SmarTroll / AquaTroll Calibration using the VuSitu Mobile App

OVERVIEW

Horizons Regional Council's Sampling Teams use both the In-Situ SmarTroll MP (Smartroll) and In-situ AquaTroll 400 (AquaTroll) handheld meters for determining and recording the following field parameters at all SoE, point discharge and groundwater sites where possible (the exception being sewage treatment ponds and effluent discharges). Horizons also use these meters for lake profiling and to provide check data for continuous water quality sites.

The AquaTroll replaces the now discontinued Smartroll. Both instruments share the same probes, and both utilise the same VuSitu App to display the instruments readings. The instruments do differ in cables, the Aquatroll uses a twist lock mechanism and the SmarTroll uses a screw lock, as such, the correct Wireless Troll Com (battery/baro unit) must be used. All new battery/baro units for either instrument uses the VuSitu App – these can be identified as those that are rechargeable. The older AA battery powered battery/baro units only work with SmarTroll's and the older ISitu Mobile App.

Horizons Regional Council generally records the following parameters with the AquaTroll/ Smartroll:

Parameter	Sensor Type	Range	Accuracy	Resolution	NEMS
Water Temperature	PT100	-5 to 50°C	± 0.1°C	0.01°C	**Yes**
Air Temperature	Thermistor	-20 to 70°C	± 2.0°C max	0.1°C	No
Barometric Pressure	Battery Pack	300 to 1100 mbar	± 3.0 mbar max	0.01 mbar	**Yes**
Depth	Non vented absolute PT	0 – 76 m	0.1% FS @15°C ± 0.3% FS Max from 0°C to 50°C	0.01 m	No
Dissolved Oxygen (%)	Optical (RDO)	0-80% 80-200 % 200-500 %	± 1% ± 2% ± 10% of reading	0.1%	**Yes**
Dissolved Oxygen (mg/l)	Optical (RDO)	0-60 mg/L	±0.1mg/L from 0 to 20 mg/L ± 2% of reading from 20-60mg/L	0.01mg/L	**Yes**
Conductivity	4-Electrode Cell	5 to 100000 µs/cm	± 0.5% + 1µs/cm	0.1µs/cm	**Yes**
pH	Glass electrode	0 to 14 units	± 0.1 units from 0-12 pH units	0.01 pH units	**Yes**
ORP	Platinum button	-1400 to +1400 mV	± 5.0mV	0.1mV	**Yes**

TRAINING REQUIREMENTS:
Prior to field use, all staff are required to be trained by the Discrete WQ Portfolio Holder. Once trained to the Discrete WQ Portfolio Holder's satisfaction the Training Log [Section 15.6 Appendix 8] will be updated in the Ops Manual.

SmarTroll / AquaTroll Calibration using the VuSitu Mobile App

Calibration of the Aquatroll/SmarTroll's (Troll) must be carried out prior to each sampling run. All parameters to be collected in the field need to be calibrated on the same day prior to any data acquisition. Conductivity, pH and ORP sensors must be checked and recorded at the end of the day using the appropriate standardised solution).

Record the calibration and complete the end of day checks on the calibration form in the Trolls labelled book (*form: 14.2 Appendix 1*). Record the marked number of the instrument as either **SmarTroll_XX** or **AquaTroll_XX.**

The Trolls should be found ready for use in an unassembled state:

- The Sondes should be in the WQ lab in their calibration cups with a saturated sponge wafer
- The cables should be bound with dust caps on the ends in the WQ Lab
- The Battery/Baro units should be charging with the iPads within the office(s)

MAKE SURE THE SONDE # AND BATTERY/BARO UNIT # MATCH

Note1: Having the instruments unassembled reduces stress on the connectors of the cable/instrument.

Note 2: The Sondes stored in this way means that they are stable and ready for RDO calibration without the need to allow for additional stabilisation time before calibration. The calibration cap with the vent hole should be on top of the calibration cup.

Note 3: at the end of the day, the instrument should be disassembled and left as found

Assemble the Troll, turn on the Battery/Baro unit, start the VuSitu App on the idevice (iPhone, iPad), and start working your way down the calibration form

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1. BAROMETRIC PRESSURE CHECKS

Record the barometric pressure at the time of calibration of the Troll unit. This is checked against is the Manawatū at Victoria Avenue (VIC) barometer, which is, also recorded (simply read from the display screen). Note we use true (raw) barometric pressure. Calibrations are intended to occur at the WQ Lab where this check can be made. Otherwise mark the Manawatū at Victoria Avenue field as OFFSITE. Do not record these values at the end of the day in lieu at the time of calibration.

Troll unit barometer vs. VIC barometer value: If the difference is >+/-5mbars between the two notify the Discrete Water Quality Portfolio holder/proxy. Consider using a different Troll.

