CATCHMENT DATA

DATA VALIDATION

WATER TEMPERATURE

Version Number:	2.4 (immediately prior to NEMS)
Issue Date:	26/04/2013
Portfolio:	Water Quality
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horizons
regional council

Introduction

The specification for water temperature data is contained within the water quality / water temperature portfolio documents.

These corrections notes assume that the person(s) undertaking data corrections have been through basic data correction training for the water temperature data source. These notes are reference material to coincide with the respective training. Contact a Regional Coordinator or Analyst for assistance if you need help.

Validation Methodology

The methodology employed in the validation of water temperature data has been adapted from the ISO748 standard where:

- Minimum alteration of the raw data state through the correction to reference; achieves the best quality data. (Linear Transformations, offset adjustment)
- Complex alteration of the raw data state to the reference results in data poorer quality. (Ramping, time lags, non-linear transformations, synthetic/modelled records).

The basis for correction of water temperature data is through the development of common offsets over time (per sensor); with reference to the manual inspections with a calibrated reference sensor. The correction made to the continuous data is not absolute; as there is an accepted error with both the continuous sensor and the reference sensor (this is documented within the specifications for this parameter).

This Data Validation document identifies the basic procedures to follow when undertaking the processing and reviewing Water Temperature Data.

It is suggested that if there is a change of sensor in this period then the period should be reduced to end at the time of the sensor change. Generally each sensor will have its own required offset that may take a minimum of six inspections to finalise.

Also if there has been a significant event during the selected period then it might be prudent to end the period before the event, in the case that there is not enough information on the effects of the event on the sensor or site characterises.

It is also suggested that the batch is ended if the sensor location has been moved (orifice lowered or raised) as the depth in the water profile at which the temperature is being recorded will have adjusted.

Be aware that long-term offsets are being added to logger code. This should be noted on the respective chit; there should also be an obvious step in data with a programme change if it has not been commented. Continue with the current process outlined and check for consistency of the offset. If the correct offset has been applied in the field a transformation should not be needed unless there has been a significant event/knock to the orifice(instrument)/sensor replacement….if a change in the offset is obvious within the data apply a transformation to correct this and notify the appropriate Regional coordinator.

Validation is undertaken in batches of data; which generally covers the period post the last validation period (but not limited to). The Batch number is merely an index number to provide traceability.

NEMS Processing Procedures have been adopted from July 2010 within the validation of this data source. The NEMS document is subject to adjustment.

If you are not fully familiar with the validation of this data source or are unsure of the procedures to follow please read this document in full and /or consult with a Data Analyst or Coordinator, to obtain further assistance.

VERSION	CHANGES MADE:	DATE ADOPTED	BY
V1			*Cawthorn*
V2	*Pictures. Further elaboration on the basic steps*	*2011*	*Cowie*
V2	*Inspections which do not contain Water Temperature verification are no longer recorded with the processing file as (-1) unless they are at Boundary Points [origin of data changes], i.e. logger changes/programme changes, site movement/site re-location, or instrument changes.*	*9/2/12*	*Cowie*
V2.1	*Comments added but not noted in pervious version change. Cowie changed links.*	*23/08/2012*	*Cawthorn*
V2.2	*Added Specific information about processing WT to appendix at end. MUST BE READ*	*09/10/2012*	*Cowie*
V2.3	*Added comments concerning Ebro calibration issues*		*Cowie*
V2.4	*Updating notes. Immediately prior to adoption of new NEMS*	*26/04/2013*	*Cowie*

1.0 Creating Your Working Directory

Open the Logsheet Loader and fill in the processing register, registering your correction period. You will need to do this first to obtain a batch number for the new period of processing.

Collate and photocopy the chits for all inspections during this period including the last chit of the previous batch.

Create a data processing folder on the network drive. The file path should be as shown in Figure 1:

\\Ares\Environmental Data Validation \Water Temperature\<SiteName>\<Batch#>\...

