



Borewatch

User Manual

Models HBW-001, HBW-002

Date September 2026

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1. Introduction

1.1 Overview

The Borewatch is a compact, low-power telemetry, logging, and alarm system designed for borehole and groundwater monitoring. It is housed in a 49 mm diameter stainless steel IP68 tube and is built to fit inside standard 2-inch (50 mm) well casings and bore pipes.

The Borewatch is self-contained — no external enclosure and no mains power infrastructure is required. The sensor cable is supported by an integrated lug at the bottom of the unit; for in-bore installations, the entire assembly is lowered on a single suspension line from the top lug.

The Borewatch has a built-in web server — any standard web browser will access it, no special software is required. Use the web interface to configure the unit, view live data, download logs, calibrate sensors, and run diagnostics. Connect using a LANlink Cable (Ethernet) or HLink Dongle (Wi-Fi) at the Halytech Comm Port on the top of the unit.



1.2 Package Contents

Item	Qty
Borewatch unit	1
Battery pack — fitted inside the unit, disconnected for shipping	1
Comms port sealing cap	1
Quick Start Guide	1

A SIM card is not supplied — source one from your preferred carrier with mobile data and SMS enabled.

No M12 connector or cable is supplied. Source your own M12 mating connector, or order the HBW-003 M12 input cable — see Section 9.

Voltage-divider resistors for 0–5V and 0–10V sensors are not supplied — see Appendix B for the values.

External antennas are not supplied — order separately. See Section 1.4 for required antenna count by modem variant.

The LANlink Cable and HLink Dongle are available separately from Halytech and are required for initial configuration.

1.3 Typical Applications

- Borehole monitoring
- Groundwater monitoring
- Irrigation
- Agriculture
- Environmental monitoring
- Water treatment

1.4 Part Numbers and Options

Current models:

Item code	Modem	Antennas required
HBW-001	4G	2 × SMA
HBW-002	Cat-M1 / NB-IoT	1 × SMA

Both models include 20 channels supporting SDI-12, Modbus, 1 digital input, 1 analogue input, and system monitors. The Borewatch supports virtual (Super) channels for on-device calculations — see Section 2.1.

Software options (ordered separately from Halytech):

Item code	Option	Description
FBW-003	LiveSMS	Extended SMS capabilities: remote web access, alert escalation, modem scheduling, additional SMS commands — see Appendix G
FBW-005	DNP3	SCADA integration via DNP3 protocol — see Appendix I
FBW-006	DNP3 + LiveSMS	Both options together, ordered under one code

2. System Overview

2.1 Inputs

The Borewatch provides a single firmware channel pool supporting up to **20 configurable channels**. All channel types — native inputs, system monitors, intelligent sensor readings, and virtual channels — share this pool.

Channel allocation:

Type	Native count / limit
Analogue input (native)	1
Digital input (native)	1
System monitors	up to 4
SDI-12 / RS-485 Modbus sensor channels	up to total limit
Virtual channels (Super Channels)	no sub-limit
Total configurable channels	20

Analogue input accepts voltage signals (0–2.5V native range) or current loop signals (4–20mA, factory calibrated). External resistors are required to accept 0–5V or 0–10V signals — see Appendix B. The analogue input is shared with the open-collector output on pin 5 of the M12 connector and is selected via an internal jumper.

Digital input accepts voltage-free switch contacts. It can be configured as: Switch, Switch State, Counter, Event, or other digital types supported by the firmware. There is no galvanic isolation between the digital input and internal circuitry.

SDI-12 and Modbus sensors connect via the M12 connector. Each physical sensor may provide one or more channel values — each value occupies one channel slot. The 20-channel total is the limit, not the number of physical devices connected. See Appendix C for connection and configuration.

Virtual channels (Super Channels) are software-calculated channels derived from other inputs. The Borewatch supports $Ax + By + C$, Evapotranspiration, Wind Speed / Direction, Rating Table, and SWL (Standing Water Level). See Section 5.4.3 for the full description of each type. SWL is the headline bore application — depth-to-water calculated from a pressure transducer.

2.2 System Monitors

The following system inputs are built in:

Input	Description
System temperature	Internal temperature of the Borewatch unit
Battery voltage	Voltage of the internal lithium battery pack
External power voltage	Voltage applied via the Halytech Comm Port (when external power is connected)
Internal moisture sensor	Detects moisture inside the enclosure

2.3 Controls

The Borewatch has three outputs available on the M12 sensor connector:

Output	Connector	Function
Control 1 — Switched Power (PWR OUT)	Pin 2	Boosted 12V switched power — drives external sensors regardless of battery state; max 200 mA
Control 2 — Open Collector (OC)	Pin 5 (jumper-selected)	Open collector to ground through a 440Ω resistor; nominal 10 mA
Low-voltage sensor supply (LV OUT)	Pin 8	Internal low-voltage supply for sensor power — 3.3V or 5V (user selectable); approximately 20 mA usable

Controls 1 and 2 can be activated manually via the web interface, triggered by alarms, or used as sensor power warmups. Output names are user-definable.

Pin 5 is jumper-selected: the same pin is used for either the Open Collector output or the Analogue input. Set the internal jumper to match your application — see Appendix A.

The boosted 12V output is unique to the Borewatch — it provides regulated 12V even when the internal battery voltage is lower, allowing reliable power to submersible sensors throughout the battery's life.

2.4 Alarms

The Borewatch supports 16 independently configurable alarms. Each alarm can:

- Trigger on a channel value, date/time schedule, periodic interval, or as a Super Alarm (combination of other alarms)

- Send SMS alerts to up to 3 phone numbers and email alerts to up to 3 email addresses
- Activate or pulse a control output
- Trigger faster logging while active

Alarms can be acknowledged via the web interface, by SMS command (LiveSMS option), or automatically after a configurable timeout.

2.5 Logger

The logger stores up to 300,000 records in non-volatile FLASH memory — records are retained without power. The logger records channel readings, control state changes, alarm events, communication events, and system events. Time resolution is 1 second.

The Borewatch supports two independent automatic report slots, each configurable for period (1 minute to 1 day), format, and delivery destination (FTP, email, or HTTP/HTTPS POST).

For a full list of report formats, see Appendix J.

2.6 Communications

Interface	Detail
Mobile	4G (HBW-001) or LTE Cat-M1 / NB-IoT (HBW-002)
Ethernet	Via LANlink Cable to the Halytech Comm Port — for configuration and local access
Wi-Fi	Via HLink Dongle to the Halytech Comm Port — for configuration and local access
SIM card	Nano SIM
Antenna(s)	External, SMA male — 4G: 2 × external; Cat-M1: 1 × external

The default LAN IP address is `192.168.0.177`. The default Wi-Fi IP address (via HLink) is `192.168.2.177`.

3. Installation

Recommendation: Before going on site, configure the Borewatch using your sensors or simulate them. The Borewatch allows setups to be saved and restored — make use of this. If you have similar site configurations or standard templates, start with one of them. Much easier in the workshop than out on a bore site.

A typical installation sequence is:

1. Open the unit at the sensor (bottom) end.
2. Unplug the ribbon cable from the end cap.
3. Slide the battery out and unplug it from the inline connector.
4. Open the unit at the top end and slide the electronics assembly out.
5. Install the SIM card.
6. Connect the battery.
7. Close both end caps.
8. Connect to the web interface via LANlink or HLink and complete configuration.
9. Connect the antenna(s).
10. Connect the M12 sensor cable.
11. Mount and suspend the unit in the bore.

3.1 Opening the Unit

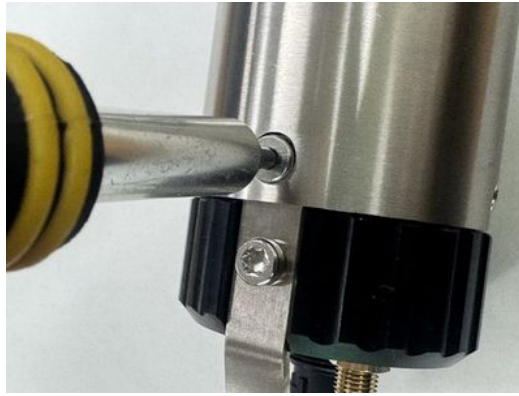
The Borewatch electronics are accessed by opening both end caps in turn. The sensor (bottom) end cap is opened first to disconnect the battery; the top end cap is opened afterwards to slide the electronics out and access the SIM card.

Tools required: 2.5 mm hex driver for the end cap locking screws. There is one screw per end cap.

Before opening: disconnect any external antenna, LANlink, HLink, or sensor cable. Work on a clean, dry surface.

Sensor (bottom) end cap:

1. Remove the hex locking screw from the sensor end cap.



2. Twist the end cap to release the bayonet lock and remove it.



3. Unplug the ribbon cable from the end cap.



4. Slide the battery part way out of the tube to expose the battery connector. If it does not slide out, tap the unit gently.

5. Unplug the battery inline connector. Remove the battery.



Always disconnect the battery before sliding the electronics assembly out — it protects the unit from accidental shorts during handling.

Top end cap:

6. Remove the hex locking screw and bayonet-release the top end cap in the same way as the sensor end cap.
7. Carefully slide the electronics assembly out from the top end, guiding the ribbon cable so it doesn't snag.



The PCB is now accessible for SIM card installation.

3.2 Installing the SIM Card

A SIM card is required to send automatic reports and alarms over the mobile network. The SIM holder is on the PCB and uses a **Nano SIM**.

SIM PIN: Most SIMs ship with no PIN enabled. If yours does have one, insert it into a mobile phone first and disable the PIN in the phone's settings before installing it in the Borewatch.

If the SIM was previously used in an iPhone, disable iMessage before installation — see Appendix N.

1. Locate the SIM holder on the PCB.
2. Slide the metal SIM mechanism a couple of millimetres until it clicks, then hinge it open.
3. Place the Nano SIM into the plastic tray, observing the notched corner orientation.



4. Hinge the metal mechanism back over the SIM and slide it to the locked position.



The Nano SIM and the metal SIM mechanism are small and fiddly — take care to seat the SIM flat in the tray before closing the mechanism.

3.3 Connecting the Battery

The Borewatch ships with the internal lithium battery pack fitted but disconnected. Connect the battery before closing the unit.

1. Slide the electronics assembly back into the tube through the top end, guiding the ribbon cable so it doesn't snag.
2. Position the battery connector and plug it into the inline connector at the sensor (bottom) end.



3. Slide the battery back into the tube.



The battery pack (HBT-001) is a 7.2V lithium thionyl chloride (Li-SOCl₂) cell, 13 Ah. It is user-replaceable. The same cell is used across the mihiy family, repackaged for the tubular enclosure with closed-cell foam buffering. See Section 7.1 for replacement.

3.4 Closing the Unit

Close the sensor (bottom) end first, then the top end.

Sensor (bottom) end:

1. Reconnect the ribbon cable to the end cap.



2. Refit the end cap using the bayonet mechanism — engage the bayonet and rotate to the locked position.



3. Refit and tighten the hex locking screw.



Top end:

4. Refit the top end cap using the bayonet mechanism — engage the bayonet and rotate to the locked position.
5. Refit and tighten the hex locking screw.

