the WP3 document: the GeologicUnitPartRole h serveral cases ("Molasse", "Ophiolitic mÃ©lange", ...).

Role	-	There is no corresponding property in GeoSciML-Portrayal
Proportion [urn] CompositionPart/proportion	M	• Where there is only one CompositionPart is the GeologicUnit the Proportion propert **urn:cgi:classifier:CGI:ProportionTerm:201001:all**. • Where there are multiple CompositionParts in the GeologicUnit the CompositionPar largest proportion of the GeologicUnit should be given a Proportion value of **urn:cgi:classifier:CGI:ProportionTerm:201001:predominant**. • All other CompositionParts should be given a Proportion value of **urn:cgi:classifier:CGI:ProportionTerm:201001:subordinate**. • Note that where there are multiple CompositionParts in the GeologicUnit one must b **urn:cgi:classifier:CGI:ProportionTerm:201001:predominant** and this will be the the lithology of the GeologicUnit.
Proportion	-	There is no corresponding property in GeoSciML-Portrayal
GeologicUnit/metamorphicCharacter/MetamorphicDescription The following attributes describe the metamorphism of a geologic unit. It is optional. If a data provider do not wish to describe metamo geologic units, then these attributes are not required. Only one Metamorphic description can be given		
Metamorphic facies [urn] MetamorphicDescription/metamorphicFacies	O	Use of the 1GE vocabulary " MetamorphicFacies". Several Metamorphic facies can be
...		
Metamorphic facies [urn]		
Metamorphic grade [urn] MetamorphicDescription/metamorphicGrade	O	Use of the 1GE vocabulary " "MetamorphicGrade"
MetamorphicDescription/protolithLithology/RockMaterial The following attributes describe the protolith lithology of the metamorphic description. It is optional, and there can be several protolith given, then consolidation degree and lithology are mandatory		
lithology [urn] RockMaterial/lithology		Use the 1GE vocabulary " Lithology".
consolidation degree [urn] RockMaterial/consolidationDegree		If a lithology is given, then the consolidationDegree should always be set to **urn:cgi:classifier:CGI:ConsolidationDegree:200811:consolidation_not_specifie**
purpose RockMaterial/purpose	O	If a lithology is given, then the purpore should always be set to **typical_norm**
Metamorphic character, description...	-	There are no corresponding properties in GeoSciML-Portrayal

In OneGeology-Europe the only types of structure that are being used are Faults and Contacts. Contacts are only being used to describe Calderas, Impact Craters, and Glacial Stationary Lines. Below we have separated Faults from Contacts becuase in GeoSciML-Portrayal they have different mappings.

Mapping OneGeology-Europe GEOLOGIC UNITS to GeoSciML-Portrayal ShearDisplacementStructureView features

Note that whilst many of the properties required for the OneGeology-Europe GEOLOGIC STRUCTURES mapping are optional, or not specified by GeoSciML-Portrayal ShearDisplacementStructureView features, GeoSciML-Portrayal mandates other properties (that is properties not found in OneGeology-Europe) are defined, such as movementType_uri and deformationStyle_uri. Please refer to the GeoSciML-Portrayal ShearDisplacementStructureView features page of the cookboook for more information.

Mapping OneGeology-Europe GEOLOGIC UNITS to GeoSciML-Portrayal ShearDisplacementStructureView features