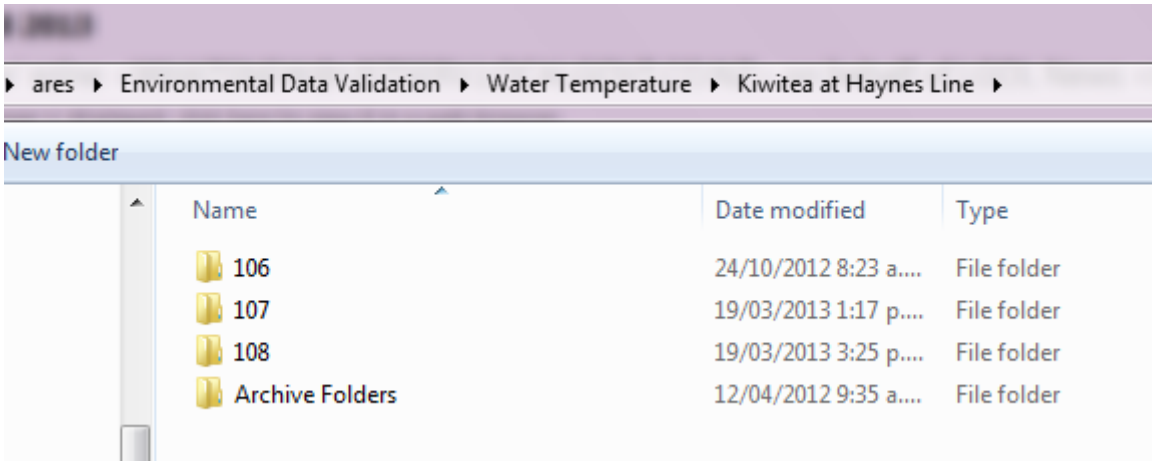


Figure 1

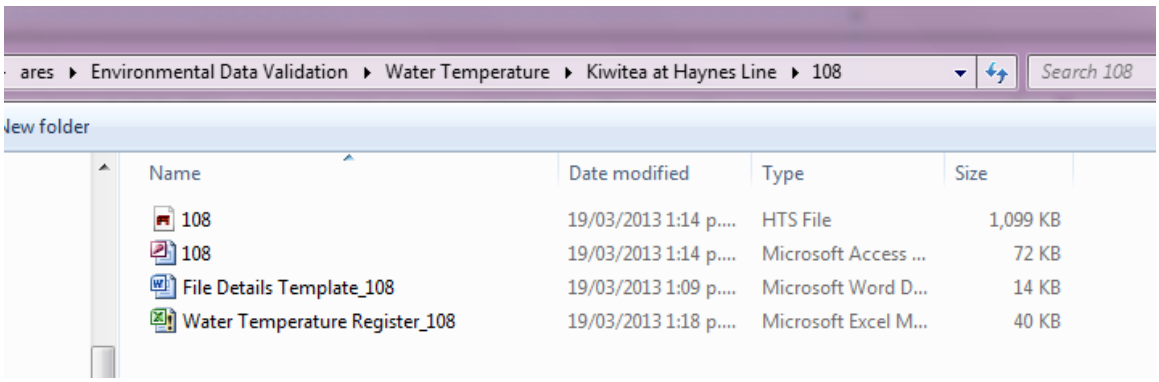


Figure 2

The above processing folder should also contain the following as shown in Figure 2:

A. File Details Template.docx (FDT)

B. Water Temperature Register.xlsx

   (which now contains the URF in the first tab, Adjusments Register in the second and the Comment Sheet in the third tab)

C. Audit.mdb

These can be copied from the processing documentation files as shown in Figure 3:

\\Ares\Environmental Data Validation\WaterTemperature\Docs\...

