SCADA SYSTEM AT GOULBURN VALLEY WATER

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ABSTRACT

Goulburn Valley Water is the authority responsible for servicing the water and sewerage treatment needs of 48 townships in the north eastern region of the state. This requires the operation and maintenance of some assets which are in remote locations and require daily surveillance due to lack of automation.

Managing the operations and maintenance of a typical Water Supply System is not an easy task considering the constraints of public accountability, water industry regulations and environmental issues to name a few. The advancement in computer technology and telemetry systems has enabled the supervisory, control, and data acquisition (SCADA) process to be used as a powerful tool for water industry operation and management.

Telemetry systems have traditionally been used to provide a 'control connection' between remote locations, provide access and control to such locations, and to provide various levels of automation. This paper discusses the justification, development and implementation of a SCADA telemetry system for Goulburn Valley Water.

KEYWORDS

SCADA, Justification, Scope, Development , Tenders, Control, Implementation

1.0 INTRODUCTION

In 1994, the Goulburn Valley Region Water Authority was formed from the merger of several authorities such as Shepparton Regional Water Authority, Rodney Water Board, Euroa-Nagambie Water Authority, Shires of Cobram and Numurkah etc. to name a few.

Cobram was the only township which had a complete Supervisory Control and Data Acquisition (SCADA) radio telemetry system at the time of the formation of the Authority. Although the Cobram network was fairly primitive regarding remote control access, it had identified a potential for improvement to customer service response, access to key information and general operational cost saving benefit.

The Cobram system had been operational for some 18 months at the time of the merger, which allowed the authority to identify with key benefits a regional SCADA system could provide. The SCADA Telemetry Project was identified in the 1994/95 Business Plan and prior to its implementation was subjected to an Economic Evaluation and Justification. This report was completed in June 1995 and demonstrated that the project would affectively pay for itself in a period of approximately 4 Years.

2.0 DISCUSSION

2.1 Justification

A justification report, based on economic benefit, remote locations, outdated or non existent alarming, identified a need for the development and implementation of Radio based SCADA Telemetry System. Main issues for Management to consider prior to approval of the Telemetry Project were:-

- Most of the former authorities had alarm systems for their sewerage pumping stations and water treatment plants which varied from red lights on top of switchboards to alarm diallers.

- Some authorities, prior to merger with Goulburn Valley Water, saw the need for the installation of on site data loggers. The data loggers required weekly visits to down load from the facility to a database. The databases were frequently non user friendly and the information was seldom used because of this.

- An additional critical issue being a lack of expertise in managing the systems saw that planning issues were simply not being addressed and poor system decisions were being made.

- The staff who had responsibility of managing their systems were frequently unaware of any problem existing at a site until the customer complained about a service difficulty. Also, the implementation and optimisation of expenditure to get the most from the capital intensive sewage and water systems was not occurring.

- Consideration to day to day operational issues by utilising additional technology for remote control access to assets, to the various levels of automation of treatment plants, and to the utilisation of tariff energy control for the day to day operation of assets.

2.2 Project Approval

Approval of the Goulburn Valley Region Water Authority SCADA Telemetry System Project was adopted in July 1995. This was based on a detailed review of options and associated benefits as were identified in the Economic Evaluation and Justification for this major project.

