



CSIRO

Land and Water

Development of a Data Management and Desktop Data Delivery System for Douglas Shire Water Quality Data.

A Report to Douglas Shire Council and the
Department of the Environment and Heritage

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Natural Heritage Trust

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An Australian Government Initiative

CSIRO Land and Water Client Report

March 2004

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2. Executive Summary

A Data Management and Desktop data Delivery System for Douglas Shire activity 5.9 has been completed. The system is currently operational and is using CSIRO infrastructure. The interim URL is <http://www.data-tv.csiro.au/DSCDDD/index.aspx>. The water quality data is visible and available to both internal and external users. The system consists of three applications, two web-based and one windows-based. The first web-based system is used for general viewing and retrieval of integrated Water Quality Data, and the second for operation of the automatic sampling stations. The windows application is for maintenance and administration of the system.

A data and knowledge management workshop was held on the 23-24 of October 2003 at Douglas Shire Council offices to assist in defining system requirements. The workshop produced a list of users, the types of information these users would need, and also outlined how the users would want to manipulate data. This list of users and uses then formed the basis for the development of the Requirements Specification.

The primary user of this system was identified as the Douglas Shire Council and in particular the Water Quality Officer. Other users would be state organizations (DNR, EPA etc.), schools, and community interest groups with interests in Douglas Shire.

To share the data electronically over the web, an interface has been designed and implemented using XML web services. XML web services allow any authorized user to connect directly with the data source, query it, and extract the information that they require directly.

There will be an ongoing requirement to import Water Quality data as it becomes available.

The system needs to migrate to the Douglas Shire Council. To host and operate this system the council will need to invest in both hardware and software infrastructure. Also, there will be a need for a person who is suitably skilled in the operation of a database to ensure the correct ongoing operation.

There is a subsequent activity where the data management system will be assessed and the success of this development will be reported there.

3. Introduction

Activity 5.9 of the EA funded suite of technical projects that will underpin the development of a Water Quality Improvement Plan is titled '*The development of a data management and desktop delivery system*'. The requirement for this system comes out of the need to provide a single repository and point of contact for all the water quality data collected as part of the Douglas Shire Water Quality Improvement suite of projects.

One of the primary objectives of these projects is the monitoring of long term trends in water quality of the rivers and waters in the shire (in the first instance, sediments and nutrients) but later objectives may include other water quality indicators. The water quality trend data needs to be stored safely, securely and should be available easily to authorized users.

The data sources in this suite of projects are varied and may grow over time. It is important that the system be flexible enough to allow for this growth. Another key function of this system is to provide for the integration of the water quality data, which can be time consuming and troublesome if not managed correctly.

The requirements dictate a particular solution. The preferred way to store large quantities of data securely and safely is to use a SQL database. This system uses such a database. The system is also required to provide the data to a range of users easily and quickly. This is done by using the web to distribute the data.

This report details the steps that have been taken in the development of the system and presents some of the system in screen capture graphics.

3.1. Project Definition

One of the most important activities in a software development project is to adequately define the specification of the project. This specification is usually in the form of a project Vision, which details the overall concept of the project and then in specific 'Use Cases' which describe how specific users might use the system. A requirements specification is also normally prepared. This aids in guiding the development of the software.

To gain a further insight into what was needed a stakeholder meeting was convened at which the possible uses for this system were discussed.

3.1.1. Stakeholder Meetings

A Knowledge and Data Management workshop was convened in Douglas Shire during October 2003 to progress these issues. A cross section of interested parties from the Shire was present, including representatives from:

- Douglas Shire
- Mossman Agricultural Services
- Cane Growers
- Mossman High School

The output from this meeting was a list of Use Groups (A grouping of system users), broken down into users and how the system would be used by those users. It was felt that the primary users of the Douglas Shire system would be the Douglas Shire Council itself. The list of use groups and users is detailed in Table 1 Possible Data Users

Use Group	User	Use
Douglas Shire Council	Water Quality Officer (WQO)	Will want to know the status of the stations to determine if any maintenance is required.
	WQO	Will want to know if an event is happening or is about to happen to allow for planning of work and to alert grab samplers.
	WQO and council	Will want access to long term trends in water quality, actual versus targets.
	WQO	Will want access to all data knowing that the data is securely stored and cataloged.
Researchers	CSIRO,EPA,NRM,A FFA,ACTFR, Universities including undergrad, honours and PhD students and other research organizations.	Will want to discover what data is available and will want access to the data via direct download.
Students	Mossman high, Mossman state public school	Will want to access summarized data for school projects
Community	Residents	Will want to access realtime river heights to determine if there are any flood concerns.
	Tourist operators	Might want access to summarized data to promote their businesses.
	Fisherman	Might want access to tide and turbidity information
	Irrigators	Might want access to realtime rainfall data
	Aquaculture	Might want access to realtime riverheight and salinity data.
	Environmentalists	Might want access to long term trends in water quality, actual versus targets
	Farmers	Might want to look at long-term changes

		to see effect of runoff control measures on their properties
Extension Services	Mossman Ag. A	Will want access to the water quality data.

Table 1 Possible Data Users

The possible users of the data and how they might want to use it was assessed and then reduced to a compact list of requirements.

3.1.2. Requirement specifications

Described below is a list of requirements that are to be fulfilled by the system.

1. Water Quality Data is to be stored securely and safely in a non proprietary manner.
2. All Water Quality data will be stored with relevant meta-data to maximize future use.
3. All Water Quality data will be integrated and available as a single database (Dataset).
4. There will be a provision to import legacy (existing old) datasets.
5. Data will be delivered over the web.
6. There will be a publishing process to ensure that only released data is available for general viewing.

3.1.3. Activity Vision

The activity vision articulates the overall purpose and use of the system. It also expands on some of the requirements in more detail to allow the developers to get a better understanding of what is required.

There are three types of Water Quality data that will be generated during the Water Quality project undertaken in the Douglas Shire: they are Grab Sample data, Automatic Sample data and Automatic continuous records. The management system is required to integrate these sets of measurements and manage them in an appropriate way. Each data set or data-stream will be described by appropriate meta-data using an ANZLIC based meta-data

standard. The system will retrieve the automatic station data directly via telemetry. All data is to be quality coded using a suitable quality coding scheme. The data parameters to be stored are detailed in Appendix 1.

