# WMS-T User Stories / Use Cases / Requirements

## Revision history

This is revision 3 of this document. This revision removes the costings which are now supplied separately by our financial system.

Revision 2 of this document, removed the following use cases from the proposal presented in version 1:

- Epic 1: User Story 5: Layout map item supporting time constraints
- Epic 1: User Story 6: Support temporal constraints for vector layers

Revision 2 of this document added:

- support DIM_REFERENCE_TIME is added for Epic 1, User Story 4
- Added Epic 3: User Story 1: Logging of network requests

## Glossary:

**WMS-T** - Temporal Web Mapping Services - a web portal service capable of rendering a web map in time slices. Passing a date/time parameter to the service will cause it to render data for that date/time. http://www.opengeospatial.org/standards/wms
DIM_REFERENCE_TIME -
**QGIS** - Free, Open Source Desktop GIS - see http://qgis.org
**OGC** - Open Geospatial Consortium - the organisation defining open standards for the geospatial industry. http://www.opengeospatial.org/standards
**Time Manager** - a popular plugin for QGIS for working with temporal data. https://github.com/anitagraser/TimeManager
QEP - https://github.com/qgis/QGIS-Enhancement-Proposals/issues/128

# Scope:

### Need

“To be able to work with temporally bound datasets delivered by WMS-T in QGIS”

## Goals & Objectives

- a clean implementation such that other temporally bound data sources can be supported using the same paradigm
- updated user interface elements in QGIS that will allow users to discover the range of temporal data in a data source and select a particular time slice from that dataset.
- to have a way in future to support the creation of temporal animations for all formats of temporally based data (similar to those currently provided by the time manager plugin), including raster datasets such as WMS-T, vector data with date/time attributes, and potentially in the future, temporal data collection formats such as NetCDF.

## Missions (Business Case)

The mission of this work is to create the basic infrastructure for temporal datasets in QGIS and to allow users to visualise different time slices from these datasets.

## Identification of Key Use Cases (Operational Concepts)

- to add a WMS-T layer to QGIS, specifying the time slice to be displayed
- to be able to specify a specific time slice (using an expression if desired) in QGIS layouts and reports so that a map designed in the layout manager will be 'pinned' to a particular time slice
- to be able to 'walk' through time slices in each temporally enabled map layer and render them sequentially to the display
- when viewing a list of available layers in remote WMS services in QGIS browser, we want to be able to manually force a refresh to bypass the layer cache

# References:

1. OpenGIS Web Map Service (WMS) Implementation Specification
2. http://www.opengis.net/doc/bp/wms-tnz/1.0 - use case for WMS-T implementation
3. https://qgis.org/api/classQgsMapCanvas.html
4. https://qgis.org/api/classQgsRasterLayer.html
5. https://qgis.org/api/classQgsMapSettings.html
6. https://issues.qgis.org/issues/17648 - ticket for WMS refresh support
7. https://issues.qgis.org/issues/14396 - older ticket relating to WMS refresh
8. https://github.com/qgis/QGIS-Enhancement-Proposals/issues/128 - WMS-T
9. http://apps.socib.es/Leaflet.TimeDimension/examples/ - Inspiration of WMS-T examples in leaflet

## Assumptions

Assumptions about the project must be stated. Assumptions require some work to prevent them from becoming risks. This additional work should happen as soon as possible once the project starts. It is highly recommended to allocated specific individuals to validate each assumption.

- we will support only WMS 1.3.0 specification for WMS support
- our work will be accepted by the QGIS community. We cannot guarantee this but we have catered for this community acceptance process in our project design.
- we will exclude elevation from our dimensional data concept for this work

## Risks

Major product risks which compromise project success should be listed. Like the assumptions, these will require work early in the project. It is also highly recommended to allocated specific individuals to manage each risk.

- we do not scope the work correctly and overcommit ourselves
- we encounter a major technological hurdle that we cannot overcome or takes a long time to overcome

## Constraints

Constraints on the project may include budget, schedule, human resources, political, technological. Anything that constrains the solution space.

- we have limited time and we want to limit the complexity of work we undertake so may need to limit the scope of some features
- we may encounter blockers in delivering this work that make it difficult to guarantee delivery to specific deadlines. In particular the system of community review in QGIS means that we cannot guarantee when features get merged.