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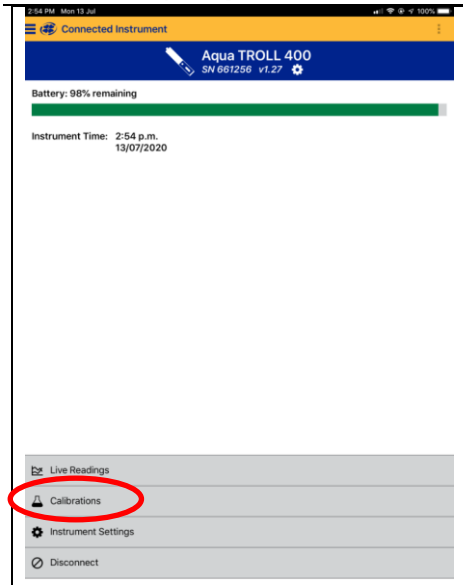
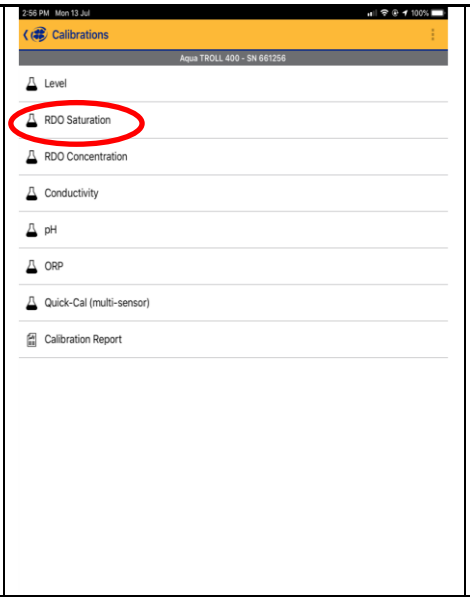
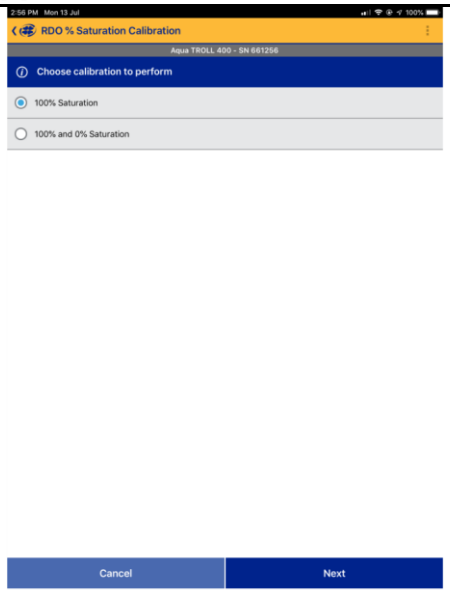
2. RUGGED DISSOLVED OXYGEN (RDO) CALIBRATION

The calibration process starts with a 1-Point RDO calibration. **The Troll should have been left stored in the cup with a moist sponge. This means that it is already stored in 100% saturated air and is ready to go**. *If the Troll is not gently dry the RDO probe and sensing material with a paper towel, ensuring the surface is free of water. Place in the calibration cup and wait 10 minutes for the temperature to stabilise before calibrating.*

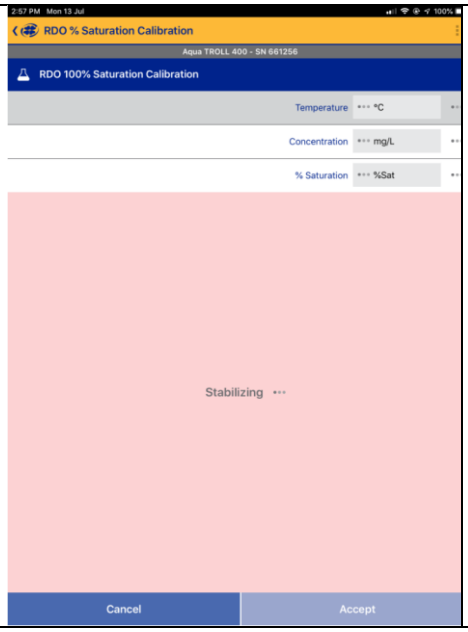
SmarTroll / AquaTroll Calibration using the VuSitu Mobile App