For the water sample chemical analysis data, a method will need to be identified to smoothly and easily transfer the data from the EPA to the DSC database. It is unclear at this stage in what form and how this will be done.

Alarm System

Once samples are collected by automatic stations they need to be processed as rapidly as possible. To facilitate this collection and processing, an automated alarm system will be employed. This alarm will be triggered by the automatic stations themselves upon sample collection and will be either by Email or SMS message (or both).

3.1.4. Data Delivery System (DDS)

The data will be delivered to authorized users and the public. The system will be web based and there will be at least 2 levels of functionality dependant on the users role. Two roles expected are: project partner and public access. The public delivery pages may need some additional explanatory information so that the public can make use of the data. It may be necessary to split the public access into a number of interest groups. For project partners the system will present the data directly into an Excel spreadsheet or a graphical display of the data in a time series form.

The data to be viewed or accessed will be selected by a map based Data Discovery Tool (DDS). Once the data to view (or retrieve) has been selected it will be displayed in either tabular or graphical form. The DDS will provide basic aggregates as listed in the 'aggregate' and 'periods' menus of the web page.

There is a requirement to have a publishing process, so that there will be an authority that approves the data for public viewing: ie a 2 stage database data transferal process.

3.1.5. Stakeholder Use Scenarios

To further understand what is required it is common to develop *use scenarios*. These *use scenarios* describe how a user of the system might use the system. By recording these scenarios a greater insight in to what is needed can be developed. The use scenarios developed as part of this project are detailed in Appendix 4.

4. System Software Description

This section details the software developed for the Data Management system. Three applications and a number of additional services have been developed. The major applications are:

1. Web Based data viewer and data retrieval tool.
2. Web based operational reports.
3. Windows application for administering the system.

The additional services that have been developed are for things such as importing the data and providing system operational alarms.

4.1. Importing Auto-Station Data

The auto-stations are controlled by a Campbell Scientific¹ CR10X data-logger which is connected to a Giga² CDMA mobile cell phone data modem enabling remote downloads of the data. Campbell Scientific provides a software program called LoggerNet that is used to download data from these loggers. LoggerNet also includes the necessary routines to schedule a data download as well as the actual download. In this system, LoggerNet is used to connect to the auto-stations CR10X using the mobile data-modem. The data is downloaded every 6 hours from 7am. Data retrieved by LoggerNet is in a comma separated variable

file format. To import the data into the SQL database a two step process is used. The native data format from the CR10x is described as a flat file i.e. the data variables are in columns. The first step in the importation is importing the flat file data into a flat data table within the database. The tools used for this process are the inbuilt Data Transformation Services (DTS) supplied with Microsoft SQL Server. Two transformations have been written to allow this importation. These flat tables provide two additional functions which are: as a backup of the auto-station data as well as the data source for the alarming. The import second step is then to integrate the auto-station data with the other water quality data. This is done by another DTS. This DTS is run at six hour intervals to allow the latest data to be imported to the integrated database in a timely fashion.

4.2. Importing Water Quality Data

At the time of writing it has not been possible to obtain any actual Douglas Shire Water Quality sample results. The Water Quality samples from Douglas Shire are to be analysed by the Queensland Government Department of Health Laboratory (QDHL) which is the same laboratory that analyses the Queensland Environmental Protection Agency (QEPA) water quality samples. Therefore, the QEPA has established remote links to this laboratory and has established protocols for transferal of their sample results from QDHL into their database system. It makes sense that we take advantage of these. The proposed data transfer route is from QDHL to EPA to Douglas Shire. QEPA has sent some test data for assessment and routines have been written based on this format. These routines may need some fine tuning when the real water quality data becomes available.

4.3. Alarm System

A key component in the operation of the automatic sampling stations is the generation of system alarms to alert operators (Douglas Shire Council water

quality officer) that samples have been obtained and the samplers require unloading.

This component is written using the Microsoft DTS to interrogate the database after each transferal of data from the auto-stations. The latest records are queried and if an alert condition is met, an alert message is sent to an email or SMS address. The phone numbers, email addresses, alert messages and alert conditions are easily configurable through the SQL database manager. The SMS messages are sent via email to MessageNet³ for transmission on the mobile phone network. The alerts that were used were:

1. When sampler has taken one sample.
2. When sampler has taken twelve samples.
3. When the sampler has taken twenty three samples.

This system was operational by 1/12/2003 and has worked well over the wet season to date.

4.4. XML Web Services (Information Sharing)

To share information electronically between computer networks is quite difficult. The reason for this is that networks are designed to be secure and prevent any access from another network as any access might be insecure. Security in this discussion is related to vulnerability to a malicious attack that may compromise the network. Using a recently developed technology, XML (Extensible Markup Language) web services, it is now possible to easily share information using only an existing internet web server. Internet web servers are now among the most robust servers on a computer network due to their exposure to potential attacks.

To aid in the distribution of Douglas Shire water quality data, a web service architecture has been used. The location of the web service in the architecture can be seen in Figure 4-1 Software Architecture Diagram.

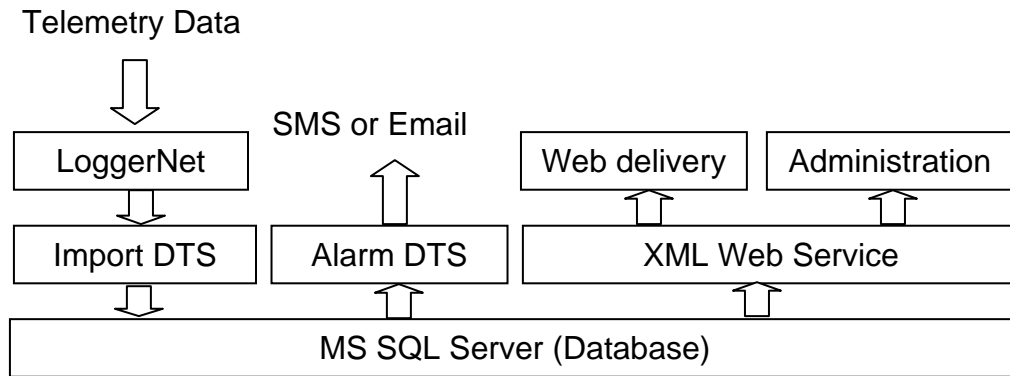


Figure 4-1 Software Architecture Diagram.