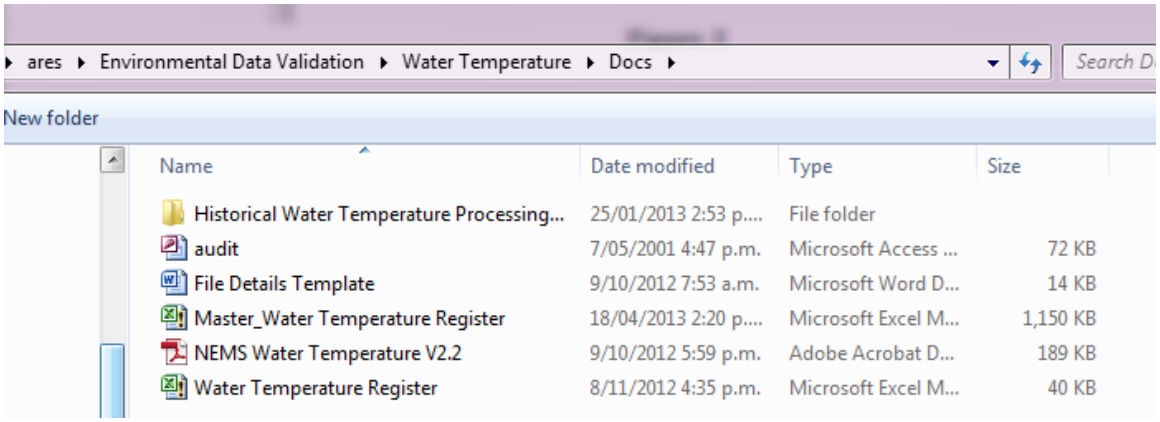


Figure 3

Rename the File Details Template and Water Temperature Correction Register so that it contains the batch # i.e.

102 FILE DETAILS.DOC

102 <SITENAME> WT.XLS (OR XLMS)

Or as shown in **Figure 2**

Configure the Hilltop processing files.

Rename the Audit file (Audit.mdb) to the Batch number generated in the Logsheet Loader i.e. 102 (Figure 2).

In Manager create a new .hts file and call it the batch number i.e. 102.hts in the newly created processing directory as above. If you have done this correctly, Hilltop will state that there is an audit trail in the background. If it does not, then you need to make the audit.mdb the same as the hts file, if an audit file fails to generate a connection then contact an Analyst.

If you complete your Validation/corrections and there is no audit trail, there will be problems during the review process and the URF may be declined.

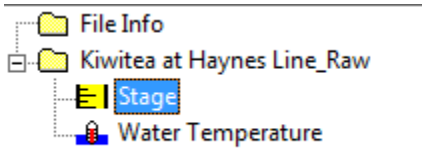
Obtain all the chits/inspection information for the current period (Batch) of data Validation as generated in Logsheet Loader. Check that all the information is on the chit and photocopy these.

It is suggested that you have access to the Calibration information relating to the batch period for any sensors or reference sensors, this includes any survey information and non-conformance reports.

The reason for indexing the batch number and the folder/file structure is that the system databases (Hilltop, Logsheet Loader, Audit trails) are now linked. This enables connections and reporting between the different systems.

2.0 POPULATE RAW DATA TO YOUR FILE

In your Hilltop file, copy the original (raw) water temperature data from \\ARES\ORIGINAL\HILLTOP TELEMETRY\<SITECODE>.HTS or \\ARES\ORIGINAL\INTERNAL\<SITECODE>.HTS to your Hilltop file and call it <<Site>_Raw> as shown below.



For Dissolved Oxygen Sites, the water temperature data is contained as part of the dissolved oxygen data sources, for processing, this data needs to be transformed to the Water Temperature datasource when copied to the Working file.

Copy the Water Level data for the site you are correcting. This can be obtained from either the archive/sub archive or raw hilltop files. You should obtain the supporting data which is of the highest standard available, to ensure that you have the best understanding of the site characteristics for the periods of data you are validating.

If you anticipate the batch of data will be complex, copy the up and/or downstream water temperatures of other nearby sites as well as rainfall data at site or neighbouring rain gauge. This information is informative for the water temperature processing.

If you have not processed the current site before, or are unfamiliar with the site, copy the last batch of processing to the file located in the respective Data Correction Folder on *\\Ares\Environmental Data Validation\WaterTemperature\etc.* This should provide some direction of the site performance and any site issues; leading up to the period you are validating.

3.0 POPULATE THE FILE DETAILS TEMPLATE

Fill the FDT with the site and correction parameter

In Hilltop Manager > Right click the <SiteName_Raw> and select details and copy that information in to the FDT.

