



New Mexico and the assessment of continuous monitoring data

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Overview

- Introduction: Assessments using continuous monitoring data in New Mexico:
 - 303(d)/305(b) assessment questions
 - Critical time periods
 - Parameters collected for assessments
- Assessment Protocols in New Mexico
- Continuous monitoring data case study: Temperature criteria and assessment
 - Data processing – challenges and solutions
 - Macro-enabled template spreadsheet with VBA scripts for QA/QC
- Database management and final assessment determinations
 - Data “flow” and future improvements
- Wrap up: Contact information and questions



Assessments using continuous monitoring data



- 303(d)/305(b) assessment using continuous data:
 - Temperature impairments – > numeric standards (most common)
 - Nutrient and DO impairments – > numeric and narrative standards (very common)
 - pH, turbidity and specific conductance impairments –> numeric and narrative standards (least common)
- Critical time period is assessment focus:
 - Temperature – captures yearly maxima (summer)
 - Nutrients and DO – growing season
 - pH, specific conductance, and turbidity –no specific time period
 - Pros: “growing season” most indicative of pollutants entering water body, most designated uses utilized due to adequate flows
 - Cons: Low-flow winter periods still important for many designated uses



Continuous Monitoring Data Collection

- Temporary deployment of multiparameter sondes, temperature and other dataloggers 2 weeks - 6 months
- Temperature
- Turbidity
- Dissolved Oxygen
- pH
- Specific Conductance

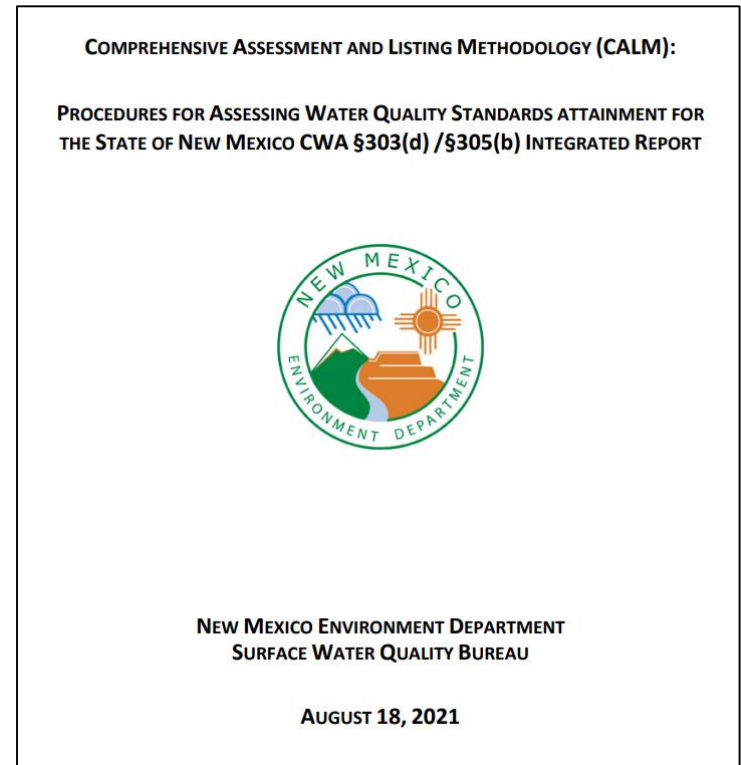


Multiparameter sonde deployment using rebar anchor (Pecos River)



Comprehensive Assessment and Listing Methodology

- Assessment Protocols: “CALM”
- Appendices contain parameter-specific listing methodologies for long-term deployment (LTD) data or “large datasets”
- Translate narrative standards for assessment
- Requirements for continuous data to assess for some aquatic life uses in streams and rivers



Appendices

- A Data Quality Tables
- B Temperature Listing Methodology
- C Nutrient Listing Methodology for Wadeable Perennial Streams
- D Nutrient Listing Methodology for Lakes and Reservoirs
- E Large Dissolved Oxygen Dataset Listing Methodology
- F Large pH Dataset Listing Methodology
- G Sedimentation/Siltation Listing Methodology for Wadeable Perennial Streams
- H Turbidity Listing Methodology for Coldwater Perennial Streams and Rivers
- I Integrated Reporting Category 4b Protocol



