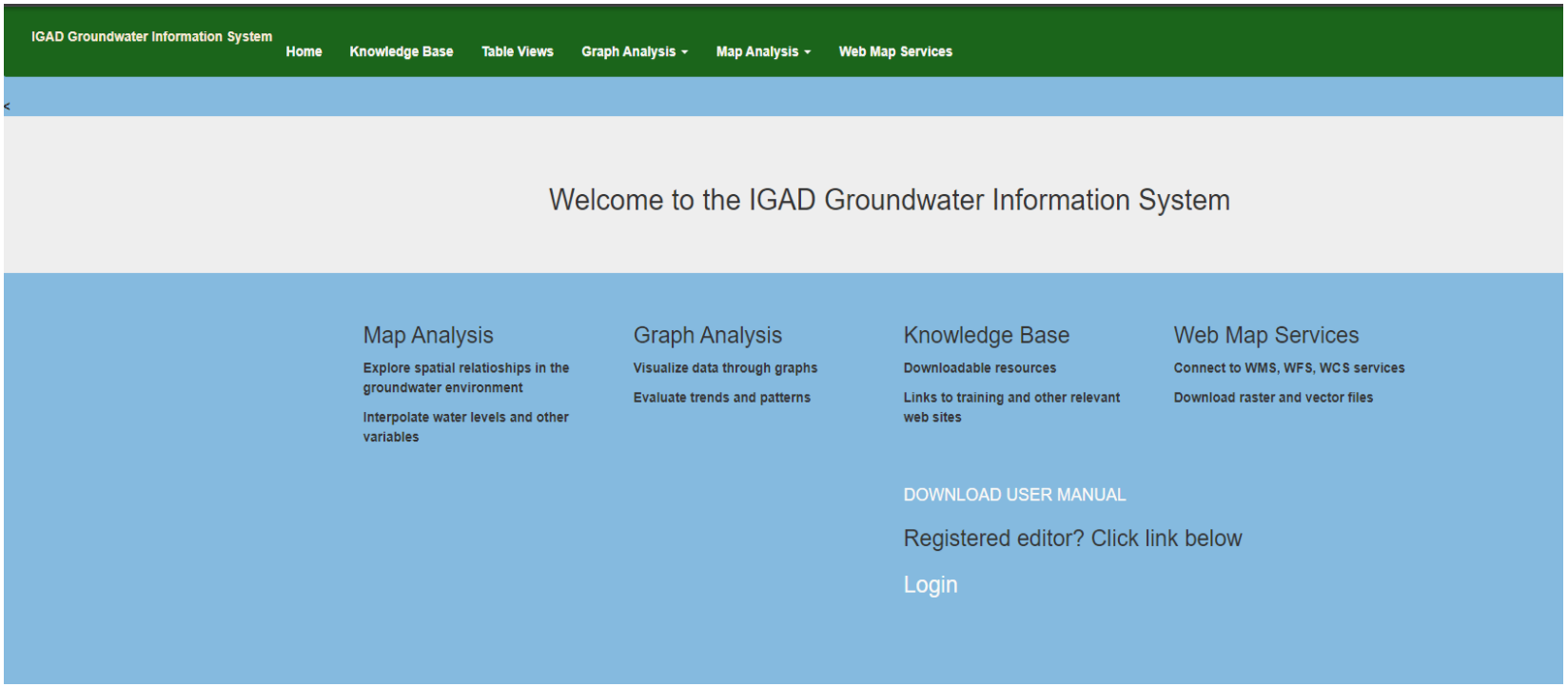
IGAD GWIS USER MANUAL

Contents

Introduction

The IGAD Groundwater Information System was designed for countries in the IGAD region to better assess their shared aquifers and to facilitate mutual management of their precious groundwater resources. Key words, assessment and shared aquifers, have guided the design which focuses on transboundary aquifers and provides analytical tools for scientific evaluation, particularly the graph and map modules. It is based on dynamic data fed by a database that can be periodically updated, including time series, and has the ability to detect trends and patterns. It is by no means complete, as only three countries have been included thus far – Kenya, Ethiopia, and Somalia. It is also expected that, besides the addition of other member states, new features and capabilities can be added during Phase 2.

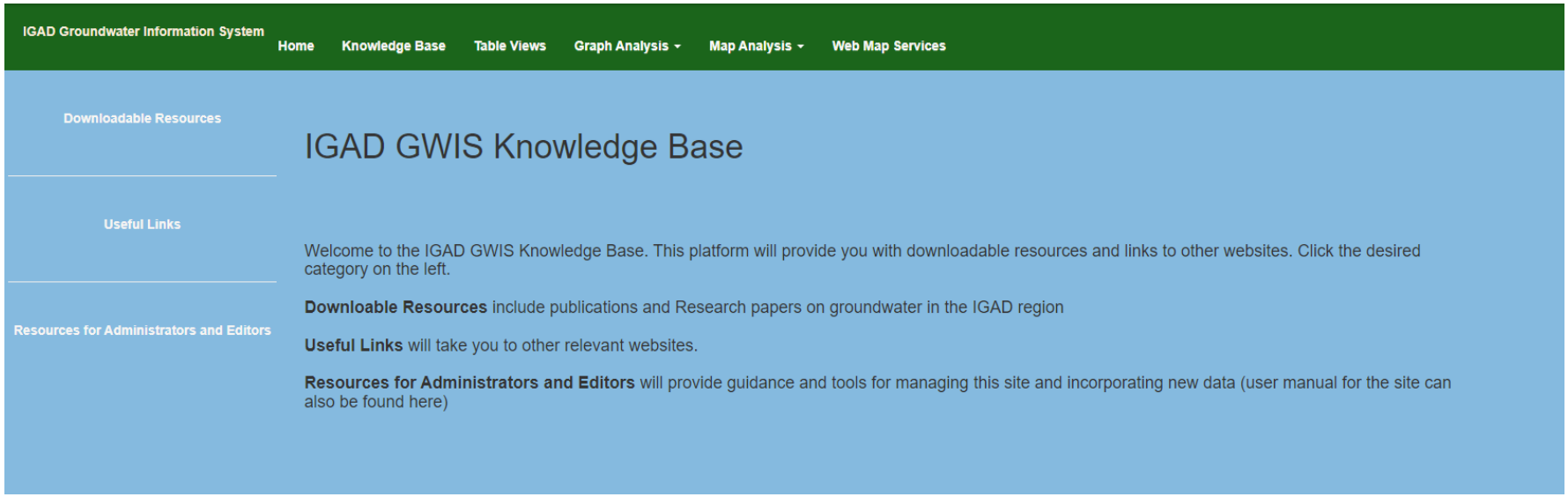
Upon entering the system, the user is greeted with the following Home page.



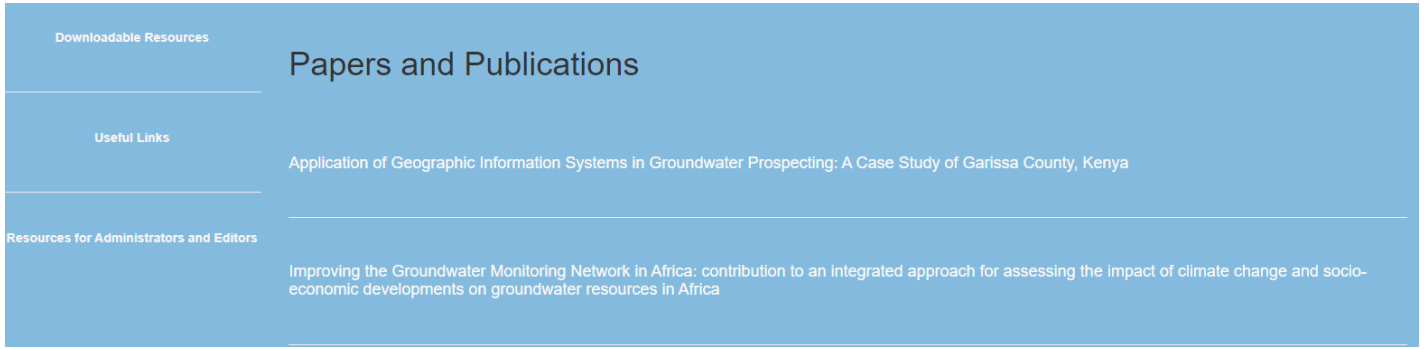
We shall examine the items in the navigation bar from left to right. It is recommended that you click on the link to download the user manual (this document). There is also a Login link for Registered Editors.

Knowledge Base Page

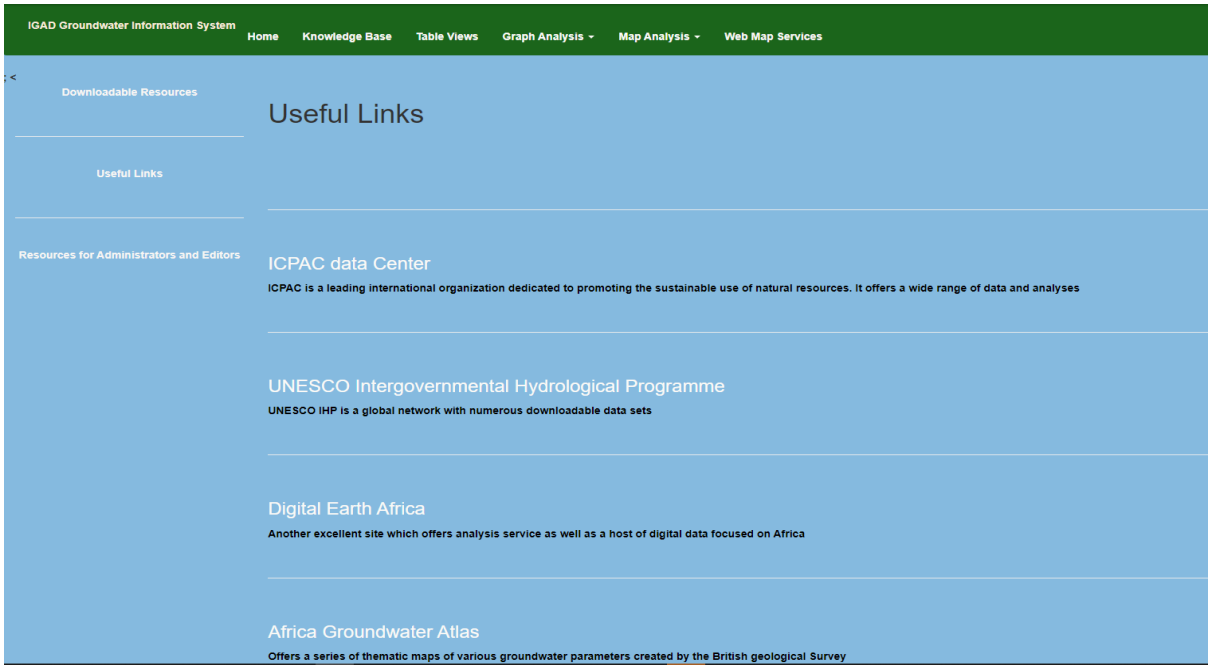
There are three sections to the Knowledge Base: Downloadable Resources, Useful Links, and Resources for Administrators and Editors.



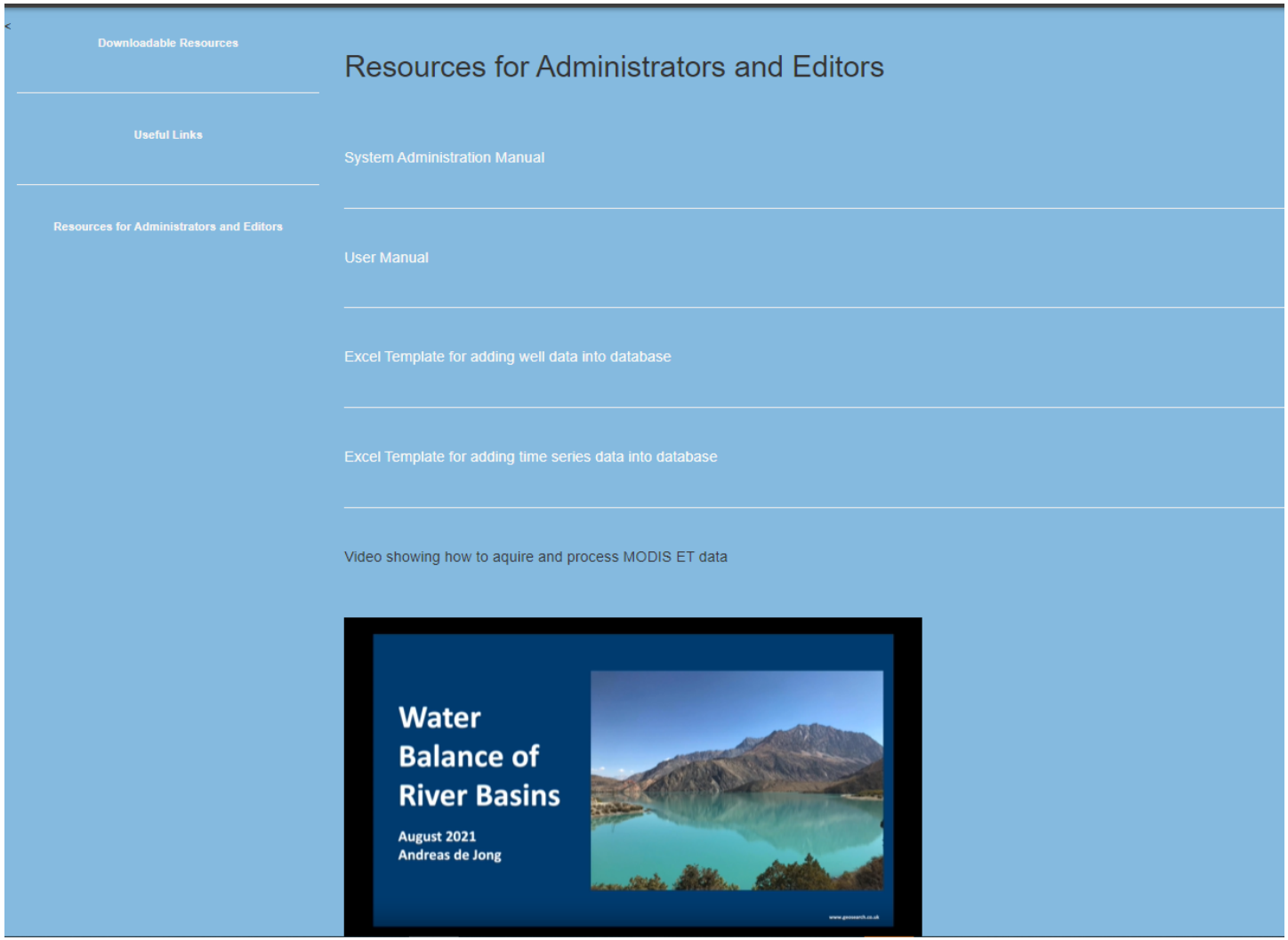
Downloadable resources page



Useful Links page

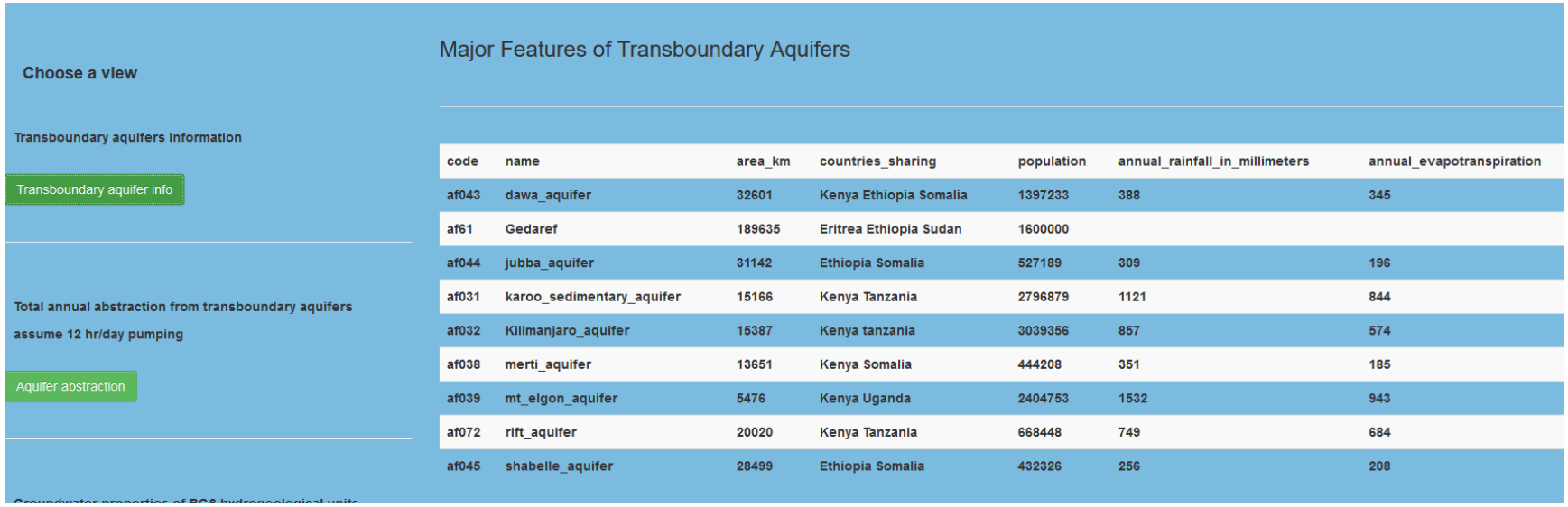


Resources for Administrators and Editors



Boreholes (Table Views)

First view shows us some information concerning transboundary aquifers



Choose a view

Transboundary aquifers information

Transboundary aquifer info

Total annual abstraction from transboundary aquifers assume 12 hr/day pumping

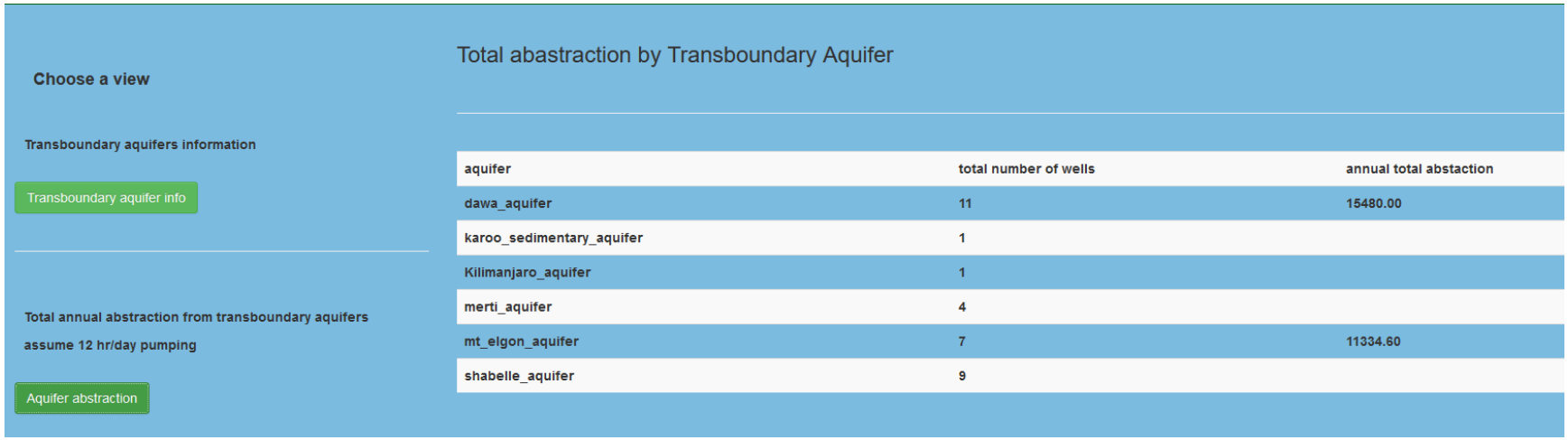
Aquifer abstraction

Groundwater properties of BGS hydrogeological units

Major Features of Transboundary Aquifers

code	name	area_km	countries_sharing	population	annual_rainfall_in_millimeters	annual_evapotranspiration
af043	dawa_aquifer	32601	Kenya Ethiopia Somalia	1397233	388	345
af61	Gedaref	189635	Eritrea Ethiopia Sudan	1600000		
af044	jubba_aquifer	31142	Ethiopia Somalia	527189	309	196
af031	karoo_sedimentary_aquifer	15166	Kenya Tanzania	2796879	1121	844
af032	Kilimanjaro_aquifer	15387	Kenya tanzania	3039356	857	574
af038	merti_aquifer	13651	Kenya Somalia	444208	351	185
af039	mt_elgon_aquifer	5476	Kenya Uganda	2404753	1532	943
af072	rift_aquifer	20020	Kenya Tanzania	668448	749	684
af045	shabelle_aquifer	28499	Ethiopia Somalia	432326	256	208

The second view gives us the number of wells and the total abstraction for transboundary aquifers that contain wells



The third view examines whether there are differences and patterns in wells sunk in the various hydrogeological units classified by the British Geological Survey (BGS). Specific capacity is discharge in cubic meters per hour divided by the drawdown and 'dbg' means depth below ground. The field orig_wellno is the original well number as given by the national agency of the country.