GEOLOGIC STRUCTURES. Each feature should have at least the following attributes		
featureMember/MappedFeature for each MappedFeature		
A unique feature ID	M	This unique ID is often named "fid" within a shapefile
identifier	M	Globally unique identifier for the individual feature. Recommended practice is that the primary key for the spatial objects in the source data in case information needs interchange format back to the source database. This identifier is analogous to the MappedFeature.
Observation method [urn] MappedFeature/observationMethod	?	Always "urn:cgi:classifier:CGI:MappedFeatureObservationMethod:201001:compil in the database or within the shapefile: can be directly encoded in the GeoSciML r
observationMethod [string]	O	ObservationMethod is a convenience property that provides a quick and dirty appr metadata when data are reported using a feature view (as opposed to observatior
The positional accurancy [numerical value] MappedFeature/positionalAccuracy	M	It is recommended that the same, approximate, value be given for all MappedFeat around 250m for a 1:1 million scale map.
positionalAccuracy [string]	O	Preferred use is a quantitative value defining the radius of an uncertainty buffer ar a positionAccuracy of 100 m for a line feature defines a buffer polygon of total wid line. Some other text description that quantifies position accuracy may be provide vocabulary. Vocabulary used should be described in the dataset metadata.
The sampling frame [urn] MappedFeature/samplingFrame	M	This property should be set to **urn:cgi:feature:CGI:EarthNaturalSurface** for the and **urn:cgi:feature:CGI:BedrockSurface** for the bedrock map
The sampling frame	-	There is no corresponding property in GeoSciML-Portrayal
The geometry MappedFeature/shape	M	
shape [GM_Object (GM_curve)]	M	Geometry defining the extent of the feature of interest.

FAULT: *featureMember/MappedFeature/specification/ShearDisplacementStructure*
the following data are the attributes of the geologic structure which the current mappedFeature is a part of

A unique Geologic Structure ID [Any type] ShearDisplacementStructure	M	Each GeologicStructure should be given a unique identifier.
A unique Geologic Structure ID	-	There is no corresponding property in GeoSciML-Portrayal
The name of the geologic Structure ShearDisplacementStructure/name	O	Could be a simple name (text) or a urn (see the WP3 explanatory notes)
name [string]	O	Display name for the ShearDisplacementStructure. This may be a generic fault ty 'strike-slip fault', or a particular fault name, e.g. 'Moine thrust', 'san Andreas Faul
The observation method [urn] ShearDisplacementStructure/observationMethod	M	either **urn:cgi:classifier:CGI:FeatureObservationMethod:201001:data_from_s** where the property values are derived from a single source document, or **urn:cgi:classifier:CGI:FeatureObservationMethod:201001:synthesis_of_mul** where they are derived from multiple source documents.
observationMethod [string]	O	Metadata snippet indicating how the spatial extent of the feature was determined. convenience property that provides a quick and dirty approach to observation met using a feature view (as opposed to observation view).
The purpose ShearDisplacementStructure/purpose	?	For OneGeology-Europe the Purpose property should be set to : **typical_norm**.
The purpose	-	There is no corresponding property in GeoSciML-Portrayal
FAULT TYPE		
Fault Type [urn] ShearDisplacementStructure/faultType	?	**For all Faults the property faultType must be populated** with the URN of one c the vocabulary " FaultType".
faultType [string]	O	Type of ShearDisplacementStructure (as defined in GeoSciML).
Fault Type [urn] ShearDisplacementStructure/faultType	?	**For all Faults the property faultType must be populated** with the URN of one c the vocabulary " FaultType".
faultType_uri [string]	M	URI referring to a controlled concept from a vocabulary defining the fault (ShearDi Mandatory property - if no value is provided then a URI referring to a controlled cc value is nil must be provided.

Contact/preferredAge/GeologicEvent
An age as "preferredAge" can be optionally provided for glacial stationary lines

The event Age GeologicEvent/eventAge	M	The eventAge field should be populated as a numeric range (two attributes) or as attribute). The age recorded as a negative number (e.g. -250)
representativeAge_uri [string]	M	URI referring to a controlled concept specifying the most representative stratigrap GeologicUnit. This will be defined entirely at the discretion of the data provider an selected from the geologic feature's geological history or a value summarizing the history.
The event Age GeologicEvent/eventAge	M	The eventAge field should be populated as a numeric range (two attributes) or as attribute). The age recorded as a negative number (e.g. -250)
representativeOlderAge_uri [string]	M	URI referring to a controlled concept specifying the most representative older valu age intervals for the GeologicUnit. This will be defined entirely at the discretion of a single event selected from the geologic feature's geological history or a value su the feature's history.
The event Age GeologicEvent/eventAge	M	The eventAge field should be populated as a numeric range (two attributes) or as attribute). The age recorded as a negative number (e.g. -250)
representativeYoungerAge_uri [string]	M	URI referring to a controlled concept specifying the most representative younger v stratigraphic age intervals for the GeologicUnit. This will be defined entirely at the and may be a single event selected from the geologic feature's geological history or part of the feature's history.
The event process [urn] GeologicEvent/eventProcess	M	It is up to each data provider to present several event process (therefore, several for describing the process that formed the geologic structure. Use the 1GE vocabu
...	O	
The event process [urn]	O	
geologicHistory [string]	O	Text (possibly formatted with formal syntax) description of the sequence of events affected the ShearDisplacementStructure. Events include process and optional er
The event environment [urn] GeologicEvent/eventEnvironment	O	It is up to each data provider to present zero or several event environment (theref distinct names) for describing the environment in which theGeologicStructure was
...	O	vocabulary " EventEnvironment"
The event environment [urn]	O	
The event environment	-	There is no corresponding property in GeoSciML-Portrayal