Continuous Monitoring Data Collection

Require continuous data component to assess for aquatic life use in streams and rivers:

- ❑ Temperature
 - ▣ Index period: late May-September
- ❑ Turbidity
- ❑ pH
- ❑ Dissolved Oxygen
- ❑ Nutrients – 24-hour Delta-DO
 - ▣ Index period: ecoregional growing season



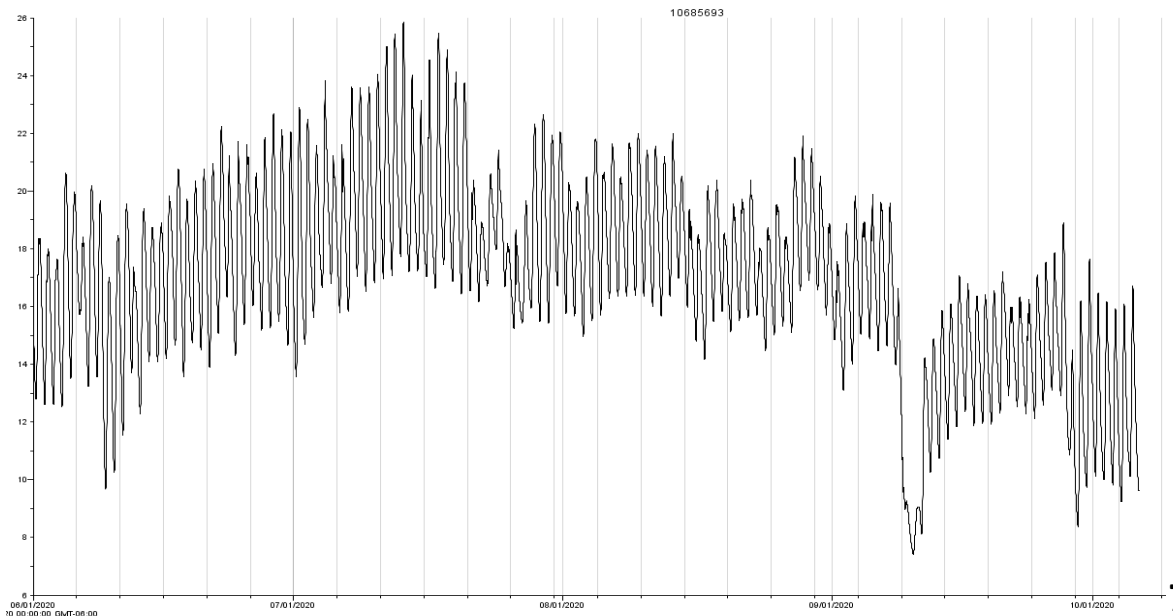


Temperature criteria and assessment

Table 1. New Mexico's temperature criteria by ALU (from 20.6.4.900 (H) NMAC)

AQUATIC LIFE USE	MAXIMUM TEMPERATURE (°C)	4T3 ^(a) (°C)	6T3 ^(a) (°C)
High Quality Coldwater (HQCWAL)	23	20	
Coldwater (CWAL)	24		20
Marginal Coldwater (MCWAL)	29		25 ^(b)
Coolwater (CoolWAL)	29		
Warmwater (WWAL)	32.2		
Marginal Warmwater (MWWAL)	Routinely exceeds 32.2 ^(c)		
Limited	No default established		

- River/stream temperature: 4T3, 6T3, and maximum temperature standards based on Aquatic Life Use
- Determination of non-support made if:
 - Measured 4T3 or 6T3 > applicable temperature criteria
 - Maximum allowable temperature exceeded on more than one day in same calendar year (excluding outliers)
 - Require continuous data to calculate





Temperature criteria and assessment

- Long-term thermograph datasets needed to fully assess
 - ▣ Capture period of seasonal maximum water temperature
 - ▣ Plotted data show ascending and descending “limbs” of thermograph
- Grab data - non-support only
 - ▣ Need long-term data to confirm impairment determination prior to TMDL (IR Cat 5C)

