



KISTERS WATER QUALITY MODULE Implementation at NSW Office of Water - Overview -

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Agenda

- Introduction
- Project delivery
- KiWQM concepts
- KiWQM functionality
- Benefits
- Future directions



Introduction

❖ The New South Wales Office of Water, Australia

- New South Wales (NSW) is Australia's most populous state covers an area of 800,642 km² (497,495 miles²).
- The NSW Office of Water (NOW) is responsible for the management of the state's surface water and groundwater resources.
- Part of their core business is to monitor the quantity, quality, and health of aquatic ecosystems and water extractions in the state.
- In the most populous state on the driest inhabited continent in the world during a period of climatic uncertainty, knowledge of NSW's water resources is essential.



Department of
Primary Industries
Office of Water

Introduction

❖ The New South Wales Office of Water, Australia

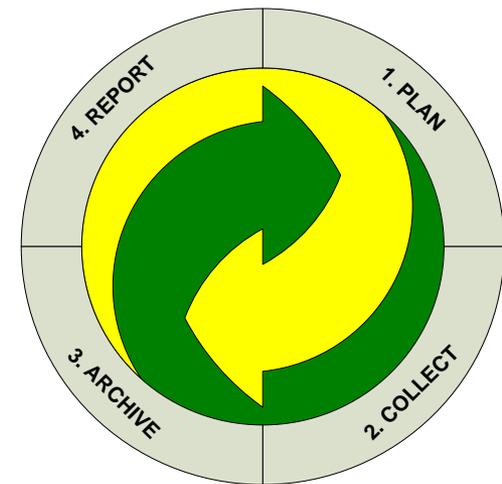
- Operates four concurrent monitoring programs
 - river gauging stations for the measurement and control of surface water flow,
 - groundwater bores to monitor the status of aquifers,
 - water quality and biological samples to monitor the health of surface and ground water, and
 - metering to measure the volumes of water usage from surface waters and aquifers
- Archives the data collected and makes it available to the general public



Introduction

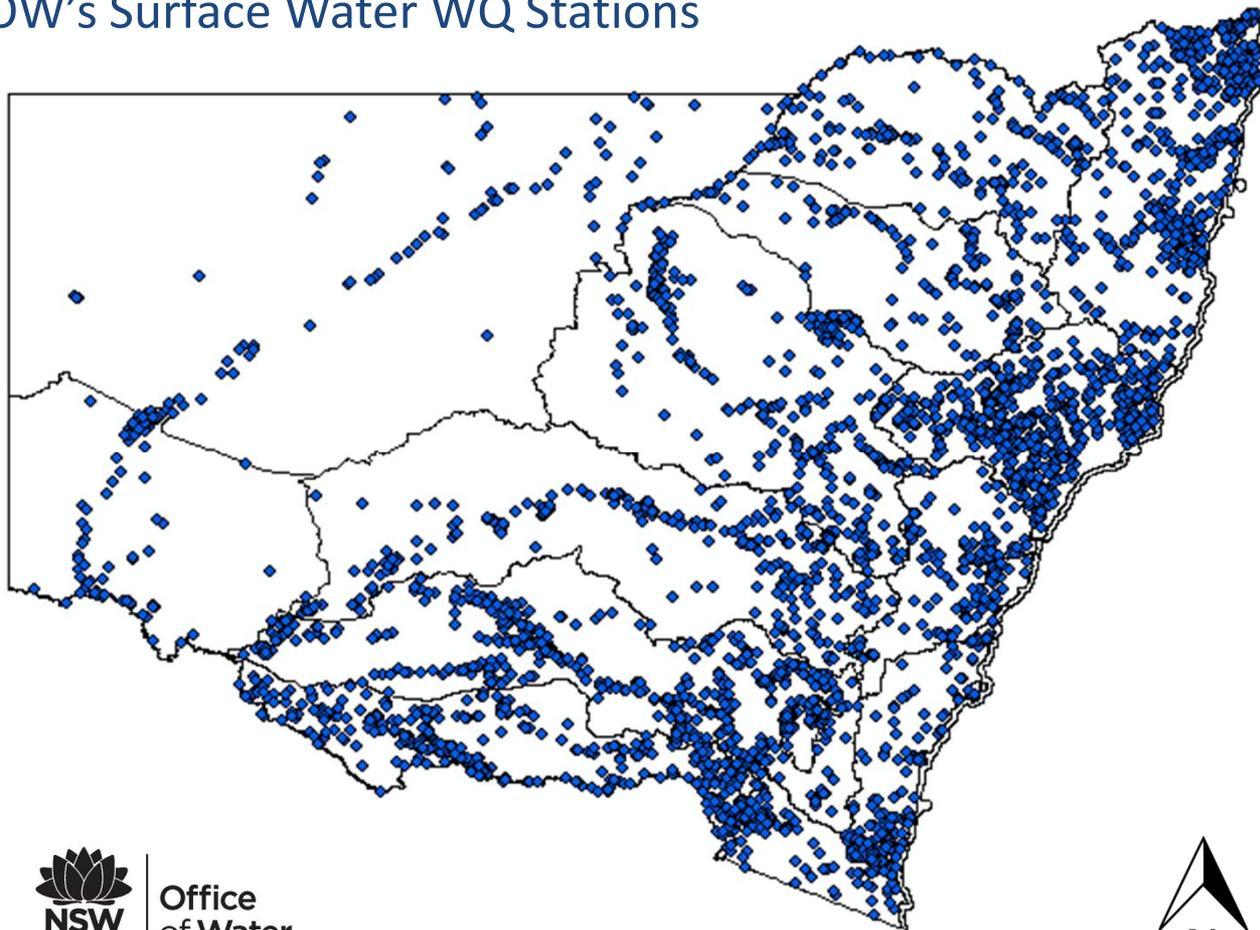
❖ NOW's Water Quality Process Model

1. Plan Define Objectives Design Programs Plan Operations Develop Protocols	2. Collect Preparation Field Liaison Sample Collection Sample Handling
3. Archive Lab Analysis Data Transmission Data Approval Database Storage	4. Report Data Audit Data Provision Statistical Analysis Reporting