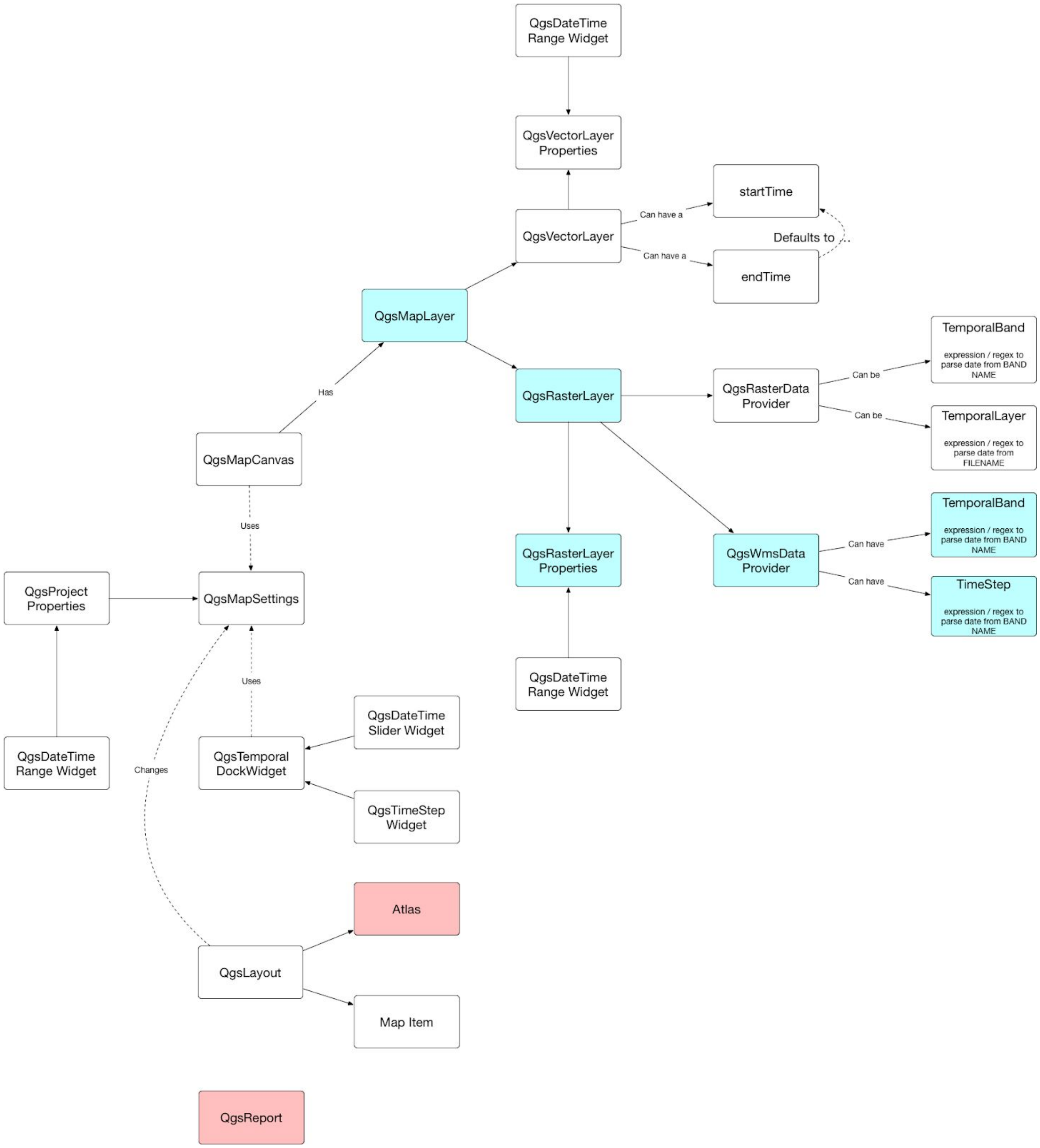
## Authority/Responsibilities

Identify divisions of responsibilities between the customer/client and the supplier.

1. Canadian partner organisation
   a. Mapgears
2. Kartoza
   a. Kartoza shall employ the principles of the Essential SAFe agile framework in the implementation of the project. In terms of responsibilities in the SAFe® framework, refer to the Kartoza SAFe® implementation description.
   b. Kartoza shall convene monthly progress meetings with the Client during which progress shall be presented and discussed.
   c. Kartoza shall be the lead developer on this project.
3. North Road
   a. North Road shall provide expert advice during the project.

   b. They shall work to ensure that any code developed is an acceptable candidate for merging into the QGIS master branch.
   c. They shall assist with architecture and design considerations.
4. Customer
   a. The Customer shall act as key stakeholder and will provide access to additional stakeholders

# Context Diagram



# Epics:

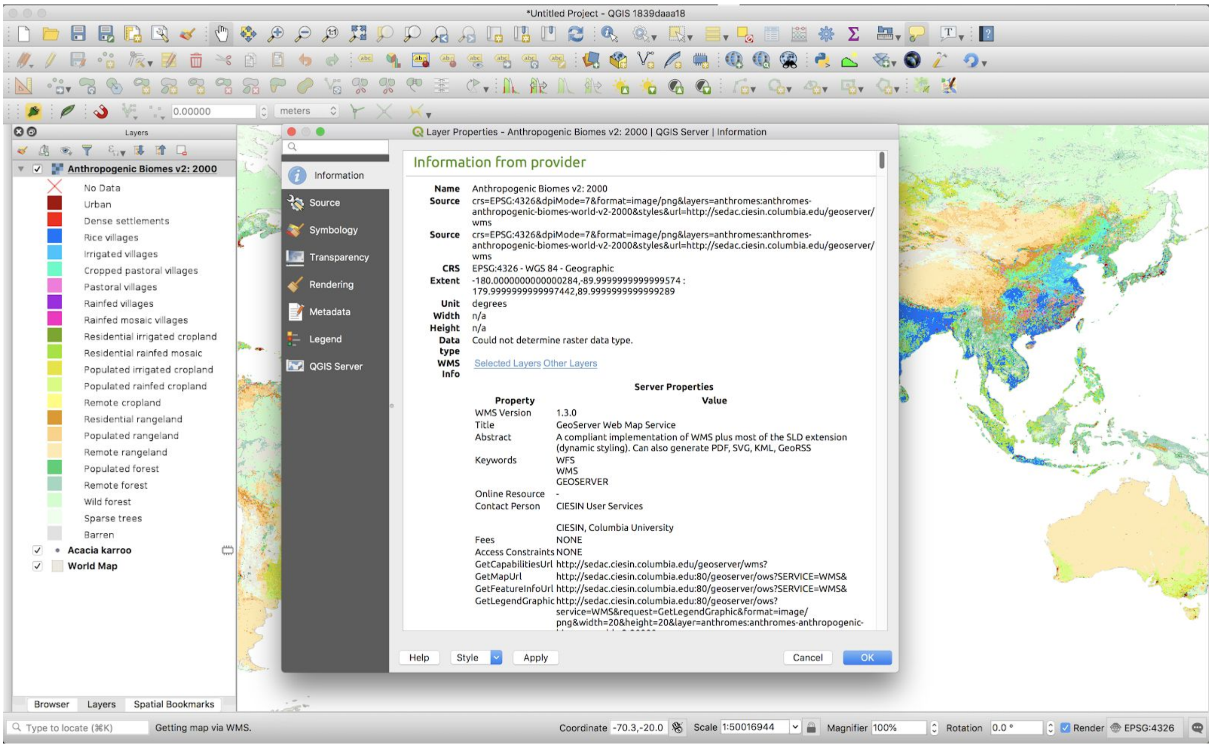
1. QGIS Desktop WMS-T Support
2. Enhanced management of W*S Capabilities caching
3. Logging of network requests

# User Stories

## EPIC 1: QGIS Desktop WMS-T Support

### ✔ User Story 1: Status: Completed

**Expectation:** As a QGIS user, when I add a WMS-T layer to QGIS, I want to see the time range and interval metadata for that data source clearly displayed in the QGIS layer metadata panel.