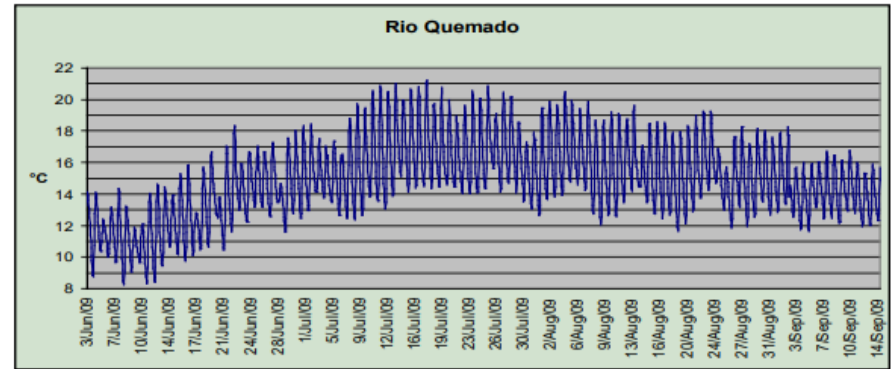


Figure 1. Example of assessable dataset for full support determination (adequate duration and includes summer season maximum temperature less than applicable maximum criterion of 23°C for high quality coldwater aquatic life use)

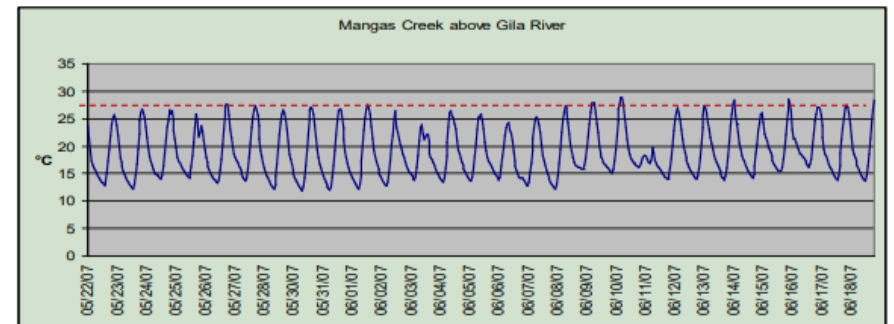
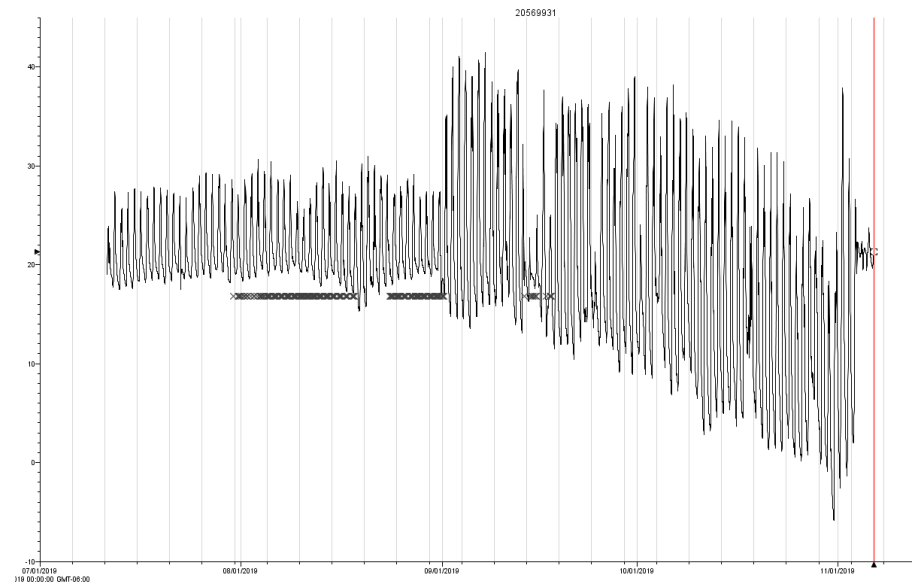


Figure 2. Example of assessable dataset for non-support determination *only* (applicable segment-specific maximum criterion of 28°C is exceeded on more than one day in this limited duration dataset)



Temperature criteria and assessment

- Loggers used: Hobo WTP or Tidbit (where stream drying and logger exposure suspected)
- A typical two-year watershed survey will result in 80-140 temperature logger deployments
- Lots of data – efficient processing, QA/QC and upload method needed