Verify that both end caps are fully bayonet-engaged before tightening the hex screws — the hex screw locks the bayonet against accidental rotation; it does not seal the unit on its own.

3.5 Mounting and Suspension

The Borewatch is installed suspended in the bore:

Method	Typical use	Mounting hardware
Suspended (in-bore)	Borehole / well monitoring with the unit inside the casing	Suspension line on the top lug; sensor cable supported by the bottom lug

Comms connector cap — fit before leaving site: the supplied cap for the Halytech Comm Port must be fitted before leaving site. The LANlink Cable or HLink Dongle is removed at the end of the configuration session, leaving the comms port unused — the cap maintains the IP68 seal in normal operation. All other connectors (antennas and M12 sensor) remain in use throughout the installation life and do not require caps.

Cable support — suspended installations: support the sensor cable from the integrated sensor support lug at the bottom of the Borewatch, or from a dedicated mounting point.
Do not rely on the M12 connector to support the weight of the sensor cable — the connector is for electrical contact only and can fail mechanically if loaded.

Suspended installation procedure:

1. Attach the sensor cable to the integrated support lug at the bottom of the Borewatch — use a stainless steel cable tie, lashing cord, or your standard support method.
2. Connect the M12 sensor cable to the connector (see Section 3.7).
3. Connect the antenna(s) and seal the connection(s) — see Section 3.6.
4. Attach a suspension line to the top suspension lug.
5. Lower the Borewatch slowly into the bore, paying out the suspension line, sensor cable, and antenna cable together. Avoid kinking or twisting the antenna cable. Mount the Borewatch as high in the bore as is practical — only the sensor goes down to depth on its cable.
6. Secure the suspension line at the bore head.
7. Fit the comms connector cap.

Keep the Borewatch out of the water — mount it high in the bore. A submersible level sensor has a vent tube or a reference port. That vent runs up the sensor cable to the Borewatch. If the Borewatch goes under water, the vent goes under water too, and the sensor gives a wrong reading. Mounting it as high as is practical also keeps it easy to reach for service.

Concealed installations: the Borewatch is designed to fit inside a 2-inch (50 mm) well or

pipe with standard caps and casings — completely concealed from view.

3.6 Connecting the Antenna

External antenna(s) connect to SMA male connector(s) on the top end cap:

Variant	Antennas required
4G (HBW-001)	2 × SMA
Cat-M1 (HBW-002)	1 × SMA

Procedure:

1. Connect the SMA antenna cable(s) to the connector(s) on the top end cap.



2. Hand-tighten only — **do not use tools on SMA connectors**. Overtightening damages the connector.
3. Seal each connection with self-vulcanising rubber tape.

Antenna placement options:

Installation type	Antenna placement
Bore extends above ground, plastic casing	Antenna can be mounted inside the bore casing — plastic does not block the signal
Bore extends above ground, metal casing	Route the antenna cable out of the bore; mount the antenna externally
Below-ground / gatic cover installation	Whip antenna on the pit wall near the top, or a flat-blade antenna fed through a small hole in the cover, sealed with epoxy

Cat-M1 vs 4G in restricted environments: Cat-M1 offers better RF penetration than standard 4G LTE in pit and below-ground installations. Choose HBW-002 (Cat-M1) for marginal-signal sites where the antenna cannot be mounted clear of the ground.

3.7 Connecting Sensors

Sensors connect to the **M12 8-pin socket** at the bottom (sensor) end of the unit. No M12 mating connector is supplied. Source your own and wire it to the sensor side, or buy the ready-made HBW-003 M12 input cable from Halytech. Wire colours follow the M12 standard colour code.

Pinout summary: see Appendix A for the full pinout. For wiring of specific sensor types, see Appendix B. For SDI-12 and Modbus connection, see Appendix C.

Summary of input connections:

Sensor type	Wire to
Switch, counter, event (pulse)	Digital In (pin 1) → GND (pin 7)
4–20 mA current loop	OC/AIN (pin 5) → GND (pin 7) — direct, no external resistor
Voltage 0–2.5V	OC/AIN (pin 5) → GND (pin 7) — direct
Voltage 0–5V or 0–10V	OC/AIN (pin 5) via voltage divider — see Appendix B
SDI-12 sensor	SDI-Data (pin 6), GND (pin 7), and sensor power as required (LV OUT pin 8, PWR OUT pin 2, or external)
Modbus RS-485 sensor	RS485 D– (pin 3), RS485 D+ (pin 4), GND (pin 7), and sensor power as required

Sensor power:

The Borewatch can power external sensors from three sources, all on the M12 connector:

Source	Voltage	Max current	Use
PWR OUT (pin 2) — Control 1	Boosted 12V regulated	200 mA	Submersible sensors needing 12V regardless of battery state
LV OUT (pin 8)	3.3V or 5V (user selectable)	approx. 20 mA	Low-voltage sensors and peripherals that accept 3.3V or 5V
External supply via Halytech Comm Port	12–22V DC	—	Solar-supplemented installations

Pin 5 jumper: the analogue input shares pin 5 with the open-collector output. Set the internal jumper to **AIN** for analogue input or **OC** for open-collector output before installation. Both functions cannot be used simultaneously.

Fit the supplied comms connector cap to the Halytech Comm Port before leaving site — the antenna and M12 sensor connections remain in use throughout the installation life.

3.8 External Power

External power or a solar panel can be connected via the Halytech Comm Port at the top end cap to supplement the internal battery. External power is **optional** — the Borewatch operates from internal battery alone under the standard reference scenario (1-hour logging, daily reports, good signal, self-powered sensor, 1 alarm per month) for up to 5 years.

Parameter	Value
Input voltage range	12–22V DC
Switchover threshold	Modem switches to external supply when applied voltage exceeds 9V
Connection	Halytech Comm Port — pin 6 (USB Power) positive, pin 4 (GND) negative
Minimum current	100 mA above 9V to run the modem as well; 10 mA above 9V runs everything except the modem

 **Check your supply voltage before connecting external power.** The external power input accepts **12–22 V DC** and has only **limited over-voltage protection**. More than 22 V DC will permanently damage the Borewatch.

Solar panels — use a 12V panel. The Borewatch is designed for a 12V solar panel. A 12V panel may be connected directly, because its open-circuit voltage stays inside the 12–22 V

range. A panel of a higher rating, such as 24V, will likely damage the Borewatch. Do not connect one directly — run it through a regulated solar controller set to 12–22 V.

The Borewatch has three possible power sources. In priority order:

Source	Behaviour
External power above 9V via the Halytech Comm Port	The entire Borewatch (modem and electronics) runs from the external supply. The internal battery is not drained while external power is present.
USB via LANlink Cable or HLink Dongle (configuration sessions)	Powers all device functions except the modem. Useful for extended configuration sessions without draining the battery.
Internal battery	Primary source in normal field operation.

The internal Li-SOCl₂ battery is non-rechargeable — external power does not charge it.

External power supply operation

Connect the positive to pin 6 and the negative to pin 4. The supply must be above 9V.

How much current the supply delivers decides what it can run:

Current available above 9V	What it runs
10 mA or more	Everything except the modem
100 mA or more	Everything, including the modem

Size a solar panel from those figures and your own site conditions — hours of sun, panel orientation, and how often the modem transmits.

3.9 Commissioning Checklist

Before leaving site, confirm all of the following:

- Mobile signal is adequate — at least three of the four signal bars on the web interface (see Section 5.11)
- Location name and site ID set correctly
- Date and time correct
- All configured inputs are reading as expected
- Administrator password changed from default

- APN configured and modem is successfully connected
- Test report sent and received at the configured destination
- Comms port cap fitted (after LANlink/HLink removed)
- Setup saved to disk as a backup copy

Signal strength reference:

Level	Rating	Action
Excellent	≥75%	No action
Good	≥50%	No action
Acceptable	≥40%	No action
Poor	<40%	Reposition antenna

The device screen shows signal as a dBm value and a four-bar icon, not as a percentage. Use the bar count as your guide on site: three or four bars is good, one or two bars means you should try a better antenna position.

4. Web Interface

The Borewatch has a built-in web server. Any standard web browser can be used — no special software is required. The web interface is used for configuration, viewing live data, downloading logs, calibrating sensors, and running diagnostics.

4.1 Connecting to the Borewatch

Option A — Via LANlink Cable (Ethernet):

1. Disconnect the computer from all networks, including Wi-Fi.
2. Plug the round Borewatch-end of the LANlink Cable into the **Halytech Comm Port** at the top of the unit.
3. Plug the computer-end connectors into the computer's LAN and USB ports.
4. Wait 30 seconds for the Borewatch to register.
5. Open a browser and go to: `http://192.168.0.177`

The LANlink Cable powers the Borewatch electronics while connected — no drain on the internal battery during configuration sessions.

Option B — Via HLink Dongle (Wi-Fi):

The HLink Dongle plugs into the **Halytech Comm Port** and creates a Wi-Fi access point directly from the Borewatch. Any Wi-Fi capable device — phone, tablet, or laptop — can connect without needing a LAN port. Keep the dongle plugged in throughout the session.

1. Plug the HLink Dongle into the **Halytech Comm Port**.
2. On your device, connect to the Wi-Fi network created by the Borewatch.
3. Open a browser and go to: `http://192.168.2.177`

The HLink Dongle also powers the Borewatch electronics while connected — no drain on the internal battery during configuration sessions.

4.2 Logging In

The login page is shown on first access. Enter the username and password.

Field	Default value
Username	user
Password	changeme

Change the password on first login — see Section 5.3.

If credentials are lost, contact Halytech for assistance. The user cannot recover access independently.

Three access levels are available — see Section 5.3 for details.

4.3 Alarms Page

The Alarms page is shown by default after login. It displays the current state of all configured alarms, auto-refreshing every 10 seconds.

To acknowledge an active alarm, click on it in the alarm list. For alarm status codes, see Appendix E.

4.4 Inputs Page

The Inputs page shows the current reading of all configured input channels at the time the page was loaded. Refresh the page to get updated readings.

4.5 Controls Page

The Controls page shows the current state of each control output and allows manual activation and deactivation. Multiple controls can be changed before saving — click **Save** to apply all changes at once.

4.6 History — Download Logged Data

The History page allows logged data to be downloaded from the Borewatch as a CSV file.

1. Set the **End Date** and **End Time** — the download will include records up to this point.
2. Set the **Number of Records** to download.
3. Select the **Format** — see Appendix J for available formats.
4. Select the direction: **Oldest first** or **Newest first**.
5. Click **Download** — the browser will save the file.

4.7 View Setup

View Setup displays the current configuration in read-only form. Use this to verify settings without entering Change Setup.

4.8 Change Setup

Change Setup is the configuration area. All configuration changes are made here.

Important: Logging and alarm generation are suspended while Change Setup is active. This applies for the entire time any Change Setup page is open. Change Setup exits automatically after 20 minutes of inactivity. All controls are turned off by default when Change Setup is entered (configurable via Advanced Settings).

4.9 About

The About page displays the device serial number, firmware version, and licence information.

4.10 On-Page Help

Most Change Setup pages include a built-in **Help** button. Click it to display context-sensitive help for that page directly in the browser.

5. Configuration

All configuration is performed via Change Setup in the web interface. Connect using the LANlink Cable or HLink Dongle — see Section 4.1.

