Tasmania
DEPARTMENT of INFRASTRUCTURE, ENERGY and RESOURCES

Mineral Resources Tasmania
Tasmanian Geological Survey
Record 2005/01

MRT statewide groundwater monitoring network: Data collection — September 2004

by A. R. Ezzy and M. Latinovic

Contents

Appendices

A CD-ROM containing all MRT groundwater time series processed data, as at October 2004, is available on request.

Definitions

Dataflow data logger — Device installed in boreholes in 1995 to record pressure and temperature measurements that can be used to calculate the standing water level in the borehole over time.

Odyssey data recorder — Device installed in boreholes in 2003 to record pressure and temperature measurements that can be used to calculate the standing water level in the borehole over time.

REV (representative elementary volume) — Volume of water to be removed from a borehole before a sample is collected for laboratory chemical analysis.

SWL (standing water level) — The height of the water table in the borehole with respect to the site-specific ground level at the base of the borehole collar.

Executive summary

Decommissioning of the *Dataflow* standing water level (SWL) recording system is 95% complete. One hundred percent data capture was achieved from the *Odyssey* SWL system. Hydrographs and temperature plots generated from the *Odyssey* data illustrate a major warm summer recharge event followed by prolonged cooler winter recharge. Manually-recorded SWL data indicated that during 2004, Tasmania experienced one of the highest periods of winter recharge recorded since 1991. A variable pattern of recharge intensity was also identified for different geographical regions.

Additional *Odyssey* data recorders will be required to test updated software and replace any malfunctioning units during the March 2005 monitoring round. Data collection procedures require further refinement. It is recommended that a hand-held computer be considered for the downloading of the *Odyssey* data and collection of field metadata.

Conclusions in this report are based on incomplete data without reference to rainfall and stream flow data which are currently unavailable to MRT. Adequate management of water resources would require further investigation of groundwater and surface water interactions.

Introduction

The purpose of this report series is to provide a six-monthly summary of the groundwater monitoring network after bi-annual field data capture. These reports will be distributed to stakeholders. The focus of this report is on describing SWL values and their significance. Because of the time delay in analysing water chemistry, these results will be reviewed on a less frequent basis. As this is the first report of a series, any comments on content and style are welcomed.

Data were captured from the statewide, NHT salinity and Devonport networks during September 2004. A more detailed outline of the types of data captured during each monitoring round is provided in Ezzy (2004). Recharge intensity, demonstrated by SWL and temperature data, indicates that hydraulic conditions vary between aquifer types in the northwest, central north, northeast, east coast and southeast of Tasmania. Stream flow and rainfall data are required to further develop a qualitative interpretation of the variability in regional groundwater recharge patterns.

Groundwater quality sampling

During the September 2004 monitoring round, the Representative Elementary Volume (REV) groundwater sampling procedure was applied where flow rates were sufficient. Boreholes with low flow rates were sampled as close as possible to the recommended REV.

Water samples collected during the September 2004 monitoring round have been submitted to the MRT laboratory for analysis; results are pending. Appendix 1 contains the laboratory results for the March 2004 monitoring round.

Manual SWL readings

Manually-recorded SWL data indicated one of the highest degrees of winter recharge across the monitored areas of Tasmania since 1991. September 2004 manual SWL readings occur in the top 5% to 10% for most monitored sites. Appendix 2 contains updated manual SWL graphs.

Automatic pressure and temperature data

Dataflow system

All *Dataflow* units, expect for Winnaleah and nine installed in NHT salinity boreholes, were decommissioned during September 2004. Because of the higher quality of *Odyssey* data, only four *Dataflow* units (Cressy, Pawleena Road, Port Arthur and Ross) were field calibrated at the time of decommissioning. Hagley, Togari, Barrington, Mooreville Road, Chudleigh, Waterhouse, Melton Mowbray, Jetsonville, Branxholm, Little Swanport, Bicheno and St Marys were all decommissioned and not calibrated. All unserviceable and still operational units were identified and appropriately labelled. The latest six months of raw unprocessed *Dataflow* data has been transferred onto the MRT server.

Odyssey system

All data for the last six months were captured from the *Odyssey* system. The ability to generate hydrographs from the software in the field proved useful for quality assurance checking of the hardware and data integrity. Battery voltages imply that most batteries will require replacement during the March 2005 monitoring round.

Hydrographs generated from the *Odyssey* data illustrate a major warm summer recharge event in the last week of January 2004 in the central north, northeast, east coast and southeast of Tasmania. Equilibrium of the groundwater systems appears to have taken between two to three weeks, depending on the localised system.

Prolonged cooler winter recharge started with statewide rainfall events in the second week of June, ending with a warming effect and decline in recharge during the second week of August. Because of the intensity and magnitude of the winter recharge events, equilibrium still had not occurred for most boreholes

during the September 2004 monitoring round. This style of groundwater winter recharge was noted during the last monitoring round.

Some hydrographs demonstrate the effect of sampling on the equilibrium of the boreholes within the local groundwater system. After sampling the Osmaston and Ross boreholes, groundwater temperature briefly increased by 20°C. A short-term effect of increased groundwater temperature also occurred after sampling the Montagu, Lilydale, Melton Mowbray and Buckland boreholes. Some boreholes may take days (South Forest, Osmaston, Lilydale, Pipers River, Ross, Melton Mowbray, Tunnack, Bicheno, Port Arthur) or weeks (Cressy) to recover after sampling. In the future, these data may be used for pump test calculations. The Calder borehole only had 50% SWL recovery after sampling.

Some hydrographs have misleading straight lines in late March, where no data was collected due to an initial high recording frequency resulting in the exhaustion of memory in the *Odyssey* hardware. Appendix 3 contains the temperature and hydrographs of the *Odyssey* data recorded since commissioning in December 2003. A CD-ROM, containing all groundwater time series processed data as at October 2004, is available on request from MRT.

Interpretation of regional and individual borehole time series and manual SWL/temperature data

The following is a summary of the regional main events and individual status of the monitored aquifers.

Northwest Region summary

Monitored aquifers in the northwest region were recharged during the winter season of 2004. While time series data were not collected for the Burnie Tip 1 monitoring borehole, the hole was artesian during both the 2004 monitoring rounds. Manual SWL data implies that some aquifers have completed a recharge cycle and reached equilibrium, while other aquifers appear stressed due to over-extraction from local boreholes. The Montagu data suggest that unsustainable groundwater extraction rates from local groundwater systems in this region may result in the long-term depletion of groundwater resources.

Trowutta — Feature ID 16530

A borehole approximately 100 m to the south is currently in use (Feature ID 709). The drilling record for Feature ID 709 indicates that it is extracting water from the upper two aquifer levels (total depth 18.3 m). The monitoring borehole was drilled through five aquifer levels (14 to 16, 26, 45, 56 and 67 m).

Before the March 2004 monitoring round, hardware failure occurred in the *Odyssey* data recorder installed in this borehole. The data recorder was repaired by the supplier and then re-installed during the September 2004 monitoring round. No hydrograph is presented for this borehole.

Togari — Feature ID 16531

Feature ID 16619 is currently not in use and was drilled 100 m to the east of the monitoring borehole in 1998. An irrigation extraction borehole with no known drilling report is located 50 m to the south. The irrigation borehole is pumped seasonally as required by the property owner.

The hydrograph for the monitoring borehole (page 33) indicates local groundwater extraction events took place between December 2003 and April 2004. *Odyssey* data collected between April 2004 and September 2004 appear to show the natural recharge of the local aquifer. Long-term manual SWL readings imply that the aquifer completed a recovery cycle during the winter of 2004.

Montagu — Feature ID 16532

Drilling reports exist for seven other boreholes drilled within one kilometre of the monitoring borehole (Feature IDs 279, 289, 308, 339, 344, 360 and 552). Four local aquifer levels are indicated by these drilling reports, at 2 to 6, 12 to 15, 22 and 31 metres. The drilling report for the monitoring borehole indicates that it was drilled through the first, third and fourth aquifer levels. None of the other seven boreholes appears to have been drilled into the fourth aquifer. An irrigation extraction borehole with no known drilling report was drilled 30 m to the northeast of the monitoring borehole in 2000. The irrigation borehole is set to a daily pumping cycle and is in use all year.

The effect of pumping from the irrigation borehole is clearly shown as daily drawdown and recovery on the hydrograph (page 34). A winter recharge trend overprints the signature of daily pumping in the hydrograph. Individual winter recharge events can be identified from the groundwater temperature graph. SWL values have not risen above 4.5 m since March 2003, even with the considerable large regional recharge events of winter 2004. This suggests that the current extraction rate of groundwater from the local aquifer levels is unsustainable.

South Forest — Feature ID 16527

Drilling reports exist for ten other boreholes drilled within one kilometre of the monitoring borehole (Feature IDs 277, 278, 365, 412, 429, 465, 614, 4371, 4385 and 4421). No current use information is known about these boreholes. The drilling reports indicate three main aquifer levels at 7 to 12, 20 to 24 and 38 metres.

The rapid drawdown on the hydrograph (page 35) to 15 m in March 2004 was caused by the sampling event. A steady decline in SWL occurred during the summer and autumn months (possibly due to local groundwater extraction). This was followed by a rapid rise in SWL during mid June and then prolonged high SWL during winter, with a steady sharp decline in SWL starting in mid-August 2004. SWL data indicate

that the local groundwater system was still not at equilibrium during early September 2004. At least two major recharge events (possibly four) can be seen in the graphs of temperature data for the winter months. Time series and manual SWL data indicate that this aquifer has an annual recovery cycle.

Calder — Feature ID 16533

No drilling reports exist for any boreholes within one kilometre of the monitoring borehole. The drilling report for the monitoring borehole indicates aquifer levels at 12 and 47 metres.

The drawdown from 17 to 25 m in March 2004 was caused by the sampling event. After the sampling event, the hydrograph (page 36) shows a very slow recovery over three months. This recovery phase also appears to be overprinted by recharge events associated with winter rainfall. The hydrograph indicates equilibrium within the groundwater system had occurred by July 2004. Time series data and manual SWL readings imply this aquifer has a long-term rising water table connected to the deeper aquifer (47 m) and recharged by the upper aquifer (12 m).

Mooreville Road — Feature ID 16535

Basalt and metasedimentary rocks host fractured aquifers within one kilometre of the monitoring borehole. According to drilling reports, the local basalt aquifer occurs between 27 and 33 m (Feature IDs 4475 and 4539). Drilling reports also indicate that up to four aquifer levels exist in the metasedimentary rocks at 7, 14 to 18, 27, and 40 to 48 metres (Feature IDs 4547, 14959 and 16535). At the time of drilling the monitoring borehole intercepted the lower two aquifer levels. Feature ID 14959 is located approximately 150 m to the southeast of the monitoring borehole and was drilled to the depth of the fourth aquifer level. Current use of this borehole is unknown.

The smooth nature of the hydrograph (page 37) suggests that the lower aquifer levels are monitored at this site. Winter recharge began in June (with a sharp rise in the water table) and then the water table remained elevated for three months. A slight drop in temperature occurred at the same time as the highest peaks in the hydrograph.

Hampshire — Feature ID 16534

Two boreholes (Feature IDs 16995 and 17008) are located to the north within one kilometre of the monitoring borehole. These two boreholes were drilled in the local basalt aquifer to the first aquifer level, between 20 to 25 metres. The monitoring borehole was drilled through the first aquifer level to a second aquifer level at 40 metres. The annual extraction volume for the two boreholes to the north is unknown.

The hydrograph and temperature graph (page 38) show a warm recharge event in the last week of January 2004, followed by three months of colder winter recharge. Individual winter recharge events are clearly seen on both graphs. This would imply that the local basalt aquifer has a good hydraulic connection to rainfall and related infiltration. More data are required to determine the recovery cycle of this aquifer.

Central North Region summary

The various aquifers currently monitored in this region all experienced good winter recharge events. Some have completed a recovery cycle, while others still show signs of depletion of groundwater resources. A major recharge event occurred in the last week of January 2004, which has assisted aquifers to complete a recovery cycle during the following winter. The Spreyton monitoring borehole, which is not monitored for SWL, provided an artesian flow from the pressure cap during both 2004 monitoring rounds.

Barrington — Feature ID 16536

There are sixteen drilling reports of boreholes drilled in this basalt aquifer within 500 m of the monitoring borehole (Feature IDs 1770, 1868, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 4334, 15047, 17714, 17715, 17126 and 17178). Four aquifer levels were intersected by the drilling at 10 to 15, 21, 30 to 35 and 42 to 45 metres. Current pumping rates are unknown for all 16 boreholes.

The hydrograph for this site (page 39) shows the warm summer recharge event in the last week of January 2004 and three months of colder winter recharge. Individual winter recharge events are also clearly seen in the temperature graph. Long-term manual SWL data indicate that this aquifer is being depleted by one metre approximately every seven years. The unregulated use from the high concentration of boreholes in the local area is stressing the aquifer and may result in a progressive lowering of yields from the local boreholes.

Beulah — Feature ID 4290

This borehole was added to the monitoring network in 2003 after the old Beulah monitoring bore was destroyed by forestry operations. No drilling reports exist for a one kilometre area around this monitoring borehole. Aquifer levels were not recorded at the time of drilling.

Odyssey data for this monitoring borehole still require processing due to corruption of the header file. The *Odyssey* header file was corrected during the September 2004 monitoring round.

Chudleigh — Feature ID 16538

Drilling reports indicate that six boreholes have been drilled in the local area (Feature IDs 2282, 2283, 2284 2285, 2286, 17770). The location accuracy of these drilling sites is greater than one kilometre. A seventh hole (Feature ID 17196) with an unknown location was drilled on the same property to a similar depth ten years before the monitoring borehole. No information

on aquifer levels is recorded in any of the drilling reports, including the monitoring borehole.

Warm recharge in the last week of January 2004 is clearly seen in the temperature graph and the hydrograph (page 40). The system then returned to equilibrium, until the SWL rose by seven metres in June 2004. The first two weeks of the June recharge were warm, followed a 2°C drop in temperature as the cooler winter recharge continued. The remaining winter recharge events show a slight decline in temperature with the corresponding peaks in SWL. Up to eight recharge events occurred during the 2004 winter months. With reference to the long-term manual SWL data, processed *Dataflow* data and the recent *Odyssey* data, this aquifer appears to have a good hydraulic connection with the local hydrological system and currently is not under stress.

Osmaston — Feature ID 16539

Drilling reports indicate that two boreholes (Feature IDs 2339 and 2342) were drilled into the same Permian aquifer within 500 m to the east of the monitoring borehole. At the time of drilling both these boreholes were reported as operating. Three aquifer levels at 16, 22 and 30 m were intercepted by the two boreholes. The drilling report for the monitoring borehole only recorded an aquifer level at 52 metres.

The smooth nature of the temperature graph and hydrograph (page 41) implies that the fourth aquifer level is currently monitored. The inverse spike in the hydrograph and corresponding spike in the temperature graph represent the March 2004 sampling event. Long-term SWL data imply that this aquifer has a three to four-year recovery cycle and that the local groundwater resource is currently not being over-extracted.

Hagley — Feature ID 16540

Fifteen drilling reports exist for boreholes within one kilometre of the monitoring borehole (Feature IDs 2367, 2369, 2478, 2479, 2494, 2366, 2493, 2477, 2441, 15128, 17682, 18179, 18189, 18190, and 18191). Four main aquifer levels have been intercepted at 6 to 15, 20 to 27, 60 and 64 metres. The monitoring borehole was drilled through the first two aquifer levels. The extraction rate of groundwater from all local boreholes is unknown.

The 'noise' in the hydrograph (page 42) most likely represents pumping events from the local boreholes. The late January recharge and the winter recharge events are both overprinted by 'noise'. Long-term manual SWL data imply that this aquifer has a seven-year recovery cycle, which was completed during the 2004 winter recharge.

Cressy — Feature ID 16541

Three boreholes have been drilled to over 100 m depth within 500 m of the monitoring borehole (Feature IDs 3811, 3816 and 3817). Only one aquifer level, at 64 m, was recorded in the drilling reports. The monitoring borehole was drilled to 102 m but the depth of intercepted aquifer levels is not recorded in the drilling report. The local groundwater is saline and therefore may not be used by the general public.

The March 2004 sampling event can be seen in the temperature graph and hydrograph (page 43). Winter recharge events only resulted in a rise of 0.2 m of the SWL. This monitoring borehole is located in a large regional groundwater flow system. The time period since monitoring started is considered to be too short to determine an aquifer recovery cycle. Longer term monitoring SWL data is still required.

Lilydale — Feature ID 16542

Two boreholes have been drilled within 300 m of the monitoring borehole (Feature IDs 16174 and 16175). Drilling reports indicate three aquifer levels at 10, 15 and 32 metres. The monitoring borehole intercepted the second aquifer level at the time of drilling. Current use of the two close boreholes is unknown.

A major late January recharge event and at least five winter recharge events can be seen in the hydrograph (page 44). The March sampling event can also be seen in both the temperature graph and hydrograph. The long-term manual SWL data imply that this aquifer has a recovery cycle greater than ten years and even with the 2004 winter recharge, the aquifer has not fully recovered.

Northeast Region summary

Each monitored aquifer in this region has a distinct SWL behaviour pattern based on the nature of the host materials (solid rock and/or unconsolidated sediments), location within the catchment, and the depth of the monitored aquifer level. Significant winter recharge of the aquifers has occurred in this region during 2004.

Pipers River — Feature ID 16543

Three boreholes have been drilled in a Mathinna Beds fractured rock aquifer within one kilometre of the monitoring borehole (Feature IDs 15350, 15549 and 15551). Current use of the boreholes is unknown. Drilling reports recorded four aquifer levels at 6, 24, 39 and 47 metres. The monitoring borehole intercepted the three lower aquifer levels.

The temperature graph and hydrograph (page 45) both had a misleading straight line in March 2004, which represents two weeks of no data prior to sampling. The hydrograph contains some noise overprinting a partial sine wave shape. The 2004 winter recharge started as a smoothly rising SWL in July. Longer term SWL data are required to determine the recovery cycle of this aquifer.

Waterhouse — Feature ID 16544

No aquifer levels are recorded in drilling reports of the seven boreholes drilled within one kilometre of the monitoring borehole (Feature IDs 4842, 4844, 15598, 15599, 17513, 17619 and 17620). All boreholes were

drilled in Tertiary sedimentary rocks. The current water extraction rates and usage are unknown.

The hydrograph (page 46) shows a rise of 0.6 m in SWL during the last two weeks of June and the first two weeks of July 2004. At least six further recharge events occurred during the winter months. Long-term manual SWL data imply that the aquifer is currently not stressed. Because of the small degree of movement of the SWL, a recovery cycle is difficult to define.

Jetsonville — Feature ID 16545

Three drilling reports of boreholes within one kilometre (Feature IDs 4804, 4830 and 17637) provide little information on aquifer levels. A detailed engineering log for a borehole, drilled two kilometres to the west in similar Tertiary sedimentary rocks, recorded seven aquifer levels in the first 35 m of drilling (Ezzy, 2002).

The warm recharge event in the last week of January 2004 is seen in the hydrograph and the temperature graph (page 47). At least seven major cooler recharge events occurred during the winter months. Long-term manual SWL data and the most recent winter hydrography imply that the Tertiary sedimentary aquifer currently has an annual recovery cycle.

Branxholm — Feature ID 16546

Eight drilling reports (Feature IDs 15639, 15666, 15677, 15706, 15711, 15712, 15723 and 15735) within one kilometre of the monitoring borehole imply five aquifer levels at 6, 12, 18, 28 and 57 metres. The monitoring borehole was drilled through the three lower aquifer levels. A borehole 200 m to the south (Feature ID 15677) is currently used to supply a household and small garden.

Recharge events occurred in late December 2003 and again in late January 2004 (page 48). The winter recharge corresponds with a continuing fall in groundwater temperature, with no warming occurring between the winter recharge events. Long-term manual SWL data imply that this aquifer currently has an annual recovery cycle.

Winnaleah — Feature ID 16547

Five drilling reports exist for boreholes drilled within one kilometre of the monitoring borehole (Feature IDs 15638, 15640, 15659, 15667 and 15676). Three aquifer levels have been intercepted at 6 to 10, 24 and 54 metres. The monitoring borehole intercepted the first and third aquifer levels. All boreholes were drilled in a Tertiary basalt aquifer.

An *Odyssey* data recorder is not currently installed in this monitoring borehole and past *Dataflow* time series data is incomplete. Long-term manual SWL data imply a stable third aquifer level with little seasonal flux in SWL. This borehole appears to be draining the upper two aquifer levels into the lowest aquifer level and should be decommissioned and a new borehole drilled to the first two aquifer levels only.

Midlands Region summary

The monitored aquifers in this region were recharged during the 2004 winter months. The Bothwell monitoring borehole is not monitored for SWL and provided an artesian flow during both the 2004 sampling events. Groundwater increased in temperature during the autumn months. Aquifers monitored in the central area of this region have not completed a recovery cycle during the winter recharge.

Ross — Feature ID 16553

One borehole (Feature ID 17954) was drilled in Triassic sedimentary rocks 500 m south of the monitoring borehole. The current status of this borehole is unknown. Drilling reports recorded aquifer levels at 4, 16 and 24 metres. The monitoring borehole intercepted at least the second aquifer level.

The temperature graph and hydrograph (page 49) both show peaks representing the March 2004 sampling event. An increase of groundwater temperature occurred during the autumn months. Based on the long-term SWL data, the 2004 winter recharge did not complete a recovery cycle for this aquifer. The last recovery cycle had a four-year duration and occurred in 1996.

Melton Mowbray — Feature ID 16529

Three boreholes have been reported within 500 m of the monitoring borehole (Feature IDs 4188, 4189 and 4206). Four aquifer levels at 24, 32, 35 and 45 m are recorded in the drilling reports for the boreholes. The monitoring borehole intercepted the three lowest aquifer levels.

The temperature graph and hydrograph (page 50) both have peaks representing the March 2004 sampling event. An increase of groundwater temperature occurred during the autumn months followed by a decrease during the winter months. The hydrograph indicates that the SWL of the monitoring borehole is very active between 1.0 and 1.5 m depth. The late January 2004 recharge event appears on the hydrograph. The winter recharge appears to be overprinted by an addition process, such as local extraction of groundwater or capillary rise due to thermal/solar radiation. The long-term SWL data indicate that this aquifer is in a state of semi-equilibrium.

Tunnack — Feature ID 16550

Eight boreholes have been reported within 500 m of the monitoring borehole (Feature IDs 4116, 4117, 4197, 4198, 4199, 4227, 4270 and 17976). Five aquifer levels at 5, 9 to 12, 19 to 24, 30 and 62 m have been intercepted by the boreholes. The monitoring borehole was reported to have intercepted the first and last aquifer levels at the time of drilling. Current status of the local boreholes is unknown.

The hydrograph (page 51) shows the 2004 winter recharge starting rapidly during June and then

peaking in mid-August. The long-term manual SWL data imply that this aquifer has completed an eight-year recovery cycle during the winter recharge event. Based on aquifer levels and SWL data, this borehole is most likely monitoring the complete hydro-stratigraphy of the aquifer.

East Coast Region summary

This region was significantly recharged during late January 2004, with recharge continuing through the winter months for the Bicheno and Little Swanport aquifers. The St Marys and Buckland aquifers returned to equilibrium after the January recharge event. Because of the potential hydraulic equilibrium of the aquifers with local streams and base aquifer flow (or a combination of the two), aquifers in this region may easily become depleted if groundwater extraction activities are not closely regulated.

St Marys — Feature ID16526

No drilling reports exist for boreholes within one kilometre of the monitoring borehole. The monitoring borehole intercepted two aquifer levels at 12 and 22 metres.

The hydrograph (page 52) shows a major recharge event in late January 2004 and the aquifer took two months to return to equilibrium. Winter recharge was quite small in comparison to the summer recharge event. Based on the long-term manual SWL data, the aquifer appears to have an annual recovery cycle.

Bicheno — Feature ID 16548

Three boreholes have been reported within one kilometre of the monitoring borehole (Feature IDs 17547, 17548 and 17551). Three aquifer levels at 11, 15 and 20 m have been reported, although deeper levels may have been intercepted and not noted due to the drilling technique. The monitoring borehole is reported to have intercepted the top two aquifer levels. Groundwater usage is unknown for the three nearby boreholes.

The hydrograph (page 53) shows the warm late January 2004 winter recharge, followed by a prolonged slow and static rising SWL starting in April. The long-term manual SWL data imply that the aquifer is currently in a phase of recovery. This recovery phase may vary between 3 to >6 years.

Little Swanport — Feature ID 16549

No drilling reports exist for boreholes within one kilometre of the monitoring borehole. The monitoring borehole intercepted two aquifer levels at 7 and 17 metres.

The hydrograph (page 54) shows a period of recharge starting in January 2004 and continuing through the winter months with high SWL. The long-term SWL data imply that the aquifer has an eight-year recovery cycle which was completed during the 2004 winter recharge.

Buckland — Feature ID 16551

No drilling reports exist for boreholes within one kilometre of the monitoring borehole. The monitoring borehole intercepted two aquifer levels at 30 and 36 m hosted in Triassic sedimentary rocks.

A short, rapid, warm recharge event in late January 2004 can be seen in the hydrograph and temperature graph (page 55). The aquifer then returned to equilibrium with no significant winter recharge events. The long-term manual SWL data suggest that the aquifer currently has an annual recovery cycle. If new extraction boreholes are drilled in the aquifer, the recovery cycle may increase to >10 years, depending on the extent of groundwater extraction.

Southeast Region summary

Winter recharge occurred in all monitored aquifers in this region, although volumes were not always sufficient to complete a recovery cycle. The Huonville monitoring borehole remained artesian during both 2004 sampling events. The Pawleena Road aquifer is currently at risk of over extraction which would deplete the first aquifer. There is potential in this region for groundwater extraction to reach unsustainable limits.

Pawleena Road (Sorell) — Feature ID 16554

Drilling reports indicate that eleven boreholes exist within 500 m of the monitoring borehole (Feature IDs 2930, 2956, 3013, 3014, 3015, 3020, 3331, 3338, 16500, 16501 and 16512). Five aquifer levels have been recorded at 10 to 13, 18 to 21, 25 to 30, 37 and 54 metres. The drilling report states that the monitoring borehole intercepted the first and third aquifer levels.

The hydrograph (page 56) shows that recharge has occurred in the aquifer between April and September 2004. Several nearby boreholes have been used for irrigation over the last decade. This can be seen in the long-term manual SWL data. The aquifer is currently under stress and has been so for the last ten years. In recent years the first aquifer level has come close to exhaustion due to over extraction. A fresh recovery stage has started during 2004. Groundwater extraction from this aquifer should be regulated.

Port Arthur — Feature ID 16528

Only one borehole has been reported within one kilometre of the monitoring borehole (Feature ID 17771). Feature ID 17771 was drilled as the original monitoring borehole for the area and has been capped since the time of drilling. The yield of the borehole was very low and therefore not used for monitoring purposes. No aquifer levels were recorded for the monitoring borehole. Feature ID 17771 intercepted three aquifer levels at 4, 6 and 33 metres.

The hydrograph and temperature graph (page 57) show a period in March 2004 where no data was recorded due to a shortage of memory in the *Odyssey* data recorder. The warm late January recharge event was followed by a fall in SWL, until the winter

recharge caused a rise in SWL. At least ten recharge events occurred during the 2004 winter. The long-term manual SWL data indicate that the aquifer currently has an annual recovery cycle.

Snug — Feature ID 17773

One borehole (Feature ID 3491), used to supply several houses, exists within one kilometre of the monitoring borehole. No aquifer levels were recorded for the monitoring borehole. Feature ID 3491 recorded one aquifer level at 12 metres. Both boreholes were drilled in Triassic sedimentary rock.

The hydrograph and temperature graph (page 58) show a period in March 2004 where no data was recorded due to a high frequency of readings that resulted in the exhaustion of memory in the data recorder. A decline in SWL during the summer and autumn months was followed by a period of winter recharge. Short drawdown and recovery cycles in the hydrograph imply the local up-gradient extraction borehole may be affecting the SWL of the monitoring borehole. The long-term manual SWL data indicate that the aquifer has a four to seven-year recovery cycle and appears to have started a new cycle in 2003.

Summary

The *Odyssey* data downloaded in March 2004 and September 2004 demonstrated that this automatic monitoring system is significantly more reliable than the decommissioned *Dataflow* system. The *Odyssey* data are precise and accurate when compared to the manual SWL data.

Temperature and SWL data from the *Odyssey* system indicate that SWL boreholes and groundwater quality boreholes may need to be separate monitoring boreholes in the long term, where technically and economically possible. Separate groundwater quality monitoring boreholes are required for Cressy, Calder, Pipers River, Lilydale and Tunnack. Because of aquifer levels and no appropriate bentonite seals, the Winnaleah borehole requires immediate decommissioning and redrilling to monitor the first aquifer level.

Additional *Odyssey* data recorders are required to replace the remaining *Dataflow* data loggers. Data collection procedures can be further automated using a hand-held computer. Long-term data collected from the groundwater monitoring network supplements Department of Primary Industries, Water and Environment stream flow and rainfall data used to manage Tasmanian water resources. Key points still to be addressed include legal accessibility to sites, upgrading the current network, identifying groundwater over-extraction 'hot spots', and suitable sites for future boreholes (with respect to current rainfall stations, stream flow monitoring sites, and conceptual groundwater flow system models).

References

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EZZY, A. R. 2004. An overview of the Mineral Resources Tasmania statewide groundwater monitoring network. *Record Tasmanian Geological Survey* 2004/04.

[20 January 2005]

APPENDIX 1

Laboratory results for the March 2004 monitoring round

Analyses by L. Hay, Mineral Resources Tasmania, Rosny Park

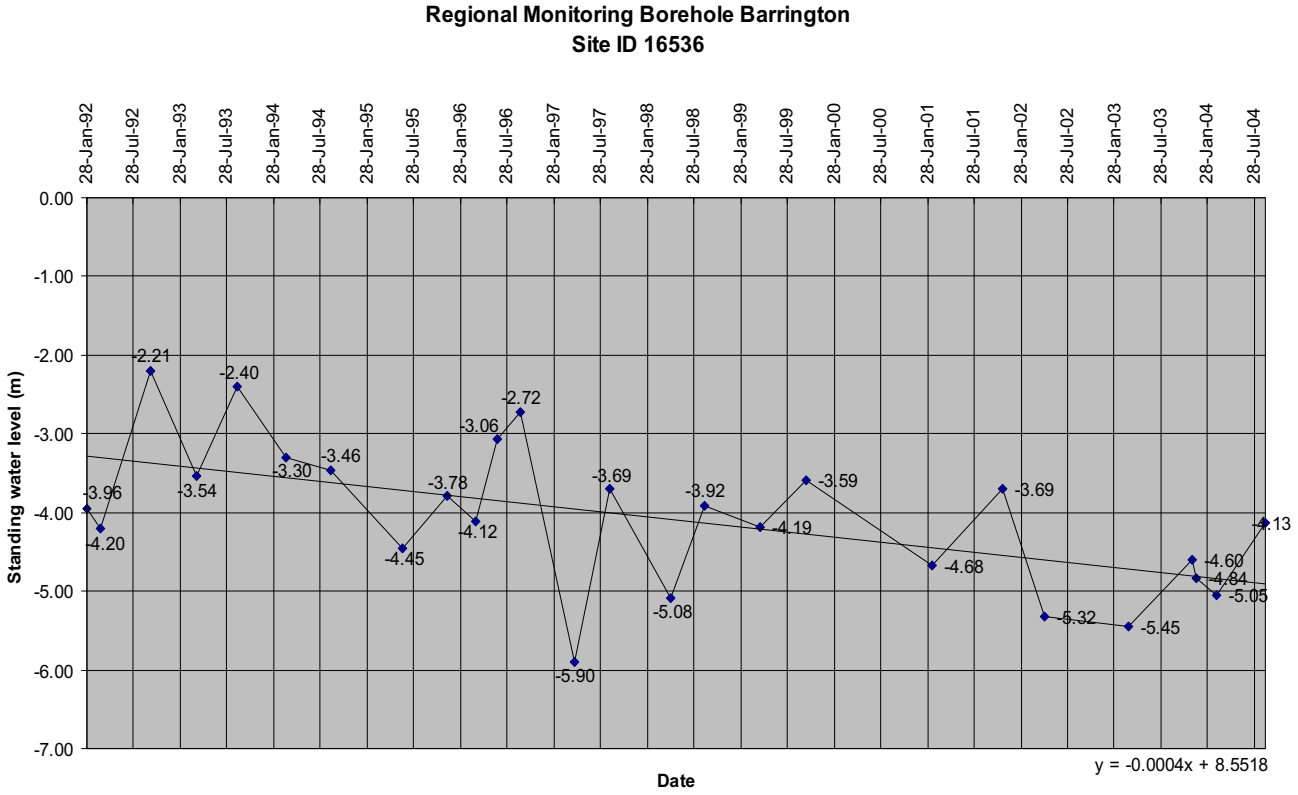
Lab. Anal. No.	20040071	20040072	20040105	20040073	20040106	20040107	20040088	20040089	20040090	20040076	20040074	20040075
Location	Barrington	Beulah	Bicheno	Bothwell	Branxholm	Buckland	Burnie Tip No.1	Burnie Tip	Burnie Tip No.4	Free's Bore	Calder	Chudleigh
Date Sampled	04/03/2004	04/03/2004	24/03/2004	05/03/2004	23/03/2004	25/03/2004	03/03/2004	03/03/2004	03/03/2004	03/03/2004	02/03/2004	04/03/2004
Date Analysed	07/05/2004	07/05/2004	01/07/2004	07/05/2004	01/07/2004	01/07/2004	07/05/2004	07/05/2004	07/05/2004	07/05/2004	07/05/2004	07/05/2004
pH	6.6	6.5	7.7	7.4	6.2	6.4	7.6	5.4	7.4	7.0	6.2	4.6
Conductivity (µS/cm)	201	152	6470	1280	96	1800	380	144	299	172	154	55
Item (mg/L)												
Ca^{++}	10	6.2	220	120	1	6.9	24	1.9	14	7.5	5.9	1.2
Mg^{++}	9	10	250	51	2.5	29	17.5	4.2	6.9	6.1	3.3	1.4
$Fe^{++(+)}$	0.4	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	7.2	< 0.1
Al^{+++}	0.8	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	0.4
Na^{+}	18	6.6	750	75	11	280	20	15.5	35	13.5	16.5	4.9
K^{+}	0.5	1.2	9.2	2.4	2	6.1	3.3	0.9	2.6	2.3	1.4	0.2
Cl^{-}	14.5	12.5	1900	150	23	530	37	25	18	27	29	12.5
F^{-}	< 0.1	< 0.1	< 0.1	0.2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
$SO4^{-}$	< 5.0	< 5.0	120	135	< 5.0	18	< 5.0	< 5.0	< 5.0	< 5.0	8.2	< 5.0
NO_3^{-}	10	< 10	< 10	< 10	< 10	< 10	10	25	10	10	< 10	< 10
CO_3^{-}	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
HCO_3^{-}	85	67	320	400	< 5.0	9	145	7.5	130	39	23	nil
TDS	136	106	4040	847	55	993	240	91	188	123	132	46
Perm. Hardness	nil	< 5.0	1300	185	10.5	125	14.5	16	nil	12	23	11
Temp. Hardness	67	55	260	320	< 5.0	7.4	120	6.2	64	32	18.5	nil
Alkalinity	70	55	260	320	< 5.0	7.4	120	6.2	105	32	18.5	nil

Lab. Anal. No.	20040108	20040077	20040078	20040109	20040110	20040111	20040112	20040079	20040080	20040081	20040082	20040113
Location	Cressy	Hagley	Hampshire	Huonville	Jetsonville	Lilydale	Little Swanport	Melt. Mowbray	Montagu	Mooreville Rd	Osmaston	Pawleena Rd
Date Sampled	22/03/2004	04/03/2004	03/03/2004	26/03/2004	23/03/2004	22/03/2004	24/03/2004	05/03/2004	02/03/2004	03/03/2004	01/03/2004	29/03/2004
Date Analysed	01/07/04	07/05/2004	07/05/2004	01/07/04	01/07/04	01/07/04	01/07/04	07/05/2004	07/05/2004	07/05/2004	07/05/2004	01/07/04
pH	7.1	7.9	7.2	7.4	5.8	6.1	7.8	7.6	7.2	4.8	6.9	8.0
Conductivity (µS/cm)	3050	521	170	940	139	280	3500	2220	1470	64	1310	2470
Item (mg/L)												
Ca^{++}	110	35	11	53	1.3	11	69	85	95	0.3	36	105
Mg^{++}	88	24	5.4	19	2.4	5.9	105	60	36	1.1	26	97
$Fe^{++(+)}$	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Al^{+++}	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Na^{+}	320	34	12	97	20	32	480	290	140	8.6	155	250
K^{+}	21	1	1.8	7	0.9	3.1	8.5	3.4	7.6	0.3	20	1.9
Cl^{-}	880	52	19.5	200	34	23	750	450	300	12.5	310	520
F^{-}	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.7	< 0.1	< 0.1	< 0.1	< 0.1	0.5
$SO4^{-}$	< 5.0	< 5.0	< 5.0	36	< 5.0	68	69	61	70	< 5.0	32	30
NO_3^{-}	10	10	10	< 10	10	10	< 10	< 10	< 10	< 10	50	25
CO_3^{-}	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
HCO_3^{-}	66	200	49	110	< 5.0	< 5.0	700	490	240	nil	66	500
TDS	1810	333	115	578	70	223	1990	1240	951	50	840	1470
Perm. Hardness	580	22	9.5	120	12.5	48	29	62	190	5.4	145	250
Temp. Hardness	54	165	40	91	< 5.0	< 5.0	570	400	195	nil	54	410
Alkalinity	54	165	40	91	< 5.0	< 5.0	570	400	195	nil	54	410