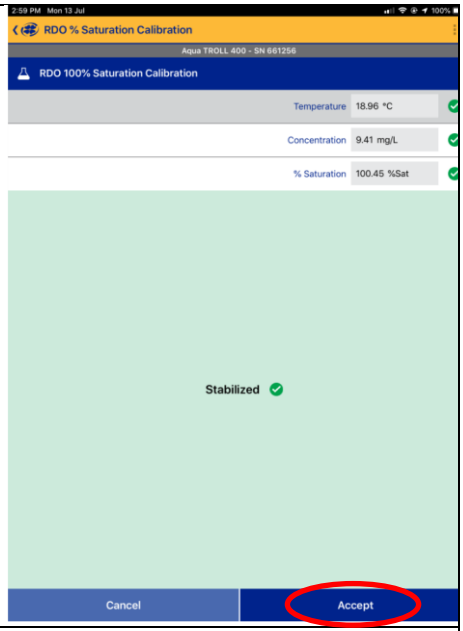






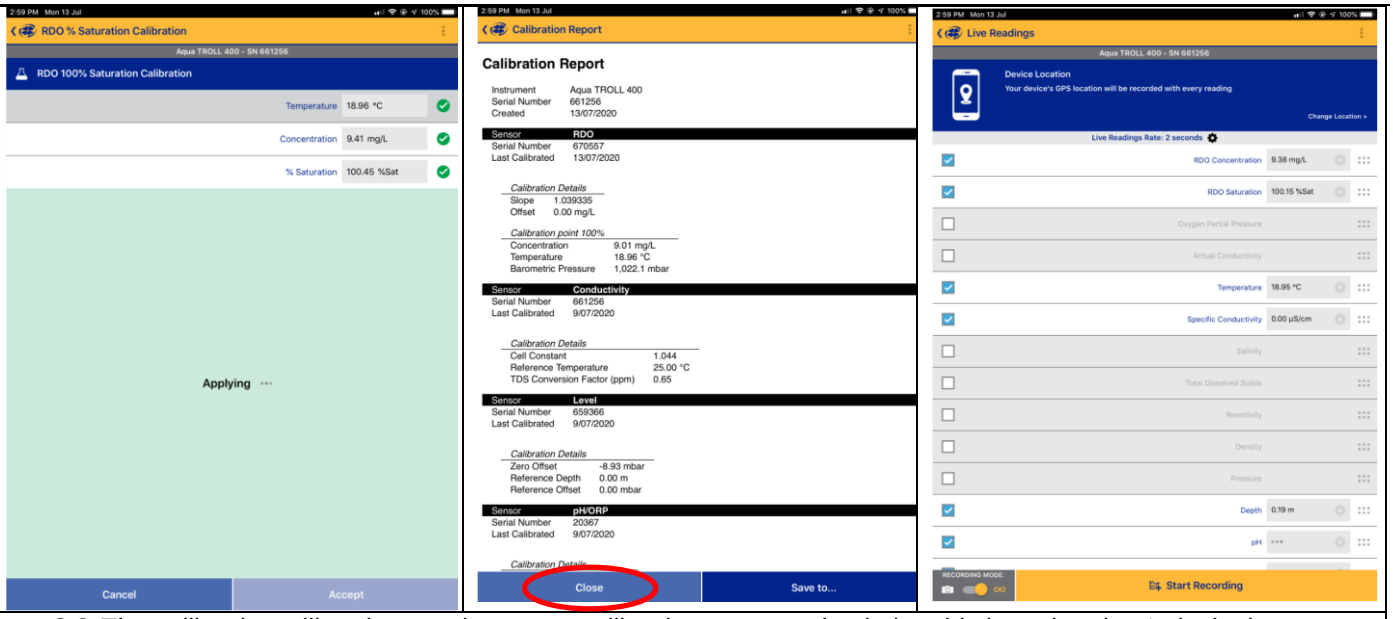
2.1 From the main menu, select **Calibrations**
2.2 From the calibrations menu select **RDO Saturation**
2.3 For a 1-Point calibration, select **100% Saturation**





2.4 Make sure the vented cap is installed on the calibration cup and a water saturated sponge is placed in the bottom of the cup – a screen image will prompt you – select **next**
2.5 Allow the Troll to stabilise – the screen will turn green, select **Accept**

SmarTroll / AquaTroll Calibration using the VuSitu Mobile App



2.6 The calibration will register and create a calibration report – check that this is updated to today's date, **select Close**

2.7 Return to the **home screen/main menu**, select **Live Readings**

2.8 Record the **RDO Saturation** both **%** and **mg/L** and **temperature**

2.9 Complete the pass calibration part of the form.

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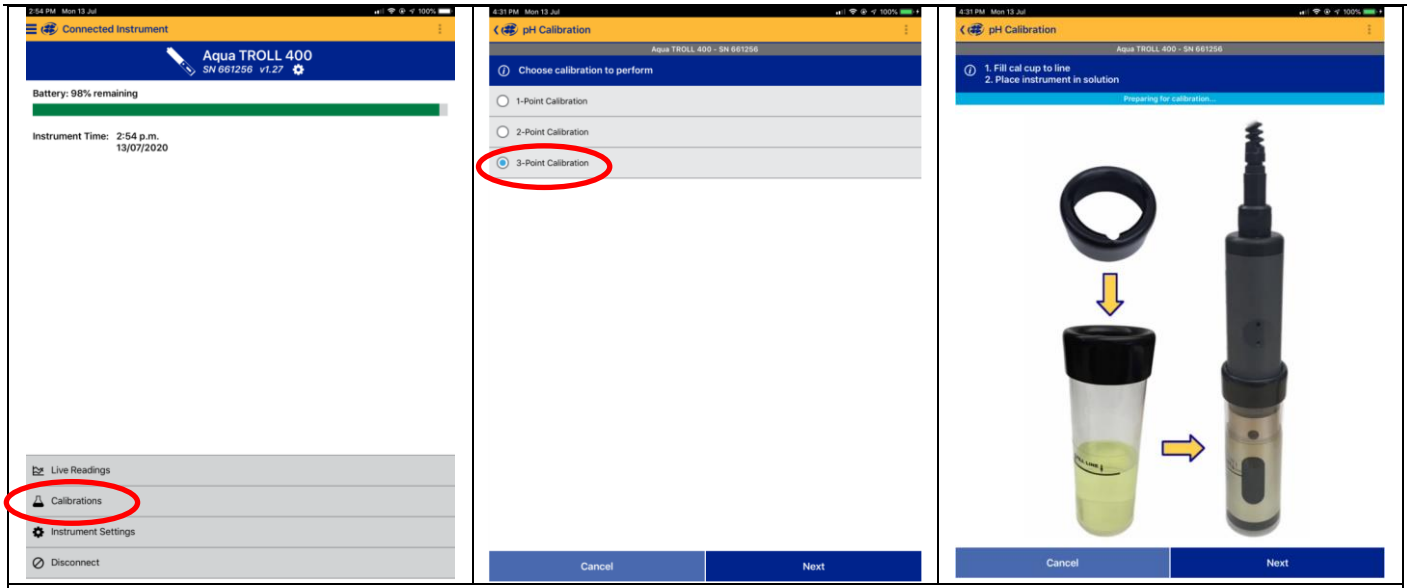
3. pH CALIBRATION

