miniSASS Data Management: Development of an online map-based data portal

Online map-based miniSASS data portal

Report to the
WATER RESEARCH COMMISSION

by

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1 BACKROUND AND INTRODUCTION

One of the biggest challenges in Africa which needs to be addressed immediately if we are to achieve the UN Millennium Development Goals and the Africa Water Vision 2025, is the lack of adequate human (technical and managerial), financial and material resources for effective water resource management (UNEP, 2008; Matlock, 2008; Revenga *et al*., 2005). A key limitation to effective water resource management is the lack of data covering the quality of water resources as a result of the shortage of facilities and skilled people to collect and analyse the data (UNEP, 2008). Furthermore, the need for capacity building, public awareness and participatory approaches are crucial to the sustainable management and monitoring of African water resources, particularly those which are trans-boundary in nature (African Water Vision, 2000; UNEP, 2008).

miniSASS (mini Stream Assessment Scoring System - Box 1), a community river health monitoring tool was developed in response to these issues through the use of community participation and a simple aquatic biomonitoring technique to determine river health. This low technology, scientifically reliable and inexpensive participatory technique to monitor water quality in rivers and streams allows a simpler understanding of the successful, but technically complex, macroinvertebrate bioassessment technique, the South African Scoring System (SASS). miniSASS facilitates real-time monitoring and investigation of water quality and pollution sources by any age group, thus building capacity and enabling improved water resource management (Graham et al., 2004).

Box 1: Aquatic Biomonitoring *(from Graham* et al*., 2004, p 26-27)*
miniSASS is an aquatic biomonitoring tool. The method involves collecting samples of readily identifiable aquatic invertebrate taxa from the river using a standardized method. A quality score is allocated to each taxon giving an indication of the taxon's sensitivity to pollution. The overall quality score is interpreted using a table of ecological categories for both rocky and sandy type rivers. For example, a rocky river with a score over 7.9 is an unmodified river in natural condition

Six years after its original development, the miniSASS tool was further refined (version 2) following an audit of users' needs, expectations and the perceived limitations of miniSASS with the updated version subjected to field testing (WRC Report KV 240, K8/733). The upgrade of miniSASS identified the need for miniSASS generated results to be submitted to a central database where results could be gathered, checked, stored and shared by national and international communities, with the most viable option being submission of data into an online map-based data portal with geospatial mapping (Graham, 2009).

This project was thus initiated to further develop the miniSASS package as a citizen science river health monitoring tool through the development of a dedicated website and tailored database for the universal capture, exploration and sharing of miniSASS data by citizens. An active, user-friendly central internet data portal for miniSASS data submission would empower every community and school in Southern Africa (and potentially Africa and beyond) to become part of an international network of river health monitors. The online map-based data portal is in the form of a website (www.minisass.org) which provides a dedicated home for miniSASS.

This report briefly outlines the features and functionality of the miniSASS website and database components, as well as the testing phase outcomes.

2 APPROACH OF THE STUDY

This report closes off the development of the online map-based data portal for the management and display of miniSASS data collected by miniSASS users. The final refined miniSASS data portal and database has been tested and refined in order to meet the aims of the project. The miniSASS data portal is in the form of a website and spatial database which allows miniSASS users to add their own miniSASS results, sharing results nationwide and further promoting miniSASS as a citizen science tool. The website provides a dedicated home for the miniSASS biomonitoring tool, to promote its use and to serve the miniSASS user community by providing a central hub for river health data, supporting materials, instruction, and news of the latest activities that have taken place.

The interface to the data portal is in the form of a digital map, allowing users to find their location, navigate the river and catchment spatially, explore other user's results, as well as capture their own results. In this way the miniSASS data portal promotes knowledge sharing, while in the process creating a national database of citizen-collected river health data. Reasons for the changes in river health over space and time can be explored based on the land uses and other activities that can be observed on the interactive Google Earth/satellite maps, supplemented by local knowledge. Communities can use the information and knowledge to illustrate the condition of their rivers, and investigate pollution sources. Land users such as farmers, forestry or industries can monitor and self-regulate the impact of their activities on the surrounding river environment.

3 OUTLINE OF THE ONLINE MAP-BASED MINISASS DATA PORTAL

3.1 Approach

The website outlines the correct methods for collecting a miniSASS sample, the explanation of river categories, a miniSASS checklist and hints and tips for getting ready for sampling. Updated and improved field sheets are available for download,

where you will find the information and score sheet, identification guide and dichotomous key for miniSASS.

Users are also able to submit for upload, and view reports of projects that have used miniSASS, other educational resources and literature references relevant to miniSASS. A dedicated Wordpress blog was created to share the latest miniSASS news, where miniSASS has been undertaken and all the projects that miniSASS forms part of.

3.2 Components of the website

3.2.1 Key Features

The miniSASS website supports the database, and is based on a Content Management System (CMS) such that basic website content can be edited and updated by an administrator with basic training or experience in desktop publishing.
The supporting pages of the website include the following:

a. Home – Introduction to website and brief theory
    - Monthly macroinvertebrate profile.
    - Latest news and events via the miniSASS Wordpress blog which has been embedded on the home page.
    - Facebook page live feed.
b. How to – miniSASS instructions and illustrations covering the following;
    - User registration.
    - Data Upload.
    - Data exploration.
    - Method Verification.
c. Downloads – Access to miniSASS resources
    - miniSASS pamphlet and field sheets.
    - School curriculum exercises.
    - Link to literature references relating to miniSASS.
    - Project reports which involved miniSASS.
d. Partners - Links to other online resources from partners
e. Contact Us – Contact form

3.2.2 Additional features

a. Recent observations

This feature appears on the right of every page on the miniSASS website as a direct link and shortcut to the most recent miniSASS observations displayed on the map that have been added by website users. This feature allows the user easy access to see the miniSASS score, the user or organisation that entered it as well as the date that the miniSASS observation was collected.

b. Explanation text when hovering over buttons

3.2.3 The miniSASS data portal

a. User interface - A map interface allowing functionality to explore the catchment, switch spatial layers on and off, as well as add sites, upload miniSASS results and explore miniSASS data.
b. Spatial database - storing data such as sites, results, registered users etc.

3.2.4 Links to miniSASS user communities on social media

a. Facebook live feed
b. Wordpress blog

3.3 Specifications and outline

A live working document was maintained of the technical design specifications for the miniSASS web site, and was stored online as a shared document for editing by members of the project team during the project development.

The website is aimed at all miniSASS users which covers a wide public spectrum, such communities, schools, government departments, conservancies and enviro-groups. Users that are interested in water quality are able to browse and search for rivers and obtain miniSASS data. Only registered members are able to enter miniSASS data. Upon completing registration, the user is immediately able to login and use the system. The administrator has the capability to edit and verify users results. Website users are assigned different rights according to the CRUD principle:

- Create – only registered users have Create rights. This allows them to log in and add miniSASS sample data to the data map. Create rights are automatically assigned to new users.
- Read – all users have Read access. This means that anyone using the web site will be able to browse the miniSASS data on the map without having to log in.
- Update – certain users can be granted Update rights, which means that they can log in and edit existing miniSASS data. Update rights are granted to administration staff.
- Delete – administration staff can be granted Delete rights, which means that they can log in and verify, edit or delete existing miniSASS data.