In Hilltop Manager it is suggested that you review the data for unmarked gaps (i.e. where the gap has no gap marker). Water Temperature is recorded at an interval of 5/15 minutes; any period greater than this interval should be a marked gap.

Right click gaps and list, (if any), the Gaps in the raw File and list any gaps deleted in the Gaps Deleted field. If there are none, then enter *"no gaps"* within the FDT.

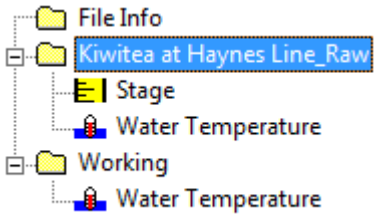
If there is any missing data (gaps) for the period that you are validating, you will need to locate this period of data or determine if the gap is valid. Look for any downloads during inspections or check the Non-conformance system. Contact the Regional Coordinator to obtain the missing data and/or determine if it is in-fact a period of missing data if you have

been unable to determine this prior. This data should be updated to the site original files first then copied to your working file.

4.0 LOADING THE CHECK DATA

Once you have photocopied the inspection chits/inspection, do the following:

Copy the '<SiteName>_Raw' site to another site within the object tree called *'Working'*. This *'Working'* data is where you enter check data and do minor edits to the data.



It is recommended that you number and highlight each of the inspections (on the log sheet); to enable easier QA of the processing period. Highlight pertinent information including, date, time, Ebro values, Programme Changes and comments about orifice movement or Dissolved Oxygen sensors.

(Contact the staff member that undertook the inspection or the regional coordinator if there is a significant issue that needs to be resolved concerning Logsheets; significant issues require a non-conformance report).

Highlight all the Ebro and YSI check data inspections.

Once in the *'Working'* site, select the check data (the hilltop icon that looks like a clipboard).

Enter in the check data dates and times into their respective fields and comments from the Logsheet Loader. Cross check these with information on the Logsheets. If the Logsheet Loader is incorrect please correct the entry, if the logsheet/chit is incorrect please find out why and resolve the issue before continuing processing.

Enter in the check data information. If there is no water temperature information, you need to enter a '-1' into the water temperature check column. All inspections require entry as there may be inspections and site modifications without temperature check data that could affect site performance.

Enter relevant inspection comments into the check data comments field. Especially if something has been done or noted that might affect the Water Temperature data quality.

Then save the loaded data. (It is suggested that you regularly 'save', as there is no auto save function in hilltop software).

List and copy the Inspection comments (check data comment) into "FDT".

QUALITY CODING INSPECTIONS

- As of 10/10/2012 all Check Data used requires a corresponding quality marker.

Quality coding inspections/Check Data creates awareness of the implications of what the water temperature check data is telling you. This step is completed after the check data has been loaded and before the editing

Quality coding the inspection/check data requires the processor to consider the inspection itself and its validity when correcting the data and applying offsets as required.

- Normal Inspection QC 600
- If taken away from sensor (opposite bank/downstream >10m/high stage event) QC 500 [Check SOE sites are at the Hydro site]
- Site inspection and no Water Temperature checks have been made QC100. The inspection should still be loaded (-1) in the check column, pertinent comments to the site if there are any, this enables tracking of site issues. These are logged to track any changes which may have occurred while staff on site.

The quality coding can be used to differentiate a passed/failed calibration specific to the inspections it was used for/Ebro which was used for the inspection

Non Hydrology Reference data (other sources i.e. Sampler) QC 500

- *Reference data from Hydrology Log Sheets QC 600*
    - *From 16/2/2012 to 15/8/2012 Ebro9 QC 200*
- *Synthetic Inspections (used to aid data corrections) QC 300* Synthetic inspections into Adjustment Register
- *ANY reference data considered faulty/suspect QC 200*

5.0 POPULATING THE CORRECTION REGISTER

In the check data field, list out the dates/time, check data and inspection comments and enter these into the correction register. Also populate the difference column:

DIFFERENCE = RECORDED VALUE - CHECK

In Excel, select the *'Get Hilltop Check Data'* macro. This will extract the inspection values and the associated logger values. Copy the logger values to the *Adjustments register (Column D).*

If you're unsure on how to do this, ask an Analyst.