Information from provider

**Name** Anthropogenic Biomes v2: 2000
**Source** crs=EPSG:4326&dpiMode=7&format=image/png&layers=anthromes:anthromes-anthropogenic-biomes-world-v2-2000&styles&url=http://sedac.ciesin.columbia.edu/geoserver/wms
**Source** crs=EPSG:4326&dpiMode=7&format=image/png&layers=anthromes:anthromes-anthropogenic-biomes-world-v2-2000&styles&url=http://sedac.ciesin.columbia.edu/geoserver/wms
**CRS** EPSG:4326 - WGS 84 - Geographic
**Extent** -180.0000000000000284,-89.9999999999999574 : 179.9999999999997442,89.9999999999999289
**Unit** degrees
**Width** n/a
**Height** n/a
**Data type** Could not determine raster data type.
**WMS Info** Selected Layers Other Layers

**Server Properties**

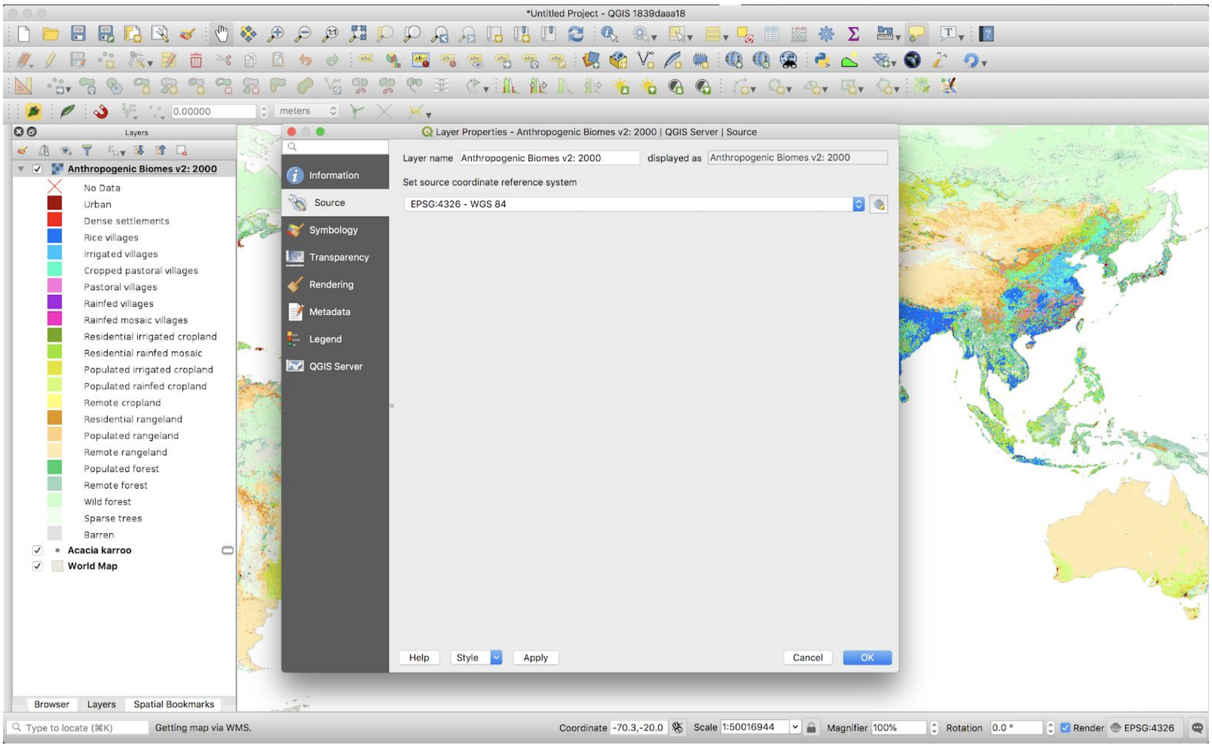
| Property | Value |
|---|---|
| WMS Version | 1.3.0 |
| Title | GeoServer Web Map Service |
| Abstract | A compliant implementation of WMS plus most of the SLD extension (dynamic styling). Can also generate PDF, SVG, KML, GeoRSS |
| Keywords | WFS<br>WMS<br>GEOSERVER |
| Online Resource | - |
| Contact Person | CIESIN User Services<br><br>CIESIN, Columbia University |
| Fees | NONE |
| Access Constraints | NONE |
| GetCapabilitiesUrl | http://sedac.ciesin.columbia.edu/geoserver/wms? |
| GetMapUrl | http://sedac.ciesin.columbia.edu:80/geoserver/ows?SERVICE=WMS& |
| GetFeatureInfoUrl | http://sedac.ciesin.columbia.edu:80/geoserver/ows?SERVICE=WMS& |
| GetLegendGraphic | http://sedac.ciesin.columbia.edu:80/geoserver/ows?service=WMS&request=GetLegendGraphic&format=image/png&width=20&height=20&layer=anthromes:anthromes-anthropogenic- |

Since WMS is a read-only source, we do not propose to make these metadata editable in the metadata tab.

**Acceptance criteria: Given** that the WMS Capabilities parser is verified through unit testing to meet the specified requirements, **when** a user adds a WMS-T layer in QGIS **then** the temporal range and interval shall be visible in the metadata panel.

## User Story 2:

**Expectation:** As a QGIS user, when I add a WMS-T layer, I want to be able to constrain the date range for that datasource and alter the default interval.



*Untitled Project - QGIS 1839daaa18

Layer Properties - Anthropogenic Biomes v2: 2000 | QGIS Server | Source

Layer name Anthropogenic Biomes v2: 2000 displayed as Anthropogenic Biomes v2: 2000