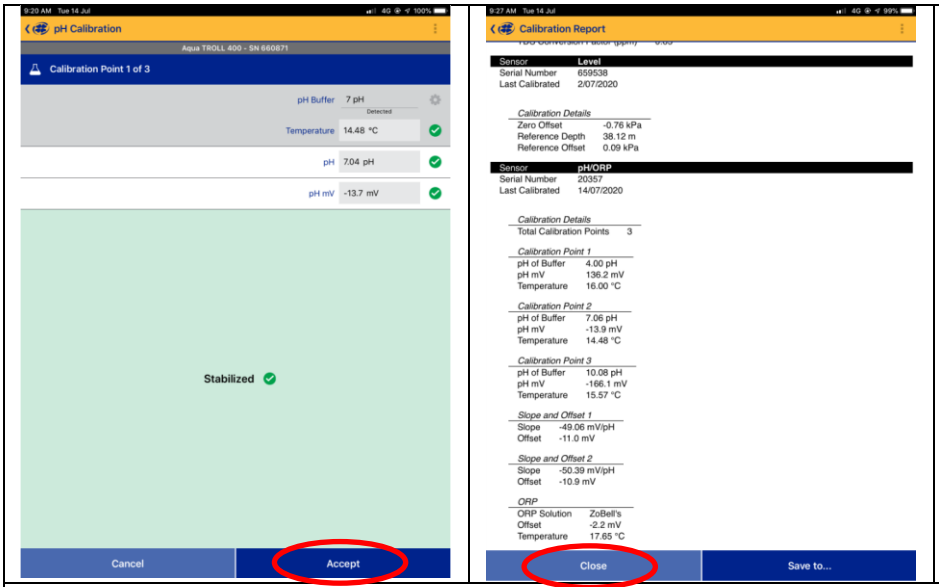
A 3-Point calibration is always to be undertaken. Start with the pH 7 buffer as this sets the offset and is a good indicator of the health of the sensor, followed by the pH4 and 10 buffers.

NOTE: *The pH/ORP probes have a limited lifespan and do require regular maintenance by the Discrete Water Quality Portfolio holder. If you observe above normal stabilisation times and/or high mV readings when in the pH7 buffer [high = greater than +-35mV] please comment on the bottom of the form and notify the Discrete Water Quality Portfolio holder. Consider using a different Troll.*

SmarTroll / AquaTroll Calibration using the VuSitu Mobile App



3.1 From the main menu, select **Calibrations**
3.2 From the calibrations menu select **pH, then** Select **3-Point calibration**
3.3 You will be prompted to put the Troll into pH7 Buffer



3.4 Allow the Troll to stabilise – the screen will turn green, then record the: **(i) pH Buffer value** (top above temperature). **(ii) Temperature (iii) pH mV value** (the bottom value)
3.5 Select **Accept**
3.6 You will be prompted to put the Troll into **pH4 Buffer** – rinse with water first.
3.7 Place into the pH4 Buffer and repeat steps 3.4 to 3.5.
3.8 You will be prompted to put the Troll into **pH10 Buffer**– rinse with water first
3.9 Place into the pH10 Buffer and repeat steps 3.4 to 3.5.
3.10 The calibration will register and create a calibration report – check that this has updated, **select Close**
3.11 The Troll is now calibrated for pH. Return to the home screen to do the Specific Conductivity Calibration.

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4. SPECIFIC CONDUCTIVITY (SPC) CALIBRATION

SmarTroll / AquaTroll Calibration using the VuSitu Mobile App

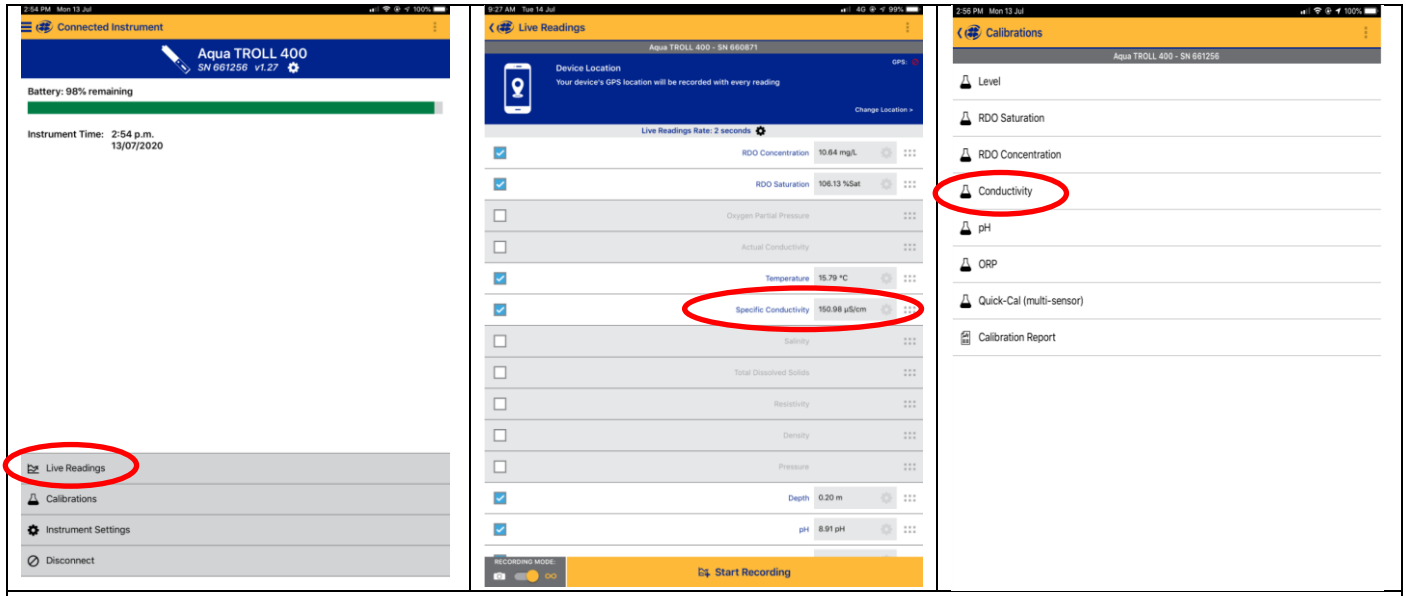
Prior to use the Troll needs to have a 1-Point calibration for SPC, with a before after check undertaken. The strength of SPC standard solutions used for both checks and calibrations will vary depending on the environment the Troll is being used in. Therefore, this SOP references the appropriate solutions used to calibrate surface, lakes and groundwater environments in **GREEN** and references the appropriate solutions used to calibrate for coastal (saline/brackish) environments in **BLUE**.