Productivity of BGS Hydrogeological Units

well_no	orig_wellno	discharge_m3_per_hr	specific_capacity	water_strike_1_dbg	BGS Hydrogeological unit
2016-06-08-Ke-950	c22445	1200.00		69.00	Igneous Volcanic
2016-01-03-Ke-925	c22178	466.67		20.00	Sedimentary - Tertiary-Quaternary; largely unconsolidated
2016-01-03-Ke-143	c22442	466.67		20.00	Sedimentary - Tertiary-Quaternary; largely unconsolidated
2012-04-12-Ke-542	c21201	425.81			Igneous Volcanic
2016-11-03-Ke-226	c22173	353.33		84.00	Igneous Volcanic
2016-11-03-Ke-398	c22440	353.33		84.00	Igneous Volcanic
2015-05-29-Ke-968	c21441	293.33		160.00	Igneous Volcanic
2007-12-09-Ke-591	c19238	288.00		22.00	Igneous Volcanic
2007-12-09-Ke-308	c18484	288.00		22.00	Igneous Volcanic
2007-07-17-Ke-796	c16800	264.00		34.00	Igneous Volcanic
2007-02-02-Ke-524	c16774	264.00		68.00	Sedimentary - Tertiary-Quaternary; largely unconsolidated
2016-08-12-Ke-508	c22118	263.89		37.00	Igneous Volcanic
2016-08-12-Ke-427	c22280	260.00		30.00	Sedimentary - Tertiary-Quaternary; largely unconsolidated
2014-12-20-Ke-620	c21250	246.67	0.58	155.00	Igneous Volcanic
2014-04-15-Ke-824	c22207	240.00		54.00	Sedimentary - Tertiary-Quaternary; largely unconsolidated
2015-09-28-Ke-314	c21587	240.00		230.00	Sedimentary - Tertiary-Quaternary; largely unconsolidated
2014-02-19-Ke-367	c20913	233.33	22.52	46.00	Igneous Volcanic

The fourth view shows the geological materials encountered at well screens (where water is withdrawn) and compares these to the BGS unit and identifies the transboundary aquifer the well is located in.

Lithology of Wells

well_no	orig_wellno	lithology at screen 1	lithology at screen 2	lithology at screen 3	BGS Hydrogeological unit	aquifer
2017-09-28-Ke-996	c22357	weathered limestone		highly weathered limestone boulders	Sedimentary - Palaeozoic-Mesozoic	karoo_sedimentary_aquifer
2024-05-09-Et-740	wq1	sand & gravel			Unconsolidated sedimentary	dawa_aquifer
2013-02-15-Ke-219	Ke022				Sedimentary - Tertiary-Quaternary; largely unconsolidated	merti_aquifer
2016-12-18-Ke-828	Ke124				Sedimentary - Tertiary-Quaternary; largely unconsolidated	merti_aquifer
2017-02-24-Ke-873	Ke123				Sedimentary - Tertiary-Quaternary; largely unconsolidated	merti_aquifer
2016-11-11-Ke-688	Ke125				Sedimentary - Tertiary-Quaternary; largely unconsolidated	merti_aquifer
2011-06-23-Ke-285	Ke087				Precambrian - Archaean	mt_elgon_aquifer
2012-02-17-Ke-126	Ke089				Precambrian - Archaean	mt_elgon_aquifer
2016-02-18-Ke-292	Ke126				Precambrian - Archaean	mt_elgon_aquifer
2006-03-12-Ke-566	Ke093				Igneous Volcanic	mt_elgon_aquifer
2024-05-09-Et-825	wq6				Sedimentary - Jurassic carbonate rocks	dawa_aquifer
2024-05-09-Et-728	wq3				Sedimentary - Jurassic carbonate rocks	dawa_aquifer
2024-05-09-Et-342	wq5				Unconsolidated sedimentary	dawa_aquifer
2024-05-09-Et-327	wq66				Sedimentary - Tertiary-Quaternary; largely unconsolidated	dawa_aquifer

The fifth view gives us a summary of water quality analyses for various samples and wells. Total cations in milliequivalents per liter should equal the total anions. The percent errors shows the how much deviation there is from this rule and any error over 10% shows that sample to have poor analysis and results questionable. tdi stands for Total Dissolved Solids.

Water Samples Ionic Balance with Error

well_no	sample_no	total cations	total anions	tdi	percent error
2024-05-09-Et-740	1	2.012643	1.121437	3.134080	28.43596845007147233000
2024-05-09-Et-832	2	10.079929	3.566242	13.646171	47.73270831795966795400
2024-05-09-Et-728	3	2.993284	2.186378	5.179662	15.57835240986767090200
2024-05-09-Et-342	5	8.477029	6.599282	15.076311	12.45495002059854031900
2024-05-09-Et-825	6	3.183534	2.349515	5.533049	15.07340708531589002700
2024-05-09-Et-327	4		2.307878		
2024-05-09-Et-929	7		3.069515		
2024-05-09-Et-248	8	6.473853	2.838551	9.312404	39.03720242377800619500
2024-05-09-Et-946	9	4.152560	3.066800	7.219360	15.03956029343321291600
2024-05-16-Et-120	S98_01785	2.212323	1.626343	3.838666	15.26519889982613751800
2024-05-16-Et-748	S98_01786	1.341732	1.442450	2.784182	-3.61750776350109296000
2024-05-16-Et-430	S98_01788	1.712688	1.470759	3.183447	7.59959251716771160300
2024-05-16-Et-834	S98_01789	1.081912	0.772730	1.854642	16.67071057379267804800
2024-05-16-Et-627	S98_01790	2.497611	2.529159	5.026770	-0.62759983050746304300
2024-05-16-Et-713	S98_01791	1.697202	1.425060	3.122262	8.71618076894251667500
2024-05-16-Et-426	S98_01792	2.257770	1.300322	3.558092	26.90902877160005980700
2024-05-16-Et-246	S98_01793	1.464537	1.260123	2.724660	7.50236726784259320400

This view shows the elevations of the bottom of screens and the length of screened intervals, along with coordinates of wells. This table can be copied and pasted into excel or a text file and downloaded for further data analysis (e.g.GIS.

Screened intervals and elevation of screens

easting	northing	elevation_bottom_of_first_screen	screened_interval_1	elevation_bottom_of_second_screen	screened_interval_2	elevation_bottom_of_third_screen	screened_interval_3	discharge_m
39.830382	-3.744163	-15.00	9.00					
39.830037	-3.751119	-7.00	9.00					
37.264331	-1.481787	1649.00	12.00	1595.00	18.00	1583.00	6.00	43.33
36.973551	-1.261702	1437.00	18.00	1419.00	12.00	1407.00	6.00	66.67
36.791359	-1.266787	1568.00	12.00	1550.00	6.00	1532.00	6.00	66.67
36.828309	-1.281808	1550.00	12.00	1520.00	12.00	1490.00	12.00	66.67
36.791481	-1.250125	1530.00	12.00	1494.00	30.00	1458.00	30.00	120.00
36.889442	-1.252548	1435.00	18.00	1405.00	24.00	1375.00	24.00	120.00
36.806962	-1.265996	1501.00	18.00	1471.00	24.00	1441.00	24.00	120.00
36.778000	-1.259236	1575.00	12.00	1557.00	12.00	1533.00	18.00	33.33
36.717230	-1.327625	1653.00	18.00	1629.00	18.00	1599.00	24.00	160.00
36.307631	-0.716148	1900.10	-17.10					168.00
36.209494	-0.758787	1939.50	-85.50	1944.50	-116.50			353.33
36.755517	-1.290040	1697.00	12.00	1673.00	18.00	1643.00	18.00	36.69
36.836671	-1.282276	1435.00	48.00	1423.00	6.00	1411.00	6.00	80.00
36.802747	-1.331419	1495.00	18.00	1477.00	12.00	1453.00	18.00	68.00
36.307631	-0.716148	1840.10	42.90					168.00

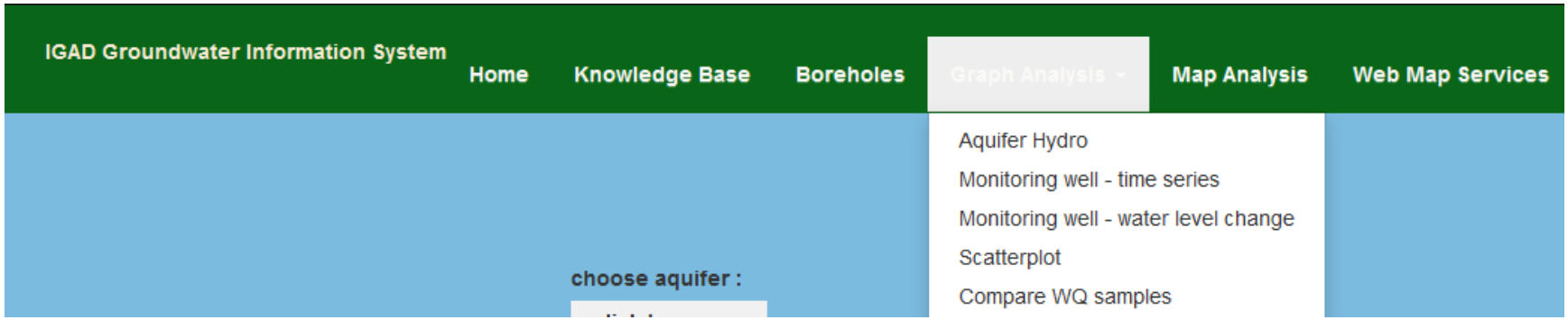
This view shows the distances of wells from the nearest stream and the hydrological characteristic of that stream. Such information is useful for identifying areas where conjunctive use schemes may be feasible. This query, due to the geometrical calculations, takes a long time to run – rom one to even several minutes. An alert box pops up informing the user of this period of waiting, while nothing happens on the screen.

Well Distance to Nearest Stream/Conjunctive Use Assessment

well_no	orig_wellno	nearest distance to stream km	aquifer	catchment area	annual excess precipitation mm	annual excess precipitation cubic meters
2024-05-16-Et-430	bdfake3	0.10439855020000001	shabelle_aquifer	55.59	48	2668320
2024-05-16-Et-713	bdfake6	0.14350189931	shabelle_aquifer	37.6	48	1804800
2016-02-18-Ke-292	Ke126	0.23036351818	mt_elgon_aquifer	58.81	589	34639090
2024-05-16-Et-246	bdfake8	0.26724203558	shabelle_aquifer	36.77	48	1764960.0000000002
2024-05-09-Et-728	wq3	0.37781858234	dawa_aquifer	13.69	43	588670
2007-05-03-Ke-641	Ke031	0.4146615874	Kilimanjaro_aquifer	28.09	283	7949470
2024-05-16-Et-748	bdfake2	0.43311965755	shabelle_aquifer	32.71	48	1570080
2024-05-16-Et-748	bdfake2	0.47457849859	shabelle_aquifer	4.28	48	205440
2024-05-16-Et-748	bdfake2	0.47457849859	shabelle_aquifer	14.32	48	687360
2024-05-16-Et-426	bdfake7	0.56014757585	shabelle_aquifer	52.14	48	2502720
2024-05-16-Et-426	bdfake7	0.76658676165	shabelle_aquifer	23.51	48	1128480
2012-02-17-Ke-126	Ke089	0.78845121893	mt_elgon_aquifer	44.86	589	26422540
2016-11-11-Ke-688	Ke125	0.8498657641	merti_aquifer	62.03	166	10296980
2024-05-16-Et-426	bdfake7	0.89913861601	shabelle_aquifer	12.82	48	615360
2012-09-13-Ke-729	Ke109	0.93170692959	dawa_aquifer	23.13	43	994590
2011-06-23-Ke-285	Ke087	0.9806123661399999	mt_elgon_aquifer	12.45	589	7333050
2006-03-12-Ke-566	Ke093	1.0165048257	mt_elgon_aquifer	97.01	589	57138890

Graph analysis

Moving to the next item we see the menu for the Graph analysis module



Aquifer Hydro

The first item gives a graphical display of the hydrology of each of the transboundary aquifers. Once an aquifer is chosen from the drop down list two graphs get populated with data – Yearly totals and Monthly averages of both rainfall and actual evapotranspiration, calculated from a record dating back to 2000 until end of 2023 The default is a bar chart, but users can switch back and forth using the buttons on the chart. *IN ALL OF THE GRAPHS YOU CAN HOVER THE MOUSE OVER THE POINT OR BARS TO SEE THE X AND Y VALUES*.

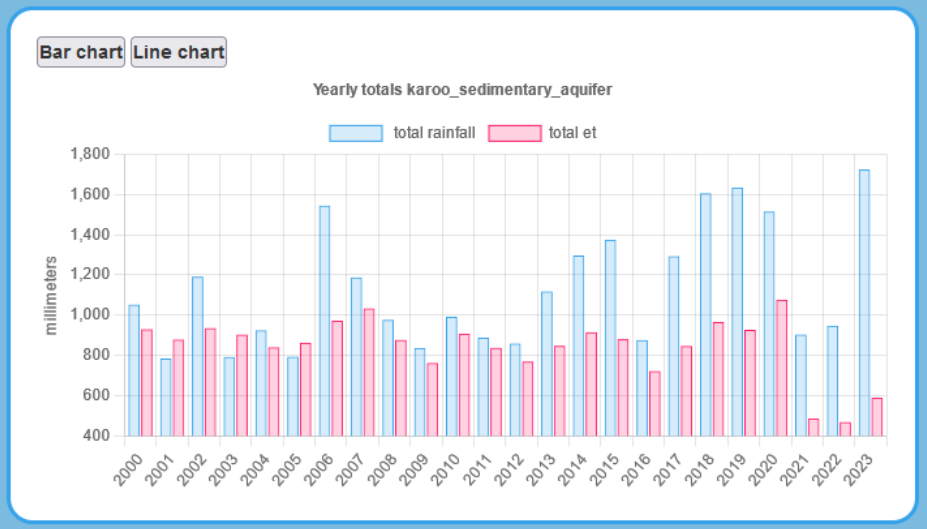
choose aquifer :

--click here--

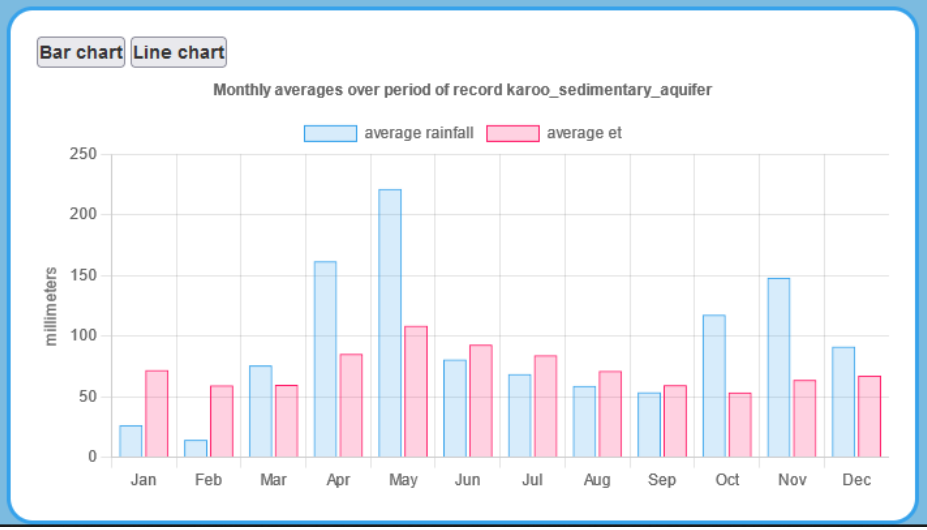
Submit aquifer name

You can hover mouse over bars/ points to see plotted values

Yearly totals



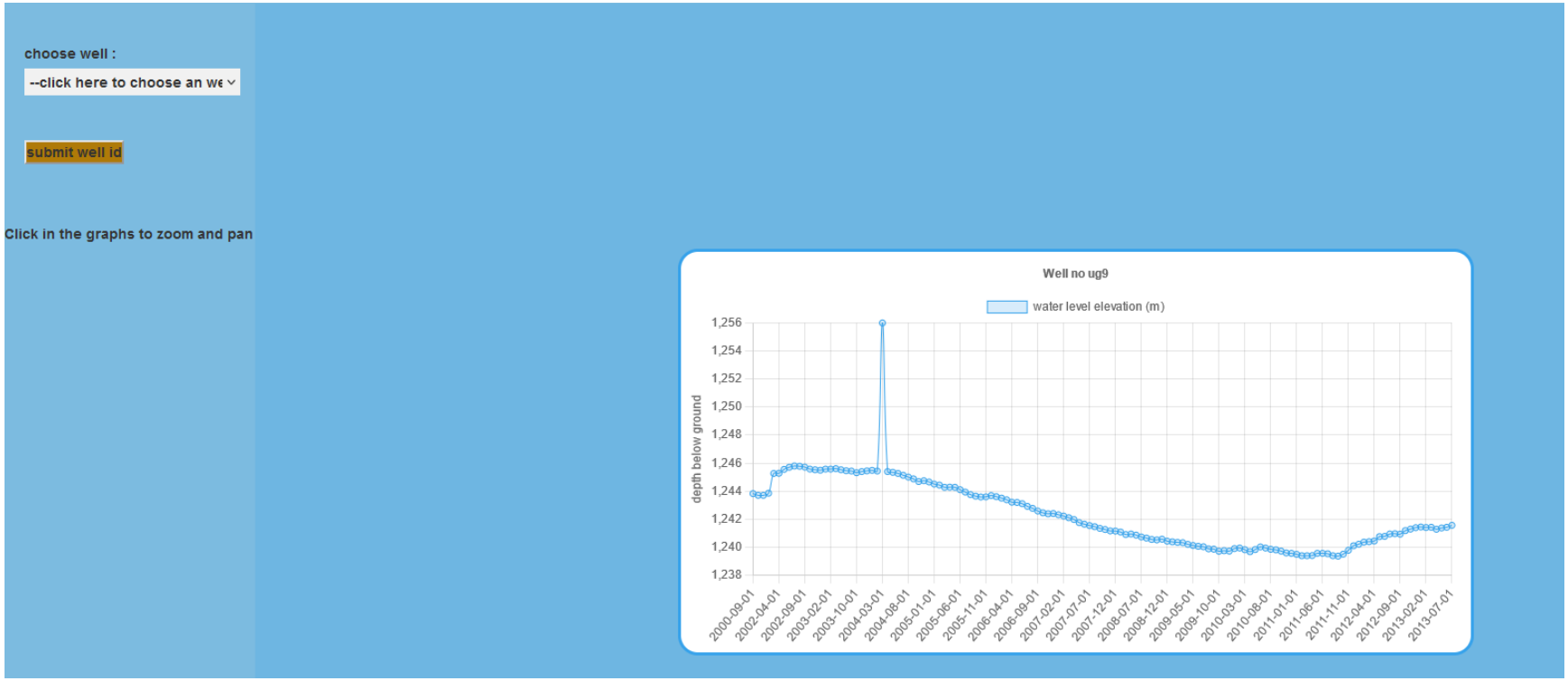
Monthly averages over period of record



Monitoring Wells - Time Series

The second item in the menu is monitoring wells time series. So far, two sets of monitoring wells are in the database, one set from Uganda and the other Somalia (source: IGRAC). Choosing one of the wells will produce a line graph showing variations in water levels as measured from the ground. Perieod of record varies. For the well shown in the figure, measurement were from 2000 to 2013.

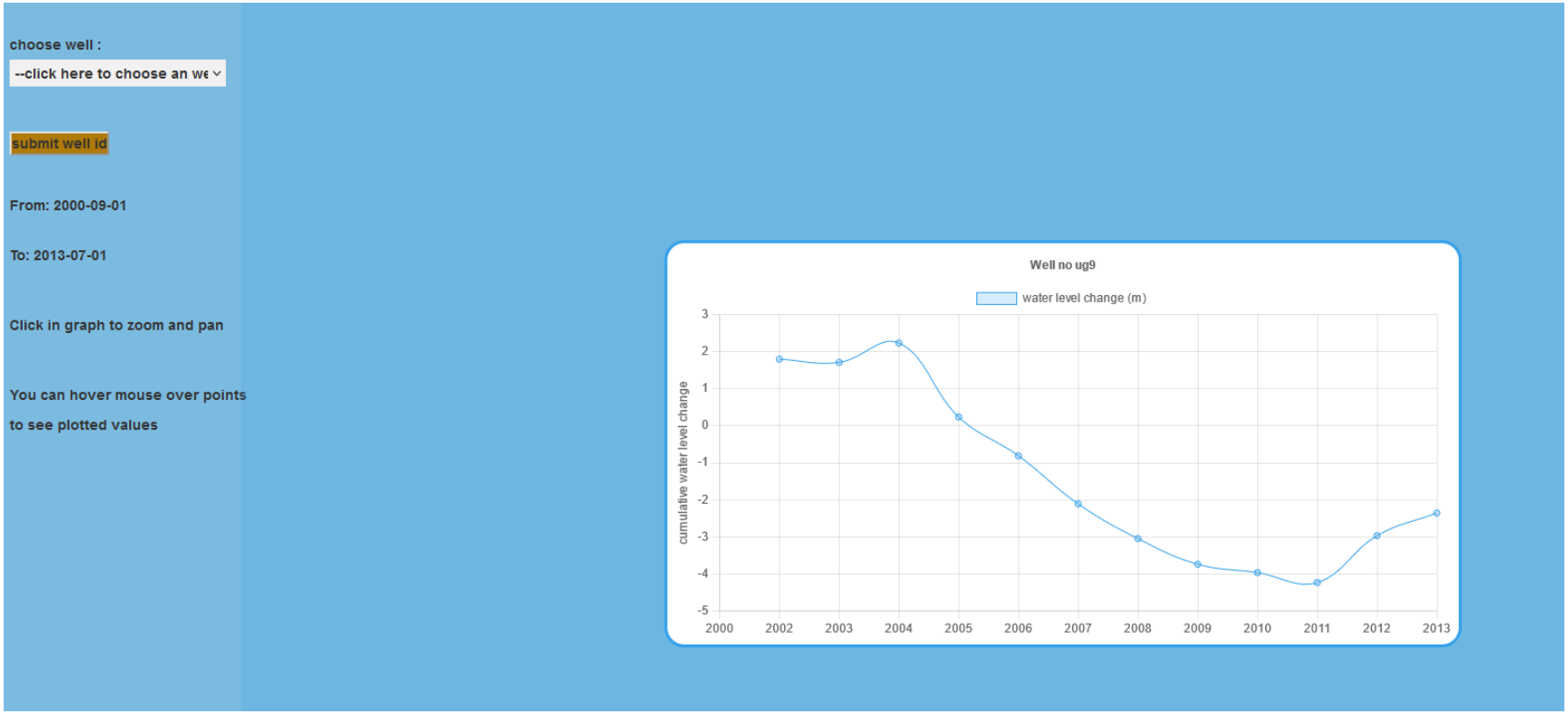
You can click in the graph to zoom in and pan left-right-up-down.