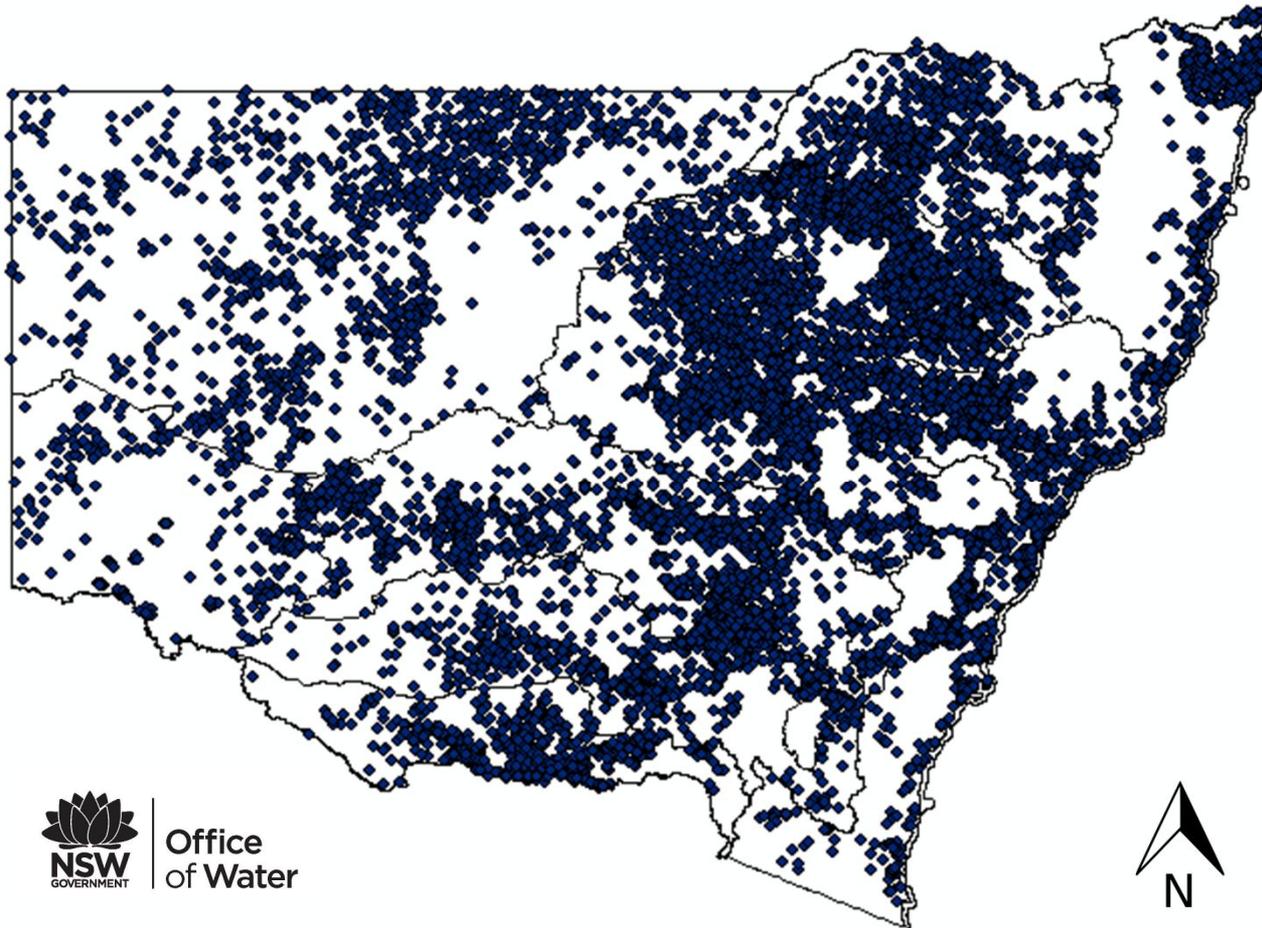
Introduction

❖ NOW's Surface Water WQ Stations



Introduction

❖ NOW's Groundwater WQ Stations



Introduction

❖ NOW's Water Quality Data Management History

- Original system was an external VAX mainframe
- In the mid 1990's the department built a centralized client-server application called TRITON (Centura on Oracle)
- Main NSW archive for SW and GW water quality data for 15 years
- Restructures and cutbacks led to system support issues



Introduction

❖ Drivers for Change

- Federal regulatory reporting changes (Water Act 2007)
- NSW regulatory reporting changes (Water Management Act 2000)
- NSW state plan outcome delivery
- Increasingly complex reporting requirements
- Lack of resources for system enhancements
- New reporting channels required e.g GIS, web
- Better internal system integration needed
- Technology platform alignment
- Whole of Government approach

In 2008 funds were sort and the decision was made to go to tender to seek a commercial off the shelf product to meet the growing needs of the organization

Introduction

❖ System Requirements

- flexible and scalable to meet changing needs
- ease of use and maximum functionality
- powerful data querying and filtering
- advanced data visualisation and reporting tools
- enhanced graphical representations e.g vertical profiles, box-whisker
- provision of a data audit trail of all data changes and other QA/QC tools
- powerful and automated data import and export tools to improve data quality and reduce re-work
- seamless integration with existing corporate databases Hydstra/TS and LIMS
- GIS integration and web publishing
- access for multiple state agencies
- external data transfer to the federal government agency in an agreed standard format for Australian Water Resources Information System

Kisters successfully tendered for the project in 2009



Introduction

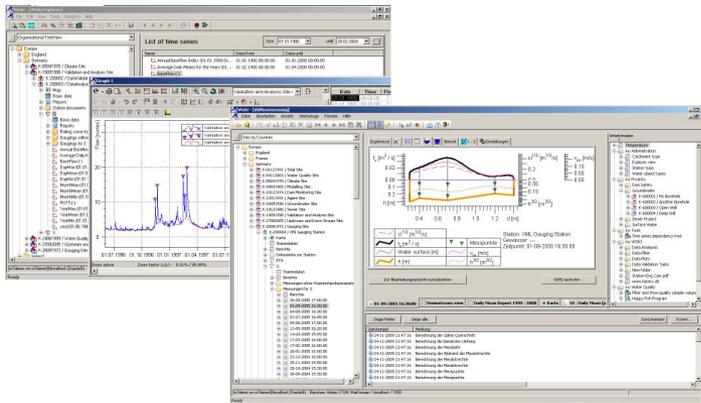
❖ Selection Factors

- Mature product development and large existing user base (WISKI)
- Extensive experience in water data systems
- Proven software development methodologies
- High level quality assurances processes e.g unit, load and performance testing
- Large project management experience
- Required integration with Hydstra - time series, groundwater and GIS
- Reliable system support infrastructure
- Ease of use and maximum functionality
- Advanced data visualisation and reporting
- Required automation components

Project Delivery

❖ Kisters Solution

- KISTERS Water Quality Module – **KiWQM** - was designed in response to the requirements of the NSW Office of Water
- It was built around the existing infrastructure of KISTERS' Hydrological time series product – **WISKI** - **W**ater **I**nformation **S**ystem **K**ISTERS.
- While the main purpose of the system is to store discrete water quality samples and results – it also has access to the full range of WISKI time series operations via KiTSM services.



The screenshot shows the KISTERS KiWQM login screen. The header includes the KISTERS logo and the text 'KiWQM 7.1.7.5 Alpha'. The main area contains a login form with the following fields:

- User:
- Password:
- Domain:
- Host:
- Port:

There is a checkbox for 'Save password' which is currently unchecked. At the bottom, there are three buttons: 'Connect', 'Cancel', and 'Help'. The background of the login screen features a gallery of framed portraits and a small figure of a person looking at them.