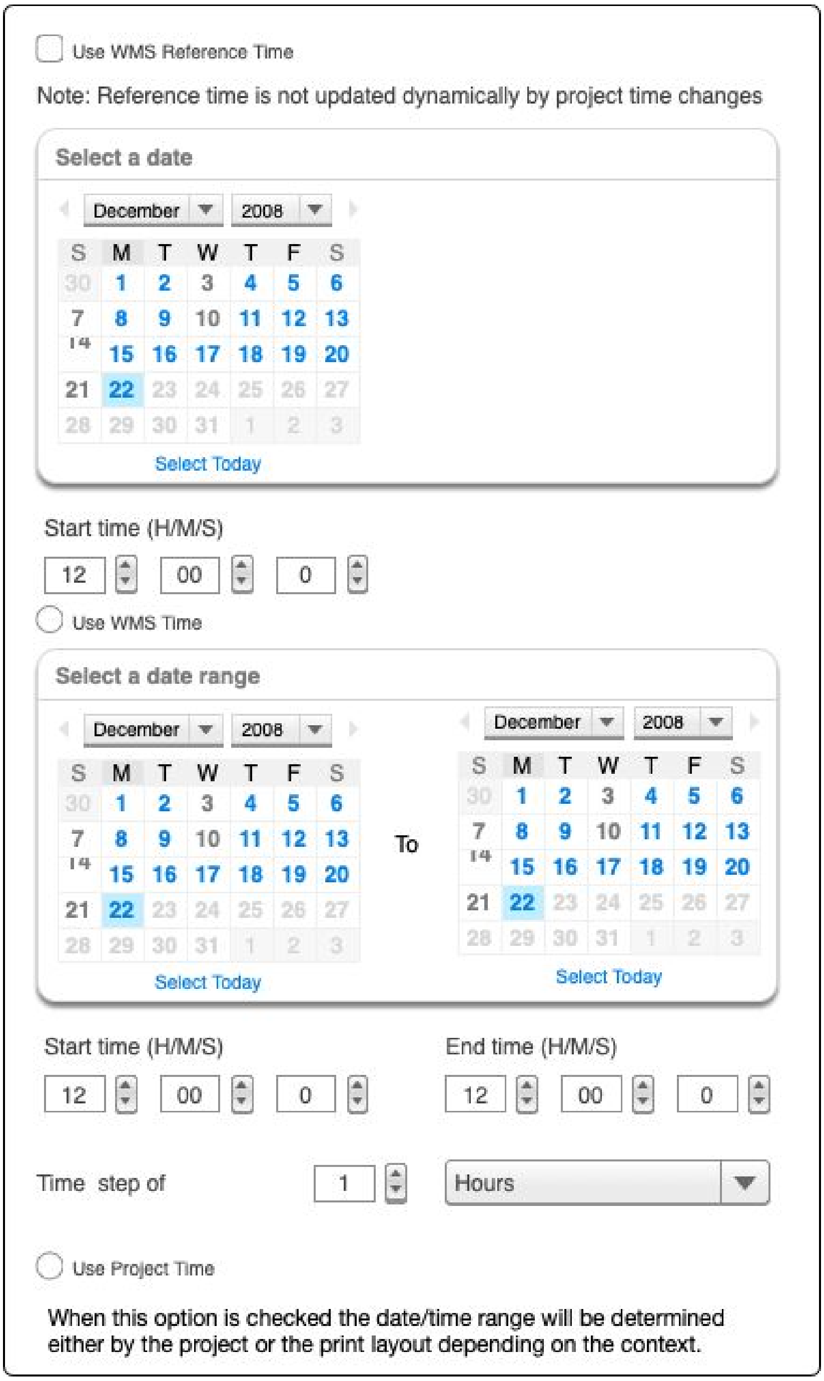
Set source coordinate reference system

EPSG:4326 - WGS 84

Getting map via WMS.

Coordinate -70.3,-20.0 Scale 1:50016944 Magnifier 100% Rotation 0.0 ° ☑ Render EPSG:4326

We propose to add into the source tab for a time-based layer’s properties the ability to define the desired time range as per the mock-up below (style and layout may differ in final version):



□ Use WMS Reference Time

Note: Reference time is not updated dynamically by project time changes

Select a date

December ▾ 2008 ▾

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 30 | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 28 | 29 | 30 | 31 | 1 | 2 | 3 |

Select Today

Start time (H/M/S)

12 : 00 : 0

○ Use WMS Time

Select a date range

December ▾ 2008 ▾

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 30 | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 28 | 29 | 30 | 31 | 1 | 2 | 3 |

Select Today

To

December ▾ 2008 ▾

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 30 | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 28 | 29 | 30 | 31 | 1 | 2 | 3 |

Select Today

Start time (H/M/S)

12 : 00 : 0

End time (H/M/S)

12 : 00 : 0

Time step of 1 Hours ▾

○ Use Project Time

When this option is checked the date/time range will be determined either by the project or the print layout depending on the context.

Two modalities will be supported for WMS time specifications:

1. The use of a **product time** (e.g. the time which the provided dataset is intended to reflect) which will be appended to a request in the form of *time = [2015-10-10T12:00:00Z, 2015-10-11T00:00:00Z]*

2. The use of a **reference time** (e.g. the time when a product model ran) which will be appended to WMS requests in the form of *dim_reference_time=2015-10-10T00:00:00Z*

*Example: We have a weather forecast for 5 days time which was generated today.*

*The Product Time will be today + 5 days*
*The Reference Time will be today*

These modalities can be used together by only the product time will be used for the QGIS global time slice as described in Use Case 4 below.

As well as a user interface to support time-based configuration, the C++ and Python API's will be extended to support the new options.

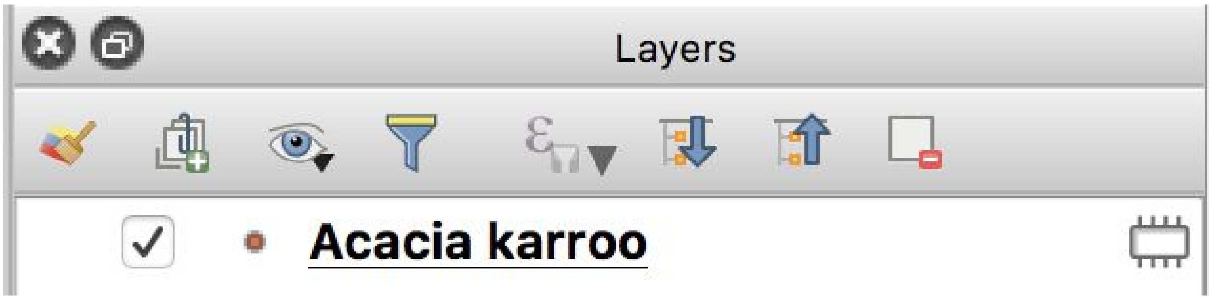
**Acceptance criteria:**

1) **Given** that the API is verified through unit testing to meet the specified requirements, **when** a layer has a time restriction in place it **shall** render data only for that time slice.
2) **Given** that a user interacts with the QGIS user interface, **when** they enter time constraints in the layer properties, it **shall** only the render only data for the selected time slice.