Monitoring Wells – water level change

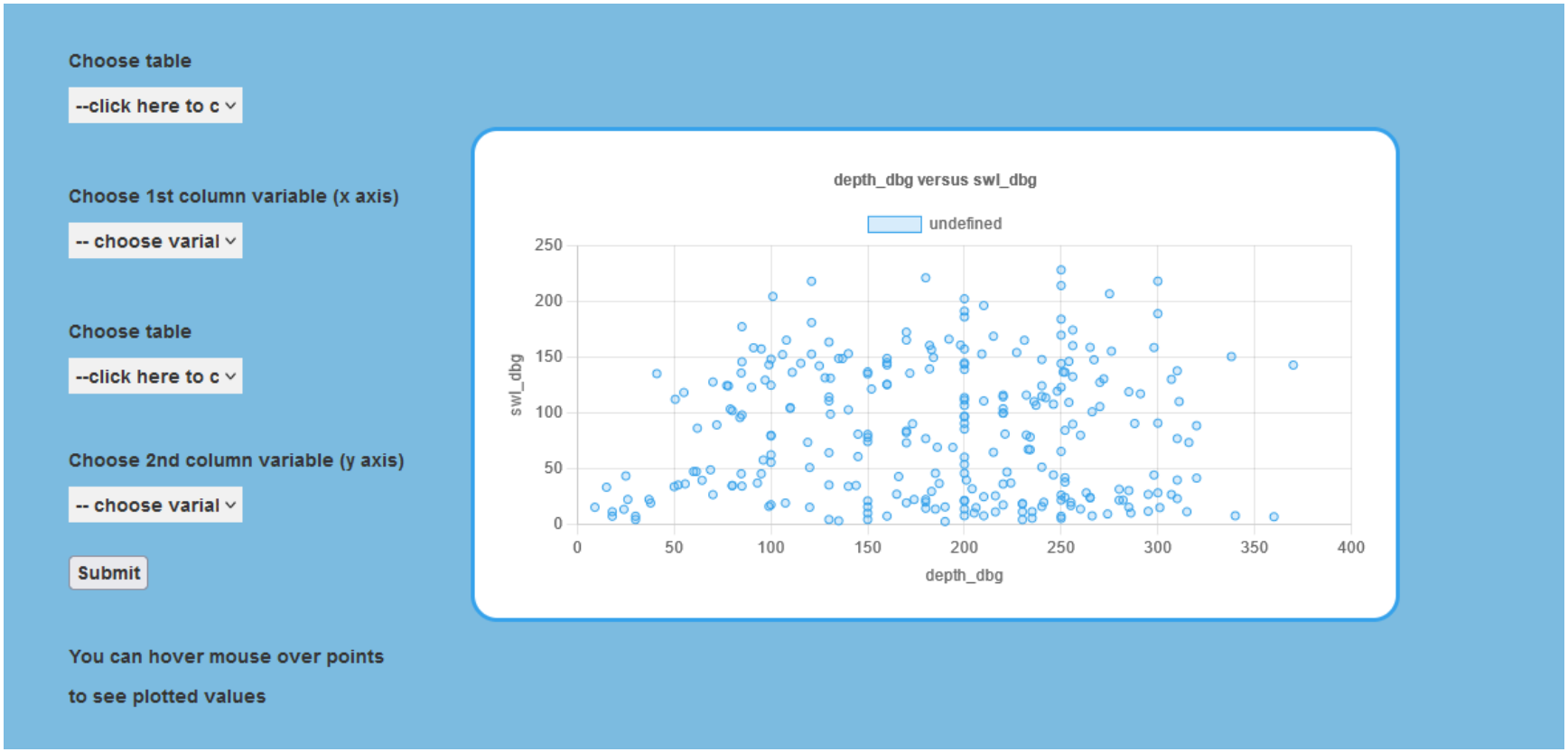
This graph shows the amount of change in water level since the start of measurements. In this graph, the levels are in terms of meters **above mean seal level (amsl)**

Note that the panel on the left displays the start and end date of measurements. Again, zooming and panning is enabled.

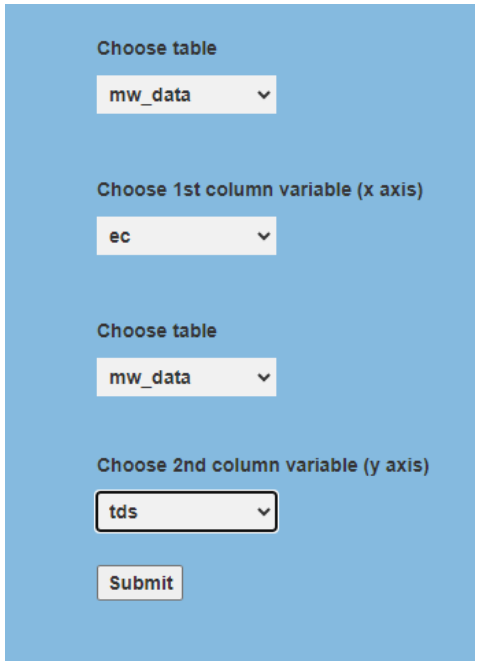


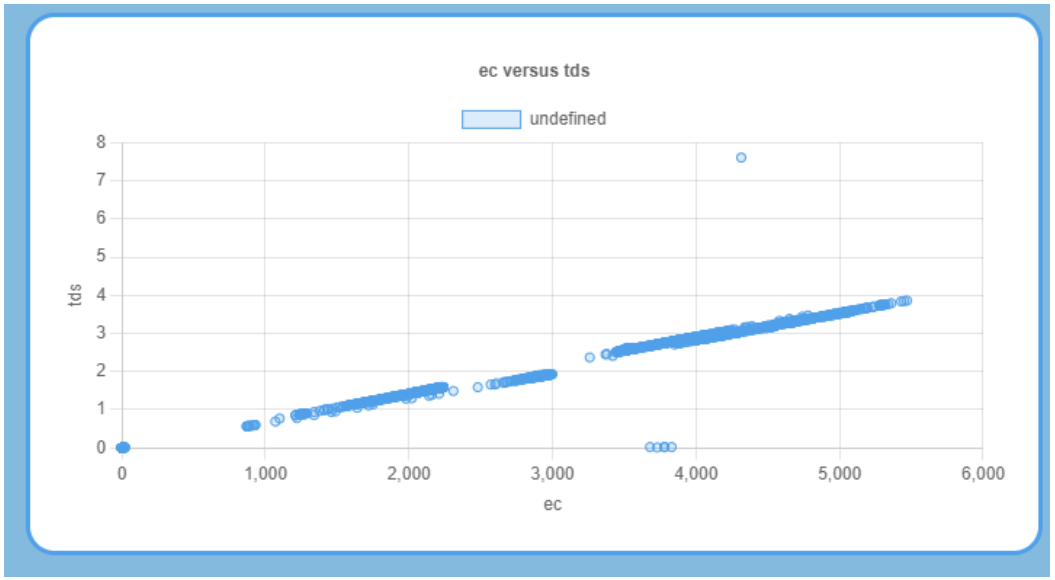
Scatterplot

On this page the user can plot nearly all meaningful variable in nearly every table in the dtabase in order to discern any relationhips between them. One must choose a table in the first dropdown list, to see the variables that table has to offer which is shown in the second dropdown list. The procedure is repeated to choose the second variable. Below we see well depth below ground level plotted against static water level depth below ground. There doesn't seem to be much of a relationship.



However, if we plot Electrical Conductivity (ec) versus total dissolved solids (tds), both from the mw_data table (monitoring well data) we see a strong positive relationship.





For this graph, and for the interpolation map in the map module, the user needs to be familiar with the table names an column names in the database. A list is given in the following pages for reference.

Names of tables and columns in the database

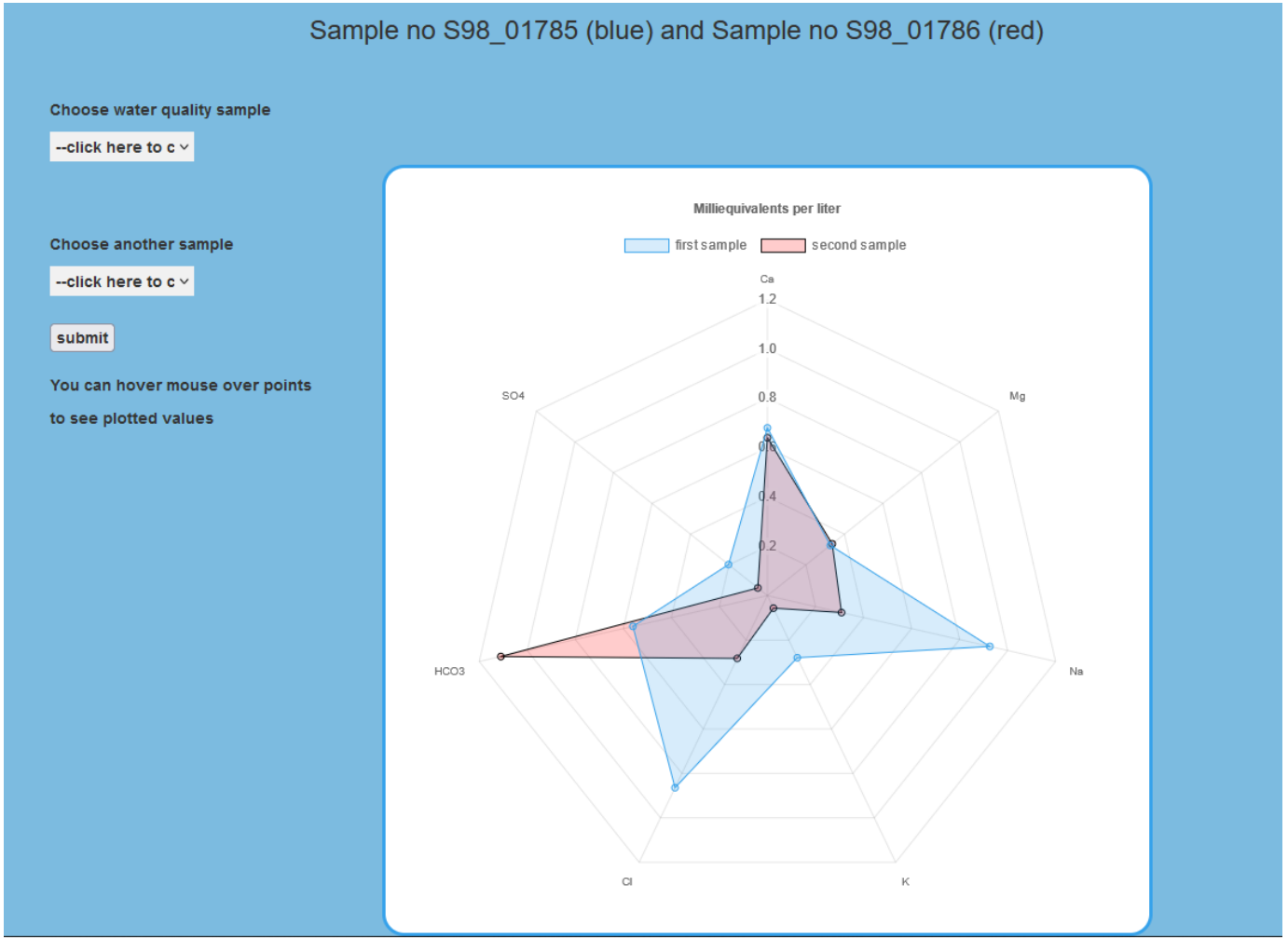
Table	columns	comment
CONSTRUCTION	well_no	well identifier for GWIS
	depth_dbg	borehole total depth below ground level
	drilling_meth	drilling method
	hole_diam_mm	Maximum hole diameter in millimeters
	casing_diam_mm	Maximum casing diameter in millimeters
	screen1_top_dbg	top of first screen interval in meters below ground
	screen1_bot_dbg	bottom of first screen interval in meters below ground
	screen2_top_dbg	top of second screen interval in meters below ground
	screen2_bot_dbg	bottom of second screen interval in meters below ground
	screen3_top_dbg	top of third screen interval in meters below ground
	screen3_bot_dbg	bottom of third screen interval in meters below ground
	pump	type of pump installed
HYDROGEO	swl_dbg	static water level depth below ground
	dwl_dbg	dynamic water level (during pumping) measured from ground
	discharge_m3_per_hr	pumping rate of well in cubic meters per hour
	specific_capacity	measured as discharge divided by drawdown

	depth_br_bg	depth to bedrock measured from ground
	water_strike_1_dbg	first encounter of water entering borehole
	water_strike_2_dbg	second water inflow into borehole
	lithology1_descrip	lithology corresponding to first screen interval in construction table
	lithology2_descrip	lithology corresponding to second screen interval in construction table
	lithology3_descrip	lithology corresponding to third screen interval in construction table
	transmissivity	transmissivity measured in meters squared per day from pumping tests
	storage_coefficient	storage coefficient measured from pumping tests
MW_DATA	water_level_amsl	water level above mean sea level
	water_level_bg	water level measured from ground surface
	ec	electrical conductivity in microsiemens per centimeter (µs/cm).
	ph	pH
	temp	temperature in degrees Celsius
	tds	total dissolved solids in mg/l
	salinity	measured in grams/liter
RIVER_DISCHARGE	discharge_cumecs	river discharge in cubic meters per second

WQ	sample_no	primary key & unique identifier for sample one well can have more than 1 sample but sample can only belong to 1 well
	temp	temperature in degrees Celsius
	ph	pH
	ec	electrical conductivity in microsiemens per centimeter (µs/cm).
	ca_mgl	calcium in milligrams per liter
	mg_mgl	magnesium in milligrams per liter
	na_mgl	sodium in milligrams per liter
	k_mgl sodium in	potassium in milligrams per liter
	cl_mgl	chloride in milligrams per liter
	hco3_alk_mgl	bicarbonate alkalinity measured in milligrams per liter
	so4_mgl	sulfate measured in milligrams per liter
	disso2	dissolved oxygen in milligrams per liter
	no3_mgl	nitrate in milligrams per liter
	fe_mgl	iron measured in milligrams per liter
	f_mgl	fluoride measured in milligrams per liter
	as_mgl	arsenic measured in milligrams per liter

Compare WQ samples

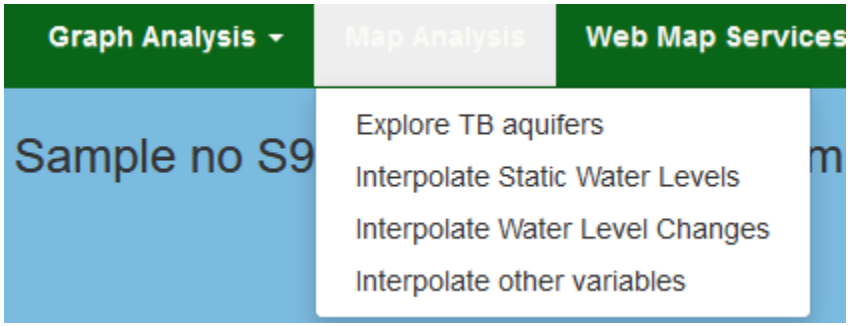
In this graph, major cations and anions are plotted on what is called a radar chart and their axes are arranged radially. Units are in milliequivalents per liter, which is the proper way to compare ion concentrations. The advantages of this type of chart is that it is easy to see patterns. Water samples showing similar patterns maybe of the same aquifer. In this example, these two samples are most likey to come from different groundwater bodies. Samples are chosen by sample number, which is the identifier in the water quality table.



Map Analysis

Navigate to MapAbnalysis on the navigation bar. The first item in this category is Explore TB aquifers while the rest are interpolation maps.

Each page is described in detail.



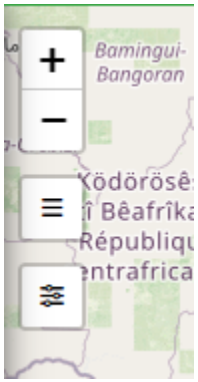
All maps have a scale bar at bottom left that adjusts as you zoom in, and the center bottom footer displays the map coordinates of the mouse position and the zoom level.

Explore TB Aquifers

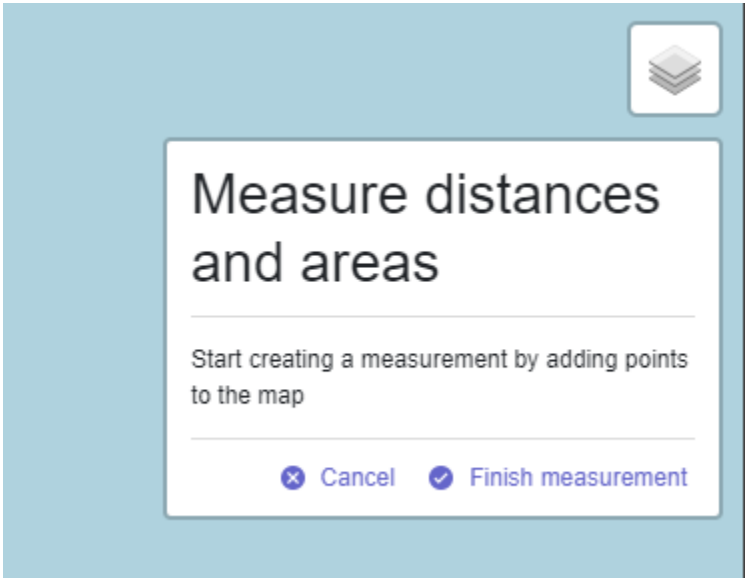
Within this page lies much of the GIS functionality of the system. It is designed to provide a conceptual model for each of the transboundary aquifers, which may be helpful for groundwater modeling. There are various layers whose visibility is controlled by the layer controls in the top right that looks like a stack of rectangles. Underneath that is a button, that when clicked, expands into a dialogue box

where you can measure straight line distance or polygonal areas. On the left side are the zoom controls on top, the popout menu button below that, and at the bottom is a special button that enables side-by-side comparison of two different layers

Buttons on top left: zoom in/out, popout menu button for selecting aquifers, and the Compare button.



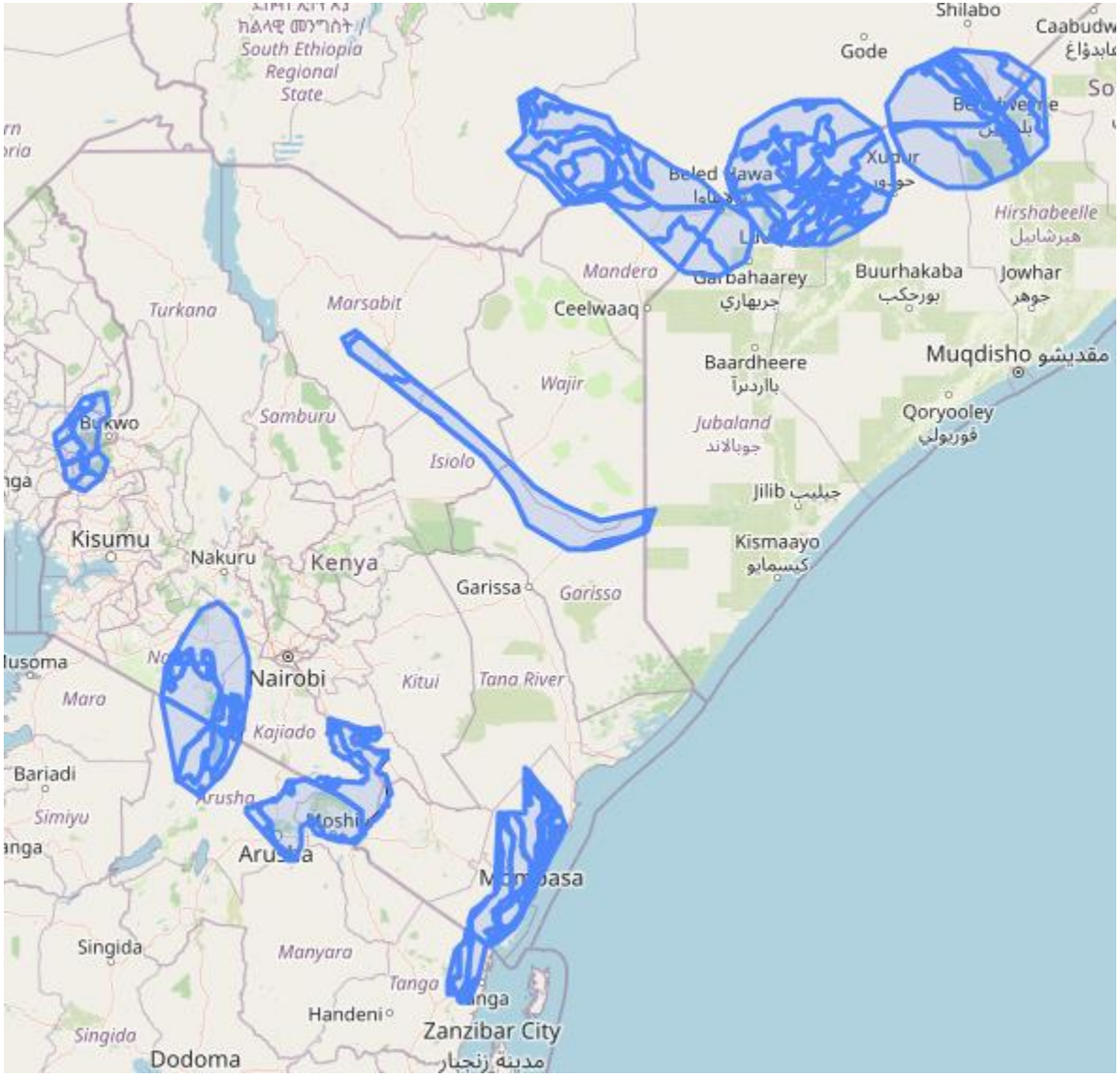
Layer control, and underneath, the measure tool with dialogue box expanded.