On-page Help. Each Change Setup page has a ? Help button that opens an in-context help window with field-by-field guidance. This manual covers configuration at a reference level — for screen-by-screen detail of every field, use the Help (?) buttons in the device.

Recommended first-time configuration order:

1. Set location name and site ID
2. Configure network — APN, primary/secondary network method
3. Test mobile connectivity — signal strength test and test SMS
4. Configure input channels
5. Configure controls
6. Configure alarms
7. Configure reports
8. Save setup to disk
9. Reset report starting point

5.1 Location and Site ID

Navigate to **Change Setup** → **Change Location / Site ID**.

- **Location name** — used in SMS alerts, report filenames, and the web interface. Up to 16 characters.
- **Site ID** — secondary identifier included in reports.
- **Long location name** — extended location name used in reports when the "Use long location name" Advanced Setting is enabled.
- **Modem phone number** — the SIM card's phone number. Must be entered manually — it is not read automatically from the SIM.
- **SMS PIN** — 4-digit PIN required for control activation and remote access commands (LiveSMS option). Set to to disable.

5.2 Time and Date

Navigate to **Change Setup** → **Date and Time Settings**.

1. Click **Set from computer** to synchronise the device clock from the browser's system time.
2. Or enter the date and time manually.

Always set the clock to standard (non-DST) time — daylight saving is not supported.

NTP synchronisation: The Borewatch synchronises its clock automatically once per day via NTP when a mobile connection is available. Without NTP, the clock may drift up to 30 seconds per month. To sync immediately, click **Synchronise now**. NTP settings can only be modified by the Administrator account.

5.3 Username and Password

Navigate to **Change Setup** → **Change Usernames and Passwords**.

Three access levels are available:

Level	Default username	Default password	Permissions
Administrator	user	changeme	Full configuration access
Service	service	changeme	View readings, diagnostics, calibration, save setup, manual upgrade
User	user	user	View readings only

Change the Administrator password on first access. Default credentials are the same on all devices from the factory.

5.4 Input Channels

Navigate to **Change Setup** → **Change Input Setup**.

For each channel:

1. Set the **Type** — select input type (see below).
2. Set the **Name** — user-defined channel name (used in reports and the web interface).
3. Set the **Units** — engineering units for display and calibration.

4. Set the **Logging period** — how often to log data, or select **General** to use the shared logging period.
5. Use the **Options** icon (cog) for additional per-channel options.
6. Use the **Examine** icon (magnifying glass) to request a new reading from the sensor.

The screenshot shows the 'Change Input Setup' page for 'borewatch'. It features a table with 20 channels. Channels 1-16 are 'Disabled'. Channels 17-20 are configured with various sources like Moisture, Voltage, and Temperature. At the bottom, there are global logging settings: 'General logging period' set to 5m, 'General fast logging period' set to 5m, and 'Logging offset' set to 00 hours 00 minutes.

Type	Source	Name	User ID	Units	Logging
1	Disabled				
2	Disabled				
3	Disabled				
4	Disabled				
5	Disabled				
6	Disabled				
7	Disabled				
8	Disabled				
9	Disabled				
10	Disabled				
11	Disabled				
12	Disabled				
13	Disabled				
14	Disabled				
15	Disabled				
16	Disabled				
17	System (Moisture)	Moisture	Moisture Internal	16	1h
18	System (Voltage)	External Power	Power In	17	V
19	System (Voltage)	Battery	Battery1	18	V
20	System (Temperature)	Temperature	Temp Internal	19	C

General logging period: 5m
 General fast logging period: 5m
 Logging offset: 00 hours 00 minutes

Global logging settings (at the bottom of Change Input Setup):

Setting	Description
General logging period	Logging interval for all channels set to "General"
General fast logging period	Logging rate during alarm fast-logging
Logging offset	Shifts logging time from on-the-hour (e.g. offset 20 min → logs at :20 past each hour)

All channels are also logged automatically at midnight each day, regardless of logging period.

5.4.1 Input Types

Native inputs (physical inputs on the M12 connector):

Type	Description
Switch	Logs each state change (ON/OFF) and duration the switch was ON. Active = digital input shorted to GND. Minimum stable state: 3 seconds.
Switch State	Logs state at each logging period. Does not log ON duration.
Counter	Increments on each pulse. Max 100 Hz (5ms minimum pulse width). Calibratable to engineering units (e.g. litres per pulse).
Event	Records each pulse with timestamp and running total. Suitable for pulses less than once per 30 seconds.
Analogue (Voltage)	Records voltage at each logging period. Native range: 0–2.5V.
Analogue (4–20 mA)	Factory calibrated with built-in biasing resistors. EOR indicates sensor not connected or not functioning.
Analogue (Switch)	Connects a switch to the analogue input. Reads ON if voltage < 1.25V; OFF if 1.25–2.5V.

The Borewatch has 1 native digital input and 1 native analogue input. The Difference type, which requires two digital inputs, is not available on Borewatch.

5.4.2 System Inputs

System inputs are built-in monitors:

Input	Description
System temperature	Internal temperature of the Borewatch unit
Battery voltage	Voltage of the internal lithium battery pack
External power voltage	Voltage applied via the Halytech Comm Port (when external power is connected)
Internal moisture sensor	Detects moisture inside the enclosure

5.4.3 Super Channels

Super Channels are derived channels calculated from other input values. They share the same channel pool as native and system inputs.

Type	Description
Rating Table	Interpolates from a user-supplied stage/discharge lookup table (up to 100 pairs).
$Ax + By + C$	Sum, difference, or scaled combination of two channels
Evapotranspiration	Hargreaves model using solar radiation and mean temperature
Wind Speed / Direction	Vector average, angular average, or Sigma Theta (Yamartino method)
SWL	Standing Water Level: $SWL = OFFSET - Head$ — purpose-built for groundwater applications

Super Channels can be used in reports and as alarm trigger sources, the same as native or system channels. They are not normally calibrated — the input channels are calibrated and Super Channel calculations operate on those calibrated values. The exception is **SWL**, which must be calibrated once to set the current reading; the offset is calculated automatically from there.

Rating Table

Selects an input channel and applies linear or logarithmic interpolation against a user-supplied lookup table. The table is generated from Hydstra software and uploaded to the device.

Once a Rating Table Super Channel is set up:

1. **Change Input Setup** → **cog (Options)** — choose the input channel that feeds the rating table.
2. A **Rating Table Options** button appears at the bottom of the Change Input Setup page. Open it to:
 - Upload a rating table (Hydstra format)
 - Select the **Interpolation Method**: Linear or Logarithmic
3. After upload, a **Rating Table Management** page becomes accessible from Change Setup — use this to download the existing table or upload a replacement.

$Ax + By + C$

Performs the calculation:

$$z = (A \times x) + (B \times y) + C$$

Where A and B are scaling factors (can be negative), x and y are input channels, and C is a fixed offset (added or subtracted from the result).

Use the cog (Options) icon to select the input channels and enter A, B, and C.

Example — water depth from a pressure sensor with atmospheric compensation:

A pressure sensor at the bottom of a bore reads gauge pressure (water depth + atmospheric); a second sensor reads atmospheric pressure. To get water depth in metres from sensors reading in bars (1 bar $\approx$ 10.19 m of water):

- A = 10.19, x = depth-pressure channel (bar)
- B = -10.19, y = atmospheric-pressure channel (bar)
- C = 0

Result: water depth in metres, atmospheric pressure subtracted.

Evapotranspiration

Calculates daily reference evapotranspiration (ET_0) using the Hargreaves model:

$$ET_0 = 0.0135 \times (T + 17.78) \times R_s \times (595.5 - 0.55 \times T) / 238.8$$

Where:

- **T** = mean daily temperature (°C)
- **R_s** = total daily solar radiation (MJ/m²/day)

Use the cog (Options) icon to select the input channels for temperature and solar radiation.

Wind Speed and Direction

Four calculation methods are available, depending on what the input channels report. Each method averages over the Super Channel's logging period.

Method	Inputs	Result
Wind Speed Vector Avg	Instantaneous wind speed + instantaneous direction	Vector-averaged wind speed
Wind Direction Vector Avg	Instantaneous wind speed + instantaneous direction	Vector-averaged wind direction
Wind Direction Average	Instantaneous wind direction	Mean direction (correctly handles 0°↔360° wrap)
Wind Direction Sigma Theta	Instantaneous wind direction	Standard deviation of direction (Yamartino method)

SWL — Standing Water Level

Calculates standing water level in a bore from a head-of-water input. This is the primary virtual-channel application for the Borewatch.

SWL = OFFSET – Head

Where Head is the water depth above the sensor and OFFSET is set automatically during calibration.

To use:

1. Set up a head-of-water input channel (typically a pressure sensor calibrated in metres of water).
2. Add a Super Channel with type **SWL** and select the head channel as input.
3. Calibrate SWL once: enter the **current standing water level** as the desired value. The offset is computed automatically from there.

5.4.4 Channel Logging Options

Option	Description
Log Difference	Logs the change since the last log rather than the raw value. Variants: Any / Positive only. Useful for meters.
Minimum change	Minimum change threshold before a log entry is made, combined with a Force Log interval.
Filter type	Average (all input types); Integrate (SDI-12, RS-485, Rating Table, Ax+By+C inputs).
Log Min/Max	Logs minimum and maximum values within each logging period in addition to the standard value.
Periodic Reset	Resets the accumulated value at a set interval (1, 3, 6, 12, or 24 hours) — used for daily totals such as rainfall.
Warmup source	Assigns a control output as a sensor power supply that activates before each reading.

5.5 Input Channel Calibration

Navigate to **Change Setup** → **Change Input Setup** → **Calibrate** (for the relevant channel).

Calibration formula: `value_calibrated = (value_raw × scaler) + offset`

Available calibration methods:

Method	Description
Change Offset Only	Adjusts offset only — useful for fine-tuning a zero point
4-20mA Calibration	Enter the real-world value at 4 mA and 20 mA — device calculates scaler and offset
2-point calibration	Apply two known inputs and enter expected outputs — see §5.5.1
Manual calibration	Enter scaler and offset directly
Change Desired Value	Align the running counter to the source meter's current reading — see §5.5.3 (counter / event inputs only)

5.5.1 2-Point Calibration (Analogue)

Applies to: Analogue (Voltage), Analogue (4–20 mA).

2-point calibration automatically calculates the scaler and offset by taking two raw readings and the user's real-world values for each.

Procedure:

1. Apply a known low input to the sensor (e.g. immerse a pressure sensor in 20 cm of water).
2. On the calibration page, take a reading. Enter the real-world value (e.g.) in the **desired reading** field.
3. Click **Click here** to lock in the first point.
4. Apply a known high input (e.g. immerse the sensor in 290 cm of water).
5. Take a reading. Enter the real-world value in the desired reading field.
6. Click **Click here** to lock in the second point.
7. Click **Save** to commit the calibration.

Constraints:

- The two points must be separated by at least **1000 raw counts** for analogue voltage inputs, or at least **4 mA** for 4–20 mA inputs. If the spacing is less than this, calibration will fail and the procedure must be restarted.
- Larger spacing between the two points produces more accurate calibration.