Processing temperature data

- Main challenges:
 - Time intensive “processing” data for upload and assessment– including cleaning up, cropping, QA process
 - Determining whether logger data is representative of ambient conditions (and thus assessable):
 - Submerged in area with adequate flow for duration of data recording period
 - Not buried in sediment, covered with debris, or exposed
 - Data with these characteristics, or otherwise not indicative of ambient conditions are not used for assessment





Continuous monitoring data management

Solution: Macro-enabled template spreadsheet with VBA scripts for importing time series, QA/QC, drift correction, calculating statistics for assessment data, formatting for database upload

Site: 50PecosR763.6	Pecos_R blw_Glorieta_Cr_20May2020_10498708_temp.csv	Parameter	Corrected Qualifier	Rejected Qualifier	Linear Drift Correction
LTD Type/# WTP/10498708	Dataset	Assessability	Temp. °C	SC µS/cm	Parameter: Temperature C
Lat/Long: 35.5258971, -105	Comments: Should Reflect Qualifiers (if used)	Average	SC µS/cm	DO %	Start Date+Time: 8/6/21 12:30
	Codes: Both=either FS or NS, Non=NS only, Neither=Not Assessable	Maximum	DO, mg/L	pH	Stop Date+Time: 8/17/21 13:15
	Note: Summary statistics do not include Rejected Data	Minimum	Turb, NTU	Qualifier	Interval: 0:15:00
	Rejected: Based on instrument verification beyond Maximum Allowable Limits, exposure/burial, or malfunction			Comments	Correction Amount: -0.74

DATE	DATE+TIME	Temp	SpCond	DO Sat	DO Conc	pH	Turbidity	Qualifier	Comments
5/20/2020	10:15:00	10.51							
5/20/2020	10:30:00	10.51							
5/20/2020	10:45:00	10.51							
5/20/2020	11:00:00	10.51							
5/20/2020	11:15:00	10.51							
5/20/2020	11:30:00	10.51							
5/20/2020	11:45:00	11.15							
5/20/2020	12:00:00	11.35							
5/20/2020	12:15:00	11.57							
5/20/2020	12:30:00	11.78							
5/20/2020	12:45:00	12							
5/20/2020	13:00:00	12.22							
5/20/2020	13:15:00	12.41							
5/20/2020	13:30:00	12.61							
5/20/2020	13:45:00	12.8							
5/20/2020	14:00:00	12.99							
5/20/2020	14:15:00	13.14							
5/20/2020	14:30:00	13.28							
5/20/2020	14:45:00	13.43							
5/20/2020	15:00:00	13.57							
5/20/2020	15:15:00	13.69							
5/20/2020	15:30:00	13.79							
5/20/2020	15:45:00	13.88							
5/20/2020	16:00:00	13.95							
5/20/2020	16:15:00	14							
5/20/2020	16:30:00	14.05							
5/20/2020	16:45:00	14.05							
5/20/2020	17:00:00	14.1							
5/20/2020	17:15:00	14.03							
5/20/2020	17:30:00	14.05							
5/20/2020	17:45:00	13.95							
5/20/2020	18:00:00	13.83							
5/20/2020	18:15:00	13.71							
5/20/2020	18:30:00	13.57							
5/20/2020	18:45:00	13.43							
5/20/2020	19:00:00	13.28							
5/20/2020	19:15:00	13.14							
5/20/2020	19:30:00	12.97							
5/20/2020	19:45:00	12.9							

Temp Stats Results (C°)	
4T3	
6T3	
MWAT	
Max 24hr ΔDO (mg/L)	
Result	
Turbidity Min (NTU)	
3 Day	
4 Day	
5 Day	
6 Day	
7 Day	
14 Day	
30 Day	

Summary statistics exclude rejected data

Import and format data

Tabs with charts for data visualization, calculations, QA tracking, and references

QC data, calculate parameter specific statistics, and create database upload file

MACROS

Import Thermograph | QC LTD Data

Import DOlog.csv File | Run 4T3/6T3/MWAT

Import Sonde File | Calculate Delta DO

Import Previous UL | Run Turbidity Results | Save/Create Upload

If you cannot find the saved file, check the My Documents folder on your PC



Data QA/QC

MACROS

- Import Thermograph
- QC LTD Data**
- Import Dolog.csv File
- Run 4T3/6T3/MWAT
- Import Sonde File
- Calculate Delta DO
- Import Previous UL
- Run Turbidity Results

Temp Stats Results (C°)	
4T3	23.28
6T3	22.44
MWAT	19.89

Microsoft Excel

Potential outlier(s) detected in temperature data. Review highlighted values and censor unrepresentative data.