DO NOT confuse SPC with Actual Conductivity – the device should not have this option selected on the live readings screen.

NOTE 1: *The Conductivity calibration and check solutions are prone to contamination (i.e. they are solutions not buffers) so regular solution replacement is required.* **Use the solutions only ONCE before using a rinse solution and then discarding.**

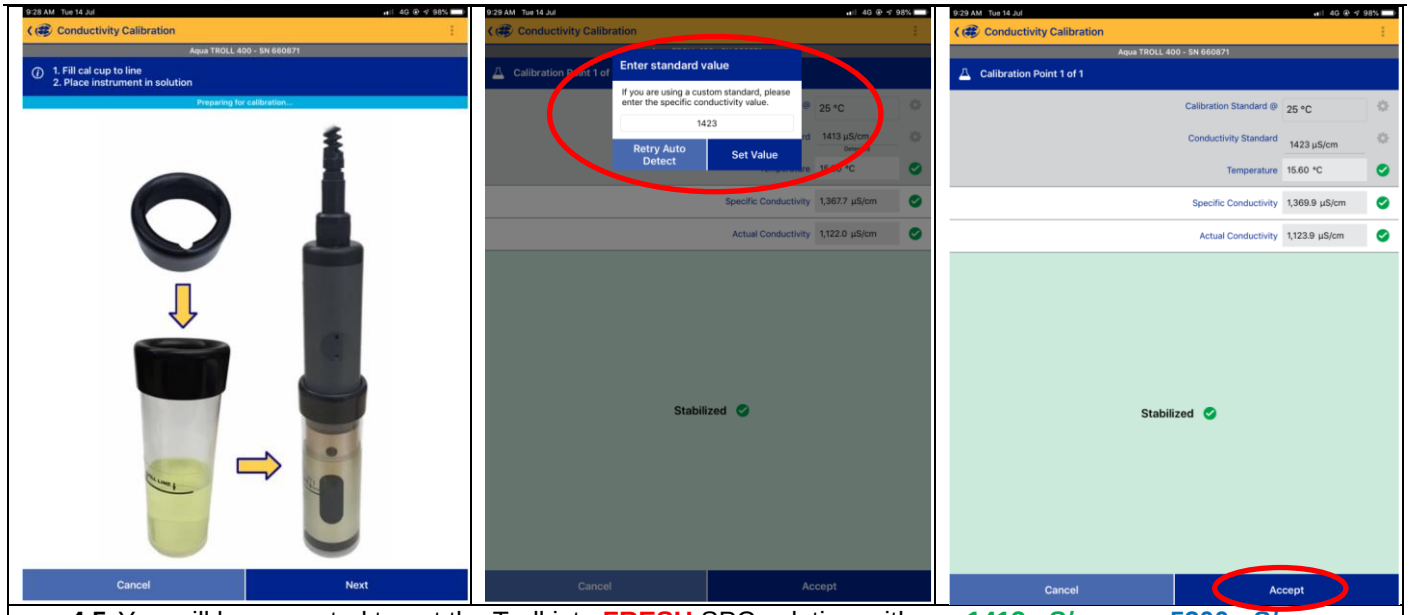
NOTE2: ***The majority of noted fails regarding Specific Conductivity are due to solution contamination.*** *If either of the pre or post calibration Specific Conductivity checks fail, thoroughly rinse the troll and replace the solution(s).* ***If it still fails (i.e. the value displayed is outside of the set range detailed in the calibration form): (i) Discrete WQ portfolio holder is to be informed (ii) the Troll is to be removed from use (iii) an alternative Troll is to be used.***

NOTE 3: *The solution bottles refer to SPC in the units of Molar (M). The units displayed by the Troll and recorded are to µS/cm. The value of the SPC standards vary from batch to batch therefore the bottles of solution should have the SPC marked in µS/cm - 0.001M equates to ~149 µS/cm. 0.01M equates to ~1415 µS/cm.*