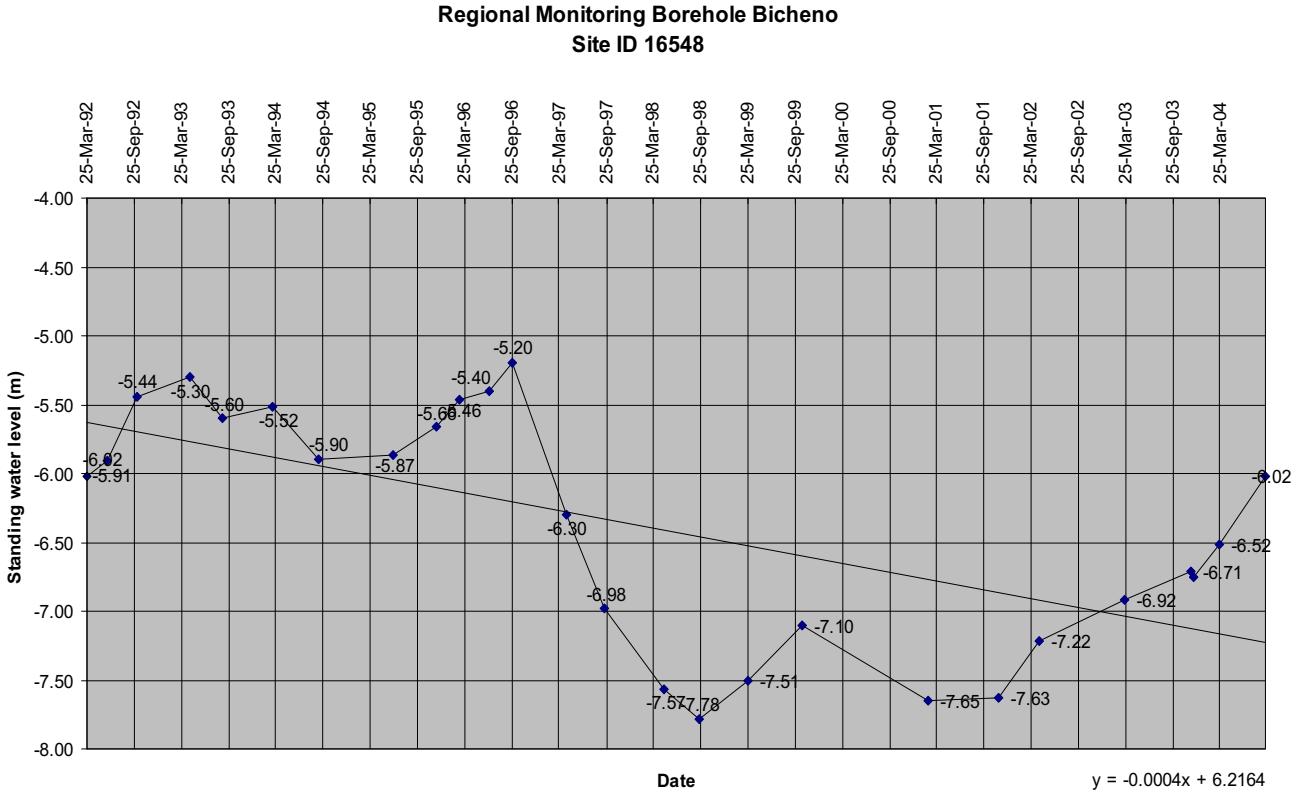
Lab. Anal. No.	20040114	20040115	20040083	20040117	20040116	20040084	20040085	20040086	20040087	20040118	20040119	20040120
Location	Pipers River	Port Arthur	Ross	St Marys	Snug	South Forest	Spreyton	Togari	Trowutta	Tunnack	Waterhouse	Winnaleah
Date Sampled	22/03/2004	29/03/2004	01/03/2004	24/03/2004	26/03/2004	02/03/2004	01/03/2004	02/03/2004	02/03/2004	25/03/2004	23/03/2004	23/03/2004
Date Analysed	01/07/2004	01/07/2004	07/05/2004	01/07/2004	01/07/2004	07/05/2004	07/05/2004	07/05/2004	07/05/2004	01/07/2004	01/07/2004	01/07/2004
pH	4.0	7.5	7.9	7.9	6.8	5.6	7.7	7.4	7.1	7.6	7.1	8.1
Conductivity (µS/cm)	493	479	4080	1420	1530	145	543	1040	251	1100	572	366
Item (mg/L)												
Ca^{++}	1	22	41	36	32	2	62	105	16	97	10.5	0.2
Mg^{++}	6.9	7.8	155	33	36	4.4	15.5	44	7.9	38	14	0.1
$Fe^{++(+)}$	< 0.1	0.4	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.5	< 0.1	< 0.1	< 0.1	< 0.1
Al^{+++}	< 0.2	0.3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Na^{+}	73	61	600	200	195	14	24	48	18.5	58	71	81
K^{+}	3	0.6	5.5	1.2	4.9	3.5	8.3	5.7	1.2	5.2	3	8.5
Cl^{-}	135	73	960	260	380	27	23	110	25	70	135	27
F^{-}	< 0.1	< 0.1	0.5	0.2	< 0.1	< 0.1	0.1	< 0.1	0.1	0.2	< 0.1	< 0.1
SO_4^{-}	11.5	19.5	75	63	100	9.6	< 5.0	69	13	340	30	< 5.0
NO_3^{-}	< 10	< 10	50	< 10	< 10	10	< 10	< 10	< 10	< 10	< 10	10
CO_3^{-}	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
HCO_3^{-}	nil	93	710	290	27	< 5.0	300	360	76	145	34	155
TDS	246	299	2320	786	920	94	313	733	162	806	319	228
Perm. Hardness	32	13	155	nil	210	20	nil	155	10	280	57	nil
Temp. Hardness	nil	76	580	230	22	< 5.0	220	290	62	120	28	< 5.0
Alkalinity	nil	76	580	230	22	< 5.0	240	290	62	120	28	125

APPENDIX 2
Updated manual SWL graphs

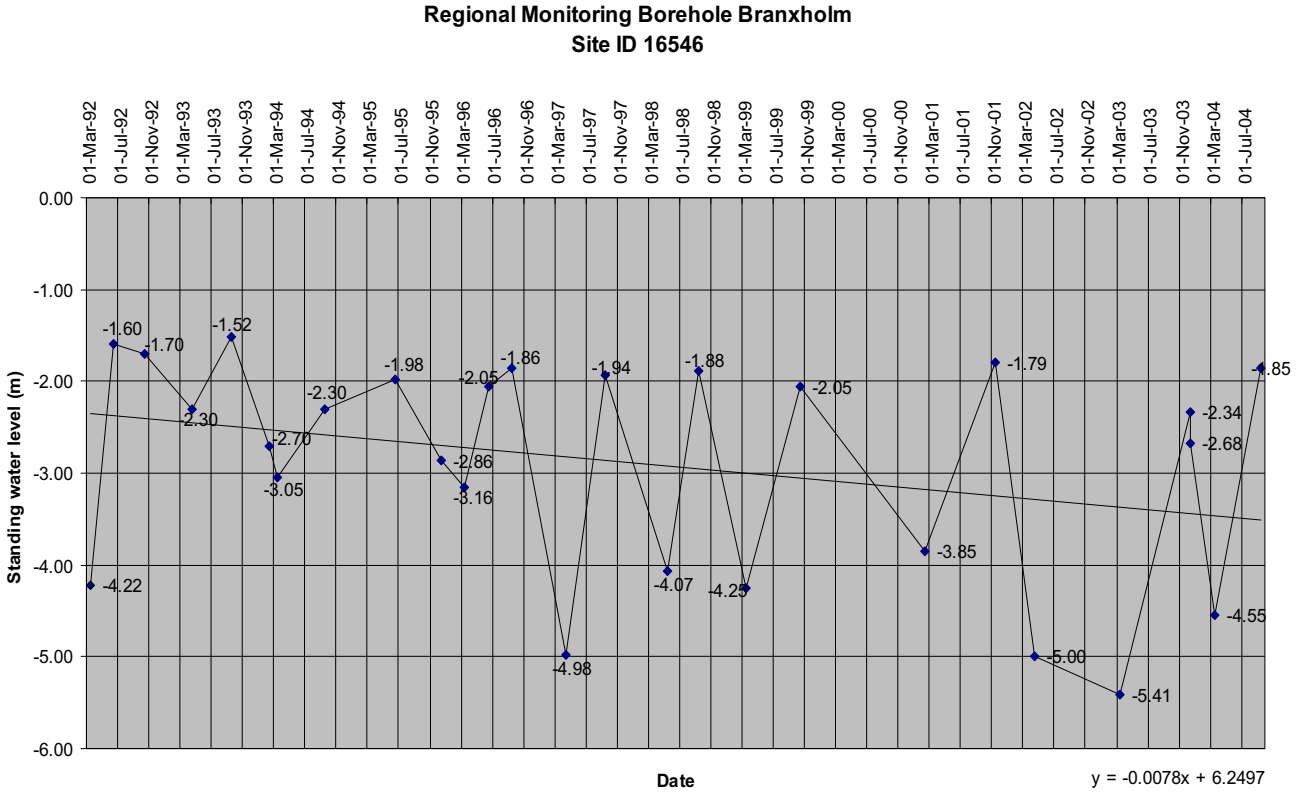
Barrington



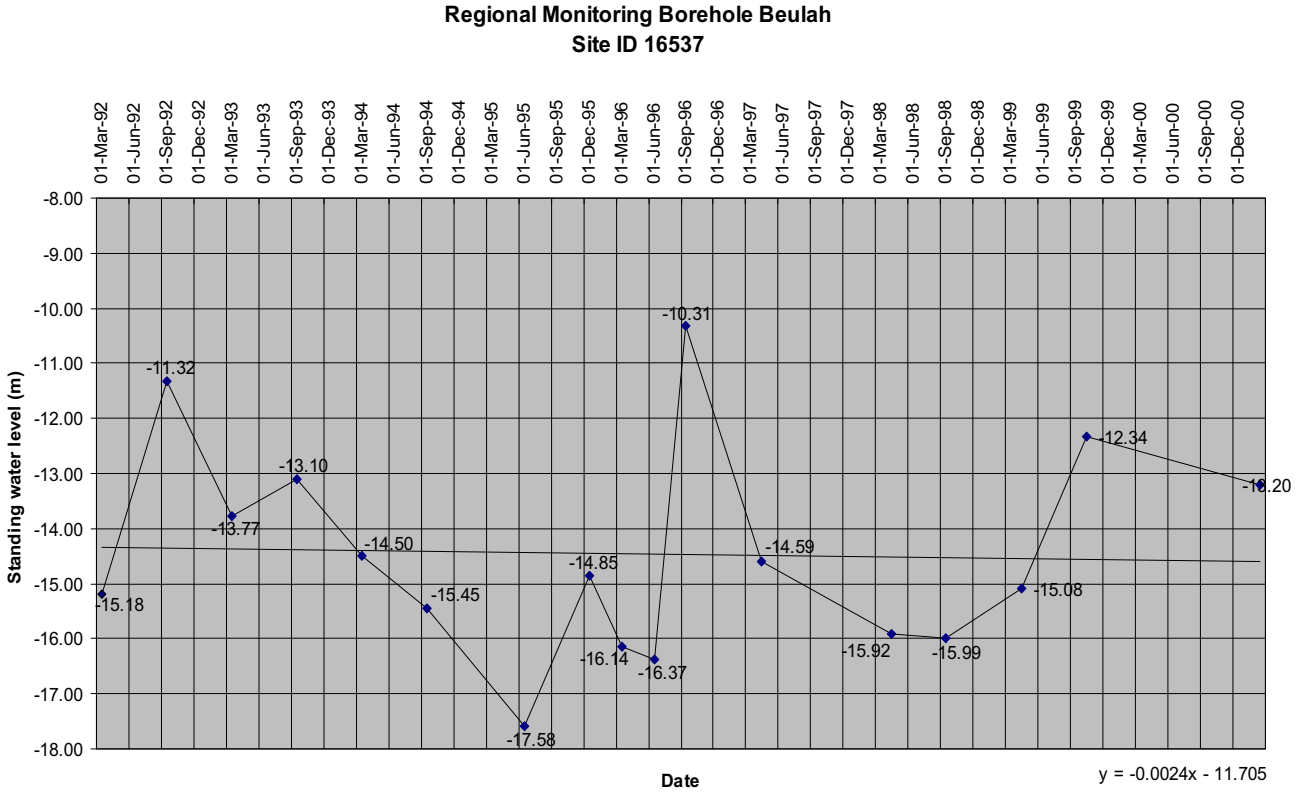
Bicheno



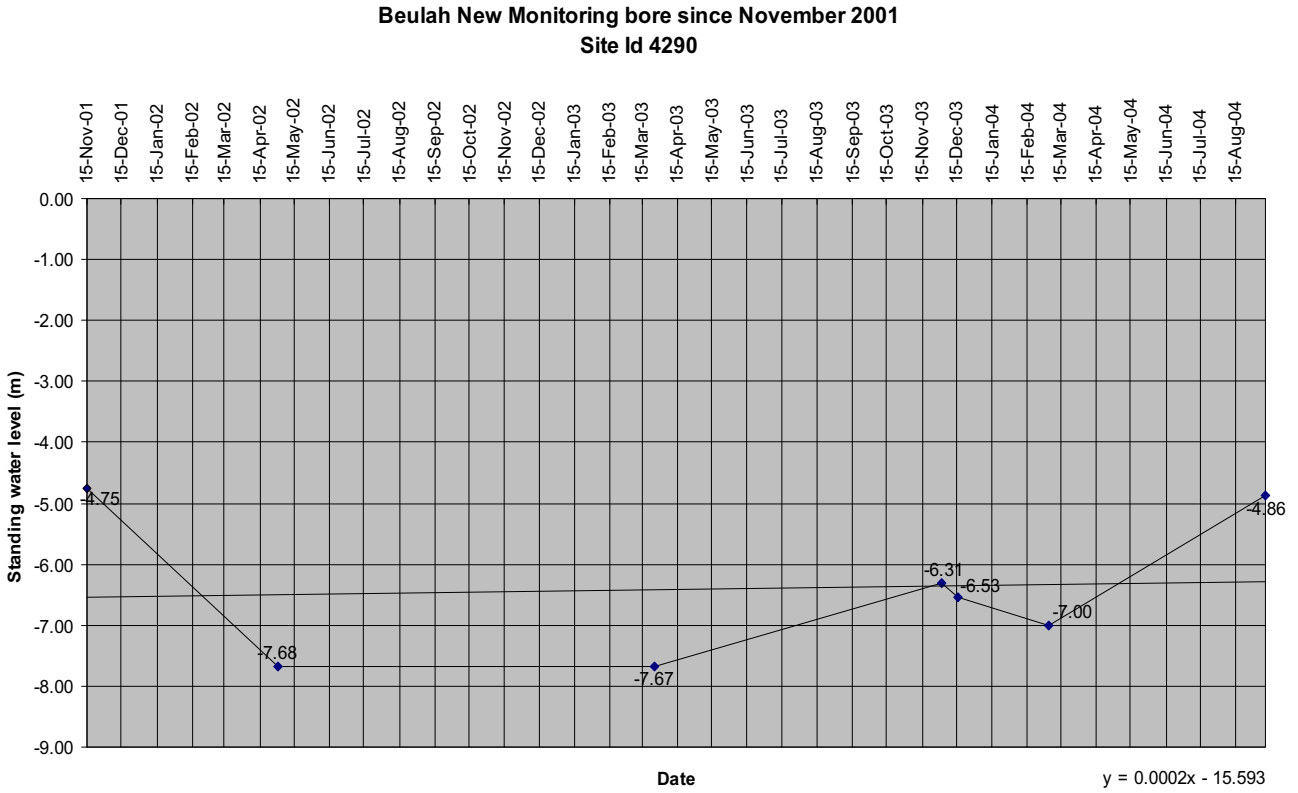
Branxholm



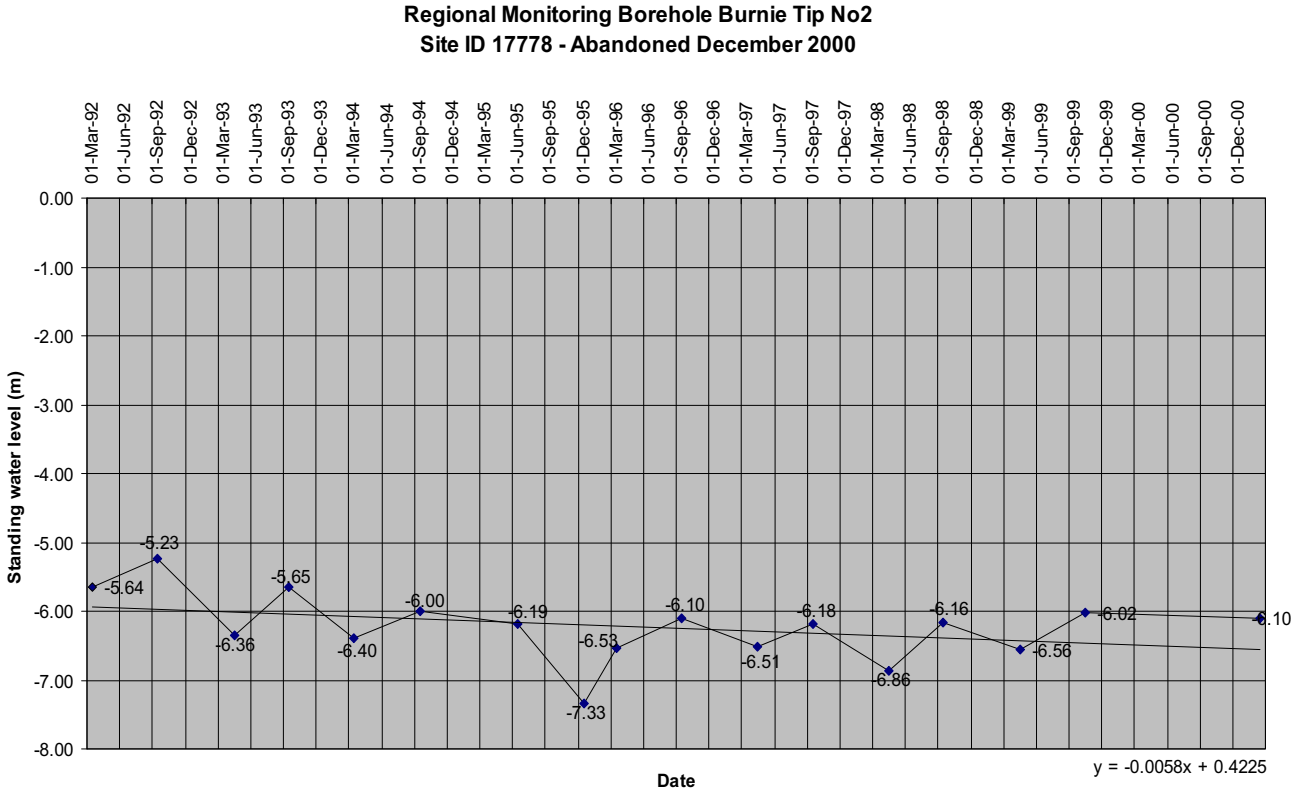
Beulah (old)



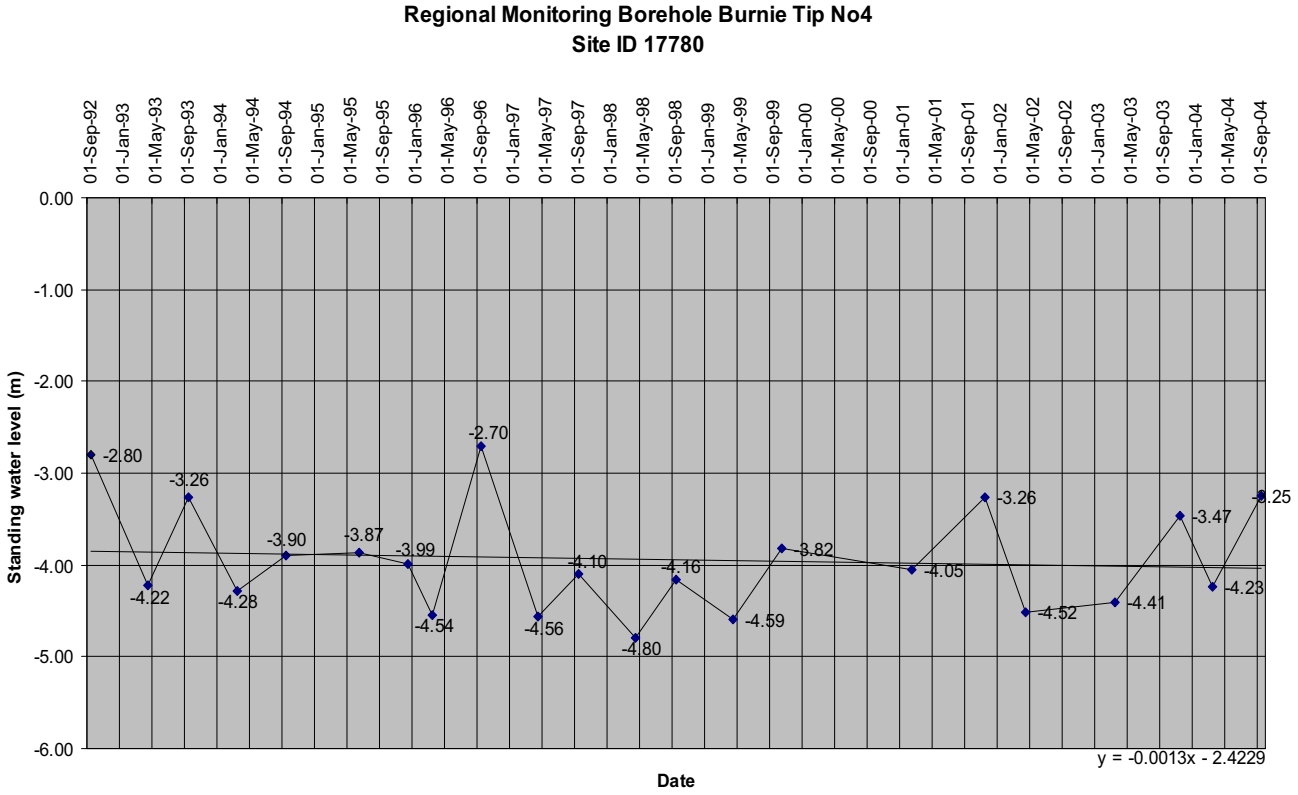
Beulah (new)