Any authorized user can query the web service⁴ and find out what sites and water quality data are available on the database and if wanted then retrieve the data.

4.5. Publishing Data

There is a requirement that the water quality data be subject to close scrutiny before it is made generally available. The database structure includes a QA/Release code. Each data point is tagged with a QA/Release code and the code is modified by the DMDDS windows administration application when the data is to be released.

Code	QA/ Release Code	Description
1	Unchecked	
2	Visually Checked OK	
3	Visually Checked Faulty	
4	Release to Partners	
5	Public Release	

Table 2 QA/Release code options.

The codes available can be seen in Table 2 QA/Release code options. The web application will not deliver data publicly unless it is tagged at level 5.

4.6. Operational Reports

Two operational reports⁵ have been developed to assist in the operation of the automatic water quality monitoring. One is for the auto-stations on the rivers and the other is for the paddock scale measurements

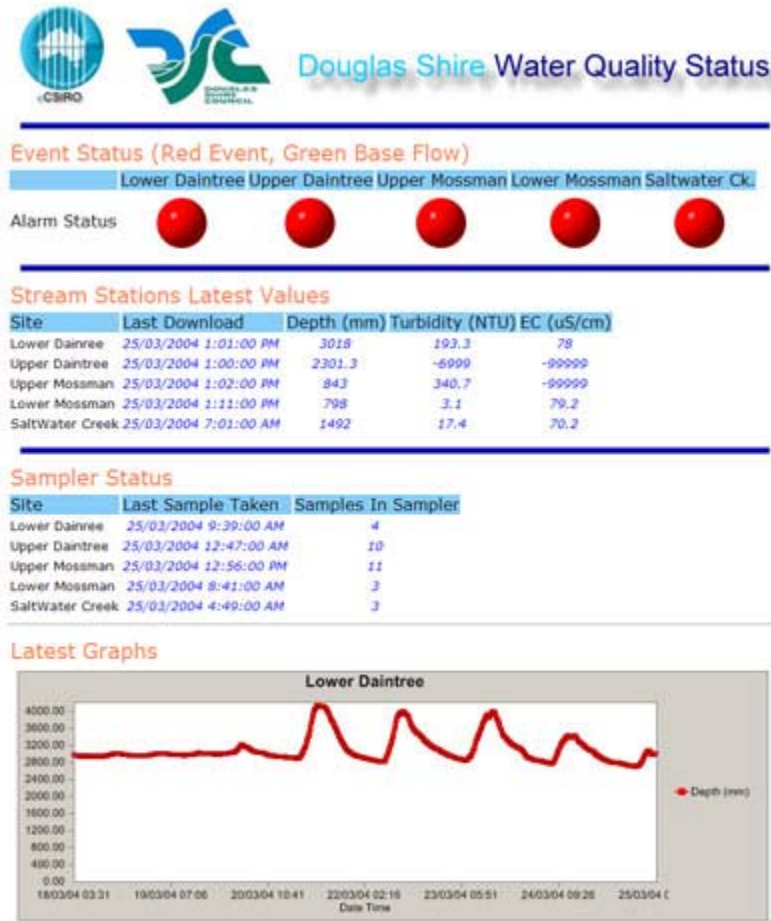


Figure 4-2 Operational Report for River Auto Stations.

The report for the river auto-stations can be seen in Figure 4-2 Operational Report for River Auto Stations. One of the additional requirements that became apparent when the grab samplers were trying to get the samples during an event was some indicator of whether or not an event was occurring. Some basic event status indicators were added to visually indicate if the gauged rivers were in event condition.

4.7. Viewing and Retrieving Data over the Web

4.7.1. Introduction

The web based Data Management System manages, stores, and presents data collected using telemetry and manual sample collection methods from current operational project sites. The Data Management System automates the process of data collection and storage and provides useful tools for manual sample data input. The data is stored on a SQL Server and data from the sites can then be queried and presented to the user over the web. The web-based delivery system has many advantages including:

- Access to data anywhere in the world from any Internet terminal.
- User-friendly interface with a GIS style site selection tool.
- Advanced query tools to access only the data that is required.
- Graphical representation and data export tools built in.
- Data is backed up and archived for maximum security.
- Site is password protected ensuring access only to allowed users.

The web based desktop data delivery system removes the workload and responsibility for the downloading and data management and therefore frees up more time for the important work of interpretation and report writing. The Data Management System becomes a valuable tool for effective gathering and delivering environmental data.

4.7.2. Data Selection Tool

The Data Selection Tool seen in Figure 4-3 allows the user to quickly locate a site within the catchment and then to query the data and to display it graphically. The user also has the options of saving the queried data directly to a spreadsheet compatible with CSV (comma separated variables) files (i.e. Microsoft Excel).