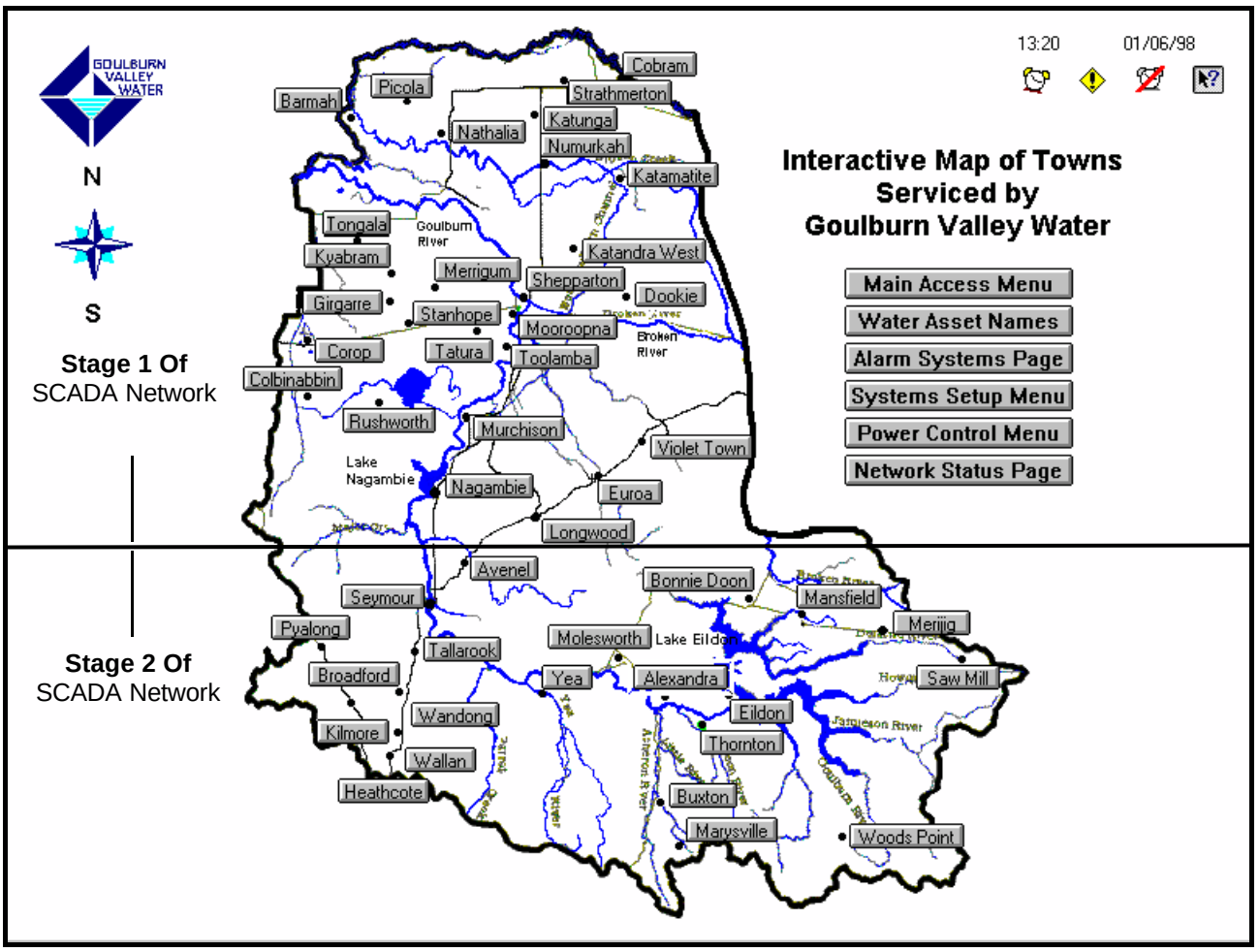
2.3 SCADA Telemetry System Scope

- In 1995, Goulburn Valley Water was responsible for the management of water and wastewater assets in 30 towns, having the city of Shepparton as its base for administrative and corporate services. Therefore, due to considerable corporate infrastructure already being in place, it became a logical point where expansion to the computer network could be arranged so that all telemetry 'top end' equipment would be centrally located for maximum strategic and economic benefit.

- It was proposed that the telemetry system should initially cater for some 178 sites, and having spare capacity so that up to 250 out stations could be interfaced. A site priority rating was adopted so that all water systems and sewerage pumping stations would be connected in the primary phase.

- The regional boundary of Goulburn Valley Water, following a voluntary merger with Mid Goulburn Water Authority in 1997, is shown in Figure 1. Telemetry provision will be extended to areas attached resulting in the merger in stage 2 of the telemetry project.

Figure 1: ***Regional Map of Goulburn Valley Water***



2.4 Project Development

Due to its scope and complexity, the development of the telemetry project was identified as being in need of combined input from consultancy and Goulburn Valley Water. A well coordinated approach was required having specific input from both of the above prior to the tendering phase. Actions which were undertaken include:

- appointment of consultant for technical input and advice concerning, selection of the most cost effective telemetry communications medium, technical administration of pending contract, and for definition of authority input requirement having regard to resources available.