5.5.2 Pulses Per Unit — a Divisor, Not a Multiplier

The **Pulses per unit** field asks how many pulses make **one** engineering unit. The device shows the reciprocal beside the field as a check. Entering for a 0.2 mm-per-tip rain gauge displays

1 mm = 5 pulses (0.200 mm per pulse)

Installers routinely confuse the two forms. A meter marked "1 pulse per 5 litres" and a meter marked "200 pulses per kilolitre" are the same meter. The field wants the second form. The volume-per-pulse figure is what the device shows back, not what you type.

Scale the units to use the three decimal places. Counter values are recorded to three decimal places, up to 999,999.999. Reporting a water meter in litres wastes them. Report in kilolitres instead — the reading still resolves down to the litre.

Meter marking	Report in	Pulses per unit	Device displays
1 pulse per 5 L	kL	200	0.005 kL per pulse
1 pulse per 10 L	kL	100	0.010 kL per pulse
1 pulse per 100 L	kL	10	0.100 kL per pulse
1 pulse per kL	ML	1000	0.001 ML per pulse

5.5.3 Change Desired Value (Counter)

Applies to: Counter, Event.

Used to align the Borewatch's running count to the current reading on the source meter — for example, after pulses were missed (sensor temporarily disconnected, or meter was reset).

1. Read the current value from the source meter.
2. On the channel's calibration page, enter that value in the **desired value** field.
3. Save. The Borewatch continues counting from that value.

The current calibrated value is also displayed on this page; click **Update** at any time to refresh it.

5.6 Controls

Navigate to **Change Setup** → **Change Controls**.

For each control:

1. Set the **Custom name** — user-defined label (e.g. "Sensor Power", "Alarm Output").
2. Set the **Warmup time** — how long the control stays active before a sensor reading, if used as a warmup.

Low voltage sensor supply — select 3.3V or 5V. The supply on pin 8 of the M12 connector is set on this page. It is a software setting; there is no jumper to move.

Match the voltage to your sensor before you apply power. Applying 5V to a 3.3V sensor can damage the sensor.

All controls are turned off by default when Change Setup is entered (configurable via Advanced Settings).

The Borewatch provides three outputs — see Section 2.3 for output types and current ratings.

Change Controls

[? Help](#)

Switched Power Out	
Custom name	Switched Power Out
Warmup time	100ms

Open Collector	
Custom name	Open Collector
Warmup time	100ms

Low Voltage Out	
Custom name	Low Voltage Out
Warmup time	100ms
Voltage	3.3V

SDI-12 Command	
Custom name	SDI-12 Command
Warmup time	100ms
On command	
Off command	

Modbus Warmup	
Custom name	Modbus Warmup Msg
Warmup time	100ms

[Cancel](#) [Save](#)

5.7 Alarms

Navigate to **Change Setup → Change Alarm Setup**.

For each alarm:

1. Set the **Alarm name**.
2. Set the **Trigger source** — channel value, date/time, periodic, or Super Alarm.
3. Set the **Control action** (optional) — turn a control on continuously, or pulse for 1–999 seconds.
4. Set the **Counter action** (optional) — increment or reset a virtual counter.
5. Set the **Log action** (optional) — immediately log another channel when the alarm triggers.
6. Set **Send alarm report** — Disabled / Once only / Two times / Repeat (fast period).
7. Enable **Fast logging** to increase logging rate while the alarm is active.
8. Set the **Message** — text included in SMS and email alerts.
9. Set the **Auto acknowledge time** — time after triggering when the alarm is automatically acknowledged (minimum 5 minutes, default 60 minutes).
10. Enter up to 3 **phone numbers** and 3 **email addresses** for alerts.

Alarm trigger sources:

Source	Description
Channel	Triggers when channel value is above, below, or changes by a set amount; or on switch state or error
Date / Time	Triggers at a specified time on selected days, months, and weekdays — see below
Periodic	Triggers at a regular interval with optional offset — see below
Super Alarm	Triggers based on combined active/inactive state of other alarms (AND/OR logic) — see below

Date / Time alarm options:

Option	Description
Trigger Time	Time of day at which the alarm should go active
Remain Active For	How long (seconds) the alarm stays active after triggering
Months of the Year	January–December — the months in which the alarm may activate
Days of the Month	1–31 — the days of the month on which the alarm may activate
Days of the Week	Monday–Sunday — the weekdays on which the alarm may activate

All three calendar conditions (Months of the Year, Days of the Month, Days of the Week) must be met for the alarm to activate. For example, a weekly alarm on Mondays at 00:00 = all months selected, all days of the month selected, only Monday selected as day of the week.

Periodic alarm options:

Option	Description
Period	How often the alarm triggers (e.g. every 1 hour, every 30 minutes)
Offset	A delay added to the trigger time. Example: period 1 hour + offset 20 minutes triggers at 20 past each hour
Remain Active For	How long (seconds) the alarm stays active after triggering

Periodic and Date / Time alarms can be combined via a **Super Alarm** — for example, "trigger every hour, but only on weekdays between 08:00 and 18:00".

Alarm behaviour:

- An alarm is **active** when its trigger condition is met, **inactive** when not.
- An alarm **triggers** (sends alerts) only when active AND unacknowledged.
- After triggering, the alarm will not re-trigger until acknowledged AND gone inactive, then active again.
- Fast logging runs at the General fast logging period while the alarm is active. Fast logging stops when the alarm deactivates, not when acknowledged.

Acknowledging alarms:

- Web interface — click the unacknowledged alarm on the Alarms page.
- Auto-acknowledge — the device acknowledges automatically after the configured time.
- SMS — using `ACK ALx` or `ACK ALL` command (LiveSMS option only).

For alarm status codes, see Appendix E.

5.8 Network Settings

Navigate to **Change Setup** → **Change Network Settings**.

Mobile Internet (Modem)

1. Set **Method** to Mobile Internet (Modem).
2. Enter the **APN** for the SIM card — confirm the correct value with your carrier or SIM provider.
3. If LiveSMS remote access is required, enter the **Remote APN** — a SIM with a public dynamic IP address is required. Contact your carrier to enable this and obtain the correct Remote APN value.
4. Enable **Authentication** only if required by the SIM — not needed in most cases.
5. Set a **Data limit** (maximum MB per day) if required.
6. Enter the **Modem phone number** — must be entered manually; it is not read from the SIM.

Primary Network	
Method	Mobile Internet (Modem) ▼
APN	
Authentication	☐
Data limit	1.000 MB/day
Report signal strength	☒
Signal strength name	Modem Signal
Signal strength format	Percentage (%) ▼
Modem phone number	

Secondary Network	
Method	None ▼

Primary and Secondary Network

- **Primary network** — used for reports, emails, NTP, and software/setup updates.
- **Secondary network** — used for report failover only; not for emails or updates.
- **Transmit mode** — Fail over or Both.

SMS Recovery

When enabled, the modem becomes active for up to 3 minutes at the configured interval (daily at midnight, or weekly) to allow delivery of queued incoming SMS messages. Works whether or not reporting is enabled.

5.9 Email

Navigate to **Change Setup** → **Change Email Settings**.

Setting	Value
SMTP port (unauthenticated)	25
SMTP port (authenticated)	587
SSL / TLS	Not supported

Enter the SMTP server address, From address, and optionally a test email address. Enable authentication and enter credentials if required by the SMTP server.

Example email configuration:

Field	Example
From address	<code>your.borewatch@yourcompany.com.au</code>
SMTP server	<code>your.preferred.smtp.server</code>
Authentication	Disabled (most common case)

Use a "From" address that clearly identifies the Borewatch unit and an SMTP server you control or have access to. If you don't have an SMTP server, contact your Halytech sales contact about options.



borewatch

Home >> Change Setup >> Email

Change Email Settings

?

 Help

Email Account

"From" email address

SMTP mail server

Authentication

Note: SSL and TLS connections are not supported.

Email Test

This test sends an email with subject "Test Mail".

Email Address

Send Test Email

Cancel

Save

To test email delivery, navigate to **Change Setup** → **Email Diagnostics** and send a test email. The SMTP conversation is displayed in real time — server response codes in red identify any issues.

Gmail is not compatible. If using a corporate mail server, confirm it accepts connections on port 25 without encryption.

5.10 Reports

Navigate to **Change Setup** → **Change Report Settings**.

The Borewatch supports two independent automatic report slots. For each slot:

Setting	Description
Reports to send	Email, FTP 1, FTP 2, HTTP — any combination
Period	1 minute to 1 day
Send report	Always, or only when new data available
Offset	Delay from start of period (e.g. daily at 6:30am: offset 6h 30m)
Enable recovery	Unsent data included in next report (up to 30,000 records)
Format	See Appendix J
Time order	Oldest first or newest first

Reset Report Starting Point: marks all existing logged records as already sent — use after setup and testing to prevent test data appearing in the first real report.

Daily Heartbeat Report: an optional status report sent once per day regardless of logging activity.

For report formats, see Appendix J.

5.11 Modem Diagnostics

Navigate to **Change Setup → Modem Diagnostics**.

Use this page to verify mobile connectivity after inserting a SIM card or changing antenna location.

Signal Strength Test:

1. Click **Mobile Signal Test**.
2. The modem turns on and displays signal strength continuously until the test is closed.

Use this test to confirm the SIM card is active and that the antenna location has adequate signal before leaving site.

Allow time for the modem to start. If the modem is off when you start a test, it needs 30 to 60 seconds to power up and find a signal. Wait at least 75 seconds before you decide a test has failed. This applies to the signal test, the test SMS, the test email, and the test report.

SMS Test:

1. Enter a phone number in the **Phone number** field.
2. Click **Send Test SMS**.

The unit sends an SMS to the nominated number containing the unit's location name, serial number, current signal strength, and date/time. A successful send confirms end-to-end mobile communication.

Signal strength reference:

Level	Threshold	Action
Excellent	≥75%	No action required
Good	≥50%	No action required
Acceptable	≥40%	No action required
Poor	<40%	Reposition antenna — connection may be unreliable

5.12 Setup Management

Navigate to **Change Setup → Manual Setup Management**.

Save setup to disk:

1. Click **Save setup to disk**.
2. Save the `.cfg` file to a known location — use as a backup or template for similar units.

Some browsers flag `.cfg` files as potentially harmful during download. This is a false positive — dismiss the warning and save the file.

Load setup from disk:

1. Click **Browse** and select a setup file.
2. Click **Load setup from disk**.

The setup file must be from the same product type and the same or earlier firmware version.

Email setup: sends the current setup file as an email attachment — useful for off-site backup.

Restore factory defaults: resets all settings to defaults. Log file data is unaffected.

5.13 Software Upgrades

Manual upgrade:

1. Navigate to **Change Setup → Manual Software Upgrade**.
2. Click **Choose File** and select the upgrade file (`.hal`).
3. Click **Upgrade Now**.
4. Wait up to 5 minutes, then reconnect to the web interface.

No progress indicator is shown during the upgrade.

Automatic upgrade: The Borewatch can check for and install new firmware automatically once per day after a report is sent, either from the Halytech upgrade server or a self-managed FTP server. Automatic upgrades will not run if reporting is disabled.

5.14 Advanced Settings

Navigate to **Change Setup → Advanced Settings**.