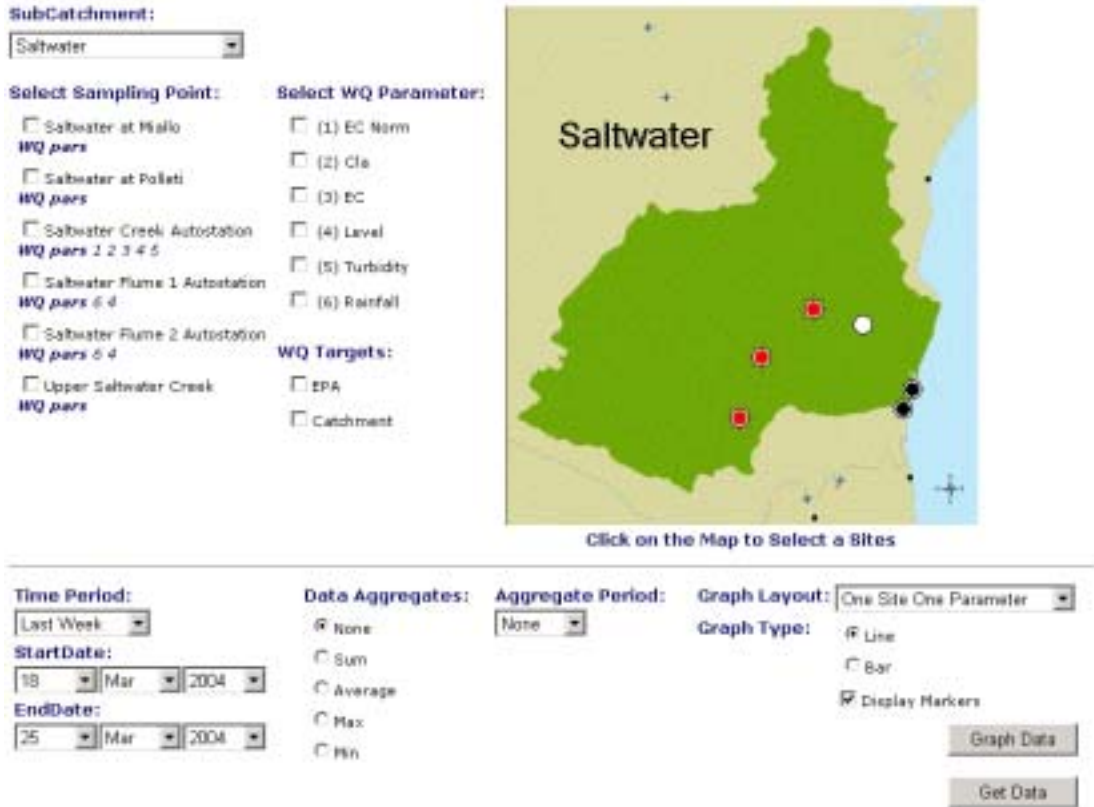


Figure 4-3 Data Selection Tool

4.7.3. Selecting a SubCatchment

When the page is first presented to the user the catchment map is displayed. The user first selects a subcatchment by clicking within the appropriate area on the catchment map or by selecting a subcatchment from pull-down list box **SubCatchment** (Figure 4-4). The user accesses the list by clicking on the down arrow on the right of the list box.



Figure 4-4 Pull-down SubCatchment list box

4.7.4. Selecting a Sample Point and Water Quality Parameters

Once a subcatchment is selected the Select Sampling Point (Figure 4-3.) list is filled with all the sites for the selected subcatchment. The Select WQ Parameters (Figure 4-5.) is also filled with the all the parameters that exist for all the sites

within the selected subcatchment. The subcatchment map is also displayed replacing the catchment map. The subcatchment map displays the sites and represents each site with an icon. Different sites can be allocated different icons and this helps to visualise the location of data, grab and non-operational sites.

Select Sampling Point:	Select WQ Parameter:
<input type="checkbox"/> Saltwater at Miallo <i>WQ pars</i>	<input type="checkbox"/> (1) EC Norm
<input type="checkbox"/> Saltwater at Polleti <i>WQ pars</i>	<input type="checkbox"/> (2) Cla
<input type="checkbox"/> Saltwater Creek Autostation <i>WQ pars 1 2 3 4 5</i>	<input type="checkbox"/> (3) EC
<input type="checkbox"/> Saltwater Flume 1 Autostation <i>WQ pars 6 4</i>	<input type="checkbox"/> (4) Level
<input type="checkbox"/> Saltwater Flume 2 Autostation <i>WQ pars 6 4</i>	<input type="checkbox"/> (5) Turbidity
<input type="checkbox"/> Upper Saltwater Creek <i>WQ pars</i>	<input type="checkbox"/> (6) Rainfall
	WQ Targets:
	<input type="checkbox"/> EPA
	<input type="checkbox"/> Catchment

Figure 4-5 Sampling Points, WQ (Water Quality) Parameters and WQ Targets lists.

Next, the user can select the sampling points and WQ (Water Quality) parameters from the lists **Select Sampling Point** and **Select WQ Parameters**. A cross in the checkbox indicates that it is selected. Sampling points can also be selected by clicking on the sampling point on the subcatchment map.

4.7.5. Selecting Water Quality Targets

WQ targets (Figure 4-5.) “EPA” or “Catchment” are selected by clicking on the check box to the left of the **WQ Target**. Selecting a WQ Target adds a horizontal line to the graphs that are generated by this page. If “EPA” is selected the line represents the Australian Environmental Protection Agencies recommended maximum value for that particular parameter. If “Catchment” is selected the line represents the Catchment Managements recommended maximum value for that particular parameter.

4.7.6. Choosing a Time Period

A time period is selected from the pull-down list box **Time Period** (Figure 4-6). The default value is “Last Week” and this automatically fills in the **StartDate** and **EndDate** fields. The user can select a different time period by clicking on the down arrow on the right of the **Time Period** list box or by selecting a time period from the **StartDate** and **EndDate** fields.

Time Period:
Last Week ▾

StartDate:
18 ▾ Mar ▾ 2004 ▾

EndDate:
25 ▾ Mar ▾ 2004 ▾

Figure 4-6 Time Period, Start and End Date selection.

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4.7.7. Selecting Data Aggregates and Aggregate Period

The data aggregate and period to apply the aggregate over are selected from the **Data Aggregates** list and **Aggregate Period** list box (Figure 4-7.). Selecting a data aggregate by checking one of the aggregates has the following affect when the data is queried:

- “None” No effect on the queried data.
- “Sum” Data is summed, or totalled, for the chosen aggregate period.
- “Average” Data is averaged for the chosen aggregate period.
- “Max” The maximum data point for the chosen aggregate period is chosen.
- “Min” The minimum data point for the chosen aggregate period is chosen.

The aggregate period is selected by clicking on the down arrow on the right of the **Aggregate Period** list box.

Data Aggregates: **Aggregate Period:**

None Sum Average Max Min

None ▼

Figure 4-7 Data Aggregates and Aggregate Period.

Note: If either the **Data Aggregates** or **Aggregate Period** is set to “None” then a data aggregate is not applied.