- advertising for expression of interest for the project. It was proposed that the tender process would be limited to four best qualified companies following consultant evaluation and recommendation. The evaluation process was based on factors which include, prior experience with large projects, company status and the provision of telemetry engineering expertise.

- appointment of a co-ordinator for telemetry systems whose principle role was to establish a full time authority base for project inquiries and other relevant duties.

- the undertaking of a preliminary radio path analysis from authority assets to elevated structures, which were either owned by the authority or a co-tenancy arrangement existed. The purpose of the analysis was to provide a basic system profile of where key infrastructure

sites, such as radio repeater base stations could be located.

- the detailed audit of all assets including locality plans of towns, schematic arrangement of systems, specific site details of components for monitoring and control requirement.

2.5 Tendering Process

Following the evaluation of expressions of interest, four successful companies were invited to submit a formal tender for the supply, installation and commissioning of specified works for the telemetry project.

In accordance with the tender process, each participant was required to be represented at a group inspection of a diverse array of authority sites. The purpose being to provide each company with the opportunity to identify with the degree of difficulty associated with the integration of telemetry equipment with existing corporate hardware, installation of field equipment, and appraisal of typical authority assets where remote equipment required for re-transmission could be located.

A further requirement by each company was to make a presentation outlining the methodology proposed for the project inclusive of arrangement of system hierarchy, samples of equipment intended for use that was either manufactured by the company or was externally acquired, the use of system software and associated configuration, and a demonstration of typical monitoring and control philosophy proposed.

2.6 Telemetry Contracts

The principle telemetry contract was let in December, 1996. Arrangement of contracts were clearly defined as being either telemetry contractor or Goulburn Valley Water responsibility. The placement of a marshalling strip at each site made provision for a contractual interface for the SCADA system and an electrical interface for plant indicator and control circuits and the SCADA system.

The principle telemetry contract made provision for:

- the undertaking of a detailed radio path analysis and provision of system design concept and data flow structure

- the supply and installation of file servers hardware and system software inclusive of configuration of graphics screens and communications software

- the supply and installation of field hardware items including provision of all terminations to a marshalling strip.

- the supply and configuration of reports generation module and value added software which included flow determination and power control functions

- the supply and configuration of pager alarming hardware and software which was compatible with existing paging devices.

Goulburn Valley Water's share of responsibility was:

- the undertaking of a detailed audit of all sites including that of control voltages, site instrumentation and the provision of detailed Input / Output schedules.

- the supply and installation of electrical components, plant indicator and control circuits,