4.1 From the home screen, select **live readings.**
4.2 Thoroughly rinse the Troll, place it into **FRESH ~ 149 µS/cm** or **1288mS/cm**, and allow to stabilise.
4.3 Record the **SPC** and **Temperature** values onto the calibration form – ***this is the pre-calibration handheld meter reading.*** Check that the value is within **126-170 µS/cm** or **1224-1352mS/cm** of the solution – if not rinse the troll and replace solution.
4.4 In order to calibrate the Troll for SPC return to the home screen, select **Calibrations** and then select **Conductivity**

SmarTroll / AquaTroll Calibration using the VuSitu Mobile App

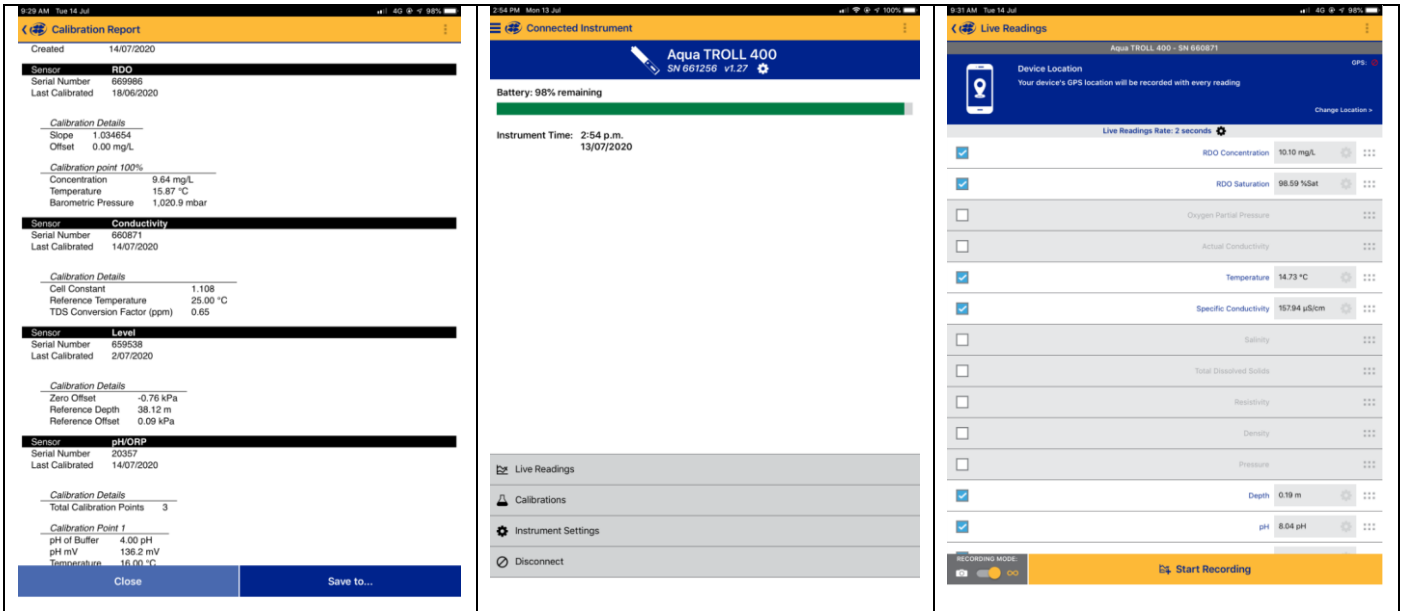


4.5 You will be prompted to put the Troll into **FRESH** SPC solution, either: **~1413 µS/cm or ~5300mS/cm**

4.6 The conductivity standard value needs to be manually adjusted to match the current batch of solution. To do this select the **gear icon** next to this field and then enter the value. Select **Set value to the value on the solution bottle**.

4.7 Allow the Troll to stabilise – the screen will turn green, Record the **SPC** and **Temperature** values onto the calibration form – ***this is the calibration value***

4.8 Select **Accept**



4.9 The calibration will register and create a calibration report – check that this has updated, **select Close**

4.10 From the home screen, select **live readings**. Thoroughly rinse the Troll and place it into **FRESH ~149 µS/cm or 1288mS/cm** and allow to stabilise

4.11 Record the **SPC** and **Temperature** values onto the calibration form – ***this is the post-calibration handheld meter reading***.

SmarTroll / AquaTroll Calibration using the VuSitu Mobile App

	4.12 Check that the value is within **126-170 µS/cm** or **1224-1352mS/cm** of the solution – if not rinse the troll and replace solution. Complete the pass calibration part of the form.