Project Delivery

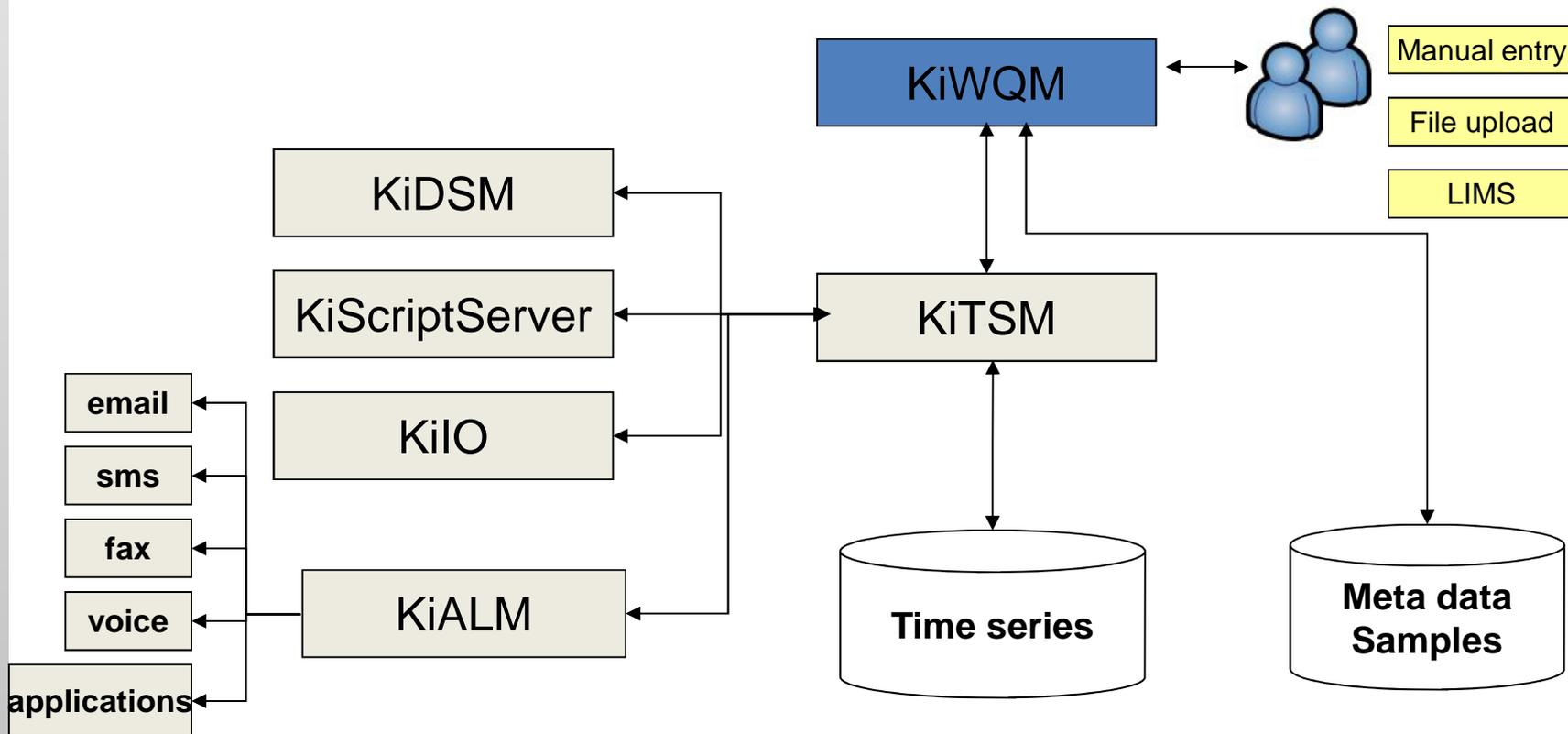
- ❖ Phase 1 - Supply of base system
 - Completed in June 2010
- ❖ Phase 2 - System Enhancements to meet NOW requirements
 - Delivered March 2011
- ❖ Phase 2.5 - Additional Algae enhancements
 - Delivered July 2011
- ❖ Phase 3 - Data conversion/data load
 - Completed June 2011
- ❖ Phase 3.5 - Historic Algae Data load
 - Ongoing
- ❖ Phase 4 - Provision of Training
 - Ongoing
- ❖ Phase 5 – Biological Module
 - In development



KiWQM went live at NSW Office of Water in June 2011

Project Delivery

❖ WISKI was extended to allow a new WQ module to work with the of the Time Series Engine and other system components



Solution Architecture

Project Delivery

❖ Data Migration

- Legacy system consisted of :
 - 323 water quality measuring programs
 - 22,000 surface water and ground water - water quality stations
 - 878 parameters
 - 585,925 samples
 - 3,504,116 results
- The legacy system was a classic Oracle relational database with approx. 50 tables
- The KiWQM data model is a combination of classic relational modelling and EAV (Entity-Attribute-Value) which is used to extend attributes to entities to capture data not found in the base model
- Each entity in the exiting database needed to be mapped to a new location in KiWQM in preparation for the migration

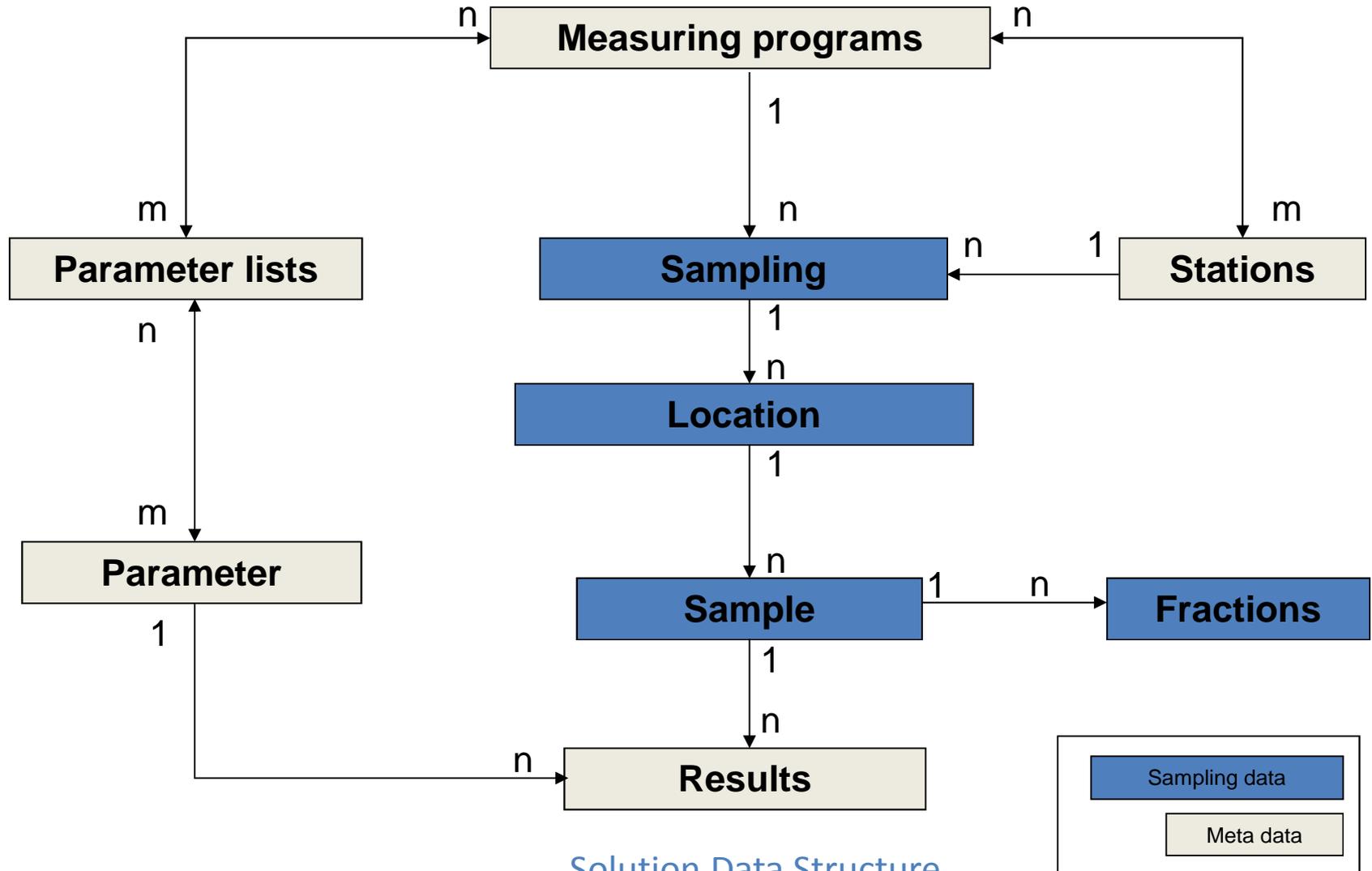
Project Delivery

❖ Data Migration

- The data migration was undertaken almost exclusively using the built in KiWQM tools used for csv and xml data import
- This framework can also be run a batch mode allowing for repeatable, traceable, unattended import of large volumes of data
- The batch import consists of a series of commands that can be used to invoke parts of the importing framework