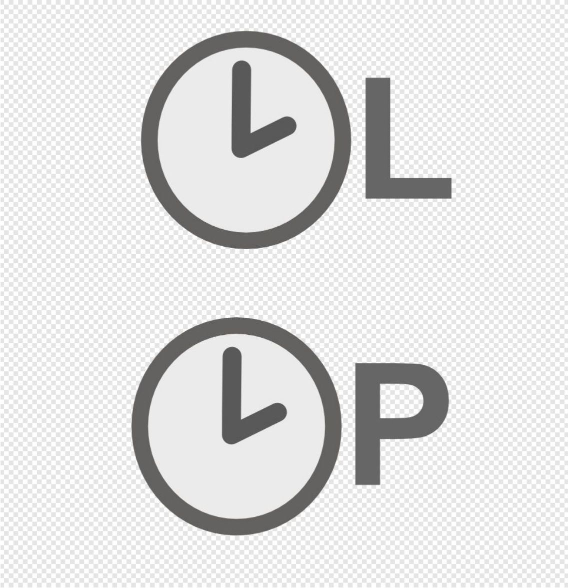
## User Story 3:

**Expectation:** As a QGIS user, when I have a WMS-T layer, I want to be able to see at a glance whether the layer is showing a time snapshot and whether that time snapshot is constrained by the layer or the project / layout.

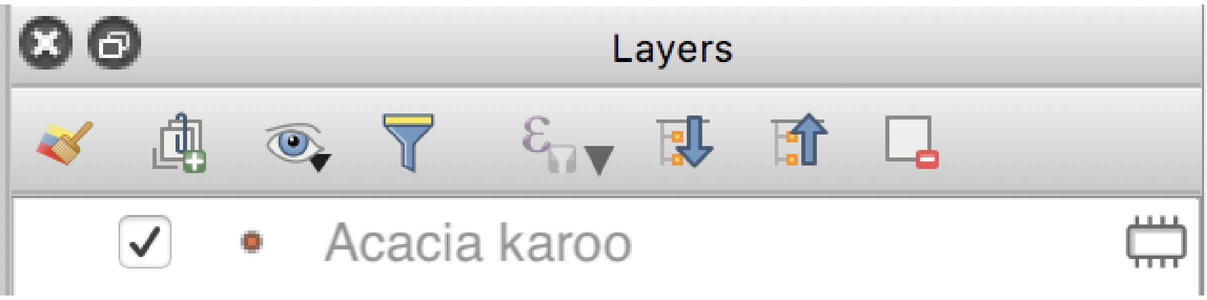
QGIS 3.4 supports the placement of small "indicator" icons next to a layer as per the memory layer example below:



We will add new icons to WMS-T and other time based layers to indicate whether these layers are time constrained by the layer properties or the project / layout properties. The following is a mock up to illustrate this, although we will work with our designer to introduce non-alphanumeric representations of this concept to keep the design locale neutral.



When a layer is time constrained and falls outside of the effective time envelope, the text of the layer legend will be rendered with a grayed out appearance.

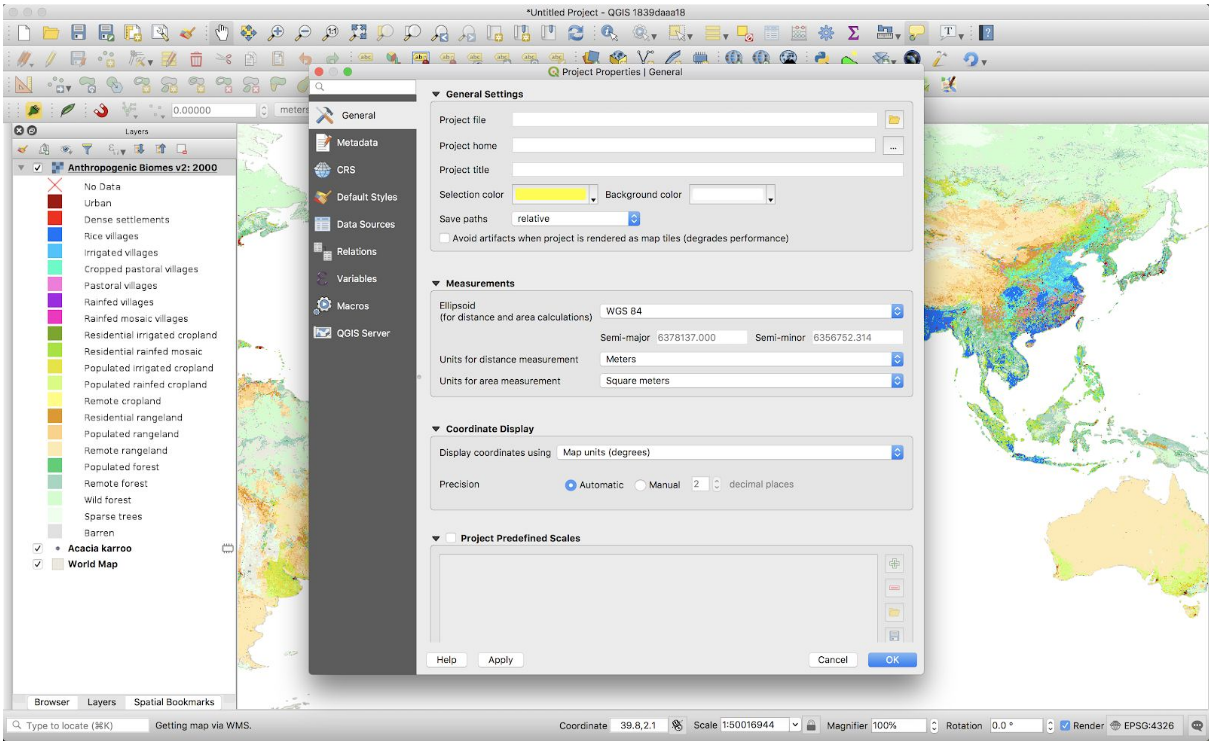


**Acceptance criteria: Given** that the visual indicators have been implemented, **when** a user enables time constraints on a layer **then** these this layer shall have an indicator next to it and be grayed out if it falls outside of the time window.

## User Story 4:

**Expectation:** As QGIS User I want to be able to globally set a time slice and time step for the main map canvas and have all time-aware layers rendered according to this time slice.

This use case will be used in conjunction with **User Story 2** above. We will introduce a new group box to the project properties dialog, general tab:



Getting map via WMS.