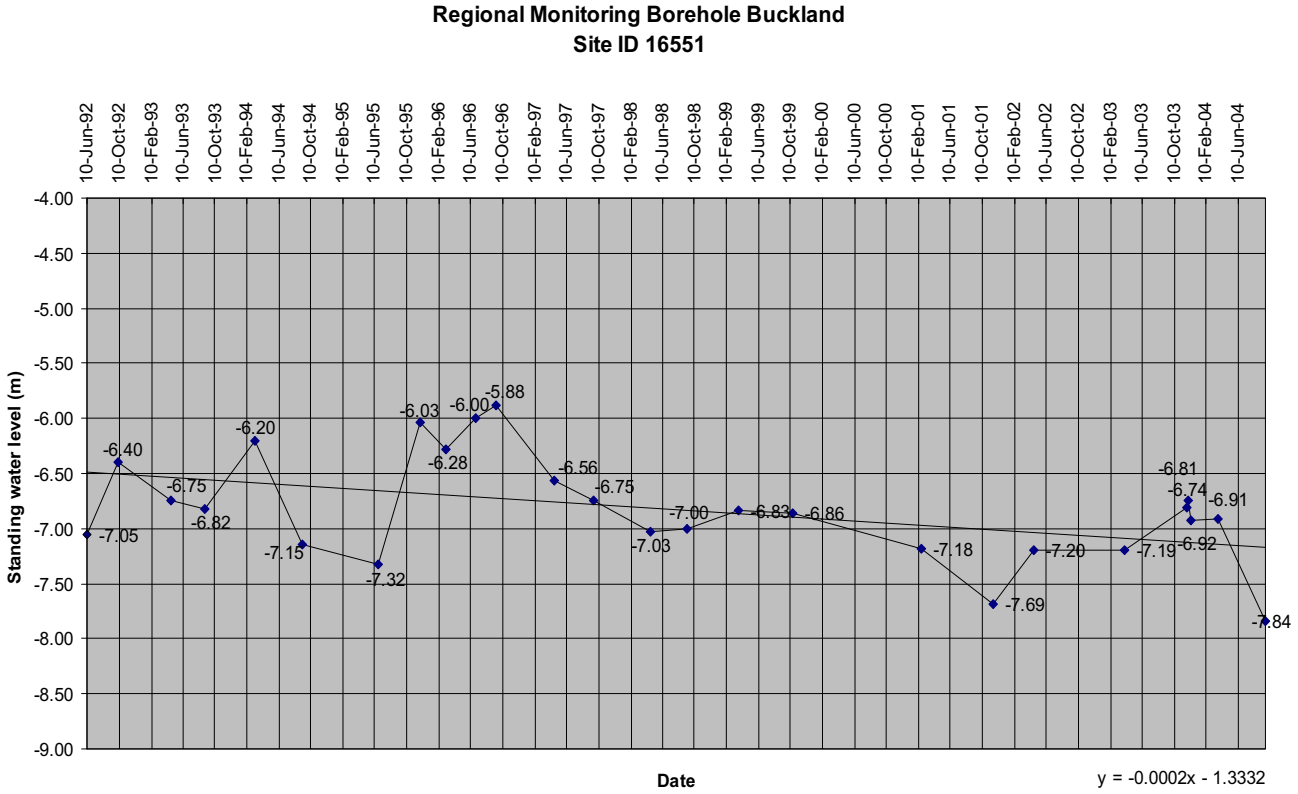
Burnie Tip No. 2



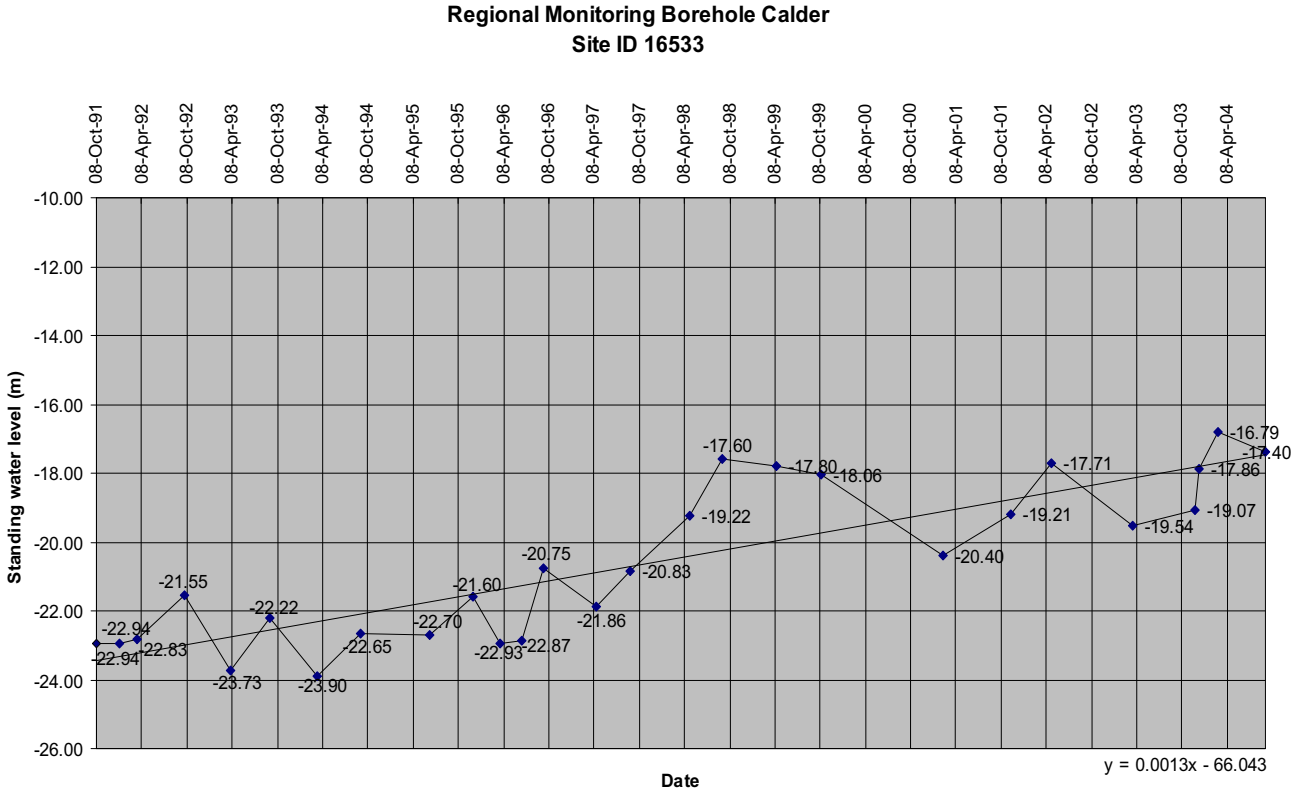
Burnie Tip No. 4



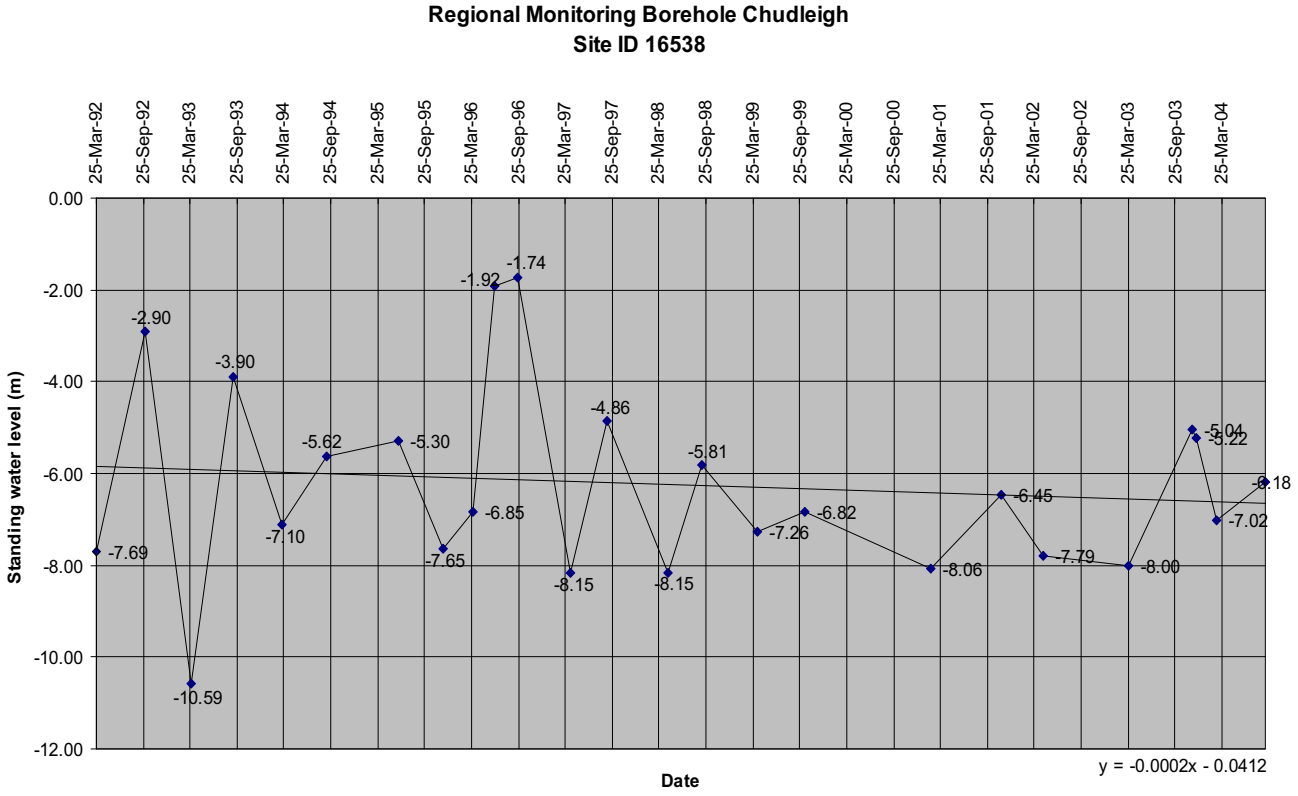
Buckland



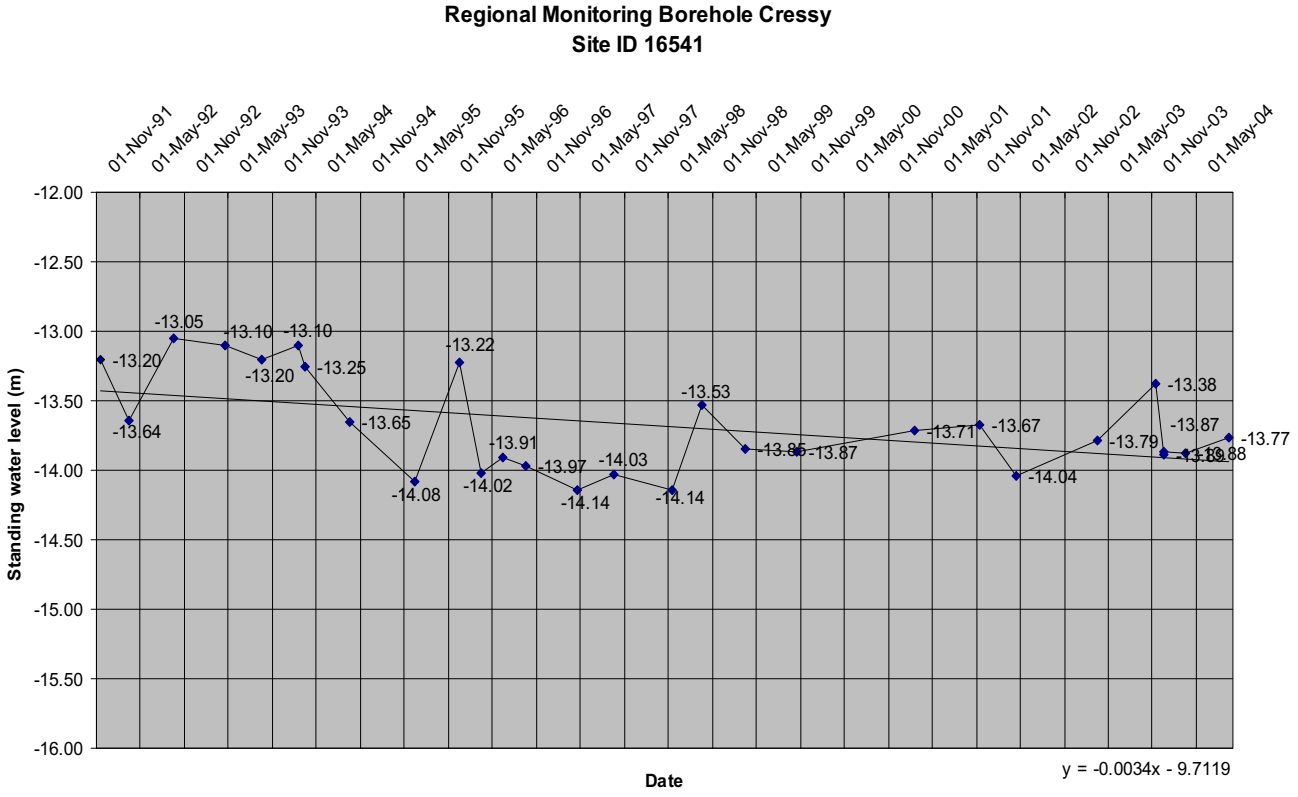
Calder



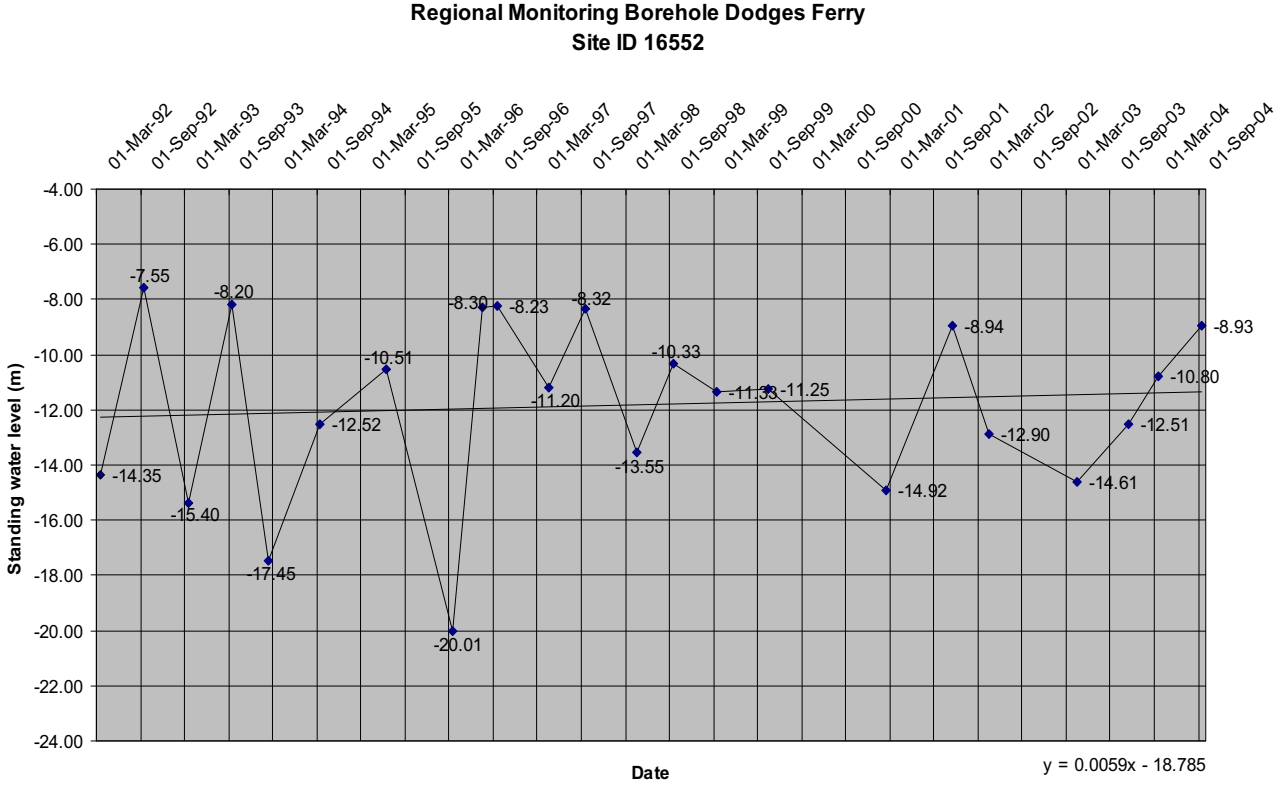
Chudleigh



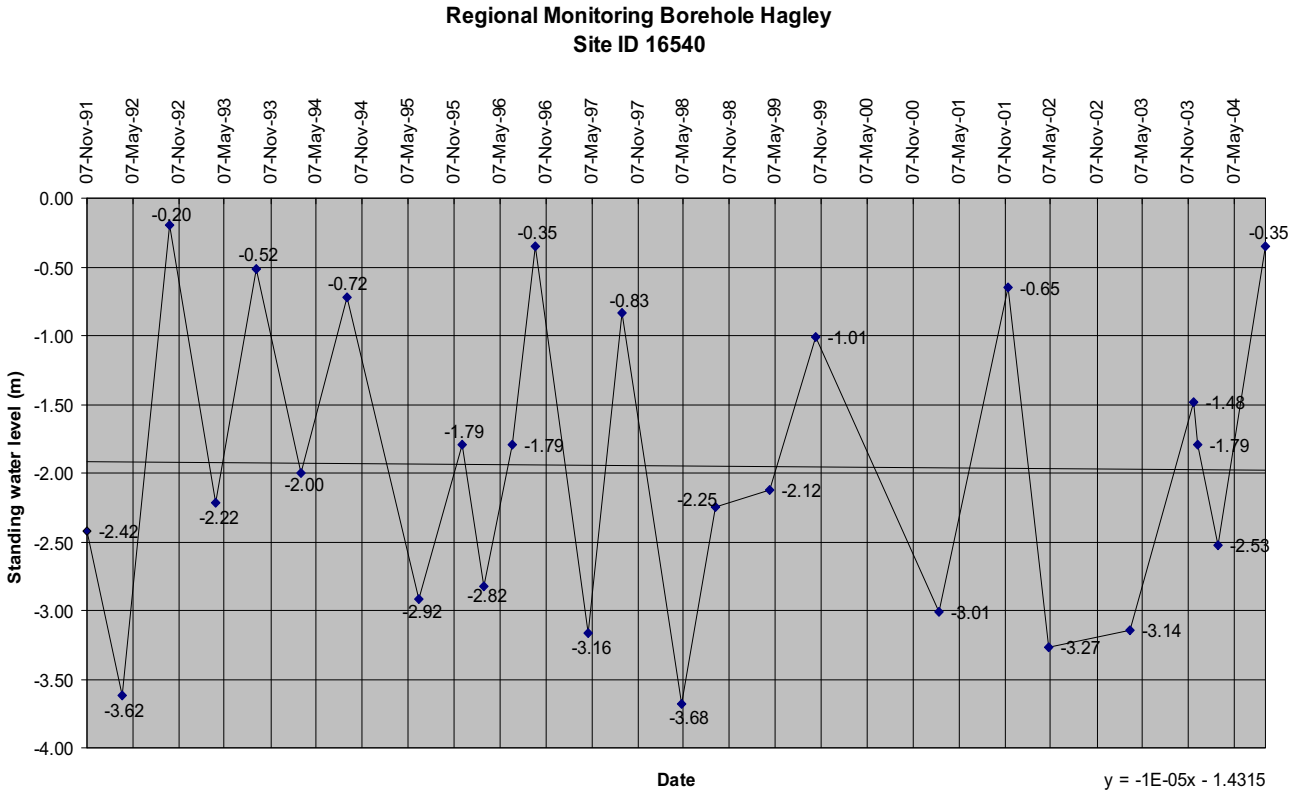
Cressy



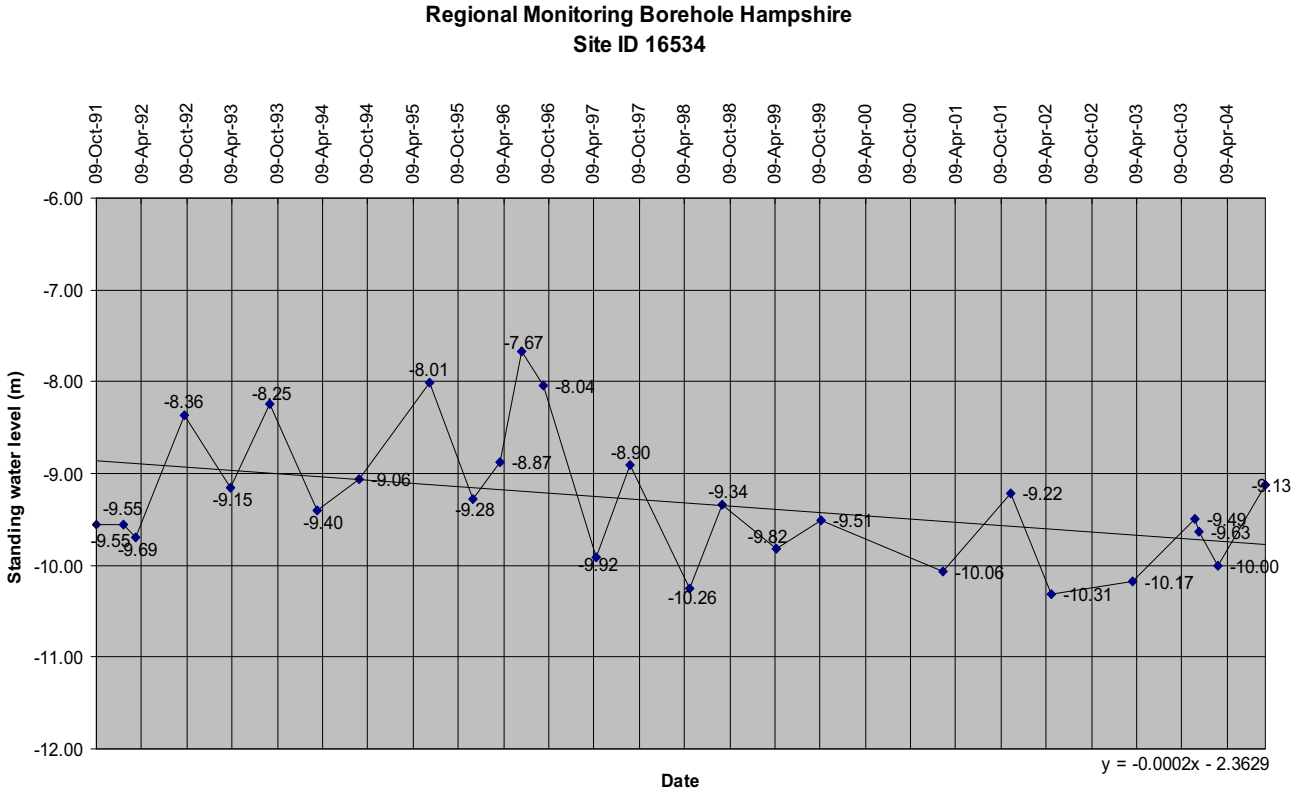
Dodges Ferry



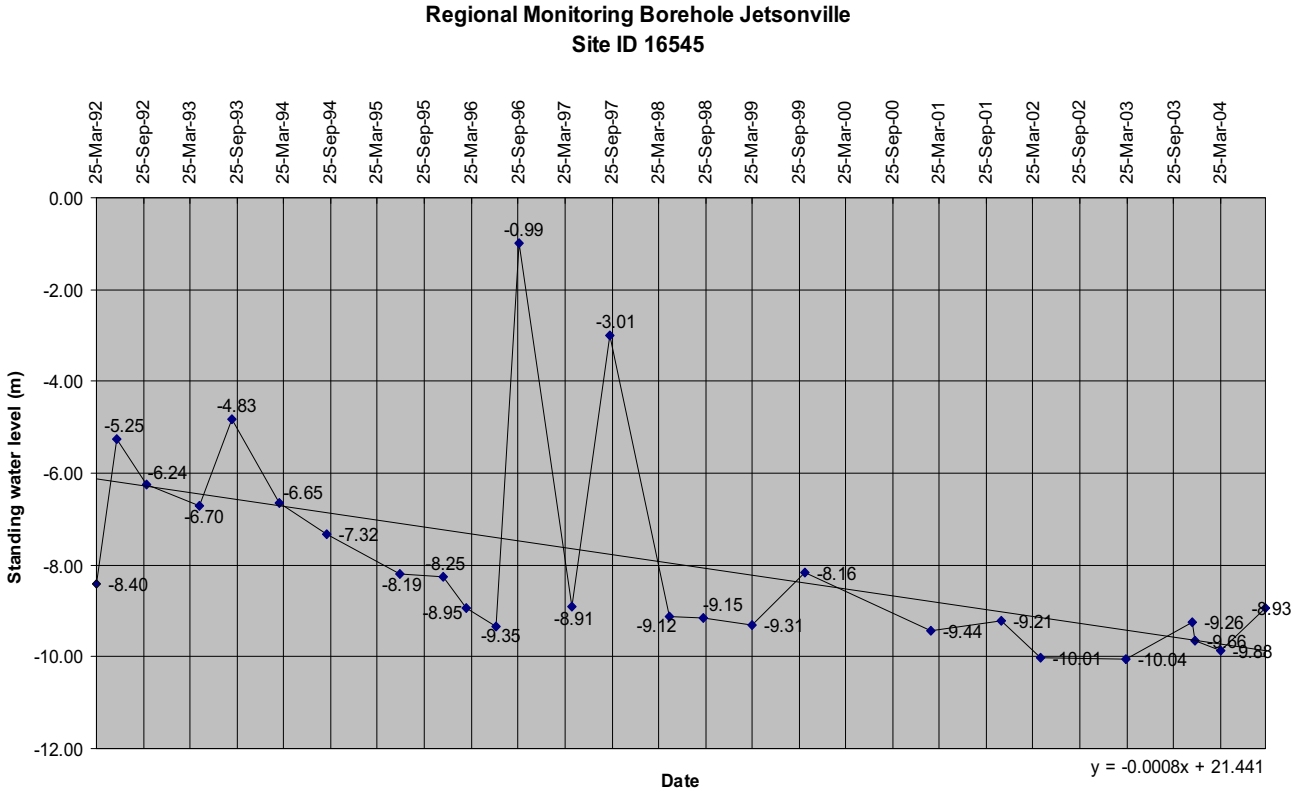
Hagley



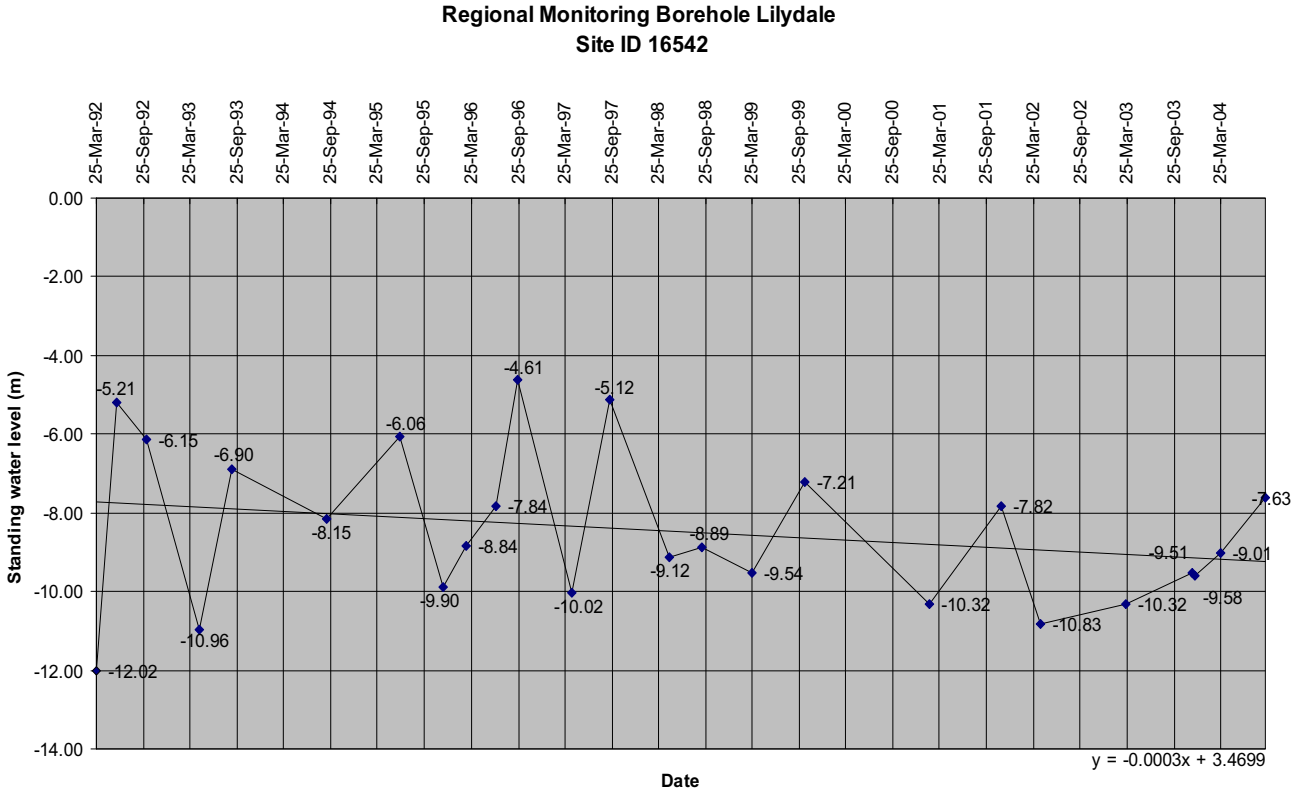
Hampshire



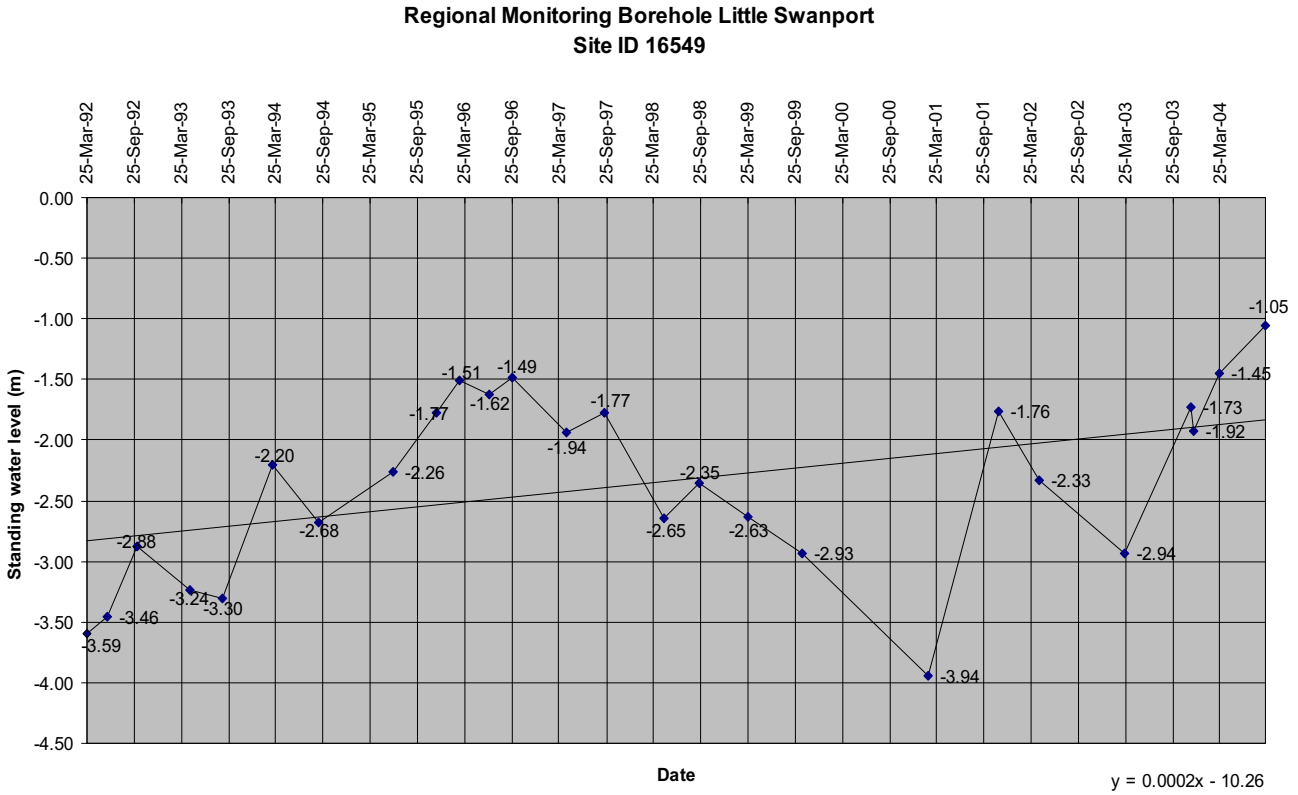
Jetsonville



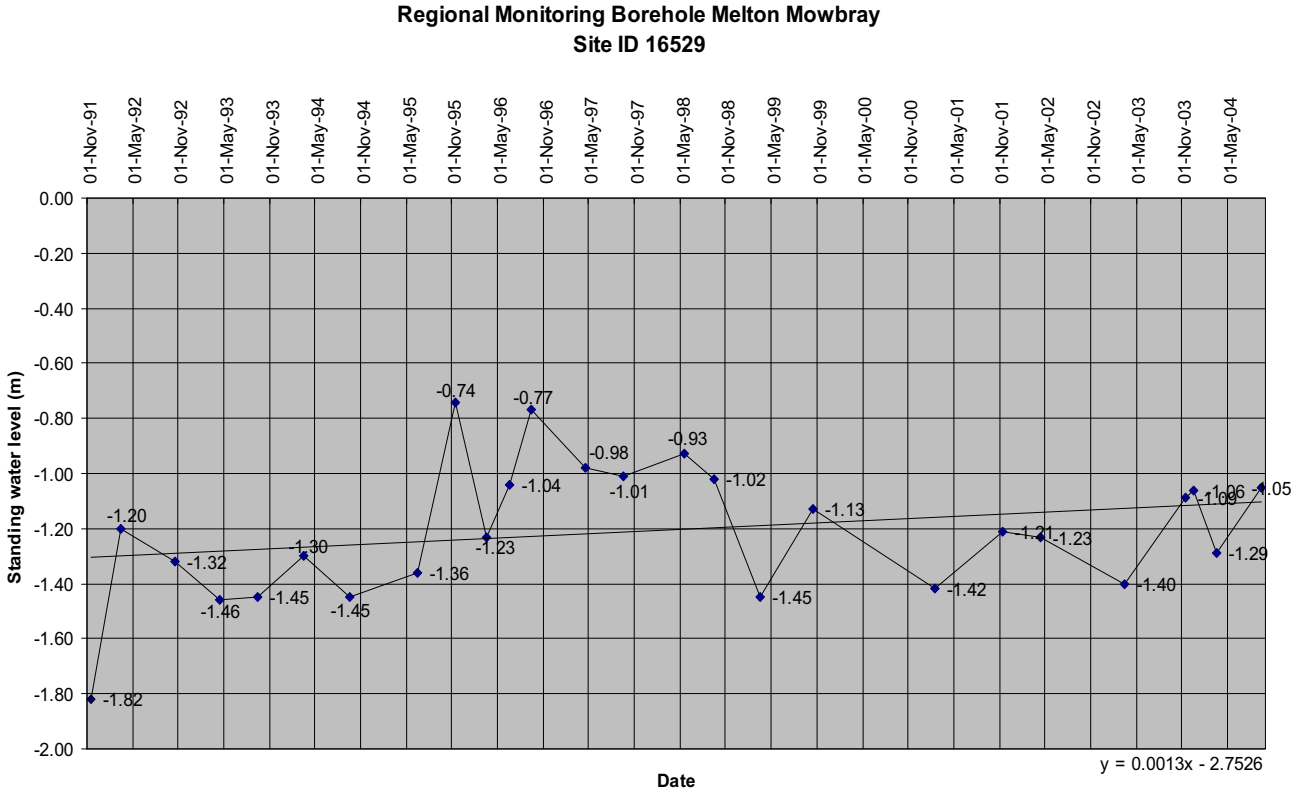
Lilydale



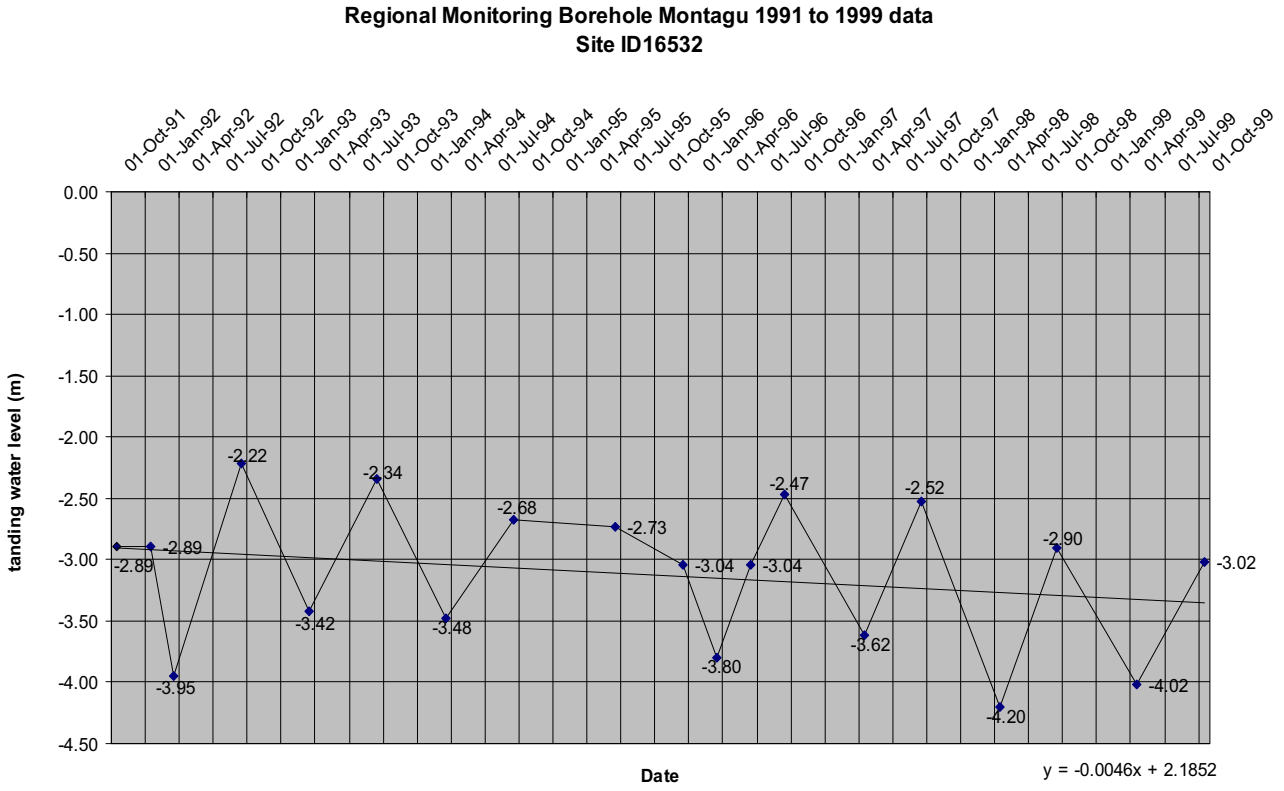
Little Swanport



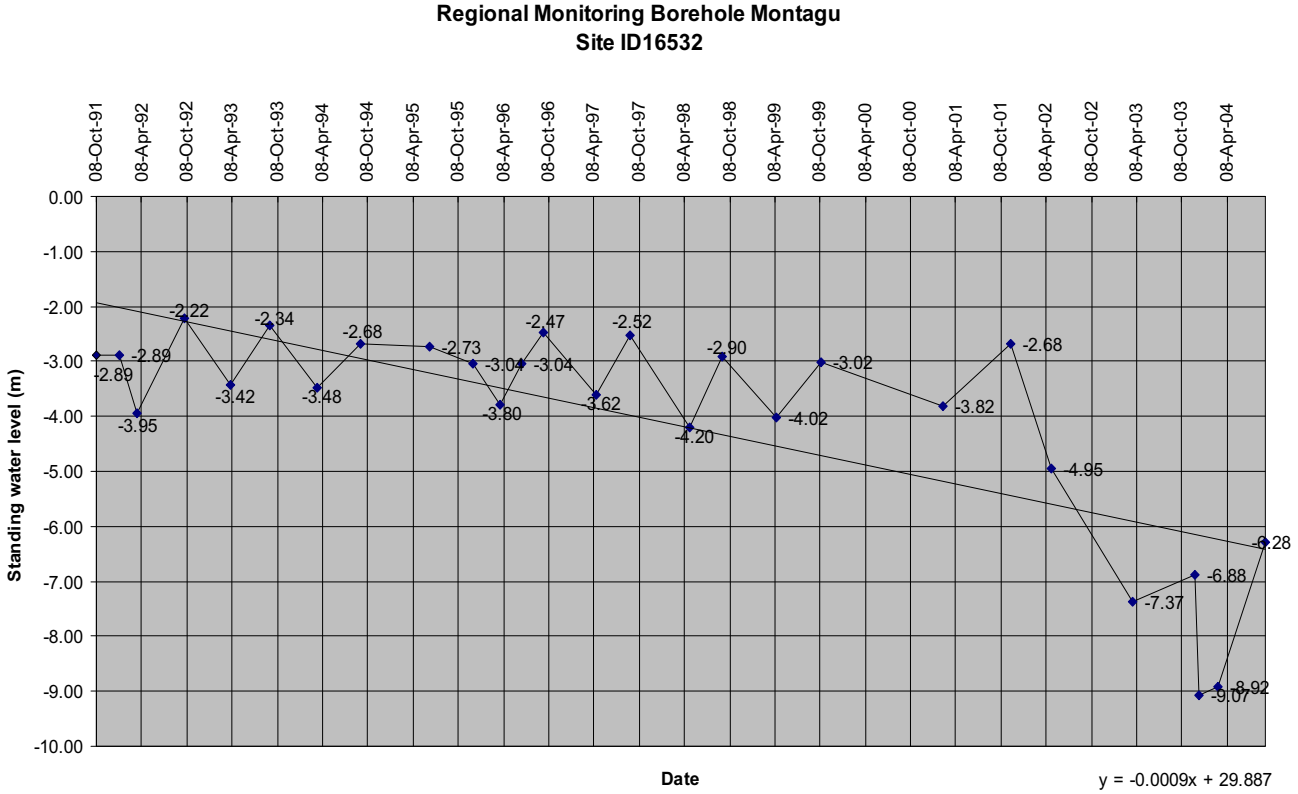
Melton Mowbray



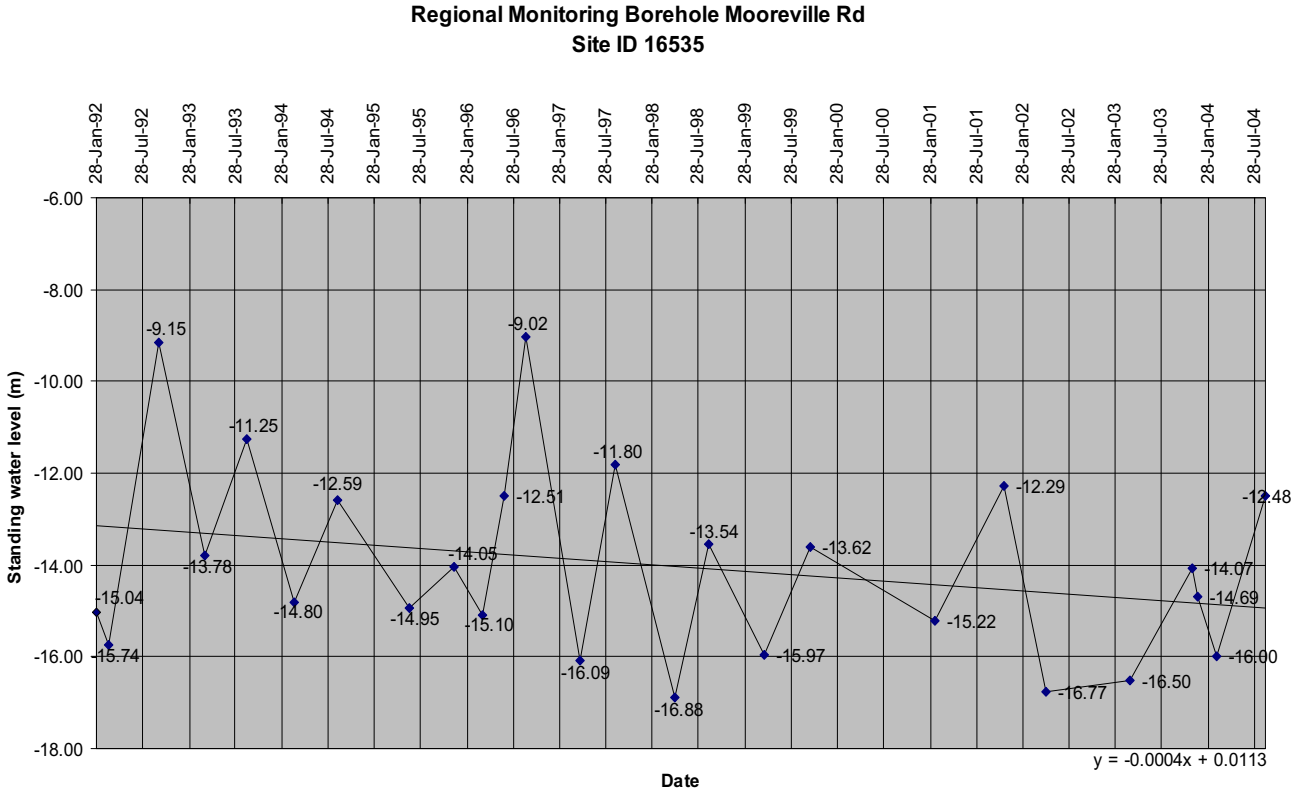
Montagu (to 1999)