Setting	Description
Turn all controls off on entry to Change Setup	Default: on. Disable to prevent controls being turned off when entering Change Setup.
Minimum auto-acknowledge time	Default: 60 min. Configurable down to 5 min.
Store messages with channel data	When off, info messages go to a separate diagnostic area — increases channel data capacity.
Enable 4-20mA error handling	Escalates out-of-range 4–20 mA readings from warnings to errors, enabling alarm triggering.
Use long location name	Uses the Long Location field in reports.
Modbus baud rate	Default: 19200. Selectable: 9600, 19200, 38400, 57600, 115200. Must match connected Modbus sensor.
Modbus parity	Default: Even. Must match connected Modbus sensor.
Modbus stop bits	Default: 1. Must match connected Modbus sensor.

6. Service Mode

Service Mode provides a restricted configuration interface for field commissioning without the risk of altering report or alarm settings.

Log in with the **Service** account credentials (default username: `service`, password: `changeme`).

Available in Service Mode:

- View all current channel readings
- Access and adjust Time/Date (NTP settings cannot be changed)
- Calibrate inputs (including Examine and Test — see Section 6.3)
- Modem diagnostics
- Save setup to disk
- Manual software upgrade

Exiting Service Mode re-enables normal logging.

6.1 Time and Date

Time and date can be set in Service Mode — see Section 5.2 for the procedure. NTP settings cannot be modified from the Service account.

6.2 Modem Diagnostics

Available in Service Mode — see Section 5.11 for the procedure.

6.3 Input Channel Calibration and Test

Navigate to **Calibration** → **[channel]** → **Examine and Test**.

1. Click **Examine and Test** on the input calibration page.
2. The input reading is temporarily reset to zero (the original accumulated value is preserved and unaffected in the log).
3. Apply test pulses — the display counts each pulse in real time.
4. Click **Exit** — the original accumulated value is restored.

This allows field pulse verification (e.g. checking a water meter reed switch) without corrupting the live reading.

6.4 Software Upgrade

Manual software upgrade is available in Service Mode — see Section 5.13 for the procedure.

7. Maintenance

7.1 Battery Replacement

The Borewatch runs from a single non-rechargeable Lithium-Thionyl Chloride (Li-SOCl₂) battery pack. Replacement part: **HBT-001** (Borewatch Battery Pack — 7.2V Li-SOCl₂, 13 Ah) — see Section 9 Accessories.

Expected service life: up to 5 years under the standard reference scenario (1-hour logging, daily reports, good mobile signal, self-powered sensors, one alarm per month).

Service life depends heavily on logging rate, report frequency, mobile signal strength, sensor power requirements, and alarm activity. Heavy SMS/LiveSMS traffic, frequent reporting, weak signal, or high-power sensors significantly reduce battery life — see Appendix M for guidance on reducing consumption.

Checking battery condition:

Battery voltage is available via the web interface as a system input — see Section 4.4 Inputs Page.

Pack	Healthy	Replace
HBT-001 (7.2V nominal)	Above 7.0V	Below 7.0V

Li-SOCl₂ cells have a very flat discharge curve — the pack holds close to its nominal voltage until near end-of-life, when it drops sharply. Acting on the 7.0V threshold gives the most reliable replacement signal.

Indicators that battery replacement is required:

- Battery voltage on the web interface drops below 7.0V
- Battery low alarm triggered (if configured to trigger on the battery voltage channel)
- Unit has been in service close to or beyond its expected service life (up to 5 years)

Procedure:

The disassembly and reassembly steps are the same as for SIM card installation — see Sections 3.1 to 3.4 for full detail with photos.

1. Open the sensor (bottom) end cap — Section 3.1.
2. Unplug the ribbon cable from the end cap.
3. Slide the battery out far enough to access the inline connector, then unplug the battery.
4. Remove the old battery pack from the tube.
5. Insert a new HBT-001 battery pack into the tube. Use HBT-001 only — do not substitute non-Halytech battery packs, even if dimensionally similar. The HBT-001 is the standard 7.2V Li-SOCl₂ cell repackaged with closed-cell foam buffering specifically for the tubular enclosure.
6. Connect the new battery to the inline connector — Section 3.3.
7. Slide the battery back into the tube and reassemble — Section 3.4.
8. Verify the unit is operating correctly — log in via the web interface and confirm the new battery voltage is reading close to 7.2V on the Inputs page (Section 4.4).

Used Li-SOCl₂ batteries must be disposed of in accordance with local regulations for primary lithium cells. Do not incinerate, puncture, short-circuit, or expose to temperatures above 100°C.

7.2 Routine Site Checks

On each site visit, check:

Check	Action
Battery voltage	View on the web interface; plan for replacement if approaching end-of-life
Signal strength	Should be ≥40% — reposition antenna or consider external antenna if below threshold
Connectors	Inspect for corrosion or damage; ensure sealing caps are fitted to any unused ports
Antenna seal	Inspect the self-vulcanising tape seal on the SMA connection(s)
Suspension line	Inspect for wear, corrosion, or fraying — replace as needed
Sensor readings	Verify readings against any reference measurement available on site
Internal moisture sensor reading	Confirm dry — any moisture reading indicates enclosure ingress and the unit should be removed for service

8. Specifications

8.1 Hardware Specifications

Parameter	Value
Inputs (total)	20 configurable channels
Native inputs	1 analogue, 1 digital
SDI-12 / Modbus RS-485	Supported
Virtual channels	Supported (no sub-limit)
System monitors	Internal temperature, battery voltage, external power voltage, internal moisture
Outputs	3 — boosted 12V switched power, open collector, low-voltage sensor supply (3.3V or 5V)
Alarms	16
Logger capacity	300,000 records
Logging period	1 second minimum
Reports	2 independent slots, FTP / email / HTTP / HTTPS
Modem	4G (HBW-001) or LTE Cat-M1 / NB-IoT (HBW-002)
SIM	Nano SIM
Antenna(s)	External, SMA male — 4G: 2; Cat-M1: 1
Internal battery	7.2V Li-SOCl ₂ , 13 Ah (HBT-001) — replaceable
Battery life	up to 5 years (1-hour logging, daily reports, good signal, self-powered sensor, 1 alarm per month)
External power	12–22V DC via Halytech Comm Port — optional

8.2 Physical Specifications

Parameter	Value
Dimensions	49 (Ø) × 410 (H) mm
Weight	720 g
Enclosure rating	IP68 (including connectors)
Enclosure material	Stainless steel
Mounting	Suspension via integrated top lug; sensor cable suspended from integrated bottom lug
Operating temperature	−20°C to +60°C
I/O connector	M12 8-pin waterproof socket
Comms connector	Halytech Comm Port — 6-pin waterproof
Antenna connector(s)	SMA male — 4G: 2; Cat-M1: 1
Warranty	12 months

9. Accessories

Separately-available items for installation, configuration, and spare parts:

Configuration tools:

Item code	Description
HHS-013	LANlink Cable — Ethernet comms cable for setup
HHS-080	HLink Wi-Fi Dongle — Wi-Fi comms for setup

Cables:

Item code	Description
HBW-003	Borewatch M12 input cable — M12 connector on a 5 m lead

Replacement battery:

Item code	Description
HBT-001	Borewatch Battery Pack — 7.2V Li-SOCl ₂ , 13 Ah

Antennas (for HBW-001 4G and HBW-002 Cat-M1 — antennas are not supplied with the unit):

External SMA antennas — contact your Halytech sales contact for current 4G and Cat-M1 antenna options suitable for the installation environment (bore casing, gatic cover, surface mount).

Contact sales@halytech.com.au for ordering.

Appendix A — M12 I/O Connector Pinout

The Borewatch I/O connector is an **8-pin M12 socket** at the bottom (sensor) end of the unit. The M12 mating connector is not supplied — see the M12 cable assembly note below. Wire colours follow the M12 standard.

Pin	Colour	Name	Function	Notes
1	White	Digital In	Switch / Counter input	Active = short to Ground
2	Brown	PWR OUT	Switched Power Out — Control 1	Boosted 12V, max 200 mA
3	Green	RS485 D–	RS-485 Data –	Modbus differential
4	Yellow	RS485 D+	RS-485 Data +	Modbus differential
5	Grey	OC / AIN	Open Collector output or Analogue input	Selected via internal jumper. OC driven by Control 2 (nominal 10 mA). AIN accepts 0–2.5V or 4–20 mA
6	Pink	SDI-Data	SDI-12 data	
7	Blue	GND	Ground	Common for all signals
8	Red	LV OUT	Internal low-voltage sensor supply	3.3V or 5V (user selectable); approximately 20 mA usable

Pin 5 — internal jumper selection:

The same physical pin is shared between the Open Collector output (Control 2) and the Analogue input. Set the internal jumper on the PCB to match the application **before** the unit is sealed and deployed. Both functions cannot be used simultaneously.

Application	Jumper position
Open collector output for relay or accessory control	OC
Analogue input (voltage or 4–20 mA)	AIN

Pin 8 — LV OUT voltage selection:

The low-voltage sensor supply on pin 8 can be set to 3.3V or 5V. Select the voltage on the **Change Setup** → **Change Controls** page. It is a software setting — there is no jumper to move.

Match the LV OUT voltage to the connected sensor before applying power. Applying 5V to a 3.3V sensor can damage the sensor.

Appendix B — Connecting Sensors

Sensor wiring is site-specific. All connections are made via the 8-pin M12 socket — see Appendix A for the full pinout.

Summary of input connections:

Sensor type	Connect to	Notes
Switch, counter, event (pulse)	Digital In (pin 1) → GND (pin 7)	Active = short to ground
4–20 mA current loop	OC/AIN (pin 5) → GND (pin 7)	Factory calibrated — no external resistor required. Pin 5 jumper must be set to AIN
Voltage 0–2.5V	OC/AIN (pin 5) → GND (pin 7)	Direct connection. Pin 5 jumper must be set to AIN
Voltage 0–5V	OC/AIN (pin 5) via 1.2 k Ω + 1 k Ω resistor divider	See note below
Voltage 0–10V	OC/AIN (pin 5) via 3.3 k Ω + 1 k Ω resistor divider	See note below
SDI-12 sensor	SDI-Data (pin 6), GND (pin 7), and sensor power as required	See Appendix C
Modbus RS-485 sensor	RS485 D– (pin 3), RS485 D+ (pin 4), GND (pin 7), and sensor power as required	See Appendix C

Analogue input — resistor divider (0–5V and 0–10V signals):

The analogue input has a native range of 0–2.5V. To accept 0–5V or 0–10V signals, fit a resistor voltage divider between the signal source and the OC/AIN pin. The divider resistors are **not supplied** — source your own to the values in the table above.

Do not apply signals above 2.5V directly to the OC/AIN pin. Use a resistor divider. Higher voltages may damage the input.

Analogue input — error indication:

When configured as a 4–20 mA input, the channel reading is shown as EOR if the sensor is not connected or is not functioning. Enable 4-20mA error handling in Advanced Settings (§5.14) to allow alarms to trigger on this state.

Pulse meter wiring practice:

- **Shielded cable — earth the shield at the logger end only.** If the meter cable has a shield, connect it to GND at the logger end and leave it unconnected at the meter end. Connecting both ends creates a ground loop, where current flows in the shield.
- **Electrical noise on long unshielded cable can cause extra counts.** The symptom is a count that jumps by more than one per pulse. Contact bounce causes the same symptom. Use shielded cable, earthed as above, and route the cable away from mains wiring, electric motors, and electric fences.