Coordinate 39.8,2.1 Scale 1:50016944 Magnifier 100% Rotation 0.0 ° ☑ Render EPSG:4326

**General Settings**

Project file

Project home

Project title

Selection color Background color

Save paths: relative

□ Avoid artifacts when project is rendered as map tiles (degrades performance)

**Measurements**

Ellipsoid (for distance and area calculations): WGS 84

Semi-major 6378137.000 Semi-minor 6356752.314

Units for distance measurement: Meters

Units for area measurement: Square meters

**Coordinate Display**

Display coordinates using: Map units (degrees)

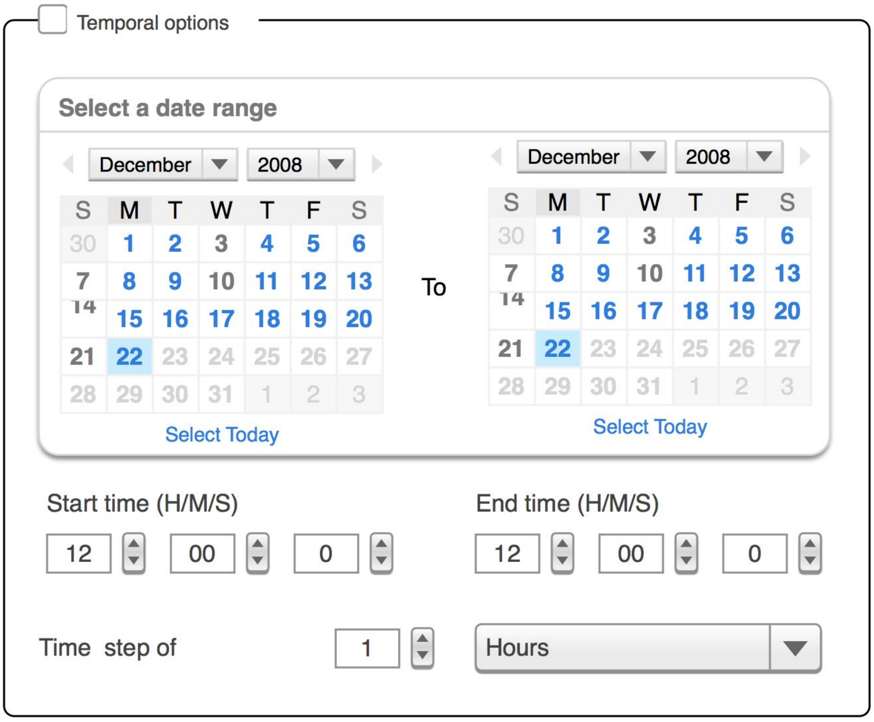
Precision ● Automatic ○ Manual 2 decimal places

**□ Project Predefined Scales**

This group box will have three widgets:

- Start date/time
- End date/time
- Step interval

The wireframe below mocks up the UI for this (style and layout may differ in final version).


□ Temporal options

Select a date range

December 2008

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 30 | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 28 | 29 | 30 | 31 | 1 | 2 | 3 |

Select Today

To

December 2008

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 30 | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| 28 | 29 | 30 | 31 | 1 | 2 | 3 |

Select Today

Start time (H/M/S) 12 00 0

End time (H/M/S) 12 00 0

Time step of 1 Hours

When a temporal layer falls outside of the project time range it shall be grayed out in the legend.

**Acceptance criteria: Given** that temporal support in QgsProject is verified  through unit testing to meet the specified requirements, **when** a user enables project level temporal options **then** all time based layers in QGIS shall be filtered to match the global project level time step.

## User Story 5: De-Scoped

**Expectation:** As QGIS User I want to be able to set a time slice for a **map layout** and have all time-aware layers rendered in the print layout according to this time slice.

## User Story 6:: De-Scoped

**Expectation:** As a QGIS user, when I add a vector layer, I want to be able to constrain the date range for that datasource and alter the time step interval.

## User Story 7:

**Expectation:** As a QGIS user, I want to be able to use a ‘time slider widget’ to adjust the active time slice that is displayed on the map canvas.

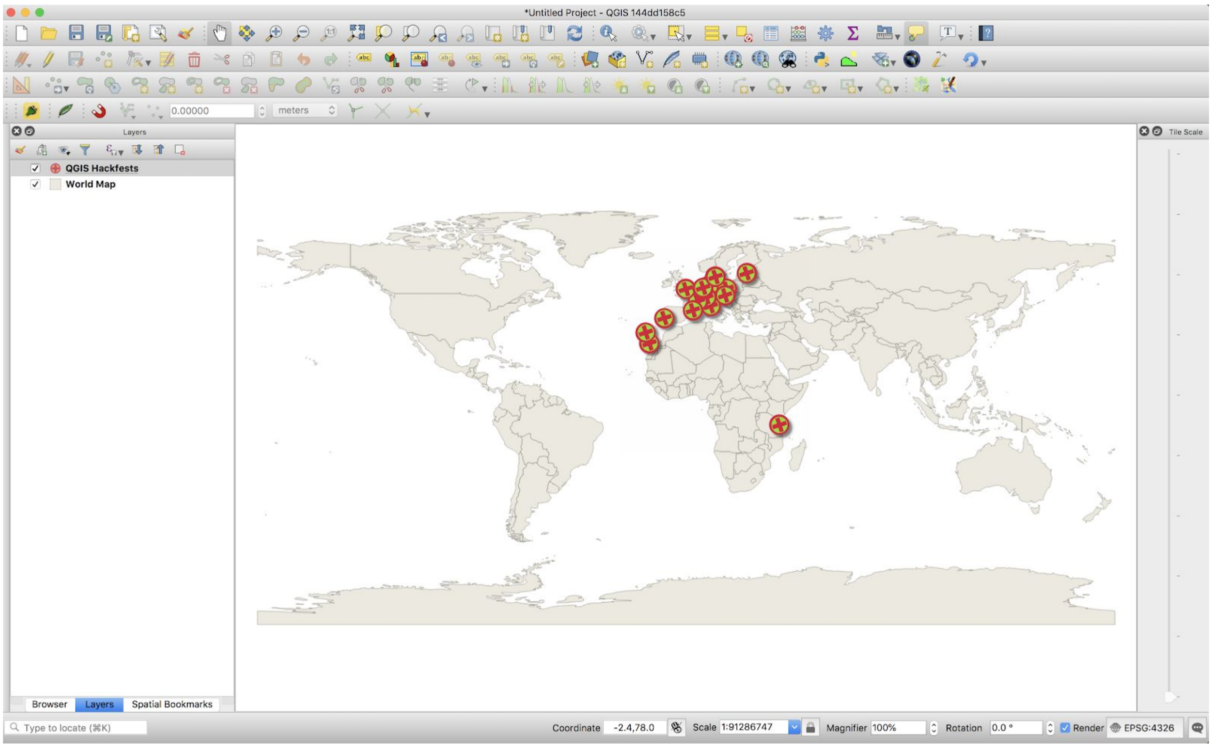
**Dependencies:** User story 4

This requirement progresses the QGIS code base to provide an experience that is quite similar to that offered by the **Time Manager plugin**.