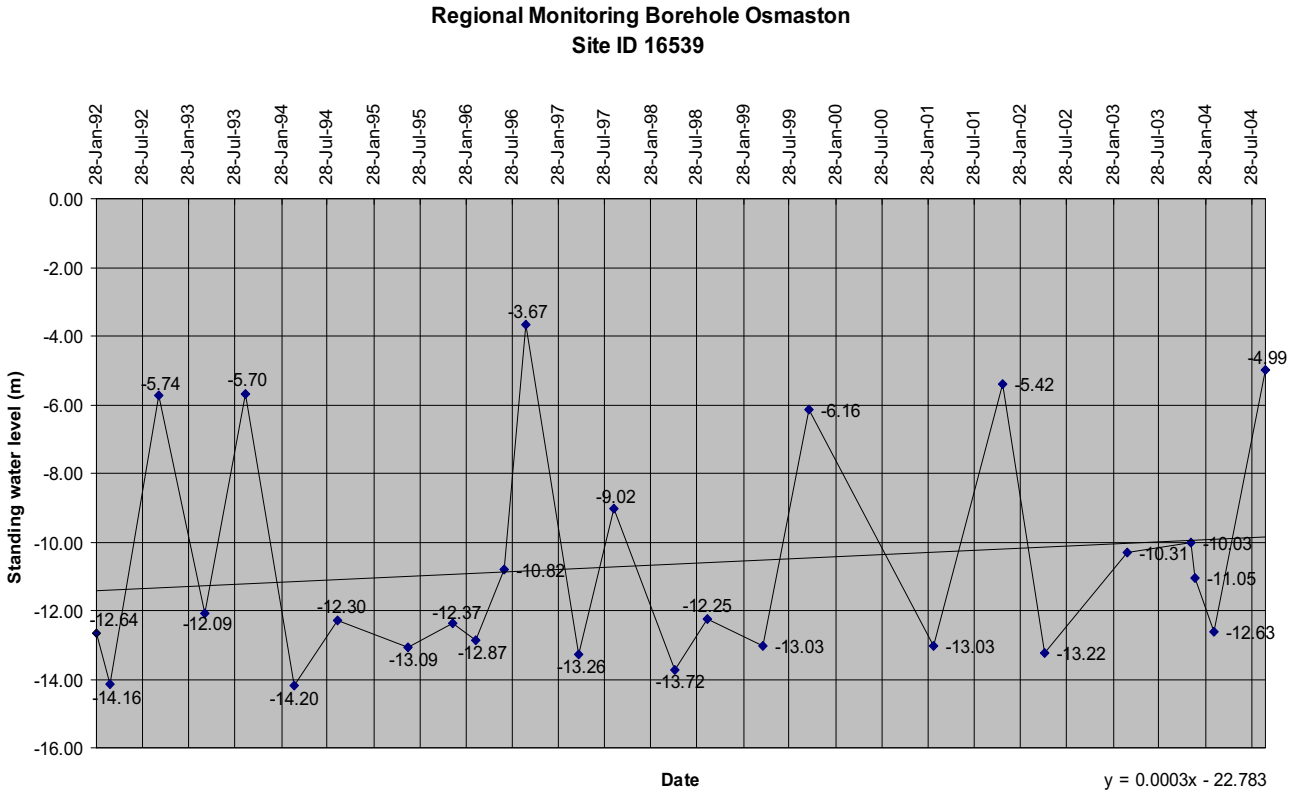
Montagu



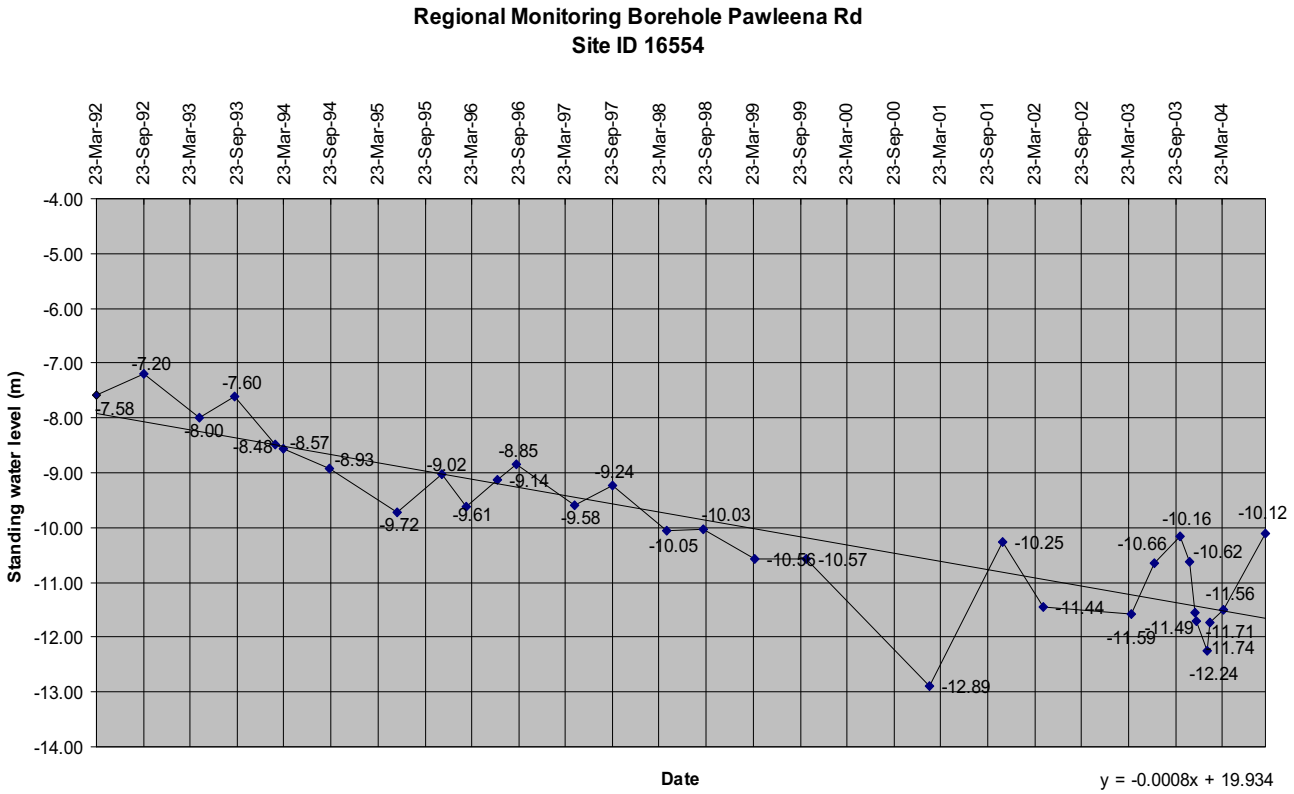
Mooreville Road



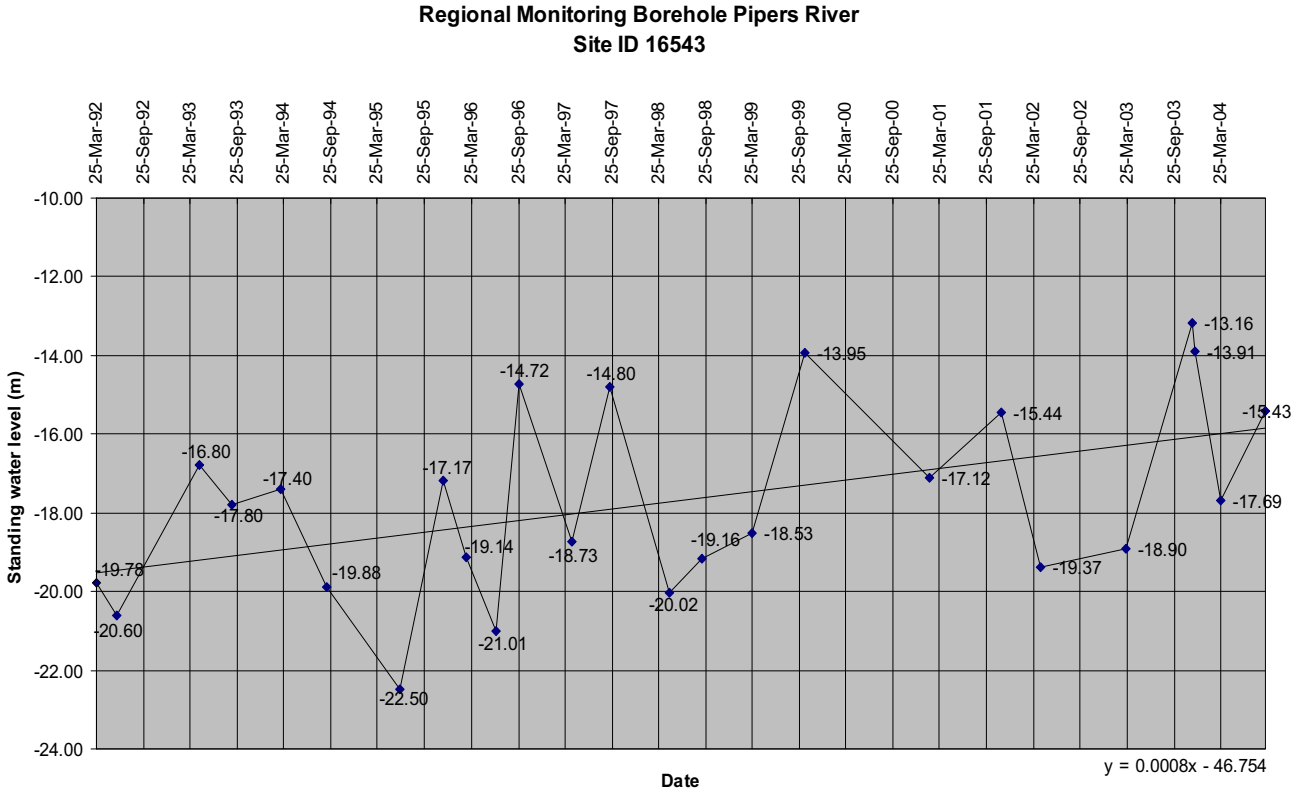
Osmaston



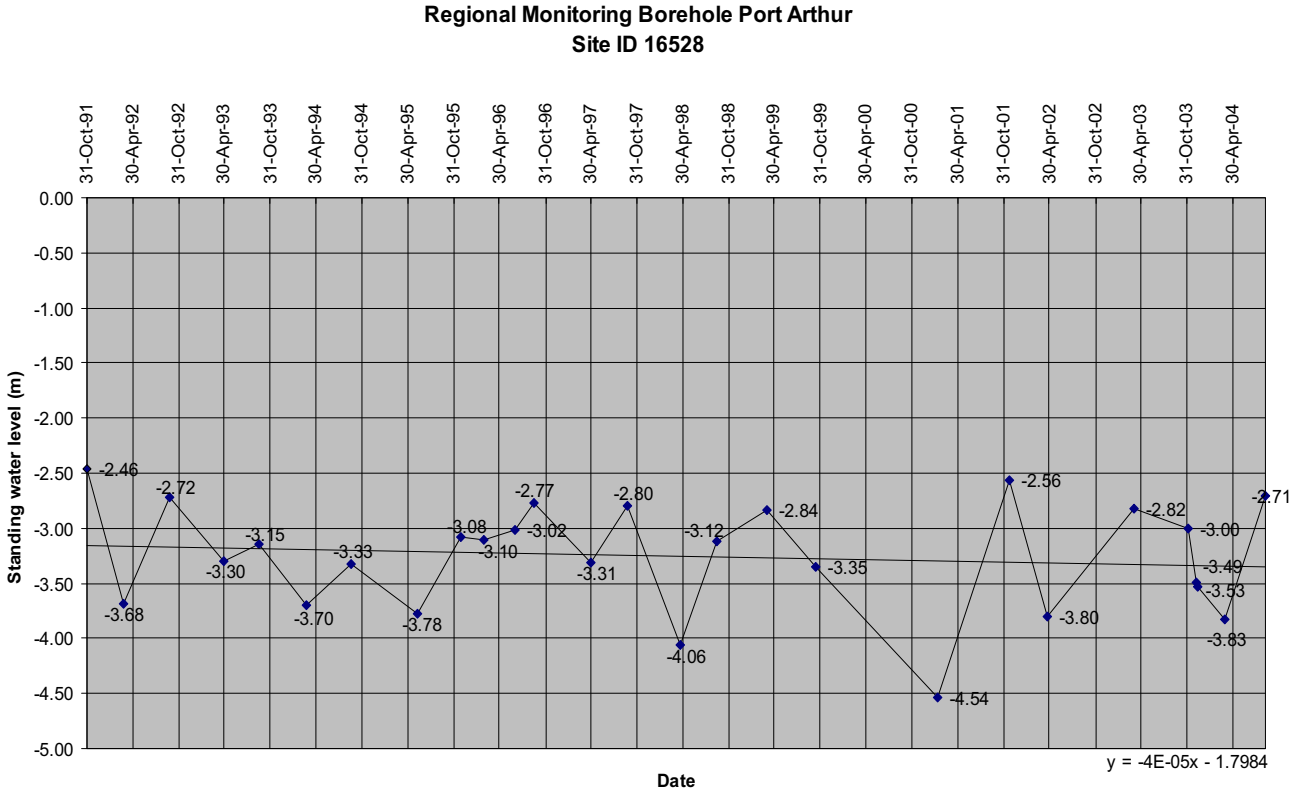
Pawleena Road



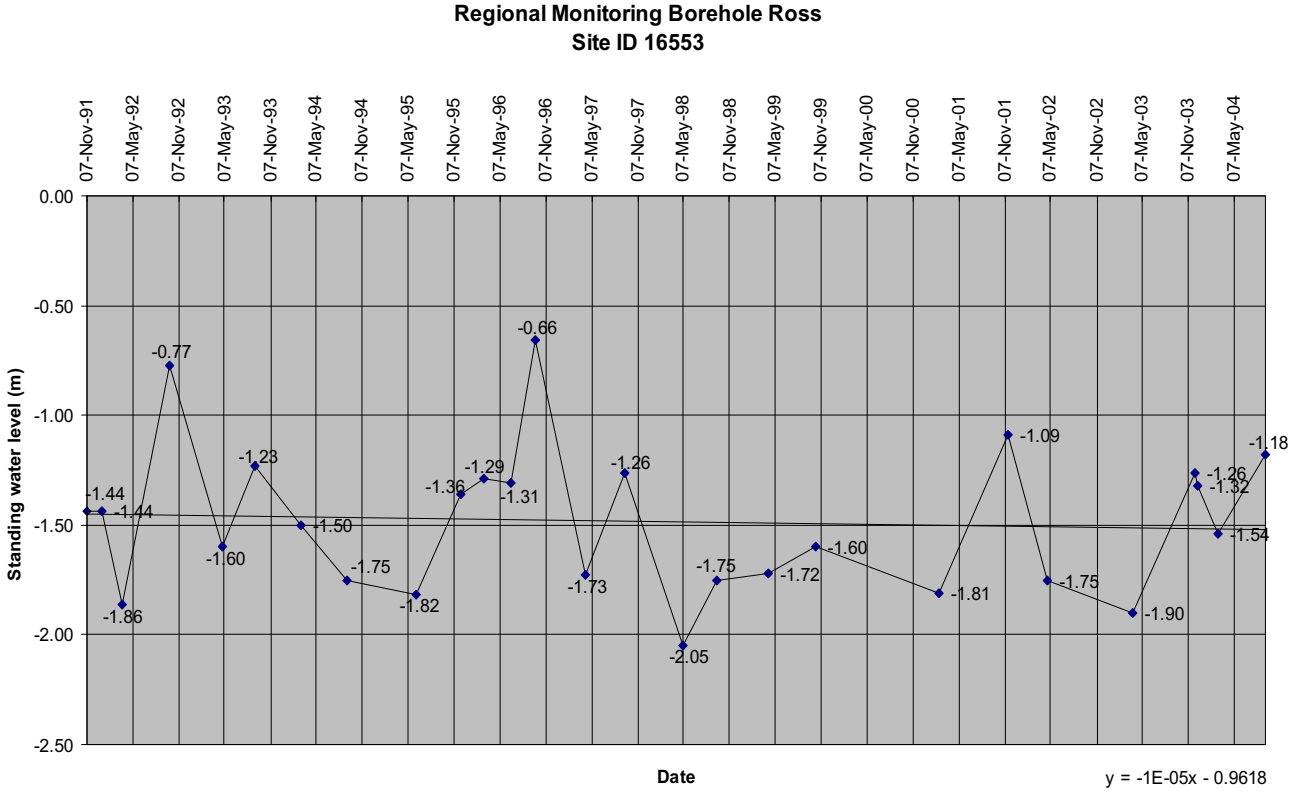
Pipers River



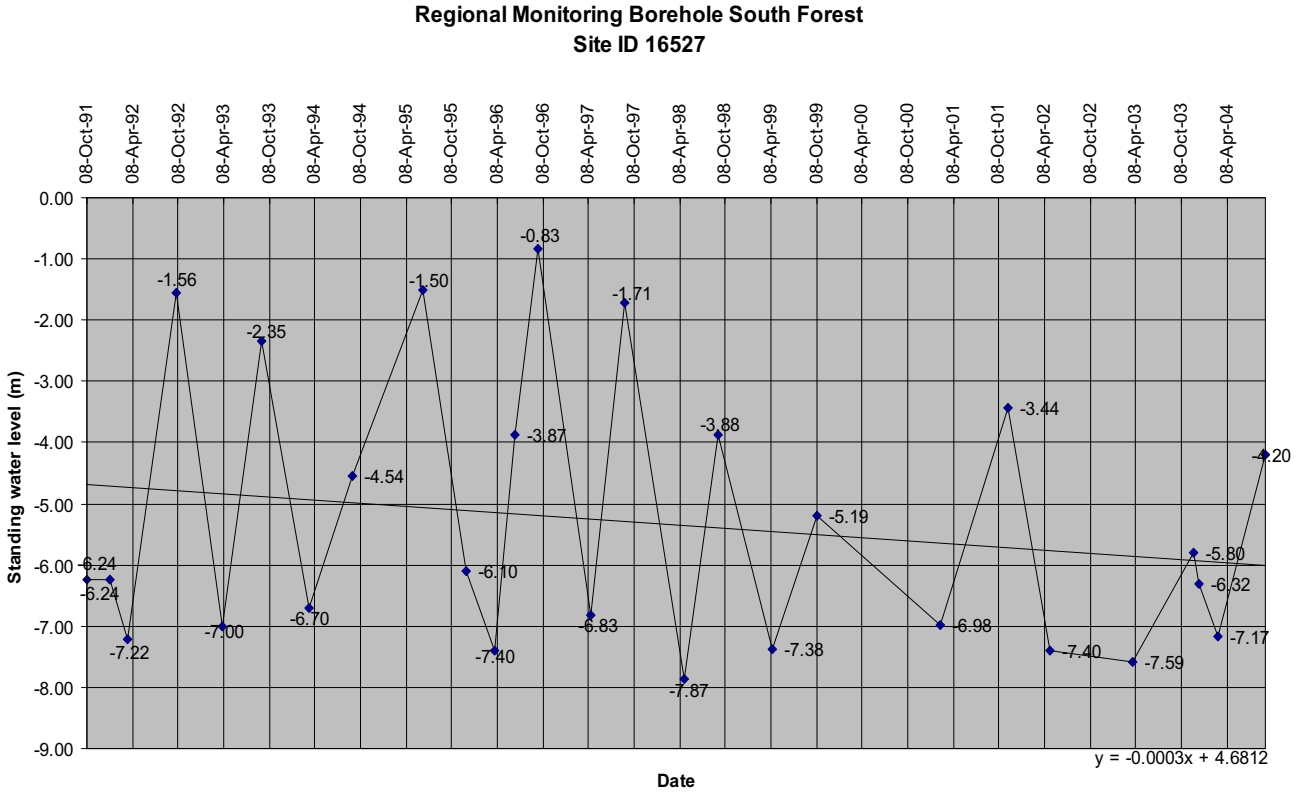
Port Arthur



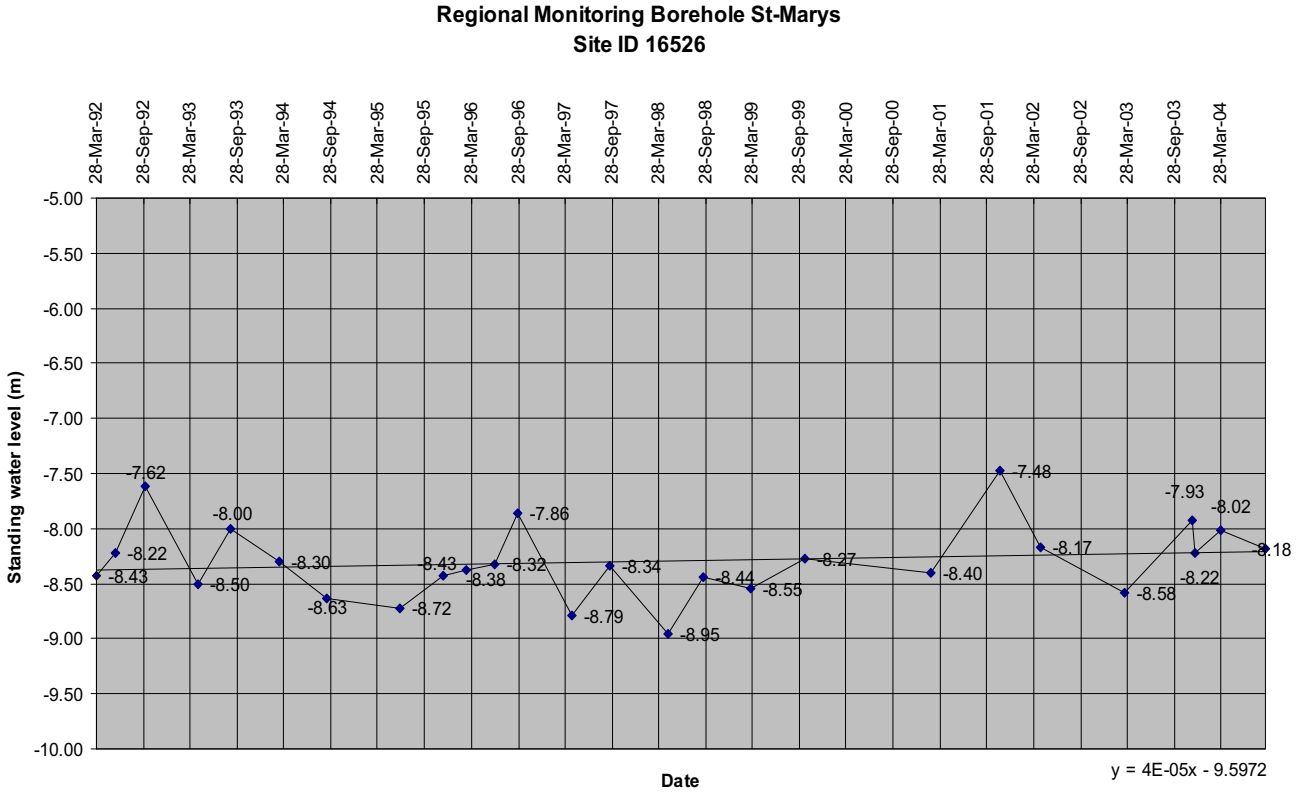
Ross



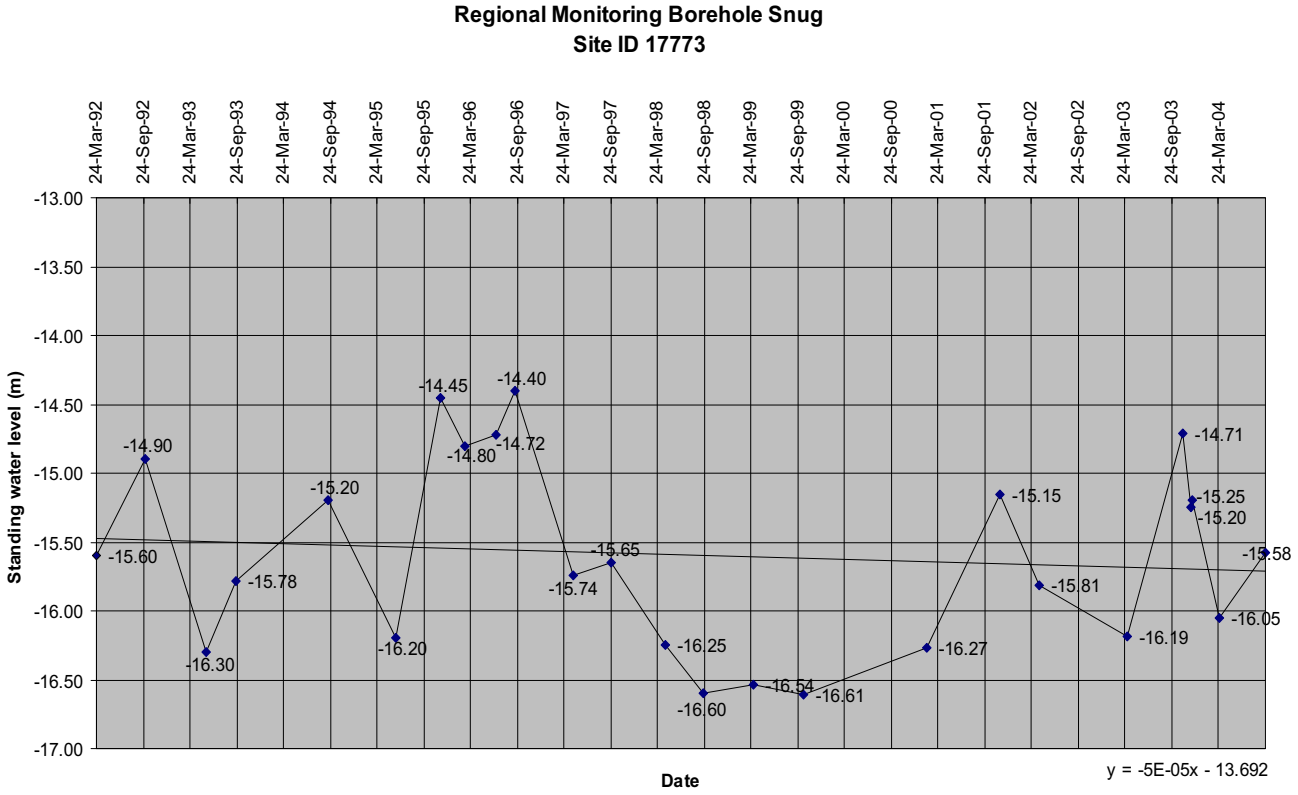
South Forest



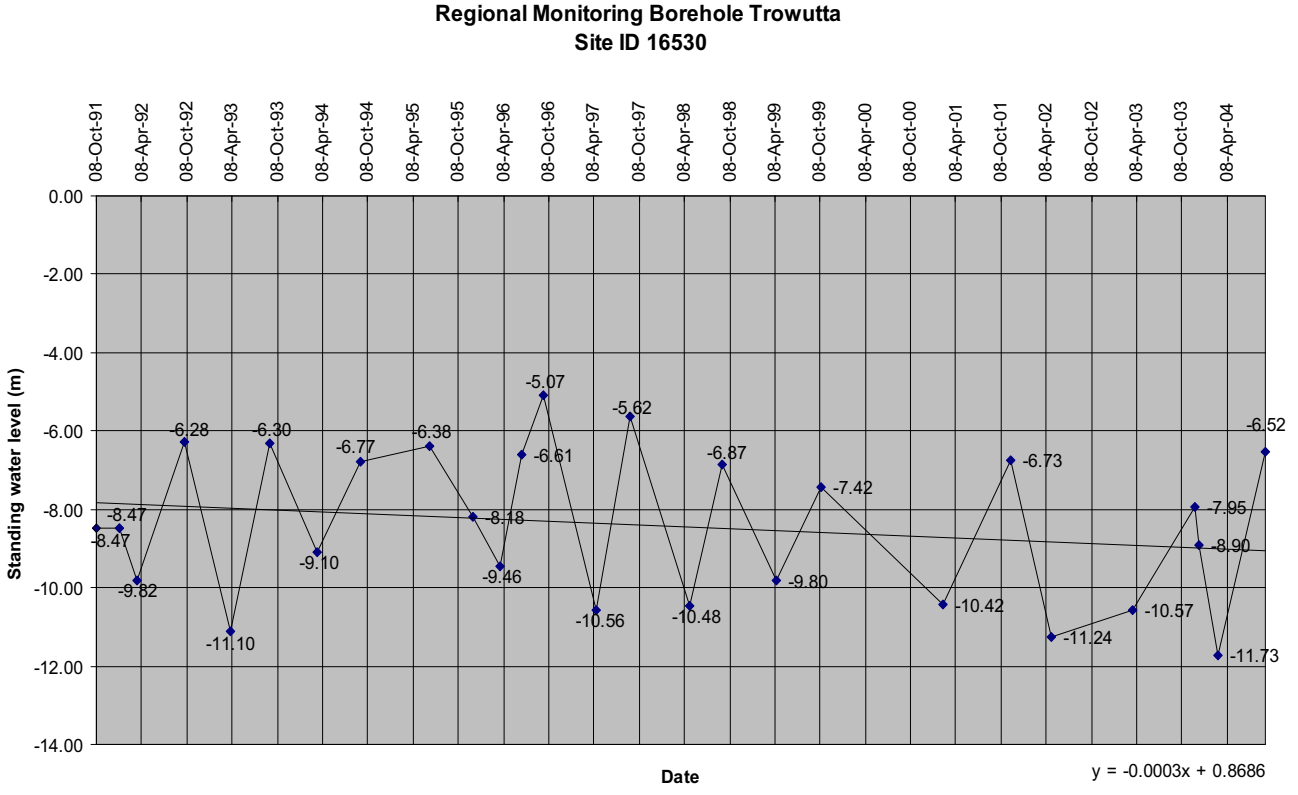
St Marys



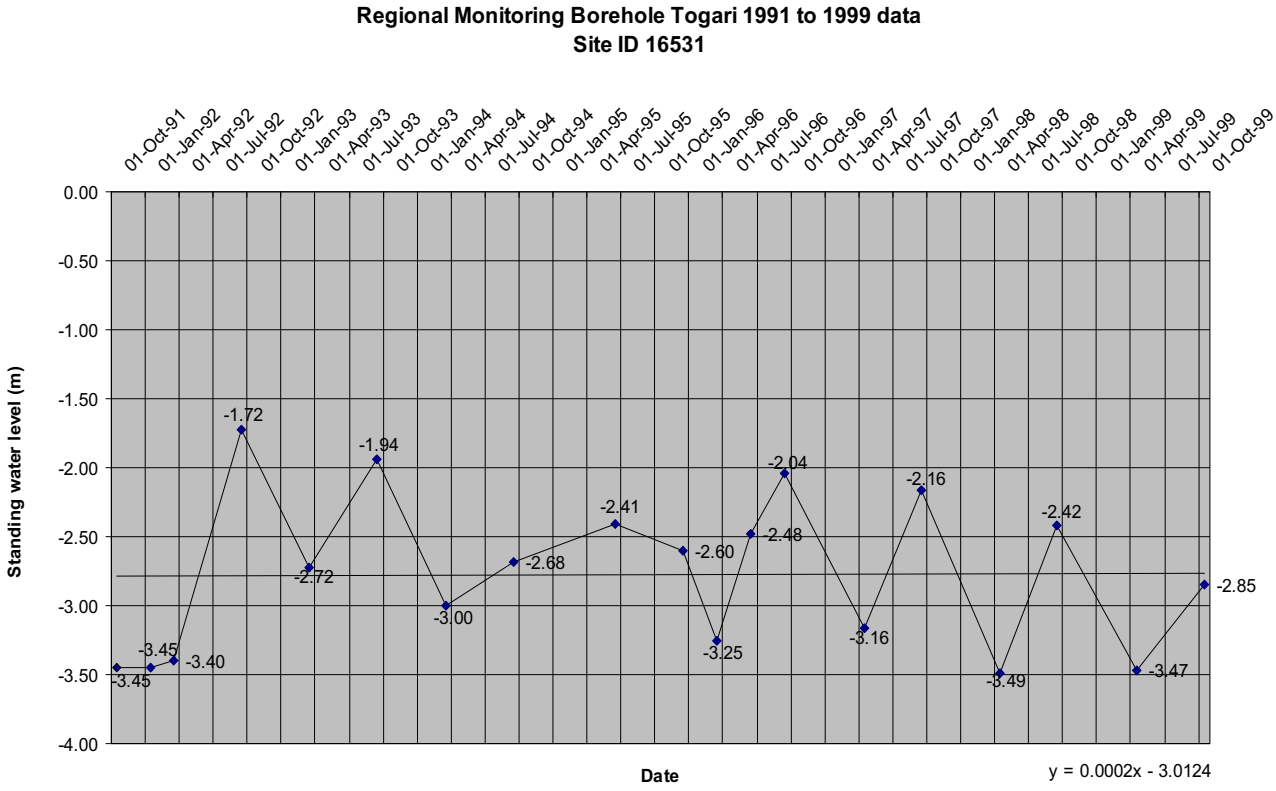
Snug



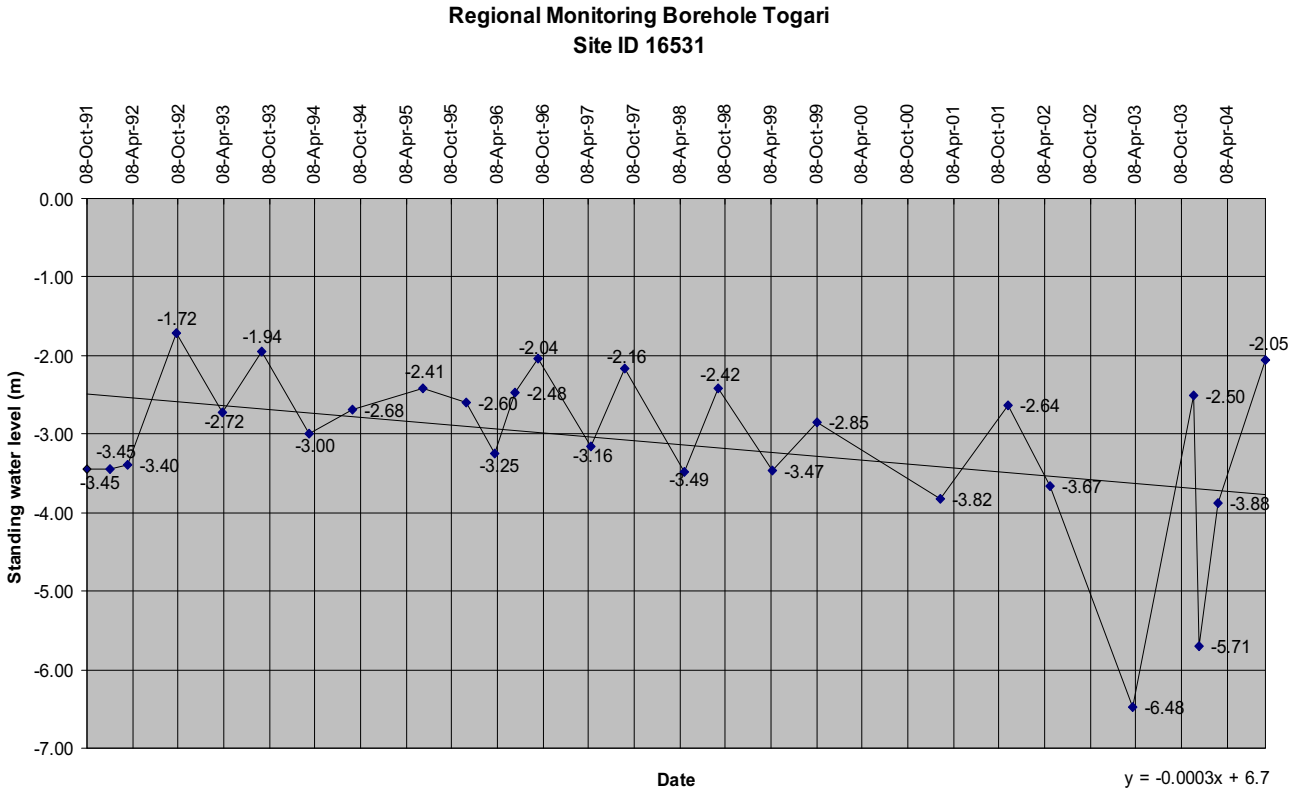
Trowutta



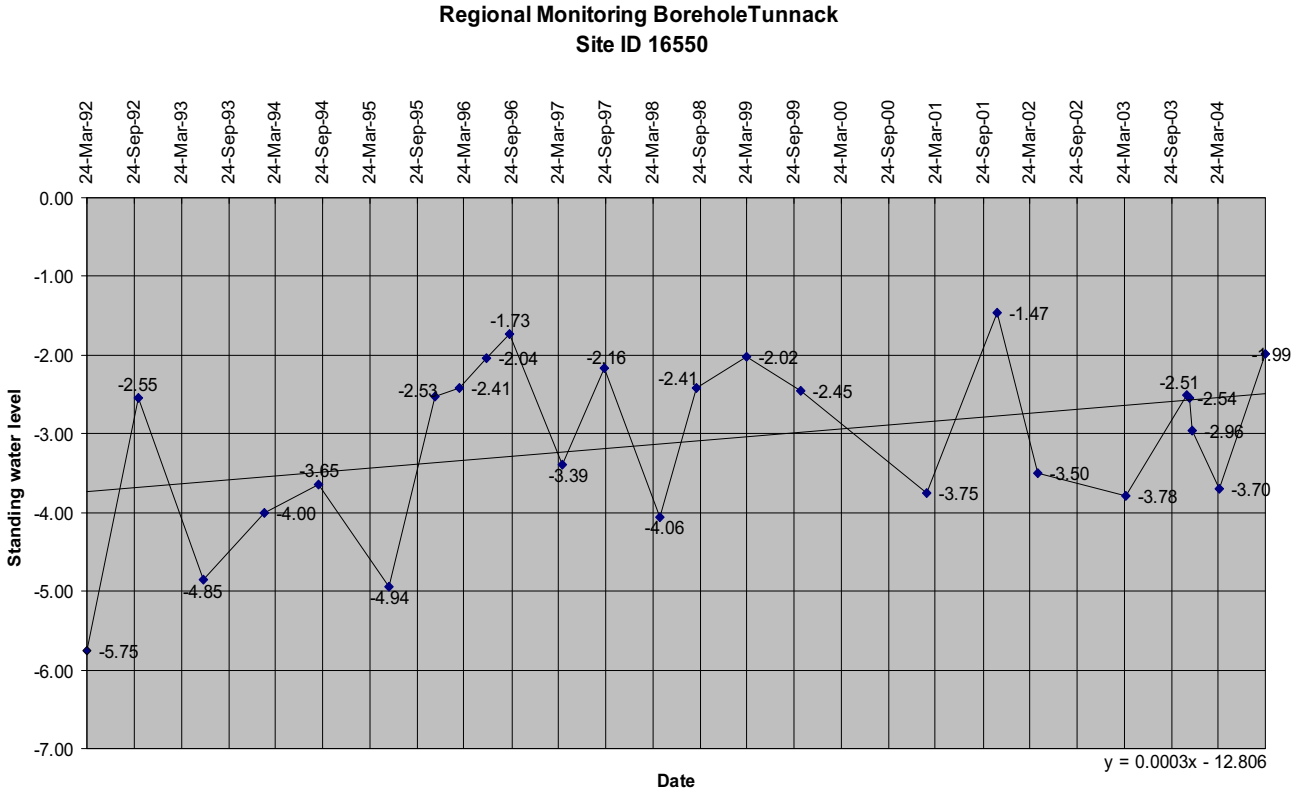
Togari (to 1999)



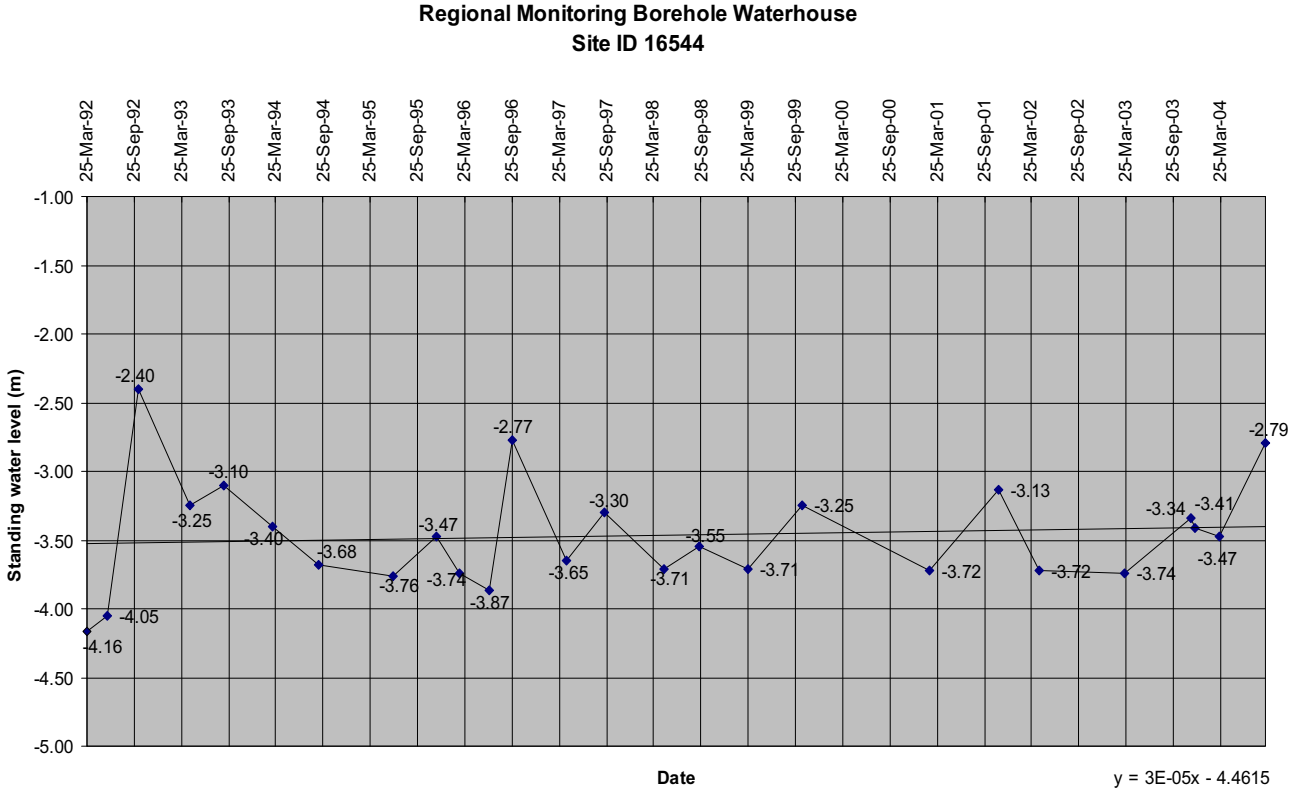
Togari



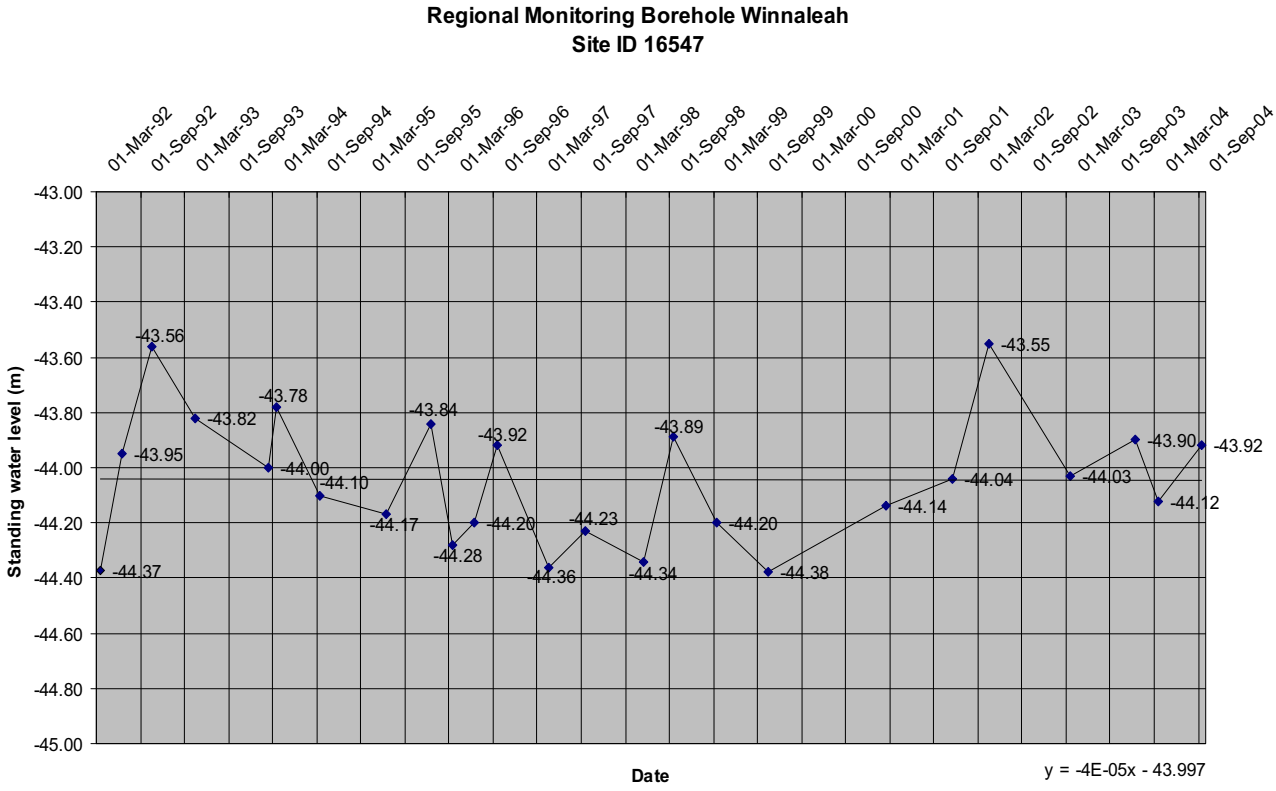
Tunnack



Waterhouse



Winnaleah


Regional Monitoring Borehole Winnaleah
Site ID 16547
Standing water level (m)
Date
y = -4E-05x - 43.997
-43.00
-43.20
-43.40
-43.60
-43.80
-44.00
-44.20
-44.40
-44.60
-44.80
-45.00
01-Mar-92
01-Sep-92
01-Mar-93
01-Sep-93
01-Mar-94
01-Sep-94
01-Mar-95
01-Sep-95
01-Mar-96
01-Sep-96
01-Mar-97
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01-Mar-02
01-Sep-02
01-Mar-03
01-Sep-03
01-Mar-04
01-Sep-04
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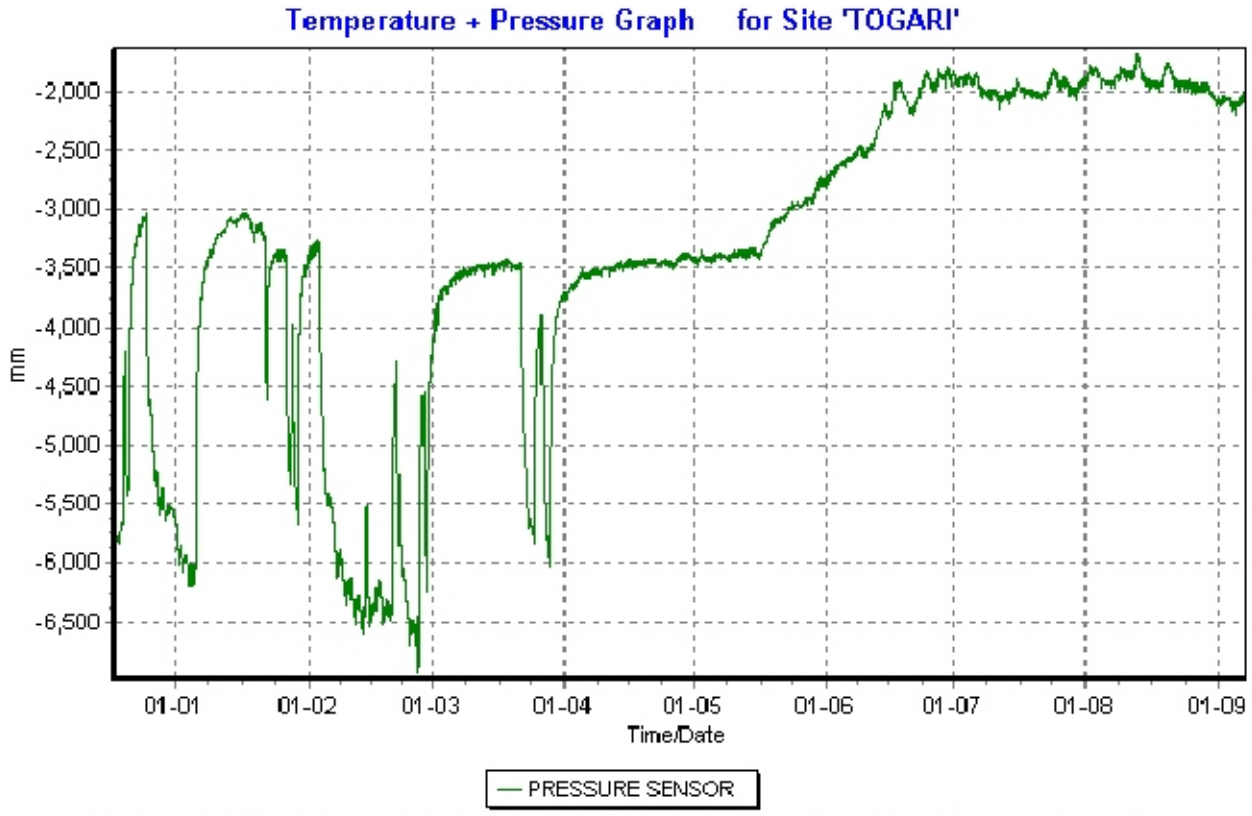
-43.56
-43.95
-43.82
-43.78
-44.00
-44.10
-44.17
-43.84
-44.28
-44.20
-43.92
-44.36
-44.23
-44.34
-43.89
-44.20
-44.38
-44.14
-44.04
-43.55
-44.03
-43.90
-44.12
-43.92

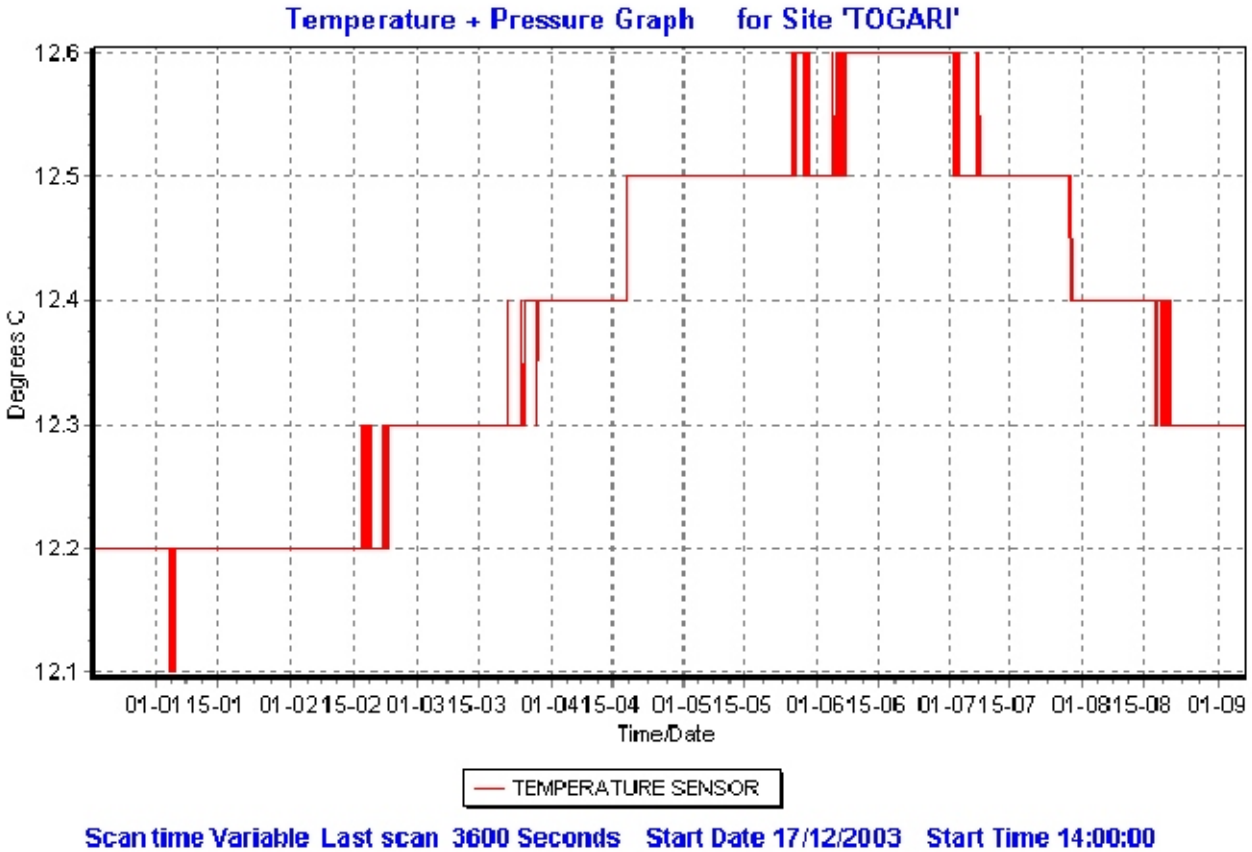
APPENDIX 3

Odyssey temperature and SWL hydrographs, December 2003 to September 2004

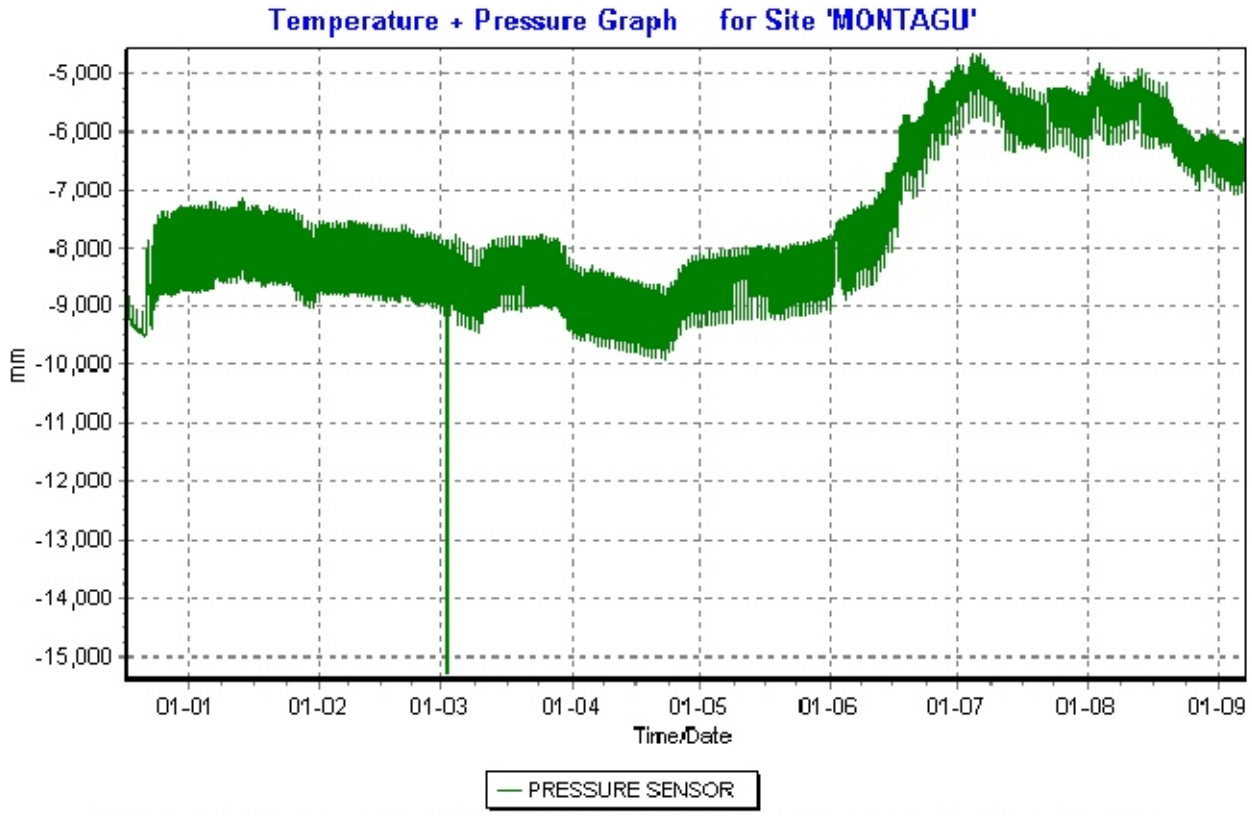
Togari (SWL)