KiWQM Concepts

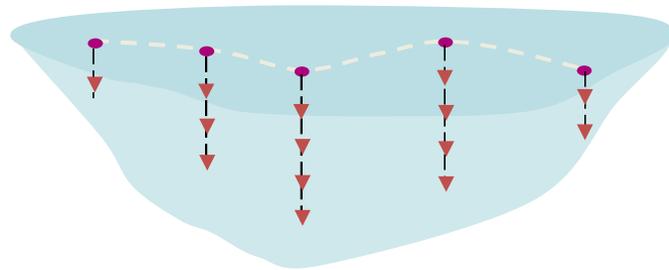
KiWQM



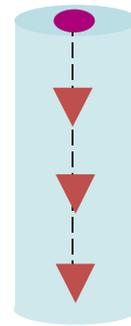
Solution Data Structure

KiWQM Concepts

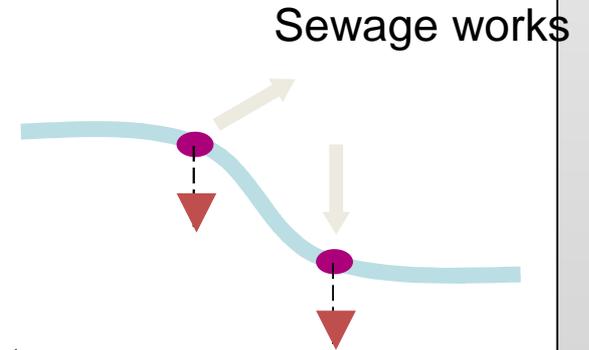
KiWQM



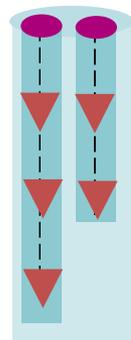
Lakes/reservoirs



Lysimeter

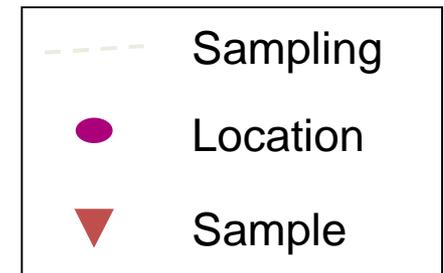
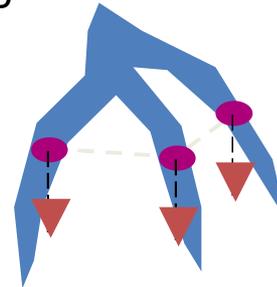


Sewage works



Bore hole
with multiple
pipes

Spring branches



Sampling Structure

KiWQM Concepts

❖ Sampling

The event during which samples are taken at a known station.

❖ Location

The actual spot at which the sample is taken. This may vary from the registered station location. Can be specified as : coordinates, name, upstream/downstream (m), cross section (m).

❖ Sample

Multiple samples can be taken during a sampling event at different depths at different times.

KiWQM Concepts

❖ Replicate

A sample that is repeated within a short space of time at the same location with the same equipment to test the reproducibility of a sampling procedure.

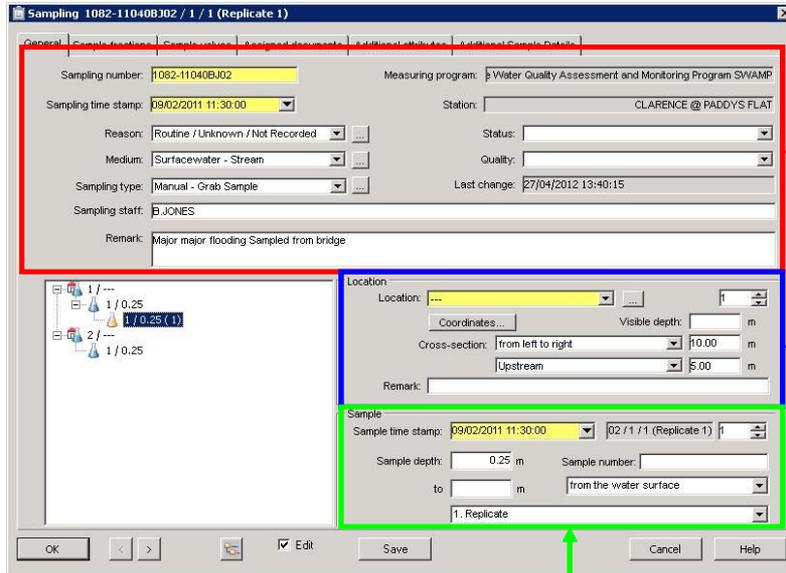
❖ Fraction

When samples are separated into one or more bottles for separate analysis. e.g one fraction is analysed in the field another at a lab, samples sent to separate labs

❖ Result

Measured or observed values of a parameter. Can be quantitative or qualitative. Can be assigned a quality code.

KiWQM Concepts



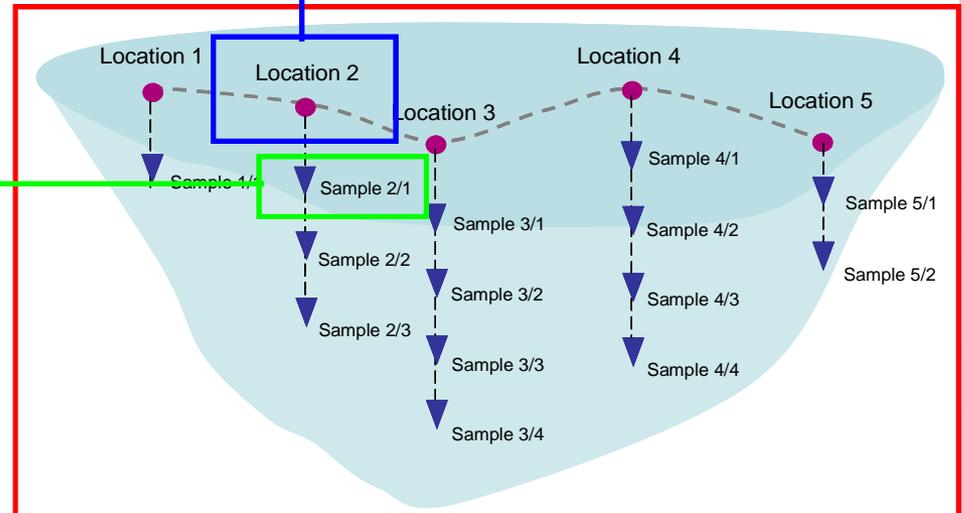
Sampling

Location

Sample

Sampling at a Lake

Sampling Structure



KiWQM Concepts

Sampling 1082-11040BJ02 / 1 / 1

General Sample fractions Sample values Assigned documents Additional attributes Additional Sample Details

	Laboratory	Entry	Fraction number	Ref./Bottle number	Bottle
1	Not Applicable	09/02/2011 11:30:00	1082-11040BJ02/0		
2	NOW Wollie Creek Laboratory (formerly Arncliffe)	11/02/2011 14:12:04	1082-11040BJ02/1		

Fraction number: 1082-11040BJ02/1 2

Entry date: 11/02/2011 14:12:04

Data source: Labware LIMS (from July 2002)

Laboratory: NOW Wollie Creek Laboratory (former)

Analysis date: 11/02/2011 00:00:00

Ref./Bottle number:

Bottle volume:

Bottle type: Bottle - PVC

Preservation: ---

Treatment: Filtered

OK < > Edit Save Cancel Help

Sampling Structure

KiWQM Concepts

Sampling ARN-11-12-010/002 / 1 / 1

General | Sample fractions | **Sample values** | Assigned documents | Additional attributes | Additional Sample Details

Sample: ARN-11-12-010/002 / 1 / 1
Parameter list: Show values for all parameter lists
Fractions: Show values for all fractions

Comparison list 1: ---
Comparison list 2: ---
Classification: ---

Show only records with values

	Parameter type	Method	Sign	Value	Unit	Comparison
1	EC25C / Electrical Conductivity @25 C	WCK - Determination of Conductivity	---	161.	µS/cm	---
2	NitrateAndNitriteAsN / Nitrate + nitrite as N	WCK - Determination of Oxidised Nitro	---	0.05	mg/L	---
3	Nitrogen - total / NitrogenTotal	WCK - Simultaneous Determination of	---	0.34	mg/L	---
4	Phosphorus - total / PhosphorusTotal	WCK - Simultaneous Determination of	---	0.067	mg/L	---
5	PhosphorusReactiveOrthophosphateDissolved /	WCK - Determination of Reactive Pho	---	0.038	mg/L	---
6	Solids - total suspended @ 105 C / TSS105C	WCK - Total Suspended Solids at 105°	---	6.00	mg/L	---
7	Turbidity / Turb	WCK - Determination of Turbidity in W	---	8.00	NTU	---

OK < >  Edit Save Cancel Help

Results

KiWQM Concepts

Sample values

Parameter list information

Parameter: 29/04/2012 14:35:08

Parameter short name: Method:

Parameter number: Unit:

Results

Value: Comparison 1:

Sign: Comparison 2:

Method: Classification:

Fraction:

Quality:

Device: Uncertainty:

Lower limit of quantitation: Detection limit: Analysis start:

Upper limit of quantitation: Analysis end:

Remark:

Standard remark:

History:

Result

KiWQM concepts

❖ Stations

A station is a place where measurements are carried out.