Sensor power (warmup):

For sensors that need power applied before sampling:

Sensor type	Sensor power	Configuration
Sensor needs boosted 12V	Connect sensor supply to PWR OUT (pin 2, Control 1)	Set Warmup source = Control 1 in Change Input Setup → Options
Sensor needs 3.3V or 5V (low current)	Connect sensor supply to LV OUT (pin 8)	LV OUT is always on; no warmup configuration needed

The warmup time is configured per control on Change Setup → Change Controls (§5.6). The control activates for the warmup period before each sample, then deactivates.

M12 cable assembly:

No M12 cable or connector is supplied with the Borewatch. You have two choices.

- Source your own M12 mating connector and wire it yourself. Follow the standard M12 colour code (see Appendix A).
- Buy the HBW-003 M12 input cable from Halytech. It comes ready made, with the M12 connector on a 5 m lead. See Section 9.

Appendix C — SDI-12 / RS-485

The Borewatch supports SDI-12 and RS-485 (Modbus) sensors via the M12 connector — see Appendix A for the pinout. Both SDI-12 and Modbus sensors can be connected simultaneously.

Each physical sensor may provide one or more channel values; each value occupies one channel slot from the device's 20-channel total. There is no limit on the number of physical devices connected.

SDI-12:

Parameter	Value
Protocol compliance	SDI-12 v1.3
Supported commands	M, C, CC, R, RC
Device address range	0–9, a–z, A–Z (each sensor must have a unique address)
Wiring (Borewatch side)	SDI-Data (pin 6), GND (pin 7); sensor power via PWR OUT (pin 2) or LV OUT (pin 8) as required

SDI-12 Interactive Mode:

Available via the Examine icon (magnifying glass) on the Change Input Setup page. Send any SDI-12 command string directly to the sensor and view the raw response — useful for debugging and configuring sensor address or parameters.

Modbus (RS-485):

Parameter	Default	Notes
Baud rate	19200	Selectable: 9600, 19200, 38400, 57600, 115200 — set in Advanced Settings (§5.14)
Parity	Even	Configurable via Advanced Settings (§5.14)
Stop bits	1	Configurable via Advanced Settings (§5.14)
Device address range	1–255	Each device must have a unique address
Supported function codes	3, 4, 6	Read Holding Registers, Read Input Registers, Write Single Register
Register addressing	0-based index	
Data address range	0–65535	
Data types	Integer (16-bit), Float (32-bit), LSW-first or MSW-first variants	Consult sensor manual for correct type
Wiring (Borewatch side)	RS485 D– (pin 3), RS485 D+ (pin 4), GND (pin 7); sensor power via PWR OUT (pin 2) or LV OUT (pin 8) as required	

Baud rate, parity, and stop bits must be configured to match the connected Modbus sensor. Do not rely on default values after a factory reset.

Modbus address format conversions:

Some sensor manuals list register addresses in legacy 5-digit format (e.g.). To convert:

Range	Function Code
1–9999	FC1
10001–19999	FC2
30001–39999	FC4
40001–49999	FC3

Remove the leading digit and subtract 1 to get the 0-based data address. Example: 40001 → FC3, address 0.

If a Modbus sensor returns an exception code, try subtracting 1 from the listed address — Modbus addressing starts at 0 per the spec, but some sensor manuals list addresses starting at 1.

Appendix E — Alarm Status Codes

These codes appear on the Alarms Status page when an alarm is sending alerts.

SMS Alert Status Codes:

Code	Meaning
1	1st attempt to 1st phone number
2	2nd attempt to 1st phone number
3	3rd attempt to 1st phone number
4	1st attempt to 2nd phone number
5	2nd attempt to 2nd phone number
6	3rd attempt to 2nd phone number
7	1st attempt to 3rd phone number
8	2nd attempt to 3rd phone number
9	3rd attempt to 3rd phone number
10	All attempts exhausted — alarm not acknowledged, no further sends

Email Alert Status Codes:

Code	Meaning
1	1st attempt to all 3 email addresses
2	2nd attempt to all 3 email addresses
3	3rd attempt to all 3 email addresses
4	Email transmission succeeded or all attempts exhausted — no further sends

Appendix F — SMS Commands

The commands listed below require the LiveSMS software option. **Without LiveSMS, the Borewatch does not respond to them**, even when the modem is on for other reasons.

This applies to the commands in this appendix only. The serial-prefixed SMS commands — `getrep`, `getcfg` and the settings commands — do not need LiveSMS. The Borewatch responds to those any time its modem is on. Without LiveSMS the modem is only on for a short time around each scheduled report, so a reply can be hours away.

To use SMS commands:

1. LiveSMS software option must be installed (order from Halytech — see Appendix G).
2. LiveSMS modem mode must be set to **Always** or **Schedule + Alarms** (so the modem is on to receive incoming SMS).
3. Commands may be sent in upper or lower case. One space between words. No spaces before or after commas.

Valid commands are acknowledged with a return SMS: `Location: OK SMS command`

Commands are not received while the modem is off — they will be received the next time the modem turns on (subject to SMS Recovery — see §5.8).

Command	Description	Example
<code>HELP</code>	Request list of supported commands	<code>HELP</code>
<code>GET ST</code>	Get current state of all inputs	<code>GET ST</code>
<code>GET CN</code>	Get current state of all controls	<code>GET CN</code>
<code>GET AL</code>	Get current state of all alarms	<code>GET AL</code>
<code>ACK ALx</code>	Acknowledge alarm x (x = 1–8)	<code>ACK AL3</code>
<code>ACK ALL</code>	Acknowledge all alarms	<code>ACK ALL</code>
<code>ON CNx</code>	Activate control x (no PIN)	<code>ON CN1</code>
<code>yyyy ON CNx</code>	Activate control x with PIN	<code>1234 ON CN1</code>
<code>OFF CNx</code>	Deactivate control x (no PIN)	<code>OFF CN1</code>
<code>yyyy OFF CNx</code>	Deactivate control x with PIN	<code>1234 OFF CN1</code>
<code>PULSE CNx</code>	Pulse control x for 1 second (no PIN)	<code>PULSE CN1</code>
<code>yyyy PULSE CNx</code>	Pulse control x for 1 second with PIN	<code>1234 PULSE CN1</code>
<code>GET REP</code>	Request current day's report via normal delivery	<code>GET REP</code>
<code>yyyy GPRS</code> <code>n,email</code>	Request remote web access session — see Appendix H	<code>1234 GPRS</code> <code>10,me@example.com</code>

Control activation commands (`ON` , `OFF` , `PULSE`) and remote access (`GPRS`) can be protected with a 4-digit SMS PIN. Configure via Change Setup → Change Location / Site ID.

Appendix G — LiveSMS

LiveSMS is a software option that extends the SMS and remote access capabilities of the Borewatch. Order from Halytech.

LiveSMS features:

- Remote web access via mobile network (see Appendix H)
- Alert escalation — resend alerts if not acknowledged within a set time
- Modem scheduling — set the modem to be on at specific times
- Additional SMS commands

Modem operating modes (configured via LiveSMS settings):

Mode	Description
Never	Modem is never left on to receive SMS commands
Always	Modem is always on
Schedule + Alarms	Modem follows the configured schedule; also turns on when an alarm triggers
Alarms Only	Modem turns on only when an alarm triggers

The modem is the dominant power consumer on the Borewatch. Use LiveSMS modem scheduling to limit on-time and extend battery life when remote access is not always required.

Appendix H — Remote Web Access

Requires LiveSMS software option.

Remote web access allows the Borewatch web interface to be accessed over the mobile network from anywhere with internet access.

Pre-requisites (one-time setup):

1. SIM card must be enabled for dynamic public IP address — contact your carrier to request this.
2. Set Network Method to Mobile Internet (Modem) and enter the Remote APN value provided by your carrier.
3. Configure email settings correctly — send a test email to confirm before attempting remote access.
4. Configure LiveSMS to keep the modem on (Always or Schedule + Alarms).

Connecting remotely:

1. Send the following SMS to the Borewatch: `yyyy GPRS n,yourEmailAddress`
 - `yyyy` = LiveSMS PIN (omit if no PIN set)
 - `n` = minutes to wait online (10 recommended)
 - `yourEmailAddress` = address where the link will be sent
 - Example (no PIN): `GPRS 10,me@example.com`
2. The Borewatch responds with an acknowledgement SMS.
3. The Borewatch sends an email containing a link to the web interface.
4. Open the link — the login page will appear.

Session behaviour:

- Session closes automatically after 5 minutes of inactivity or 30 minutes total.
- To reconnect after a session closes, send the `GPRS` SMS again.
- If the modem is scheduled to turn off, it stays on while the session is active. Once the session closes, the modem turns off and you must wait for the next scheduled on-period to reconnect.

Appendix I — DNP3

Requires the DNP3 software option (FBW-005, or FBW-006 for DNP3 with LiveSMS).

DNP3 lets the Borewatch join a SCADA system as a remote terminal unit (RTU), also called an outstation. A central master station monitors it. The Borewatch supports DNP3-L2, the level 2 subset of the standard.

To keep power use low, the Borewatch can connect to the DNP3 master and send its logged data as unsolicited responses. It does this at a set interval, when an alarm triggers, or both.

No special SIM and no special IP addressing is needed when the Borewatch calls the server. The server does not need to reach the Borewatch.

Configure via **Change Setup** → **DNP3**.

How the Borewatch connects

The Borewatch reaches the DNP3 master over LAN or over the mobile modem. Which one it uses follows the Internet method set in Network Settings.

Internet method	How it works
LAN	The Borewatch listens for the SCADA system to connect to it. Set the SCADA system to connect to the Borewatch IP address on your Ethernet LAN.
Mobile Internet (Modem)	The Borewatch connects out to the DNP3 server. It does this at the reporting interval, or when an alarm triggers. The modem turns off in between, which saves power.

Modem is the common case for a bore installation.

Your SCADA system must accept incoming connections when the Borewatch uses the modem. In ClearSCADA, set the outstation communications availability to **Incoming Only**.

Listen mode over the mobile modem needs the LiveSMS software option (FBW-003 or FBW-006) to hold the modem on, plus a SIM with a static public IP address, or membership of a VPN the SCADA server can reach. A modem given a dynamic public IP gets a new address each time it turns on, and the SCADA system cannot then find it.

⚠ Do not use listen mode over the modem without a static IP SIM.

Communications settings

Setting	Description	Default
Server IP address 1–3	IP addresses of up to 3 DNP3 master servers. When connecting out, the Borewatch tries each one in turn until a connection succeeds. In listen mode, leave all three blank to accept any master, or enter addresses to accept only those servers.	—
Server port	TCP port the Borewatch connects to. Not used in listen mode.	20000
Listen port	TCP port the Borewatch listens on. Listen mode only.	20000
Local DNP3 address	The DNP3 address of this outstation. Change it if your master has several outstations. Each outstation on the network must have a unique address.	4
Server DNP3 address	The DNP3 address of the master. 3 is the usual default for a DNP3 master station.	3
Status	The connection state — closed, listening, connecting, or connected — with the IP address in use.	—

Over the mobile modem, the servers must be reachable from the Internet. Enter their **public** IP addresses, not their internal network addresses. Ask your IT support if you are not sure.