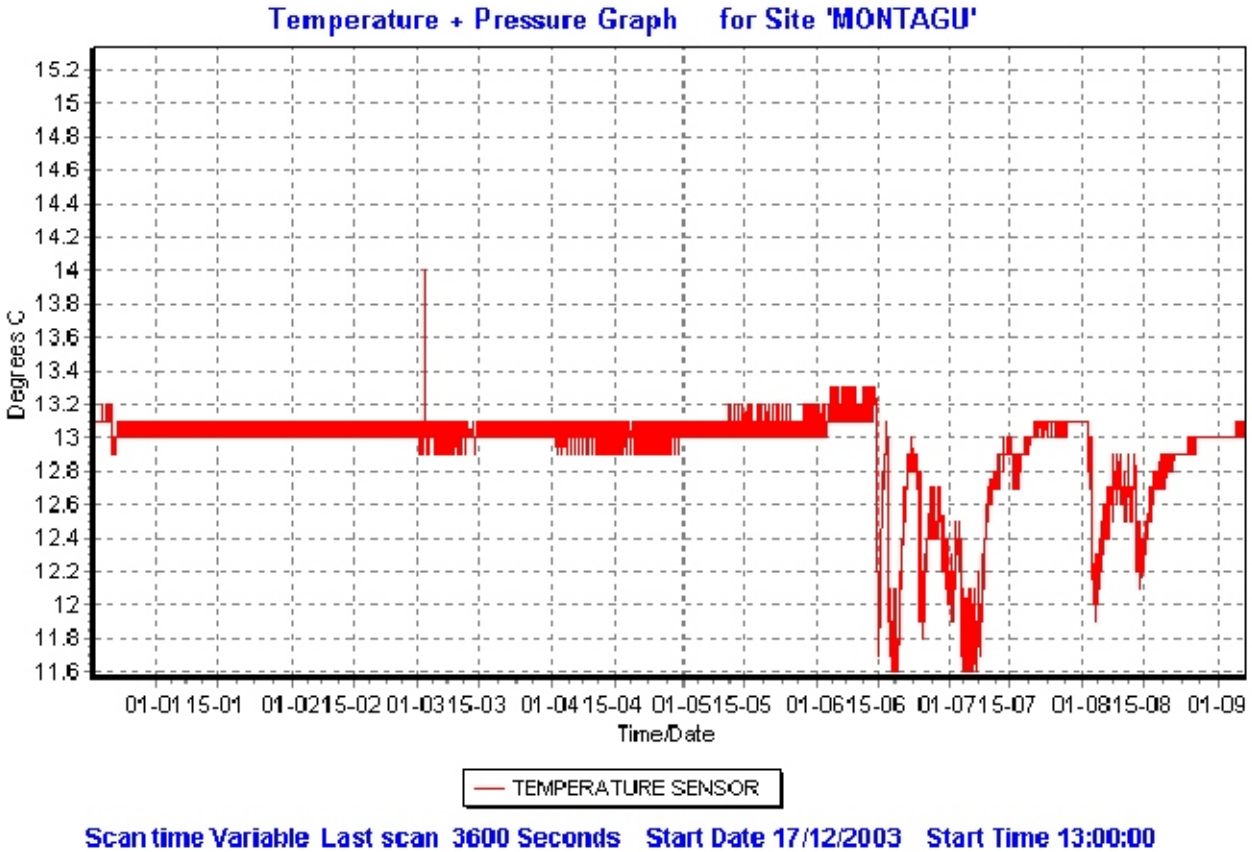
Togari (temperature)



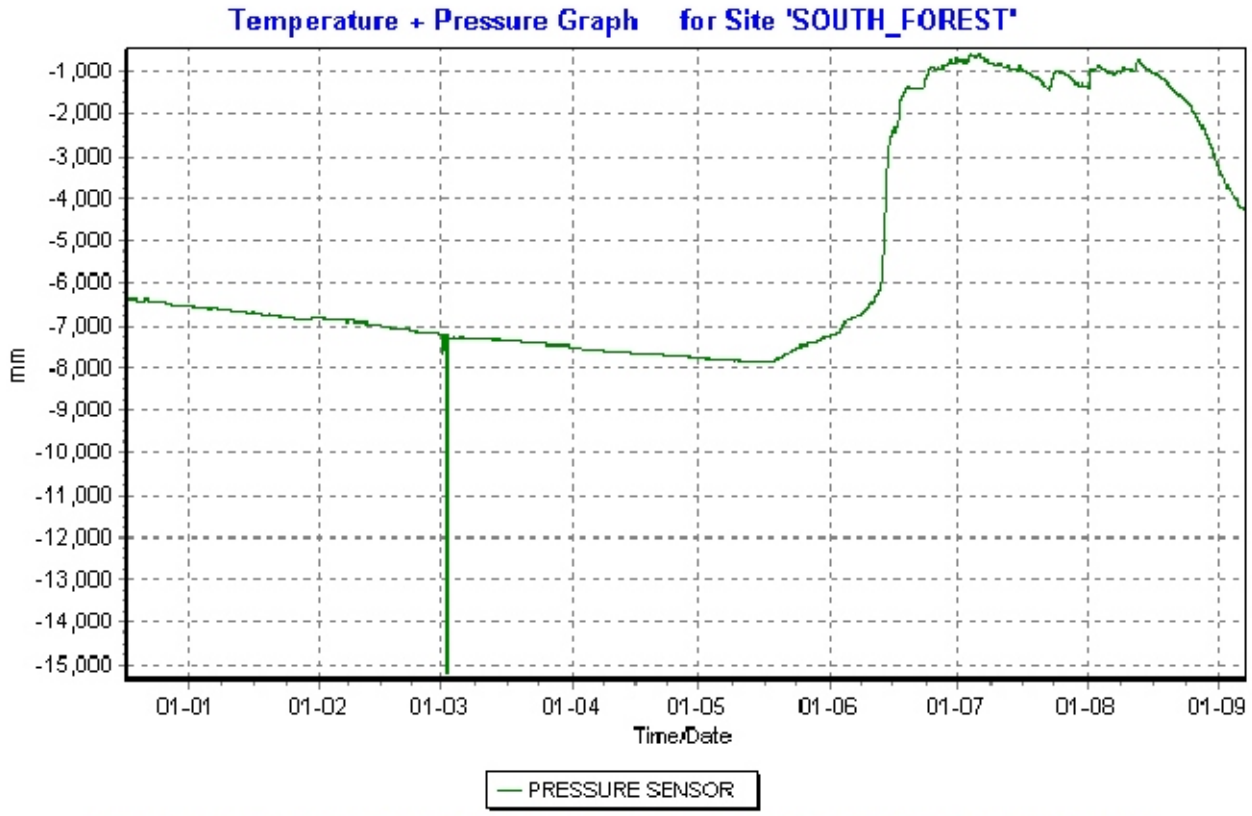
Montagu (SWL)



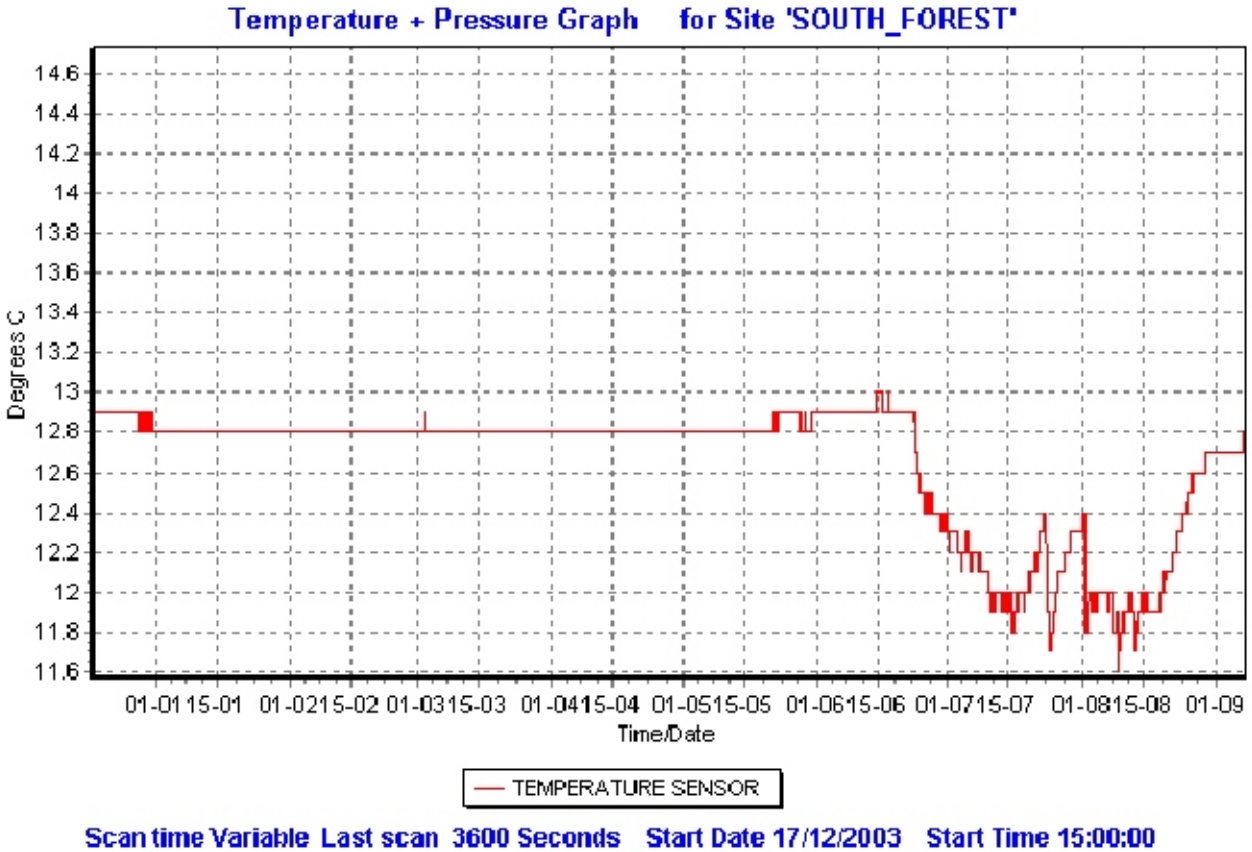
Montagu (temperature)



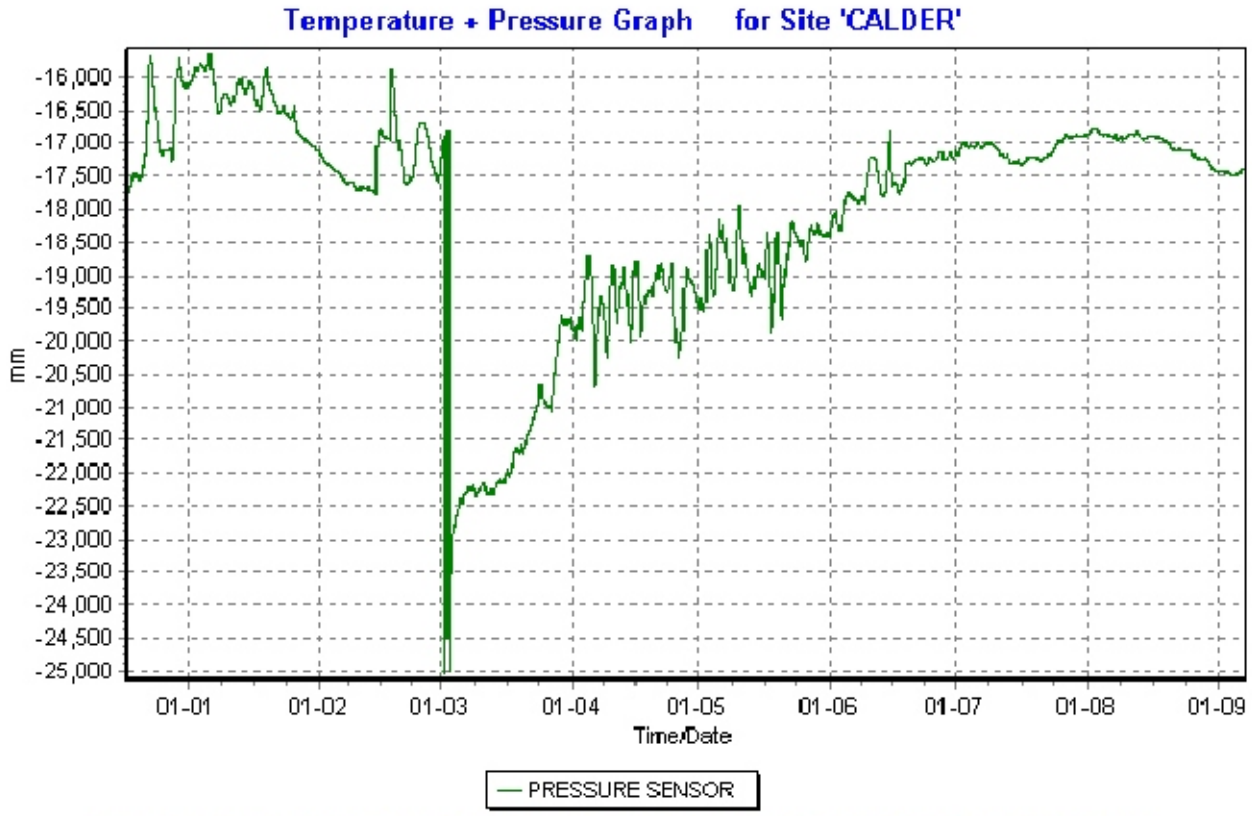
South Forest (SWL)



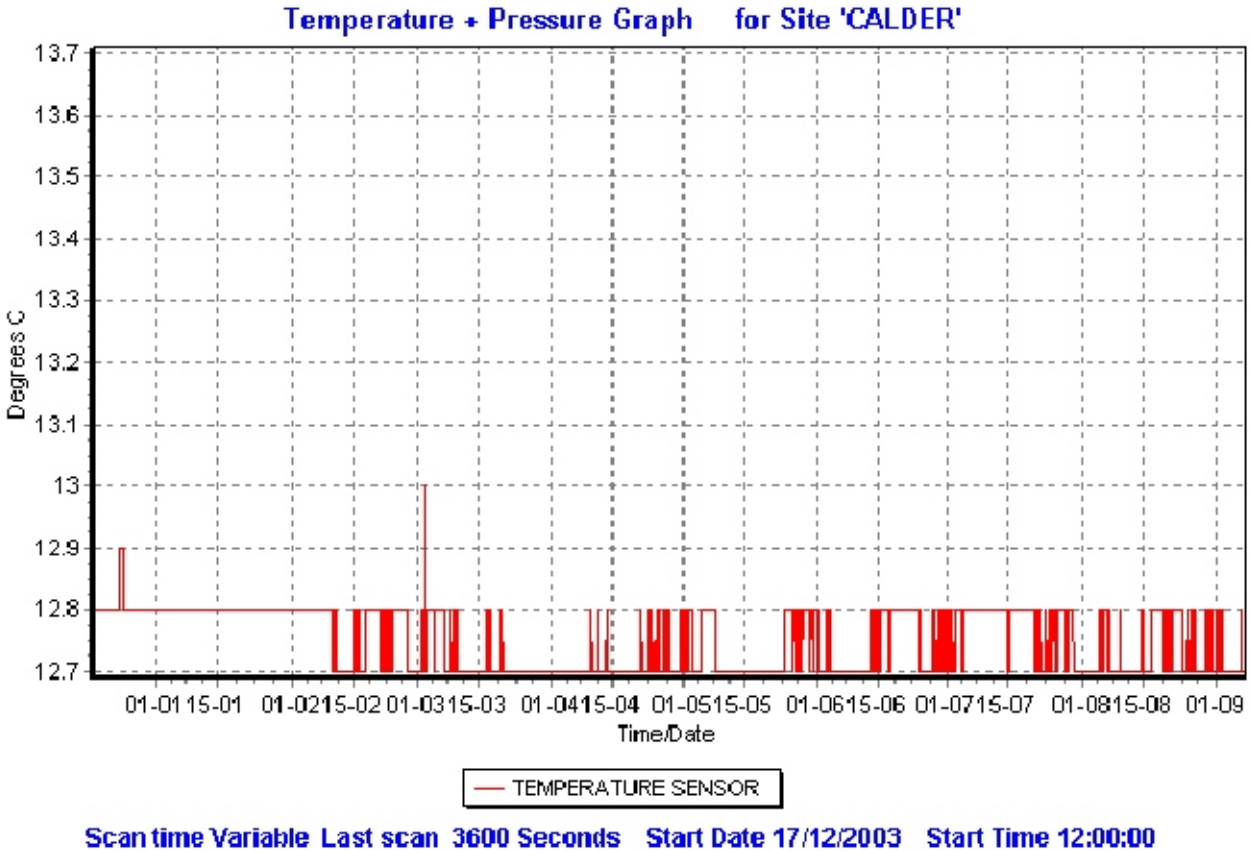
South Forest (temperature)



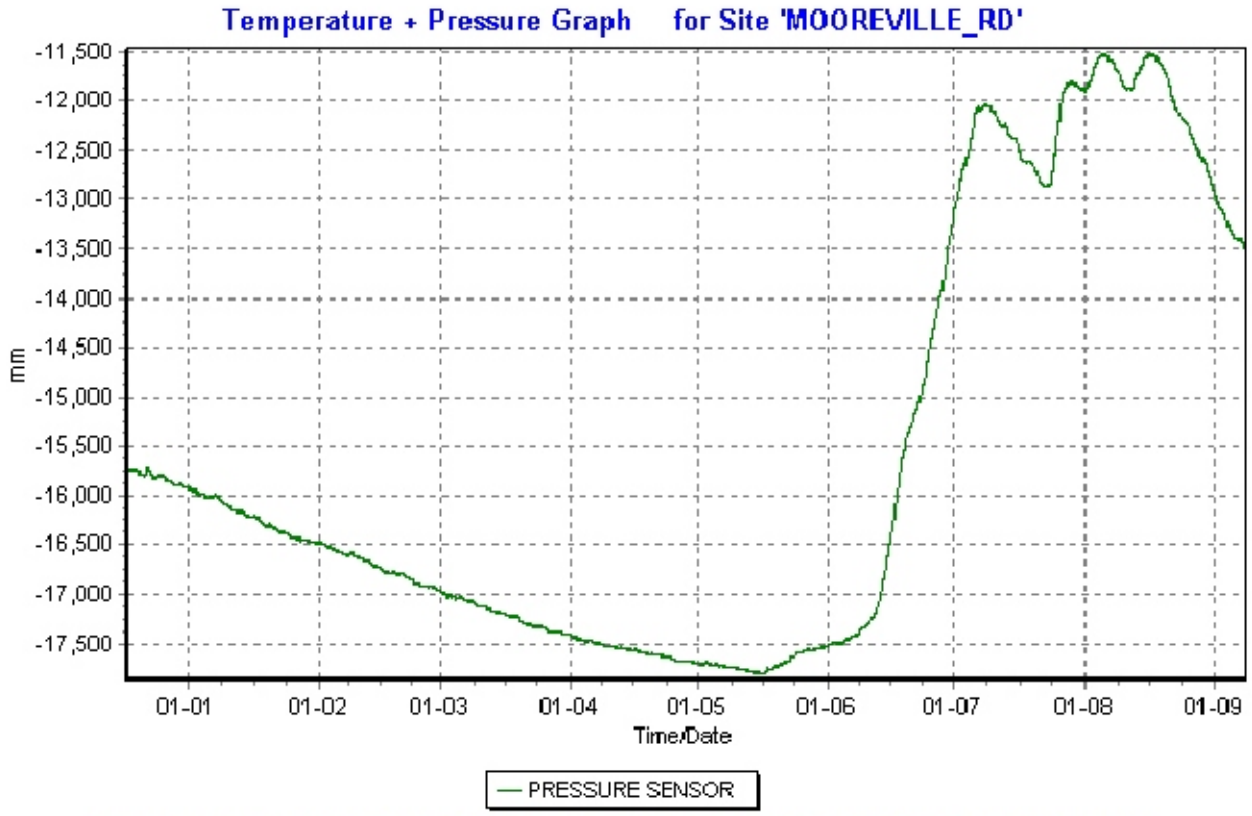
Calder (SWL)



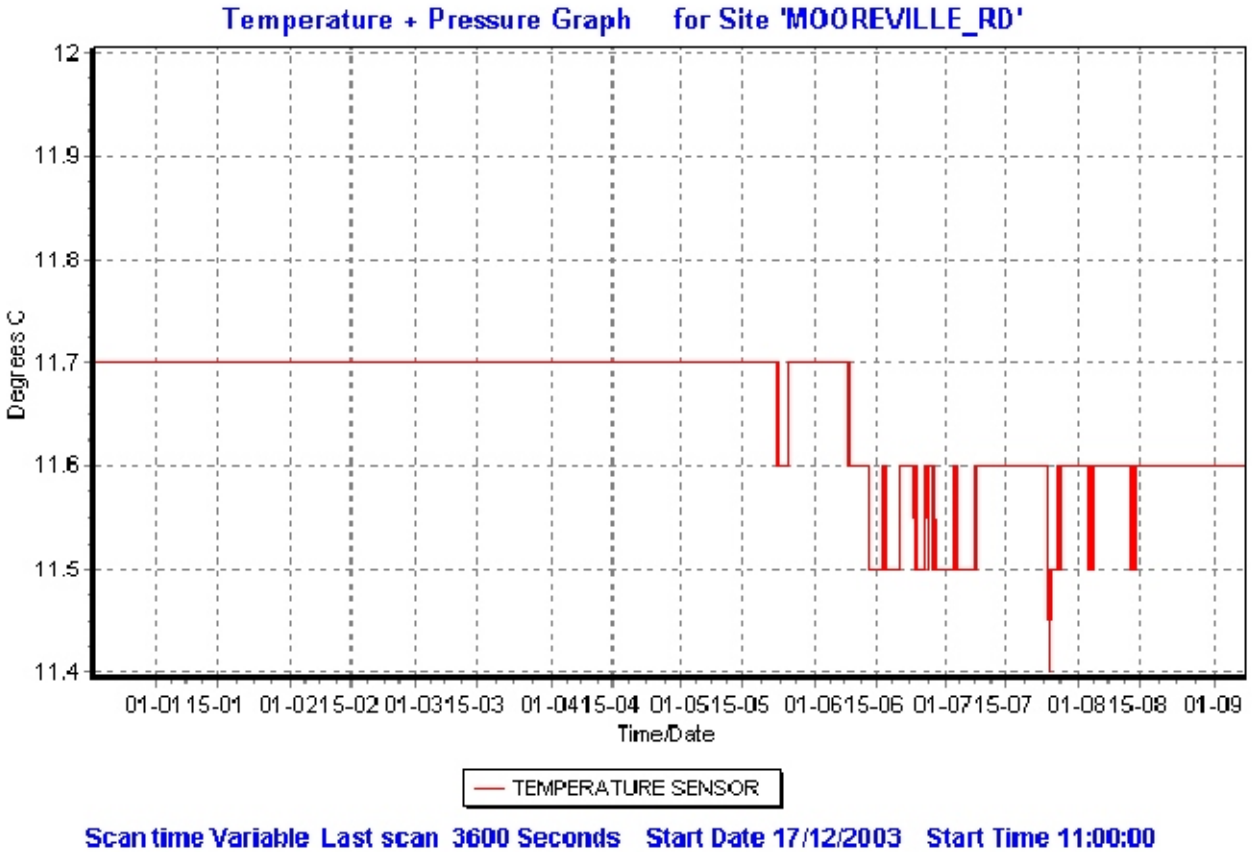
Calder (temperature)



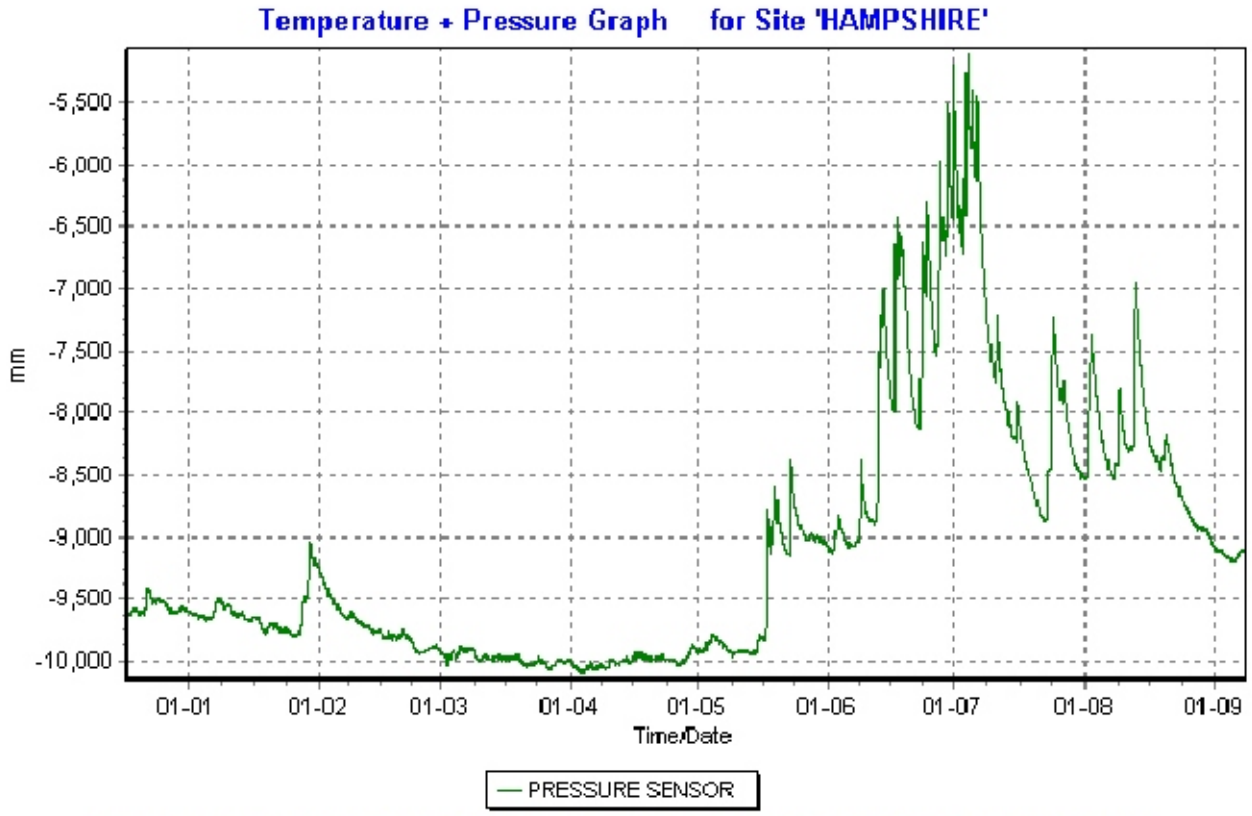
Mooreville Road (SWL)



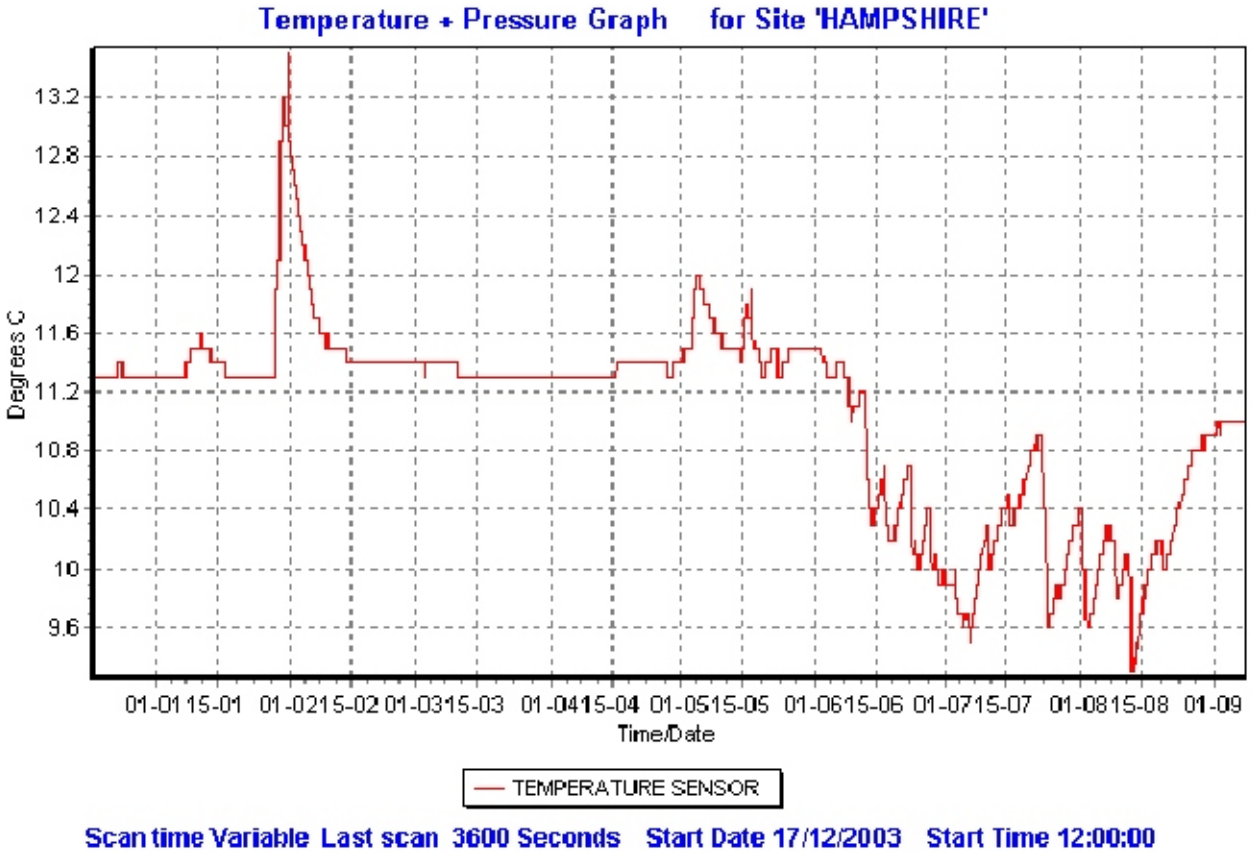
Mooreville Road (temperature)



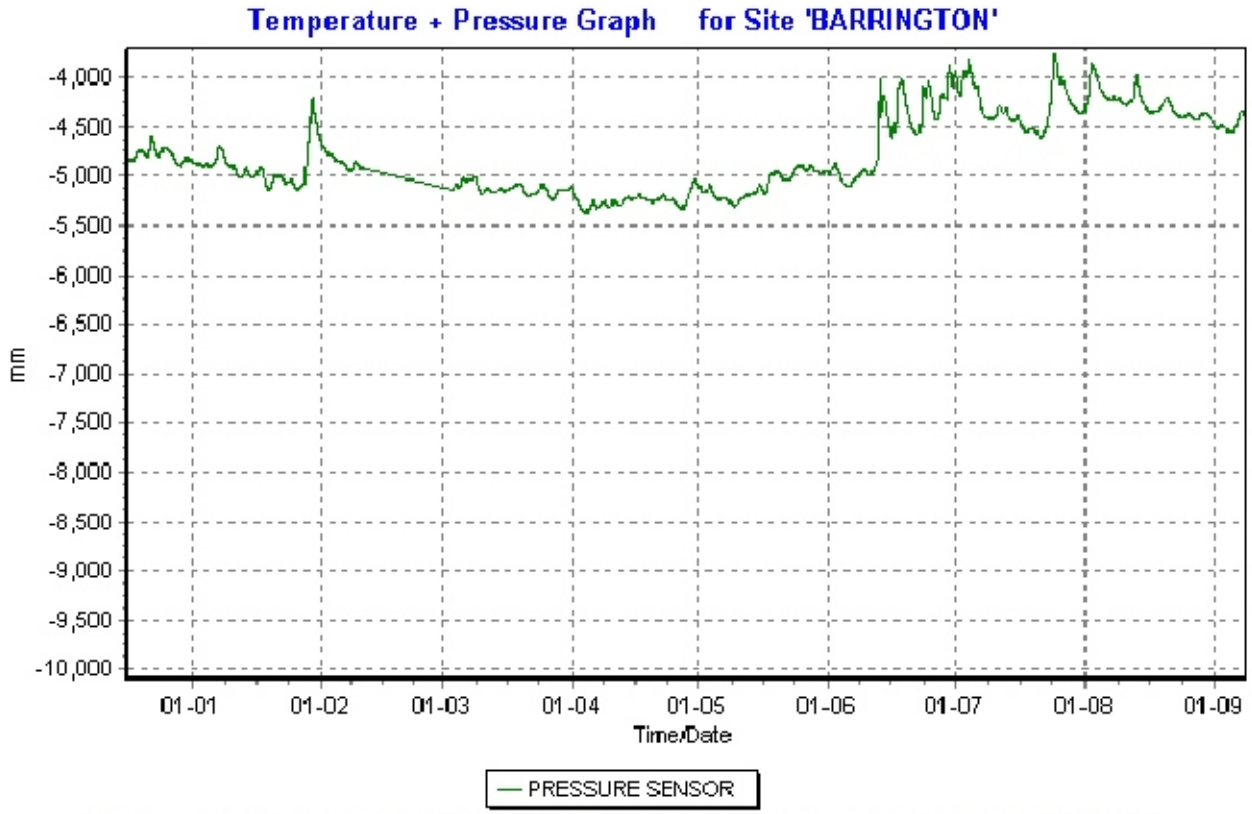
Hampshire (SWL)



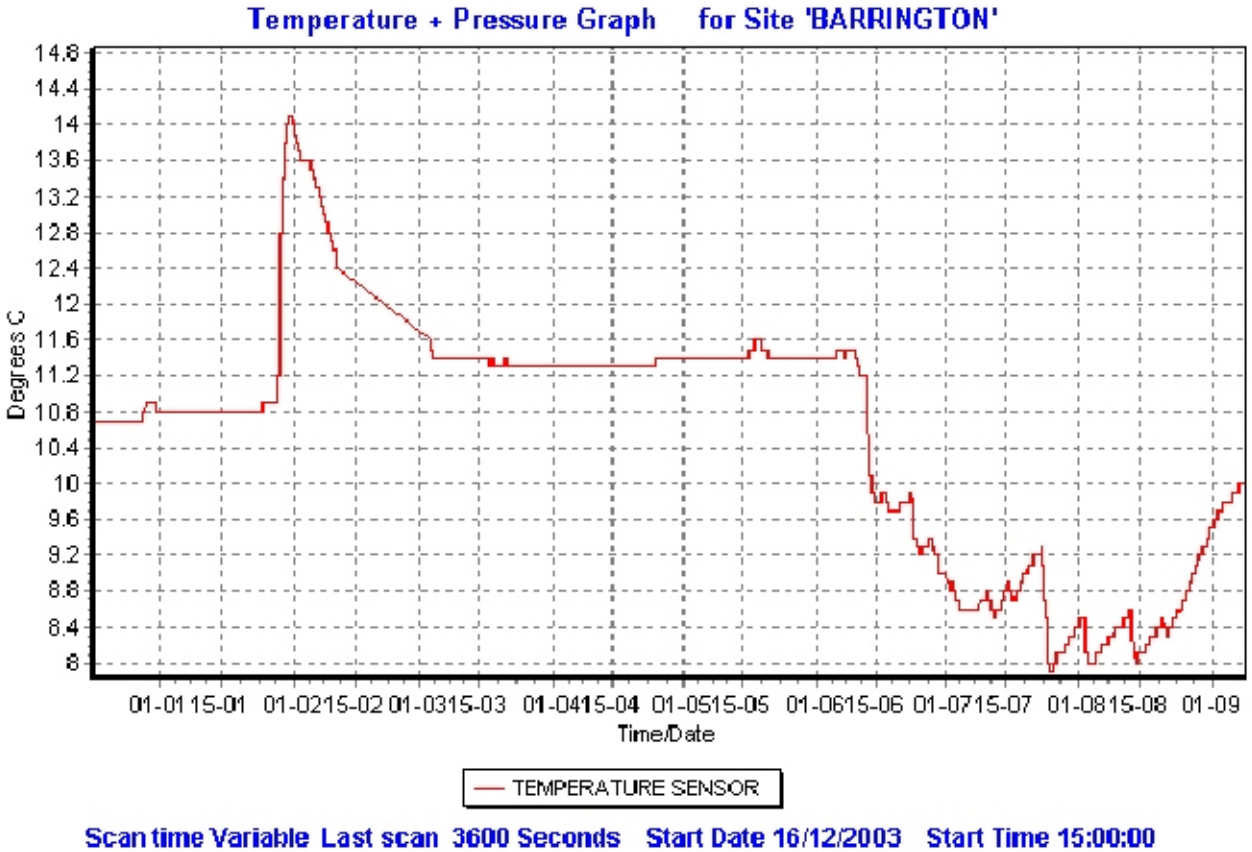
Hampshire (temperature)



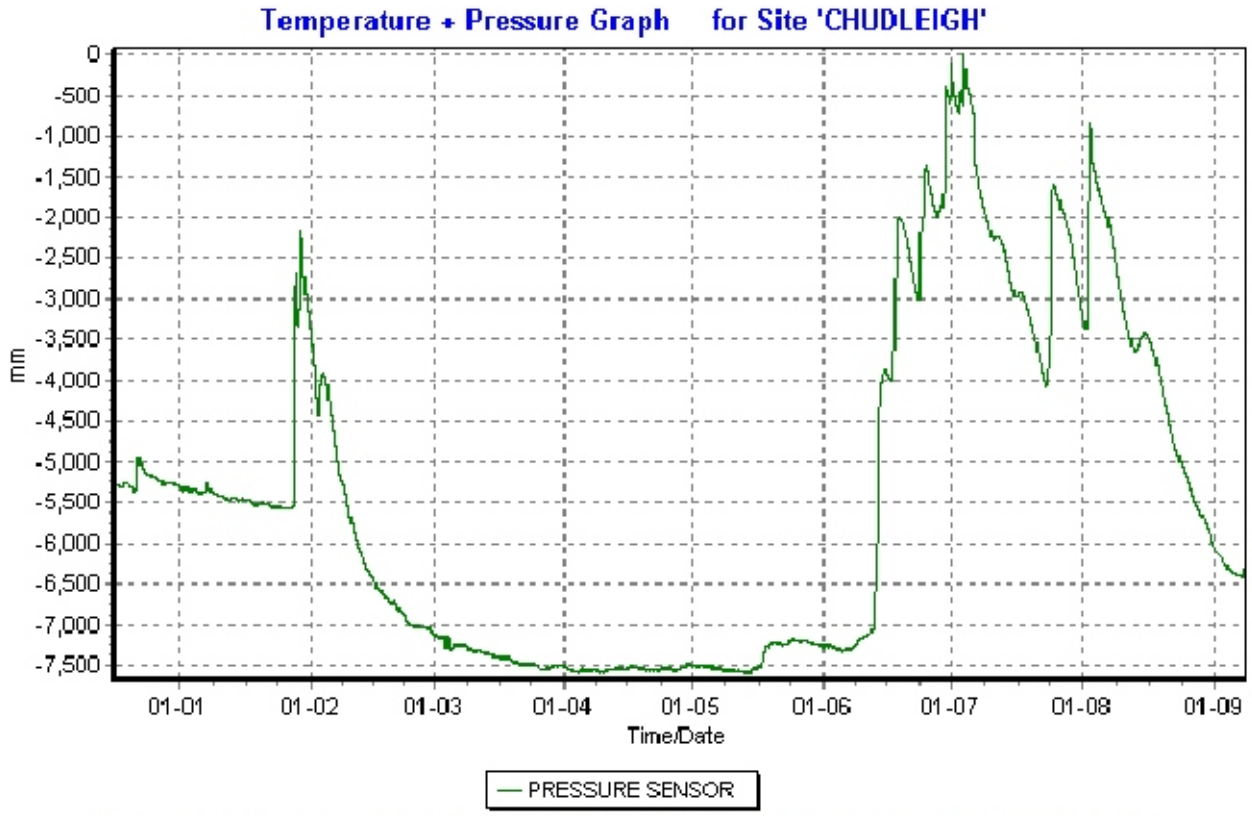
Barrington (SWL)



