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# **SURFACE WATER ASSESSMENT TEAM**

## **Guidelines and Procedures for Continuous Temperature Monitoring** (December 2005 Version 3)



### **Continuous Temperature Monitoring**

- I. Information about Stowaway Tidbits  
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The data obtained from continuous temperature monitoring will be used to determine the thermal regime of select streams and small rivers on the state's impaired waters list and to gain a better understanding of background water quality in these waterbodies. Surface water assessment team and regional staff will perform temperature monitoring during the months of April through October (or November?). The procedures and equipment described in this document are not limited to Total Maximum Daily Load (TMDL) activities, but are guidelines that apply to temperature sampling methods conducted within the TMDL program.

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- Please refer to WI DNR's Guidelines and Standard Procedures for Continuous Temperature Monitoring for information regarding additional options for equipment, procedures, and methods of deployment.
- Additional information regarding Optic Shuttle and Optic Base Station operation can be found in the user manuals or at [www.onsetcomp.com](http://www.onsetcomp.com).
- Tidbits should be deployed in conjunction with Total Maximum Daily Load (TMDL) grab sampling and continuous dissolved oxygen monitoring if possible.
- Follow procedures in this document to produce valid, high quality data.
- Refer to WI DNR's Safety Guidelines and Procedures (in progress) before going into the field.

### About the Stowaway Tidbit

The Stowaway Tidbit is a small, battery-powered device that records temperature over time. It is equipped with a microprocessor, data storage, and sensor. The Tidbit uses turn-key software when connected to a computer to initiate data collection and view collected data.

- Waterproof up to 1000 feet.
- Has a 5-year (non-replaceable) battery life.
- Does not need to be calibrated, but should be checked for accuracy before deployment.
- Can be triggered to start with a coupler or magnet, and will not communicate with Optic Shuttle or Optic Base Station unless it detects the magnet in the coupler.
- Memory stops when full (holds 32,520 data points) or can wrap around and replace oldest data when full.
- Multiple sampling with minimum, maximum, or averaging.
- Blinking LED light confirms operation.

### About the Optic Shuttle

The Optic Shuttle is a device designed to readout and re-launch data loggers (i.e. Stowaway Tidbits). It can communicate with both the Tidbit and the Optic Base Station.

- Before using a new Optic Shuttle, offload it to a computer so the internal clock will be set to local time.
- The Optic Shuttle is waterproof up to 30 feet. If it is dropped in the water, it will be fine.
- Memory capacity is 128K. That is enough memory to hold four **full** Tidbits of data. The Optic Shuttle will hold no more data than necessary, so a partially filled Tidbit will take up less space than a full Tidbit.
- The Optic Shuttle battery should last for about six years before it will need replacement. The BoxCar software will warn you when the Optic Shuttle battery is low.
- Once the data has been fully transferred, the Optic Shuttle re-launches the Tidbit immediately. The Tidbit will retain the same settings designated during the initial setup. The delayed start and trigger options are disabled when the Optic Shuttle re-launches the Tidbit.
- A **full** Tidbit will take about 6 minutes to offload onto an Optic Shuttle. The Shuttle offloads only the data collected since the most recent deployment.
- The Tidbit and Optic Shuttle communicate via infrared light. Before offloading data, ensure the surfaces of both units are clean.
- If the Optic Shuttle is full, the LED's will blink red and green and stop the tidbit. The Shuttle will need to be offloaded and the Tidbit restarted.

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- The Optic Shuttle communicates to a host computer at a 9600-baud rate. Offloading data from a full Shuttle will take about 3 minutes.
- Data can be retrieved from a Shuttle multiple times. It will not erase old data until it has been read out to a computer and then used to download a Tidbit or other data logger.
- The remaining battery and memory capacity of the Optic Shuttle can be tested while in the field by pressing and releasing the pushbutton. The Shuttle should not be connected to a Tidbit or base station. The Tidbit will start blinking its orange LED. At this time, press and hold the pushbutton. The Shuttle will blink its green LED once for each 8K of unfilled memory capacity. If there is less than one 8K block of memory remaining then the Shuttle will blink the orange LED weakly, once. If the battery is low, it will blink the red LED once and will not indicate the amount of unfilled memory.

### **About the Optic Base Station**

The Optic Base Station is designed to communicate between the Optic Shuttle and a host computer or between a Stowaway Tidbit and a host computer.

- The Base Station communicates with a Tidbit or host computer using infrared light to transfer data, but does not store or record data.
- The Base Station is water resistant, but **not waterproof!** Therefore it should not get wet and should not be taken into the field unless it is to be used with a laptop computer ashore.