Mapping OneGeology-Europe GEOLOGIC UNITS to GeoSciML-Portrayal ContactView features

Mapping OneGeology-Europe GEOLOGIC UNITS to GeoSciML-Portrayal ContactView features

GEOLOGIC STRUCTURES. Each feature should have at least the following attributes

featureMember/MappedFeature For each MappedFeature

A unique feature ID	M	This unique ID is often named "fid" within a shapefile

identifier	M	Globally unique identifier for the individual feature. Recommended practice is that this identifier the primary key for the spatial objects in the source data in case information needs to be transf interchange format back to the source database. This identifier is analogous to the identifier for MappedFeature.
Observation method [urn] MappedFeature/observationMethod	?	Always “urn:cgi:classifier:CGI:MappedFeatureObservationMethod:201001:compilation", therefo in the database or within the shapefile: can be directly encoded in the GeoSciML response.
observationMethod [string]	O	Metadata snippet indicating how the spatial extent of the feature was determined. ObservationI convenience property that provides a quick and dirty approach to observation metadata.
The positional accurancy [numerical value] MappedFeature/positionalAccuracy	M	It is recommended that the same, approximate, value be given for all MappedFeatures and will around 250m for a 1:1 million scale map.
positionalAccuracy [string]	O	Preferred use is a quantitative value defining the radius of an uncertainty buffer around a Mapp a positionAccuracy of 100 m for a line feature defines a buffer polygon of total width 200 m cen line. Some other text description that quantifies position accuracy may be provided, e.g. a term vocabulary. Vocabulary used should be described in the dataset metadata.
The sampling frame [urn] MappedFeature/samplingFrame	M	This property should be set to **urn:cgi:feature:CGI:EarthNaturalSurface** for the surface map and **urn:cgi:feature:CGI:BedrockSurface** for the bedrock map
The sampling frame	-	There is no corresponding property in GeoSciML-Portrayal
The geometry MappedFeature/shape	M	
shape [GM_Object]	M	Geometry defining the extent of the feature of interest. This is the only element with complex co contain a GML geome-try that is valid for the Geography Markup Language (GML) simple featu 06-049r1.). The shape value will generally be provided by GIS software, and will need no user
CONTACT: *featureMember/MappedFeature/specification/Contact* The following data are the attributes of the geologic structure which the current mappedFeature is a part of		
A unique Geologic Structure ID [Any type] Contact id	M	Each GeologicStructure should be given a unique identifier.
A unique Geologic Structure ID	-	There is no corresponding property in GeoSciML-Portrayal
The name of the geologic Structure Contact/name	O	Could be a simple name (text) or a urn (see the WP3 explanatory notes)
name [string]	O	Display name for the Contact. Examples: ‘depositional contact’, ‘unconformity’, ‘Martin-Escabr
The observation method [urn] Contact/observationMethod	M	either **urn:cgi:classifier:CGI:FeatureObservationMethod:201001:data_from_single_publis** where the property values are derived from a single source document, or **urn:cgi:classifier:CGI:FeatureObservationMethod:201001:synthesis_of_multiple_publish** where they are derived from multiple source documents.
observationMethod [string]	O	Metadata snippet indicating how the spatial extent of the feature was determined. ObservationI convenience property that provides a quick and dirty approach to observation metadata.
The purpose Contact/purpose	?	For OneGeology-Europe the Purpose property should be set to : **typical_norm**.
The purpose	-	There is no corresponding property in GeoSciML-Portrayal
CONTACT TYPE		
Contact Type [urn] Contact/contactType	?	In OneGeology-Europe Contacts are only being used to describe the linear features delimiting and calderas. Impact craters and calderas are not defined as polygons and the material within should be described using GeologicUnit. • For impact craters the Contact contactType property should be set to **urn:cgi:classifier:CGI:ContactType:201001:impact_structure_boundary** • For calderas the Contact contactType property should be set to **urn:cgi:classifier:CGI:ContactType:201001:volcanic_subsidence_zone_boundary** • For glacial stationary lines the Contact contactType property should be set to **urn:cgi:classifier:CGI:ContactType:201001:glacial_stationary_line** • You may also wish to give the glacial stationary line a name (see WP3 Explanatory notes)
contactType_uri [string]	M	URI referring to a controlled concept from a vocabulary defining the Contact types. Mandatory value is provided then a URI referring to a controlled concept explaining why the value is nil mu
Contact Type [urn] Contact/contactType	?	In OneGeology-Europe Contacts are only being used to describe the linear features delimiting and calderas. Impact craters and calderas are not defined as polygons and the material within should be described using GeologicUnit. • For impact craters the Contact contactType property should be set to **urn:cgi:classifier:CGI:ContactType:201001:impact_structure_boundary** • For calderas the Contact contactType property should be set to **urn:cgi:classifier:CGI:ContactType:201001:volcanic_subsidence_zone_boundary** • For glacial stationary lines the Contact contactType property should be set to **urn:cgi:classifier:CGI:ContactType:201001:glacial_stationary_line** • You may also wish to give the glacial stationary line a name (see WP3 Explanatory notes)
contactType [string]	O	Text label specifying the kind of surface separating two geologic units including primary bounda depositional contacts, all kinds of unconformities, intrusive contacts, and gradational contacts, that separate geologic units. Ideally this would be the preferred label for the concept identified l contactType_uri
Contact/preferredAge/GeologicEvent An age as â€œpreferredAgeâ€ can be optionally provided for glacial stationary lines		