4.7.8. Select a Graph Layout and Graph Type

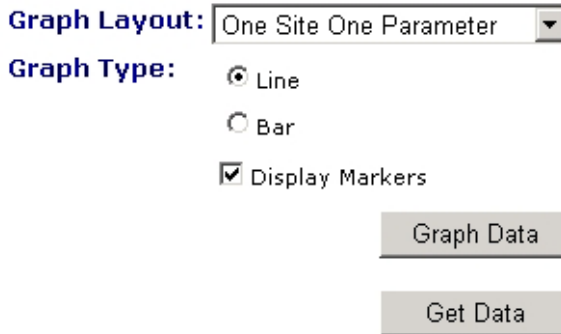
The graph layout is selected by clicking on the down arrow on the right of the **Graph layout** list box (Figure 4-8). Selecting a graph layout has the following effect when the data is queried:

- “One Site One Parameter” One graph is displayed for each site and parameter selected. I.e. if 3 sites and 4 parameters are selected then a total of 12 graphs will be displayed.
- “One Site All Parameters” One graph is displayed for each site and has all the parameters selected. I.e. if 3 sites and 4 parameters are selected then a total of 3 graphs will be displayed (one graph for each site).
- “All Sites One Parameter” One graph is displayed for each parameter and has all the sites selected. I.e. if 3 sites and 4 parameters are selected then a total of 4 graphs will be displayed (one graph for each parameter).
- “All Sites All Parameters” One graph is displayed with all the sites and parameters selected. I.e. if 3 sites and 4 parameters are selected then 1 graph will be displayed.

The graph type can be changed by clicking on the circle to the left of either “Line” or “Bar” and has the following effect when the data is queried:

- “Line” Displays a line graph.
- “Bar” Displays a bar graph.

Markers on the graph are displayed by clicking on the box to the right of the “Display Markers” field.



The screenshot shows a web interface for configuring a graph. It features a dropdown menu for 'Graph Layout' set to 'One Site One Parameter'. Below it, the 'Graph Type' section has three options: 'Line' (selected with a radio button), 'Bar' (unselected), and 'Display Markers' (checked with a checkbox). At the bottom of the form are two buttons: 'Graph Data' and 'Get Data'.

Figure 4-8 Graph Layout and Type.

4.7.9. Displaying the Queried Data Graphs and Saving Data.

Clicking on the **Graph Data** button will display the graphs on the current page for the data query selections made. Clicking on the **Get Data** button allows queried data to be saved directly over the internet to a CSV (comma separated) file on the users computer. This file is either viewed immediately or can be saved and imported into most spreadsheet programs (i.e. Microsoft Excel).

The user exits the form by closing the browser or using you're the browser's "Back" button to return to the Introduction screen.

4.8. Administering the Database

To administer the database it is necessary to have an application that will allow for the importation of data, addition of new sites and new water quality parameters. For this task a windows application DMDDS has been developed. The main screen for this application can be seen below in Figure 4-9 DMDDS main screen.. The application provides an interface to the data which is held in the database. The database configuration can be seen in Appendix 2

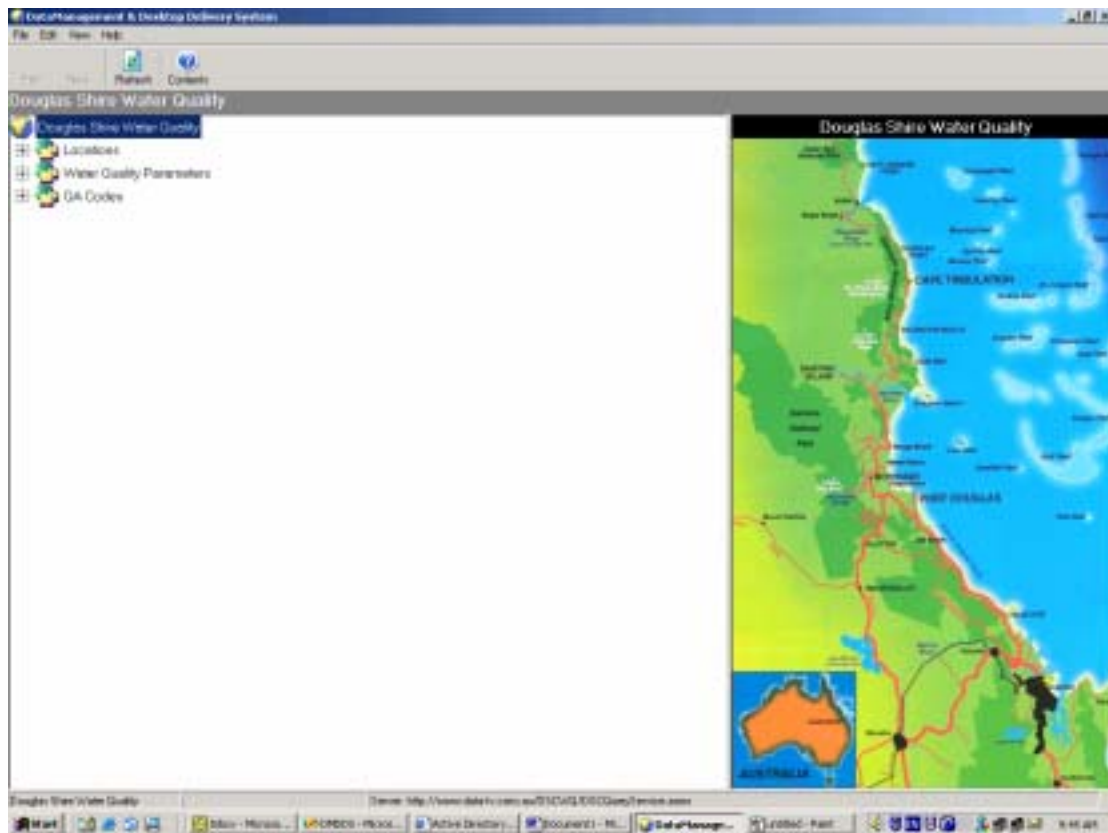


Figure 4-9 DMDDS main screen.

The Database contains water quality data from several sampling points within the Douglas Shire. The database holds information on the geography of each sampling point, the water quality parameters that can be measured, the data measurements, and the quality assurance of each measurement.