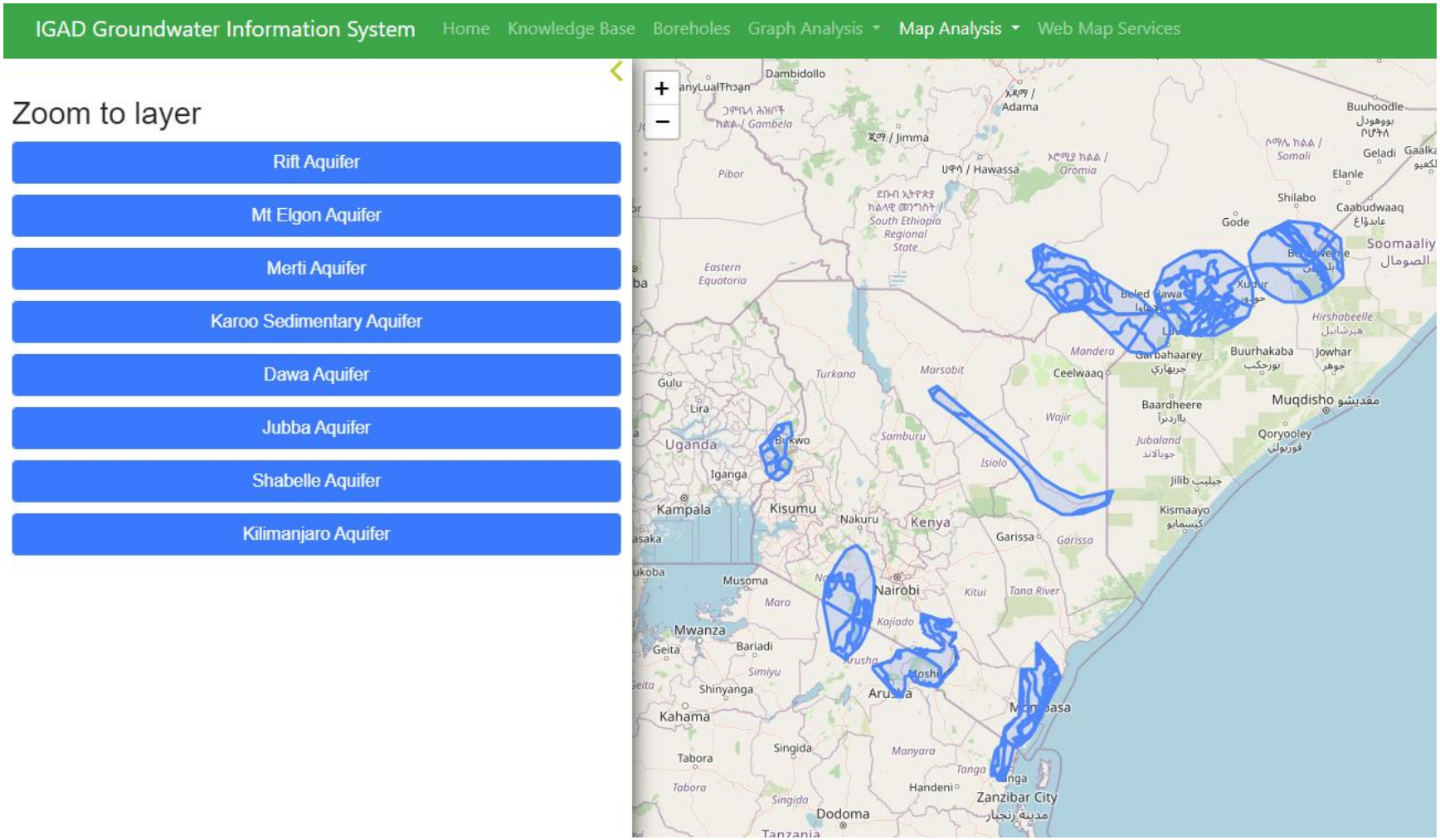
If you click on the layer control, a list appears of the layers present, divided into base maps for the top three and , separated by a horizontal line, several data overlays. For the thee base maps, only one item can be selected at one time, a choice of Open street Map,

Open Topo Map, and ESRI World Imagery. For the data overlays more than one can be chosen, however the one below will be drawn on top, so this might nor be desired, except in the case of watersheds and rivers.

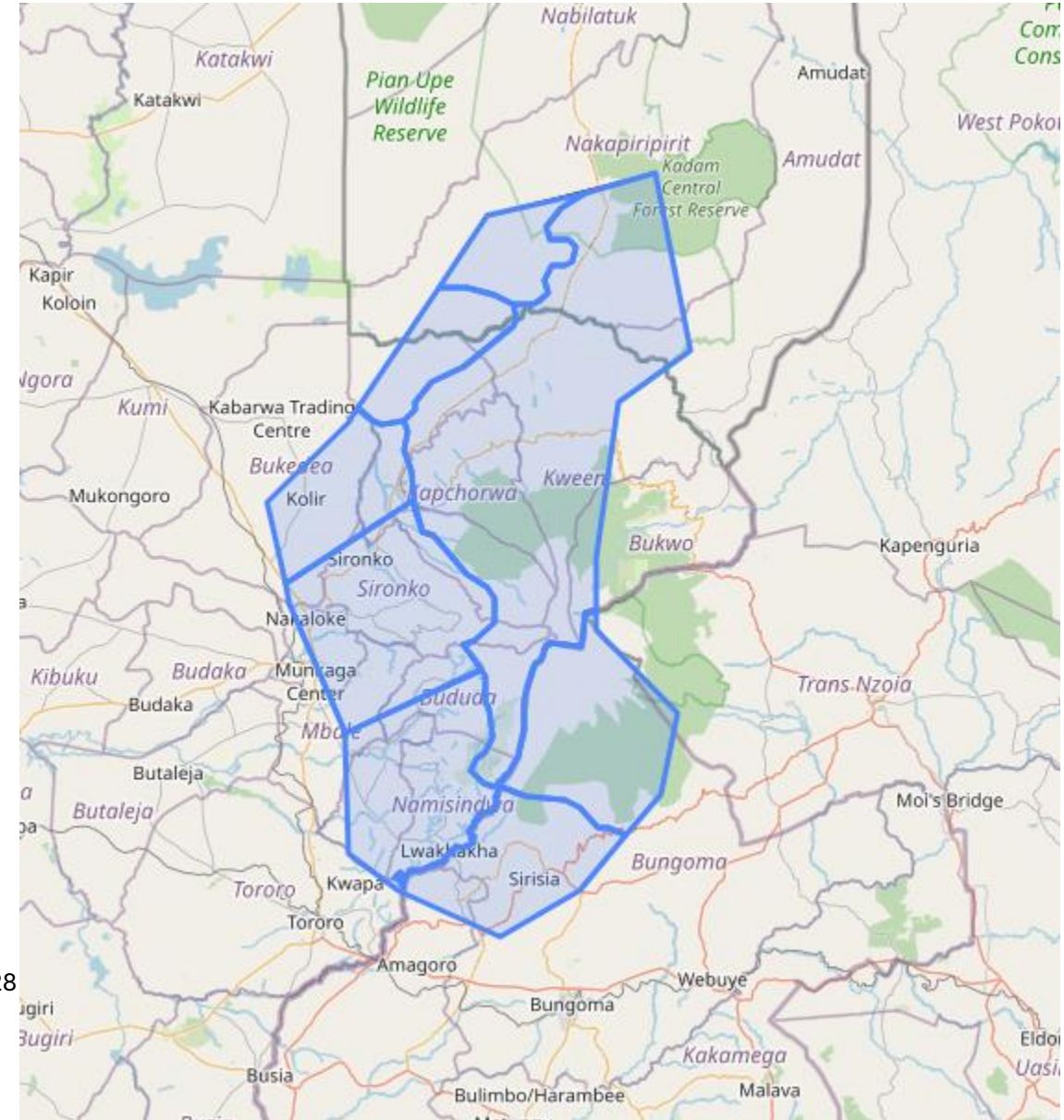
Map where hydrogeological units have been selected. If you hover over this layer, a tooltip appears with the name of the unit.



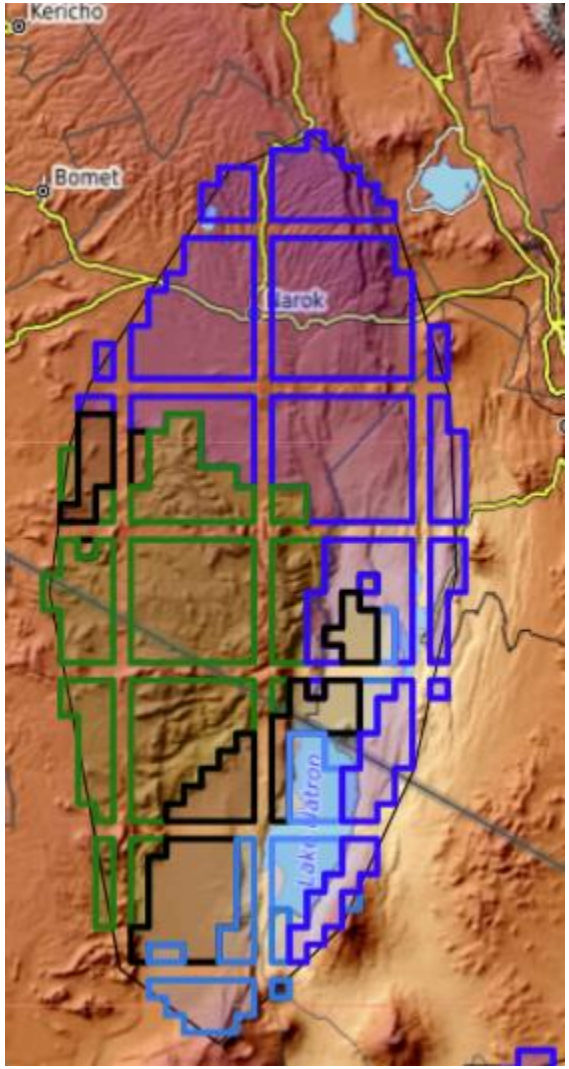
It is not convenient to see details at this zoom level. Click the popout menu button and you can choose which aquifer to zoom to.

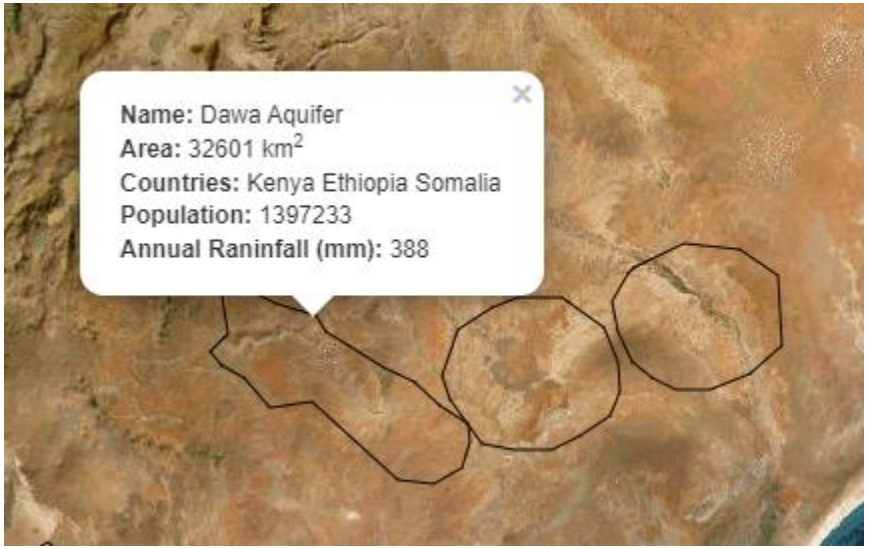


View after Mt. Elgon Auifer button clicked.

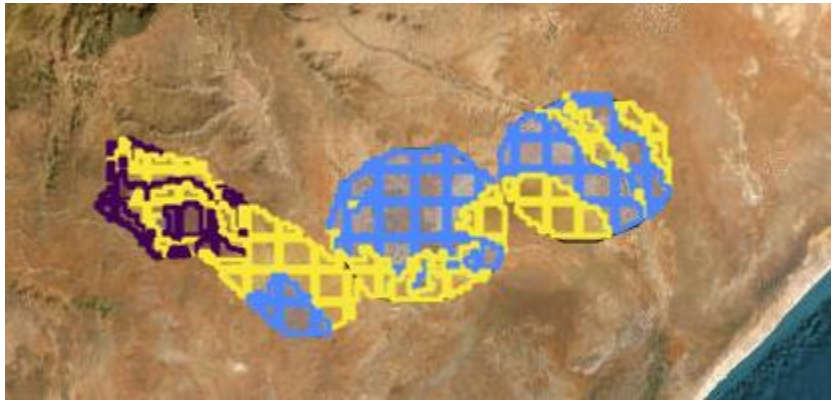


Here the groundwater storage layer is shown agains the opn topo map base layer. If you move your mouse over the aquifer, you will see the values for groundwater storage. If you CLICK on an aquifer you will get information for that aquifer

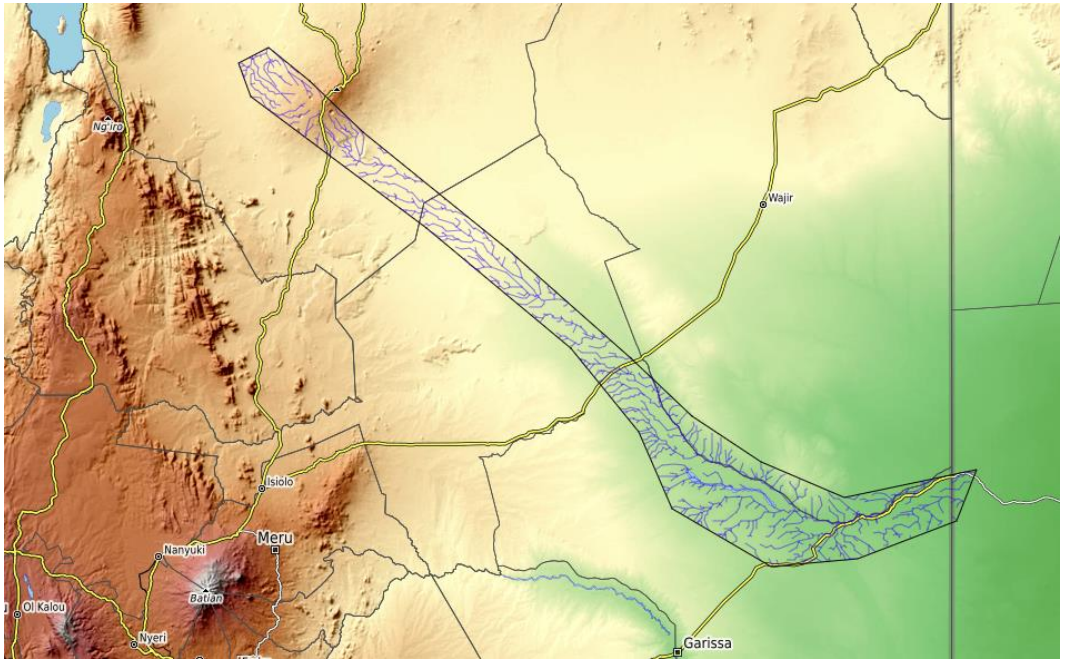




groundwater productivity with ESRI world imagery background

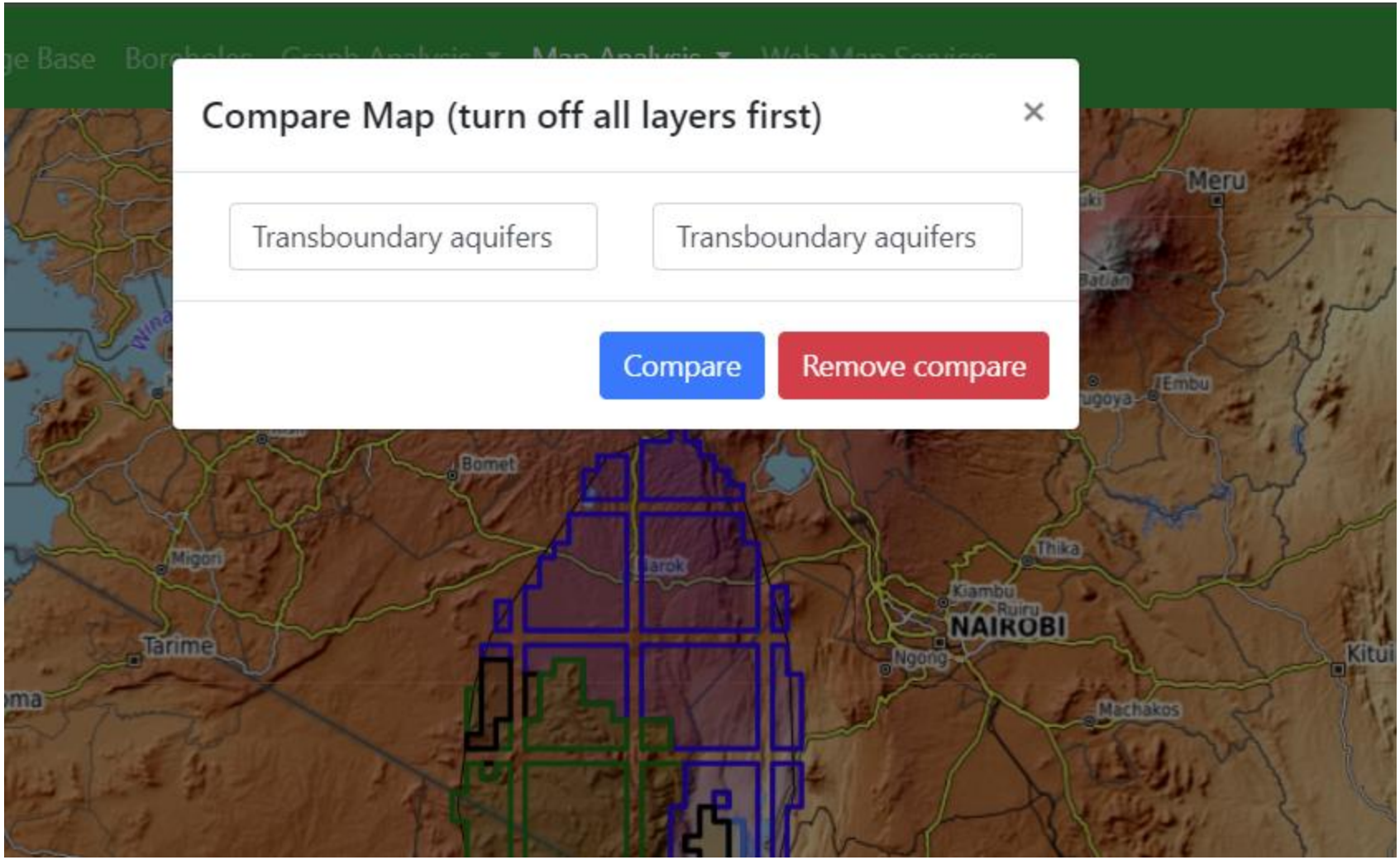


Merti aquifer with rivers shown

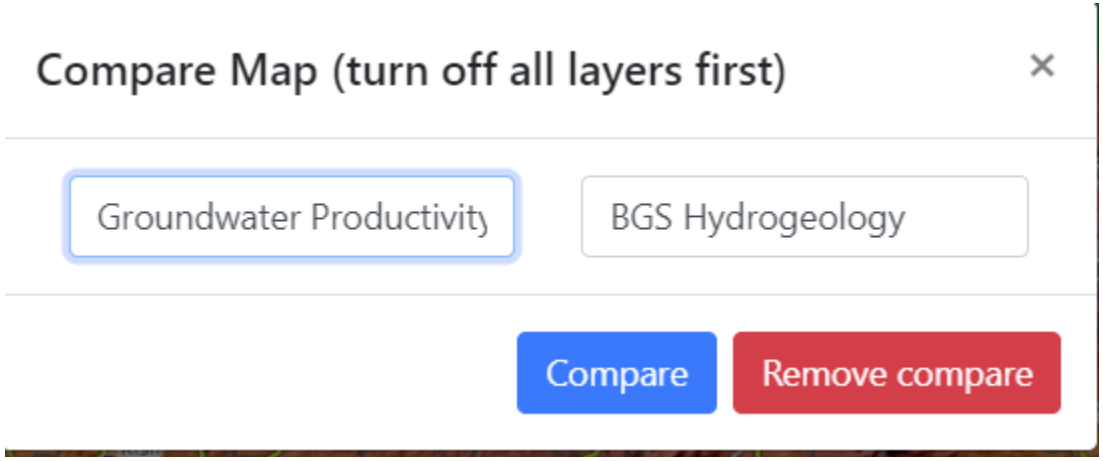


Compare Feature

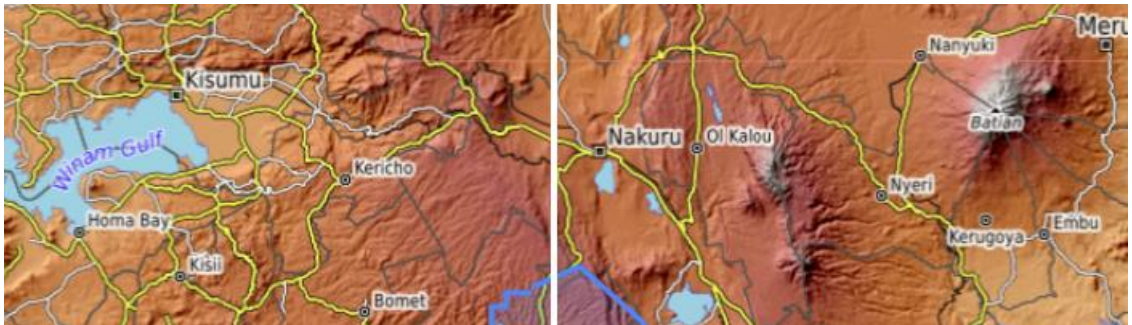
If you click the last button on the left, the Compare Map dialog appears at the top center.