OK

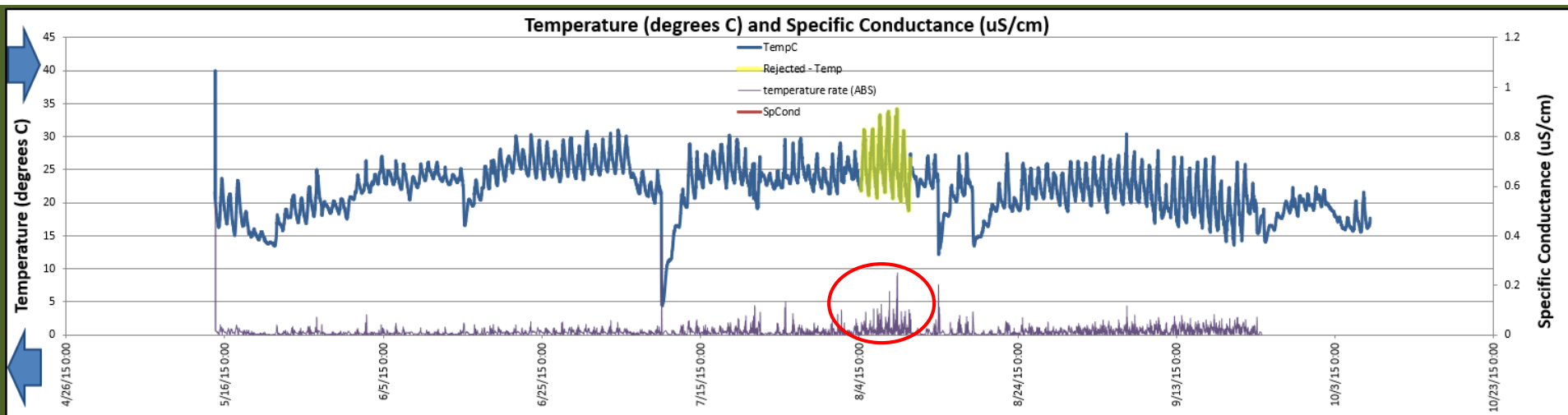
Average	21.95		
Maximum	40.00		
Minimum	4.43		
DATE	DATE+TIME	Temp	SpCond
5/14/2015	18:00:00	21.58	
5/14/2015	18:15:00	21.44	
5/14/2015	18:30:00	21.25	
5/14/2015	18:45:00	20.98	
5/14/2015	19:00:00	20.79	
5/14/2015	19:15:00	20.63	
5/14/2015	19:30:00	40	
5/14/2015	19:45:00	20.37	

- “QC LTD data” – creates graphs with QC features and scans for statistical outliers
- Outliers (temps >75th %tile of measured daily maximum temps +3x IQR)
 - Highlighted, manually reviewed/censored
 - Intended to:
 - reduce influence from autocorrelation of continuous data (independence)
 - demonstrate repeatability of an observation
 - consider potential anomalies in dataset due to extreme air temperatures deviating from seasonal norms/other anomalous events such as runoff from catastrophic fire areas, or instrument errors
- Data not representative of ambient conditions and non-assessable data are omitted from calculations to generate final assessment dataset



Data QA/QC (continued)

- “Charts” tab displays thermograph (top, blue) along with the absolute 1 hr. temperature difference (bottom, purple)
- Often, exposure indicated by >3 degree C change in temperature within an hour or less
- Data qualifier of “RT” (rejected temperature) added, graph displays rejected data in yellow, data not included in any assessment statistics





Data QA/QC (continued)