Click **Save and Restart DNP3** to apply the settings and try a connection straight away.

Watch the Status line. It shows the connection attempt as it happens, including any failure. Use it to confirm the connection works before you leave Change Setup. The same Status line appears on the DNP3 page under View Setup, so you can check the connection at any time.

Event reporting

By default the Borewatch treats every logged input value as a DNP3 event and sends it to the master.

- **Over LAN** — the Borewatch sends each event as the input is logged.
- **Over the modem** — the Borewatch sends events at an interval, to limit how often the modem turns on.

You can instead send only the values that changed. The master can rebuild the full history of a channel from that sequence of change events. This is the DNP3 equivalent of sending automatic reports by email or FTP. Use it instead of automatic reports, or alongside them.

Setting	Description
Enable Unsolicited	Whether the Borewatch sends unsolicited responses to the master
Report all logged data	Clear this to report only changes in input values. The Borewatch then only connects when it has changed data to send
Period	How often the Borewatch sends unsolicited responses — 1 minute to 1 day, or Disabled
Fast Period	The reporting rate while an alarm with Repeat (fast period) is active
Offset	A delay added to the event send time

Use **Offset** in three cases:

- To send events at a time other than midnight. An offset of 6 hours and 30 minutes sends at 6:30 am.
- To move DNP3 events away from your report times, so a report is not held up while unsolicited responses go out.
- To include a slow sensor. An SDI-12 sensor takes between 0.1 and 1 second to respond, so it would otherwise miss a send that happens exactly on the hour. An offset of 10 seconds catches it.

⚠ **Do not disable unsolicited responses when the Borewatch dials out over the modem** (listen mode off). The modem only connects when it has something to send. With unsolicited responses off it never has anything to send, so it never connects.

Keep test data out of the SCADA system. The **Reset starting point** button on the Reports page marks everything logged so far as sent. That data is then never sent to the DNP3 server. Click it after commissioning, before you leave site.

DNP3 alarms

Periodic updates may be too slow when the SCADA system must know about a condition at once — a water level crossing a threshold, or a switch closing. Set up an alarm as normal and select **DNP3 Alerts** as one of its alerting options.

When the alarm goes active, the Borewatch connects to the master and sends all unsent events. One of those events is the input change that set the alarm off.

Select **Repeat (fast period)** to keep sending events while the alarm stays active. The Borewatch connects at the Fast Period rate until the alarm goes inactive. This lets you watch an alarm condition with faster updates than the normal reporting period.

Set up a matching alarm in the SCADA system. DNP3 does not mark one event as more important than another. Every event is treated the same. The Borewatch sends the changed input value, and the SCADA system decides what it means. The SCADA system sees only the new input level.

DNP3 Alerts work alongside the other alarm options. One alarm can switch a control, send an SMS, email a report and send a DNP3 update, all at once.

Input point mapping

The Borewatch has 20 input channels, numbered 1 to 20. DNP3 uses arrays of input points instead. Each array is indexed from 0. DNP3 has three input point types: binary (on/off), analog (a signed decimal such as –12.34) and counter (a whole non-negative number that increases over time).

Channel numbers start at 1. DNP3 point indexes start at 0. Subtract 1.

Channel 1 is point 0. Channel 2 is point 1. Channel 20 is point 19.

Channel type	DNP3 input point type	Also available as
Switch	Binary	
Switch State	Binary	
Counter	Counter	Analog
Event	Counter	Analog
Analogue (Voltage)	Analog	
Analogue (4–20 mA)	Analog	
Analogue (Switch)	Binary	
SDI-12	Analog	
Modbus-485	Analog	
System (Voltage)	Analog	
System (Temperature)	Analog	
Super channel	Analog	

Most channel types map to a DNP3 analog input. The Difference type is not available on the Borewatch, because it needs two digital inputs.

The analog value is the calibrated value. It is the same number you see on the Inputs page and in reports. If you calibrated a channel to read in metres, DNP3 reports metres. Do not scale it again in the SCADA system.

The Borewatch reports the calibrated value even when you set **Log Difference** on that channel.

Why counter channels get two points. DNP3 counter points must hold whole non-negative numbers. The Borewatch lets you calibrate a counter into engineering units such as litres, which produces a decimal value. So a counter or event channel appears twice:

- a **counter point** holding a 32-bit integer, 0 to 4294967295
- an **analog point** holding the calibrated decimal value in engineering units

Use the analog point to read engineering units. Use the counter point when you need the DNP3 freeze or clear operations, because only counter points support them.

- **Freeze** copies the counter value into a matching frozen counter point. The counter keeps incrementing, and the frozen value stays put. The SCADA system can tell the outstation to freeze all counters at once, giving a snapshot at one moment in time, then read the frozen values one at a time.
- **Clear** resets a counter point to zero. DNP3 only allows counter points to be cleared. To clear a counter or event channel from the SCADA system, operate on its counter point, even when you read its analog point for reporting.

Send Level 2 Responses Only removes the analog point. Turning that advanced setting on stops the Borewatch reporting the calibrated analog point for counter and event channels. See **Advanced DNP3 settings** below.

Example. Channel 1 is a Switch named Float. Channel 2 is a Counter named Flow. Channel 3 is an SDI-12 channel named Water Level.

Channel	Name	DNP3 points
1	Float	Binary input point 0
2	Flow	Counter input point 1, and analog input point 1. Frozen counter point 1 after a freeze
3	Water Level	Analog input point 2

Output point mapping

The Borewatch has 3 controls. DNP3 treats a control as a binary output. Analog outputs are not used. Output points are indexed from 0, the same as input points.

Control	DNP3 binary output point index
Switched Power Out	0
Open Collector	1
Low Voltage Out	2

The point index follows the control **type**, not its position in the list.

Controls accept `LATCH_ON` and `LATCH_OFF` to switch on and off. `PULSE_ON` sends one pulse with an on-time between 100 ms and 600 seconds. Multiple pulses (count greater than 1) are not supported.

The Borewatch supports all DNP3 binary output commands — the control relay output block (CROB) actions select, operate and direct operate. You can read the state of an output point at any time.

DNP3 cannot override the Borewatch. It will not switch a control that an alarm or the web interface is already forcing on, and it will not switch a control used for sensor warmup. If DNP3 asked for a control to be on and an alarm then forces it off, the control stays off while the alarm is active. DNP3 switches it back on afterwards.

Setting the clock

DNP3 can set the Borewatch date and time. The Borewatch works in UTC internally, so configure the SCADA system to report UTC times for this outstation.

NTP is not needed when the SCADA system updates the clock regularly. Running both does no harm.

Resetting the Borewatch

Reset	What it does
Warm reset	Restarts DNP3 only. The same as the Save and Restart DNP3 button. Nothing else is affected.
Cold reset	Reboots the Borewatch. It is the same as switching the power off and on. The log records a power on event, even though power was never lost. Any activity such as sending a report is stopped. All alarms reset to inactive.

Both resets drop the DNP3 connection. It comes back after a minute or two. A Borewatch in listen mode listens again. One in connect mode dials the server again.

You should never need these commands. They exist so the Borewatch meets the level 2 DNP3 standard in full.

Reading device attributes

The Borewatch reports these attributes over DNP3, so you can identify the right unit in the SCADA system: software version, serial number, short location name, long location name, product name, and hardware version.

Attribute	Value
Hardware version	50

The hardware version is the same number as the device type code in a setup file header (`.DEV=50`).

File transfer

DNP3 file transfer can read the setup file, write a new setup file, and write a firmware upgrade.

Authentication. You must authenticate before opening any file, using the standard DNP3 file access mechanism. Use the Administrator username and password. The factory defaults are `user` and `changeme`.

You cannot read the firmware — it can only be written. You cannot delete the setup file or the firmware file.

File	Name	Direction
Setup file	<code>msc[serial].cfg</code>	Read and write
Firmware file	<code>msf[serial].hal</code>	Write only

`[serial]` is the Borewatch serial number. **The filename is case sensitive. Any letters in the serial number must be UPPER CASE.** A unit with serial `000D98` uses `msc000D98.cfg` and `msf000D98.hal`.

After any file transfer, send a DNP3 activate configuration request. The transfer alone changes nothing. In ClearSCADA, the Download File dialog has an **Activate** checkbox that you must tick.

The setup file you read back is the same file that **Save setup to disk** produces. Write it in the format given in Appendix O. The same filenames are used by automatic setup updates and automatic software upgrades.

Firmware upgrades. A firmware file takes about 10 minutes to download over the mobile modem. Turn off data link layer confirmations while you upload firmware. They make the transfer much slower, and TCP/IP already acknowledges every frame. After you activate the file, the Borewatch reboots to install it. This takes up to 90 seconds.

Advanced DNP3 settings

Navigate to **Change Setup → Advanced Settings**. The DNP3 block appears only when the DNP3 software option is installed.

You should not need to change any of these. They exist for strict level 2 DNP3 conformance. The defaults suit almost every SCADA integration.

Listen Mode

Value	What it does
Enabled	The Borewatch listens for the DNP3 server to connect to it. Normal when the server connection is over LAN.
Disabled	The Borewatch connects out to the DNP3 server. Modem only. The modem turns on only when needed, which saves power, and no public IP SIM is required. It turns off again once the master has the data.

The Borewatch sets this automatically from the Internet method chosen, so you rarely touch it. Two reasons to change it:

- On LAN, disable listen mode to switch the DNP3 function off.
- Over the modem, enable it only when you have LiveSMS and a static public IP SIM.

Send Level 2 Responses Only

Limits replies to what a level 2 master must be able to read. When you turn it on, the Borewatch:

- leaves timestamps out of analog and counter events
- reports analog inputs as integers only
- stops reporting the calibrated analog point for counter and event channels

⚠ **This reduces what the Borewatch can report.** Turn it on only when your master strictly enforces level 2 conformance.

Event Buffer Size

The number of unconfirmed events in one group — all analog inputs, for example — that can queue before the Borewatch sets the event buffer overflow flag.

The flag does not mean events were lost. It means more than this many events are waiting. Events may be lost after the flag is set, so the server should collect some.

This setting does not change how much the Borewatch can store or report. There is no reason to change it.

Unsolicited response timing

Four settings control how often, and how many times, the Borewatch retries an unsolicited response before the master confirms it.

Setting	Description
Unsolicited Confirm Timeout	How long, in seconds, the Borewatch waits for the master to confirm it received an unsolicited response.
Unsolicited Retry Delay	Extra time, in seconds, to wait after the timeout before sending the response again.
Unsolicited Max Retries	How many retries the Borewatch makes before it decides the master is offline.
Unsolicited Offline Delay	Extra time, in seconds, to wait between retries once the Borewatch has switched to offline mode.

How they work together:

1. The Borewatch sends an unsolicited response.
2. It waits for the **Confirm Timeout**.
3. If no confirmation arrives, it waits a further **Retry Delay**, then sends again. The gap between attempts is Confirm Timeout plus Retry Delay.
4. After **Max Retries** attempts, the Borewatch treats the master as offline and switches to offline mode.
5. In offline mode it keeps retrying, but the gap is now Confirm Timeout plus **Offline Delay**.