Make sure you turn off all layers first for this to work properly. Choose two layers, say BGS hydrogeology and Groundwater Productivity.



Click the Compare Button and a sliding line appears, showing one layer on the right and the other layer on the left. By moving the mouse, you can values form both layers. Is there any relationship between hydrogeology and proucitvity?



Interpolate Static water levels

The user must first choose a year and a month. After doing so, markers will appear representing wells that meet the criteria.

Choose year for interpolation

choose year

Choose month for interpolation

choose month

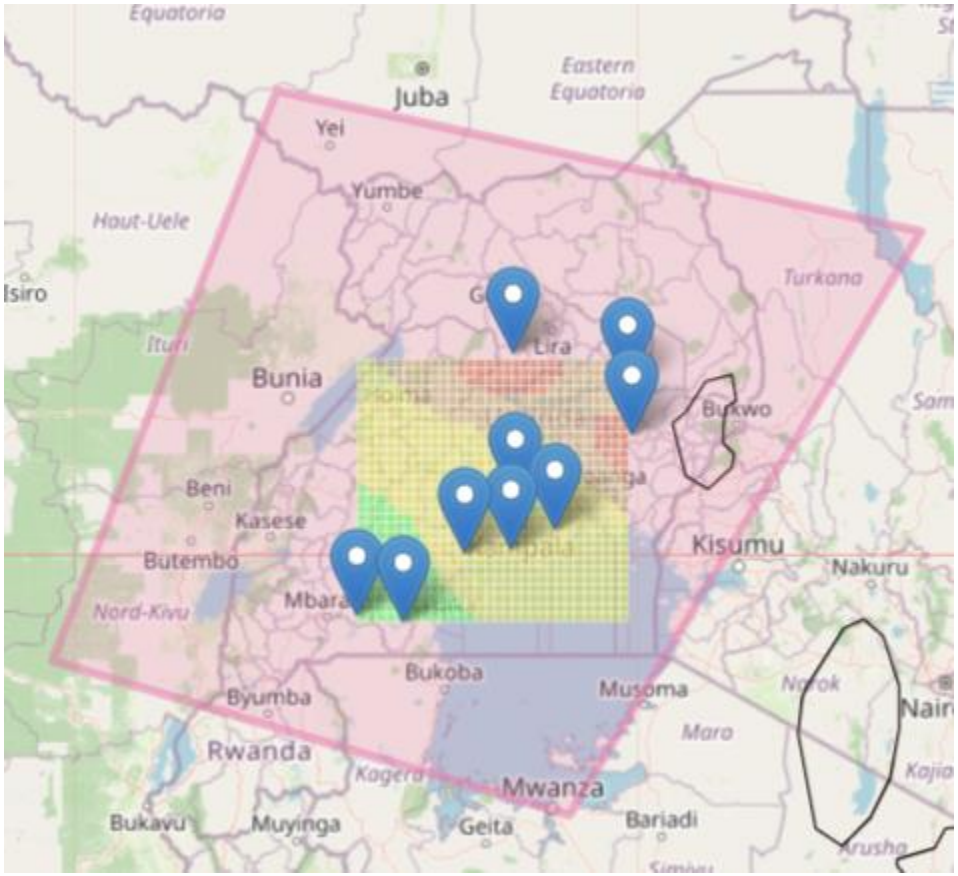
After choosing the date click on the polygon icon on the left side of the map to draw area of interest

Click finish to close the polygon

You can click mouse over markers

to see well info

After they appear, click on the polygon icon on the left side of the map to draw area of interest

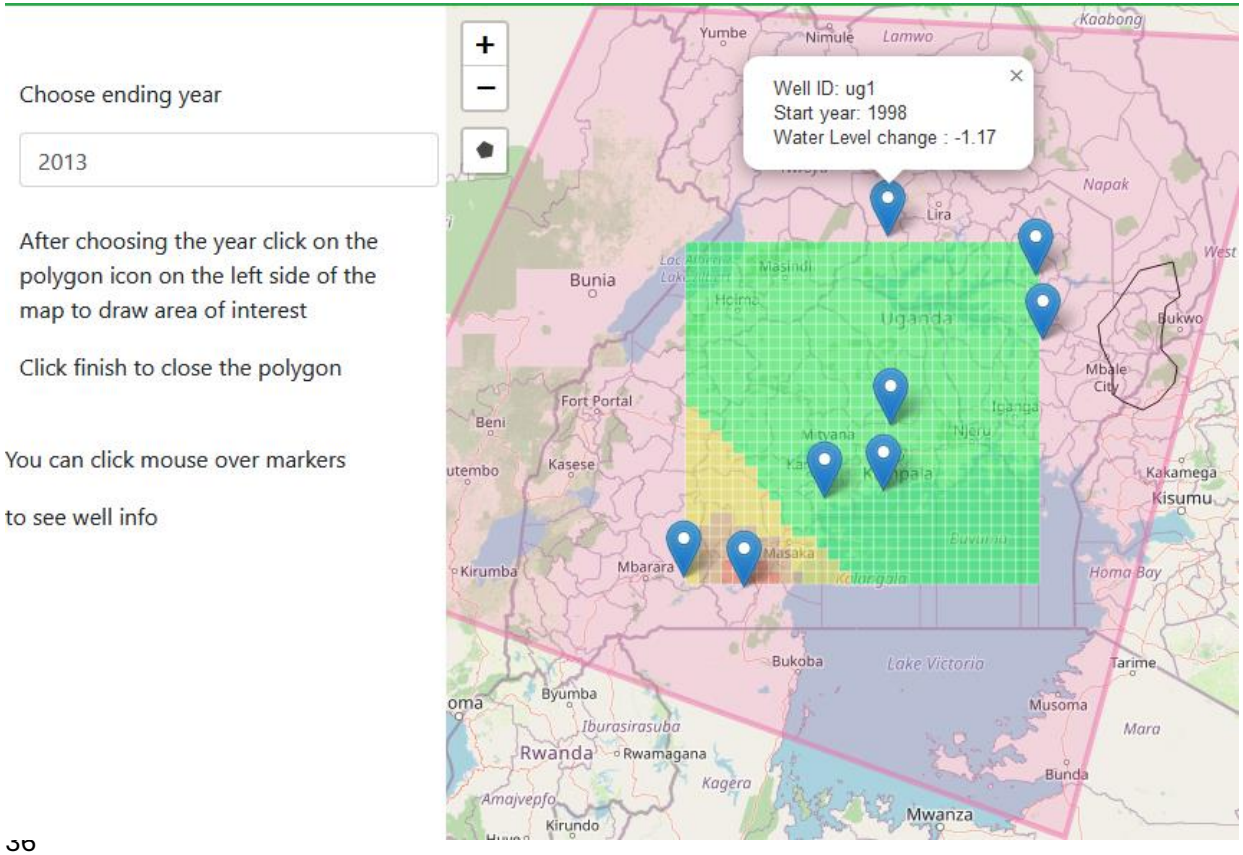


Once the color grid appears, you can move the mouse over the grid to see the values of water level amsl. Higher water levels near Lake Victoria and lower levels near lake Kyoga suggest flow is to the northeast. These two areas might be areas of recharge and discharge, respectively.

Interpolate water level changes

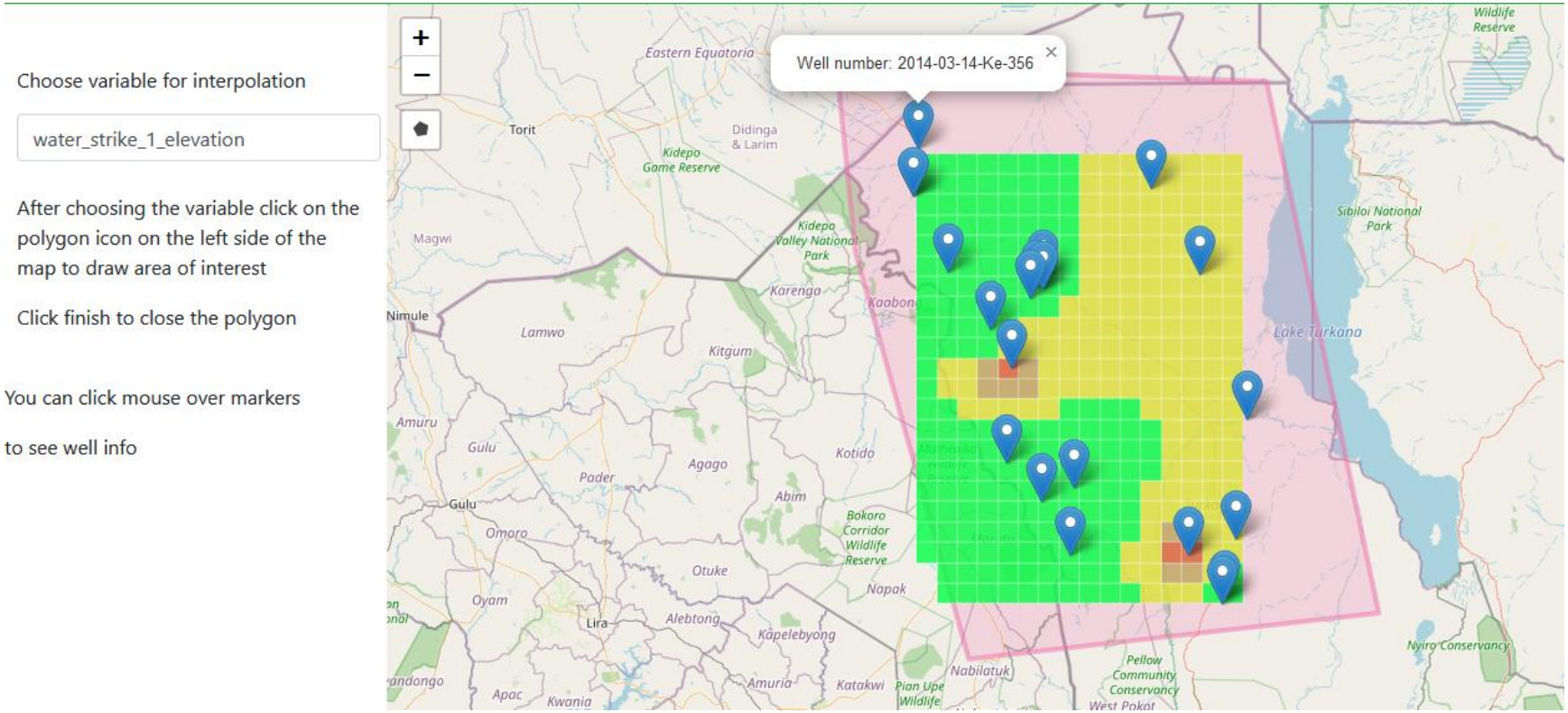
This is very similar to the previous feature, except that it creates a map of water level changes over period of record that the user determines by choosing the end year available in the dropdown list. Below the ending year is 2013 and by clicking on a well marker you get the well id and the year measurements started and the change since that time. Here the water level has changed the most in the Lake Victoria area. Note that the greatest changes occur in what the previous analysis showed to be possible recharge areas. Hver the mouse over the grid cells to see values.

Note that this analysis and the previous one uses monitoring well data that have overlapping periods of record. Other types of wells with one time measurement only are not considered.



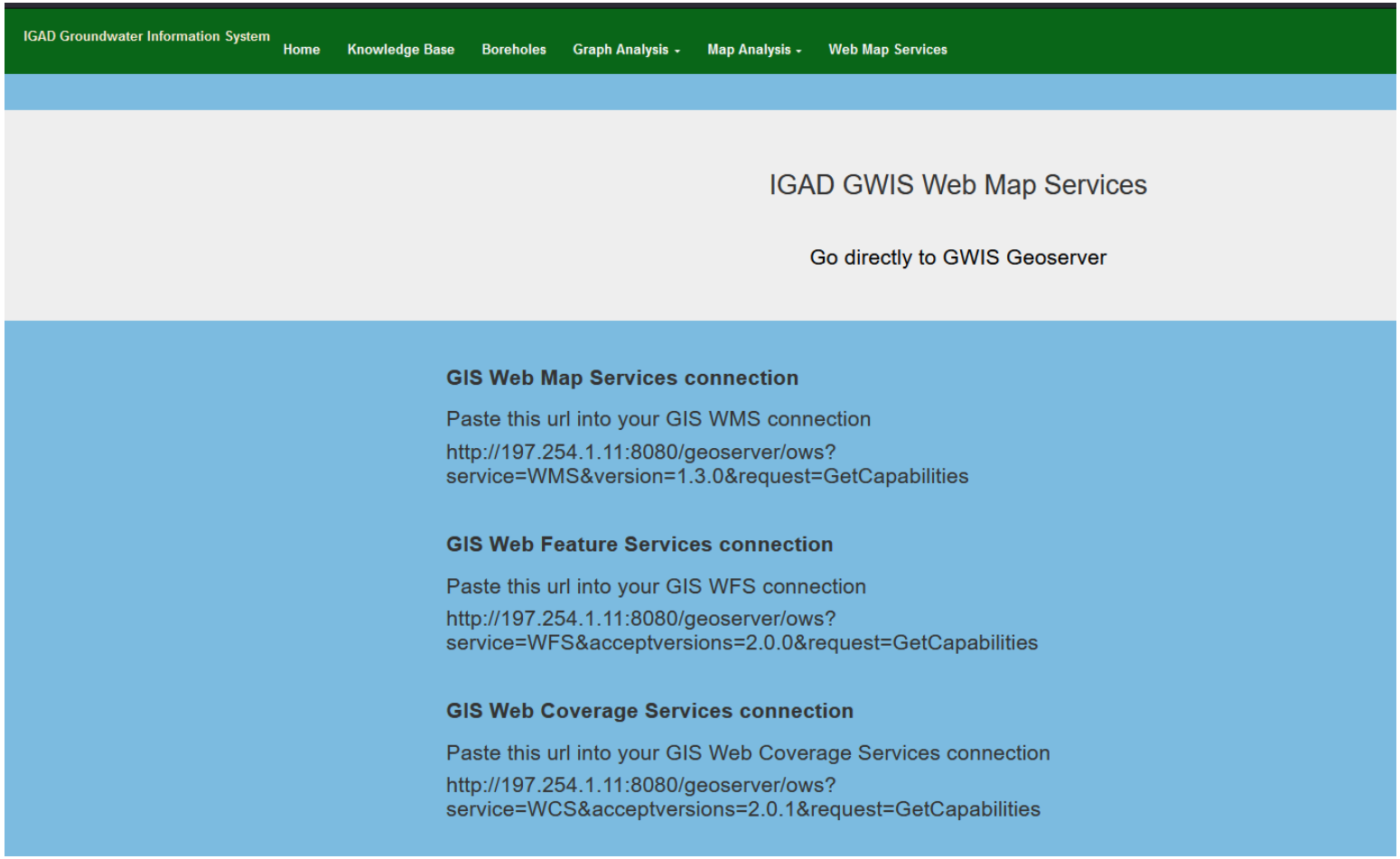
Interpolate other variables

In this map, the user can choose among many variables that are columns in numerous table. The procedure is the same as the other interpolate maps – choose variable->click polygon icon->draw polygon->click Finish. Well markers show well numbers and hovering over the colored grid will show values of individual cells. Water strike appear to be shallower on the east, near Lake Turkana.



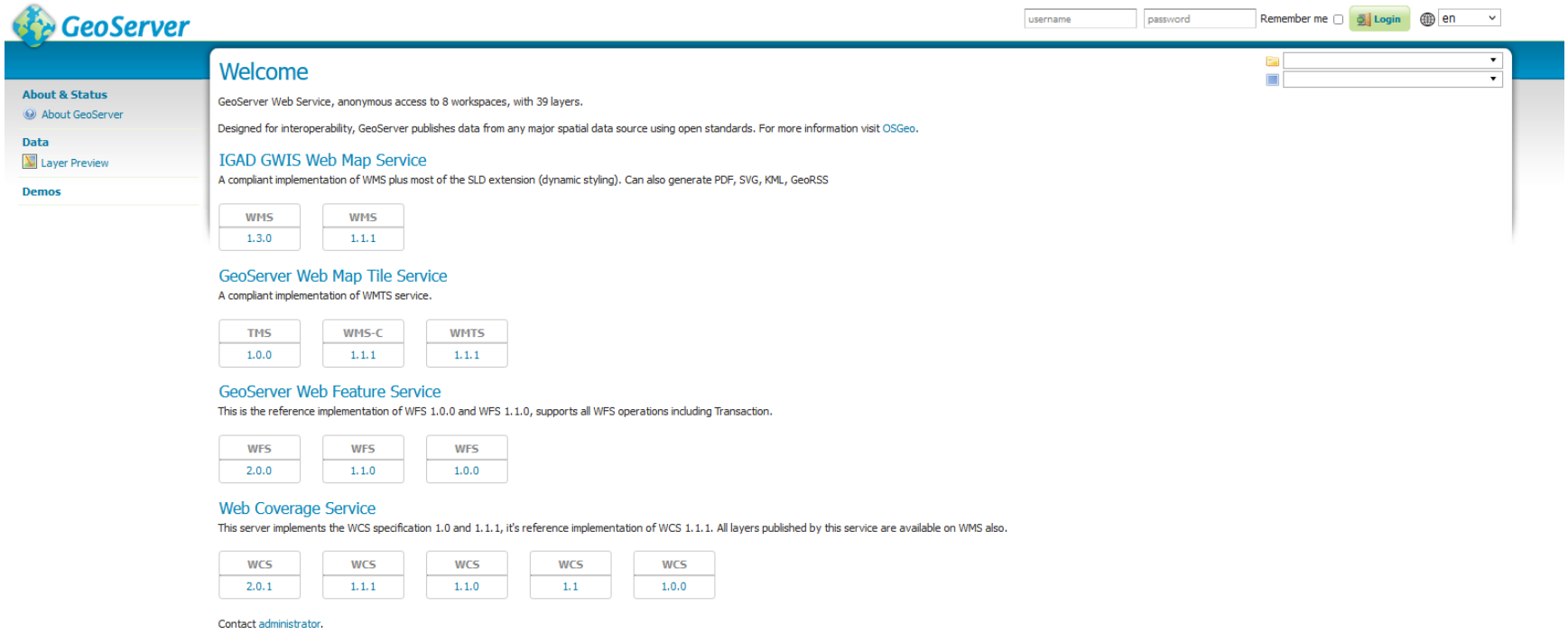
Web Map Services

Clicking Web Map Services on the navigation bar will bring you to this page. If you click on “Go directly to GWIS Geoserver”you will be taken to the IGAD Geoserver (see next page). Below, are connections to use in your desktop GIS, to bring the data directly into your GIS maps. More on this later.