The event Age GeologicEvent/eventAge	M	The eventAge field should be populated as a numeric range (two attributes) or as a single num attribute). The age recorded as a negative number (e.g. -250)
The event process [urn] GeologicEvent/eventProcess	M	It is up to each data provider to present several event process (therefore, several attributes witl for describing the process that formed the geologic structure. Use the 1GE vocabulary " Eventl
...	O	
The event process [urn]	O	
The event environment [urn] GeologicEvent/eventEnvironment	O	It is up to each data provider to present zero or several event environment (therefore, several a distinct names) for describing the environment in which theGeologicStructure was formed. Use
...	O	vocabulary " EventEnvironment"
The event environment [urn]	O	
event age, process, and environment	-	There are no corresponding properties in GeoSciML-Portrayal

Section last modified: 22 March 2016

Considerations for converting a MapServer based OneGeology-Europe service

Adding INSPIRE extended capabilities

When converting a MapServer (+ 1GE Connector) OneGeology-Europe service to an INSPIRE compliant GeoSciML-Portrayal WMS (without the 1GE Connector) the first thing you will need to do is upgrade your MapServer version to 6.2.0 (or above) to ensure you get the Extended Capabilities section.

To update/upgrade your MapServer (on Windows) installation you have several options. The current tested option for 64-bit Windows, Apache 2.4, and MapServer 6.4.1 is to use the GISInternals supplied binaries, see section 4.4.3 for details of how to install and configure such a service. The original method for installing a MapServer for Windows (MS4W) service for OneGeology services has recently been significantly updated but we have not yet had an opportunity to check that it installs and is configured it in the same way as described in the cookbook for earlier versions. Seehttp://www.ms4w.com/ for further details. Another option is to install MapServer by using the OSGeo4W binary distribution, see http://trac.osgeo.org/osgeo4w/ for further details.