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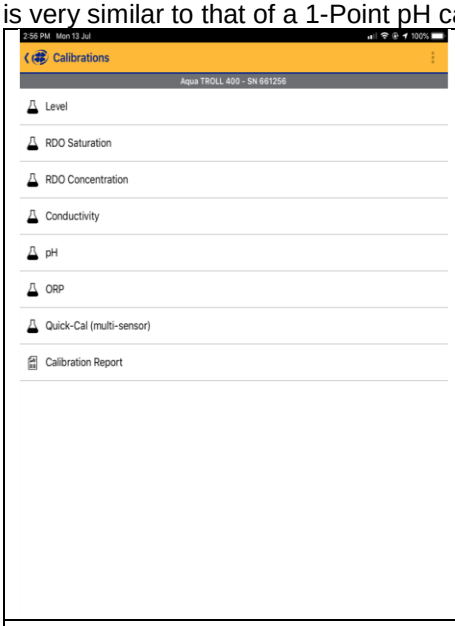
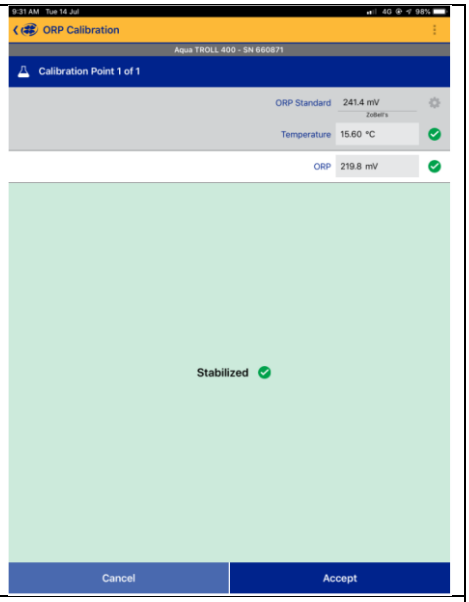
5. OXIDATION-REDUCTION POTENTIAL (ORP) CALIBRATION

Currently HRC only collect ORP for Groundwater sampling. The ORP probe is part of the pH probe, calibration of ORP is very similar to that of a 1-Point pH calibration.





5.1 From the home screen select **calibrations.**
5.2 Allow the Troll to stabilise the screen will turn green select **ORP**
5.3 You will be prompted to put the Troll into solution. HRC uses Zobells solution
5.4 Allow the Troll to stabilise the screen will turn green. Record the **ORP Standard** and **Temperature** values onto the calibration form.
5.5 Select **Accept.** The calibration will register and create a calibration report – check that this has updated, select **Close**

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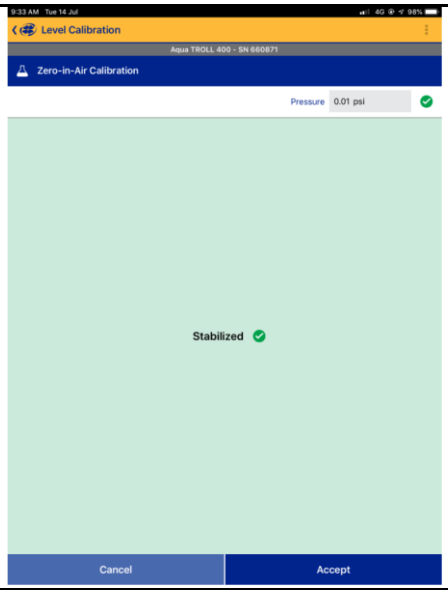
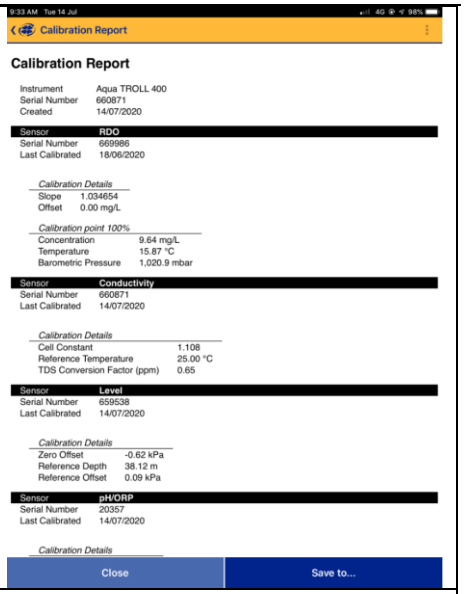
6. DEPTH CALIBRATION

Used especially for Lake profiling the Trolls can show the depth of water they are placed in. Calibrate at site immediately before use.

SmarTroll / AquaTroll Calibration using the VuSitu Mobile App





6.1 From the home screen select **calibration**
6.2 Select **Level**
6.3 Select **Zero-in-Air calibration**
6.4 Allow the Troll to stabilise the screen will turn green
6.3 Select **Accept**.
6.4 The calibration will register and create a calibration report – check that this has updated, select **Close**

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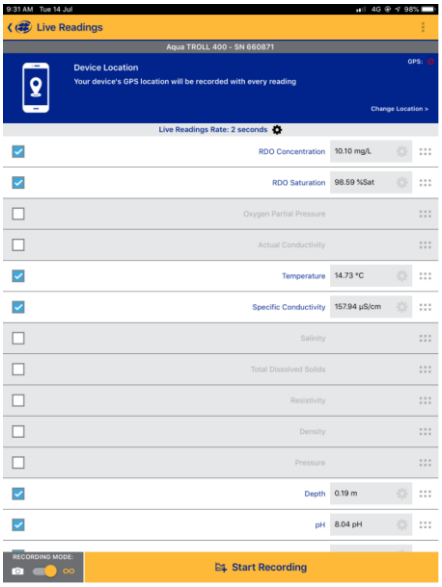
7. END OF DAY CHECKS

After completing the sampling activities, it is required to check the instrument for drift by undertaking the following checks. Turn on the Troll and idevice and select **Live Readings**:



7.1 pH 7 END OF DAY CHECK:

i. Place the sensor (still within its protective metal cover) into pH 7 buffer.
ii. Leave for a few minutes to stabilise
iii. Record the value of the pH and the temperature (no need to leave the main screen)

For the end of day check to be successful, the value displayed should be **between 6.8-7.2 pH**. If the check fails, repeat the process with fresh standard solution and a re-rinsed sensor and allow sufficient time to stabilise.