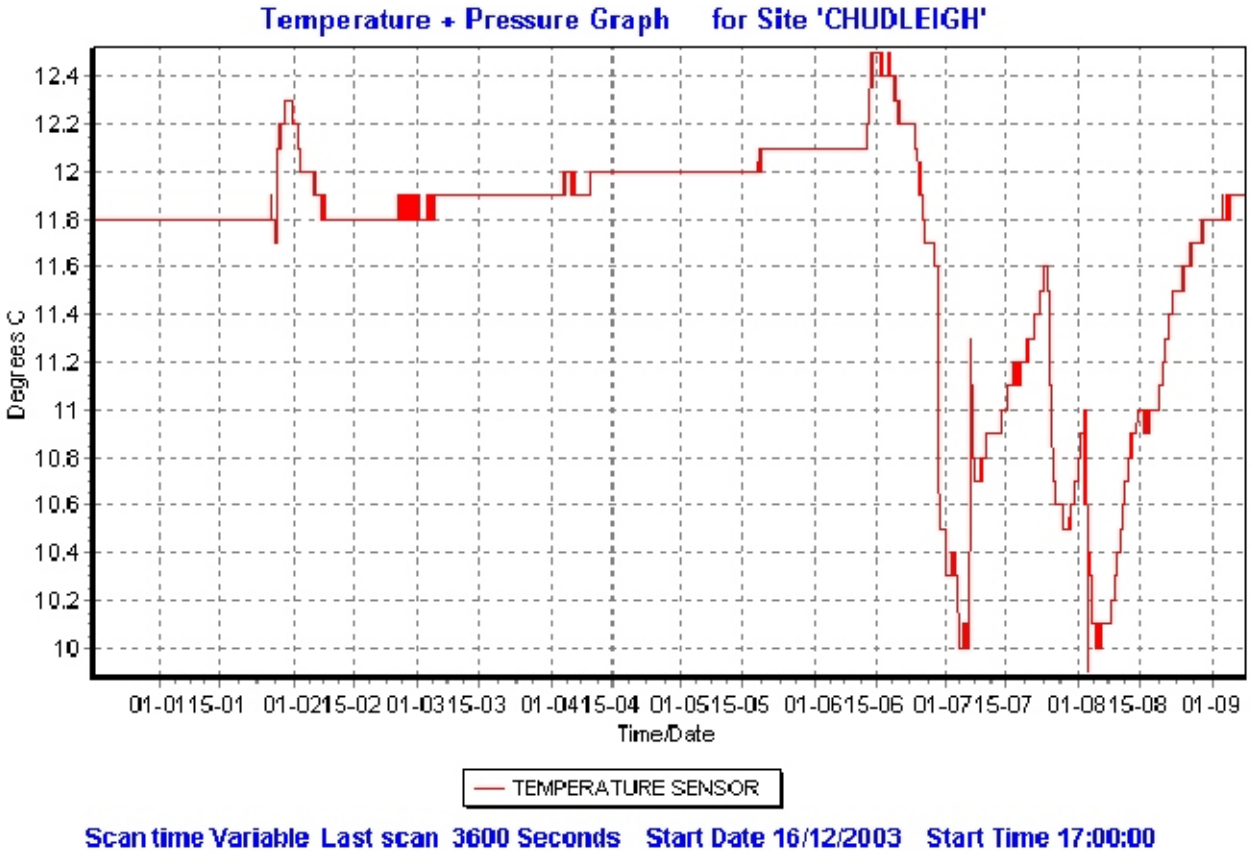
Barrington (temperature)



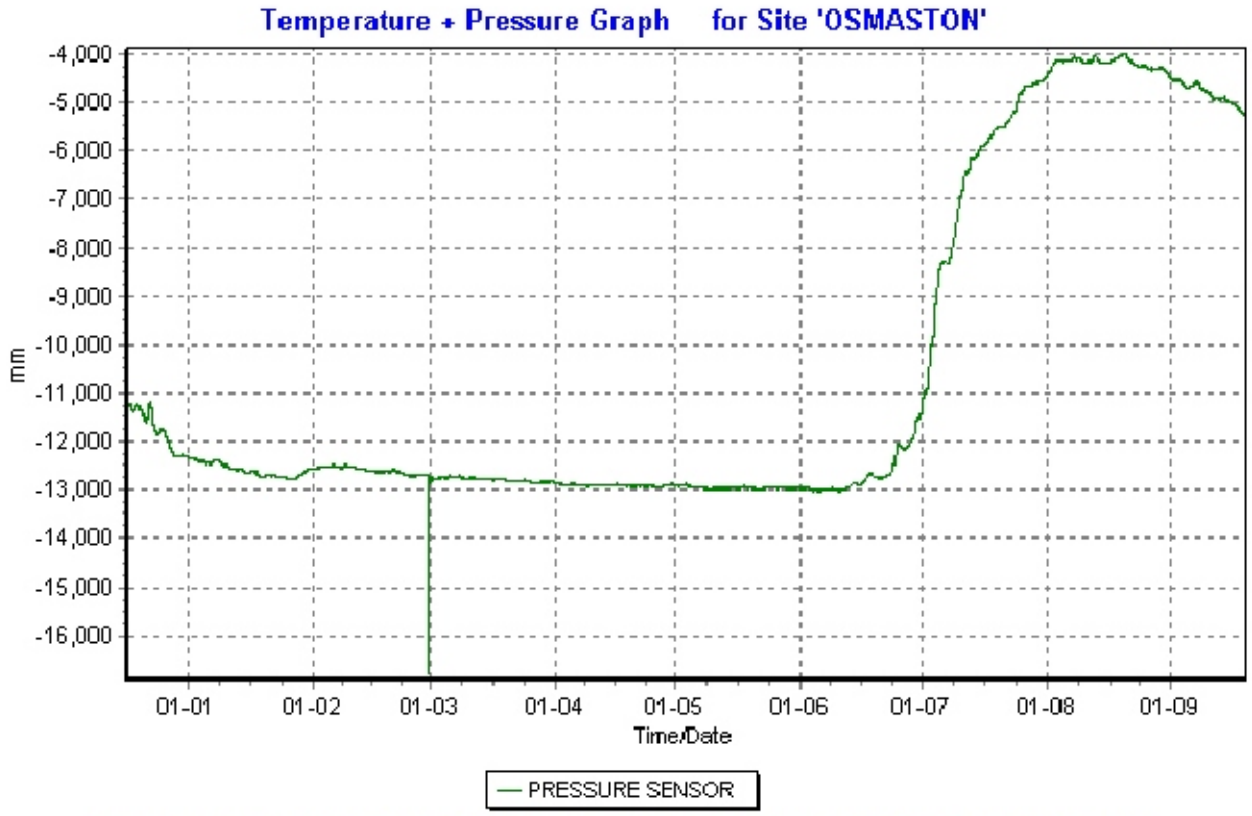
Chudleigh (SWL)



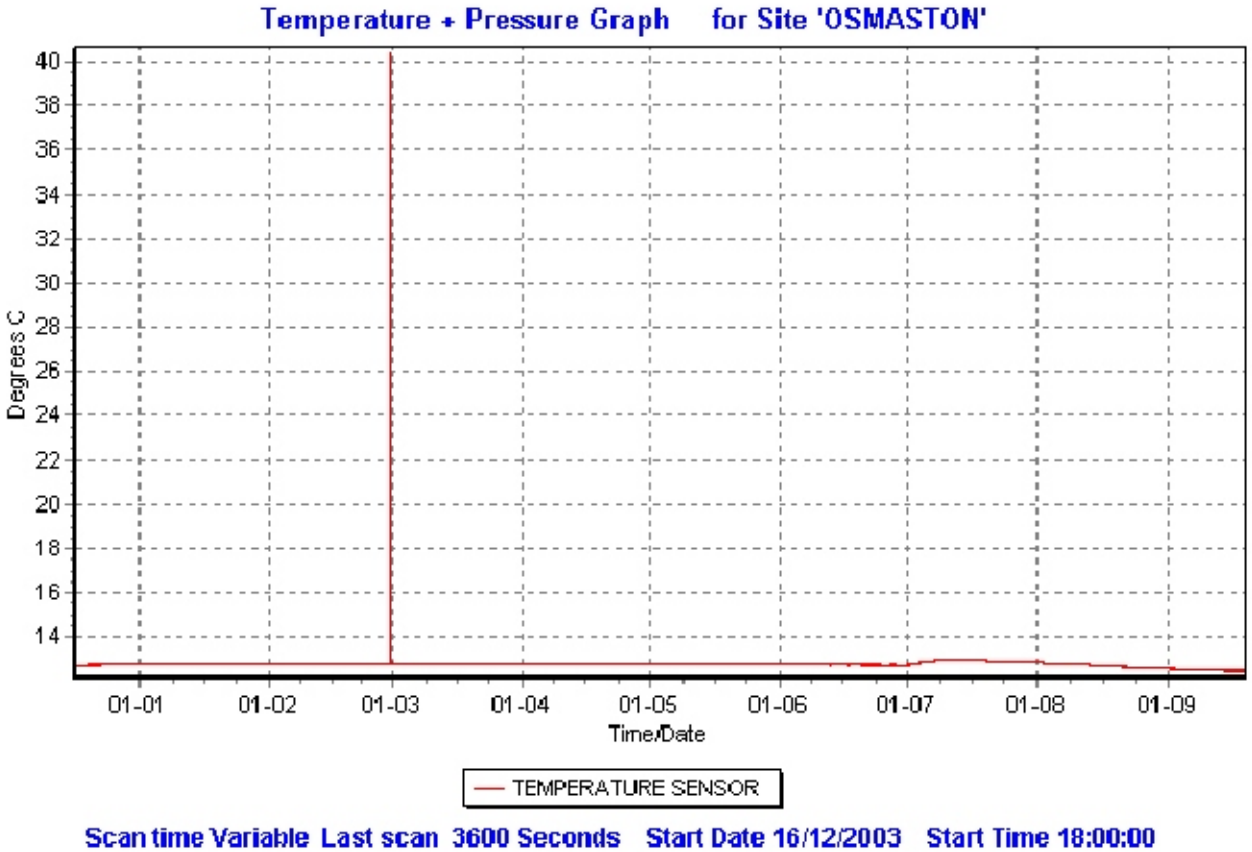
Chudleigh (temperature)



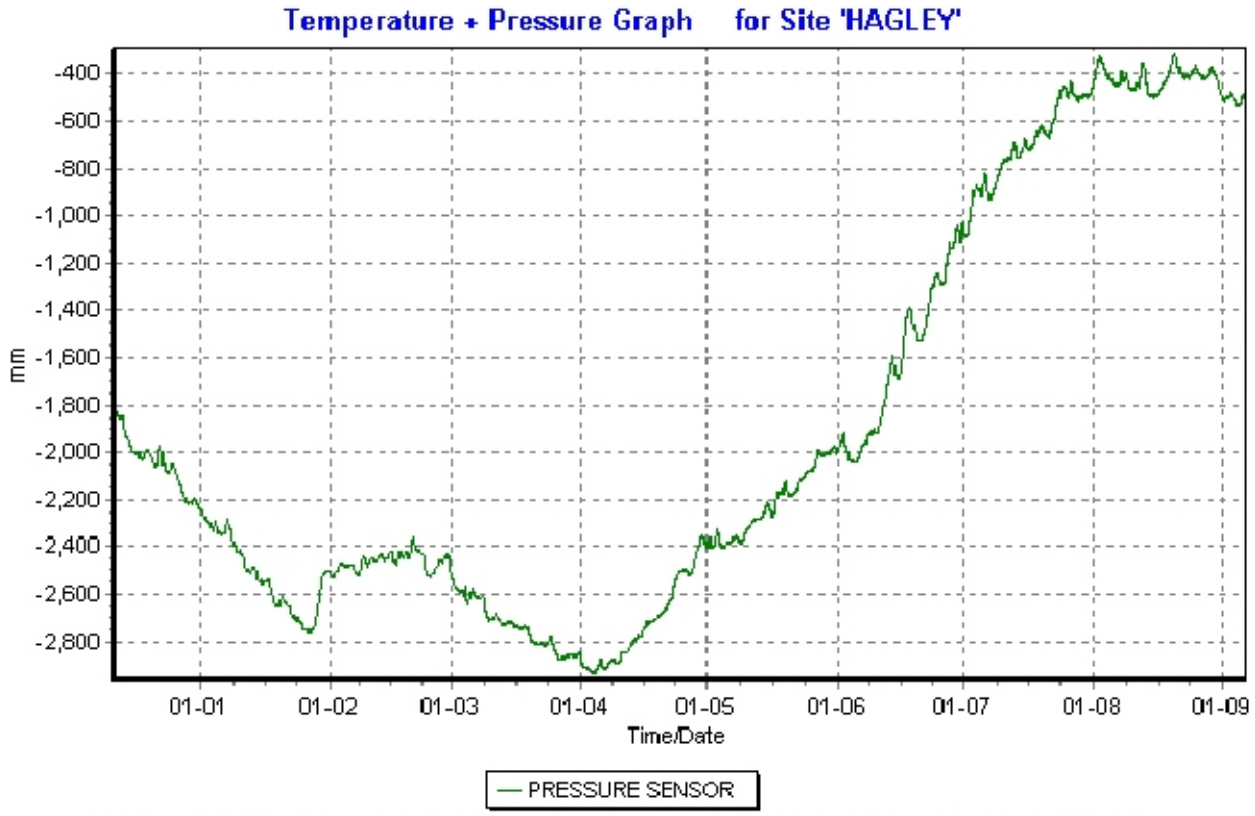
Osmaston (SWL)



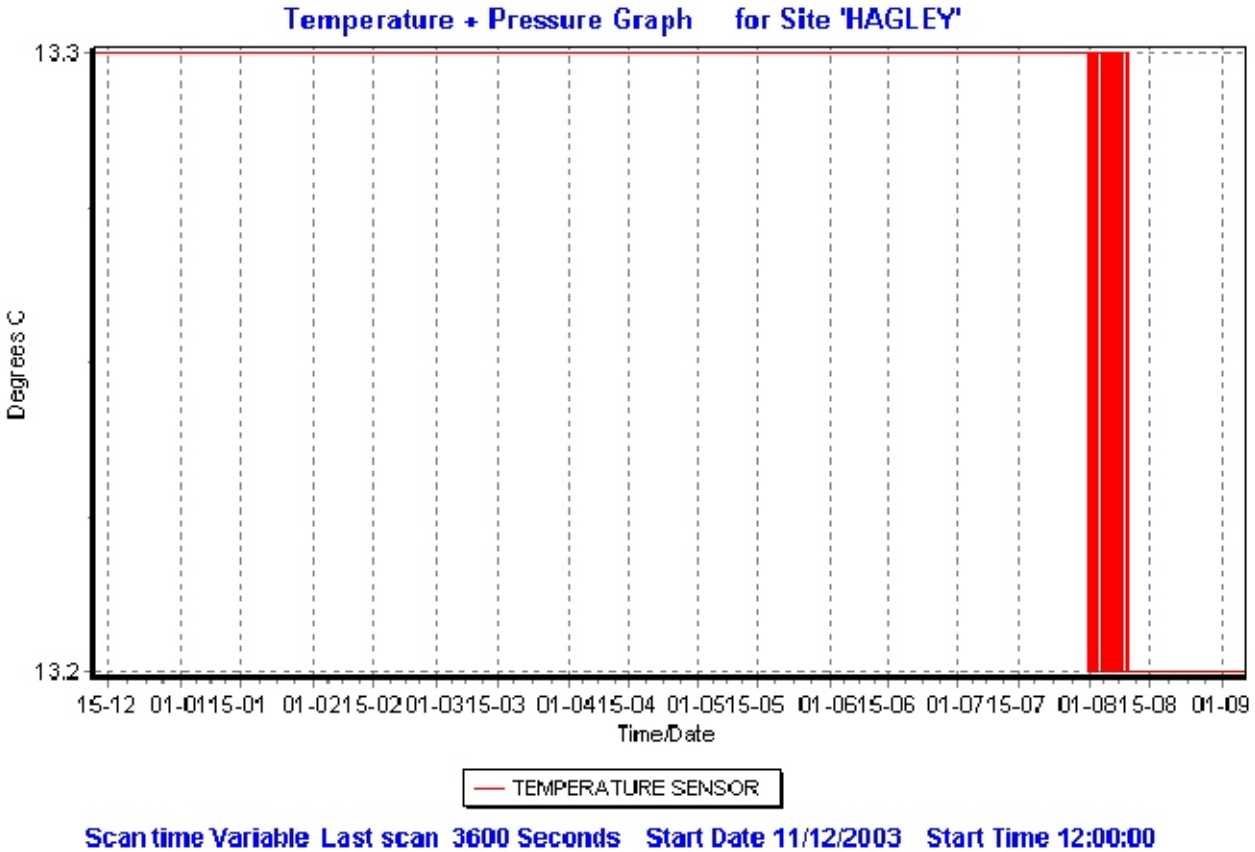
Osmaston (temperature)



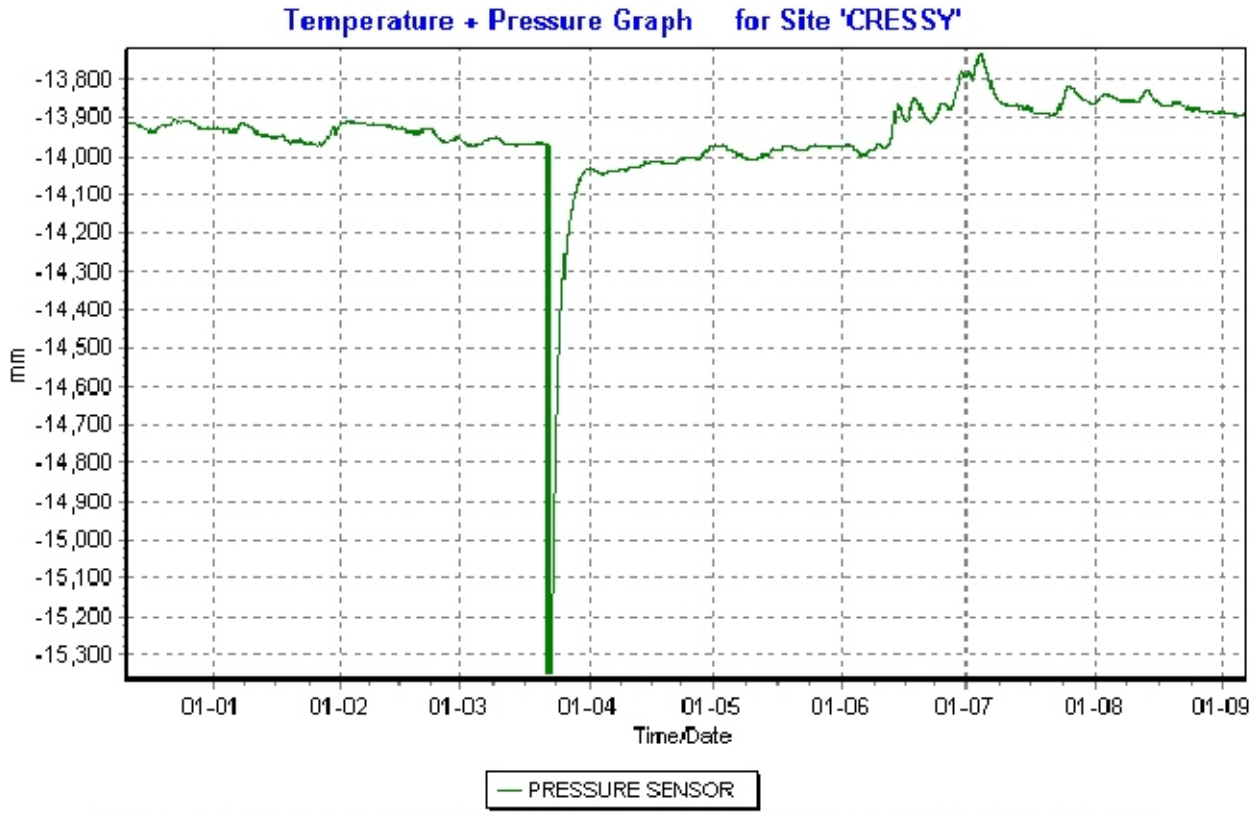
Hagley (SWL)



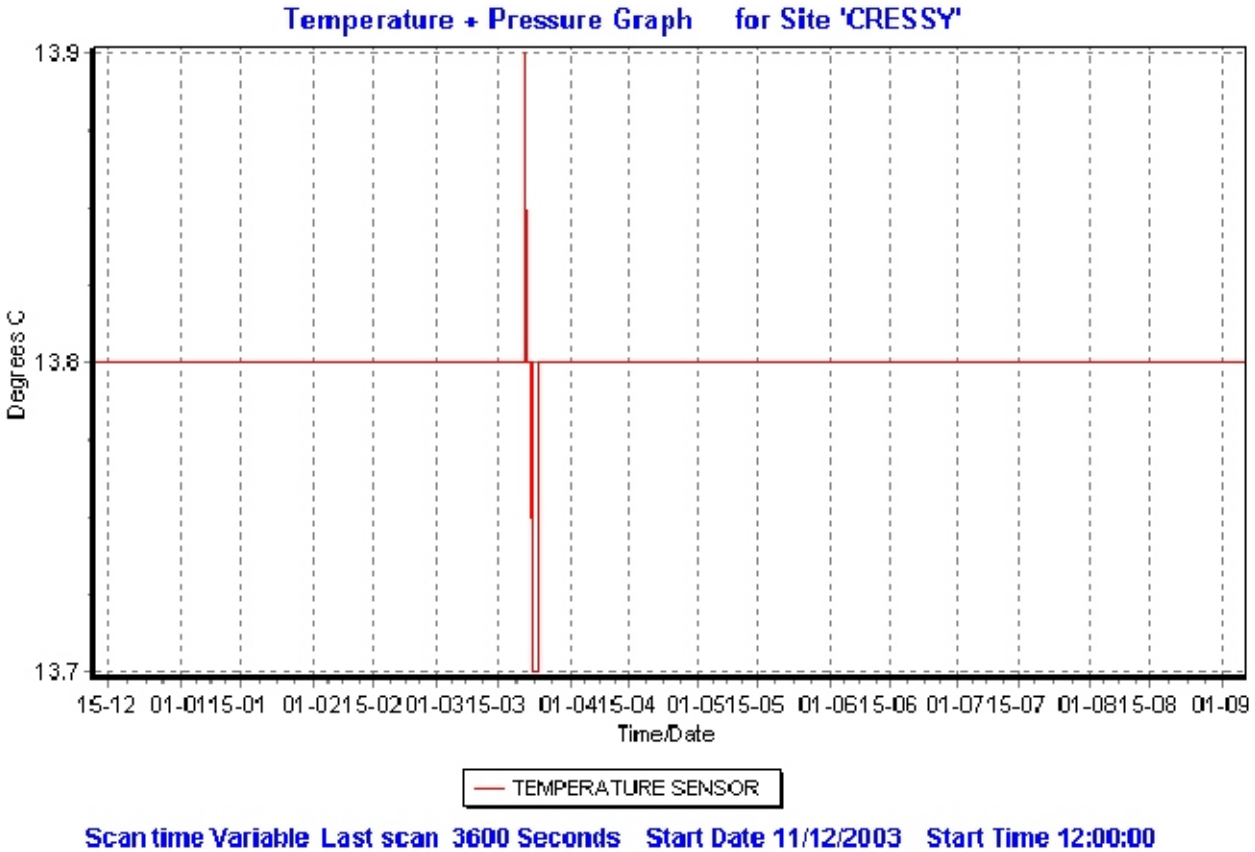
Hagley (temperature)



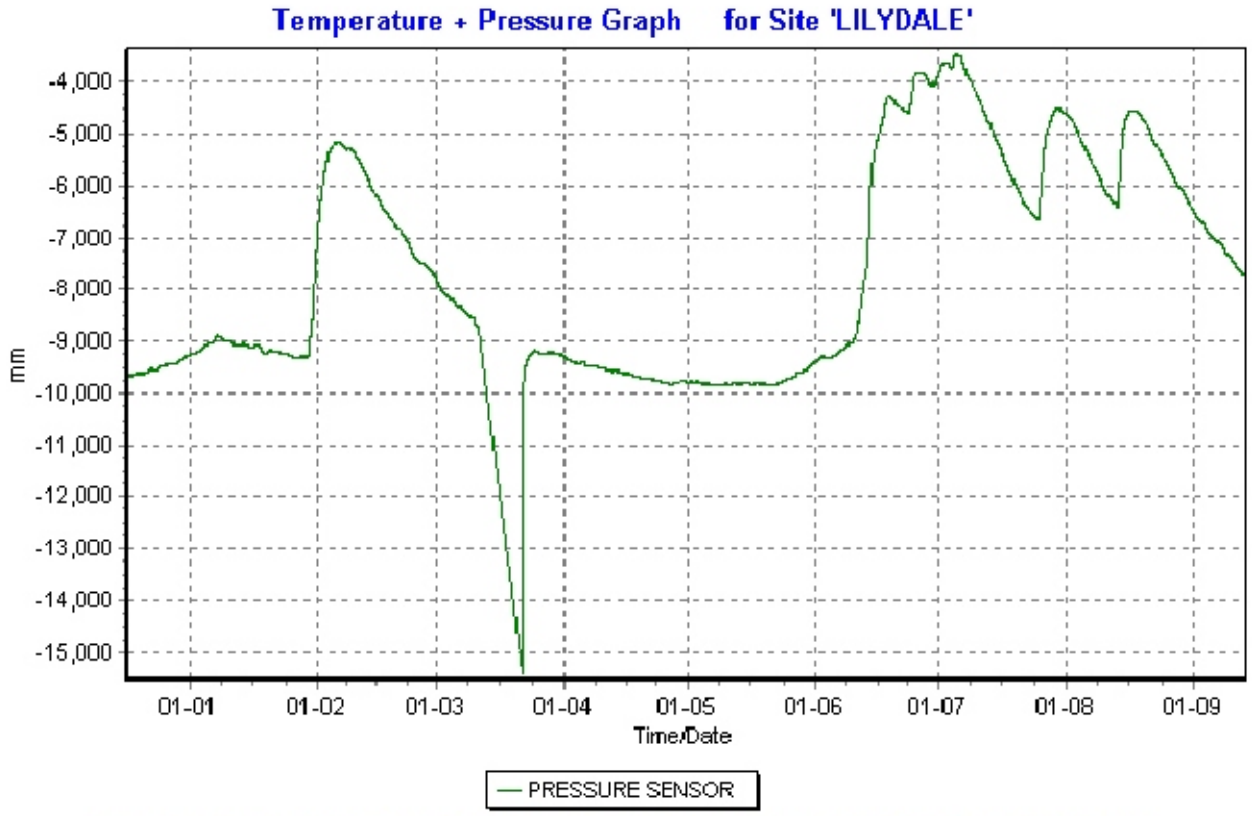
Cressy (SWL)



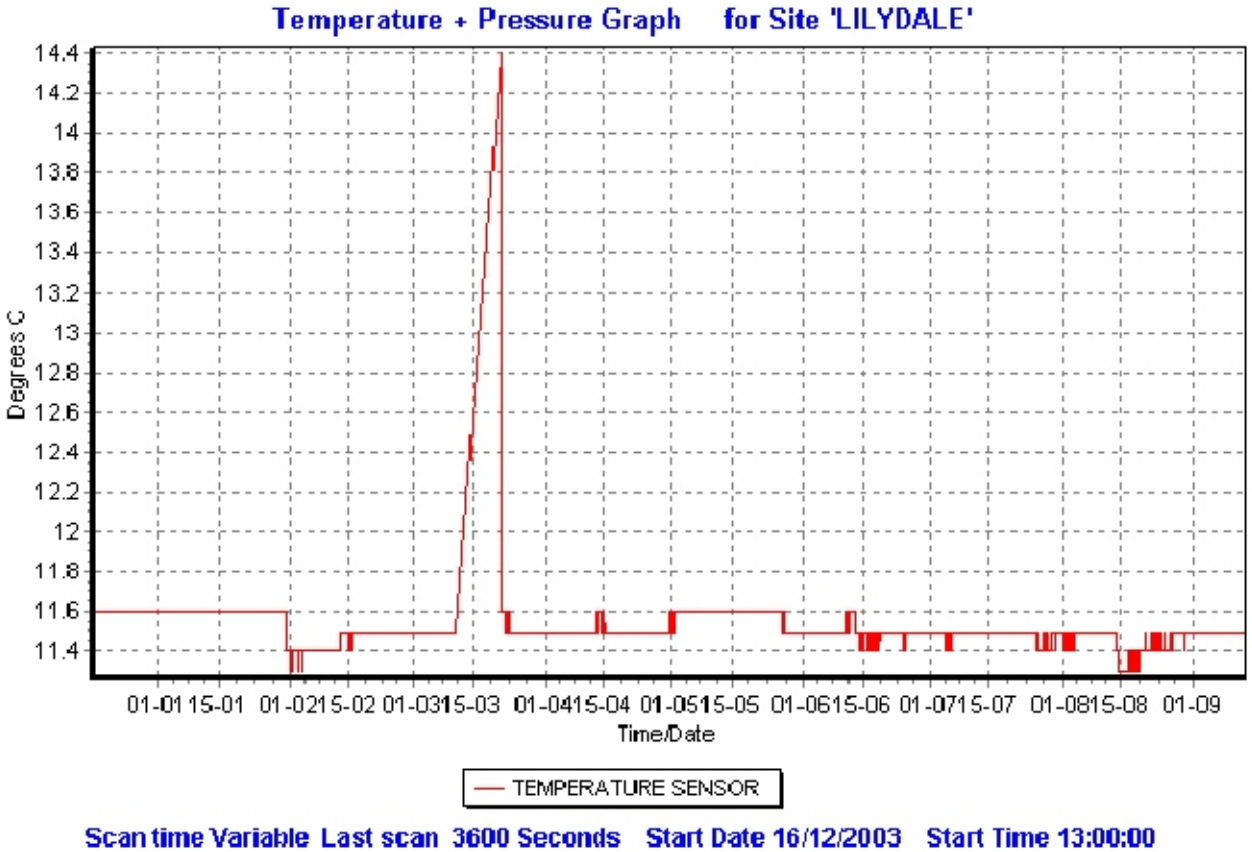
Cressy (temperature)



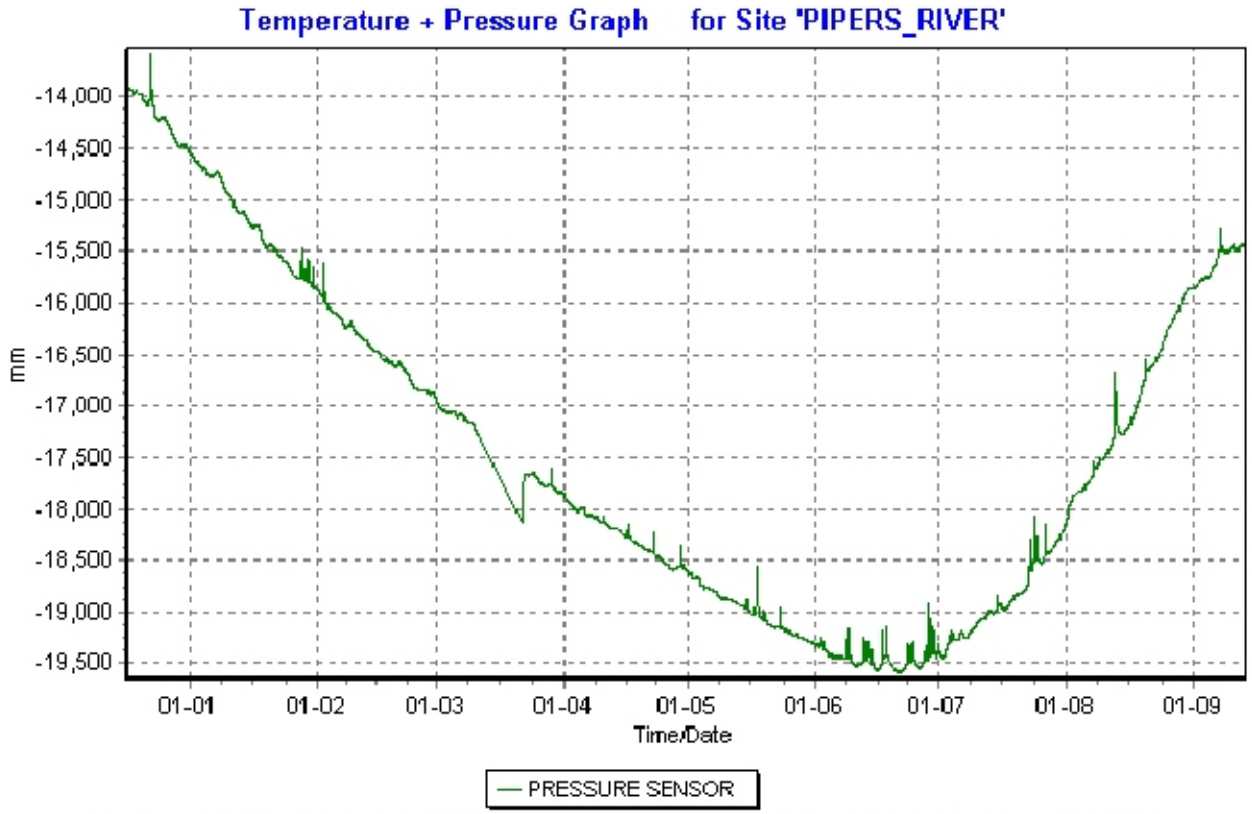
Lilydale (SWL)



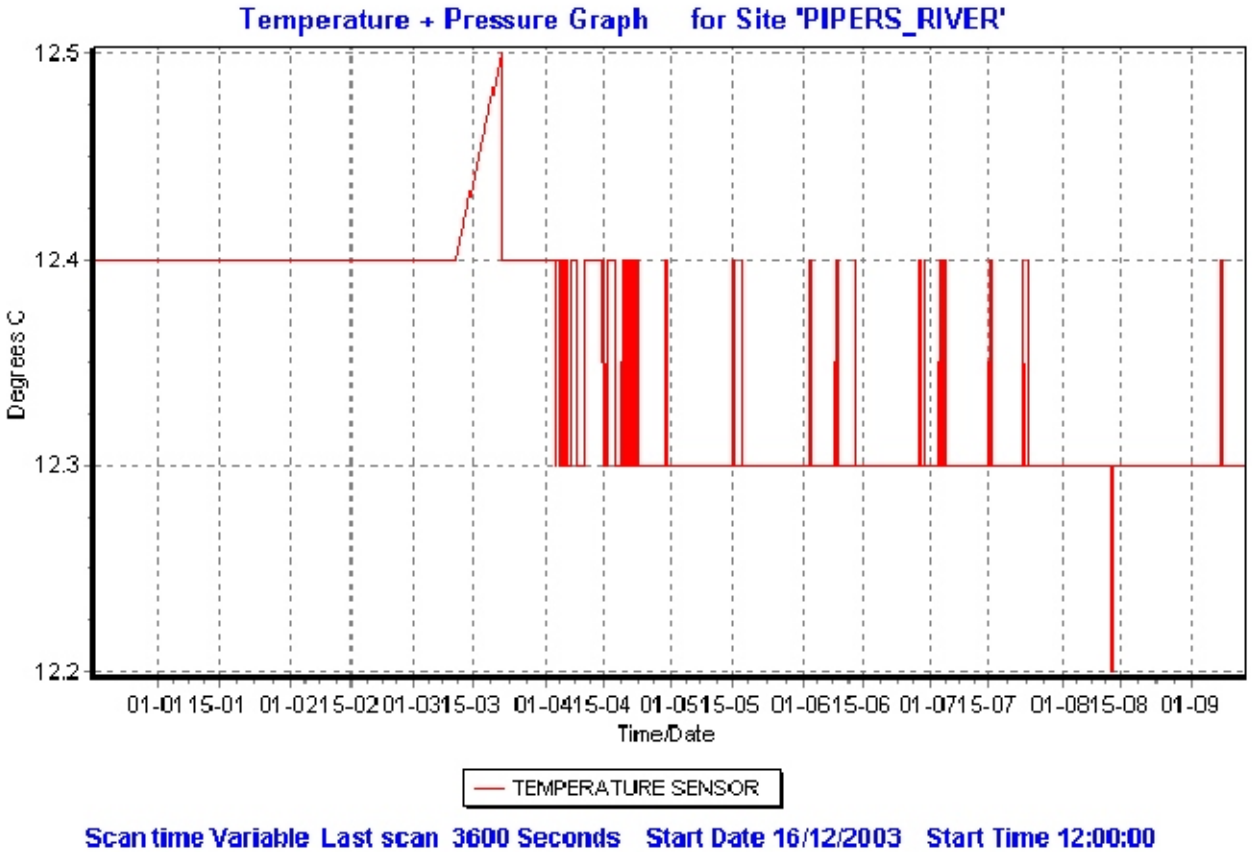
Lilydale (temperature)



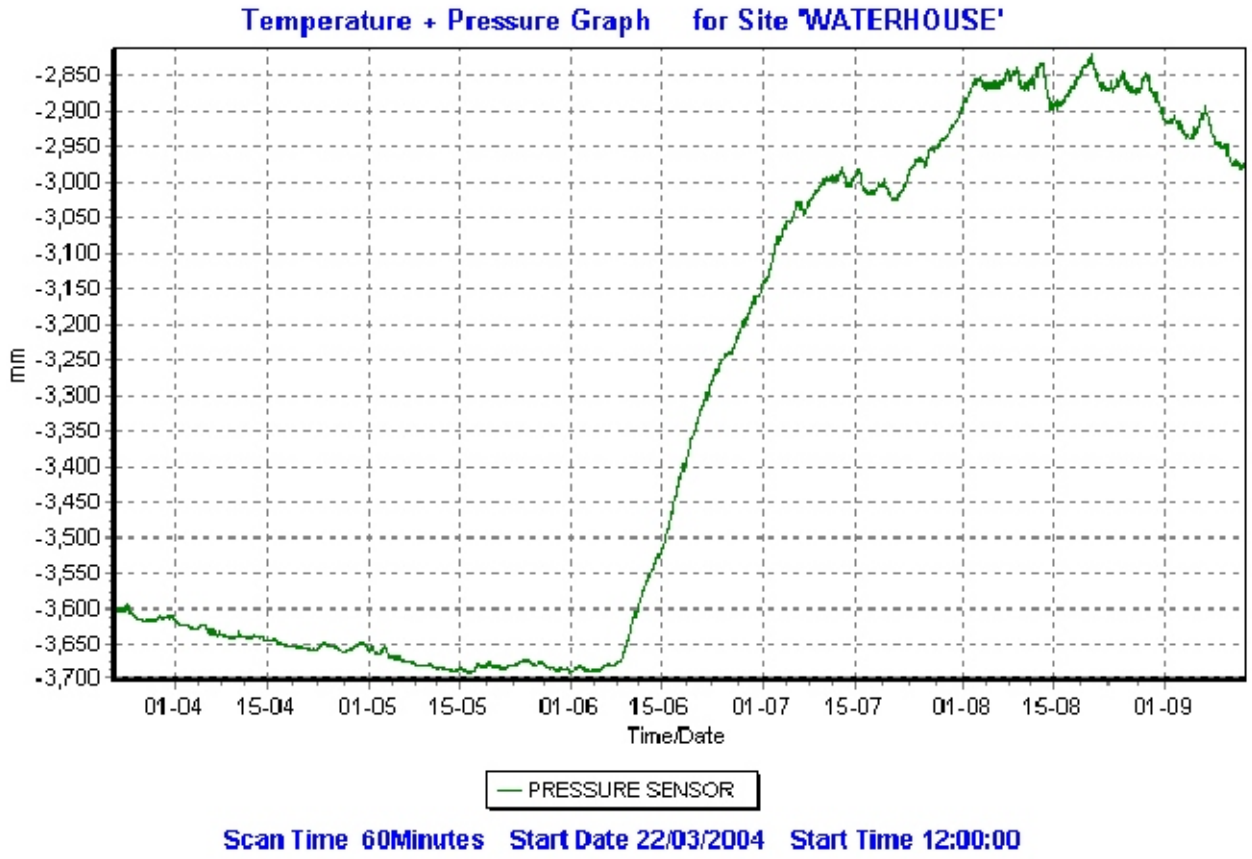
Pipers River (SWL)