For example to add a scenario 1 INSPIRE extended capabilities section (where you have an external XML document or service that provides such a document containing metadata for your WMS service) you would use the following parameters in your SERVICE > WEB > METADATA:

```
"WMS_LANGUAGES" "eng"
"WMS_INSPIRE_CAPABILITIES" "URL"
"WMS_INSPIRE_METADATAURL_FORMAT" "application/xml"
"WMS_INSPIRE_METADATAURL_HREF"
"http://metadata.bgs.ac.uk/geonetwork/srv/en/csw?SERVICE=CSW&REQUEST=GetRecordById&
ID=7822e848-822d-45a5-8584-56d352fd2170&elementSetName=full&OutputSchema=csw:IsoRecord&
```

Which would create:

```
<inspire_vs:ExtendedCapabilities>
    <inspire_common:MetadataUrl xsi:type="inspire_common:resourceLocatorType">
        <inspire_common:URL>http://metadata.bgs.ac.uk/geonetwork/srv/en/csw?SERVICE=CSW
        &REQUEST=GetRecordById&ID=7822e848-822d-45a5-8584-56d352fd2170&elementSetName=full&OutputSc
        </inspire_common:URL>
        <inspire_common:MediaType>application/xml</inspire_common:MediaType>
    </inspire_common:MetadataUrl>
    <inspire_common:SupportedLanguages>
        <inspire_common:DefaultLanguage>
            <inspire_common:Language>eng</inspire_common:Language>
        </inspire_common:DefaultLanguage>
    </inspire_common:SupportedLanguages>
    <inspire_common:ResponseLanguage>
        <inspire_common:Language>eng</inspire_common:Language>
    </inspire_common:ResponseLanguage>
</inspire_vs:ExtendedCapabilities>
```

Or to add a scenario 2 INSPIRE extended capabilities section (where you have no external metadata document for your WMS service) you could add the following parameters:

```
#============================================================================#
# INSPIRE extended capabilities
# Requires MapServer 6.2.0 and above, or the values are ignored
#============================================================================#
            "WMS_LANGUAGES" "eng"
            "WMS_INSPIRE_CAPABILITIES" "embed"
            "WMS_INSPIRE_KEYWORD" "infoMapAccessService"
            "WMS_INSPIRE_MPOC_EMAIL" "enqiries@bgs.ac.uk"
            "WMS_INSPIRE_MPOC_NAME" "Mr Matthew Harrison"
            "WMS_INSPIRE_METADATADATE" "2014-03-28"
            "WMS_INSPIRE_RESOURCELOCATOR" "http://ogc.bgs.ac.uk/cgi-bin/TFL-PSI/ows?"
            "WMS_INSPIRE_TEMPORAL_REFERENCE" "2014-06-06"
```

Which would create:

```
<inspire_vs:ExtendedCapabilities>
    <inspire_common:ResourceLocator>
        <inspire_common:URL>http://ogc.bgs.ac.uk/cgi-bin/TFL-PSI/ows?</inspire_common:URL>
    </inspire_common:ResourceLocator>
    <inspire_common:ResourceType>service</inspire_common:ResourceType>
    <inspire_common:TemporalReference>
        <inspire_common:DateOfLastRevision>2014-06-06</inspire_common:DateOfLastRevision>
    </inspire_common:TemporalReference>
    <inspire_common:Conformity>
        <inspire_common:Specification>
            <inspire_common:Title>-</inspire_common:Title>
            <inspire_common:DateOfLastRevision>2014-06-06</inspire_common:DateOfLastRevision>
        </inspire_common:Specification>
        <inspire_common:Degree>notEvaluated</inspire_common:Degree>
    </inspire_common:Conformity>
    <inspire_common:MetadataPointOfContact>
        <inspire_common:OrganisationName>Mr Matthew Harrison</inspire_common:OrganisationName>
        <inspire_common:EmailAddress>enqiries@bgs.ac.uk</inspire_common:EmailAddress>
    </inspire_common:MetadataPointOfContact>
    <inspire_common:MetadataDate>2014-03-28</inspire_common:MetadataDate>
    <inspire_common:SpatialDataServiceType>view</inspire_common:SpatialDataServiceType>
    <inspire_common:MandatoryKeyword>
        <inspire_common:KeywordValue>infoMapAccessService</inspire_common:KeywordValue>
    </inspire_common:MandatoryKeyword>
    <inspire_common:SupportedLanguages>
        <inspire_common:DefaultLanguage>
            <inspire_common:Language>eng</inspire_common:Language>
        </inspire_common:DefaultLanguage>
    </inspire_common:SupportedLanguages>
    <inspire_common:ResponseLanguage>
        <inspire_common:Language>eng</inspire_common:Language>
    </inspire_common:ResponseLanguage>
</inspire_vs:ExtendedCapabilities>
```