If the check is, still a failure document the calibration form as appropriate and notify the Discrete WQ portfolio holder as soon as possible. Either remove the Smartroll from the WQ shed or mark it not for use to avoid it being used until the Discrete WQ portfolio holder can rectify the situation.

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7.2 SPC END OF DAY CHECKS:

i. Place the sensor (still within its protective metal cover) into **FRESH** **~149 µS/cm or ~1288mS/cm** conductivity solution
ii. Leave for a few minutes to stabilise
iii. Record the value of the conductivity and the temperature (no need to leave the main screen)

For the end of day check to be successful, the value displayed should be within **126-170 µS/cm** or **1224-1352mS/cm** of the solution if the check fails, repeat the process with fresh standard solution and a re-rinsed sensor and allow sufficient time to stabilise

If the check is, still a failure document the calibration form as appropriate and notify the Discrete WQ portfolio holder as soon as possible. Either remove the Smartroll from the WQ shed or mark it not for use to avoid it being used until the Discrete WQ portfolio holder can rectify the situation.

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7.3 ORP END OF DAY CHECKS:

i. Place the sensor (still within its protective metal cover) into the Zobells Standard Solution
ii. Leave for a few minutes to stabilise
iii. Record the value of the ORP and the temperature (no need to leave the main screen)

For the end of day check to be successful, the value displayed should be **between 200-255 mV**. If the check fails, repeat the process with fresh standard solution and a re-rinsed sensor and allow sufficient time to stabilise

NOTE: the allowable range displayed on the field calibration form is out of date –the range of 200-255mV above should be adhered to.

If the check is, still a failure document the calibration form as appropriate and notify the Discrete WQ portfolio holder as soon as possible. Either remove the Smartroll from the WQ shed or mark it not for use to avoid it being used until the Discrete WQ portfolio holder can rectify the situation.

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8. CALIBRATION FORM

Once the end of day checks are completed double check all fields are completed in the Handheld Meter Calibration Form, including adding any comments, prior to finishing for the day. Place the white top copy in the inbox in the WQ lab.

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9. TROLL STORAGE

Once all checks are finished and deemed satisfactory turn the Troll off by holding down the power button on the baro/battery unit and exiting out of the idevice app (turning off the idevice afterward):

i. For safe storage ensure that the sponge is still moist and place the probe(s) into the cup (as if carrying out a DO calibration).
ii. Disassemble the cable from the sonde and baro/battery packs and carefully coil the cable up, using the Velcro cable tie.
iii. Place the components on the shelving with the others.
iv. If the backpack is damp or wet, dry out the case by either bringing into the building proper or hang the backpack up to dry.
v. If the sonde, Battery/Baro pack, backpack or cable has been covered in mud or sand, please clean, immediately after completing all end of day checks.

SmarTroll / AquaTroll Calibration using the VuSitu Mobile App

EXAMPLE CALIBRATION FORM:

XXXX **HORIZONS REGIONAL COUNCIL**
HANDHELD METER CALIBRATION FORM

Meter ID:	AQUATROLL 1	Date:	29-07-2020
Staff Member:	A.SAMPLER	Time:	14:00 NZST
Run Name:	DEMO		

BAROMETRIC PRESSURE CHECKS

Handheld Meter Reading:	1006.1	mbar
Manawatu at Victoria Avenue:	1006.4	mbar

DISSOLVED OXYGEN CALIBRATION

			Pass Calibration 99.7%-100.3%
DO% (after calibration):	100.0 %	Temperature	
DO mg/L (after calibration):	9.01 mg/L	23.41 °C	(Y) / N

3 POINT pH CALIBRATION

	Calibration Value	Temperature	mV pH Value
pH 7 (calibration):	7 *	18.0 °C	-7.3
pH 4 (calibration):	4 *	17.8 °C	+160.6
pH 10 (calibration):	10 *	17.9 °C	-179.3

CONDUCTIVITY CALIBRATION

	Specific Conductivity	Temperature	Pass Calibration SoE 126-170 µS/cm Coastal 1224-1352 mS/cm
Handheld Meter Reading:	153.1 µS/cm	17.65 °C	
Calibration value:	1416 µS/cm	16.9 °C	
Handheld Meter Reading:	154 µS/cm	17.3 °C	(Y) / N

ORP CALIBRATION

	Calibration ORP Value	Temperature
ORP (Calibration):	229 mV	17.71 °C

END OF DAY CHECKS

Staff Member: A.SAMPLER Time: 16:30 NZST

	Handheld	Temperature	Allowable Range	Passed
pH 7 Buffer:	7.12	18.3 °C	6.80 -7.20	(Y) / N
Specific Conductivity Verification solution:	154.8 µS/cm	18.49 °C	SoE 126-170 µS/cm Coastal 1224-1352mS/cm	(Y) / N
ORP Check value:	230 mV	18.33 °C	200 - 255	(Y) / N

COMMENTS:
* AQUATROLLS DISPLAY pH CALIBRATION VALUES AS 4/7/10 ONLY! THESE ARE SHOWN TO 2.D.P. IN CALIBRATION FILE.
SMARTROLLS DISPLAY pH CALIBRATIONS VALUES TO 2DP ON APP.

14.2 Appendix 1 version 6 15/07/2020