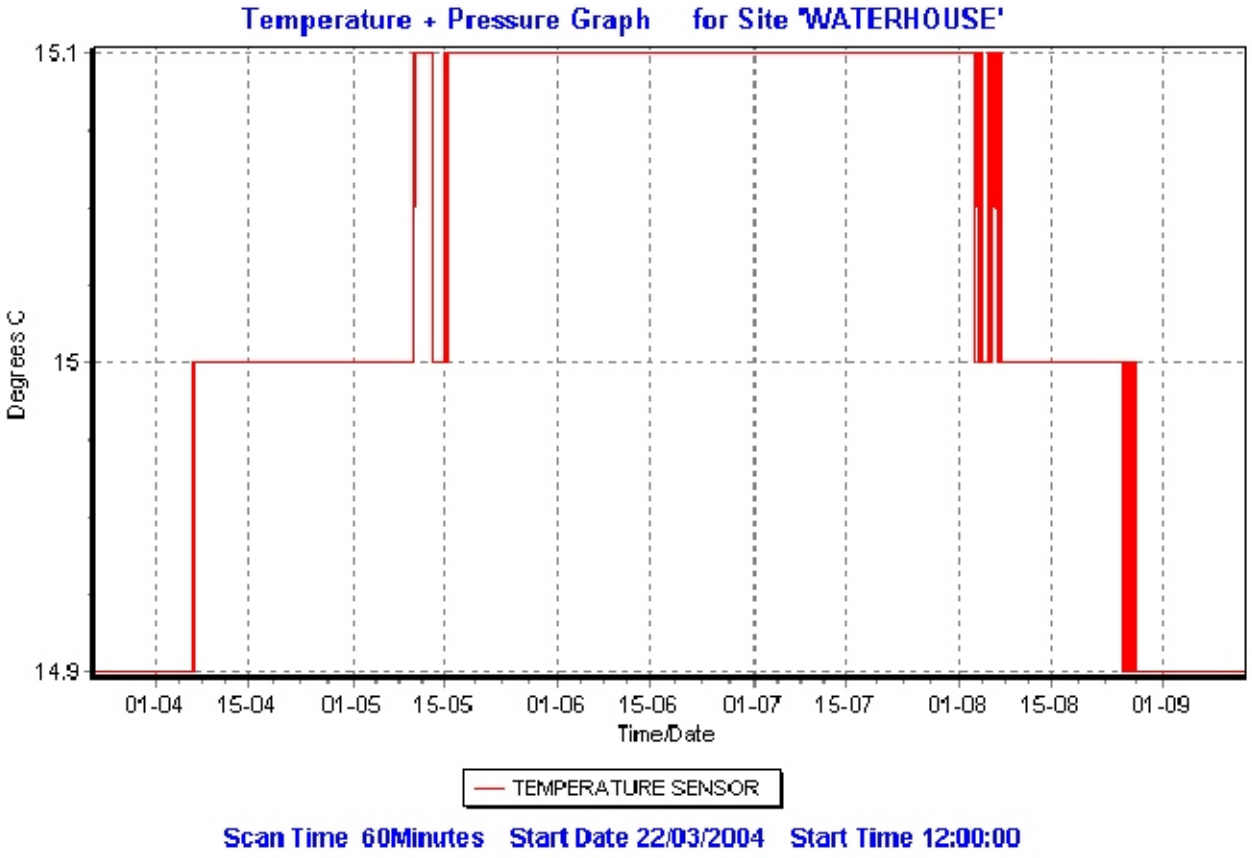
Pipers River (temperature)



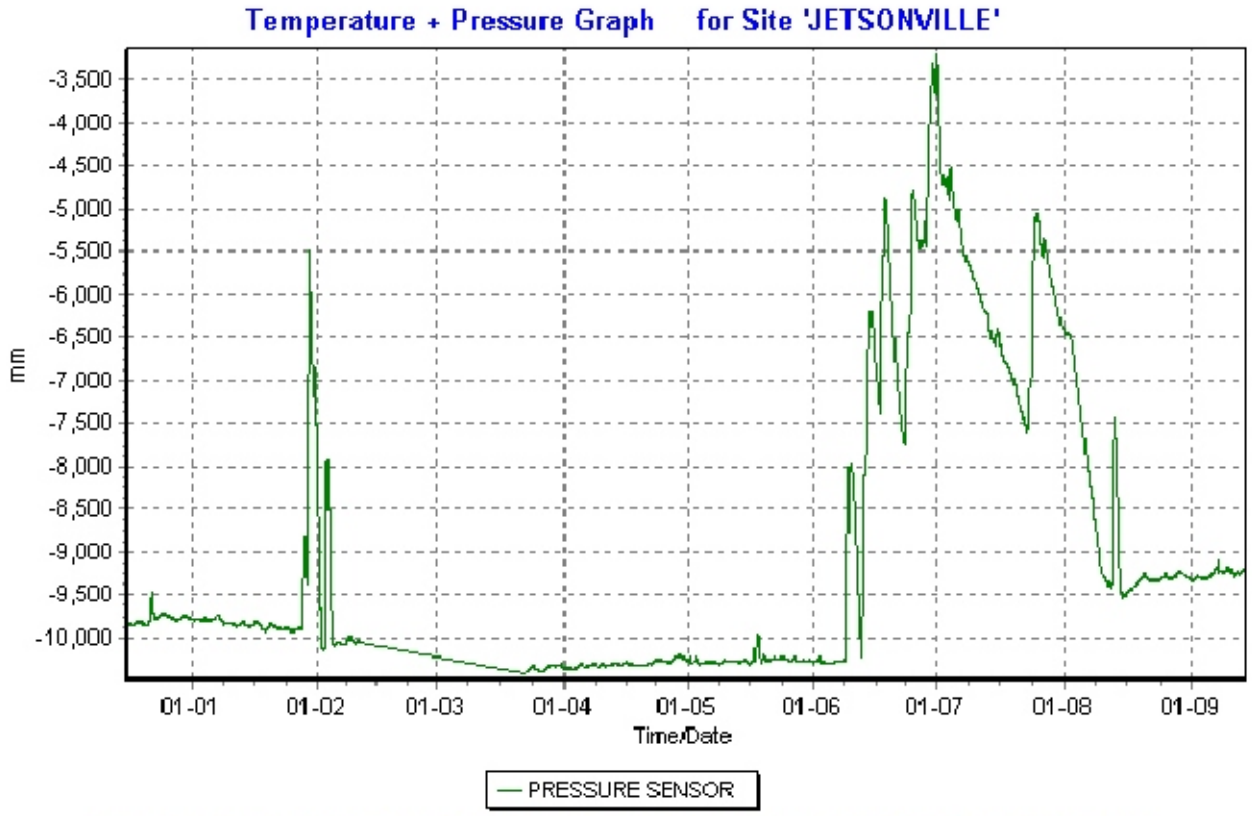
Waterhouse (SWL)



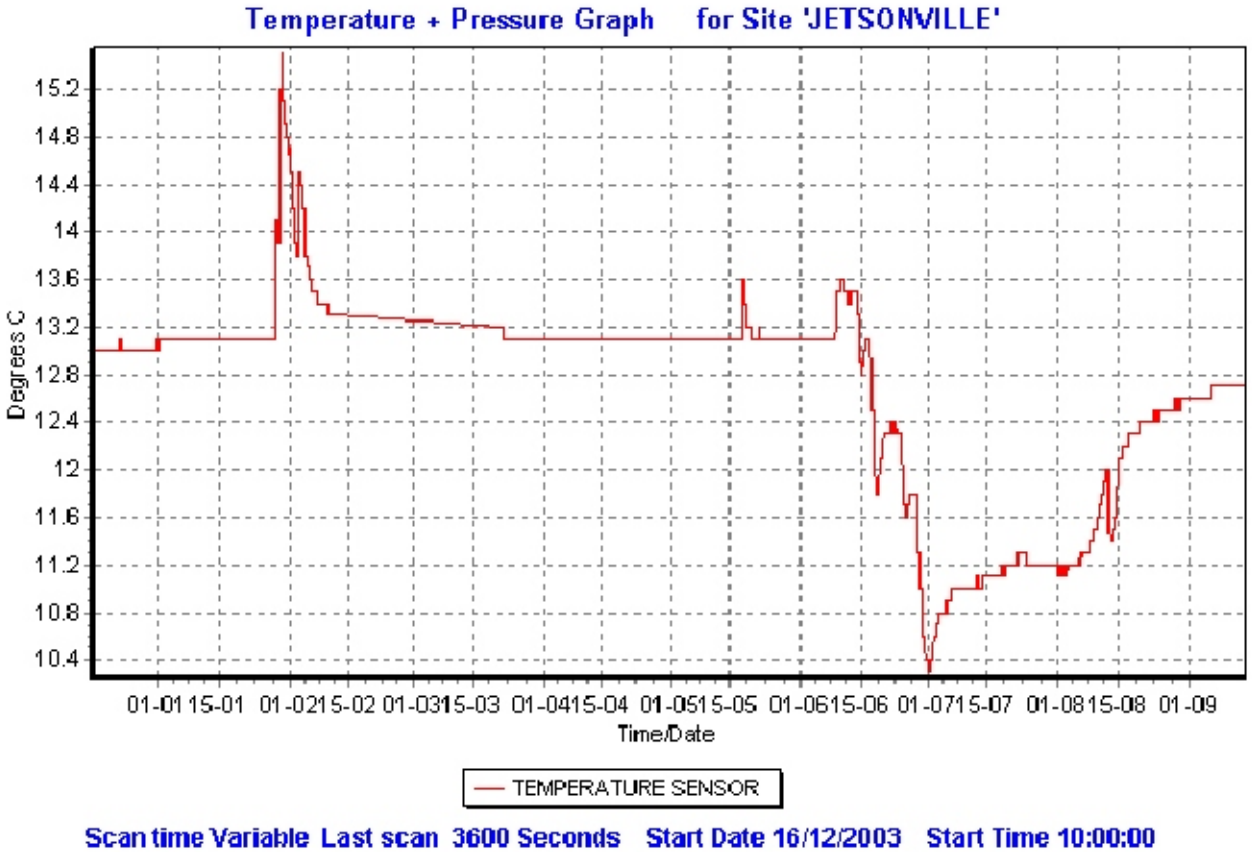
Waterhouse (temperature)



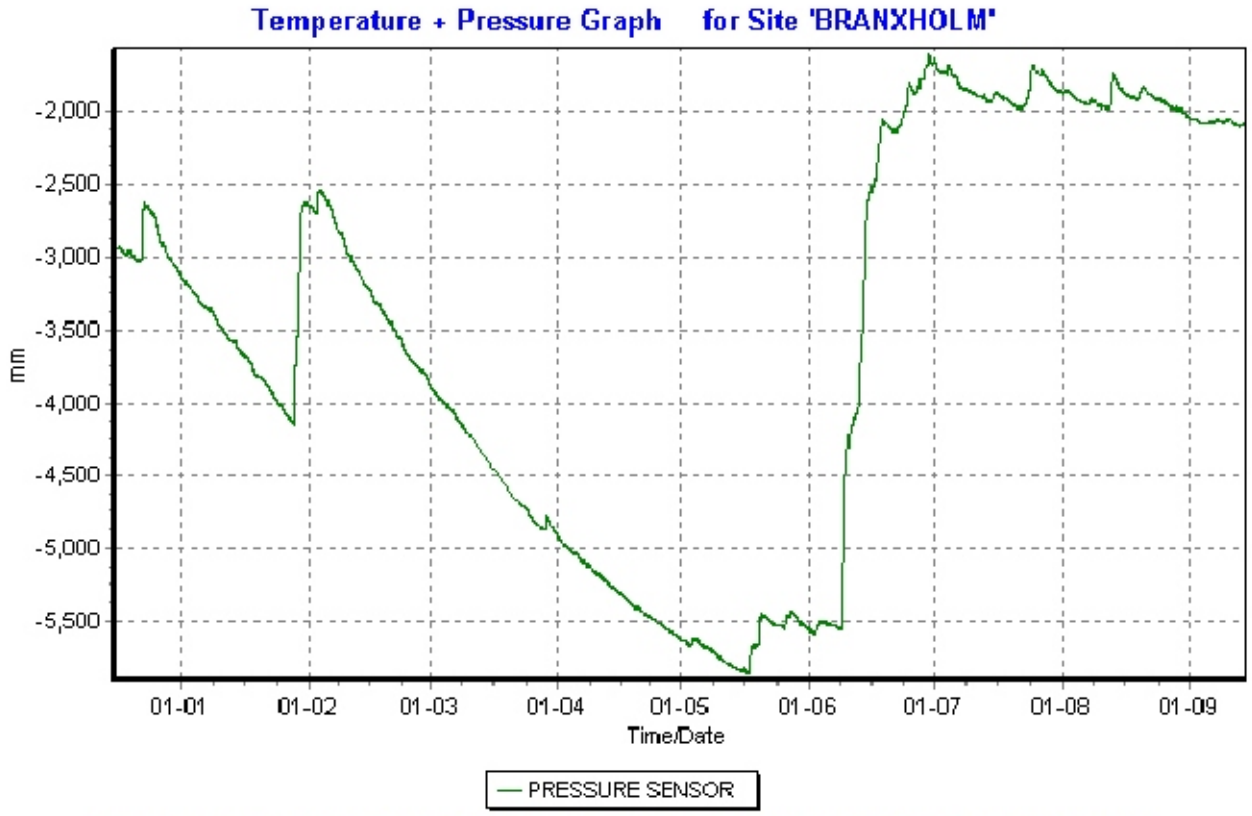
Jetsonville (SWL)



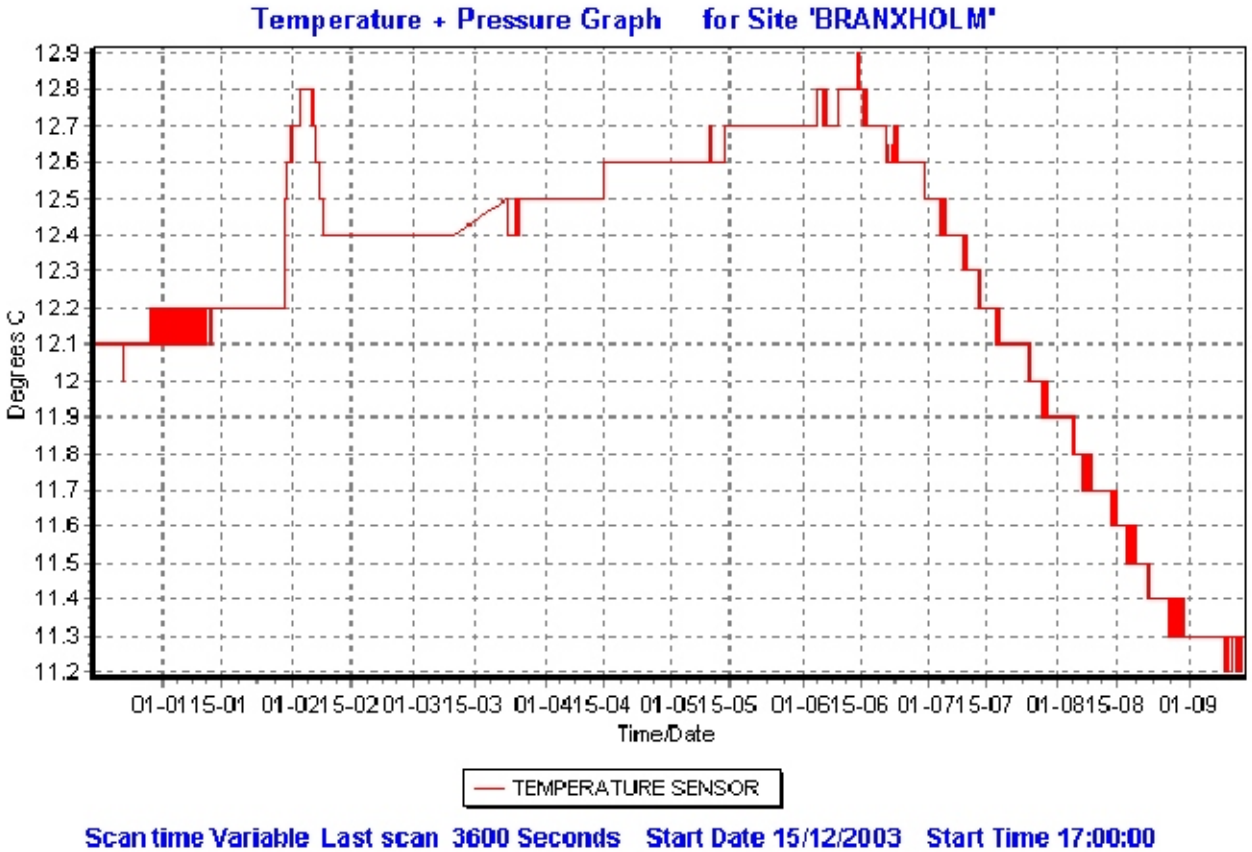
Jetsonville (temperature)



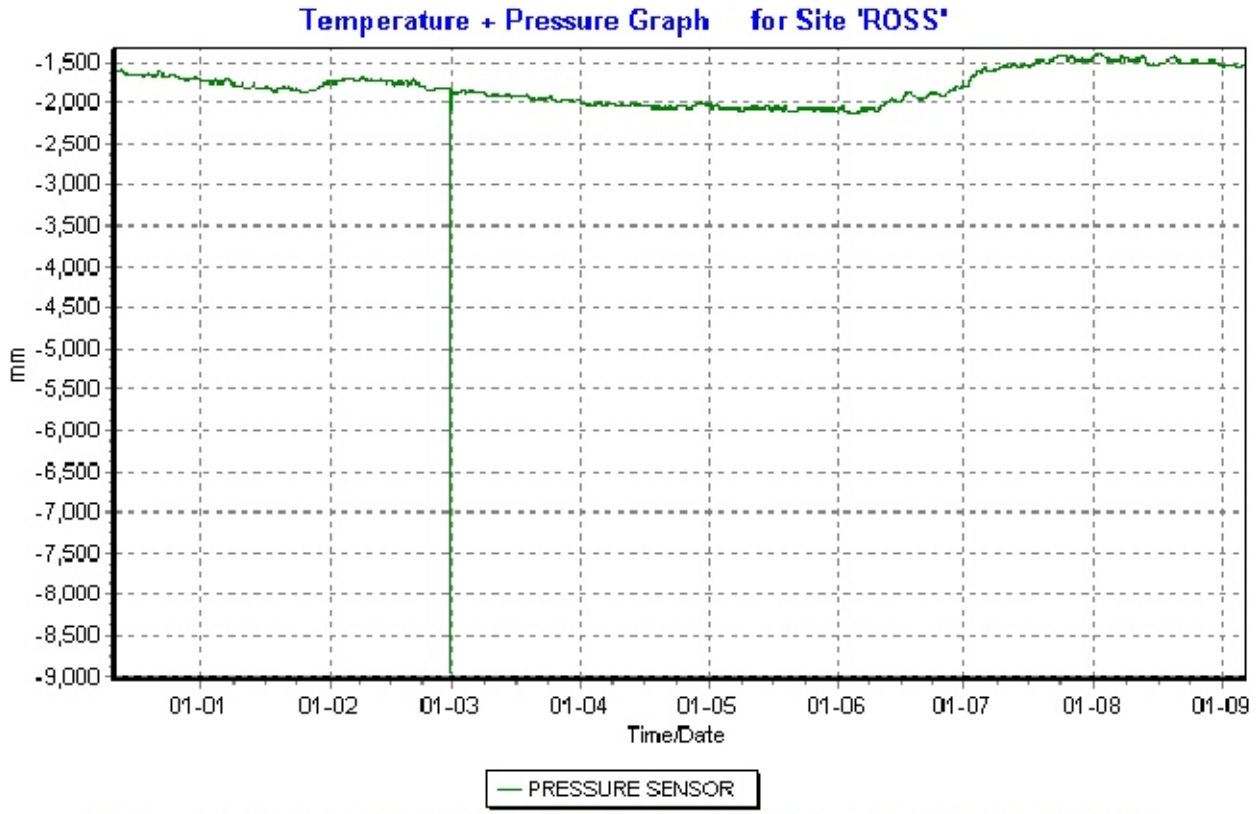
Branxholm (SWL)



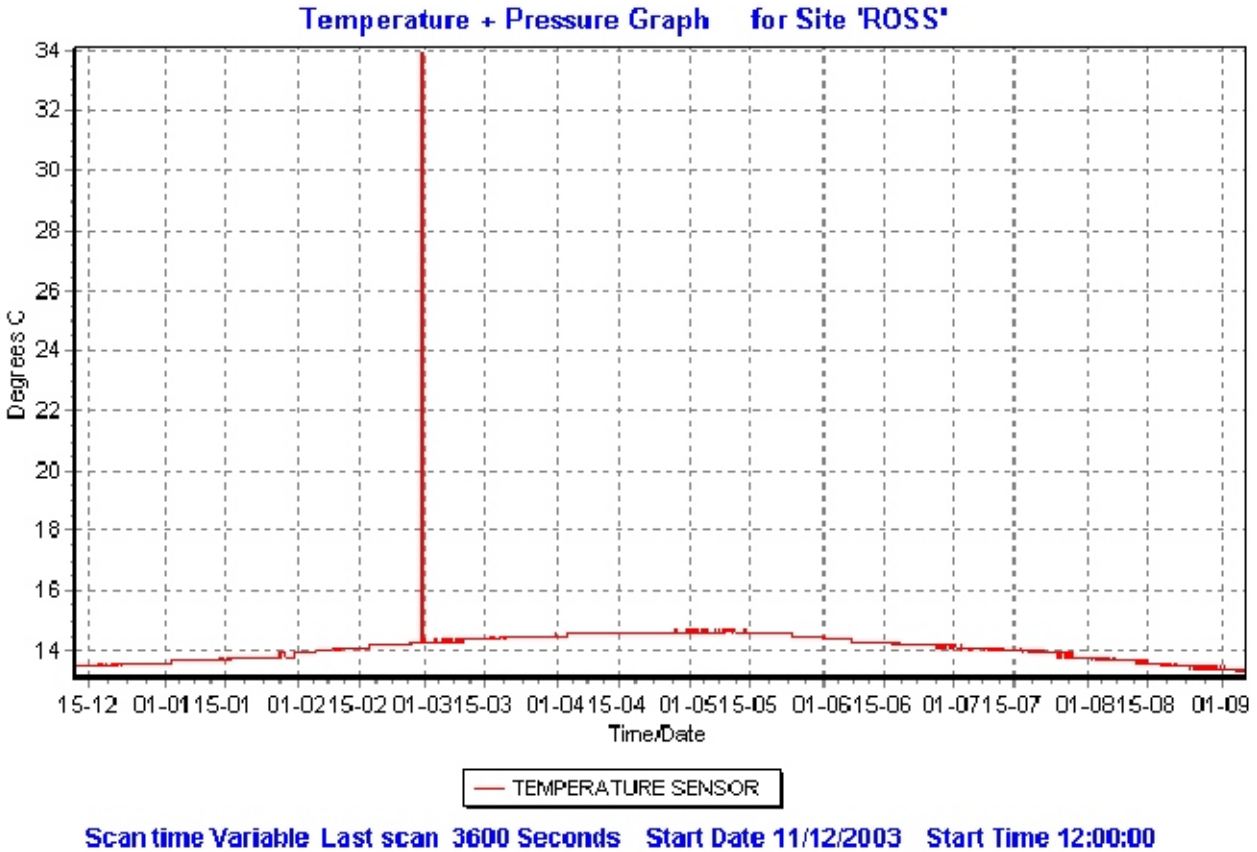
Branxholm (temperature)



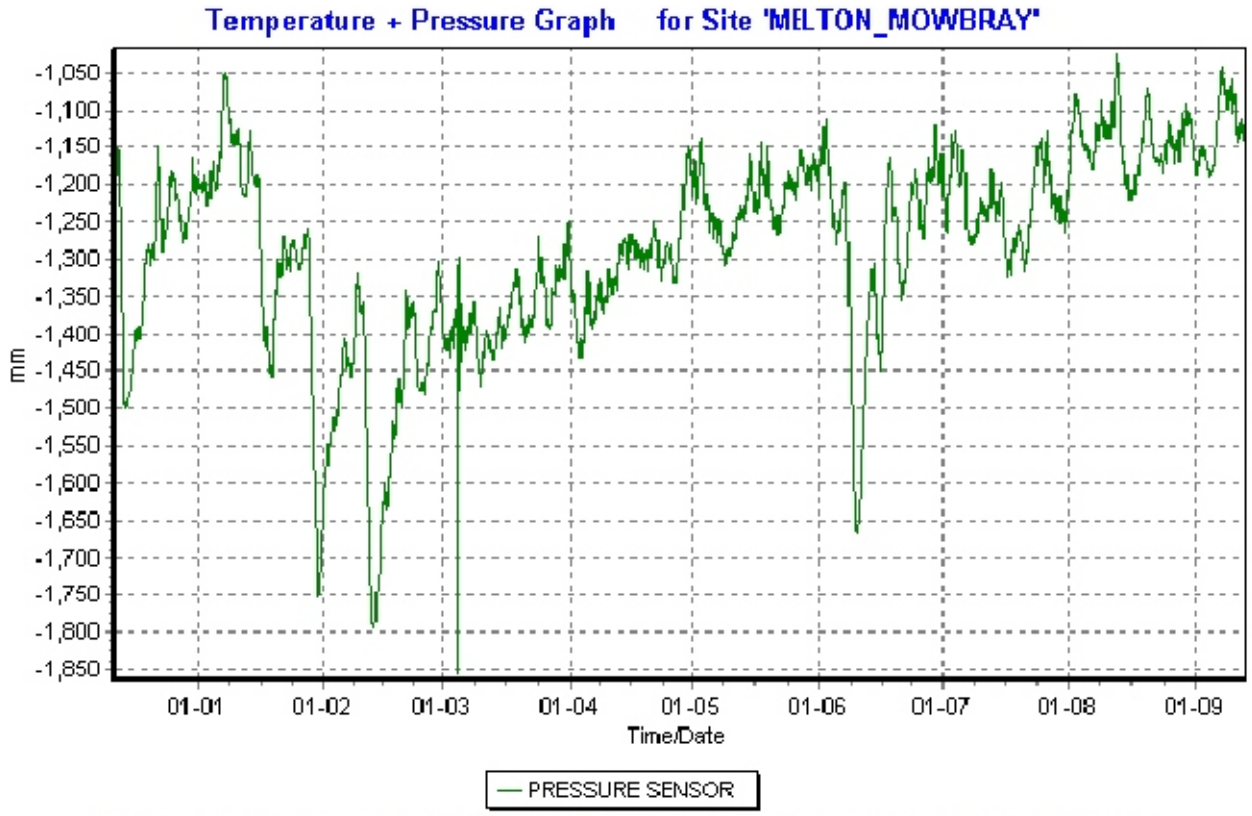
Ross (SWL)



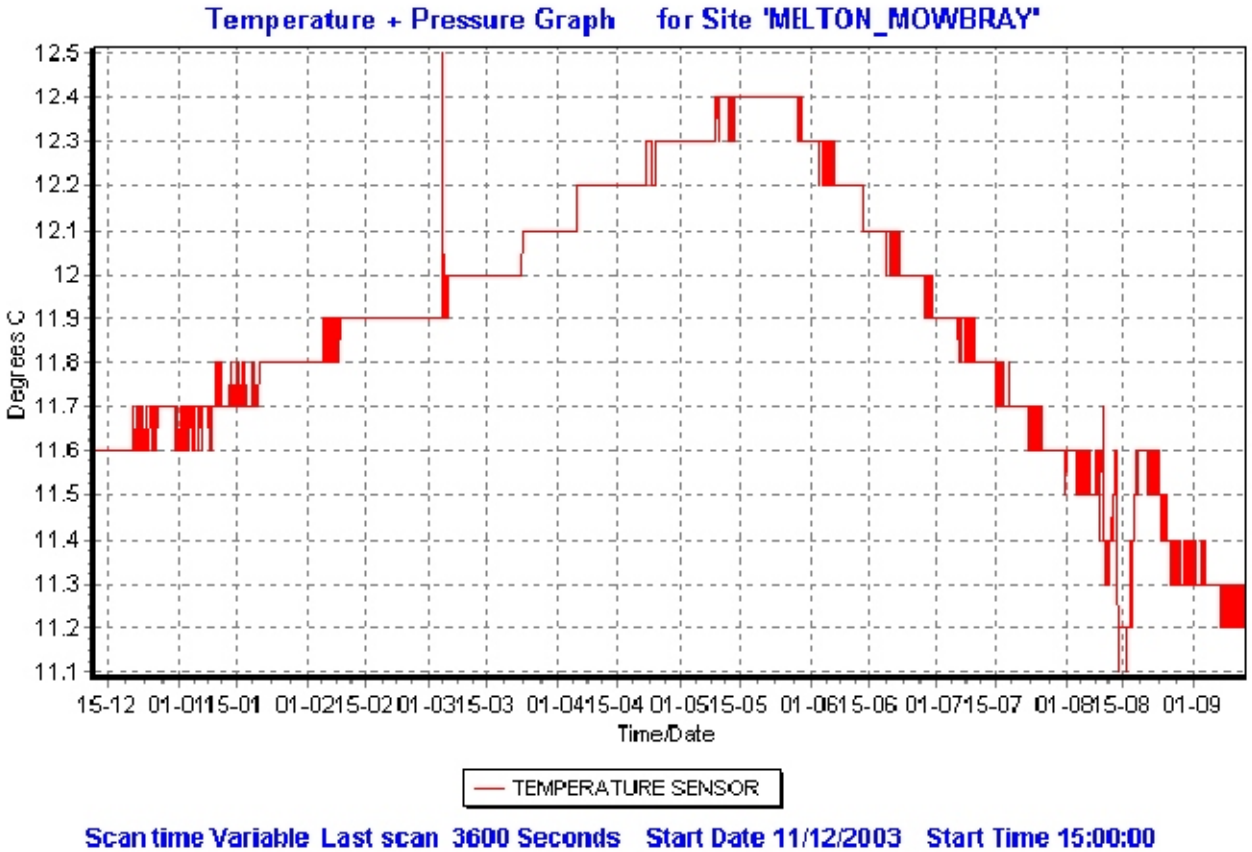
Ross (temperature)



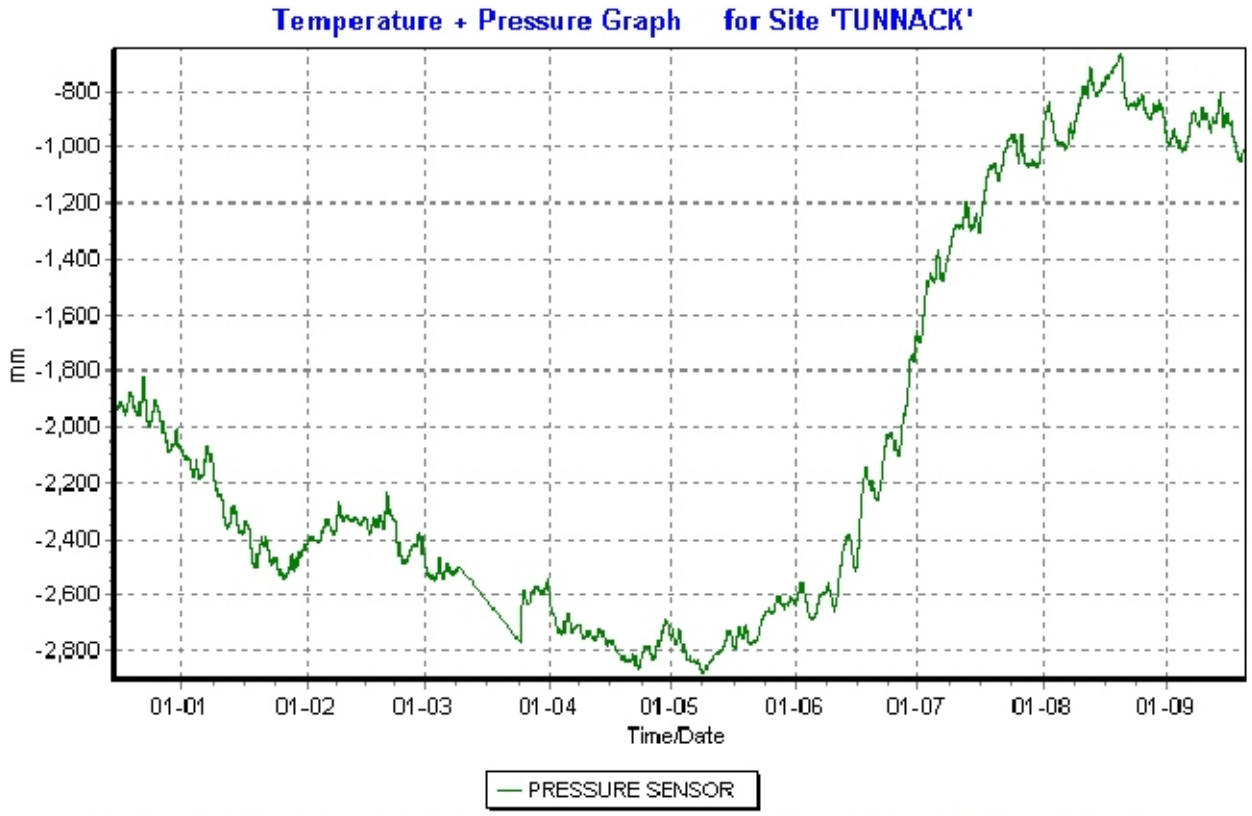
Melton Mowbray (SWL)



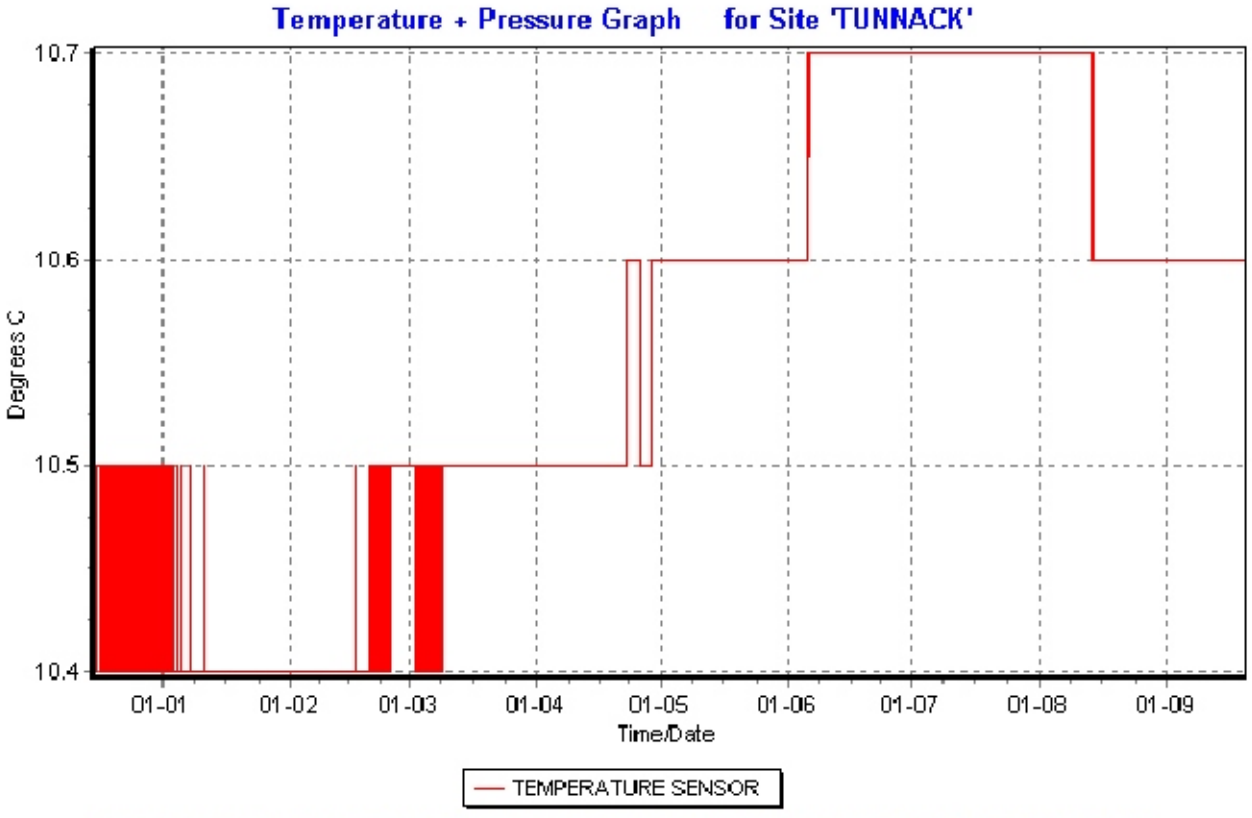
Melton Mowbray (temperature)



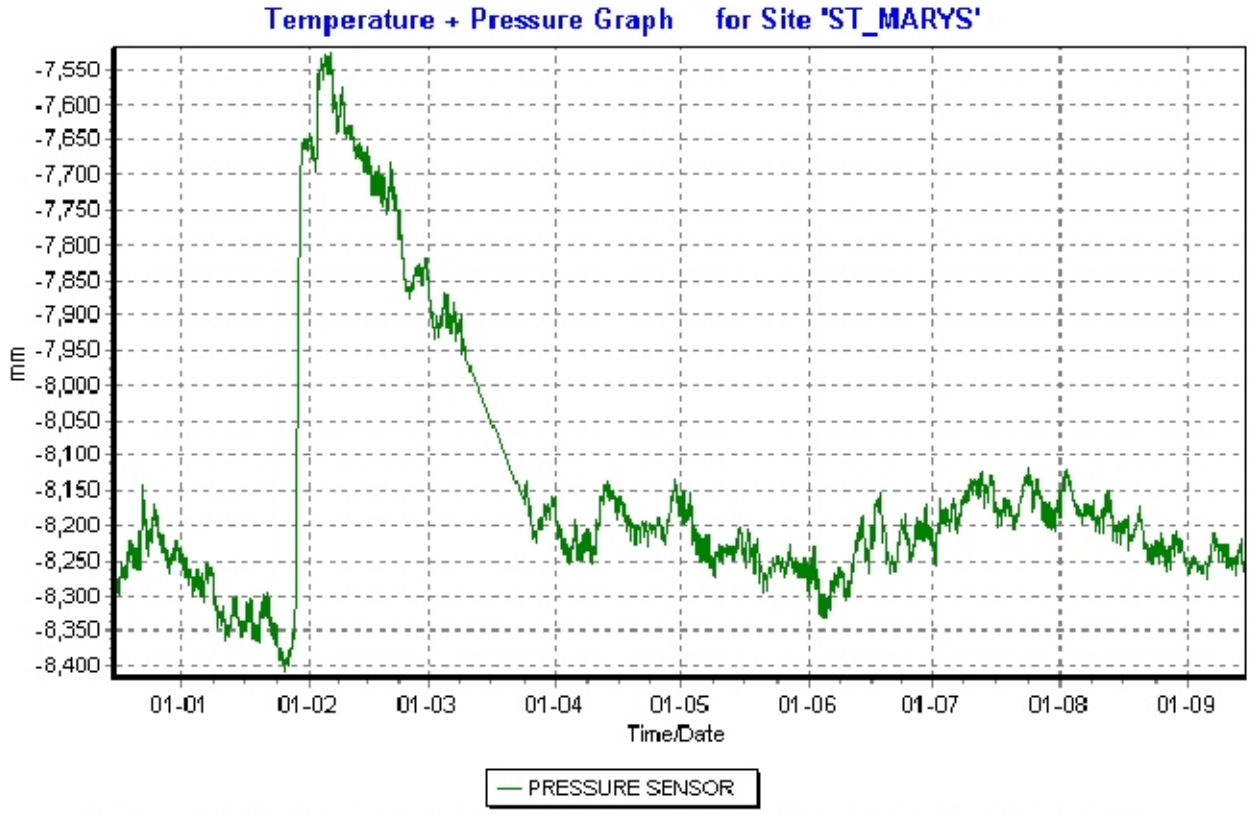
Tunnack (SWL)