Group layering

To conform to INSPIRE naming requirements for view services you will probably need to group your layers; for example if you have bedrock and surface geology layers in your 1GE service you will need to do this, or if you have different layers for surface age and surface lithology. See section 4.5 of this cookbook for details of how to configure group layering.

When giving a name to your layers one suggestion is prepending the INSPIRE MappedFeature group name to the individual layer names (which should follow the OneGeology WMS profile naming conventions), so for example if you have a number of layers for geologic units (e.g. layers representing bedrock age, bedrock lithology, surface age, and surface lithology) these would according to INSPIRE naming rules need to be part of a layer (e.g. within a grouped layer) called *GE.GeologicUnit*. The OneGeology naming conventions for a layer (see section 2.5 for details) would suggest a name for the surface age layer like *GBR_BGS_EN_1M_Surface_Age*, so combining these we would get an INSPIRE plus OneGeology layer name of *GE.GeologicUnit_GBR_BGS_EN_1M_Surface_Age*. This convention is OK if you are intending to publish a WMS only service,

however if you also intend to publish a GeoSciML-Portrayal WFS using the same configuration, you will find that there is an issue with the Feature Identifiers that is, your identifier will have a structure like *GE.GeologicUnit_GBR_BGS_EN_1M_Surface_Age.10*, and such a structure (with two or more dots) causes an error when doing a GetFeature request by ID; as MapServer seems to regard everything after the first dot as the feature identifier.

For example a request like:

```
http://.../BGS_OGE_Bedrock_and_Surface_Geology/ows?service=WFS&request=GetFeature&version=1.1.0&Fea
```

Results in the following error:

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<ows:ExceptionReport xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:ows="http://www.op
language="en-US" xsi:schemaLocation="http://www.opengis.net/ows http://schemas.opengis.net/ows/1.0.
  <ows:Exception exceptionCode="InvalidParameterValue" locator="featureid">
    <ows:ExceptionText>msWFSGetFeature(): WFS server error. Invalid FeatureId in GetFeature. Expect
  </ows:Exception>
</ows:ExceptionReport>
```

If you are also publishing a GeoSciML-Portrayal WFS using the same configuration, then you must either substitute underscores for the dot in the INSPIRE name (*GE.GeologicUnit* becomes *GE_GeologicUnit*) or omit the INSPIRE component completely.

Updating the class files and data

If your OneGeology-Europe service was based on a database, then you will just need to use an INNER JOIN in the relevant database tables using the mapping tables supplied in Appendix L; that is you just need to add some new columns into the database, using the GeoSciML-Portrayal names as the field names. You can keep the original LAYER > CLASSes in your map file and be able to show both the original OneGeology symbology (the default style), and also be able to provide different portrayals through the application of an external SLD, such as through the OneGeology portal.

If your OneGeology-Europe service was based on a shapefile, you may need to create new classes (you can keep the old classes and have these serve a different (original) symbology if desired). You may need to create new classes for a service based on a shapefile because a shapefile can only have field names up to 10 characters long and GeoSciML-Portrayal requires some field names up to 28 chararaters, (and the standard SLD files such as those used by the portal expect the full GeoSciML-Portrayal names). It is possible that you can get around this restriction by using the GML aliasing ability (see the WFS considerations section below for examples), but we have not tested this for a GeoSciML-Portrayal WMS.

Handing fields for which you have no data

As GeoSciML-Portrayal requires data (or URIs pointing to null value reasons) for data that was not required in the OneGeology-Europe services, you have a few options with MapServer if you don't have the required data (for example a specification_uri for all features). Option 1 would be to create a column in the data source and populate the rows with null value URIs (such as for example with the value http://inspire.ec.europa.eu/codelist/VoidReasonValue/Unknown/). Option 2 would be to populate the missing values within the GetFetaureInfo request template, such as below:

```
<!-- MapServer Template -->
<dl>
    <dt>identifier</dt>
    <dd>[OBJECTID]</dd>
    <dt>name</dt>
    <dd>[Name]</dd>
    <dt>faultType_uri</dt>
    <dd>[faultType_uri]</dd>
    <dt>positionalAccuracy (m)</dt>
    <dd>[PositionalAccuracy]</dd>
    <dt>movementType_uri</dt>
    <!-- Here we provide an INSPIRE nil reason for the missing movementType_uri -->
    <dd>http://inspire.ec.europa.eu/codelist/VoidReasonValue/Unknown</dd>
    <dt>deformationStyle_uri</dt>
    <!-- Here we provide an INSPIRE nil reason for the missing deformationStyle_uri -->
    <dd>http://inspire.ec.europa.eu/codelist/VoidReasonValue/Unknown</dd>
    <dt>representativeOlderAge_uri</dt>
    <dd>[representativeOlderAge_uri]</dd>
    <dt>representativeYoungerAge_uri</dt>
```

```
    <dd>[representativeYoungerAge_uri]</dd>
    <dt>representativeAge_uri</dt>
    <dd>[representativeAge_uri]</dd>
    <dt>specification_uri</dt>
    <!-- Here we supply a link to our Feature (using our Simple Fetaure GeoSciML-Portrayal WFS).
    This information isn't in the database and we can update to a full GeoSciML response when avail
    In the actual template we have this as a link -->
    <dd>http://ogc2.bgs.ac.uk/cgi-bin/BGS_OGE_Bedrock_and_Surface_Geology_in3/ows?service=WFS&
    request=GetFeature&version=1.1.0&&FeatureID=GBR_BGS_EN_1M_Surface_Fault.[OBJECTID]&</dt>
    <!-- Here we supply a link to some metadata for our datasource that isn't in the database
    In the actual template we have this as a link -->
    <dd>http://metadata.bgs.ac.uk/geonetwork/srv/en/iso19139.xml?id=6075</dd>
</dl>
```

Another option would be to configure some GML constants, see the below section on WFS considerations for the configuration details.

GeoSciML-Portrayal (simple feature ~ GML SF-0) WFS considerations

Whilst configuring a WFS is outside of the scope of this WMS cookbook, the following section is included to help you migrate your OneGeology-Europe (WMS+WFS) service to a GeoSciML-Portrayal (WMS + WFS) service; it should be noted however that such a simple feature WFS would not meet the requirements for an INSPIRE compliant download service - a full GeoSciML 4.0 complex property WFS is required for INSPIRE.

In the MAP > WEB > METADATA section you can set the default WFS language, and also configure a namespace prefix and uri GeoSciML-Portrayal for like:

```
"WFS_LANGUAGES" "eng"
"WFS_NAMESPACE_PREFIX" "gmlsp"
"WFS_NAMESPACE_URI" "http://xmlns.geosciml.org/geosciml-portrayal/4.0"
```

In any LAYER > METADATA section you can define any number of GML constants. You can use this mecahnism as a way to add nil values or other constant information that is missing from your data source but required by the GeoSciML-Portrayal schema, or simply because you wish to supply it.

In this example (below) we have used this mechanism to populate specification_uri and metadata_uri which were required with GeoSciML-Portrayal version 2; in the current version 4.0 these propreties are now optional.

```
"GML_CONSTANTS" "specification_uri,metadata_uri"
"GML_metadata_uri_TYPE" "string"
"GML_metadata_uri_VALUE" "http://metadata.bgs.ac.uk/geonetwork/srv/en/iso19139.xml?id=6
"GML_specification_uri_TYPE" "string"
"GML_specification_uri_VALUE" "http://inspire.ec.europa.eu/codelist/VoidReasonValue/Unp
```

Once a constant has been defined for a layer, the constant can be access in a template using the standard notation.

In any LAYER > METADATA section you can specify which items in your datasource to include (or exclude) in your Feature response, so in this below example we are saying effectively include everything (GML_INCLUDE_ITEMS) except (GML_EXCLUDE_ITEMS).