IGAD Geoserver

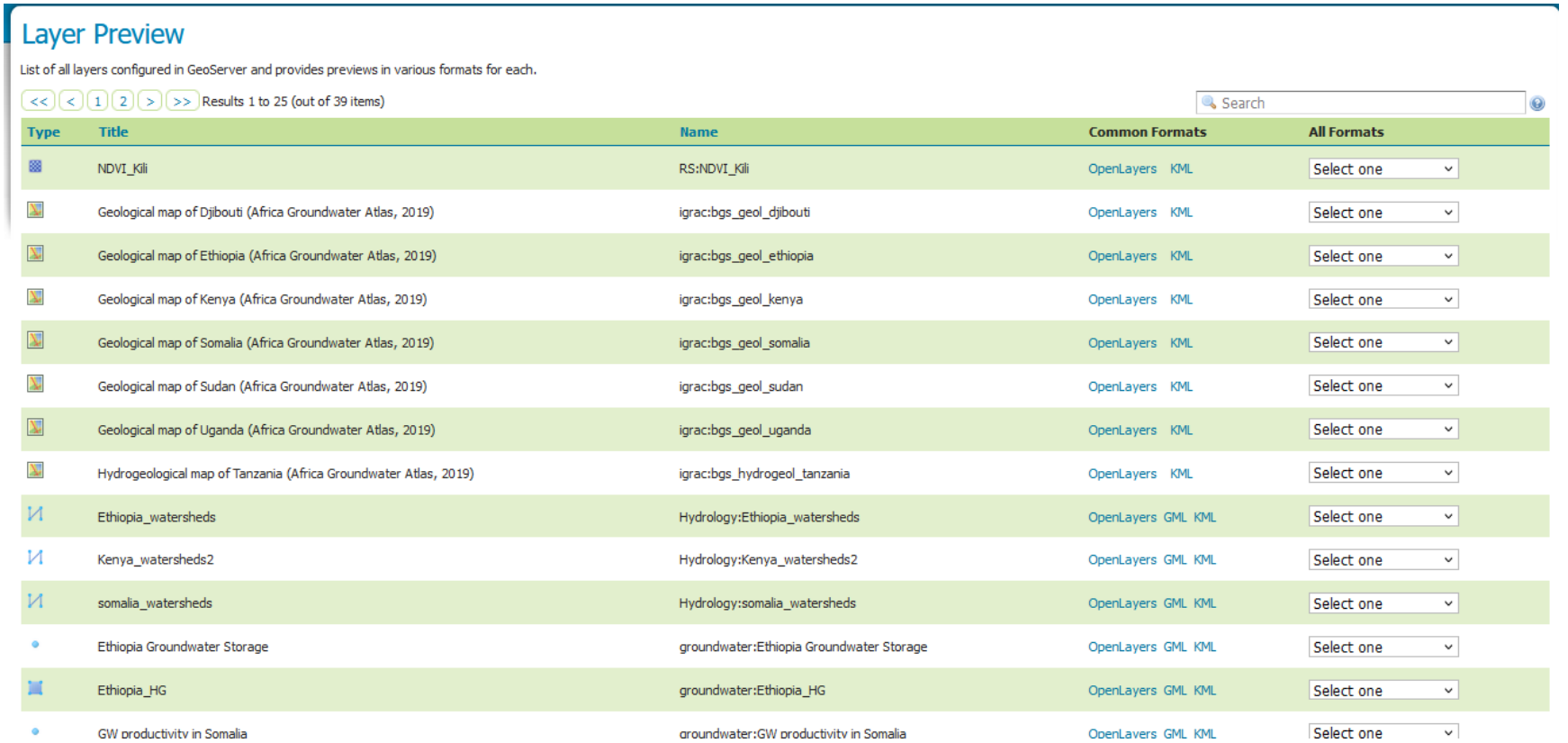
If you go to the Geoserver, you will the following page:



There are three types of services:

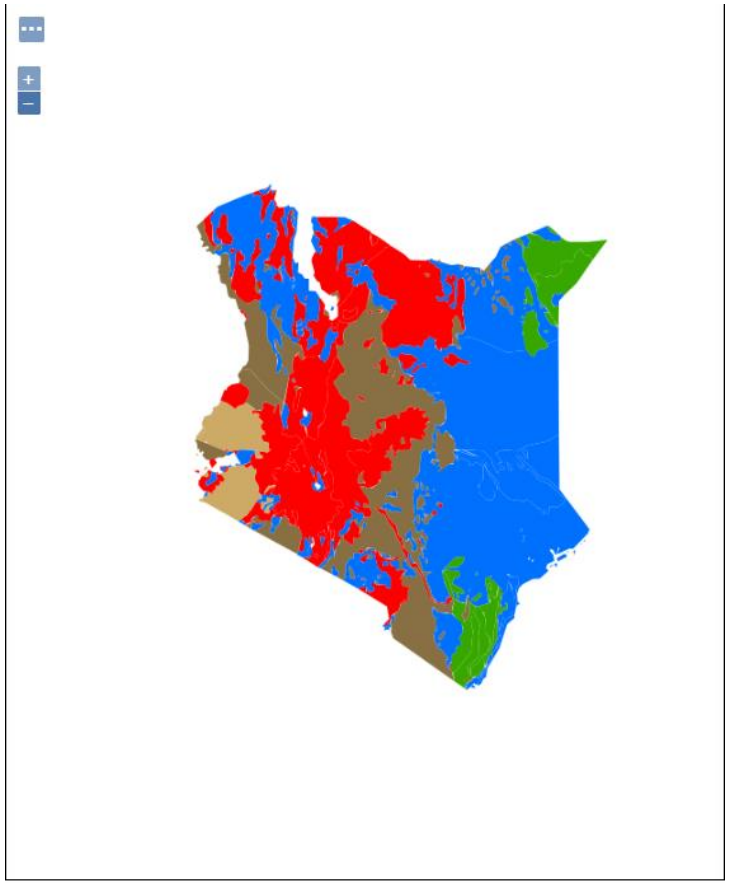
1. **Web Map Service which provides tile images of spatial data, in formats such as jpeg or PNG**
2. **Web Features Service which delivers vector data that can be edited.**
3. **Web Coverage Service which delivers rasters in various raster formats.**

The username and password are for administrators only. General users only have the Layer Preview option. Click on that and the available layers are shown:



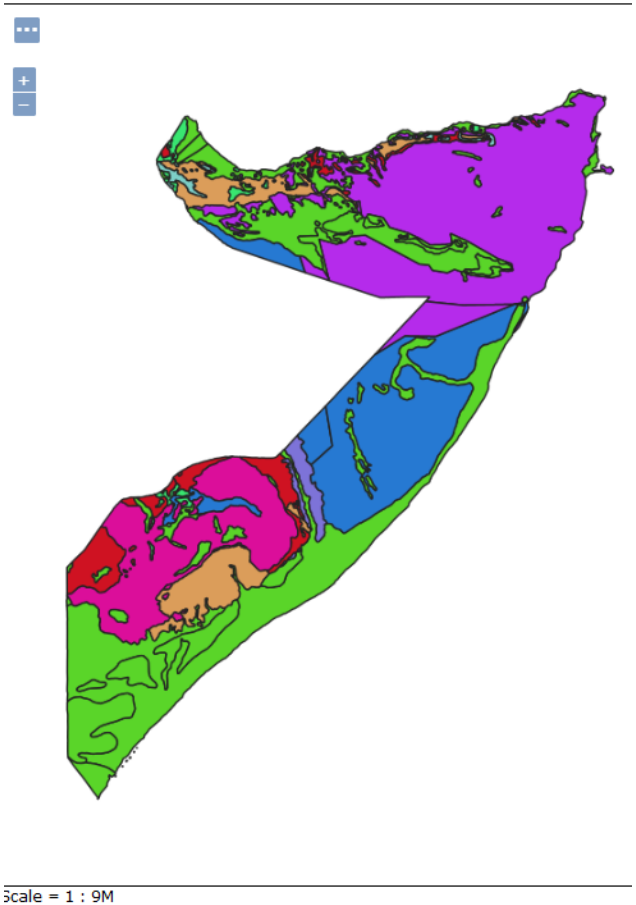
You can look through the list or use the search bar. Not there are two to three links under common formats. OpenLayers will give you a map preview in a new browser tab, the others will give you the markup language in a new browser tab which you can copy and paste if you want a GML or KML file for another application.

Open layers option for the Geological map of Kenya:



If you click on the three dots, opetions appear at the top, including adjusting width and height.

Vector layers re queryable, such as Somalia hydrogeology. Click on the map and info at that point appears at the bottom of the map.

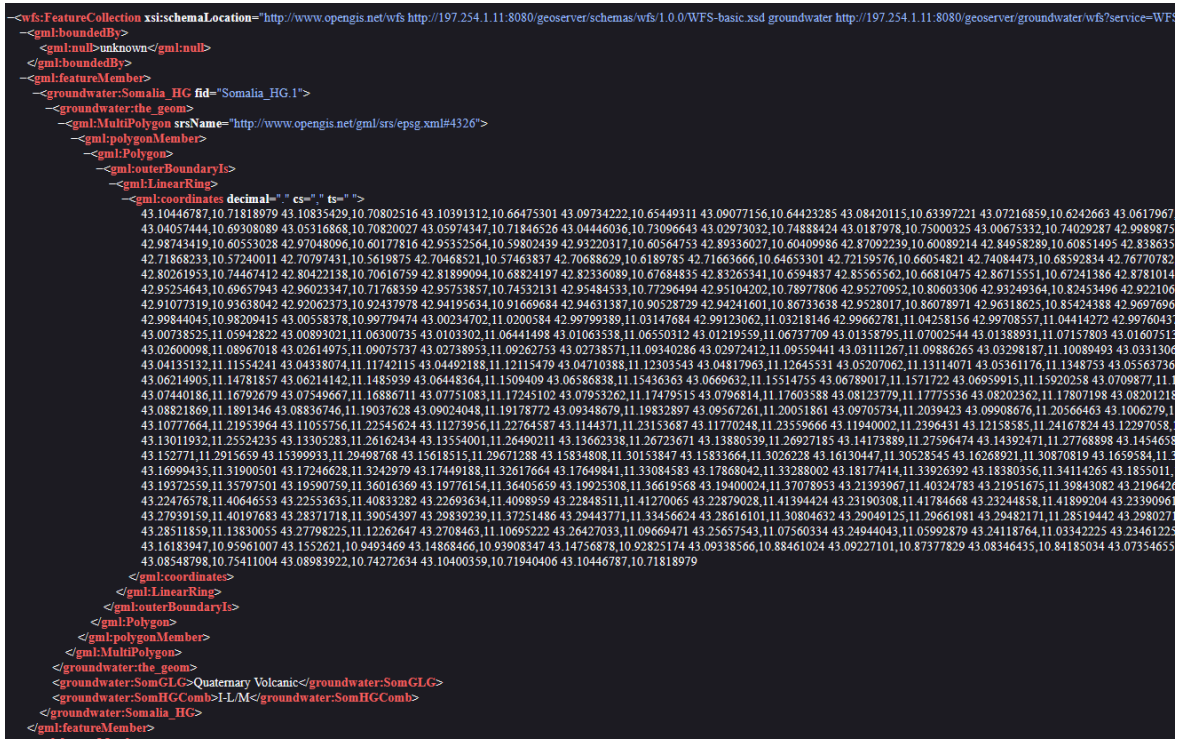


Scale = 1 : 9M

Somalia_HG

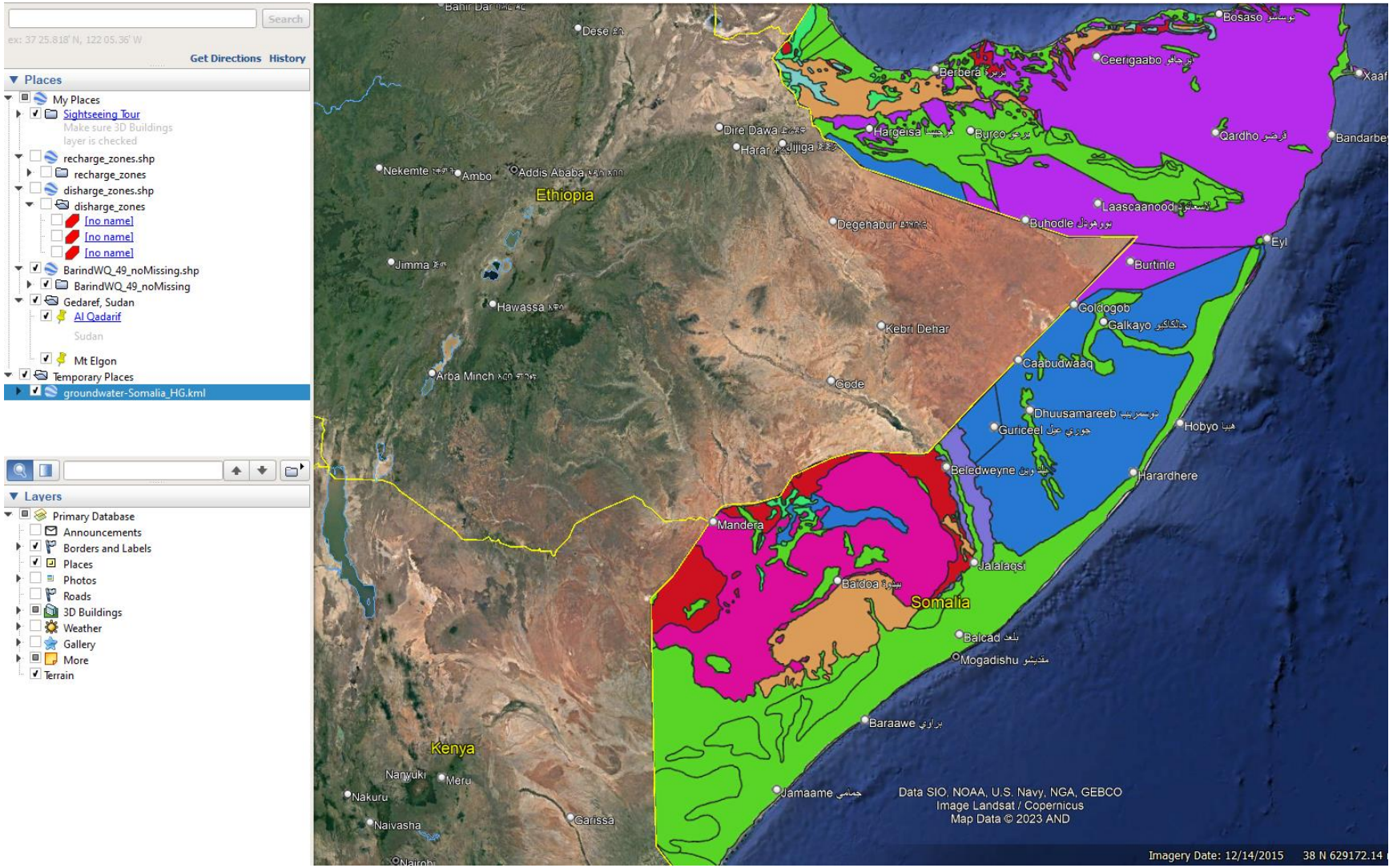
fid	SomGLG	SomHGComb
Somalia_HG.3	Tertiary Sedimentary - Palaeocene/Eocene	CSFK-M/H

If you choose the GML option you'gg get a new tabl that contains this markup:



If you choose the KML option, a KML file is downloaded. This fle can be used in Google Earth or in a desktop GIS.

Somalia hydrogeology KML file in Google Earth



If you use the urls provide on the GWIS web map service page,

GIS Web Map Services connection

Paste this url into your GIS WMS connection

http://197.254.1.11:8080/geoserver/ows?
service=WMS&version=1.3.0&request=GetCapabilities

GIS Web Feature Services connection

Paste this url into your GIS WFS connection

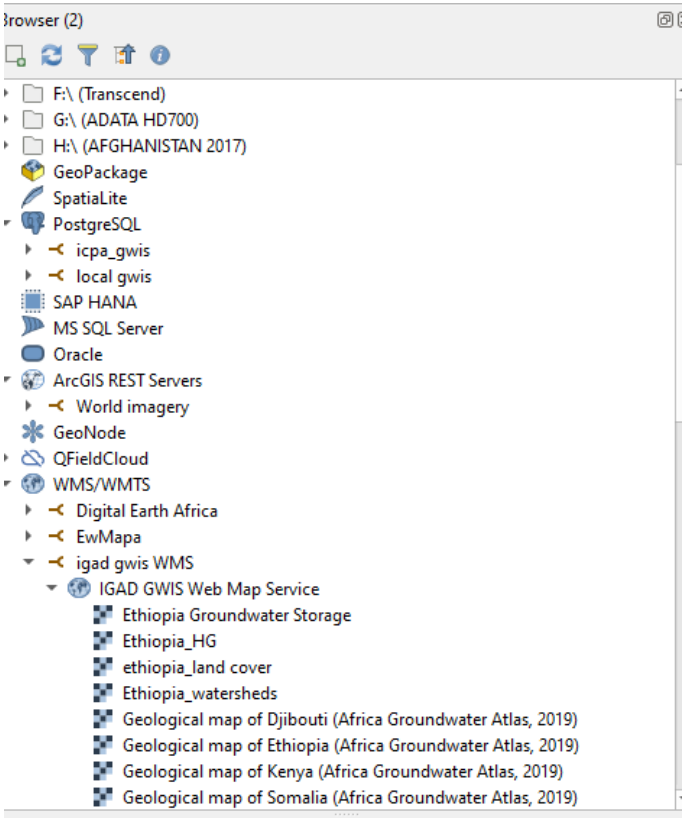
http://197.254.1.11:8080/geoserver/ows?
service=WFS&acceptversions=2.0.0&request=GetCapabilities

GIS Web Coverage Services connection

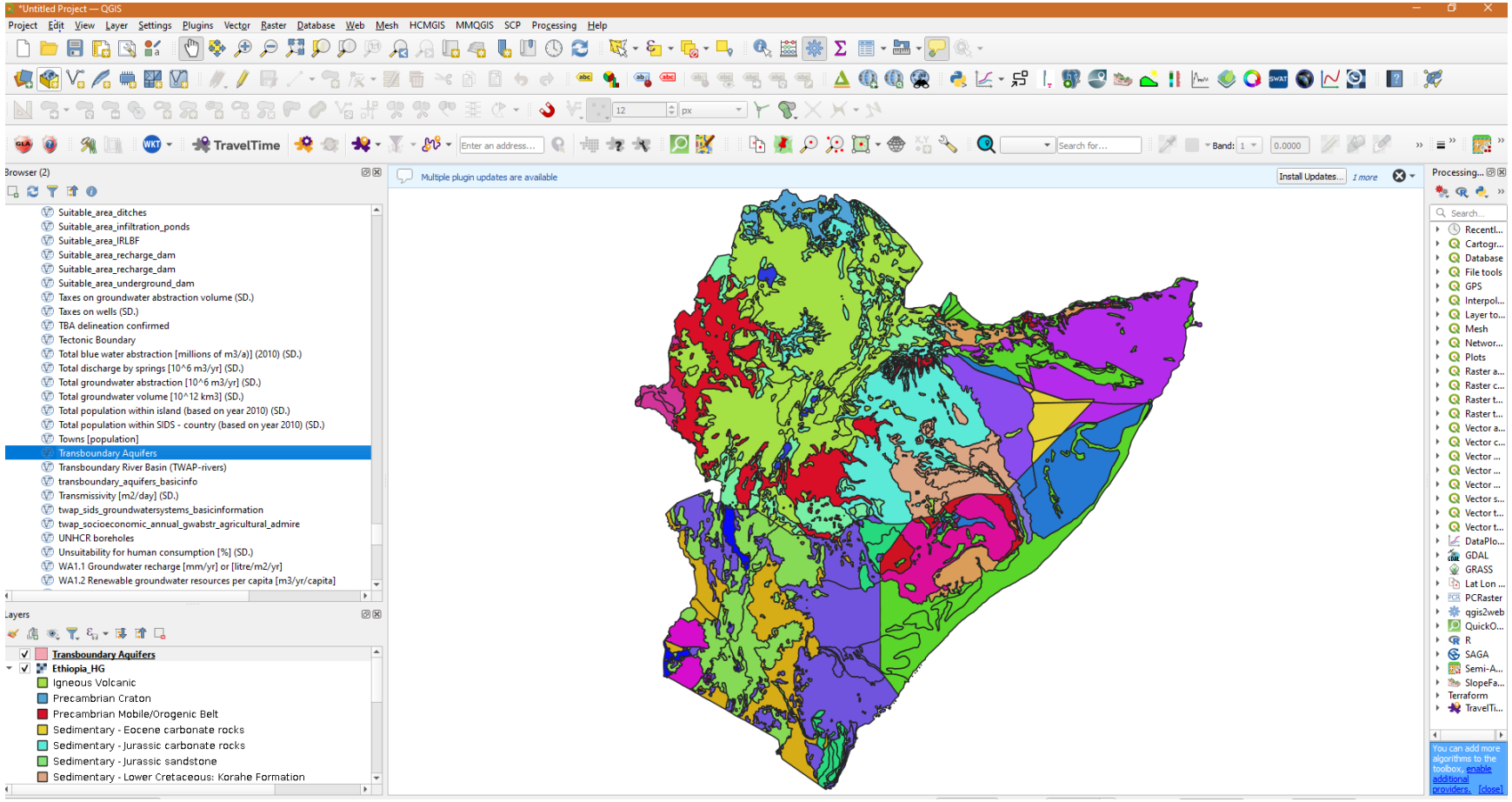
Paste this url into your GIS Web Coverage Services connection

http://197.254.1.11:8080/geoserver/ows?
service=WCS&acceptversions=2.0.1&request=GetCapabilities