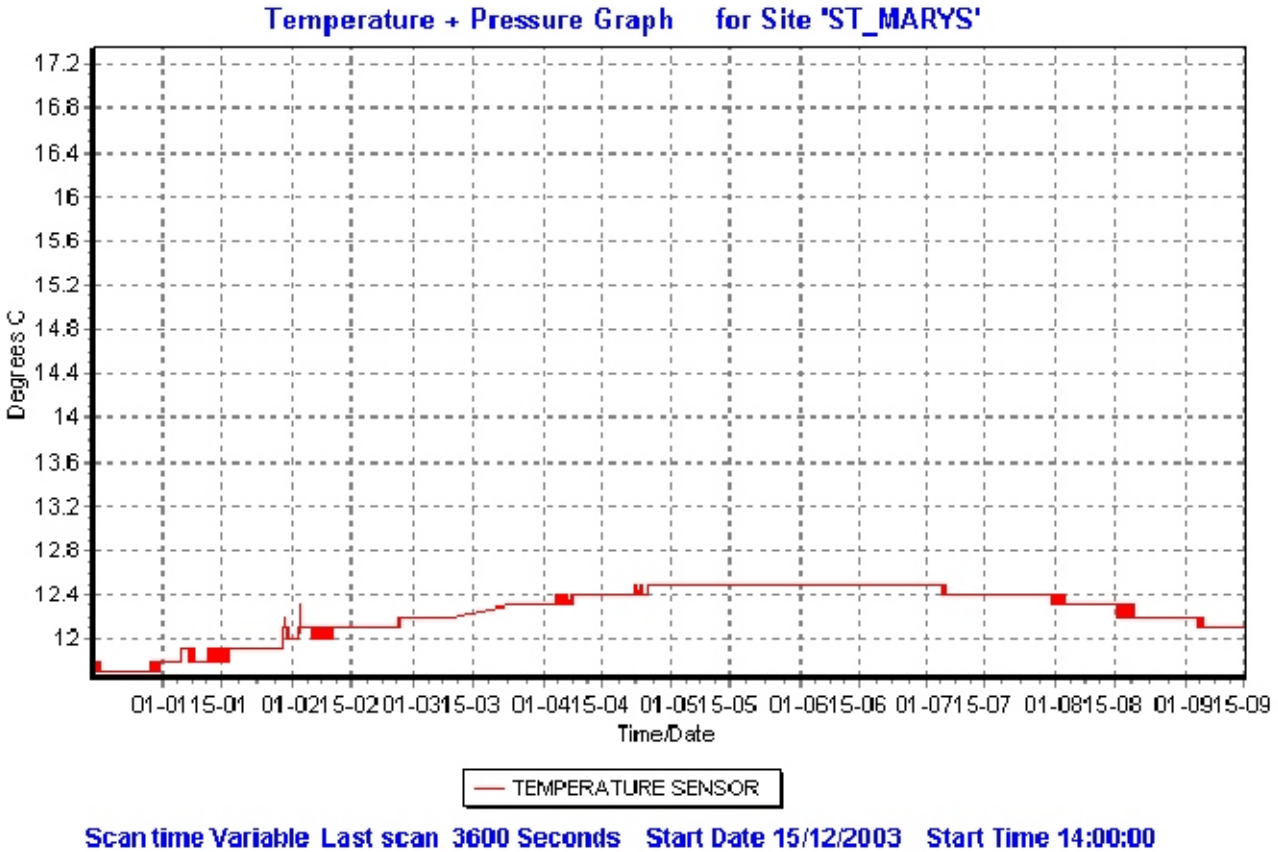
Tunnack (temperature)



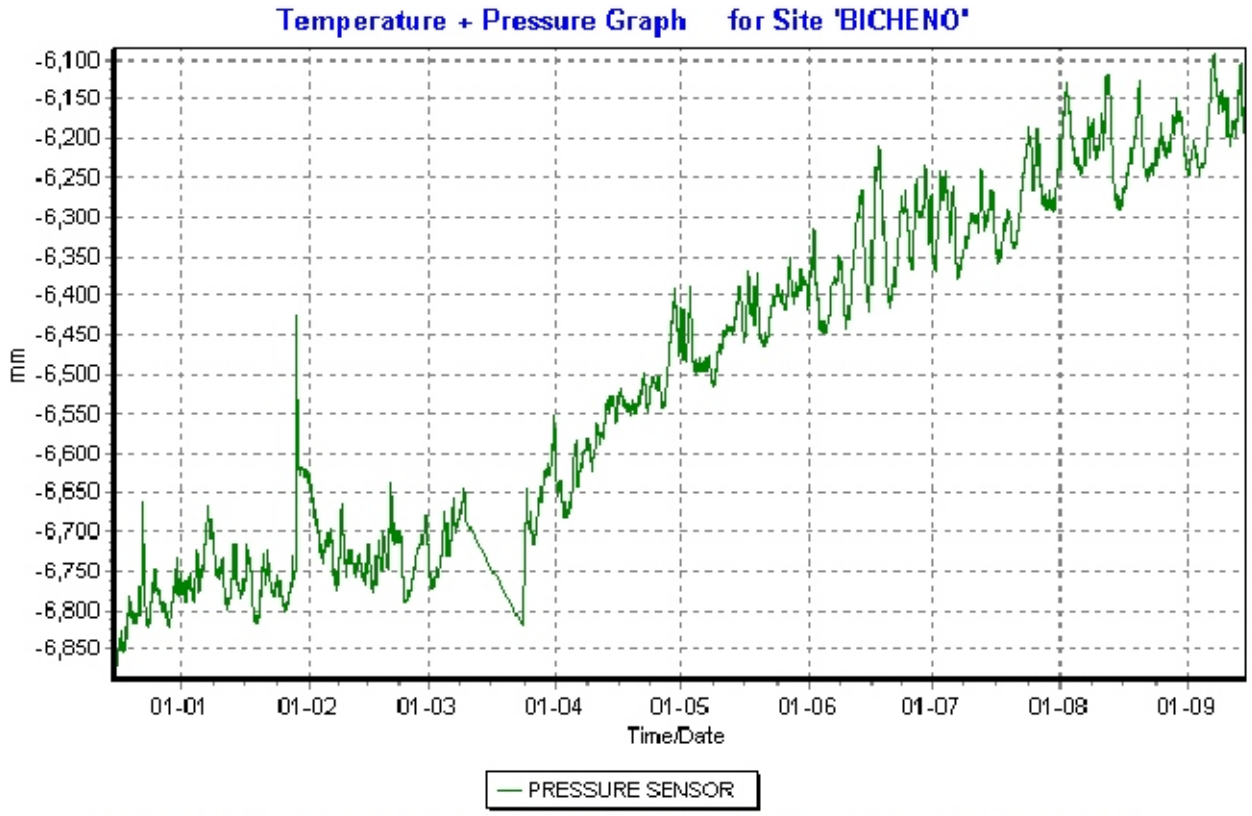
St Marys (SWL)



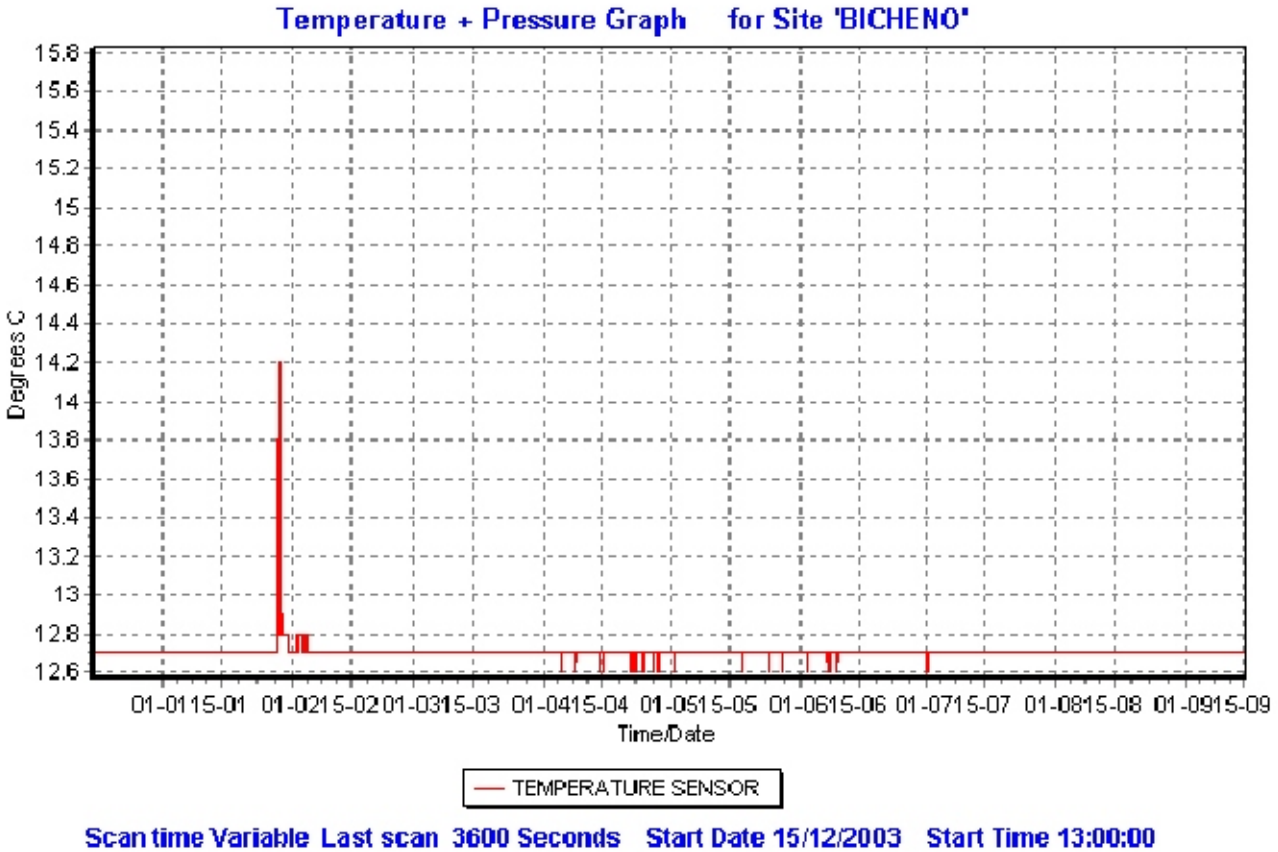
St Marys (temperature)



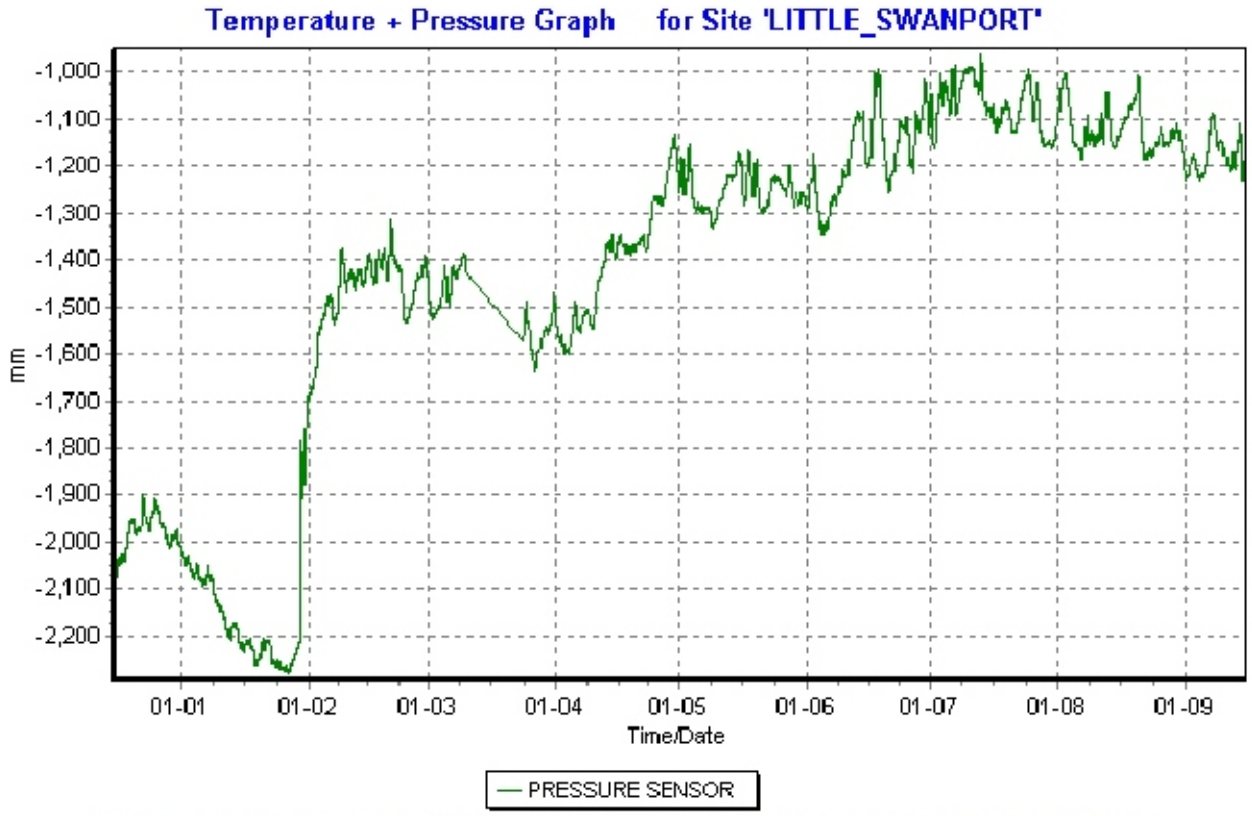
Bicheno (SWL)



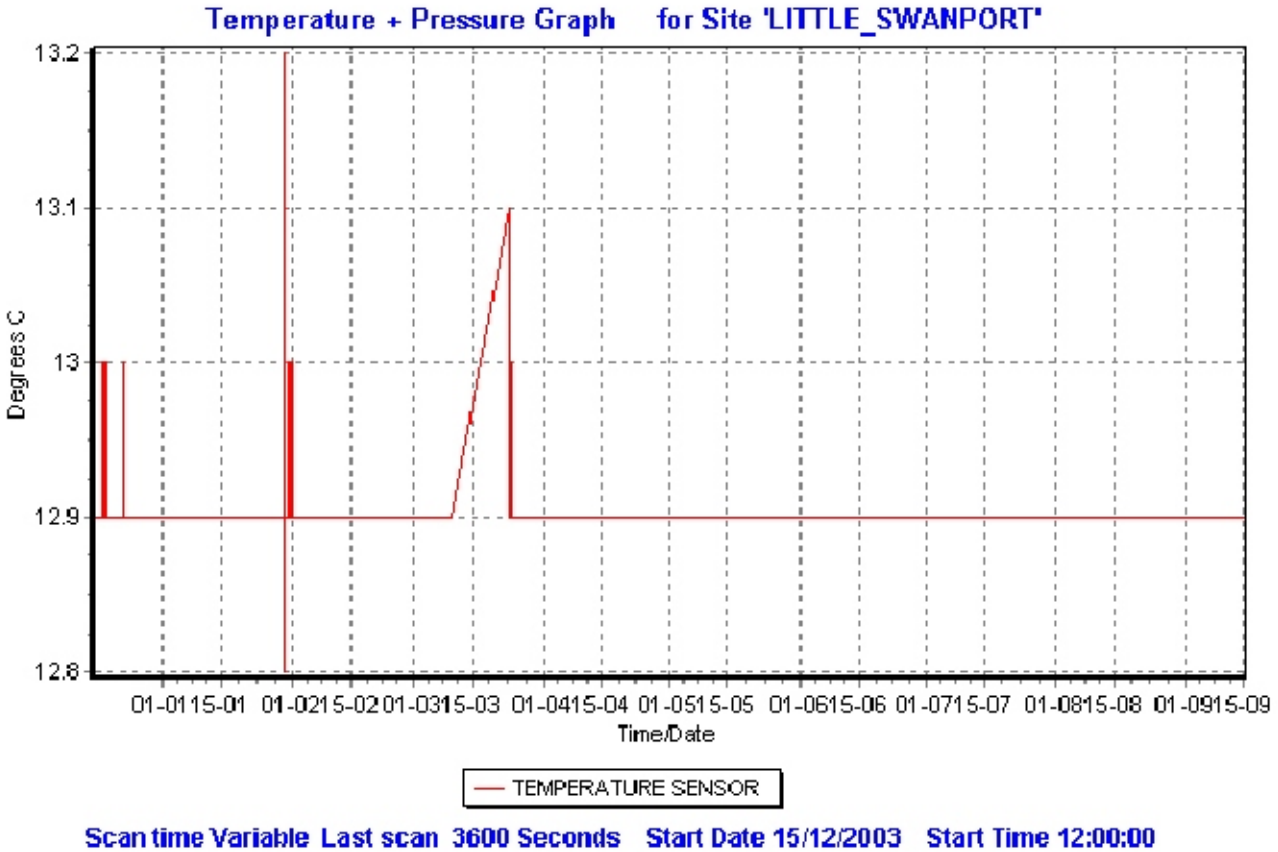
Bicheno (temperature)



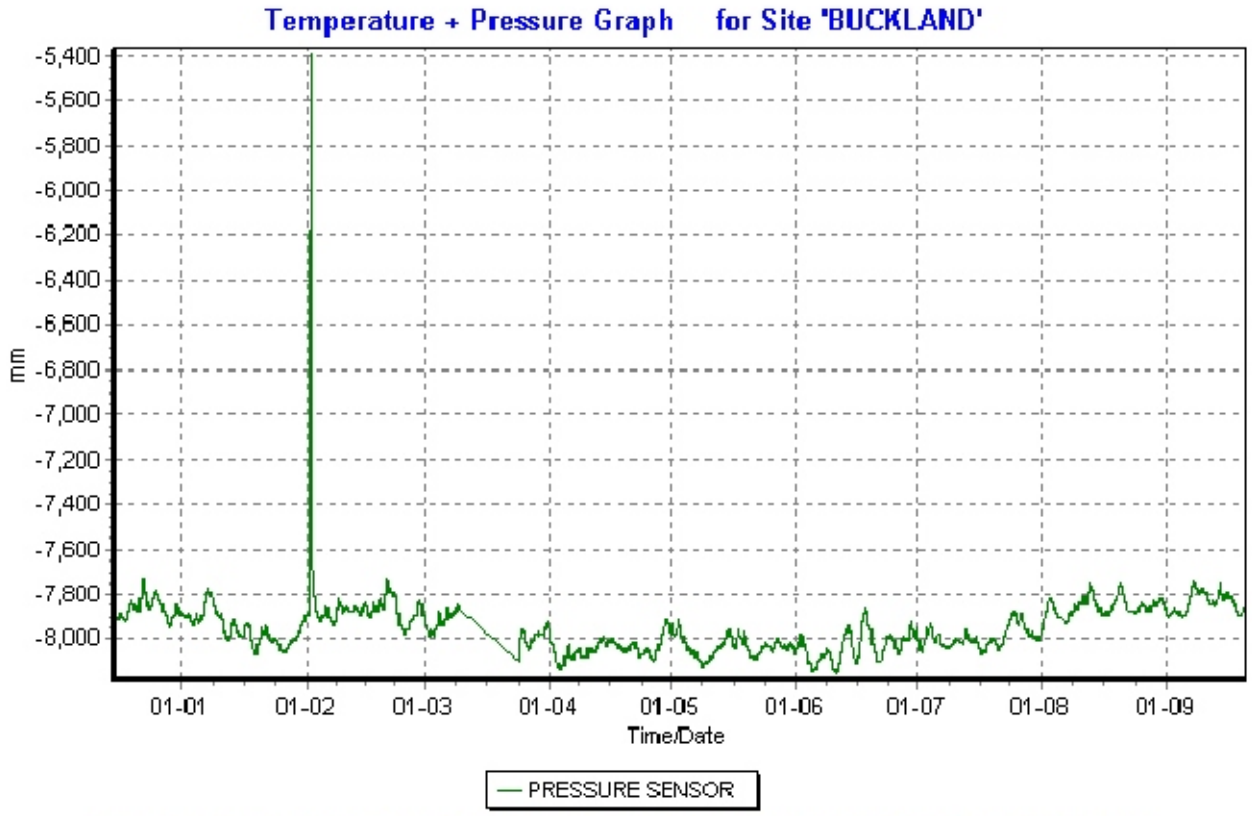
Little Swanport (SWL)



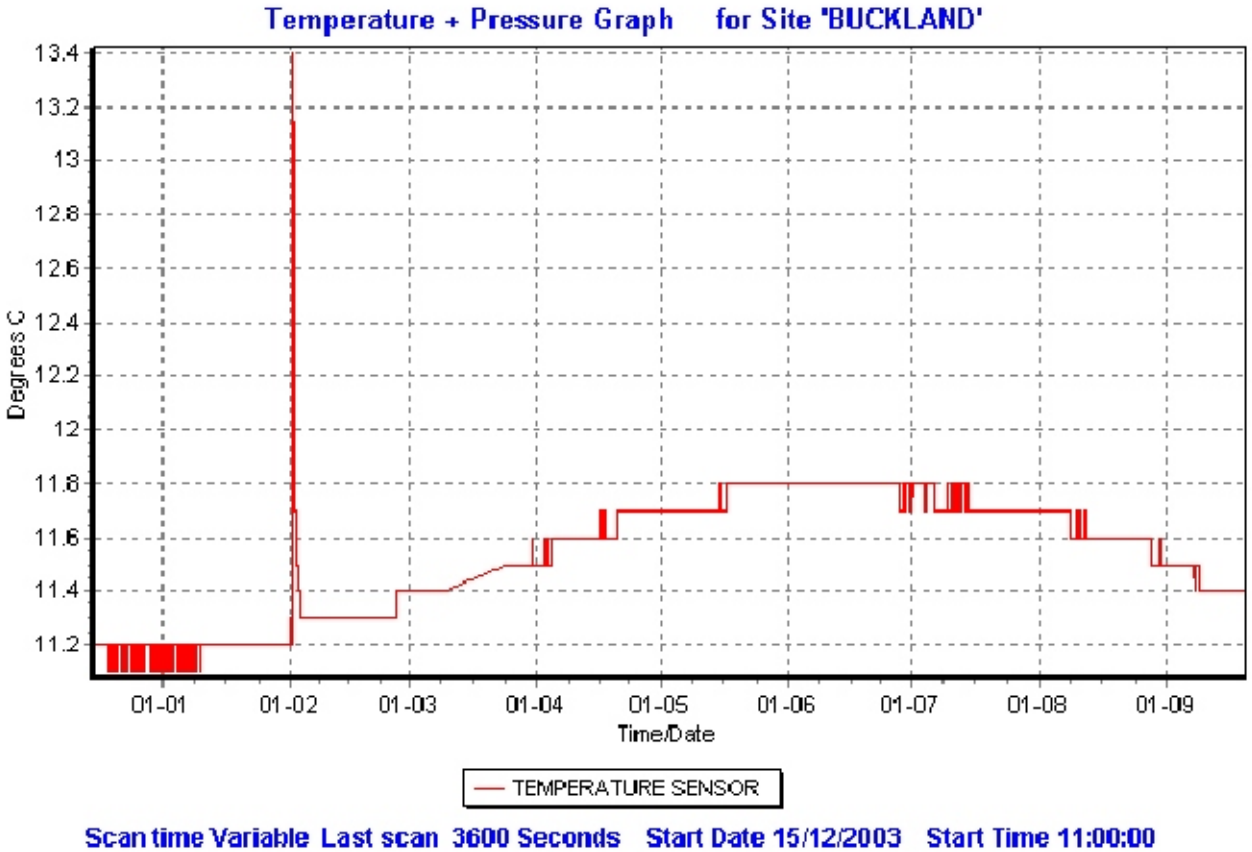
Little Swanport (temperature)



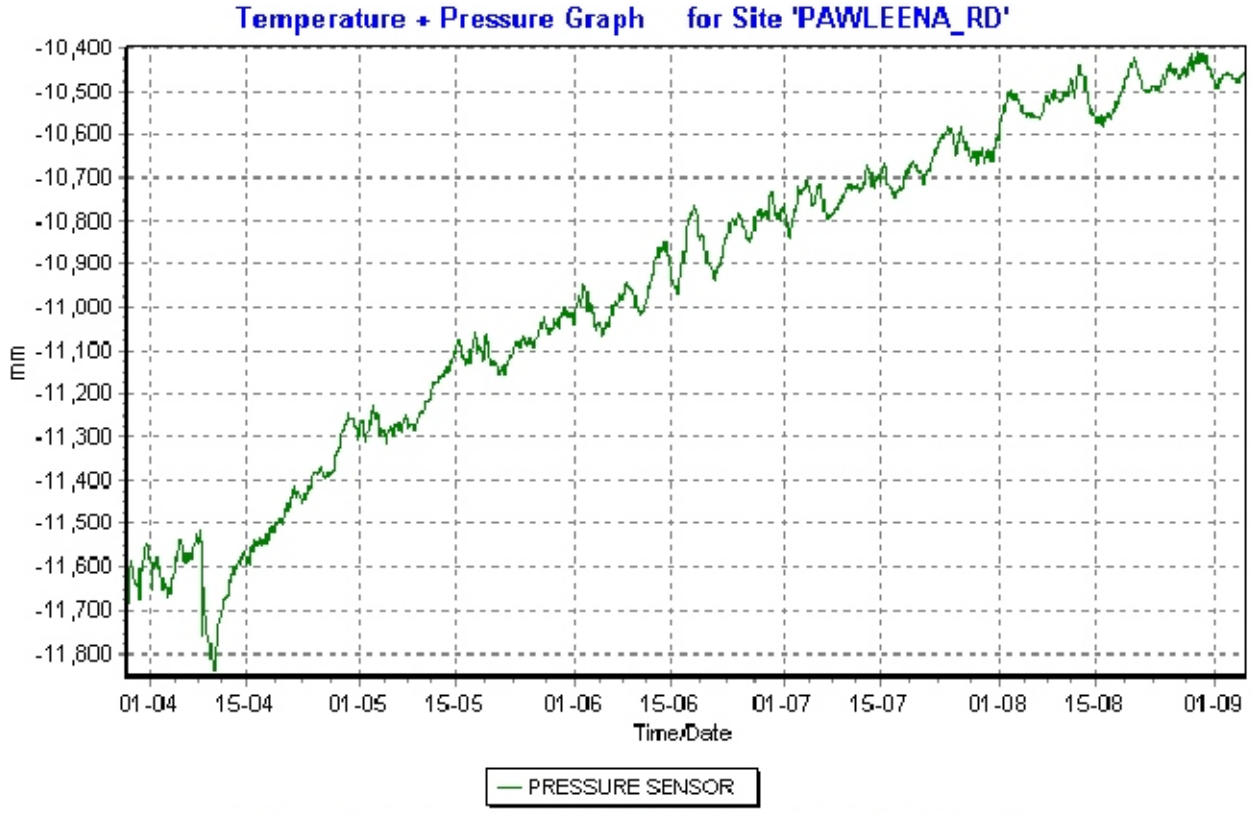
Buckland (SWL)



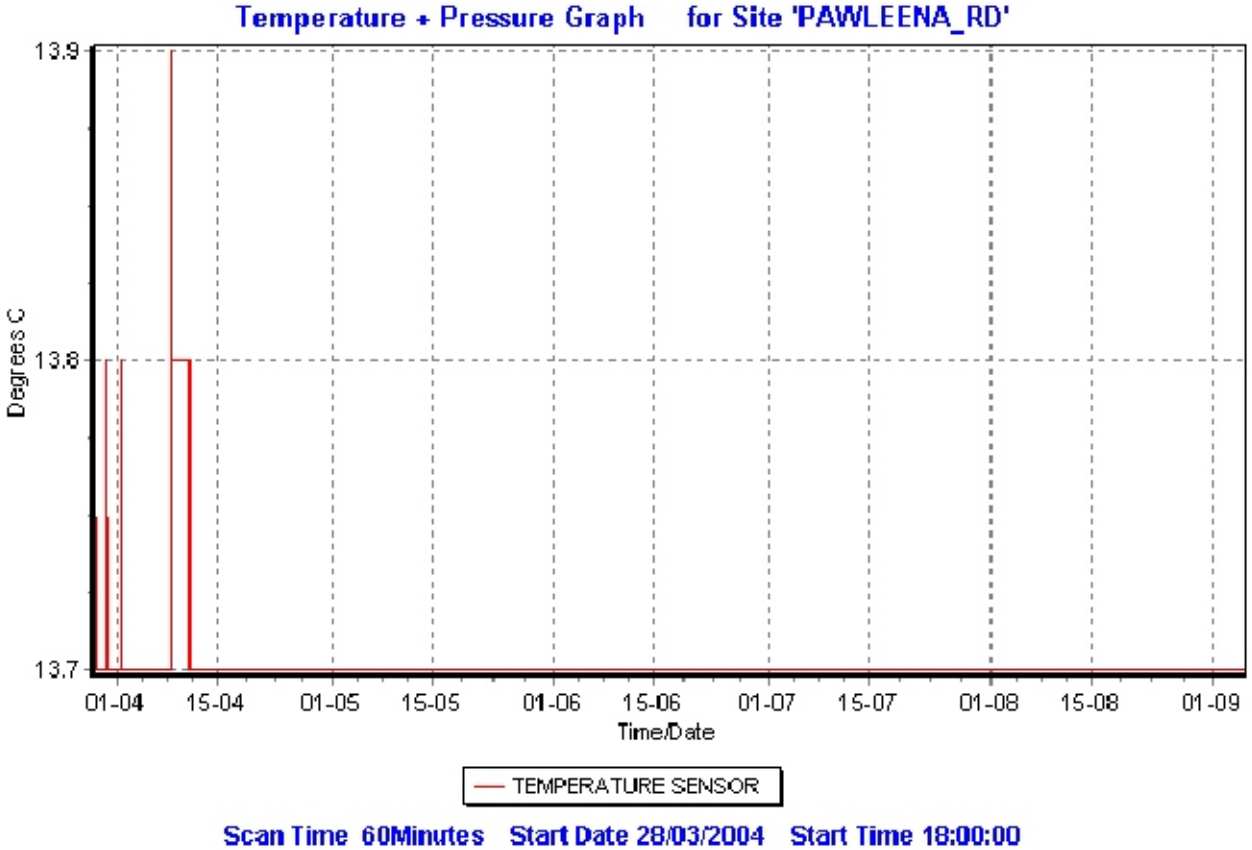
Buckland (temperature)



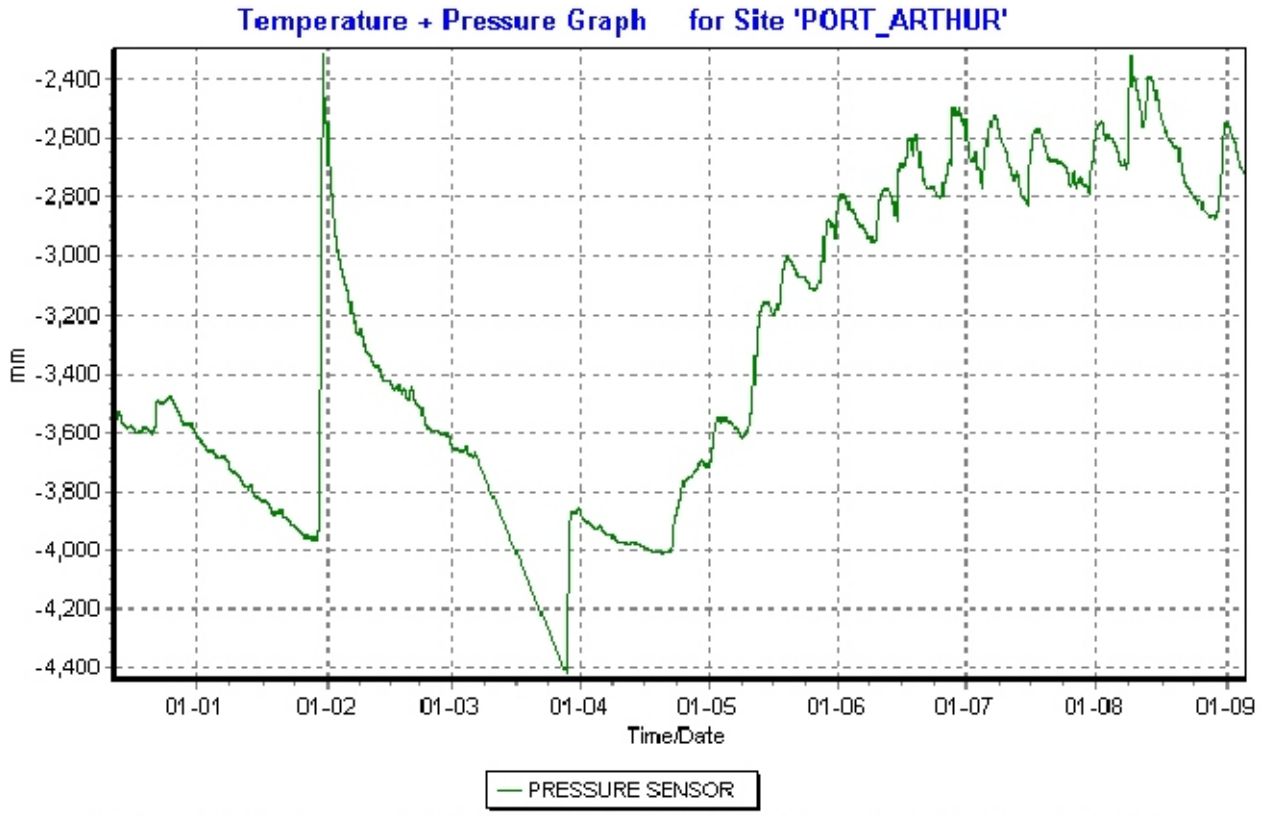
Pawleena Road (SWL)



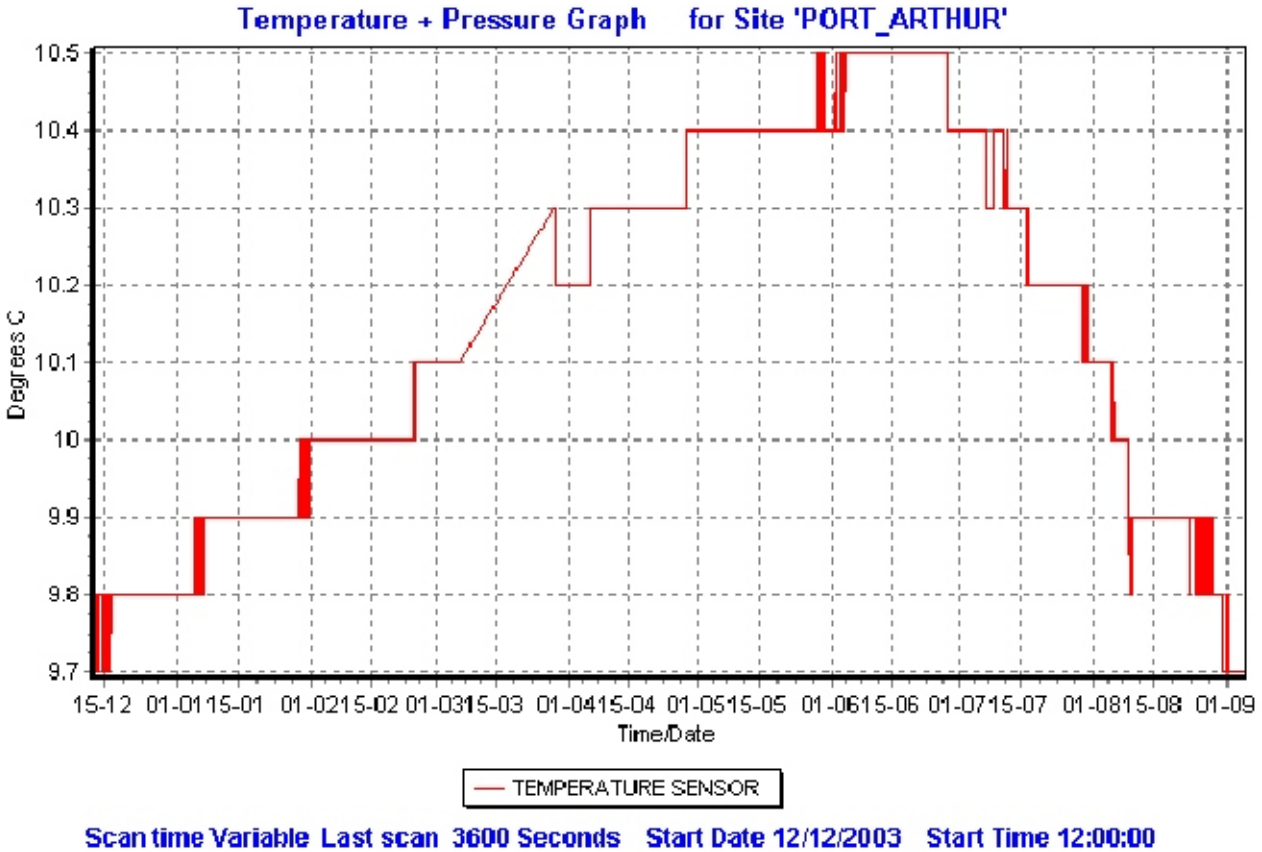
Pawleena Road (temperature)



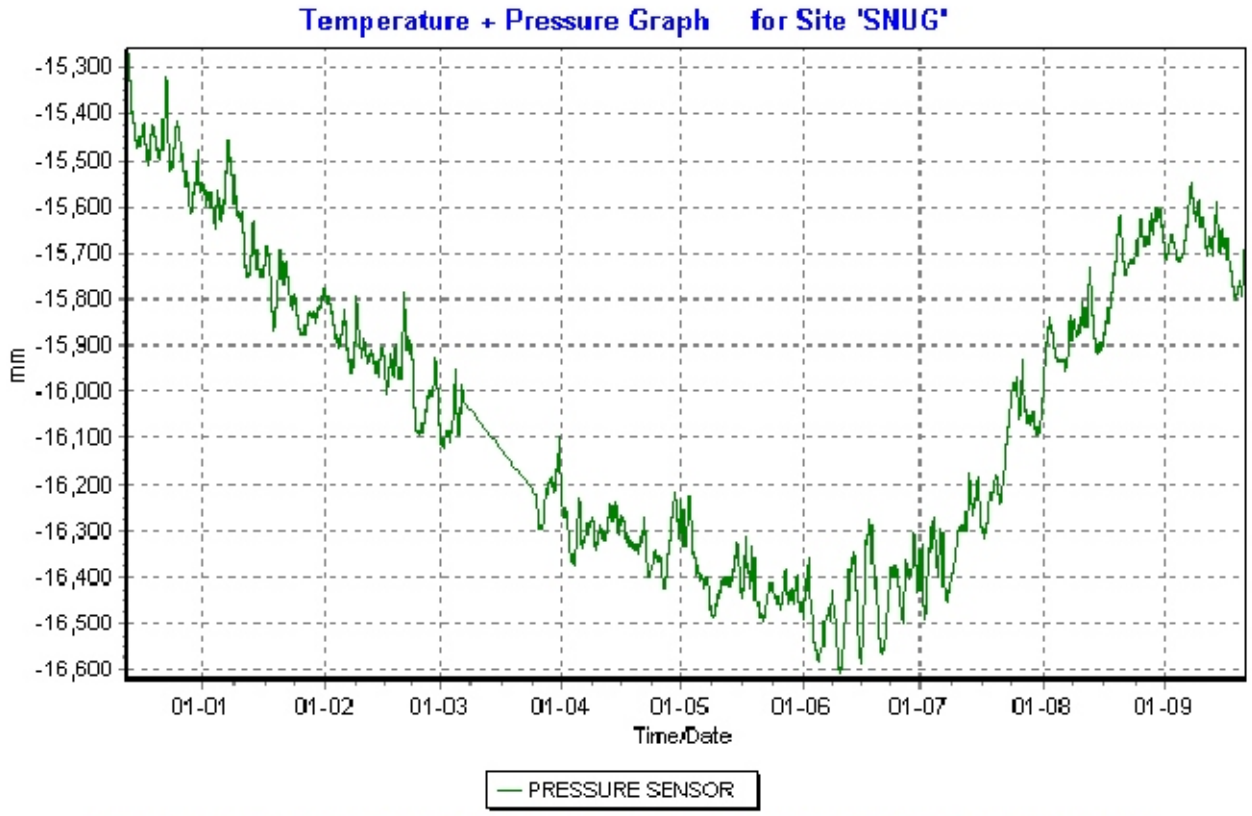
Port Arthur (SWL)



Port Arthur (temperature)



Snug (SWL)



Snug (temperature)