The station can be described and identified by coordinates

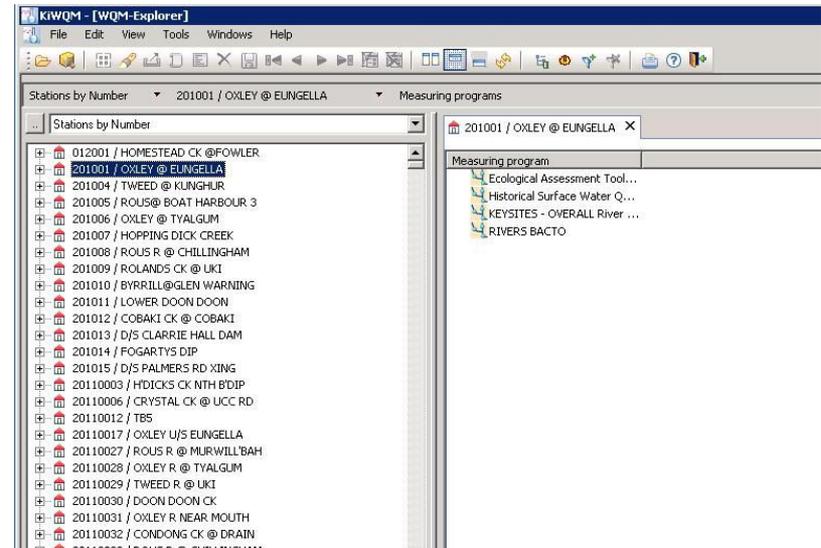
❖ Sites

A site is a general area where measurements are carried out.

A site can contain multiple stations.

❖ Measuring Programs

All samples must be collected under a measuring program aka. sampling program, measuring project, that has a defined set of objectives, guidelines and other related metadata in order to place the sampling in context and for quality assurance purposes



KiWQM Concepts

❖ Parameter Types

Individual chemical, physical or biological elements for which analysis is undertaken. E.g. pH, dissolved oxygen etc. AKA analyte, determinand, variable.

❖ Analysis Methods

Field or laboratory methods for detecting or measuring a parameter. Each method can be assigned detection and limits of quantification as well as a version number which can be linked to accreditation agency e.g. NATA. Each parameter can have one or more methods.

❖ Parameter Lists

Groups of parameters and associated analysis methods that are assigned to measuring programs to optimise the viewing of sample results

KiWQM Functionality

❖ Tree Explorer

Flexible tree view explorer nodes with multiple access points to sample results

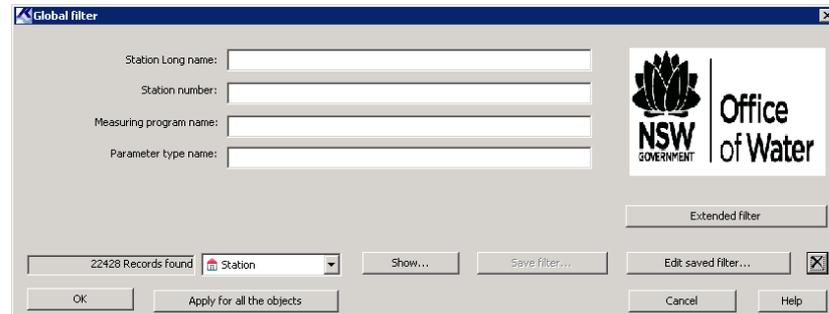
The screenshot displays the KiWQM software interface. On the left, a tree explorer shows a hierarchical structure of stations organized by organization. The right pane shows a 'Sample table' with a grid of data. The table has columns for Measuring program, Station, Number, Label, Time stamp (Sampling), Depth, and Team. The data rows show various monitoring stations and their corresponding sample results.

	Measuring program	Station	Number	Label	Time stamp (Sampling)	Depth	Team
1	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000675 / 1 / 1 (Replicate 0)	01/06/1994 10:00:00	0.5	
2	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000666 / 1 / 1 (Replicate 0)	19/04/1994 10:35:00	0.5	
3	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000656 / 1 / 1 (Replicate 0)	22/03/1994 10:20:00	0	
4	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000321 / 1 / 1 (Replicate 0)	09/06/1992 12:00:00	0	
5	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000275 / 1 / 1 (Replicate 0)	09/04/1992 12:00:00	0	
6	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000256 / 1 / 1 (Replicate 0)	16/03/1992 12:00:00	0	
7	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000239 / 1 / 1 (Replicate 0)	03/03/1992 12:00:00	0	
8	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000536 / 1 / 1 (Replicate 0)	30/06/1993 09:00:00	0	
9	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000519 / 1 / 1 (Replicate 0)	03/06/1993 11:35:00	0	
10	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000502 / 1 / 1 (Replicate 0)	06/05/1993 11:15:00	0	
11	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000486 / 1 / 1 (Replicate 0)	07/04/1993 10:30:00	0	
12	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000466 / 1 / 1 (Replicate 0)	08/03/1993 11:45:00	0	
13	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000448 / 1 / 1 (Replicate 0)	29/01/1993 10:05:00	0	
14	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000427 / 1 / 1 (Replicate 0)	22/12/1992 10:15:00	0	
15	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000423 / 1 / 1 (Replicate 0)	07/12/1992 14:45:00	0	
16	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000411 / 1 / 1 (Replicate 0)	26/11/1992 11:15:00	0	
17	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000394 / 1 / 1 (Replicate 0)	28/10/1992 12:50:00	0	
18	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000378 / 1 / 1 (Replicate 0)	01/10/1992 13:00:00	0	
19	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000357 / 1 / 1 (Replicate 0)	02/09/1992 11:00:00	0	
20	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000351 / 1 / 1 (Replicate 0)	05/08/1992 15:00:00	0	
21	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000342 / 1 / 1 (Replicate 0)	08/07/1992 11:00:00	0	
22	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000636 / 1 / 1 (Replicate 0)	15/02/1994 10:20:00	0	
23	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000624 / 1 / 1 (Replicate 0)	13/01/1994 10:00:00	0	
24	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000611 / 1 / 1 (Replicate 0)	06/12/1993 10:50:00	0	
25	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000599 / 1 / 1 (Replicate 0)	04/11/1993 14:00:00	0	
26	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000580 / 1 / 1 (Replicate 0)	06/10/1993 09:30:00	0.1	
27	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000564 / 1 / 1 (Replicate 0)	09/09/1993 10:15:00	0	
28	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000553 / 1 / 1 (Replicate 0)	13/08/1993 09:05:00	0	
29	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000226 / 1 / 1 (Replicate 0)	14/02/1992 12:00:00	0	
30	CIA Consulting WQ Monitoring	D C 500 @ BULLS ROAD	410115	000000219 / 1 / 1 (Replicate 0)	11/02/1992 12:00:00	0	