The website offers many key features (Appendix A). When viewing an observation or sample site, the user has access to the miniSASS results, site information and previous data on the site by using the miniSASS Observation Details tool (Fig 10). Search tools are available to assist users in finding a site of interest beyond using the normal map operations (panning and zooming to site). The location search on the map interface allows a drop down list to select a site using the river name, then site name and the date of the miniSASS site.

Once a user has registered and logged on, they are then enabled to upload data through the activation of four data manipulation buttons:

1. Locate site icon: The user finds the location of the sample site on the map and then clicks on that location. The data entry window opens with the coordinates of the clicked location appearing in the latitude/longitude fields (the user cannot change these). The miniSASS data is also entered using this data entry window.
2. Enter coordinates icon: Clicking this icon opens the data entry window. The user enters latitude/longitude coordinates as well as the miniSASS data
3. As users tick the miniSASS invertebrate groups that were present in their sample, the miniSASS score is immediately calculated for comparison against the result (calculated in the field).
4. When the user clicks the Save button in the data entry window, the data is saved in the spatial database as a colour-coded crab icon and reflecting the health of the river site. All data is initially flagged as dirty and this is indicated with an appropriate 'exclamation mark' icon on the map. Once the data is verified the flag is changed to clean and a normal crab icon is used to display the sample on the map.

Data can only be edited and deleted by administrators of the website.

3.4 Web site layout and interface

3.4.1 Free and Open Source Software

The project team has adopted the use of Free and Open Source Software (FOSS) throughout the project. In line with the philosophy of open source, it is a condition of use for some open source software that the code is maintained as open and fed back to the open source community. As such any code developed under this project is being stored in an open repository from where anyone interested can study, share, use, and/or modify the code. The use of open source code ensures that the database is not linked to proprietary software or code, and as such can be universally updated and transferred across platforms in the future.

3.4.2 Content Management System

A Content Management System (CMS) is used to manage and store the content of the web site, with the exception of the miniSASS data entry applications. All content apart from the data map can be maintained and updated by an administrator with basic desktop publishing skills, through the CMS administration interface.

3.4.3 miniSASS application

This is the core application of the website and consists essentially of an application self-contained in one page of the website.

3.4.4 Base layers

Users are able to toggle between the following base layers:

a. Google Maps Satellite view
b. OpenStreetMap terrain (initial state = on)
c. Google Maps Street view
d. DWA catchments and municipal boundaries which are scale dependant and labelled.

3.4.5 Overlays

Users are able to turn each of these layers on and off

a. Schools
b. miniSASS sample sites (i.e. the core miniSASS layer)

3.4.6 Layer styling

The overlay layers are styled as follows:

Table 3-1: miniSASS map interface layers and styles

Layer	Symbol	Colour	Scale
Rivers	Solid line	Light blue	All scales
Schools	Circle	Red	Primary
Schools	Circle	Navy Blue	Intermediate
Schools	Circle	Orange	Combined
Schools	Circle	Brown	Secondary

3.4.7 miniSASS sample sites layer

The ecological category of each miniSASS sample site is symbolised with a crab icon according to the following scheme:

Table 3-2: miniSASS result ecological categories and map symbolisation icons

	Ecological category (Condition)	River category	
		Sandy Type	Rocky Type
	Unmodified (NATURAL condition)	> 6.9	> 7.9
	Largely natural/few modifications (GOOD condition)	5.8 to 6.9	6.8 to 7.9
	Moderately modified (FAIR condition)	4.9 to 5.8	6.1 to 6.8
	Largely modified (POOR condition)	4.3 to 4.9	5.1 to 6.1
	Seriously/critically modified (VERY POOR condition)	< 4.3	< 5.1

3.4.8 Map view and features

The initial view of the data map shows the whole of South Africa. The Google terrain base layer and the miniSASS observations overlay are switched on. A panel to the right of the map contains the radio buttons for the base layers and check boxes for the map overlays. A toolbar above the map contains tools for zooming, panning and data entry. A home button returns the user to the initial view of the map. The legend showing the miniSASS results defaults to being open.

4 DELIVERABLES AND OUTCOMES

The key deliverable of the project was the website and database (Table 4-1), with a framework/planning document and this close-off report forming minor deliverables to serve basic project documentation. Content was developed to populate the website pages, and the miniSASS field sheets were updated and refined to best integrate with the website and database. Various press release materials were developed to promote the miniSASS website such as a brochure, poster, guideline document and popular articles.

Table 4-1: Deliverables outlined within the project proposal

Deliverable	Title	Description
1	Framework/plan of the online map-based miniSASS data portal	Document detailing the key outcomes of the Task 1 workshop, and a conceptual framework/plan of the online map-based miniSASS data portal
2	Online map-based miniSASS data portal (final tested product)	Final refined and tested miniSASS data portal for handover to the identified hosting agent for the longer term management of the miniSASS data

A beta version of the website and database was released for testing in early August 2013, with the final tested and refined product released to the public late in September 2013.

The beta release of the website was released to fifty representatives from different government and non-government organisations, business, conservancies and partner organisations. The key partner organisations included the Department of Water Affairs (DWA), the Wildlife and Environment Society of South Africa (WESSA), the Duzi-uMngeni Conservation Trust (DUCT) and conservancies that use miniSASS regularly. The website testing representatives were given a brief document that highlighted the key features of the website and a request to provide technical and general feedback. This feedback allowed the website to be polished and refined to better serve the user community.

Within the first two months of the launch over 90 users registered on the website, and over 100 miniSASS observations had been successfully uploaded across multiple provinces. However the publicity and exposure of the website is on-going, with awareness continuously expanding through word of mouth, miniSASS activity days and the promotion and feedback through the Facebook page and Wordpress blog. We trust that every school, agency and river watch/adopt-a-river, organisation already using miniSASS around the country will use the website, contribute their miniSASS river health results, and promote it to others. In this way, a public-access, interactive map of river health across Southern Africa will develop, becoming a valuable resource to illustrate the condition of our rivers, promoting action.

Users are able to receive assistance either by using the contact form on the website or by sending an email to info@minisass.org.

5 RECOMMENDATIONS FOR FUTURE RESEARCH

During the course of the research project and development of the miniSASS website and database, many additional features were identified which could greatly enhance the functionality of the tools, but which were beyond the scope and budget of this initial project. The focus of this project was to develop a solid foundation for the database, on an open source platform, where improvements and enhancements could be easily developed and plugged in during later phases.

Additional functionality for the miniSASS database could include allowing users to run **data visualisation queries** on the interactive map, such as the ability to display the results of pre-set queries selected by simple radio buttons. The queries could display the results of various interesting questions, for example; "*display all miniSASS sites falling within the 'largely natural' class*" or "*display all miniSASS results collected between selected dates/years*."

The ability for users to **attach media** (images in particular, but also video or voice notes) **to each miniSASS observation data entry** would greatly enhance the level of information captured, as well as the interest value for website visitors exploring the sample sites. Such media would help other users understand the complete scenario of the river conditions at the time of collection, as well as assist administrators in the verification of the miniSASS result.