Also, obtain the last validation batch of corrections (excel Correction register) and copy into the 'Previous' Tab/sheet

The Correction Register is used to track and document any corrections made to the period of record.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	DATA PROCESSING REGISTER													
2	Intiail Check data				Correction					Correction Notes				
3	Date/Time	External	Recorder	Difference	Correction	Ramp	Corrected	Final Difference	Quality Code	Processing Notes				Check Comments
4														
5														
6	6/10/2011 10:30	12.7	12.4	-0.3	0.3		12.7	0	600					Ebro 2
7														
8	23/11/2011 12:15	17.9	18.1	0.2	0.3		18.4	0.5						Ebro 2
9														
10	23/11/2011 12:45	13.4	13.3	-0.1	0.3		13.6	0.2						Ebro 2
11														
12	8/12/2011 11:00	18.3	17.9	-0.4	0.3		18.2	-0.1						Ebro 7
13														
14	19/12/2011 10:00	14.8	14.6	-0.2	0.3		14.9	0.1						Ebro 2
15														
16	21/12/2011 3:15	16.3	16	-0.3	0.3		16.3	0						Ebro 7
17														
18	10/01/2012 12:15	20.2	19.8	-0.4	0.3		20.1	-0.1						Ebro 7
19														
20	20/01/2012 13:30	21.1	20.9	-0.2	0.3		21.2	0.1						Ebro 7
21														
22	16/02/2012 3:30	17.3	16.7	-0.6	0.3		17	-0.3						Ebro 7

	A	B	C	D
1				
2	Intiail Check data			
3	Date/Time	External	Recorder	Difference
4				
5				
6	5/02/2010 13:30	17.2	17.4	0.2
7				
8	26/02/2010 11:45	15.3	15.3	0
9				
10	3/03/2010 13:30	15.8	15.5	-0.3

6.0 EDITING THE DATA

The *'Working'* site with the Hilltop file is where you are going to make minor edits to the data.

If you are unsure how to make adjustments using the features within Hilltop Manager, ask an Analyst to help you through

Have the Comments tap open (in the Water Temperature Register.xls), as any changes that you make to the data require a corresponding comment irrespective of reason for the edit/data adjustment. If you can't find the 'technical' term to describe what you just did, ask an analyst.

View short periods of record (typically around one month) and right click 'edit'. Look closely around inspections for missing data; spikes caused by the on-site technicians or periods of noisy data generated from sensor fouling or other issues like sensor 'burial'. Note, not everything that is done in the field will be necessarily listed on the inspection chit; you may need to consult with the Regional Coordinator for more information.

Any correction that has been 'visually' interpolated, such as a spike, greater than an hour is to be marked (quality coded) as synthetic record.

Use the review tab within excel to add comments explaining choices and decisions behind the data correction where you feel requires greater explanation. These additional tabs allow the reviewer to make a more informed decision based on why and how you corrected points within the data series.

The Comments made within the Comment Sheet tab are designed to inform the end user of data quality and decisions/adjustments made to the data. If the comment is not pertinent to the end user use the review comments within the Adjustment Register.

Be aware that data currently can come in greater significant figures than we require for data correction or our SOP and introduces additional accuracy and correction which is not required. List and export data .csv file and re-import using a re-import .csv for water temperature. This step is done either from the *'Working'* site or from the '*Corrected'* site.

Difficult Datasets

Noisy periods of data require interpolation using a virtual measurement that will generate a smoothed dataset for consideration (i.e. Final Archiving).

Missing record over diurnals should not be filled with synthetic record, without consultation with a Regional Coordinator or a Senior Analyst.

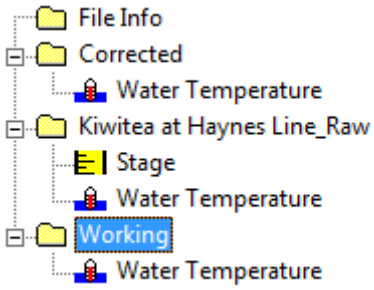
However, synthetic data can be generated by analysis of nearby sites with similar characteristics by applying regression analysis techniques. Note time lags may need to be applied to this analysis; and also review the effects that this synthetic data may have on the site data statistics; all synthetic data needs to be highlighted in final documentation for ease of review. A Senior Analyst should be consulted when applying this type of synthetic record generation over a diurnal period.