KiWQM Functionality

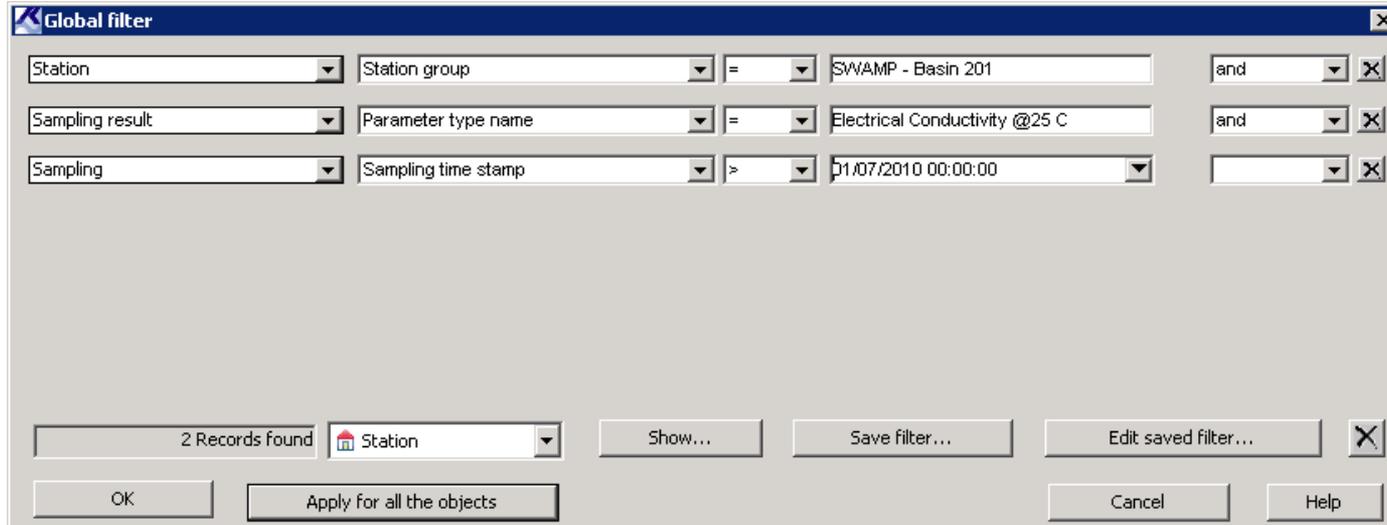
❖ Data Filtering

Simple and complex data filtering and querying



The screenshot shows a 'Global filter' dialog box with the following fields and controls:

- Station Long name:
- Station number:
- Measuring program name:
- Parameter type name:
- NSW GOVERNMENT Office of Water logo
- Extended filter:
- 22428 Records found
-



The screenshot shows a 'Global filter' dialog box with a complex query:

- Station Station group = SWAMP - Basin 201 and
- Sampling result Parameter type name = Electrical Conductivity @25 C and
- Sampling Sampling time stamp > 1/07/2010 00:00:00
- 2 Records found
-

KiWQM Functionality

❖ Comparison Lists

A list of sample parameter thresholds, standard or guideline values, e.g. the WHO drinking water guidelines

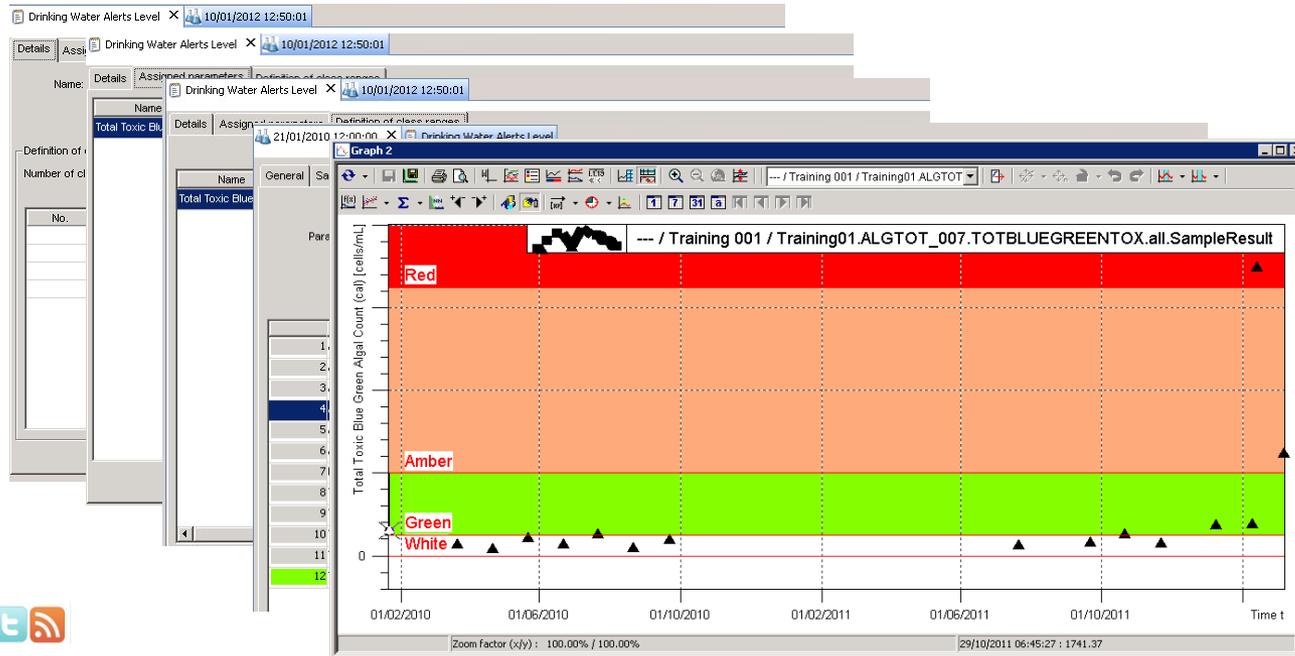
The screenshot displays the 'SWAMP Comparison List' configuration window. A red box highlights the 'Name' field, which contains 'SWAMP Comparison List'. Another red box highlights the 'Comparison list 1' dropdown menu, which is also set to 'SWAMP Comparison List'. A red arrow points from the 'Name' field to the 'Comparison list 1' dropdown. Below the configuration fields is a table with the following data:

Parameter type	Method	Sign	Value	Unit	Comparison value 1	Comparison value
1 EC25C / Electrical Conductivity @25 C	WCK - Determination of Conductivity	---	243.	µS/cm	100 (Min) < 243 < 1000 (Max)	---
2 Nitrogen - total / NitrogenTotal	WCK - Simultaneous Determination of	---	0.43	mg/L	0.1 (Max) < 0.43	---
3 Phosphorus - total / PhosphorusTotal	WCK - Simultaneous Determination of	---	0.067	mg/L	0 (Min) < 0.067 < 0.1 (Max)	---
4 Solids - total suspended @ 105 C / TSS105C	WCK - Total Suspended Solids at 105°	---	39.00	mg/L	---	---
5 Turbidity / Turb	WCK - Determination of Turbidity in W	---	28.00	NTU	---	---