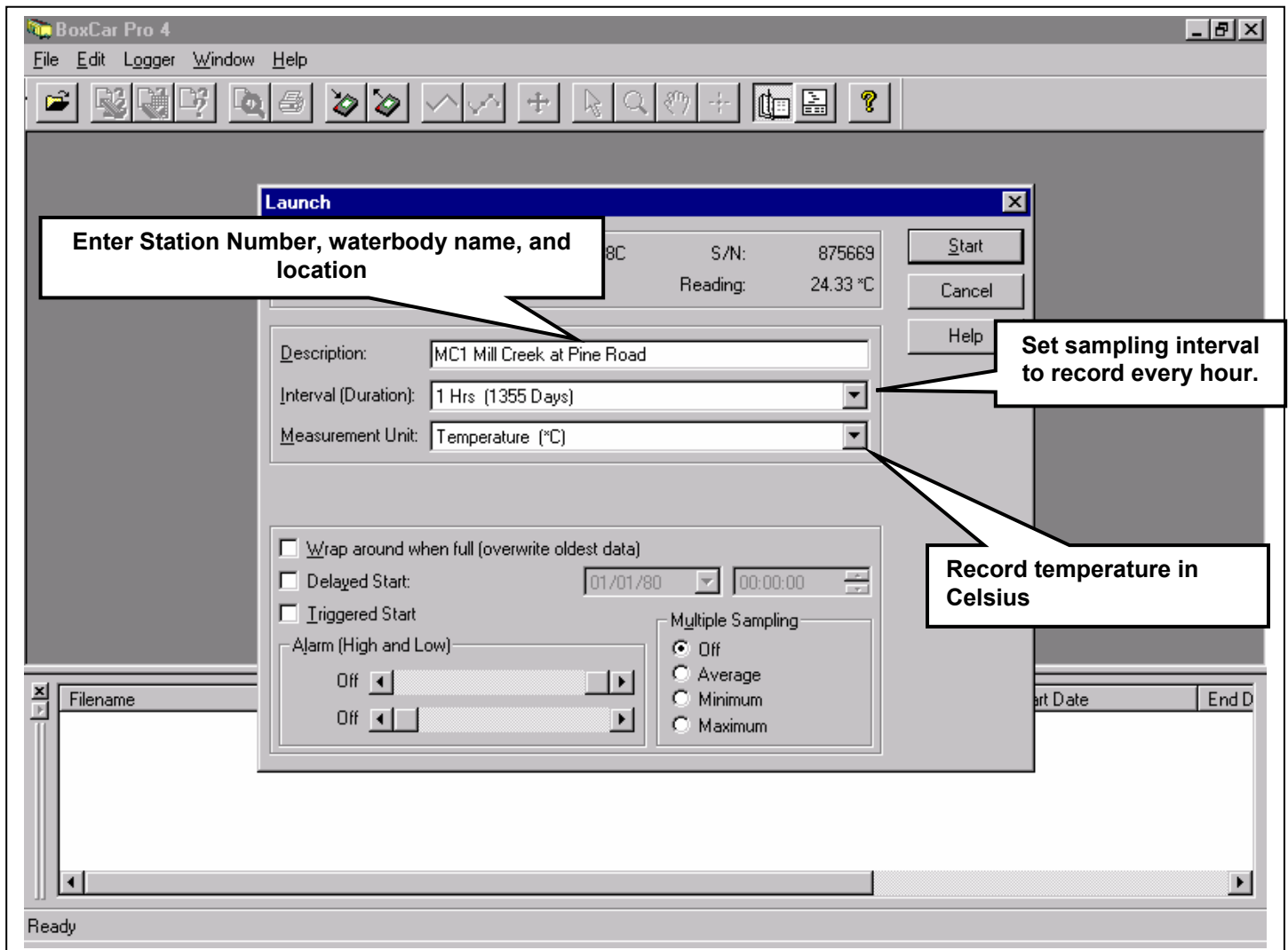
## Creating a Data File/Tidbit Set-Up

Data files can be created prior to going into the field by using the delayed start option or the triggered start option. If a laptop is available in the field, the data file can be created and started immediately.

**Equipment:** PC or Laptop, Optic Base Station, Tidbit Coupler, Stowaway Tidbit Logger, Connecting Cable, BoxCar Pro software

1. Connect the Tidbit to the base station using the Tidbit Coupler. Plug one end of the connecting cable into a PC or laptop and the other end into the Optic Base Station.
2. Open the BoxCar software, and select Logger from the toolbar. Select Launch or Ctrl+L.