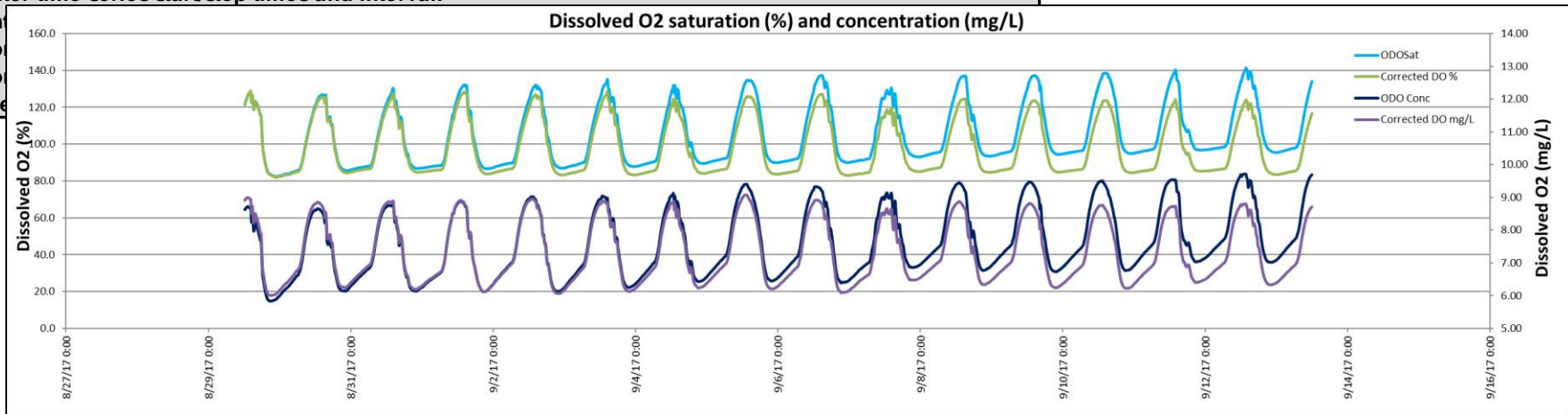
Drift Correction Tool

Linear Drift Correction		pH4 = 3.50	Turbidity Standard	Turbidity Reading
Parameter:	SpCond uS	pH7 = 7.00	0	0.44
Start Date+Time:	9/11/18 13:28	pH10 = 10.20	126	
Stop Date+Time:	9/25/18 11:28	mmHg: 650	1000	1230.2
Interval:	0:15:00	Count: 1337.00	Correct!	
Correction Amount:	10	Slope: 0.00748		

Drift Correction Instructions

1. Copy and paste data into the data fields to the left.
2. Select parameter from drop down list (Cell S2).
3. Enter time series start/stop times and interval.
4. Enter...
5. For...
6. For...
7. Pre...

Example drift corrected DO dataset





Data management and assessment

The screenshot shows the New Mexico Environment Department web application. The header includes the department logo and name. Below the header, there are navigation tabs for "Data Management", "Adhoc Report", "Administration", and "Projects". The "Data Management" tab is selected. The main content area is titled "Import Sampling Event Data" and features a link to "Upload CSV, XLS or XLSX File". Below this, there are input fields for "Project" (with the value "Not set") and "Filename" (with a "Choose File" button and the text "No file chosen"). An "Upload File" button is located at the bottom right of the form.