KiWQM Functionality

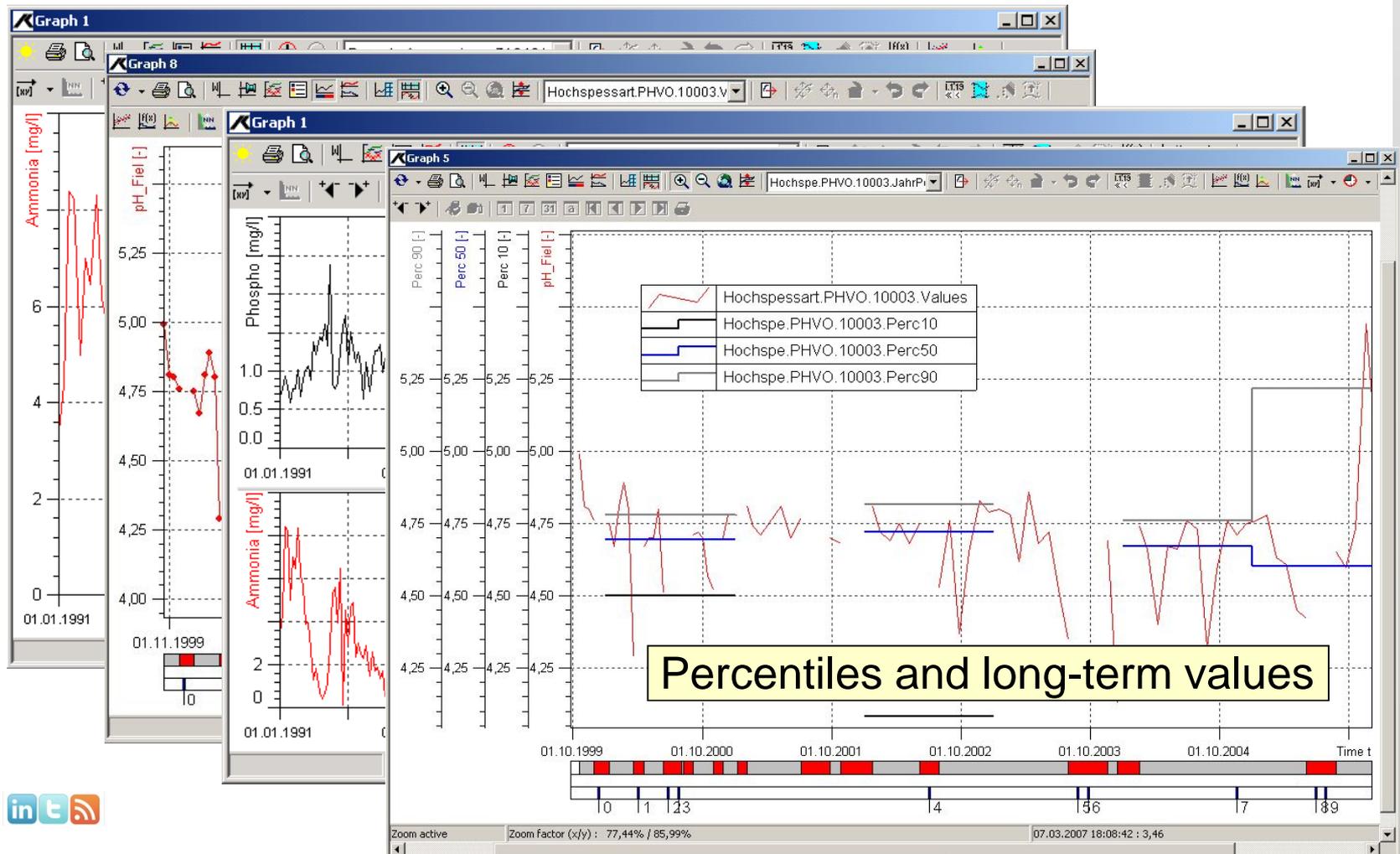
❖ Classification Systems

Can be created by defining a number of classes for a set of sampling parameter types, labels and colours for each class and limits per class for each parameter type. These classification systems can be applied to in tables, graphs, calculations, reports and maps