The DMDDS software has been authored to allow a simple method to update and maintain the Douglas Shire Council Water Quality Database. This includes being able to:

- Modify and create new locations (catchments, sites and sampling points).
- Modify and create new water quality parameters.
- Modify and create new quality assurance codes.
- Import water quality measurements subsequent to laboratory testing.
- Update the quality assurance codes associated with each water quality measurement.

Figure 4-10 illustrates the general layout of the DMDDS software and demonstrates how navigational procedures are performed within the user interface.

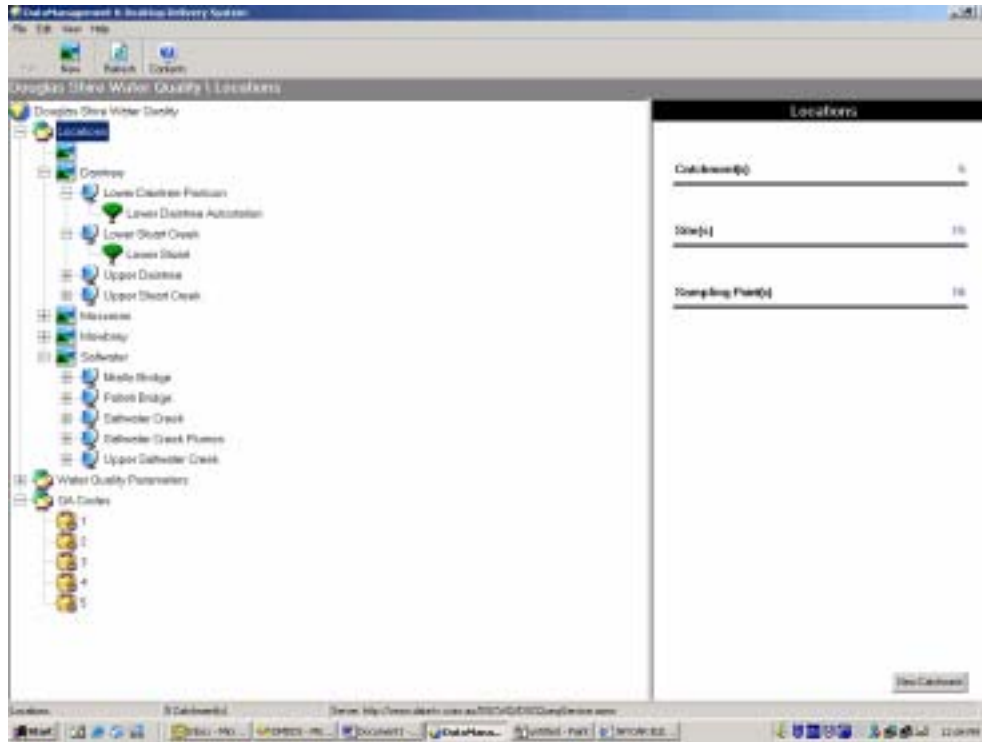


Figure 4-10 General Layout

The sampling point locations, water quality parameters and quality assurance codes are displayed in a tree structure with the sampling points branched out under their respective sites and catchments. Information appropriate to the selected tree node is obtained from the water quality database, and is displayed in the window on the right hand side. This is shown in Figure 4-11.

The screenshot shows a software dialog box titled "Edit Site" with a subtitle "Site". The dialog contains the following fields and controls:

- Identification No: 4
- Name: Lower Quaternary Protocol
- Land Use: Mixed Land use sampling
- Active:
- Photo: [Empty rectangular box]
- Location:
 - North Latitude: [Empty text box]
 - South Latitude: [Empty text box]
 - East Longitude: [Empty text box]
 - West Longitude: [Empty text box]
- Buttons: OK and Cancel

Figure 4-12 Edit

Water quality measurements can then be added to the database using two methods. The first method is to import the data from a file that is formatted into columns containing the sampling point ID the water quality parameter ID, the value, and the date. This method can be accessed through the file menu where an open file dialog will appear, and the data file can be selected. Error detection has also been implemented so that if a row cannot be added to the database, the data is added to an error log file along with a description of the error. The import data method can be seen in Figure 4-13.



(a)

(b)

Figure 4-13 Import Data

The second method of adding water quality measurements consists of selecting a sampling point and adding the new data manually. The data measurements entered are firstly displayed to the user in a data grid so that any data entry errors can easily be identified. Once the data has been confirmed to be correct, it can then be added to the database upon clicking OK. This method is shown in Figure 4-14 and is currently under construction.

WQParameterID	Value	Date
1	10	25/03/2004
1	9.9	25/03/2004
1	3	25/03/2004

Figure 4-14 New Water Quality Data

The ability to update the quality assurance codes for the water quality measurements also needs to be accounted for. Before confirming the update, it is required that the data can be visually displayed so that any errors can be identified.

4.9. Linkage with Existing Systems

To add utility to this system some thought has been given to linking the data to existing databases. The following linkages have been made:

- Cross reference to QEPA and QDNR sites; where existing data for a particular sampling site exists, it can be integrated with the additional data.
- Cross Reference to QEPA water quality descriptors. This is necessary so that when results from the samples comes back from QEPA the data can be imported easily.
- Cross reference to standard methods for water quality parameter analysis. It is important to detail the method used for the determination of each water quality indicator.

5. Requirement for handover to Douglas Shire Council

The need to have the water quality data available externally has dictated a web server based solution. Should Douglas Shire Council wish to host the data management system within the Shire the following would be required:

5.1. Hardware Required

- Microsoft Windows 2003 Server with a configuration suitable to run MS SQL Server 2000.
- Broadband internet access (greater than 128 kbps).

5.2. Software Required

- Microsoft windows server 2003.
- Microsoft SQL Server 2000.
- SoftwareFX ChartFX.net charting toolkit.

5.3. External hosting

It is also possible that should Douglas Shire not wish to host this system an external web host can be used. For example: DiscountASP at <http://www.discountasp.net/index.aspx> provide the necessary server and software required by this system at rates of around \$30Aus per month. This is a very cost effective solution as not only are you provided with software and hardware but also with the necessary technical support to keep the servers etc. going.