inclusive of any upgrades required to be terminated to the marshalling strip

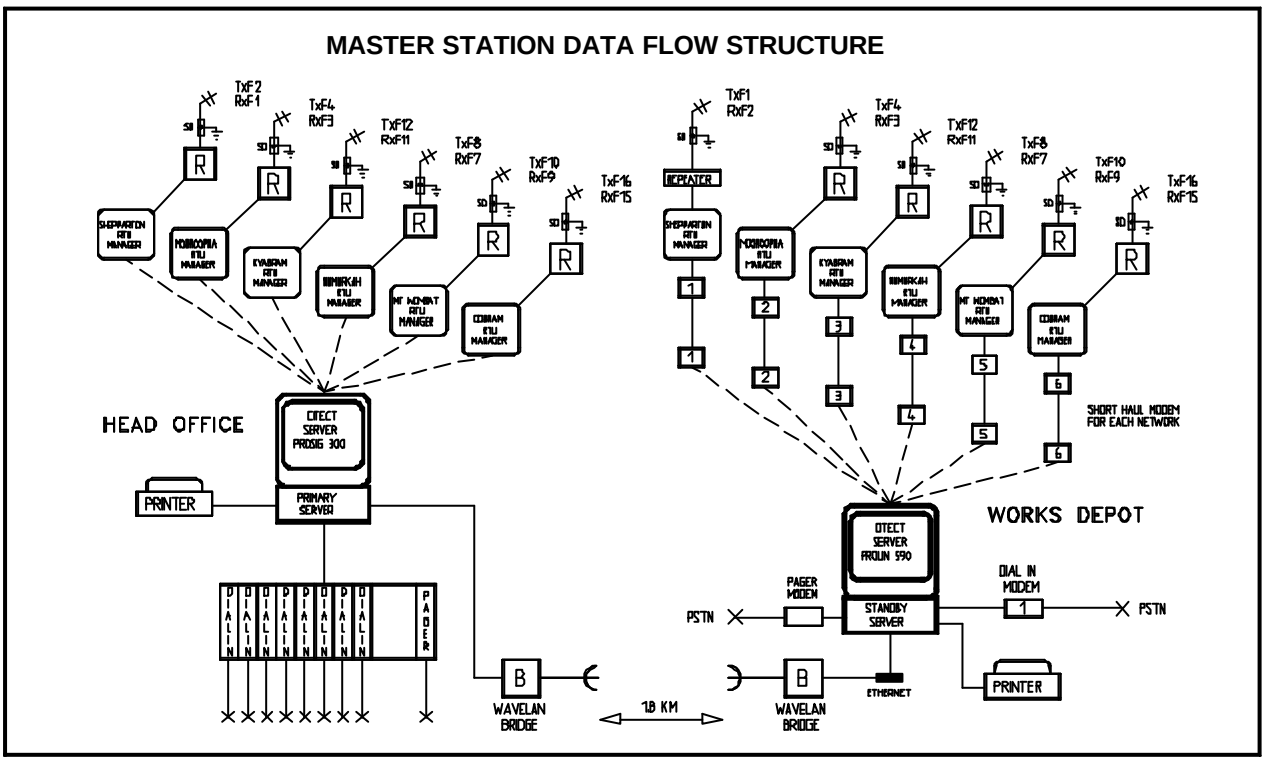
- the supply of detailed system schematics which were to be transformed to be representative of respective graphics screens of systems
- the supply of detailed instrument scaling parameters for totalising and alarming purposes
- the supply of digital (CaDD) mapping of authority towns for use with the geographical access menu hierarchy requirement

2.7 Master Station Data Flow Structure

In accordance with design submission requirement by the telemetry contractor, a master station data flow proposal was submitted which was subsequently approved by the consultants. Overview of network arrangement and data flow is described below.

Radio signals from each regional repeater are received by two sites, each with six Remote Telemetry Unit Managers (RTUM's) and one server running the GVW CITECT project.

Figure 2: ***The Master Station Data Flow Structure***



All signals from remote sites use the MODBUS protocol and a baud rate of 9600. Connection to both Telecom Pager Ports use 2400 baud and the dial in modem connection on the Standby Server uses 18200 baud.

The RTUM's behaviour is entirely defined by their operating system. Their main function is to act as a switch board passing information to and from remote sites and CITECT.

2.8 Water Supply Systems - Control

Water Supply Systems that have been connected to the SCADA Telemetry network are basically arranged in three levels of site automation.

- full automation with PLC control, local PC interface and GVW SCADA interface
- part automation with PLC control and GVW SCADA interface
- relay logic control and GVW SCADA interface

Accordingly, a monitoring and control strategy had to be identified which would cater for a diverse range of Water Treatment Plants. Consideration to Radio Transmission Traffic saturation through the respective repeater base was a major factor with particular emphasis being required at fully automated plants, at which substantial data exchange is typically managed by the local PLC. Therefore, a monitoring and control strategy was arranged to make provisions which include:

- at fully automated plants, where a local PLC and an operator interface existed, approximately 20 percent of critical plant information was interfaced to the GVW SCADA System. Typical arrangement thereby being 'common faults only' from individual components, access to plant for common plant start up and stop and access to plant backwash system. Key set points (inflow, dose rates etc.) are confined to local plant intelligence at operator interface.

  With this application the SCADA interface is achieved via a modbus serial link communications port with the local PLC. A re-mapped Input / Output schedule is arranged to provide remote SCADA access.