An additional tool which would greatly enhance the understanding and interpretation of the miniSASS data captured at a site is the functionality to generate and display a **time series graph**. At sites where a history of miniSASS data has been gathered, trends and changes in river health over time and across seasons could be interrogated through display of a simple time series graph.

As the majority of South Africa's population, and thus the miniSASS user community, do not have access to computers and internet facilities, the ability to access the miniSASS database for either **upload or viewing through mobile phones** would significantly broaden the spectrum of potential users. The development of mobile phone functionality for the miniSASS database would greatly enhance miniSASS as a citizen science data gathering tool by greatly expanding the potential user community. An additional refinement is the further development, **expansion and promotion of the method into neighbouring countries** (and beyond), with shared river basins, to facilitate trans-boundary water resource management and cooperation, as well as to show case South Africa's advances in participatory water resource management and the promotion of science and technology amongst its population.

The activities covered in performing miniSASS, the interpretation of the results, upload to the database, and the investigation of reasons explaining the river health using the online map all have great potential to be translated into **school lesson plans which integrate with the National Curriculum** (in line with the Curriculum and Assessment Policy Statements). This key area of development would have the dual purpose of promoting education and awareness of water resource issues while greatly extending the national database of citizen-collected river health data.

6 CONCLUSION

The miniSASS method has been adopted and widely applied by environmental educators across South Africa for the past 10 years. This project initiated the development of a solid foundation for the spatial database and supporting miniSASS website which can be upgraded and enhanced as needed. Two months after release the miniSASS database has already generated much activity and shows great promise in generating a national database of citizen-collected river health data. The national audience which now have better access to the tool, and facility to upload and explore results would be further broadened by future research and development of the miniSASS suite of tools. Key areas for future research and development include mobile phone upload functionality, the integration of miniSASS into the school National Curriculum and the enhancement of the data upload, exploration and display tools to enhance the level of information that can be captured interrogated and displayed.

7 REFERENCES

Africa Water Vision (2000).The Africa Water Vision for 2025: Equitable and Sustainable Use of Water for Socioeconomic Development, United Nations Economic Commission for Africa Website

http://www.uneca.org/awich/african%20water%20vision%202025.pdf, accessed 17 May 2012.

Browne M, Bruton S, Fleming G, Graham M, Shai C, Sokolic F, Taylor J, Thirion C. 2013. miniSASS Data Management: Development of an online map-based data portal. Deliverable 2: Framework/plan of the online map-based miniSASS data portal. Water Research Commission Project No. K8/1010

Graham PM., Dickens CWS. and Taylor RJ. 2004. miniSASS – A novel technique for community participation in river health monitoring and management, *African Journal of Aquatic Science*, 29 (1): pp. 25-35.

Graham PM 2009. Reassessment of the miniSASS biomonitoring tool as a resource for environmental education in the river health programme and cross-linking to with the national curriculum statement, *Water Research Commission Project K8/733*, in press.

Matlock, M. (2008) Governance of water resources in Africa, United Nations Environment Programme.
http://www.eoearth.org/article/Governance_of_water_resources_in_Africa, accessed 17 May 2012.

Revenga, C., Campbell, I., Abell, R., de Villiers, P. and Bryer, M. (2005) Prospects for monitoring freshwater ecosystems towards the 2010 targets, Philosophical Transactions of the Royal Society, pp. 397-413.

United Nations Environment Programme (UNEP) 2008. *Freshwater Under Threat: Vulnerability Assessment of Freshwater Resources to Environmental Change – A Joint Africa-Asia Report.* Joint United Nations Environment Programme and Water Research Commission Report.
http://www.unep.org/dewa/Portals/67/pdf/Freshwater_under_Threat_SDM_Pub_72dpi.pdf.