When periods of data show large drops or rises in water temperature, such as an offset change or as a result from sensor cleaning, synthetic checks are required in the register to show the ramp corrections applied to the data that period, and a comment made. Be aware/ cautious of the fact that the sensor maybe exposed (out of the water). This data needs to be removed and treated as missing record; and could be filled with synthetic data as above.

If you're unsure, consult with an Analyst or Regional Coordinator.

7.0 FINALISING THE REGISTER

Once you have made all of the changes to the data, copy the *'Working'* site to another site called *'Corrected'*. This is where you will apply transforms and ramp corrections, if any, to the data.



In the Adjustment Register, run the '*Get Hilltop Check Data'* macro again. Note any changes to the logger value into the Register. Highlight the adjusted logger value in the register and add an interpolated/correction value into the offset/multiplier column

Find a common offset if there is an offset change is apparent within the data. You will need to take into account the previous batch of data and assioated corrections and active instrument offset. The only time that offsets are changed is; if there are ramp corrections or additional data results that may change the applied offset. The new offset is applied to the current period of data correction.

If the new batch of processing changes the common offset, a ramp correction is required to adjust the old offset to the new offset. if this offset change is on the boundary of the validation bacthes then careful consideration needs to be given to the effects of all adjustment at the batch boundaries, this may require the last period (last two inspections of the previous batch) may require further review and / or adjustment. This will mean that the period of record you are validating has been extended and all references to this batch and period need to be adjusted accordingly (Logsheet Loader, Adjustment register etc). Make note of this in the correction register

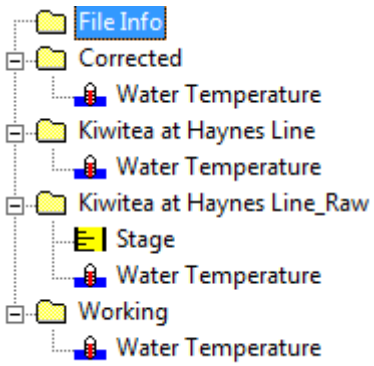
If there are check inspections with large differences, even following the minor adjustments to the data, it is statistically correct to remove these from the offset calculation – make note of any large difference in the Adjustment Register.

Once you have determined the corrections to be made, fill out the *'Corrected'* and *'Final Difference'* columns in the Adjustment Register

The long-term offset may have been loaded into the logger in which case the offset does not need to be applied within the processing batch (if there is no change deemed necessary from the Adjustment Register). A comment will be required within the Comment Sheet to note when long-term offsets have been applied to the water temperature though the logger code.

For large differences between recorded data and inspection, the reason neeeds to be sought and fully documented as a comment in the Adjustment register and in the Hilltop comments (Comments Sheet).

Once the corrections have been finalised in the Adjustment Register, apply the correction(s) to the '*Corrected'* site within the Hilltop file. If you are not familiar with transforming and ramping data, ask an Analyst. (Most failed URF's are from poorly corrected data).



Ramp and transform corrections *do not require Final Hilltop Commenting if they are undertaken within the excepted instrument error (+/- 0.8);* however, ensure that these types of correction are clearly identified/documented in the correction register!

8.0 Quality Coding the Data

Once you have completed the minor corrections in the "*Corrected*" site and adjusted the Register to dcoument the changes made during the correction process, you now apply the quality code schema to that data. All data to be quality coded to the NEMS – NQCS (circa 2010).