- at semi automated plants, where a local PLC manages only a portion of plant operation and relay logic also exists a more complex interface was used. Typically such installations required a combination of PLC common output and the installation of a marshalling strip where other plant signals and control outputs were required to provide a SCADA interface. This type of application required the installation of two telemetry processors; one for the communication with the local PLC and the main telemetry unit, and the other to provide a SCADA interface for PLC generated and relay logic operated sections of the plant. In essence such sites have two telemetry addresses and are commonly described as RTUa and RTUb , the latter being the PLC interface. Typical arrangement thereby being 'common faults only' from individual components, which are managed by the PLC, access to plant for common plant start up and stop and access to plant backwash system. Key set points (inflow, dose rates etc.) are confined to local plant arrangement.

- at relay logic operated treatment plants, which are predominantly of smaller size, all plant signals and control outputs were interfaced to the marshalling strip. A single Telemetry Processor was used and depending on I/O count etc., expansion modules were placed to provide sufficient capacity. Typical arrangement thereby being 'common faults only' from individual components. The common faults with this type of installation were 'grouped' prior to connection to the marshalling strip. SCADA access to plant includes, common plant start up and stop and access to plant backwash system. Key set points (inflow, dose rates etc.) are confined to local plant, which is normally undertaken by operator input.

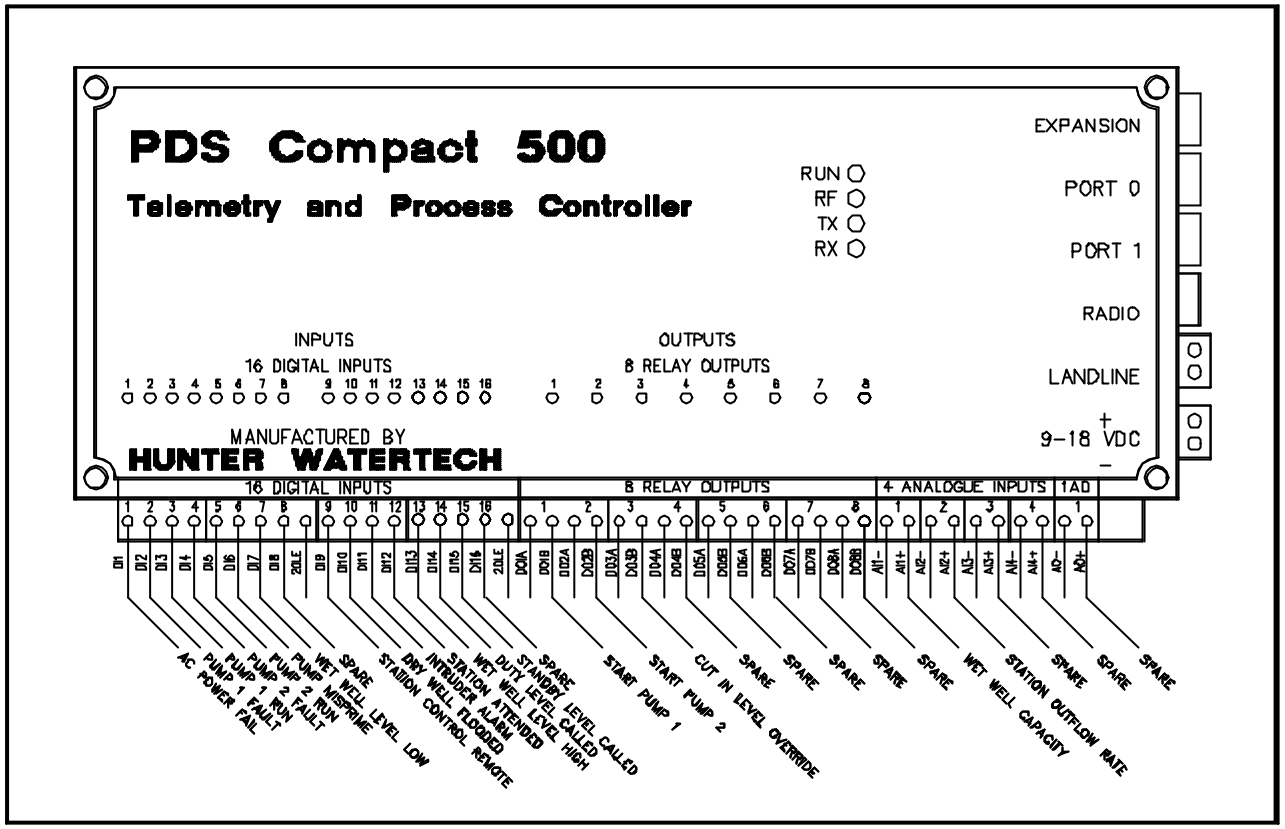
2.9 Global Approach - Sewerage Pump Stations