APPENDIX A: Model sketch of the miniSASS website

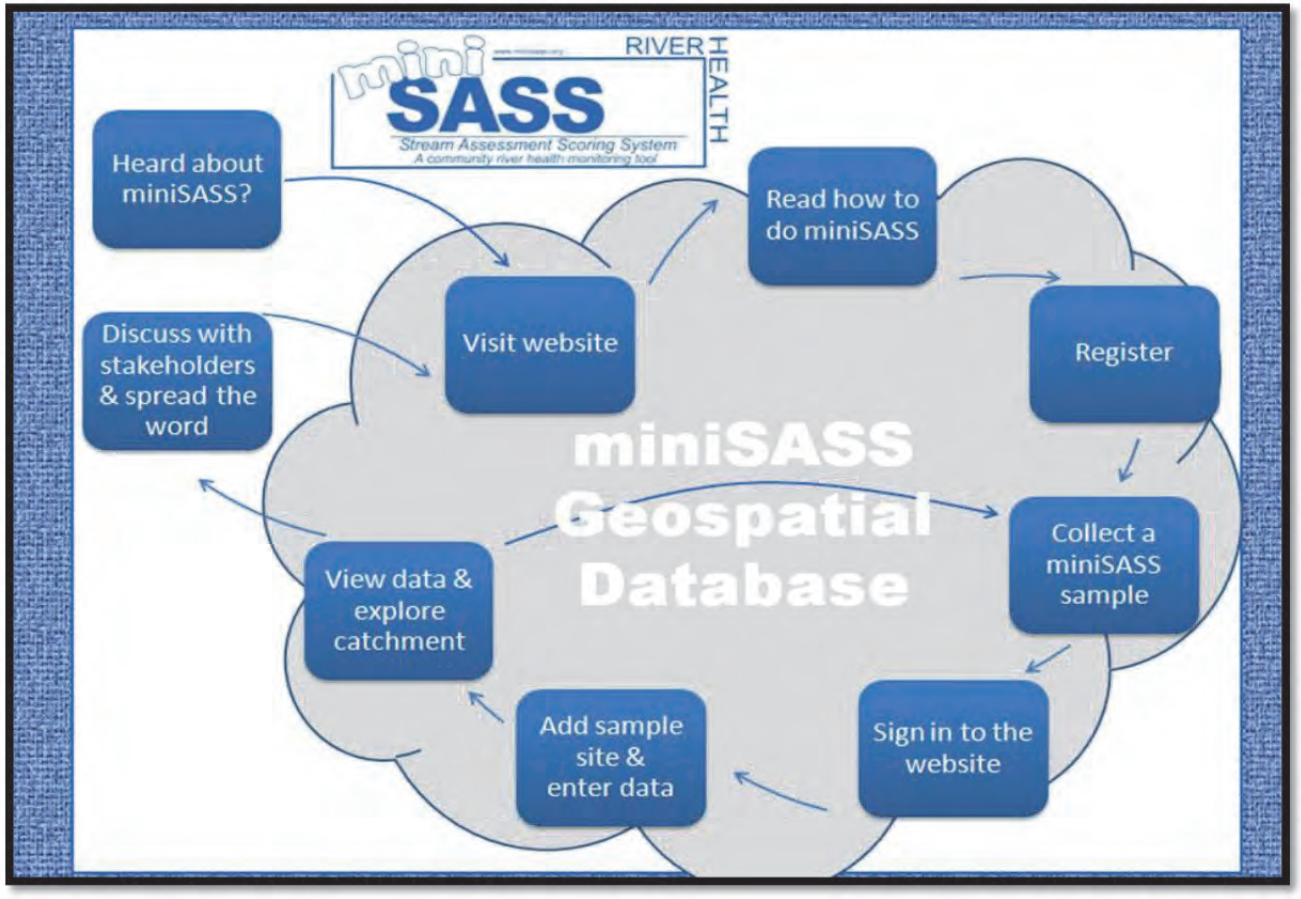

Figure 1: The role of the miniSASS website and data portal

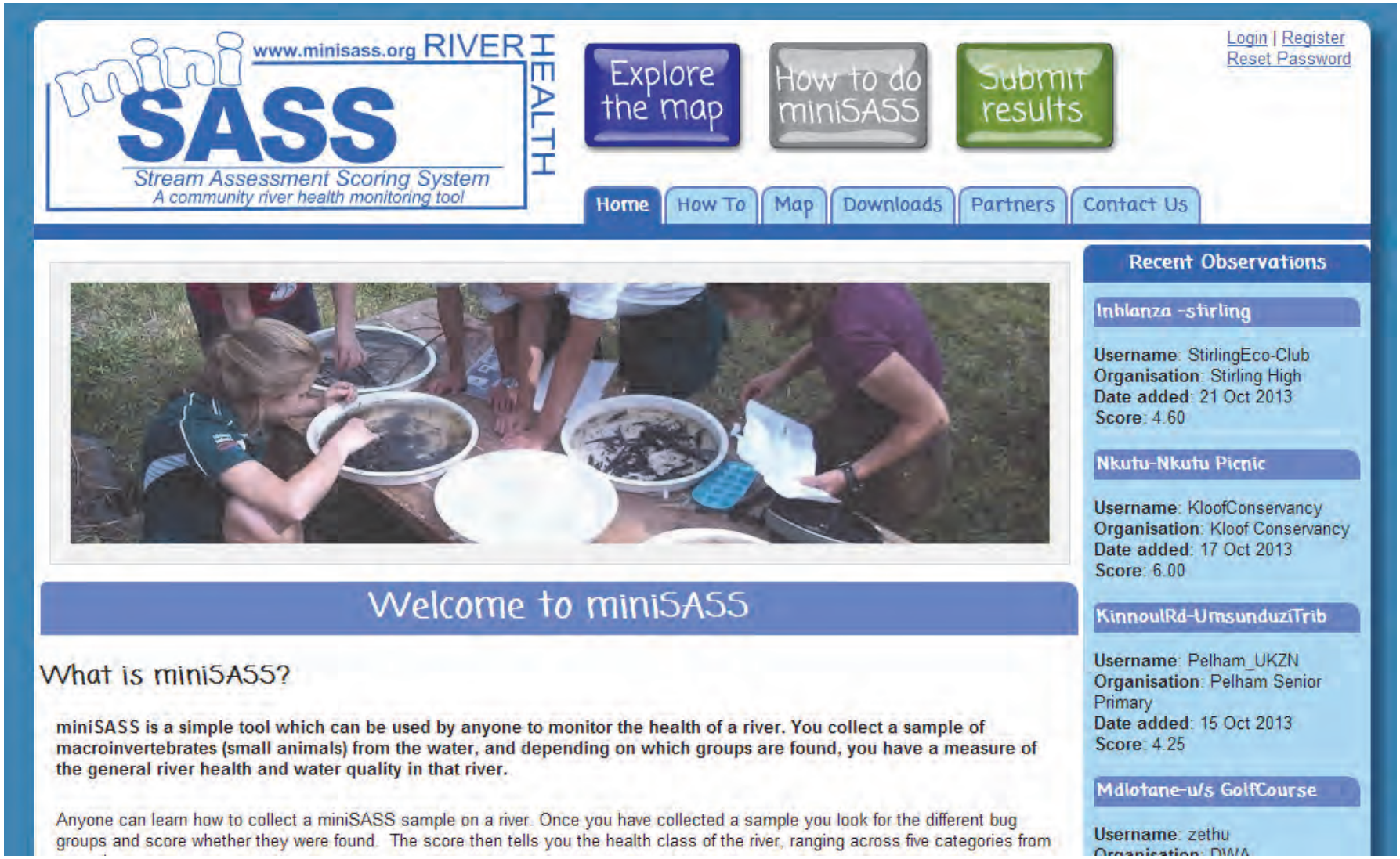

Figure 2: Home page of www.minisass.org showing, recent observations