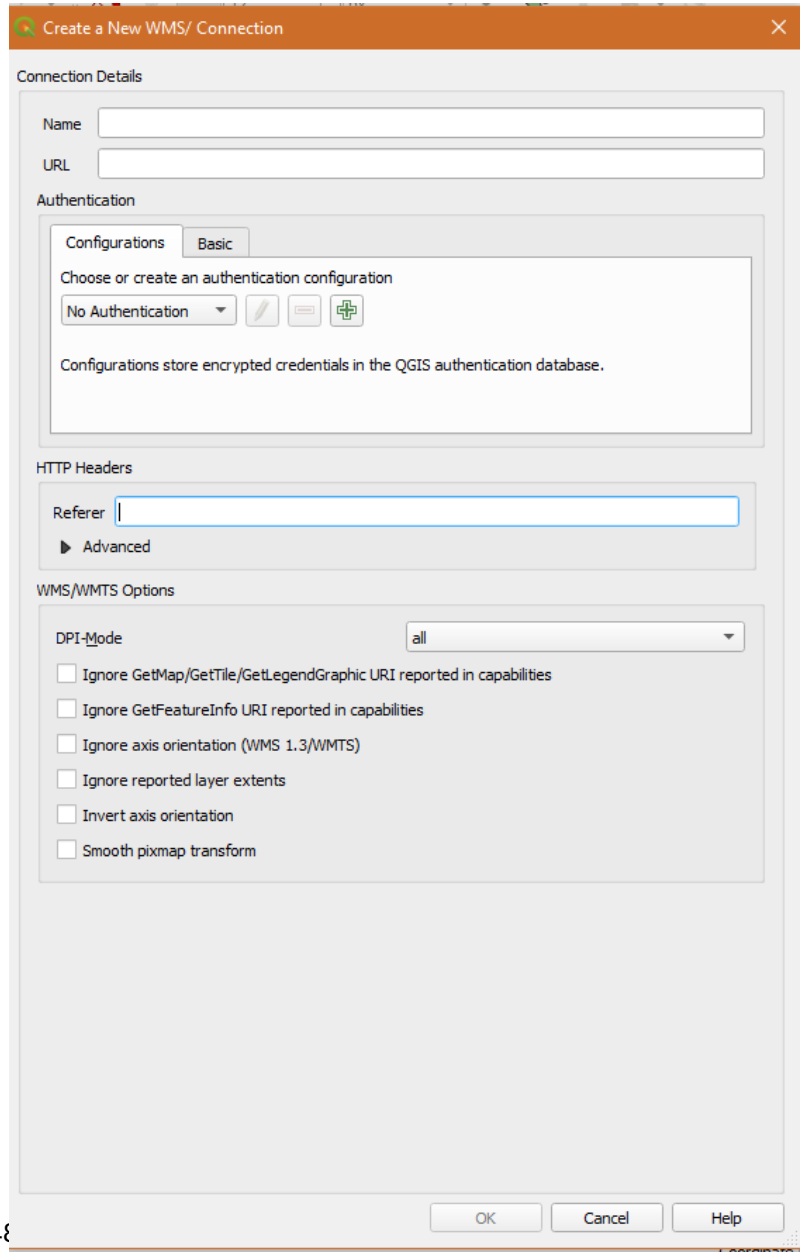
you can connect your desktop GIS, such as QGIS, directly to the IGAD Geoserver, as shown below:


Browser (2)
F:\ (Transcend)
G:\ (ADATA HD700)
H:\ (AFGHANISTAN 2017)
GeoPackage
SpatiaLite
PostgreSQL
icpa_gwis
local gwis
SAP HANA
MS SQL Server
Oracle
ArcGIS REST Servers
World imagery
GeoNode
QFieldCloud
WMS/WMTS
Digital Earth Africa
EwMapa
igad gwis WMS
IGAD GWIS Web Map Service
Ethiopia Groundwater Storage
Ethiopia_HG
ethiopia_land cover
Ethiopia_watersheds
Geological map of Djibouti (Africa Groundwater Atlas, 2019)
Geological map of Ethiopia (Africa Groundwater Atlas, 2019)
Geological map of Kenya (Africa Groundwater Atlas, 2019)
Geological map of Somalia (Africa Groundwater Atlas, 2019)

Here is a map displaying layers from the IGAD Web Feature Service displayed in a QGIS map, the combined hydrogeology of Kenya, Somalia, and Ethiopia:

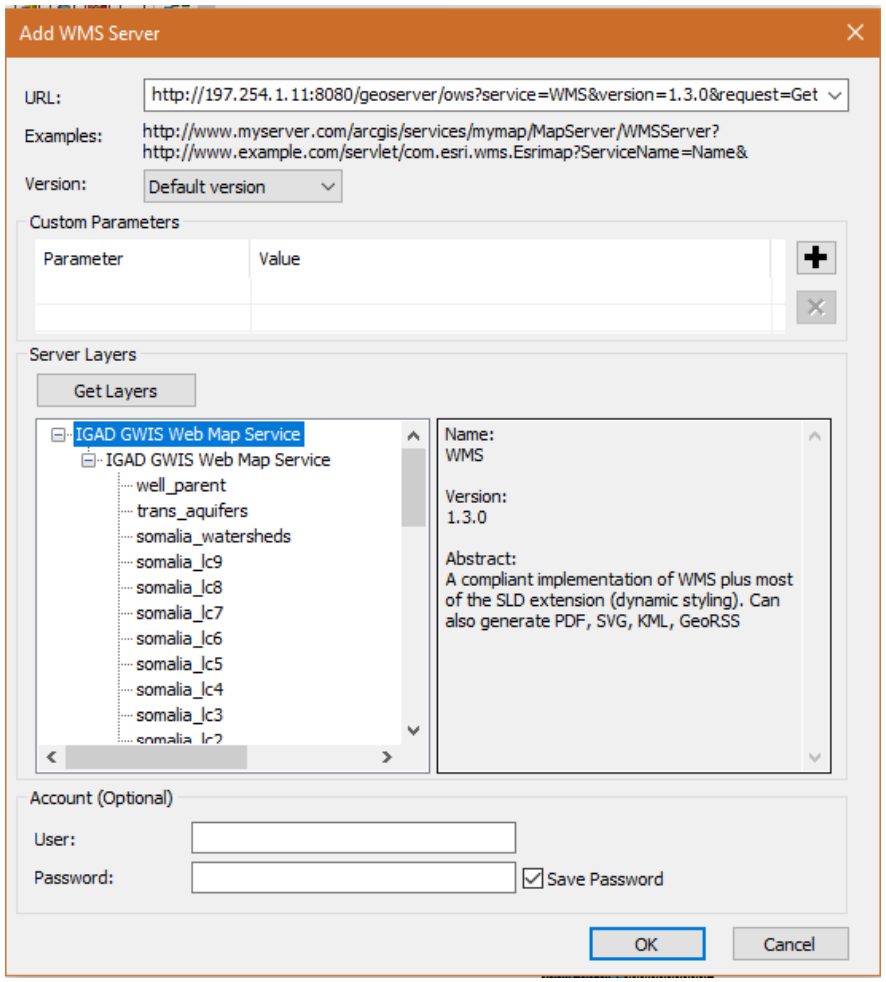


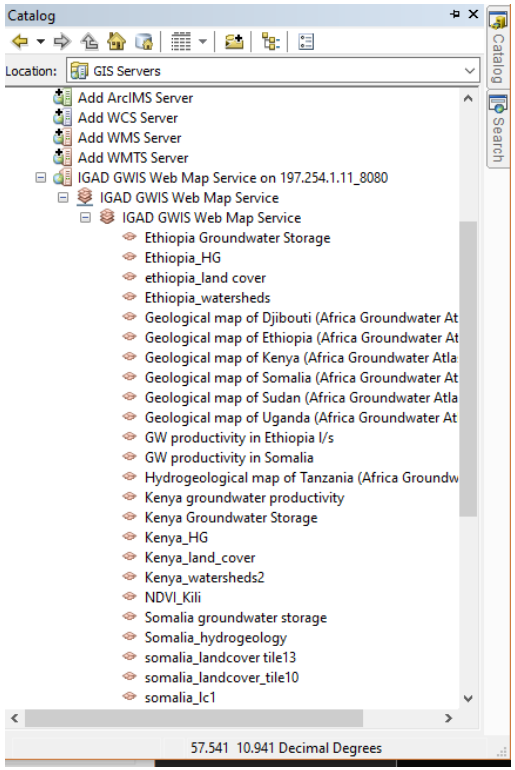
In QGIS, to connect go to the browser panel and right click WMS/WTS and choose new connection. Give it a name, for example IGAD, and In the URL field paste the URL from the GWIS web page for WMS service and paste it into the URL field.


Create a New WMS/ Connection
Connection Details
Name
URL
Authentication
Configurations
Basic
Choose or create an authentication configuration
No Authentication
Configurations store encrypted credentials in the QGIS authentication database.
HTTP Headers
Referer
Advanced
WMS/WMTS Options
DPI-Mode
all
Ignore GetMap/GetTile/GetLegendGraphic URI reported in capabilities
Ignore GetFeatureInfo URI reported in capabilities
Ignore axis orientation (WMS 1.3/WMTS)
Ignore reported layer extents
Invert axis orientation
Smooth pixmap transform
OK
Cancel
Help

Follow the same procedure for the WFS and WCS services, pasting in the corresponding URLs from the web page.

In ArcGIS go to catalogue and click on “+Add WMS server” and paste in the WMS URL, then click layers. Now the service appears in the Catalogue panel.



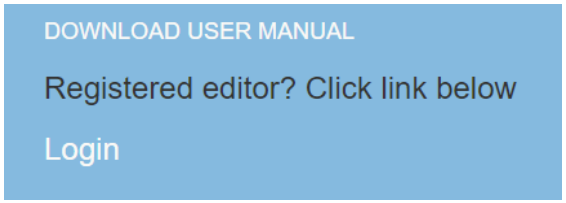


You can do the same to add WCS service, *however for WFS service, you need to install the Data Interoperability extension and add an Interoperability Connection to the WFS service*. Details can be found here:

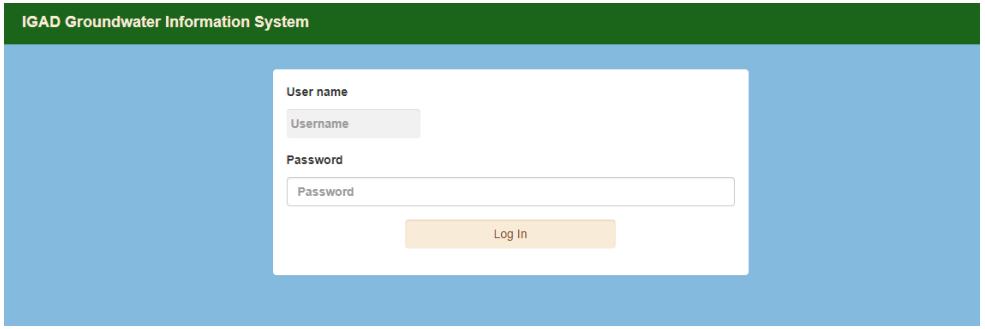
https://desktop.arcgis.com/en/arcmap/latest/map/web-maps-and-services/adding-a-wfs-service-to-arcmap.htm

Record by record entry using the GWIS web forms

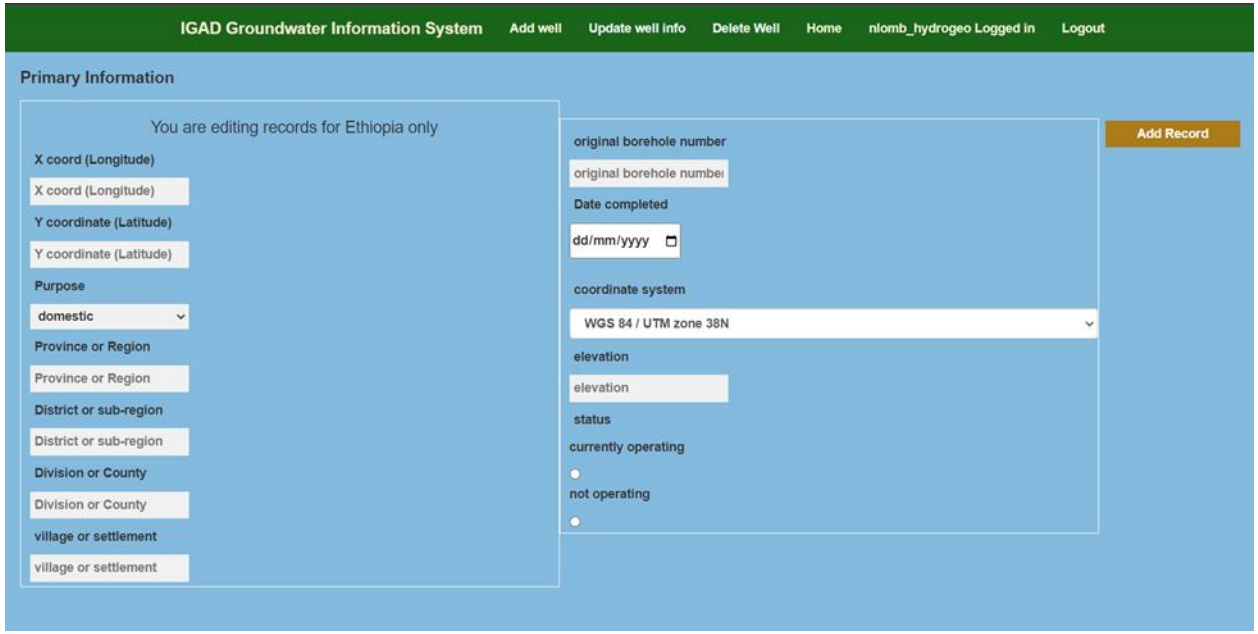
If you have been designated as a Registered Editor by IGAD, you can login to gain access to the Editing Module where you can enter or update records well records. Such designation is granted by IGAD who will enter your username and password into a special users table. You need to log in using the link on the Welcome page.



This will bring you to the login page



Successful login leads to the **first of four forms**, (all of which the user must go through), **Primary Information.**



X and Y coordinates correspond to Longitude and Latitude – be careful of the order of input. Purpose is a dropdown list box as well as coordinate system. See the next page for the choice of coordinate system. The default is 4326 – WGS 84 World GPS, since that is the default on most GPS devices, however older data may be in of the other coordinate systems. Make sure you choose the right one if that is the case. *Purpose* is a dropdown list. Choose the most similar value.

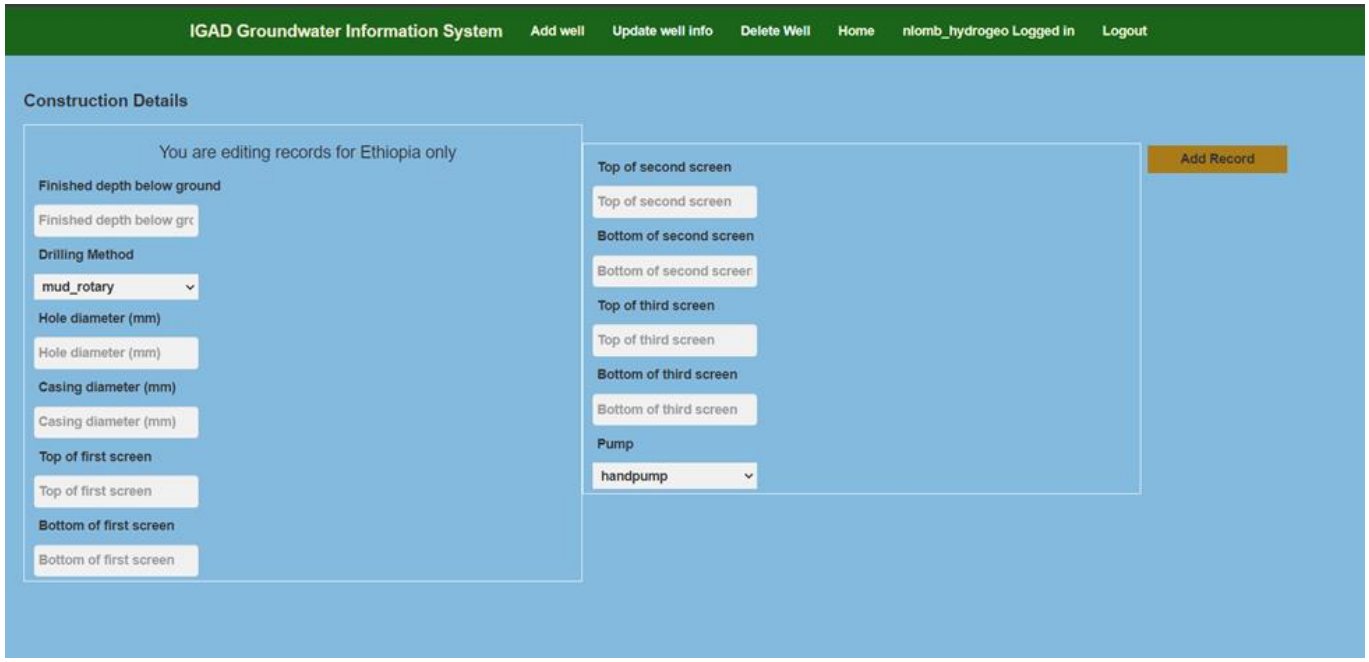
Date completed is a date picker. Click on the icon to bring up a calendar and choose the date. This is a required field and must be filled out. If it is missing just choose the current date (Today). This info is needed to generate the system well id (well_no). The original borehole number is also required.

When the form is filled out to the best of your knowledge, click Add Record button to get to the 2nd screen. If a required file is missing, a message appears, and you won't be able to proceed until filled in.

AVAILABLE COORDINATE SYSTEMS

srid integer	system character varying (100)	countries character varying (255)
4201	Adindan	Eritrea Ethiopia South Sudan Sudan
4205	Afgooye Somalia	Djibouti Eritrea Ethiopia Somalia
4210	Arc 1960	Kenya Tanzania
4326	WGS 84 World GPS	Entire world
20135	Adindan / UTM zone 35N	Eritrea Ethiopia South Sudan Sudan
20136	Adindan / UTM zone 36N	Eritrea Ethiopia South Sudan Sudan
20137	Adindan / UTM zone 37N	Eritrea Ethiopia South Sudan Sudan
20138	Adindan / UTM zone 38N	Eritrea Ethiopia South Sudan Sudan
20538	Afgooye / UTM zone 38N	Somalia
20539	Afgooye / UTM zone 39N	Somalia
21035	Arc 1960 / UTM zone 35S	Kenya Tanzania
21036	Arc 1960 / UTM zone 36S	Kenya Tanzania
21037	Arc 1960 / UTM zone 37S	Kenya Tanzania
21095	Arc 1960 / UTM zone 35N	Kenya Tanzania
21096	Arc 1960 / UTM zone 36N	Kenya Tanzania
21097	Arc 1960 / UTM zone 37N	Kenya Tanzania
32636	WGS 84 / UTM zone 36N	Egypt Ethiopia Kenya Uganda Sudan
32637	WGS 84 / UTM zone 37N	Djibouti Egypt Eritrea Ethiopia Kenya Somalia Sudan
32638	WGS 84 / UTM zone 38N	Djibouti Eritrea Ethiopia Somalia
32639	WGS 84 / UTM zone 39N	Somalia
32736	WGS 84 / UTM zone 36S	Kenya Malawi Mozambique Rwanda Tanzania Uganda
32737	WGS 84 / UTM zone 37S	Kenya Tanzania Mozambique

2nd screen Construction details



Note that on all the screens, the user is notified of the country whose records they are inserting. Because this user has been registered under Ethiopia, he/she will only be able to add new records for Ethiopia. This country information is kept in the *users* table of the database.

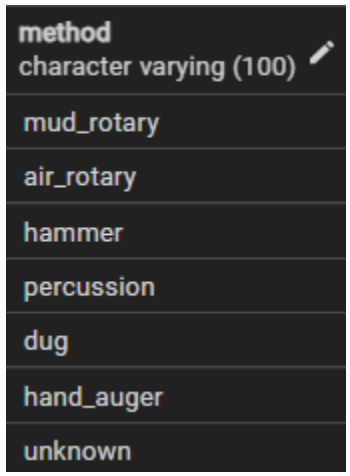
Drilling method is a dropdown list. Choose the most similar method.

Keep in mind that every numeric field (except elevation) will only allow *positive* numbers, and no text or symbols can be entered.