6. Conclusions

A data management and desktop delivery system has been developed for managing the water quality data for the Douglas Shire Council. The solution consists of three applications; one being a web based data selection and delivery tool, the second two web based operational reports and the third being a windows forms administrative tool.

The operational reports have worked well during the wet season of 2003-2004 and allowed the Douglas Shire Council water quality officer to have access to the data from the automatic sampling stations to plan for servicing.

A unique software architecture has been utilized that allows sharing of the water quality data using XML web services.

Both the data selection tool and the administrative tools for retrieval and management of the water quality database have been completed.

It is necessary for the Douglas Shire Council to host this solution as soon as the required infrastructure is in place. If the infrastructure cannot be put in place, it will be necessary to host this database at an external site as detailed in 5.3.

7. Appendix 1 Data Parameters to be stored.

7.1. Water Sample Analysis parameters

Total Phosphorus
Total Nitrogen
Total Filterable Phosphorus
Total Filterable Nitrogen
Dissolved Reactive Phosphorus
NOx
Ammonia (NH₃)
Total Suspended Solids

7.2. Automatic Station Parameters

Level
EC
Turbidity
Rainfall
Sample Taken at Time
Battery Voltage
Fridge Temperature
Water Temperature

8. Appendix 2 Database Design Specification

General types of information to be stored

- Site information:-information related to the sampling site
- Sampling point:-information pertaining to the sampling point (may be lumped with Site Information)
- Water Quality Parameters:-a list of water quality parameters and related descriptions.
- Water Quality Data:-A discrete water quality sample
- Sampling information:-Information relating to how the sample was obtained and maybe sampling conditions

The Water Quality data to be stored is to be broken down into sites and sampling points. A site is a region defined by a bounding rectangle and may contain one or many sampling points. The sampling points are a point where a water quality parameter has been measured. It is specified by Easting, Northing and elevation co-ordinates.

Below is a list of the Database Tables required (Columns and data Type)

Data for site information

- Site Name (varchar 50)
- SiteID (int)
- Land Use (varchar 50)
- Site Description (Text)
- North Latitude (varchar 50)
- South Latitude (varchar 50)
- East Longitude (varchar 50)
- West Longitude (varchar 50)
- Site Photo (image)

- Active (Boolean)
- CatchmentID (int)

Data for Sampling point

- Sampling Point Name (varchar 50)
- Sampling Point ID (int)
- SiteID (int)
- Easting (varchar 50)
- Northing (varchar 50)
- Type (Auto/Grab) (varchar 50)
- Cross Reference Site 1 (Cross reference to existing EPA siteID EPA) (varchar 50)
- Cross Reference Site 2 (Cross reference to existing siteID) (varchar 50)
- Supplementary information/Sensor information (varchar 50)

Data for Water Quality Parameters

- WQParameter ID (int)
- WQ Parameter name (varchar 50)
- Alias or Abbreviated/Common Name (varchar 50)
- Referenced Method (varchar 50)
- EPA target (varchar 50)
- Douglas Shire Target (varchar 50)
- Units (varchar 50)
- Number of Decimal Places (int)
- DSR_Code (EPA cross reference) (varchar 50)

Data for Water Quality Data

- Sampling point id (int)
- Water Quality Parameter ID (int)
- Value (float)

- Date (DateTime)
- QA code (int)
- DataSet ID (int) (not implemented)

Data for Custodian (not implemented)

- Custodian ID (int)
- Organisation (varchar 50)
- Contact person (varchar 50)
- Contact details (varchar 50)

Data for Quality assurance coding list

- QA code ID (int)
- QA code (int)
- QA code description (varchar 50)

Data for Dataset Definition (not implemented)

- DatasetID (int)
- Startdate (DateTime)
- EndDate (DateTime)
- Custodian ID (int)

9. Appendix 3 Web Services Application Programming Interface

Web Service methods.

Name: **QueryWQPSiteIDTable**

Purpose: Returns one or more water quality parameters between from a site using siteID, between a start and end date.

Call: QueryWQPSiteIDTable(string[] SiteID,string[] WQParams, string[] Aggregates,date startdate,date, endDate)

Returns: XML data set containing result set

Details: Details of the aggregates setting

Aggregate Setting	Aggregate Code	Valid Settings	Aggregate Description
Aggregate Type	AT=	S	Sum data over aggregate period
		A	Average data over aggregate period
		MX	Maximum data item in aggregate period
		MN	Minimum data item in aggregate period
		N	No Aggregation
Aggregate Periode	AP=	Y	Yearly period for aggregating over
		M	Monthly period for aggregating over
		D	Daily period for

			aggregating over
		H	Hourly period for aggregating over
		N	No Aggregation

The dates must be a string representation of a date that can be converted by the system to a date. Recommended format is “dd mmm yyyy” eg: “1 Jan 2004”. If the system cannot convert the dates it defaults to the last 7 days of data to be graphed.

Return Tables contained within the XML dataset

Table[“WQ”] is the water Quality parameter table containing the details of the WQ Parameters requested to be returned

Table[“PT”] is the sampling point details of the sampling point that WQ is requested for.

Table[“Site1”] to Table[“SiteN”] contain the water quality data for sites 1 to N.

Name: **QueryWQPSiteIDGraph**

Purpose: Return one or more water quality parameters from a site using siteID, between a start and end date.

Call: QueryWQPSiteIDGraph(string SiteID,string[] WQParams, string[] Options,string startdate,string, endDate)

Returns: URL to graph

Details: SiteID[] is an array of SiteID’s ie number

WQparams[] is an array of WQParamID ie numbers

SiteID and WQParamID must have the same dimension. This reflects that that a SiteID will always have a matching

WQParameterID to graph. The SiteID will be a valid sampling point defined in the sampling point data Table. Sampling points can be obtained by using QuerySamplingPointNames();

Similarly WQParameterID is the ID of a water Quality parameter defined in the Water Quality Table.