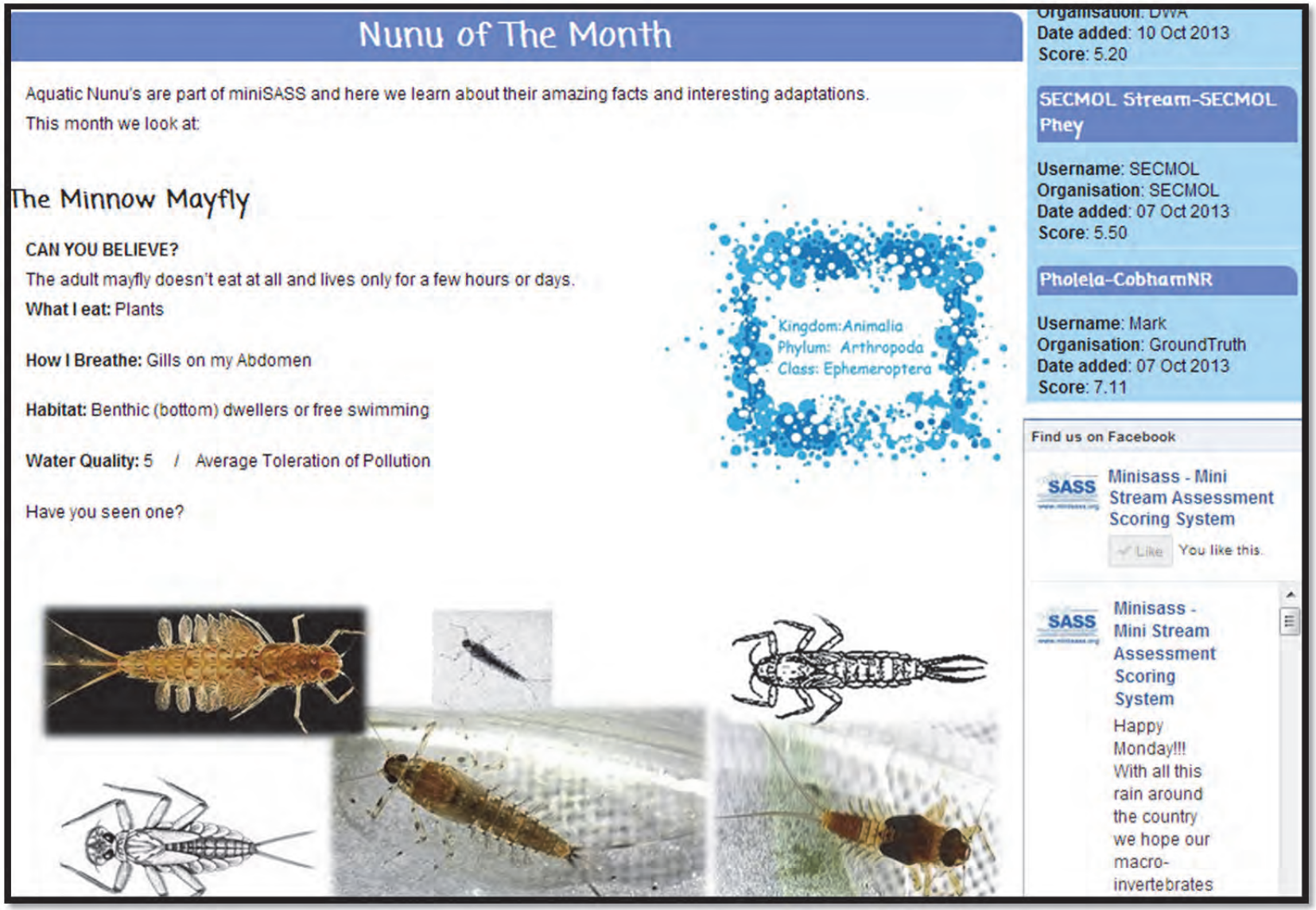

Figure 3: Home page features include “nunu of the month” and a Facebook live feed

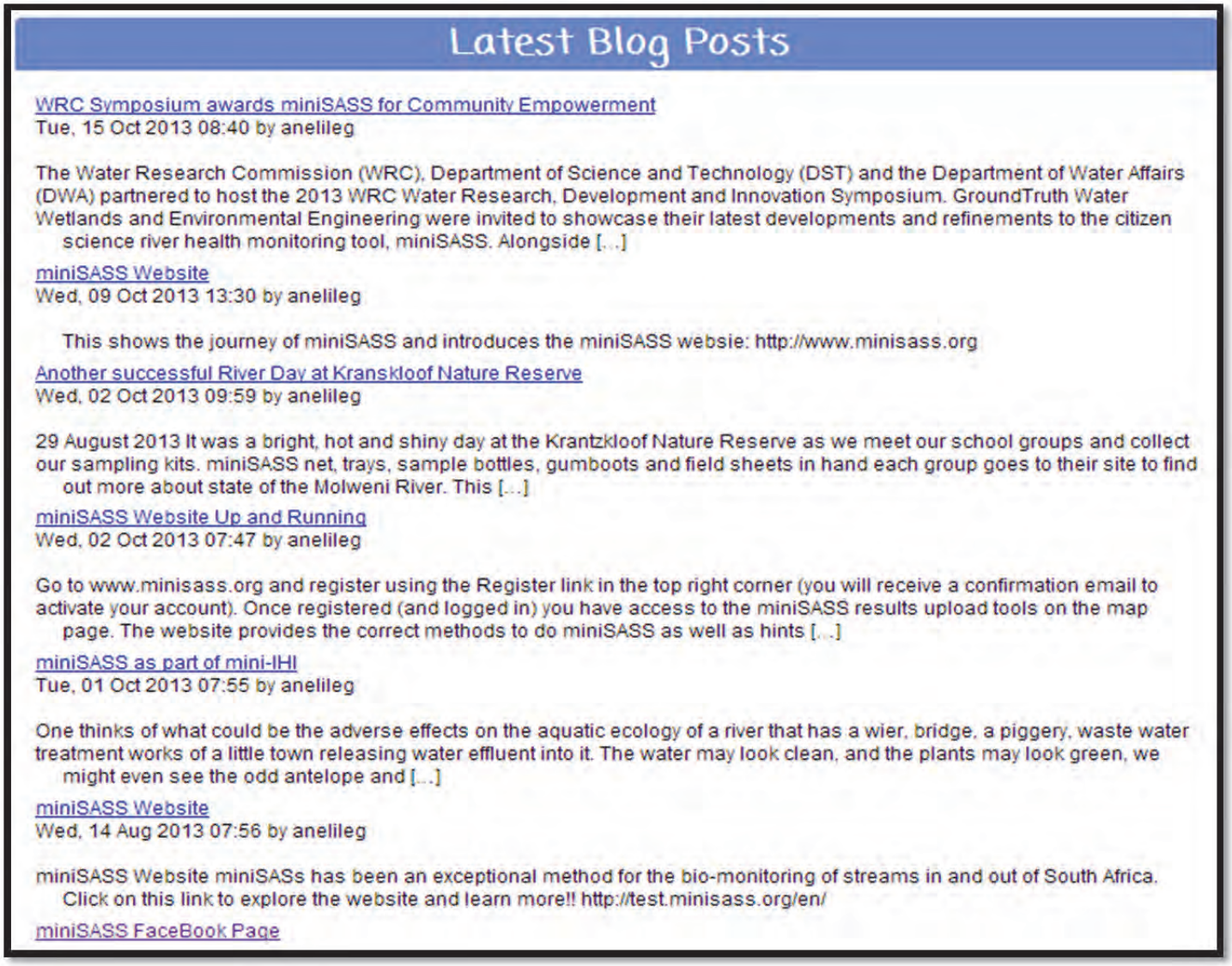

Figure 4: Latest News and events via the miniSASS Wordpress blog which has been embedded on the home page