Quality coding is required for all the changes that have been made to the data, as follows:

- Final difference after an offset has been applied are within 0.5 ºC QC = 600 (NQCS=20000)
- Final differences after an offset has been applied are between 0.5 and 0.8ºC QC = 500 (NQCS=18000)
- Final differences after an offset has been applied are > 0.8 ºC QC = 400 (NQCS=12500)
- All minor changes to data including smoothing of noise QC = 400 (NQCS=15000)
- Ramp corrections within 0.5ºC QC = 600 with comment (NQCS=18000)
- Ramp Corrections between 0.5 and 0.8ºC QC = 500 with comment (NQCS=15000)
- Ramp corrections > 0.8ºC QC = 400 with comment (NQCS=13000)
- Unverified Data QC = 200 with comment (NQCS=11000)
- Synthetic data QC = 300 with comment (NQCS=6000)
- Missing record QC = 100 with comment (NQCS=100)

When inserting quality codes, ***the lowest quality prevails***. *For example, a quality code of 12500 is applied 15 minutes (one time step) after the check value of the higher of the quality codes*

Add the quality data to the Adjustment Register and the file details template FDT

You may come across older processing that has had the quality coding schema applied differently (to the above quality coding schema); as the data has been corrected the same way, but using older schema. This is not an instant fail, but make note during the review that it is not using the current quality schema, all attempts should be made to correct this where practicable.

9.0 Final Steps

Copy the final '*Corrected'* site data (with offset transformation) to the actual Hilltop site name i.e:

<MANAWATU AT TEACHERS COLLEGE>. - SITENAME

Create another site called *'Audit'*, this will contain a Virtual Measurement that demonstrates the differences between the raw and final datasets; this is done using the Virtual Measurement described in Appendix 3. This shows the changes made to the data during the correction process and helps in the review of the data.

Fill in the rest of the file details Template: Final Details and Gaps

Open and complete the URF form in the first tab of the Water Temperature Register.

Copy the SiteName data to the Provisional Archive. **Make sure you have the *'Gap at Start'* check box ticked!**

Review the reported non-conformance for this period of record for this site. If there are issues that have been highlighted through the validation of this period of data that are not recorded in the non-conformance register then generate a report for each issue. It is critical that any missing record that has not been filled; has a reported non-conformance. Poor sensor/data performance should also be reported to the Regional Coordinator, this reporting should encompass issues like:

Significant sensor drift and/ or increase in the frequency of spikes.

Noisy data.

Other apparent trends that may highlight decreasing sensor performance.

10.0 PRINT TO ONE PDF DOCUMENT THE FOLLOWING FOR REVIEW

- The URF20XX
- The File Details Template, FDT
- Both the Adjustment Register [one with Review comments expanded and one without Review comments] and the Comments Sheet(s) [Appendix for Comment sheet]
- A graph showing the quality data at full scale for the SiteName
- A graph showing the before and after at full scale i.e. Raw and Final + checks over-plotted with the Audit Virtual Measurement, add any annotations if required.
- A graph showing the before and after at full scale i.e. Raw and Final over-plotted (using a secondary axis) with the Quality data
- The audit trail (from excel) only listed out in a tab within the Water Temperature Register – it is not printed for hand in.

It is a requirement that for complex processing, there will be annotation/references on the three monthly plots that notes/indexes (as documented in the register) where there has been

significant changes or modification to the original data; this reduces the reviewing requirements.

Open the Logsheet Loader and complete the required information for the current batch of processing.

Collate these printouts in order and “Hand in” for review and updating.

11.0 Reviewing the Data

Reviewing the data is a relatively simple process if the above steps has been followed and documented. The review process is required as a double check that the validated data meets the required standard and has produced a final dataset within the expected ranges and meets the expectation of experienced users. In some instances to maximise the usefulness of the data this SOP may not be followed but all steps & assumptions will be fully documented for review (validation of environmental data is not always a mechanical, stepped process; and does require the application of experience and an understanding of the parameter).

The list below provides the reviewer with the steps to be followed:

1. Check that all the required information is on the URF form; Cross check CDTools
2. Check the initial file details template is correct:
   - Have the check comments been made, spelt correctly or missing?