Dropdown list values

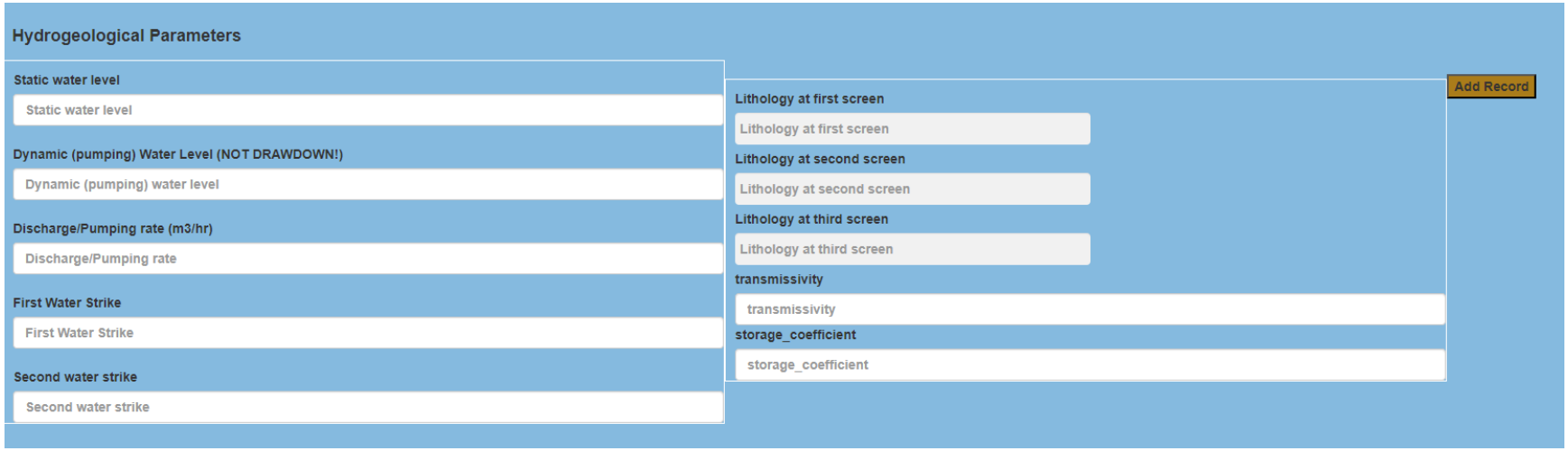
Purpose first screen (Primary Information)

Drilling method second sreen (Construction Details)



EVEN IF YOU DO NOT ENTER ANY INFORMATION, YOU STILL MUST CLICK THE ADD RECORD BUTTON. This is true for all the screen forms.

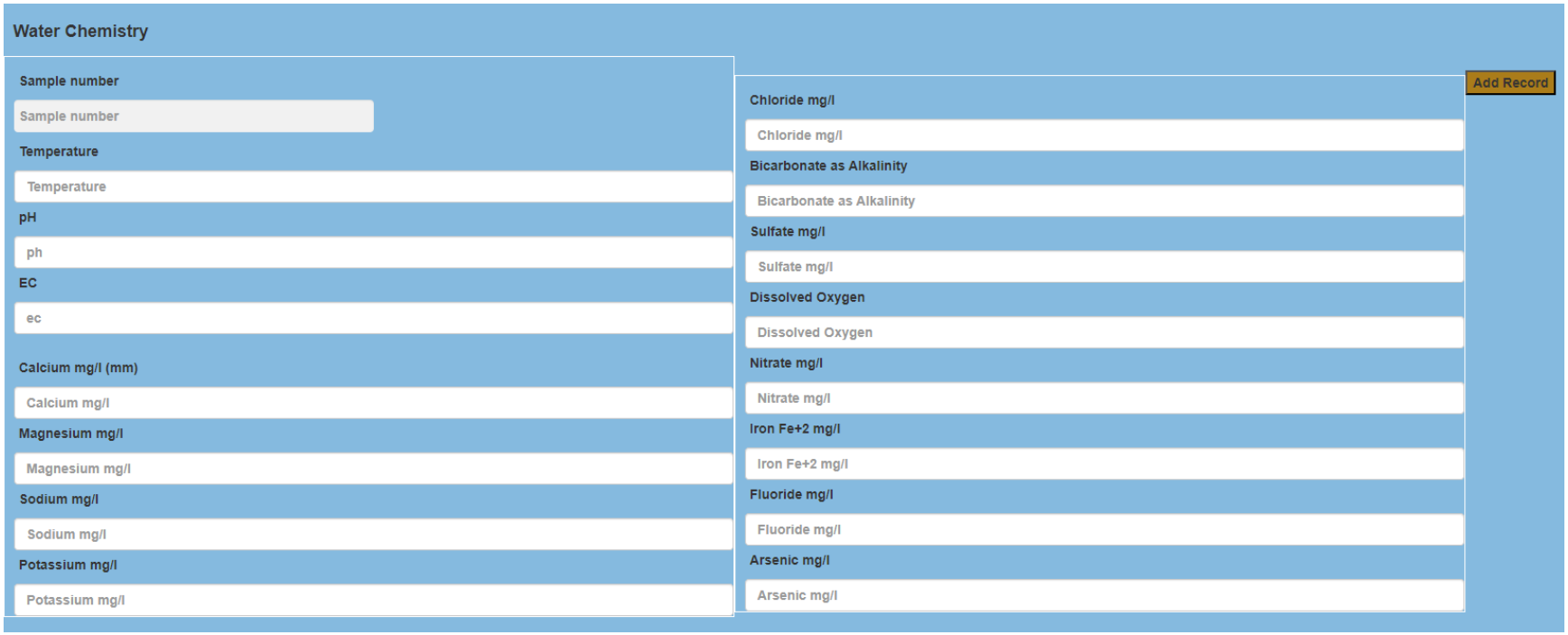
3rd screen - Hydrogeological Parameters



Fill in whatever information is available. Note that dynamic pumping level is the water level measured during pumping (Not drawdown).

Discharge is in cubic meters per hour. Lithologies are geologic materials at the level of the screens. Transmissivity and storage coefficient are parameters calculated from pumping tests. Nothing on this form is required. In any case the user needs to click the Add Record button.

4th screen - Water Chemistry



It might be helpful to refer to page 20 for the fields and their meanings. The Wq fields that correspond to this from are reproduced for convenience. Again, negative numbers of symbols such as '< ' or '>' are not allowed. In addition, there are maximum values (estimated for freshwater), that cannot be exceeded. For example, you cannot enter a value for calcium of 1000 mg/l. Check you data for decimal points or other typos.

WQ table	sample_no	primary key & unique identifier for sample one well can have more than 1 sample but sample can only belong to 1 well
	temp	temperature in degrees Celsius
	ph	pH
	ec	electrical conductivity in microsiemens per centimeter (µs/cm).
	ca_mgl	calcium in milligrams per liter
	mg_mgl	magnesium in milligrams per liter
	na_mgl	sodium in milligrams per liter
	k_mgl sodium in	potassium in milligrams per liter
	cl_mgl	chloride in milligrams per liter
	hco3_alk_mgl	bicarbonate alkalinity measured in milligrams per liter
	so4_mgl	sulfate measured in milligrams per liter
	disso2	dissolved oxygen in milligrams per liter
	no3_mgl	nitrate in milligrams per liter
	fe_mgl	iron measured in milligrams per liter
	f_mgl	fluoride measured in milligrams per liter
	as_mgl	arsenic measured in milligrams per liter

Review page

MAKE SURE TO SCROLL DOWN TO SEE ALL TABLES

Primary Information

WELL_NO	EASTING	NORTHING	PURPOSE	ADMIN1	ADMIN2	ADMIN3	SETTLEMENT
2024-08-20-Et-736	34.123400	1.246800	monitoring	NOWHERE	SOMEWHERE		Parkchester

ORIG_WELLNO	DATE_COMPLETED	ELEV	STATUS	COORD_SYS	CREATED
bh70	2024-08-20	150.00		4326	2024-08-20 08:18:00.035248

Construction Details

DEPTH_DBG	DRILLING_METH	HOLE_DIAM_MM	CASING_DIAM_MM	SCREEN1_TOP_DBG	SCREEN1_BOT_DBG
42.00	DTH ROTARY/ PRD		254	30.00	39.00

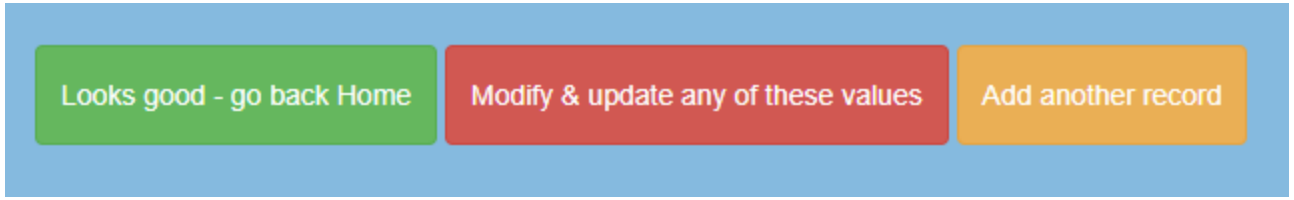
SCREEN2_TOP_DBG	SCREEN2_BOT_DBG	SCREEN3_TOP_DBG	SCREEN3_BOT_DBG	PUMP
				submersible

Hydrogeological Parameters

SWL_DBG	DWL_DBG	DISCHARGE_M3_PER_HR	DEPTH_BR_BG	WATER_STRIKE_1_DBG	WATER_STRIKE_2_DBG
21.50				28.00	36.00

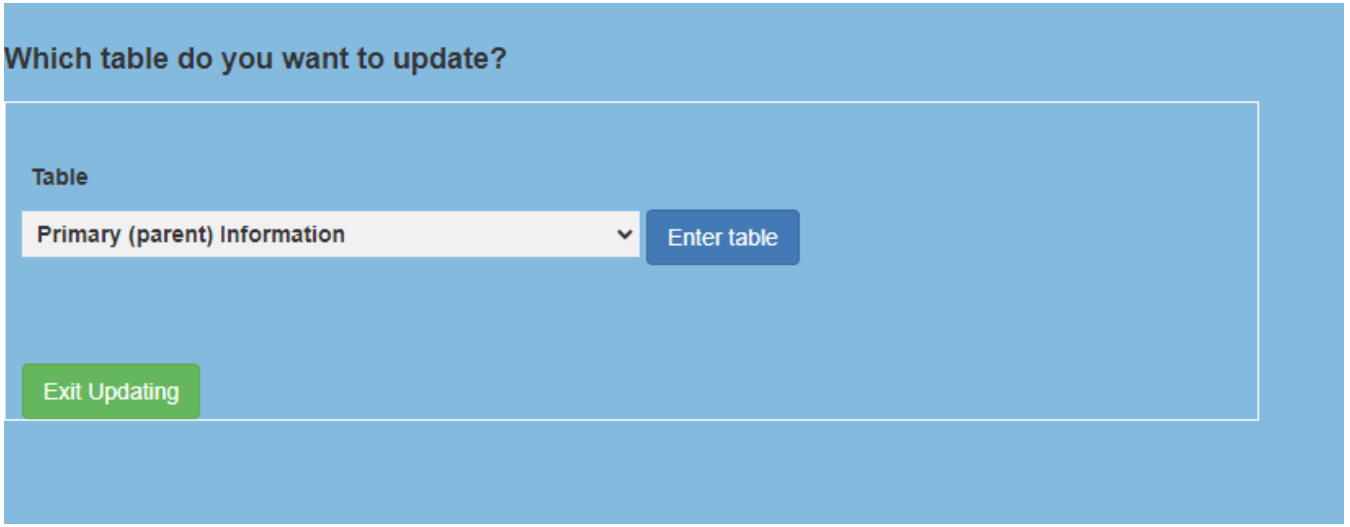
LITHOLOGY1_DESCRIP	LITHOLOGY2_DESCRIP	LITHOLOGY3_DESCRIP	TRANSMISSIVITY	STORAGE_COEFFICIENT
weathered coral rock		highly weathered limestone boulders		

This page enables the user to review the data for all tables for this well. Make sure to scroll down until you see the buttons on the bottom.



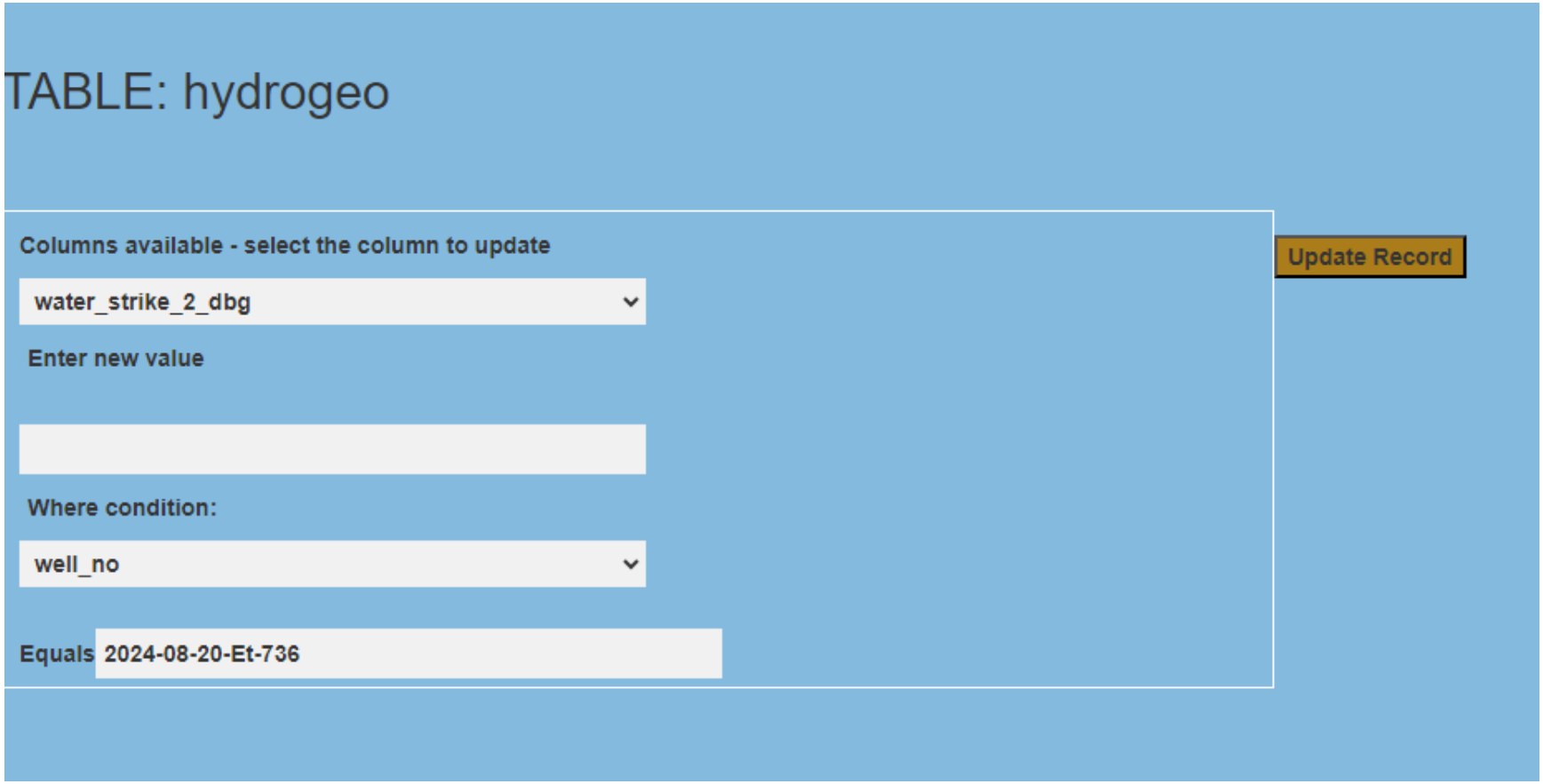
If the data looks correct, and you want to stop editing, press the first button to go back to the home page. If something is not correct you can change the values you entered by clicking the middle button. If you want to add another record, click the last button and it will bring you to the first input screen (Primary Information).

Click on the red middle button will bring you to the update page:

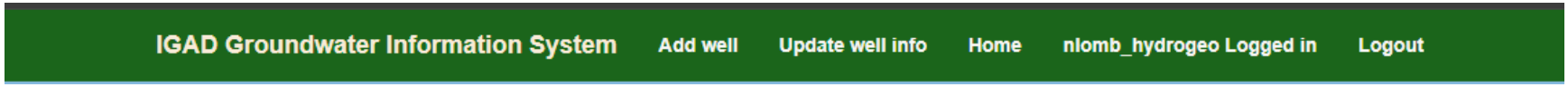


Click the dropdown list to choose one of the four tables. In this example, we'll choose hydrogeo. Click 'Enter Table' button.

A new screen displaying the table name, and four input fields appears. The first is a dropdown list of columns available for that table. Again, refer to page 20 for column names and meanings. You can enter a new value for the column variable, but the 'Where condition' and its 'Equals'value are set to well_no = the well number of the current record you just worked on, and these cannot be changed. Click the button to update the record.



You can then continue to update other values in other tables, or exit the update mode by clicking the green button, 'Exit Updating.'

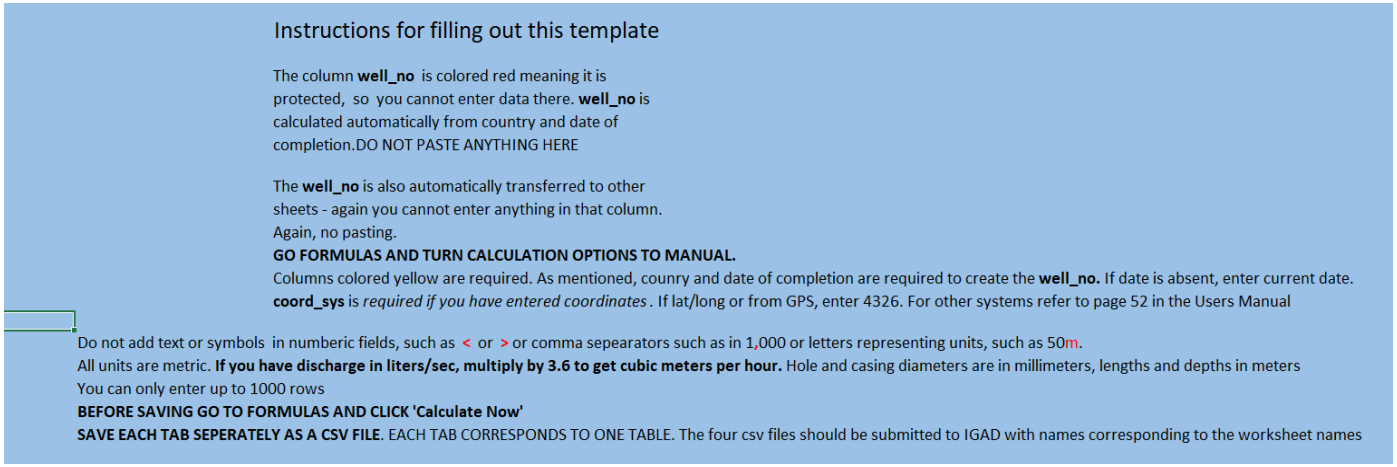


The Editing module has its own navigation bar, different from the rest of the application. Notice it has the username of the person logged in. Also note there is an item *'Update well info'* where the user is presented with similar screens as above, except more tables are offered in the table dropdown list, and on the page that follows more columns are available for update.

Excel Templates to create CSV files

Download the Excel templates from the Knowledge Base – Resources for Administrators page.

The first tab has instructions which should be read and made familiar.



Instructions for filling out this template

The column **well_no** is colored red meaning it is protected, so you cannot enter data there. **well_no** is calculated automatically from country and date of completion.DO NOT PASTE ANYTHING HERE

The **well_no** is also automatically transferred to other sheets - again you cannot enter anything in that column. Again, no pasting.

GO FORMULAS AND TURN CALCULATION OPTIONS TO MANUAL.

Columns colored yellow are required. As mentioned, counry and date of completion are required to create the **well_no.** If date is absent, enter current date.

coord_sys is *required if you have entered coordinates* . If lat/long or from GPS, enter 4326. For other systems refer to page 52 in the Users Manual

Do not add text or symbols in numberic fields, such as < or > or comma sepearators such as in 1,000 or letters representing units, such as 50m.

All units are metric. **If you have discharge in liters/sec, multiply by 3.6 to get cubic meters per hour.** Hole and casing diameters are in millimeters, lengths and depths in meters

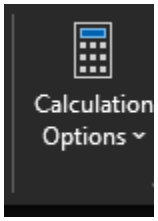
You can only enter up to 1000 rows

BEFORE SAVING GO TO FORMULAS AND CLICK 'Calculate Now'

SAVE EACH TAB SEPERATELY AS A CSV FILE. EACH TAB CORRESPONDS TO ONE TABLE. The four csv files should be submitted to IGAD with names corresponding to the worksheet names

IMPORTANT – before entering data

GO TO FORMULAS AND TURN CALCULATION OPTIONS TO **MANUAL.**



The second worksheet has information for the well_parent table

A	B	C	D	E	F	G	H	I	J	K	L	M	N
well_no	easting	northing	purpose	country	admin1	admin2	admin3	settlement	orig _wellno	date_completed	elev	status	coord_sys
1900-01-00--215													
1900-01-00--312													
1900-01-00--286													
1900-01-00--677													
1900-01-00--343													
1900-01-00--332													
1900-01-00--915													
1900-01-00--350													

Columns highlighted in yellow are required. The column **coord_sys** in lighter color is **required if coordinates are entered**. This the EPSG code. For GPS devices the default is WGS 84, which is code 4326. Refer to the table in the User Manual page 52 for other systems.

The other worksheets are straightforward. Note that sample_no in the Water Chemistry worksheet is required.

IMPORTANT

BEFORE SAVING GO TO FORMULAS AND CLICK 'Calculate Now'

SAVE EACH SHEET SEPERATELY AS A CSV FILE. EACH SHEET CORRESPONDS TO ONE TABLE. The four CSV files should be submitted to IGAD with names corresponding to the worksheet names