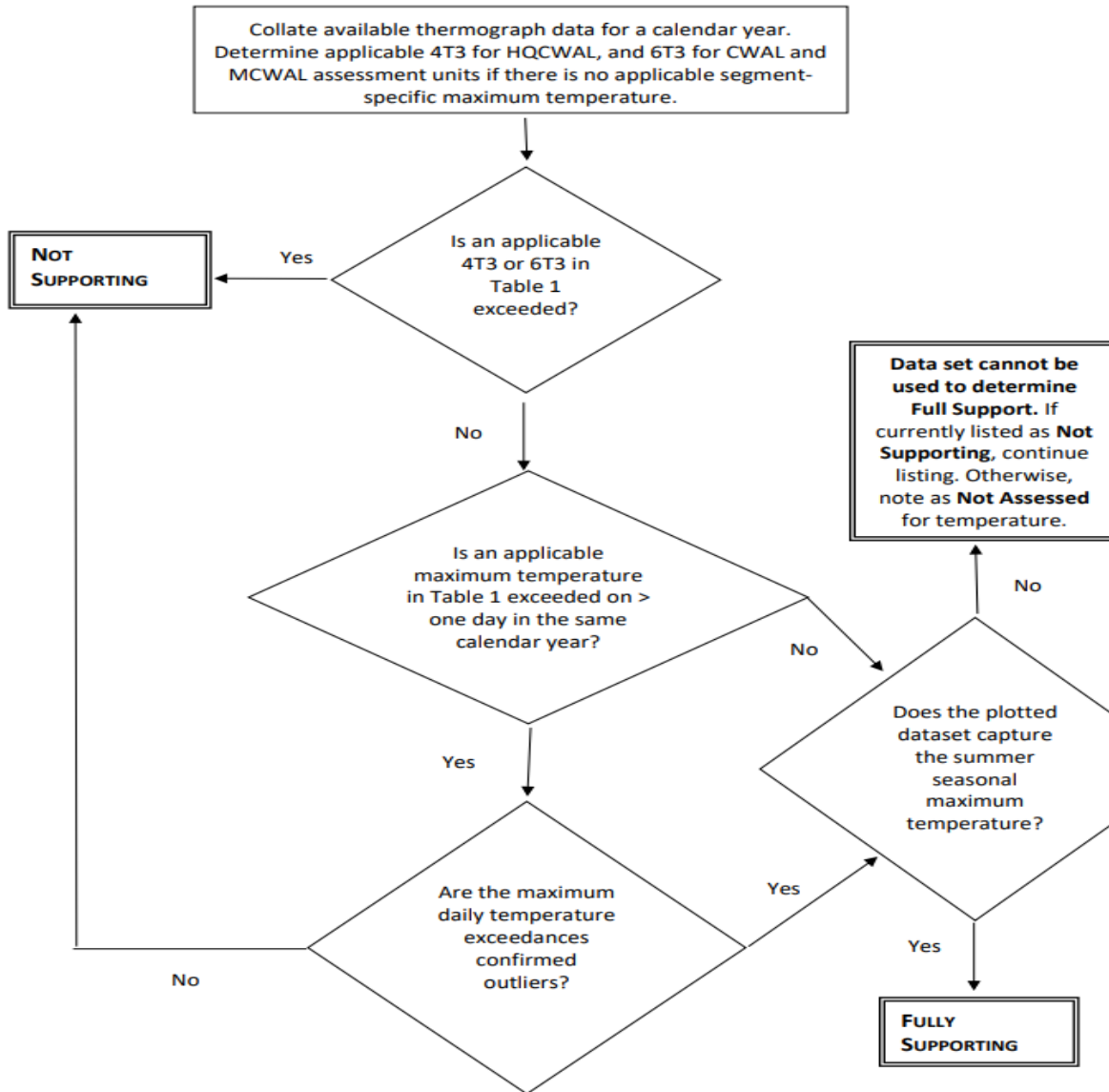
TEMP_WQC	Temp Max > Temp WQC?
23	Yes - check file
23	Yes - check file
25	Yes - check file
25	N
25	N
25	N
25	Yes - check file

- ❑ LTD template “save/create upload” macro creates upload file in .csv file format with QA/QC’ed dataset, summary statistics and information needed for assessment
- ❑ Archive raw and processed files on server
- ❑ Processed upload file uploaded into database
- ❑ Database can generate “LTD Assessment Report” spreadsheet

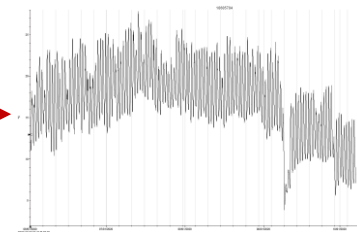
- ❑ Water Quality Standards criteria (WQC) updated in database each assessment cycle as needed
- ❑ Must check upload data file to confirm 4T3/6T3 exceedances and to determine if Tmax exceeded criteria on more than one day
- ❑ Future improvements: program spreadsheet functions into the database, skip the Excel step



Temperature assessment flow



Generalized flowchart for assessing thermograph data in rivers and streams (from CALM)





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