   (Note the mistakes/errors on the review template)
3. Is the Correction register complete and contain all of the required information (the check log sheets)?
4. Are all the changes made to the data complete and do they accurately reflect the correction processes used? Have they been commented and quality coded accordingly?
5. Does the audit trail show all the changes made within the data file. If it doesn't, then add comments to the review template and review the VM audit; for any potential issues.
6. Do the graphical printouts cover the processing period? Are there any visual inconsistencies'?
7. If minor errors exist, correct the errors (print out the periods corrected and attach to the URF) make notes of the changes within the URF documentation, and request sign off from the original processor (or Regional Coordinator). *(This provides some feedback to the original staff member that undertook the validation as well as providing a further independent review of the modified dataset).*
8. Fill out the non-conformance report if there are significant errors (that require the batch to be returned for complete rework). Note this in CDTools; on the "Return" Tab.

Correction batches only fail review, if they require complete or substantial re-correction.

If the batch of validated data meets the above quality assurance requirements, then the data can be approved and loaded the Environmental Archives.

Please review and follow the SOP: "Archiving Environmental Data".

12.0 Appendix

Specific Information Required

Documented within Non-conformance Report 1927

16/02/2012: All Ebros out of calibration (calibration expired)

15/08/2012 Ebros calibrated. All passed except Ebro 9

Ebro 9 failed calibration at the top end (above 30 degrees centigrade), sensor began to drift. For inspections during the period 16/02/2012 – 15/08/2012 Ebro 9 still within Operational Standard to be used as check for the verification of in-situ water temperature sensors. However the check data is not to be used for any offset calculations (YSI Pros or other Ebros may be used to verify and apply an offset changes observed) or amendments to the water temperature record. The quality code for inspections undertaken with Ebro 9 following the period of expired calibration (16/02/2012-15/08/2012) is to be lowered to Quality Code 500 and a comment is to be made within the comment sheet to be filed with the data source. Two comments are required where applicable:

1) All Ebros out of calibration from 16/02/2012-15/08/2012 and that all passed with the exception of Ebro 9 which showed sensor drift at the top end of calibration (above 30 degrees centigrade)
2) Batches of data which include Ebro 9 checks for the period 16/02/2012-15/08/2012 to change the Quality code for inspections to 500 to reflect the failed calibration of the Ebro and no offset changes to be applied using the Ebro 9 checks for the period.

Include any non-conformances within the processing file.

Appendix: Virtual Measurements

Gap Removal Virtual Measurement.

This Virtual Measurement will need to be adjusted for sites which have Dissolved Oxygen sensor Water Temperature as their primary.

Get "{SiteName_Raw} Water Temperature [Water Temperature]" as x
Step T
If T > 900 then
PutGap
Else
Put x
Endif

900 [seconds] is for 15 minute
300 [seconds] would be for 5 minute

Audit Virtual Measurement.

This Virtual Measurement will need to be adjusted for sites which have Dissolved Oxygen sensor Water Temperature as their primary.

Select New Site, label as Audit, Datasource: Audit and Virtual Measurement: Audit

Write in as shown in the box below:

Get "{SiteName_Raw} Water Temperature [Water Temperature]" as x
Get "{SiteName} Water Temperature [Water Temperature]" as y
Z = y-x
Put z

Appendix: Comments Sheet

The Comment sheet is designed to hold Comments for the end user of the data. The comments should be written with this in mind and outlined below are comment types used:

Instrumentation: Documenting sensor changes and types (and specifications) made at the site – or new instrumentation – pertinent to the data source which is being processed. Instrumentation comment is also filed when a new data source is set up at site and is included with an Initial Comment which is filed at 00:00 for the day, followed by the Instrumentation comment filed at 00:15. The Instrumentation comment in this case, also includes a specific description of the sensor, accuracy, measurement range etc.

Missing Record: Length of the missing record, why record missing if known?

Synthetic Data: How and where the synthetic data came from and why synthetic data was needed.

Cautionary Note: The corrected data is outside of the SOP/NEMS value i.e. QC400 and if the reason is known put it down.

Analyst Comment: This includes weird trends in the data which cannot be explained (but have been fully explored), site movements, major damage to sites, coding problems or where the analyst has had to make assumptions and interpretations of the data.

Initial Comment: Filed for a new sensor and data source at site. This comment is filed at midnight of the day the data source was deployed and is followed by an **Instrumentation** comment for the sensor installed filed at fifteen minutes past midnight.

Data Correction: Any minor corrections which had to be made to the data: what was done, why it was done?