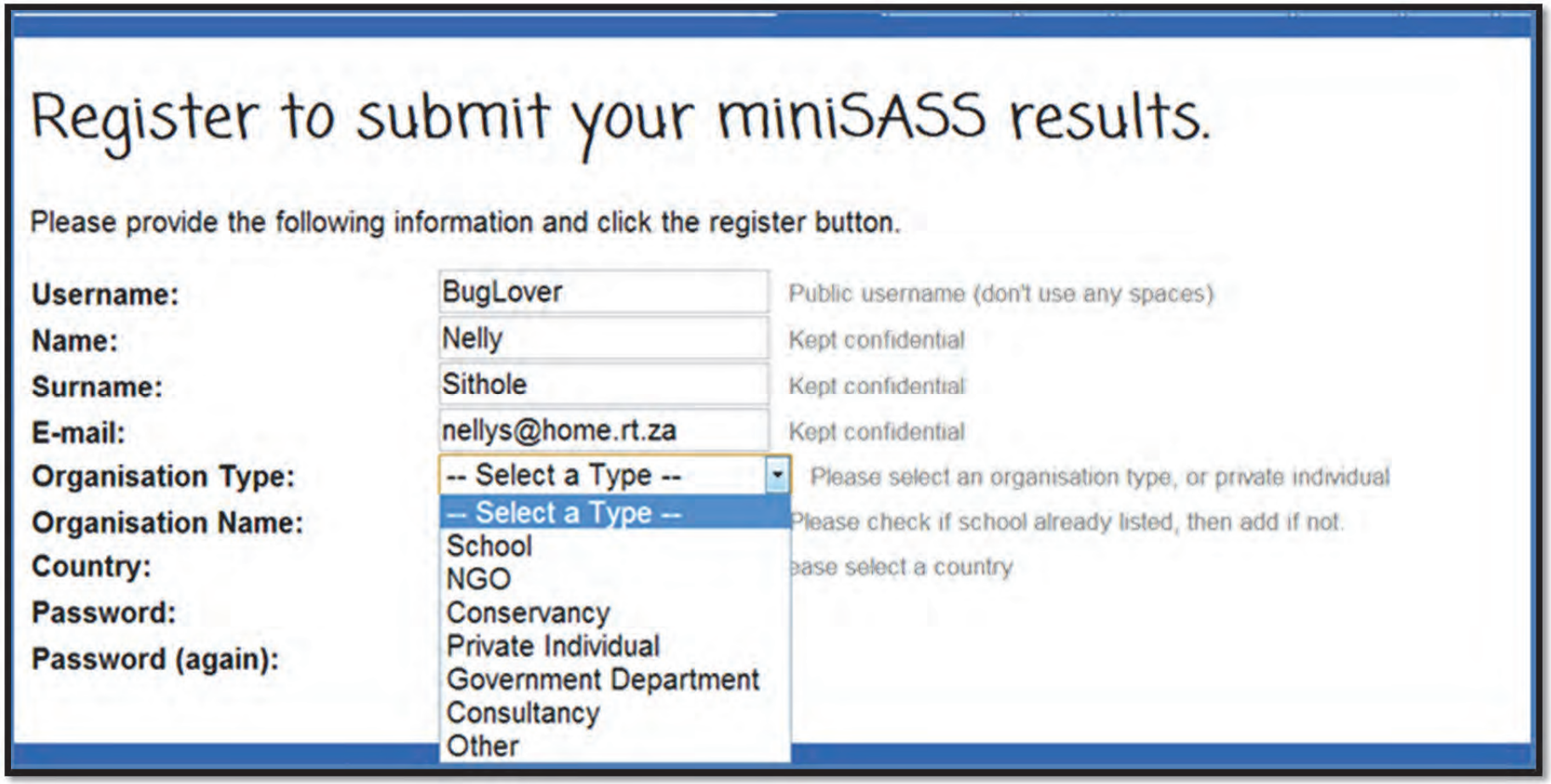

Figure 5: Registration form on www.minisass.org

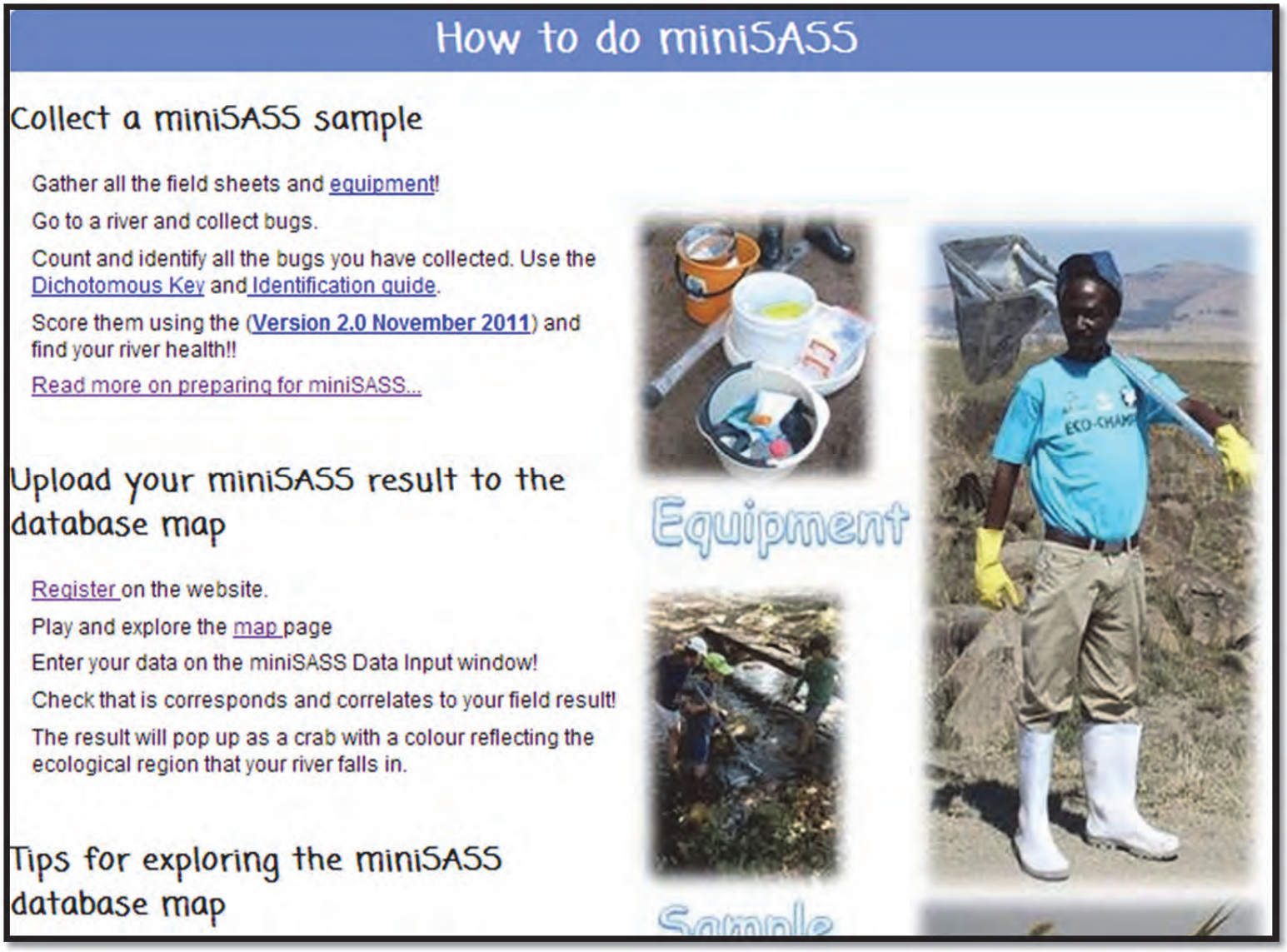

Figure 6: How to – miniSASS instructions and illustrations (User registration, Data upload, Data exploration, Method verification)