Two special cases:

- **To stop retrying in offline mode**, enter an Offline Delay above 86400 seconds (1 day). The Borewatch converts it to 2678400, which it reads as an infinite delay. The total number of retries then equals Max Retries.
- **To retry forever at the same rate**, set the Offline Delay equal to the Retry Delay. Max Retries then does not apply.

These four show the word `default`, not a number. The Borewatch calculates each one from the connection type, and for a modem connection from the event reporting period. Type your own value into any field and the Borewatch uses that instead, whatever the connection type.

Restore DNP3 Defaults

The button in the same block resets every advanced DNP3 field to its built-in default. Use it if a change has broken an integration that used to work.

Appendix J — Report Formats

Format	Description
Raw	Date, time, primary ID, secondary ID, value
Diagnostic	As Raw, plus running total for "log difference" channels; extra debug info
Diagnostic Only	Debug messages only — no channel data
Filtered	Channel name, date/time, value — no debug messages
Multi-column	One column per channel; one row per timestamp
Multi-column (aligned)	As Multi-column, snapped to logging period timestamp — recommended for SDI-12/Modbus sensors
User ID	Uses user-defined channel IDs instead of default IDs
User ID (with controls)	As User ID, plus control on/off events
Custom format 1	Counter channels with log difference only — period start/end, difference, units
RID HTTP	Royal Irrigation Department (Thailand) format
NSW DPIE eagle.io	NSW water metering framework compliant

Report file naming: `<location>_<format>D_<date>.csv`

Format codes: R (Raw), F (Filtered), D (Diagnostic), M (Multi-column), S (User ID).

Appendix K — Alert Formats

SMS alert format: `[location name]: [alarm message text] / Time: HH:MM:SS DD/MM/YY`

SMS alerts are sent to each configured phone number in order. If a send fails, it is retried 3 times at 1-minute intervals before moving to the next number.

Email alert format: `[device] at [location] / [alarm message] / Generated by Alarm: [number]
([name])`

Email alerts are sent to all configured addresses simultaneously. If a send fails, it is retried 3 times at 3-minute intervals.

DNP3 alerts: unsolicited responses — sent once only, or repeated at the configured fast period while the alarm is active.

Appendix L — Log Codes

The following codes appear in Raw and Diagnostic format reports:

Code	Event
POWERON	Device turned on
SRAMRST	Settings reset to defaults
LOGERASE	Log file erased
REBOOTRQ	Device rebooting
CLKCHG	Clock changed
UPG OK / UPG FAIL	Software upgrade result
CFG OK / CFG FAIL	Setup file install result
NTP OK / NTP FAIL	Clock sync result
LANON / LANOFF	LAN connected / disconnected
AL ACT / AL DEACT	Alarm activated / deactivated
AL ACK / AL ATTACK	Alarm acknowledged (manual / automatic)
ALSMS OK / ALSMS FL	Alarm SMS sent / failed
ALEML OK / ALEML FL	Alarm email sent / failed
R FTP OK / R FTP FL	Report FTP upload result
R EML OK / R EML FL	Report email result
MODEMON / MODEMOFF	Modem turned on / off

Appendix M — Power Considerations

Power Sources

See Section 3.8 for the priority table. Recap:

- **External power above 9V** via the Halytech Comm Port — runs the entire Borewatch (modem and electronics). Internal battery is not drained.
- **USB (LANlink Cable or HLink Dongle)** — powers all device functions except the modem during configuration sessions.
- **Internal battery** — primary source in normal field operation.

The internal Li-SOCl₂ battery is non-rechargeable — external power does not charge it.

Internal Battery

Parameter	Value
Type	Li-SOCl ₂ (lithium thionyl chloride), non-rechargeable
Voltage (nominal)	7.2 V
Capacity	13 Ah
Replacement part	HBT-001 — Borewatch Battery Pack
Expected life	up to 5 years (1-hour logging, daily reports, good signal, self-powered sensor, 1 alarm per month)

The expected life figure is quoted under the **standard reference scenario** above. Heavier modem use, faster logging, frequent alarms, or sensors that draw power from the Borewatch will all shorten battery life. See Section 7.1 for replacement procedure.

Reducing Power Consumption

The modem is the dominant power consumer. Choices that reduce modem on-time extend battery life:

Choice	Effect
Longer logging period	Fewer records to send per report
Less frequent reports (e.g. daily instead of hourly)	Fewer modem-on intervals
LiveSMS modem scheduling (Alarms Only or Schedule + Alarms)	Modem off most of the time; turns on only when needed
Fewer alarm SMS / email destinations	Less time on the modem per alarm
Self-powered sensors (sensors with their own battery)	No power draw from the Borewatch between samples

Sensor Power Draw

Sensors powered from PWR OUT (boosted 12V, pin 2) or LV OUT (3.3V or 5V, pin 8) draw from the internal battery during sampling. For maximum battery life:

- Configure sensors to use the **Warmup source** option (Control 1) so they are only powered during the brief warmup-and-sample window, not continuously.
- For SDI-12 and Modbus sensors, use the shortest warmup time that allows the sensor to give a stable reading.
- Where possible, use self-powered sensors and supply their power separately.

External Power

Parameter	Value
Connection	Halytech Comm Port — pin 6 (USB Power) positive, pin 4 (GND) negative
Voltage range	12–22 V DC
Switchover threshold	Above 9 V — Borewatch runs from external supply

External power options include a permanent DC supply (where mains power is nearby) or a solar panel. The Borewatch internal battery is not rechargeable — external power simply replaces the battery as the active source while it is present.

When external power is removed (or drops below 9 V), the Borewatch automatically reverts to the internal battery. There is no shutdown — operation continues uninterrupted.

Appendix N — SIM Cards and iPhones

If a SIM card has been activated in an iPhone before installation, Apple may have registered that number for iMessage. When iMessage is active, Apple intercepts SMS messages sent to that number — so SMS commands and alerts sent to the Borewatch will never be delivered.

Before installing a SIM that has been used in an iPhone:

1. On the iPhone, go to **Settings** → **Messages**.
2. Turn off **iMessage**.
3. Remove the SIM from the iPhone, then install it in the Borewatch.

If iMessage is already registered and the iPhone is no longer available:

Use Apple's online deregistration tool at **selfsolve.apple.com** to remove the number from iMessage before commissioning the Borewatch.

Appendix O — Troubleshooting

Mobile and Network

Symptom	Likely cause	Action
No signal strength shown	Antenna not connected, antenna cable damaged, or SIM not activated	Check the SMA connection(s) at the top end cap; inspect the antenna cable; confirm the SIM is activated with the carrier
Registration failed	Incorrect APN, antenna fault, or SIM not activated	Verify APN settings match your carrier; check the antenna; confirm SIM activation
Signal present but SMS send fails	SIM plan does not allow SMS	Contact carrier to enable SMS on the SIM
Signal present but email fails	APN, SMTP, or address configuration error; mobile data not enabled on the SIM	Confirm APN is correct; check SMTP server settings; verify to/from email addresses are valid; confirm mobile data is enabled with your carrier
SMS commands not received by Borewatch	iMessage intercepting SMS (SIM previously used in an iPhone)	See Appendix N — disable iMessage or deregister the number
Signal weak in below-ground installation	Antenna inside the bore casing, or steel cover blocking signal	Mount a whip antenna on the pit wall, or feed a flat-blade antenna through the cover and seal with epoxy. Consider HBW-002 (Cat-M1) for marginal-signal sites

Web Interface and Configuration

Symptom	Likely cause	Action
Cannot connect to web interface via LANlink	LANlink not plugged in fully; computer connected to other networks; browser cached old page	Check LANlink is plugged into the Halytech Comm Port and the computer's LAN + USB ports; disconnect from Wi-Fi and any VPN; clear browser cache. The default LAN IP is <code>192.168.0.177</code> . Check the network adapter is set to obtain an IP address automatically (DHCP)
Cannot connect to web interface via HLink	HLink dongle not seated; phone/laptop connected to home Wi-Fi	Re-seat the HLink dongle in the Halytech Comm Port. On your device, connect to the Borewatch's Wi-Fi network. The default Wi-Fi IP is <code>192.168.2.177</code>
Forgotten password	Default credentials previously changed	Contact Halytech for assistance — the user cannot recover access independently
Setup file load fails	Setup file from a different product or newer firmware version	Confirm the setup file was saved from a Borewatch (.MICROSPIDER2 format, device code 50) and from a firmware version equal to or older than the running firmware

Inputs and Sensors

Symptom	Likely cause	Action
Analogue input reads <code>EOR</code>	4–20 mA sensor not connected or not functioning	Check the sensor wiring at the M12 connector; verify sensor power if the sensor is powered from the Borewatch
Analogue input reads erratically or out of range	Voltage divider missing for 0–5V or 0–10V signal; pin 5 jumper set to OC instead of AIN	See Appendix B for resistor divider; check internal jumper for pin 5
Open collector output not switching	Pin 5 jumper set to AIN instead of OC	Set pin 5 jumper to OC; only one of OC or AIN can be used at a time
SDI-12 sensor not responding	Wrong address, wrong baud, or wiring fault	Use SDI-12 Interactive Mode (Examine icon on Change Input Setup) to probe the sensor directly. Confirm sensor power is applied
Modbus sensor returns exception	Address off by one between sensor manual and Borewatch register field	Try address – 1 (Modbus is 0-based; some manuals list 1-based addresses)

Power and Battery

Symptom	Likely cause	Action
Battery voltage trending down faster than expected	High modem use, frequent alarms, sensors powered from internal battery	Review configuration — see Appendix M; check for sensors set without a Warmup source; consider LiveSMS modem scheduling
Unit unresponsive	Battery flat	Connect a LANlink Cable or HLink Dongle — the cable powers the electronics, allowing web access to check battery voltage. If the battery is below replacement threshold, replace HBT-001 (Section 7.1)
Internal moisture sensor reading positive	Water ingress into the enclosure	Remove the unit from service; contact Halytech for service / inspection. Do not redeploy until the cause is identified and the seal restored

Appendix P — Setup File Format

Setup files are saved and loaded via **Change Setup** → **Manual Setup Management** (§5.12). The format is a plain text file with a fixed header, parameter list, and footer.

Format

```
.MICROSPIDER2
.DEV=50
.VER=<version number>
<parameter assignments, one per line>
.END
```

Header

The first three lines must be:

- `.MICROSPIDER2` — file type marker. Borewatch shares the microSpider2 platform and uses the same marker. There is no Borewatch-specific variant.
- `.DEV=50` — Borewatch device type. The Borewatch firmware rejects setup files with the wrong device code.
- `.VER=<version number>` — must match or be lower than the firmware version running on the unit. A higher version is rejected.

Body

One parameter assignment per line. Only parameters being changed need to be listed — anything not in the file keeps its current value.

Footer

The file must end with `.END`.

Editing setup files manually

Setup files exported via **Save setup to disk** can be edited in any plain-text editor and reloaded via **Load setup from disk**. Useful for:

- Bulk-deploying many units with similar configurations
- Restoring a known-good config after testing or a factory reset

- Making targeted changes without using the web interface

Some browsers flag `.cfg` files as potentially harmful during download. This is a false positive — dismiss the warning and save the file.



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