```
"GML_INCLUDE_ITEMS" "all"
"GML_EXCLUDE_ITEMS" "AgeMax,AgeMin,EventEnvironment,EventProcess,Lithology_1,Proportion
ProportionTerms_2,GeologicUnitPartRole_2,Lithology_3,ProportionTerms_3,GeologicUnitPart
GeologicUnitPartRole_4,Lithology_5,ProportionTerms_5,GeologicUnitPartRole_5,Metamorphic
SamplingFrame,GUObservationMethod,GUPurpose,SHAPE_Length,SHAPE_Area,RELEASED,gu_id,mf_i
```

In any LAYER > METADATA section you can specify an alias to be used in your feature response, so for example if your feature identifier is called *OBJECTID* in your database you can alias it to the required *identifier*, or if you want to change the case of a field (or property) from *Name* to *name* you would use:

```
"GML_OBJECTID_ALIAS" "identifier"
"GML_Name_ALIAS" "name"
```

You can specify your own grouping of the properties (and the order in which they appear) within a feature and give this grouping a

name like below. If you have used any aliases you must reference the original name and not the alias value in the grouping, though the alias will appear in the output.

```
"GML_GROUPS" "ShearDisplacementStructureView"
"GML_ShearDisplacementStructureView_GROUP" "OBJECTID,Name,faultType,observationMethod,p
movementType_uri,deformationStyle_uri,representativeAge_uri,representativeOlderAge_uri,
specification_uri,metadata_uri"
```

Section last modified: 10 December 2015

Changes June 2013

The below is a list of principal changes and updates to this cookbook since the last major update

- New guidance on layer **names** for OneGeology services
- Added section on using MapInfo to view OneGeology content
- New information on the Coordinate Reference Systems used in the OneGeology Portal
- Added sections on how to configure a WMS to provide GeoSciML-Portrayal content
- Updated screenshots in the cookbook so they show the new OneGeology Portal interface.
- Added section on how to use the GISInternals version of MapServer to create your service
- Added sections on new functionality in the OneGeology Portal
- General edits: corrected typos, made link corrections and amendments, changed some page styling

Section last modified: 13 June 2013

Changes August 2013

The below is a list of principal changes and updates to this cookbook since the last major update

- Added section on how to use a shapefile as data source in GeoServer
- Added section on how to use GeoServer Application schema add-in
- General edits: corrected typos, made link corrections and amendments, changed some page styling

Section last modified: 23 August 2013

Changes September 2014

The below is a list of principal changes and updates to this cookbook since the last major update

- Updated section on using the thematic analysis tools, to include new capabilities
- Added section on how to view service layers in multiple projections

Section last modified: 23 September 2014

Changes October 2015

The below is a list of principal changes and updates to this cookbook since the last major update

- Removed introduction section (moved to a separate how to section)
- Reorganized cookbook moving GeoServer configuration to WMS configuration section (from portrayal)
- Added information on how to help make a service INSPIRE compliant, whilst remaining conformant to the OneGeology profile.
- Added information on how configure group layering

Section last modified: 5 October 2015

Changes November 2015

The below is a list of principal changes and updates to this cookbook since the last major update

- Clarified the use of terms in the English keyword dictionary picklist.

Section last modified: 13 November 2015

Changes December 2015

The below is a list of principal changes and updates to this cookbook since the last major update

- Updated the cookbook sections on GeoSciML-Portrayal to reflect the release and use of version 4.0 instead of the originally documented version 2.0 (which is now deprecated).

Section last modified: 10 December 2015

Changes February 2016

The below is a list of principal changes and updates to this cookbook since the last major update

- Updated the ArcGIS section to include configuring group layering and named styles.

Section last modified: 19 February 2016

Changes March 2016

The below is a list of principal changes and updates to this cookbook since the last major update

- Updated the ArcGIS section to include configuring INSPIRE extended capabilities.
- Updated the Mapping OneGeology-Europe data model to GeoSciML-Portrayal section, clarified purpose of mapping table, and added spreadsheets for mapping EventEnvironment and EventProcess URNs to their CGI/INSPIRE URIs.

Section last modified: 23 March 2016