Options is an array of strings that activate attribute settings when generating the Graph

Option	Option Code	Valid Settings	Setting Description
Graph Type	CT=	L	Line graph (default)
		B	Bar Graph
		XY	XY plot (no lines)
Marker Size	M=	0-5	0=no maker,5=big marker
Line Size	L=	0-5	0=no line, 5=big line
Graph Height (pixels)	H=	0-800	
Graph Width (pixels)	W=	0-800	
Graph Title	TI=	Valid string	
Graph palette	PA=	1	Scheme1
		2	Scheme2
		3	Earth Tones

		4	Modern Business
		5	Windows
		6	Pastels
		7	High Contrast
		8	Scheme 3

Also set in the options is the aggregating of data

Aggregate Setting	Aggregate Code	Valid Settings	Aggregate Description
Aggregate Type	AT=	S	Sum data over aggregate period
		A	Average data over aggregate period
		MX	Maximum data item in aggregate period
		MN	Minimum data item in aggregate period
Aggregate Periode	AP=	Y	Yearly period for aggregating over
		M	Monthly period for aggregating over
		D	Daily period for aggregating over
		H	Hourly period for aggregating over

The dates must be a string representation of a date that can be converted by the system to a date. Recommended format is “dd mmm yyyy” eg: “1 Jan 2004”. If the system cannot convert the dates it defaults to the last 7 days of data to be graphed.

Example setup code for call (C#) for 2 parameters to be graphed

```
String[] WQParams = new string[2];
```

```
String[] SiteID=new string[2];
```

```
String[] Options=new string[3];
```

```
WQParams[0] = 1; //WQParameterID for turbidity;
```

```
WQParams[1]=2; //WQParameterID for stream depth
```

```
SiteID[0]=1;//Lower Daintree autostaion
```

```
SiteID[1]=2; //Upper Daintree autostation
```

```
Options[0] = “TI=This is a Test Graph” //set title
```

```
Options[1]=”H=250; // 250 pixels high
```

```
Options[2] = “W=750”; //750 pixels wide
```

```
//Function call
```

```
WebServiceObject.QueryWQPSiteIDGraph(SiteID,WQParams,Options,”1 Jan 2004”,”31 Jan 2004”)
```

Name: **QuerySiteName**

Purpose: Returns all Sitenames

Call: QuerySiteNames()

Returns: XML data set containing result set

Name: **QuerySamplingPointName**

Purpose: Returns all Sampling Point Names from a siteID
Call: QuerySampligPointName(string SiteID)
Returns: XML data set containing result set

Name: **QuerySamplingPointNames**
Purpose: Returns all Sampling Point Names
Call: QuerySampligPointNames()
Returns: XML data set containing result set

Name: **QuerySitesInCatchment**
Purpose: Returns all sites in a Cathment
Call: QuerySitesInCatchmente(string CatchmentID)
Returns: XML data set containing result set

Name: **QueryCatchment**
Purpose: Returns all Catchments
Call: QueryCatchmente()
Returns: XML data set containing result set

Name: **QuerySiteID (Not Active)**
Purpose: Returns all siteID's
Call: QuerySiteID()
Returns: XML data set containing result set

Name: **QuerySitesBoxed (Not Active)**
Purpose: Returns all the siteID's that are located with in a search box. The box coordinates are Easting and Northing.
Call: QuerySiteBoxed(string TopEasting, string TopNorthing, string Bottom Easting, string Bottom Northing)
Returns: XML data set of results

Name: **QuerySiteMetadata (Not Active)**

Purpose: Returns site metadata

Call: QuerySiteMetaData(string siteId)

Returns: XML data set containing result set

Name: **QueryWQPSiteID**

Purpose: Returns all water quality parameters available for that site

Call: QuerySiteWQP(string SamplingPoint)

Returns: XML data set containing result set

Name: **UpdateDataTable**

Purpose: Updates database table

Call: UpdateTable(string strAuthentication, string Catalog, DataSet
DataSet)

Returns: string with error information

Details The Dataset passed to this function must have one table with the tablename set to the name of the table in the database to be updated.

10. Appendix 4 Use Case Scenarios

10.1. Scenario 1

Main User: Douglas Shire council WQM officer.

The Douglas Shire Council requires a means to alert staff that an event condition has been met at any of the Automatic WQM stations. This will enable the council to alert grab samplers and plan for sampling and processing of the water samples.

The alerts will be sent via email and SMS to mobile phones. The alerts will only be sent once per event.

10.2. Scenario 2

Main User: Douglas Shire council WQ officers and Grab Samplers.

The Douglas Shire Council WQ officer and the participating grab samplers will want to be able to log on to a web site and check the event status for the rivers being monitored by the automatic stations. The current river height and latest real time measurements will be displayed in tabular and graphical form allowing user to assess the current situation and trend. The user will select the station of interest either by way of selecting a dot on a map, or by station name.

The DSC WQ officer will also want to log on to a site that will allow the status of the AWQ station to be obtained and assessed (system status/health). This information will be displayed in the format of a dashboard of system parameters. The parameters of interest in

addition to the above might be number of samples taken, current fridge temp, battery voltage.

10.3. Scenario 3

Main User: Douglas Shire council.

The Douglas Shire Council will want to ensure that the data obtained by the AWQ stations and by the Grab Sampling program is stored in a well cataloged and readily available format. The data will be stored on a system that has the necessary backup and security procedures, to ensure data integrity and robustness.

The data will be cataloged using ANZLIC metadata tags to ensure proper availability for other potential users.

It is envisage initially that the data will be stored on CSIRO servers but the council will plan for data migration during the course of the project.

10.4. Scenario 4

Main User: Community.

A community member will want to log on to a web site and discover what WQ data is available for a particular site or region. The data discovery would be achieved by selecting a region on a map or using a search engine to present the data of interest.

On presentation of the data catalog, the user could select the data of interest and have it presented in either tabular or graphical form.

¹ Campbell Scientific USA, www.campbellsci.com

² Giga CDMA Data Modem, available through www.maxon.com.au

³ MessageNet, www.redrock.com.au

⁴ <http://www.data-tv.csiro.au/DSCWQ/DSCQueryService.aspx>

⁵ http://www.data-tv.csiro.au/Reports/report.aspx?ReportID=DSC_Stream,
http://www.data-tv.csiro.au/Reports/report.aspx?ReportID=DSC_Flume