We propose to add a new widget that will be superficially similar to the current ‘Tile Scale’ widget (see image below). The slider in the widget will move the current canvas time forward or backwards in increments (as specified by the time increment implemented in User Story 4).

The lower and upper bounds of the time range will be defined by the time bounds set in the project properties (User Story 4).

Layers that do not have their time options set to be controlled by canvas/layout times will not be affected by these changes.



***Note** that this is not a core requirement for WMS-T support but we want to do this as part of the work proposal because there was a desire within the QGIS project to have WMS-T support implement as common infrastructure to the project. Adding Vector support will demonstrate that this common infrastructure can be used in different contexts.*

**Acceptance criteria:**

**Given** that a user interacts with the QGIS user interface, **when** they adjust the time slider in the Time Panel, QGIS **shall** only the render only data for the selected time slice.

# Out of scope

In the QEP (QGIS enhancement proposal) various other options and proposals are made. In addition while writing this proposal various other potential considerations came to light. We would like to specifically exclude the following for the initial scope of work:

- **Layouts** - Atlas will probably work using the expressions for map item date range but for this proposal we will make no effort to expose to Atlas via data defined start/end time for map items - alternative to iterating over features, iterate over time slices.
- **Reports** - out of scope
- **Multi-canvas** support - out of scope
- **Time manager** - it should be able to hook into core features for slider, time start / end fields for a layer….eventually aim to deprecate time manager but not right at the start. We will not ourselves make any changes to the Time Manager plugin.
- **Raster layers** - hide or show based on the layer's date / time metadata. Out of scope.

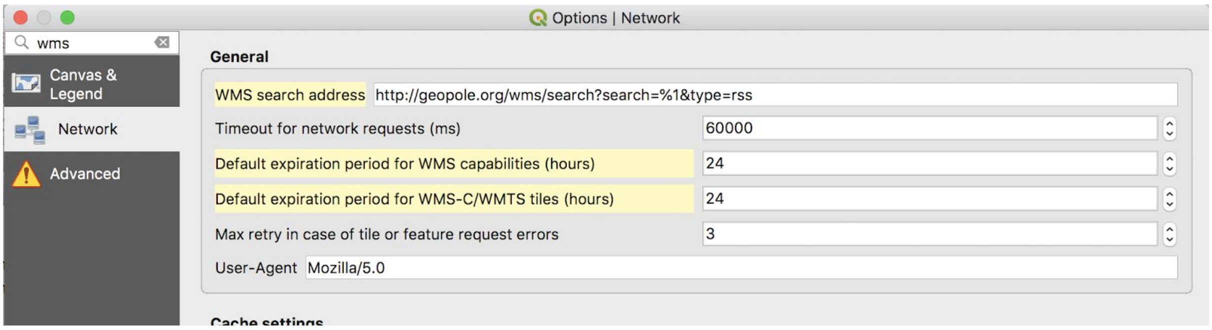
- **Raster layer archives** - formats such as NetCDF can contain multiple sub layers each for a specific time slice. Configuring these as time based layers is out of scope.
- **Temporally named rasters** - Some users may possess directories of raster files that follow a date based naming convention. Supporting these is out of scope.
- **Caching** - no special behaviour will be added to cache recent getMap requests. Normal QGIS layer caching will be supported with no code changes.
- **Time increments** - when we don’t have absolute time (in vector data) for now we would require users to make a virtual time/date field with a contrived time based on the increment number
- **Other dimensional data** - no support will be provided for dimensional data such as elevation.
- **Map themes** - QGIS map themes would not be time aware for now
- **Labels - no support for non-cached labels yet, no other label specific changes will be made.**
- **Animation** - no support for animation either at a layer’s WMS request level or at a canvas level. Third party tools such as Time Manager may utilise our API to add animation support. Animation was requested by the client but we suggest to descope it for the first round of work.

# EPIC 2: Improved management of WMS Caching

## **(required)**

**Expectation:** As a provider of OGC web services, when I alter, add or remove published layers, I would like QGIS users to be able to see these changes immediately.

Currently QGIS caches getCapabilities requests to reduce UI latency and network load. At times however, this caching mechanism can cause confusion for users (and service administrators) when they are expecting to see the updated collection of available layers. This caching mechanism can be bypassed by setting the expiration period for WMS Capabilities in the QGIS settings dialog to 0 (as shown in the image below).



WMS search address http://geopole.org/wms/search?search=%1&type=rss

Timeout for network requests (ms) 60000

Default expiration period for WMS capabilities (hours) 24

Default expiration period for WMS-C/WMTS tiles (hours) 24

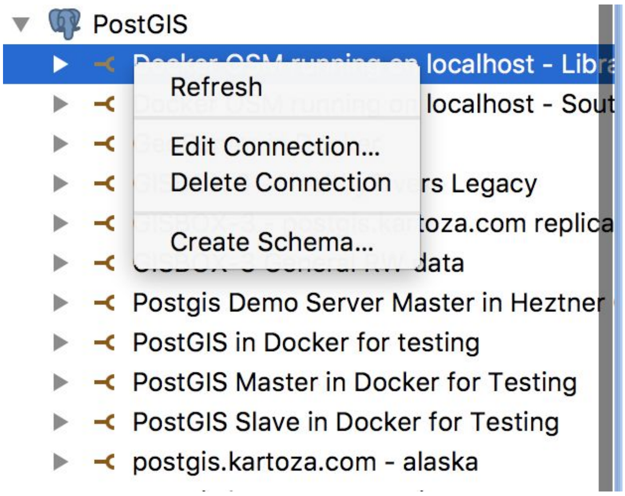
Max retry in case of tile or feature request errors 3

User-Agent Mozilla/5.0

However this solution is not optimal because:

1. It is hard for users to discover
2. Disabling caching will have a negative effect on application performance and places unneeded load on servers.