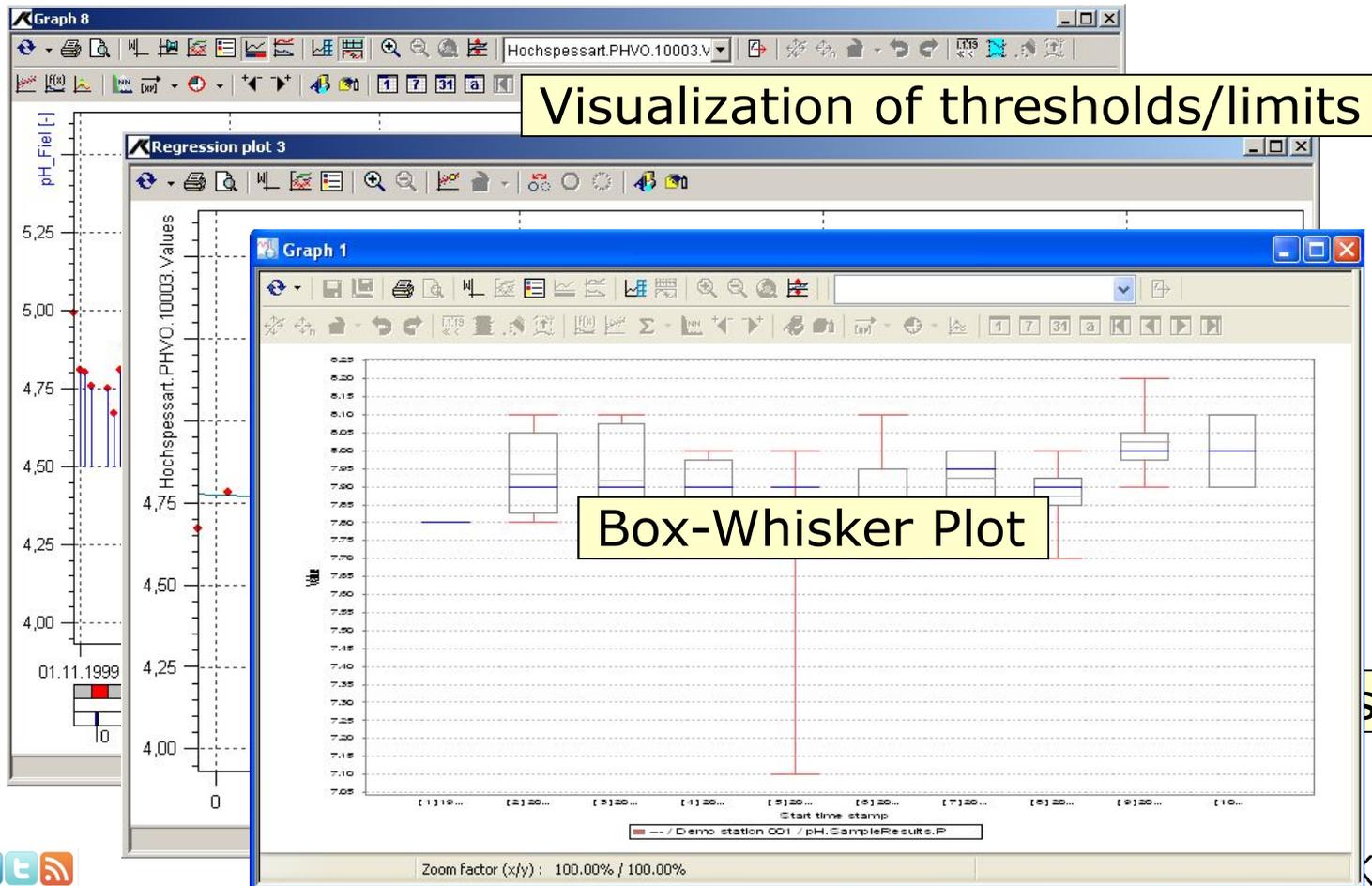
KIWQM Functionality

❖ Time Series representation



KiWQM Functionality

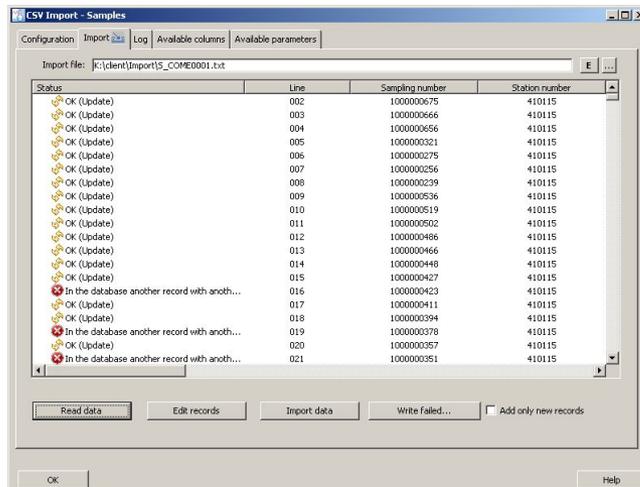
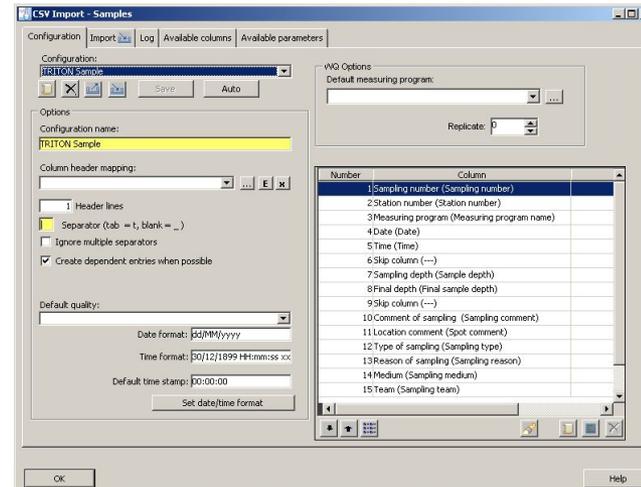
❖ Time Series representation



KiWQM Functionality

❖ Data Import

- The user configures such items as
 - column mappings
 - header lines
 - the column separator
 - a default date/time format
 - code mapping



- Configurations can be saved, reused
- Errors reported on screen
- Log files written

KiWQM Functionality

❖ Reports

- Flexible reporting framework
- Representation in EXCEL or Business Objects
- Can be custom built to meet client needs

Example : Custom Algae Alert Level Report designed for NSW Office of Water

	A	B	C	G	H	I	J	K	L	M
1				RACC station group					Report number: Test report Report date:07.07.2011	
2	Location	Site code	Date sample	Total Cyanobacteria biovolume (mm3/L)	Potential Toxic Cyanobacteria biovolume (mm3/L)	Recreational Alert Level	Drinking Water Alert Level	Livestock Alert Level	Dominant Potential Toxic Cyanobacteria present	Comment
3	Demo station 001	demo001	13.05.1999 12:00	---	---		Green		Planctonema/Cell count	
4	Demo station 001	demo001	26.05.1999 12:00	0.00500	0.00000		Amber		Chlamydomonas/Cell count	
5	Demo station 001	demo001	10.06.1999 12:00	0.00750	0.00000		Green		Elakatothrix/Cell count	
6	Demo station 001	demo001	24.06.1999 12:00	---	---		Green		Elakatothrix/Cell count	
7										

KiWQM Functionality

❖ Data Validation

- Data change history
- Data import history

The screenshot displays two overlapping windows from the KiWQM software. The background window is titled 'Sampling 10240-0001 / 1 / 1' and contains several tabs: 'General', 'Sample fractions', 'Sample values', 'Assigned documents', 'Additional attributes', and 'Specific sample properties'. The 'General' tab is active, showing fields for 'Number' (10240-0001), 'Measuring program' (Demo project), 'Time stamp' (05/06/1997 12:48:00 PM), 'Station' (Demo station 001), 'Reason', 'Medium', 'Sampling type', 'Team', and 'Remark'. The foreground window is titled 'History' and contains a table with the following data:

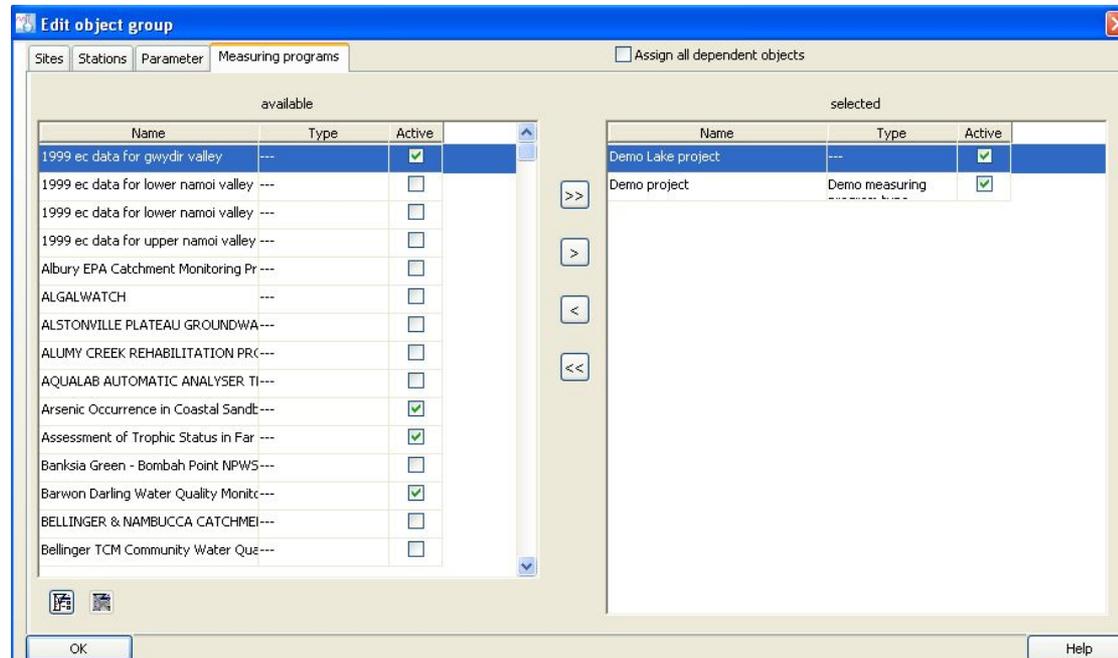
Time stamp	Action	Object	User	Column
1/28/2011 00:40:23	added	Sample production result (Sample 10240-0001)	admin	Parameter, Value, Value, Sign
1/28/2011 00:28:38	added	Sample production result (Sample 10240-0001)	admin	Parameter, Value, Value, Sign
1/28/2010 21:25:30	added	Sample production result (Sample 10240-0001)	admin	Parameter, Value, Value, Sign

Below the table, the 'History' window has fields for 'Old value', 'New value' (Parameter: Weather during sampling Value: 206 Value: 0 Sign: ---), and 'Remark'. Both windows have 'OK', 'Cancel', and 'Help' buttons at the bottom.

KiWQM Functionality

❖ User Administration

- Defining user roles and rights
- Restricted access by data type
- Restricted access by functionality



Benefits for NOW

- ❖ KiWQM has been well received
- ❖ Easy to use, modern and intuitive interface
- ❖ Flexible data mining functions
- ❖ Powerful data analysis tools – reducing the need to export data into other packages
- ❖ Automated data import and export = saves time
- ❖ Flexible custom configuration that can be performed by client = reduce costs
- ❖ Better data validation = better data quality
- ❖ Customized report generation = saves time
- ❖ GIS coupling = increased methods of data communication

Future Directions

- ❖ Algae configuration data setup
- ❖ Algae historic data load
- ❖ Increased functionality
 - Data rollback
 - Sample scheduling
 - Bulk quality coding
- ❖ New biological requirements with :
 - full taxonomic tree
 - ecological parameters
 - new site objects as transects and polygons.
- ❖ Implementation of the Alarm Manager
- ❖ Full integration with Hydstra/TS
- ❖ Web data publishing through Hydstra/Web



Any questions?

Thank you for your attention

Vicky Isaac