The telemetry contractors offer was based on a global approach to the monitoring and control strategy of sewerage pumping stations in general. This offer made provision for the use of a telemetry processor which had sufficient capacity to cater for all but four of the authority's sewerage pumping stations configuration.

The authority's site audit had identified that some 165 sewerage pump stations selected for telemetry installation were either of a twin pump station configuration or single pump unit type. The audit further identified that variable control circuit voltages, ranging from 24v AC to 240v AC existed at sites which were scattered in regional areas of the authority. Therefore, a monitoring and control strategy had to be adopted to provide a uniform interface environment for all such sites.

The result of various upgrades concerning control circuit arrangement and other associated electrical site works allowed the monitoring and control strategy to be standardised so that a PDS Compact 500 telemetry processor unit and configuration software could be used for all sewerage pump station applications. Obvious benefits of this arrangement include the range of spares required to be readily available, and the RTU software configuration development for monitoring and control purposes.

Figure 3: *Telemetry Processor For Sewerage Pump Stations*



2.10 Sewerage Pump Stations Control

A standard monitoring and control philosophy was adopted at all pump stations. Each station is fitted with a local duty / remote duty selector switch. The appropriate station control mode is selected by the user, as required. This arrangement was placed to provide flexibility for existing local control operation during the installation of telemetry equipment, for site control management during routine or break down works, and for the short term security for station operation in the event of failure with telemetry control.

In the local control mode the site hardware provides the necessary control functions for operation of the station. The telemetry unit provides monitoring and data acquisition.

In the remote control mode the site hardware provides the necessary information for the telemetry processor to control the operation of the station in addition to the monitoring and data acquisition from the site. Telemetry control features at pump stations include:

- remote access to station control, alarming inhibit control, pump duty selection, site operation inhibit, station operating parameter and alarming set points
- full utilisation of energy saving which is controlled by a user entry set point for 'calling' of the station at a predetermined time offset to empty the well prior to a power supply tariff change. Time off set selection is separately available at each site.

- automatic detection by telemetry processor of local hardware arrangement for well level control. Major pump stations are typically arranged with analogue control, whilst smaller stations and single pump systems are of the digital input type. The analogue control, which provides a 0 - 100% well capacity indication is the preferred type because it allows the user to select variable station control points.

- built in protection which prevents the operation of any unit for a period of 3 minutes following the last run of such unit, or the station standby. The inclusion of this suppression provides better protection to rising mains, and prevents pumps from excessive intermittent starting.

2.11 SCADA Implementation

The basic arrangement of the SCADA network made provision for various options concerning the implementation of the system for operational use.

A detailed report of options available identified key issues concerning the most cost effective solution for the management of water supply and sewerage assets with the SCADA monitoring and control facility.

Among options which required to be examined include:

- the placement of responsibility to regional areas, which typically had remote dial in access to the SCADA System and dedicated pager alarming availability

- the operation of a control centre for 8 hours a day and having regional input for after hours monitoring and control

- the operation of a 24 hours a day control centre for response to all customer service difficulties including those which were not monitored by the SCADA System.

The 24 hours a day control centre option was placed into service on July 1st, 1998

3.0 CONCLUSION

This paper provides an explanation of the concept and processes involved in the development and implementation of a SCADA Telemetry System. The Authority hopes that this project will demonstrate that a technical approach to the management of its assets will provide a powerful tool for the authority which will assist with the achievement specific targets and objectives along with a more secure service delivery continuity to its customers.