To address this we will add a refresh context menu to each OGC service entry point similar that that which is currently implemented for PostGIS connections (as illustrated below):


PostGIS
localhost - Libra
Refresh
localhost - Sout
Edit Connection...
Delete Connection
rs Legacy
toza.com replica
Create Schema...
data
Postgis Demo Server Master in Heztner
PostGIS in Docker for testing
PostGIS Master in Docker for Testing
PostGIS Slave in Docker for Testing
postgis.kartoza.com - alaska

Calling refresh on a browser OWS (WMS, WFS, WCS) node will invalidate the capabilities cache for that node and request a new capabilities document from the server.

**Acceptance criteria:** **Given** that OWS Capabilities cache invalidation is implemented, **when** a user refreshes a OWS node in browser dock in QGIS **then** the capabilities document will be retrieved anew and the list of available layers will be updated accordingly.

# Epic 3: Logging of Network Requests

## User Story 1:

**Note this functionality is already covered by a QGIS plugin and will likely be descoped.**

**Expectation:** As a user of QGIS, when I try to connect to an OGC service, I would like to be able to log these request to the QGIS logging window in order to support the diagnosis of issues encountered with a service connection.

**Previous discussion and security concerns:** The idea of supporting logging of network requests in QGIS has been raised before:

https://lists.osgeo.org/pipermail/qgis-developer/2018-October/054906.html

There were also security concerns raised. See:
https://lists.osgeo.org/pipermail/qgis-developer/2018-October/054914.html

An alternative approach to implementing this user story is to run a local proxy server that logs all requests and then configure QGIS to connect to the internet through that proxy server. See for example:

https://gis.stackexchange.com/questions/282662/is-there-any-easy-way-to-see-the-requests-qgis-makes-to-a-remote-server?rq=1

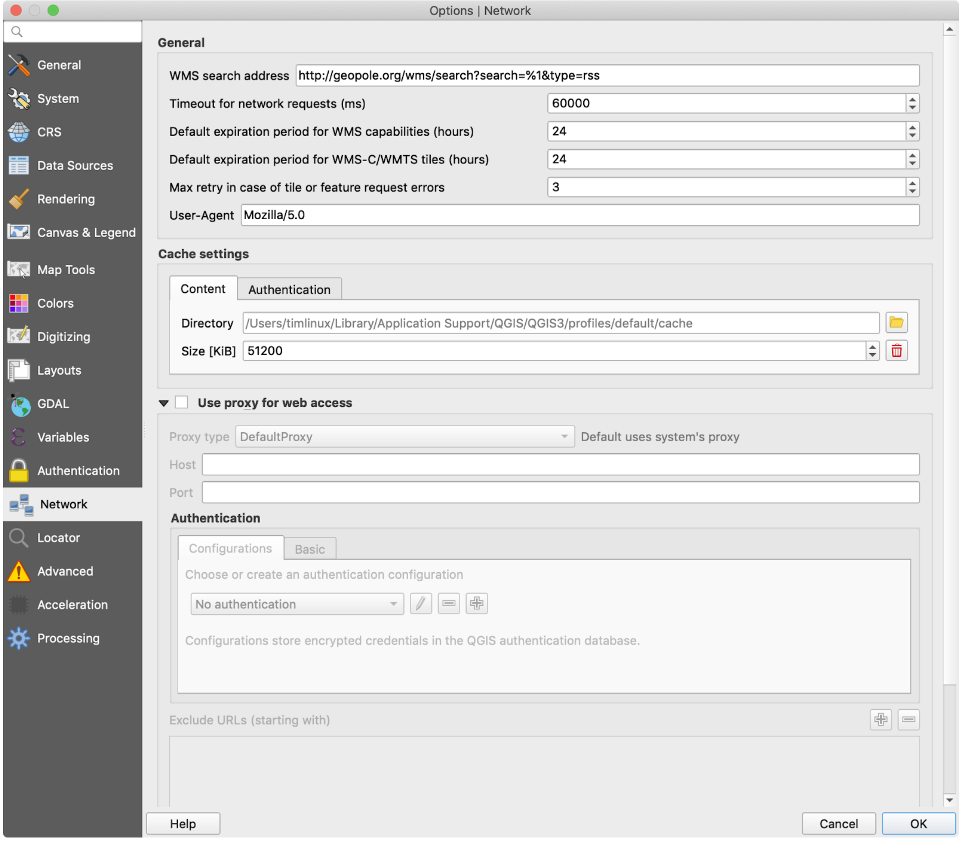
Another alternative approach is to use a tool like WireShark (https://www.wireshark.org) to watch network traffic from the host PC whilst trying to connect to the troublesome OGC service.

**Implementation caveats:** This logging approach will only work for services which make of the QgsConnectionManager class for their requests.

To provide this support we will write a short QEP (QGIS Enhancement Proposal). Given that there are some security concerns related to this requirement, we will need to ensure that the community is happy to have this functionality included in QGIS.

As a backup approach we propose to implement a small python plugin that attaches itself to QgsConnectionManager and writes event messages to the log. The python plugin would need to installed separately from the main QGIS install.

In the case of this functionality being accepted in the core QGIS project, we will add a checkbox option in the QGIS -> Options -> Network tab, allowing users to enable/disable logging. The option will be disabled by default.



General

WMS search address: http://geopole.org/wms/search?search=%1&type=rss

Timeout for network requests (ms): 60000

Default expiration period for WMS capabilities (hours): 24

Default expiration period for WMS-C/WMTS tiles (hours): 24

Max retry in case of tile or feature request errors: 3

User-Agent: Mozilla/5.0

Cache settings

Content | Authentication

Directory: /Users/timlinux/Library/Application Support/QGIS/QGIS3/profiles/default/cache

Size [KiB]: 51200

□ Use proxy for web access

Proxy type: DefaultProxy — Default uses system's proxy

Host

Port

Authentication

Configurations | Basic

Choose or create an authentication configuration

No authentication

Configurations store encrypted credentials in the QGIS authentication database.

Exclude URLs (starting with)

**Acceptance criteria:** **Given** that network logging is implemented, **when** a user enables network request logging and connects to an OGC service in QGIS **then** the logging window in QGIS will display each network request made.