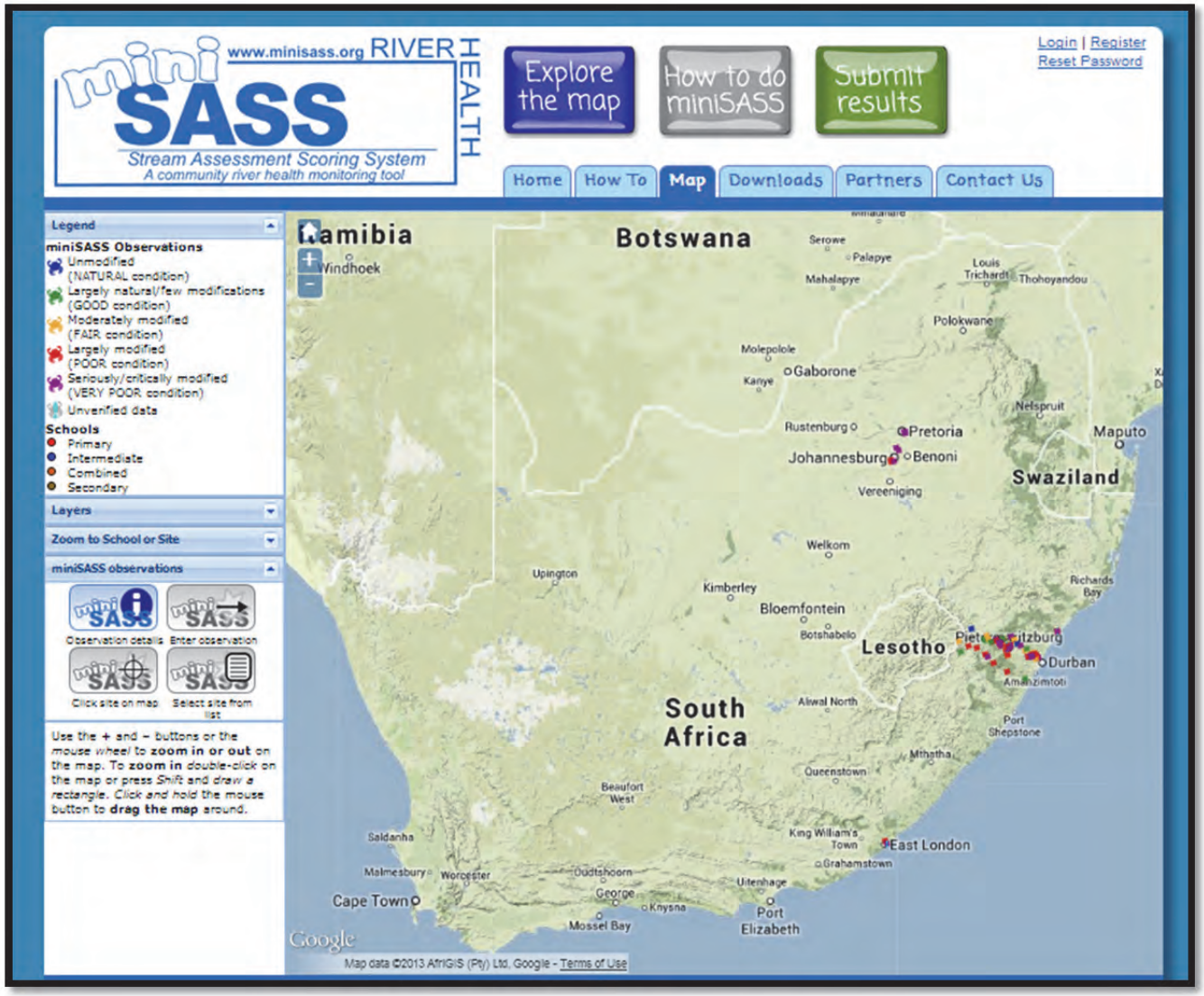

Figure 7: Map Interface

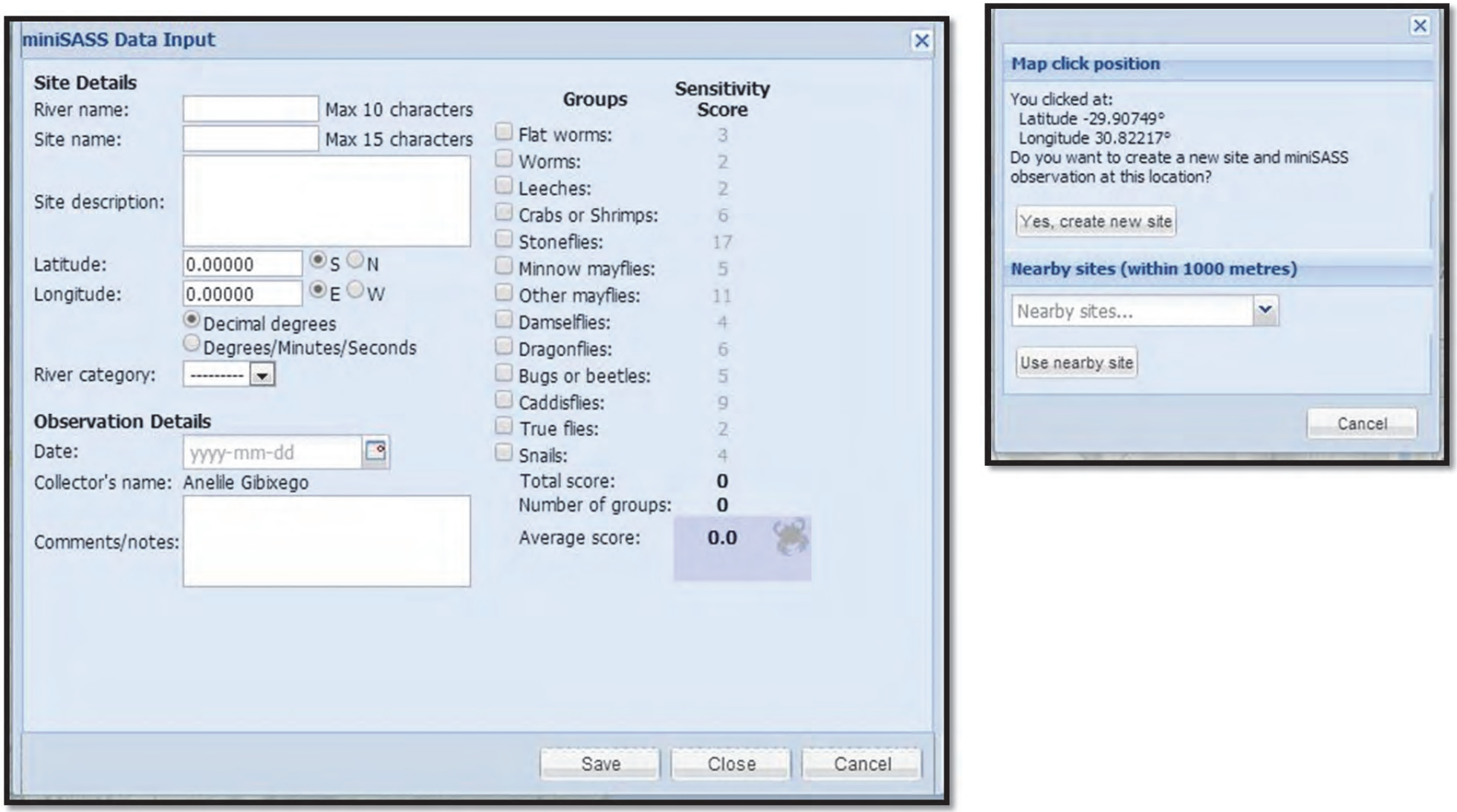

Figure 8: The miniSASS data input forms

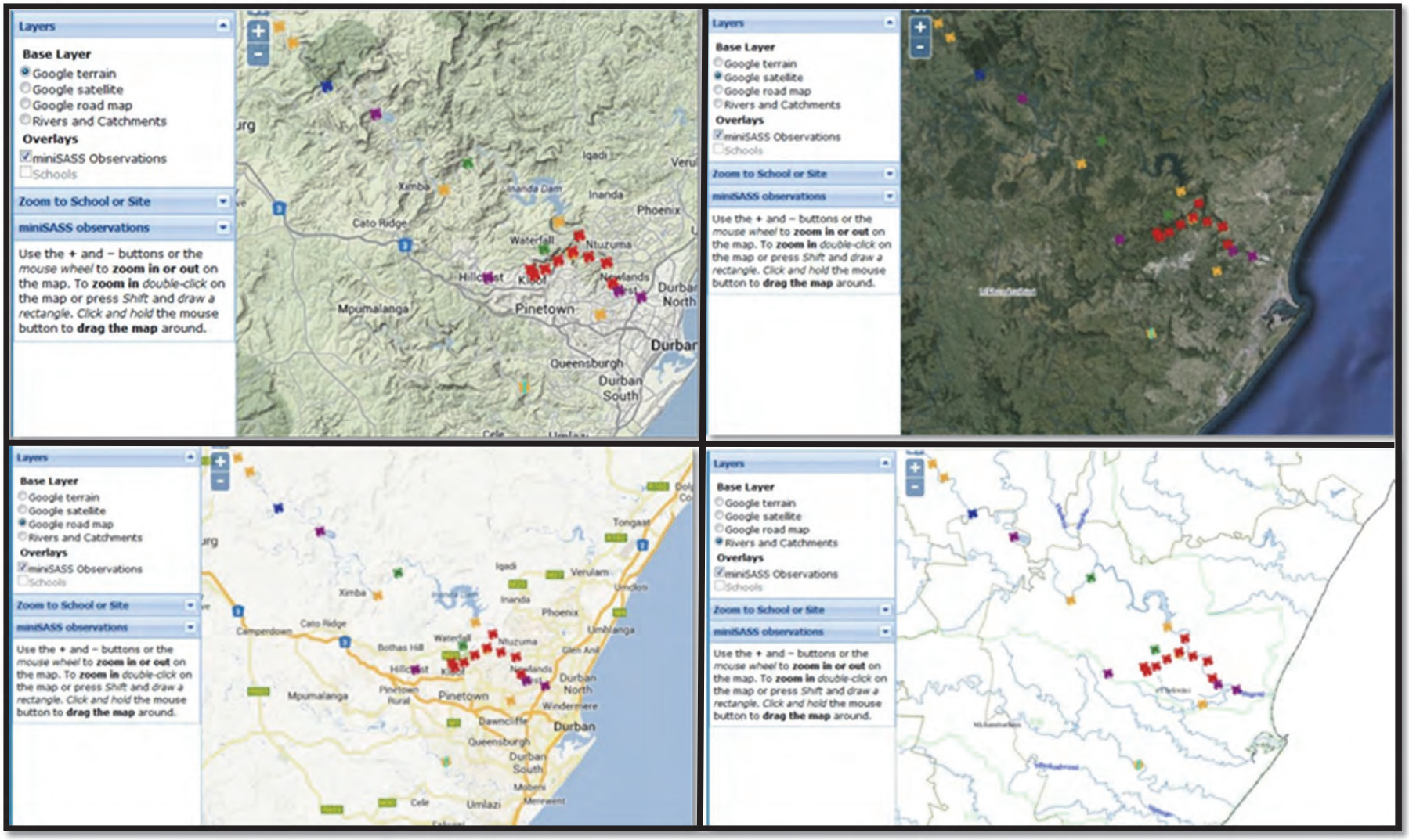

Figure 9: The four Google Earth base layers available. Google terrain (initial state on), Google satellite, Google road map and Rivers and catchments

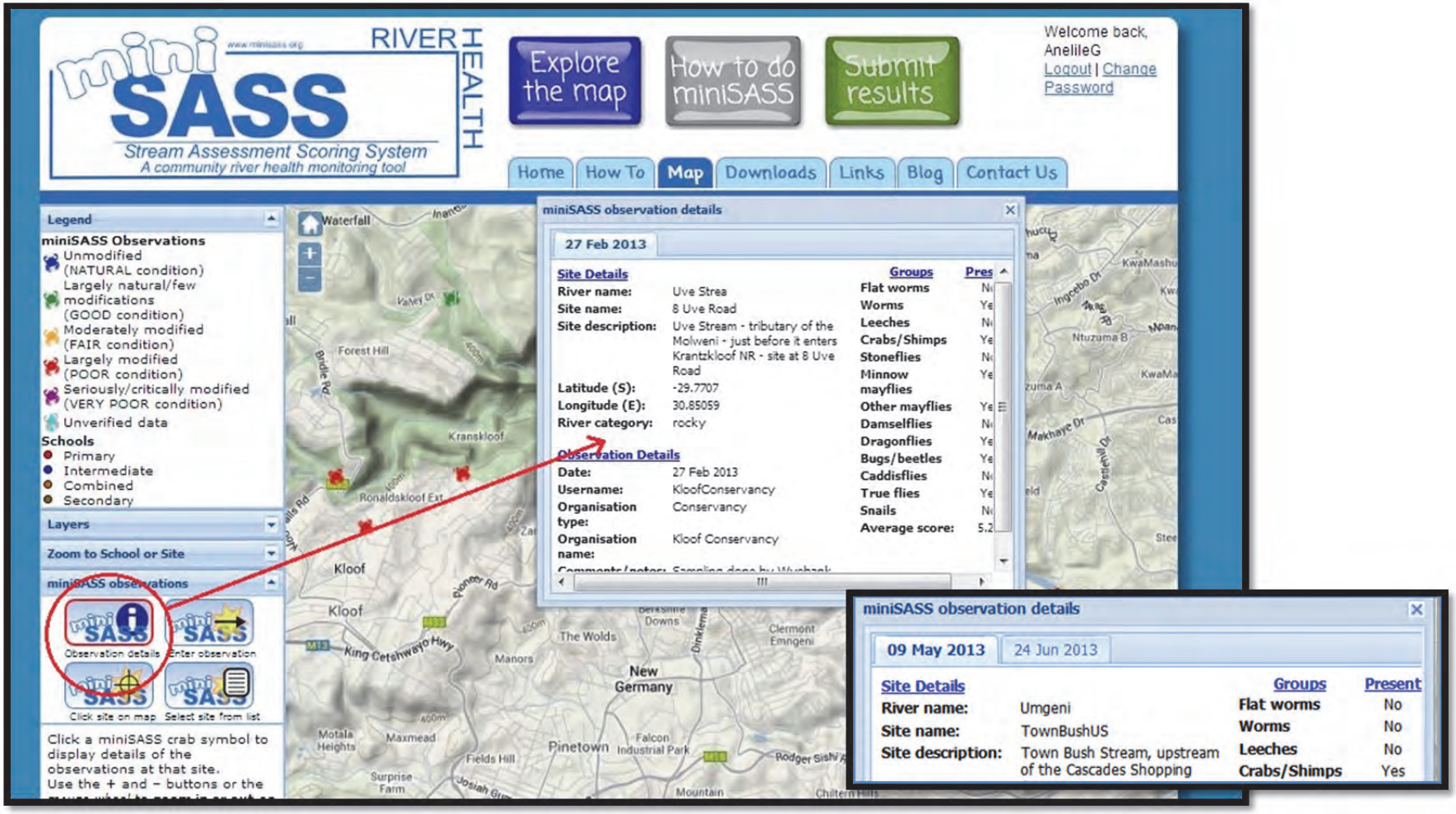

Figure 10: Information box displayed when clicking on existing miniSASS observations.

Figure 11: Schools and miniSASS observations layer activated over the Google terrain base layer.