The following screen will appear:



3. Change the description from "TEST" to include the sample station number, the waterbody name, and the Tidbit's location. (Road crossing, landowner name, etc).
4. Change the sampling interval so temperature will be recorded once per hour.
5. Set the temperature to be recorded in degrees Celsius.

6. If a laptop is available in the field, click “Start” and deploy the Tidbit immediately. If not, select the delayed start option, and set the date and time for the Tidbit to start logging. When using the triggered start option, the Tidbit will start recording when touched to a magnet or the Tidbit Coupler. A green blinking light will indicate the Tidbit has been activated.

## Tidbit Deployment

**Equipment:** Waders, 4 foot (or longer) section of re-bar, Mallet, Zip-Ties, Tidbit, GPS

1. Attempt to select a site where additional sampling will occur (i.e. grab sampling, fish or habitat surveys, continuous DO monitoring). Find an area that will be submerged, well mixed, and free of sedimentation during the period of deployment. A riffle or run is preferred to a pool. Seek shade so as to minimize any radiant heat from the sun. A deep run or riffle in the sun would also be acceptable.
2. Use a mallet or heavy hammer to pound a 4-ft or longer section of re-bar into the stream bottom. Once installed, ensure the re-bar is sturdy enough so it will not become dislodged during a runoff event. You may need to try installing the re-bar at a few different locations before finding one that will hold properly.
3. Do not leave too much of the re-bar above water. Keeping the re-bar low will help prevent large floating debris from dislodging it from the substrate. It is also important that the site selected is inconspicuous to avoid theft or vandalism.
4. Using a piece of zip-tie, thread the pointed end through the opening of the Tidbit and through the loop end of the zip tie, forming a circle.
5. Attach the looped zip-tie and Tidbit to the re-bar a few inches from the stream substrate.
6. Pull the zip tie tight to the re-bar, and trim off the excess “tail”.
7. Take a GPS reading of where the Tidbit is deployed to find it at a later date and to record location coordinates for the Surface Water Integrated Monitoring System database. It is also recommended to make note of the Tidbit/re-bar location (i.e. 10 paces north of the bridge on the right hand stream bank), and watershed conditions in a field notebook or on the field notes form.



A Hobotemp Stowaway Tidbit

## Winter Deployment

Continuous temperature monitoring can be performed during the winter months; however, care should be taken to prevent loss of equipment. The sampling site should be an area that will not freeze over. The Tidbit can withstand cold temperatures, but zip-ties become brittle and can break if frozen. In this situation, metal or wire fasteners could be used as an alternative to zip-ties. Also, the sampling site should be in an area that will not encounter large sheets of ice and rapid flow during snowmelt events, as fast-moving chunks of ice can dislodge re-bar from the substrate.

## Downloading Data in the Field

Before using a new Optic Shuttle in the field, it must be offloaded to a computer prior to use to set the Shuttle clock to local time.

**Equipment:** Optic Shuttle, Toothbrush or Soft Cloth, Tidbit Coupler, Scissors, Zip-Ties.

1. Find the re-bar. Remove any masses of aquatic plants that may have accumulated.

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2. Slide the Tidbit and zip-tie to the top of the re-bar.
3. Use the scissors or clippers to cut the zip-tie. (if the Tidbit was secured too tightly to move it toward the surface it can be clipped underwater, but be careful not to drop the Tidbit or the clippers)
4. Remove the cut zip-tie from the tidbit. Using a toothbrush or soft cloth, scrub away any dirt or film from the Tidbit surface.
5. Connect the Tidbit to the Optic Shuttle using the Tidbit Coupler.
6. Press and release the pushbutton on the Optic Shuttle to offload the data. The Shuttle will blink its orange LED as it is offloading. It will blink green next to "OK" when the offload is complete or red next to "Fail" if the offload failed.
7. If the offload is successful, remove the Tidbit from the Shuttle and coupler and press the pushbutton to stop the LED. If the offload fails, remove the Tidbit, press the pushbutton, and clean the Tidbit again. Repeat steps 5 and 6 as necessary. If the offload continues to fail, the Tidbit or Shuttle may be faulty and should be removed from the field.
8. Using a new piece of zip-tie, thread the pointed end through the opening of the Tidbit and through the loop end of the zip-tie, forming a circle.
9. Place the looped zip-tie with attached Tidbit over the re-bar a few inches from the stream substrate.
10. Pull the zip-tie tight to the re-bar, and trim off the excess.



The Optic Shuttle, Optic Coupler, and Tidbit Coupler.

## Transferring Data to a PC

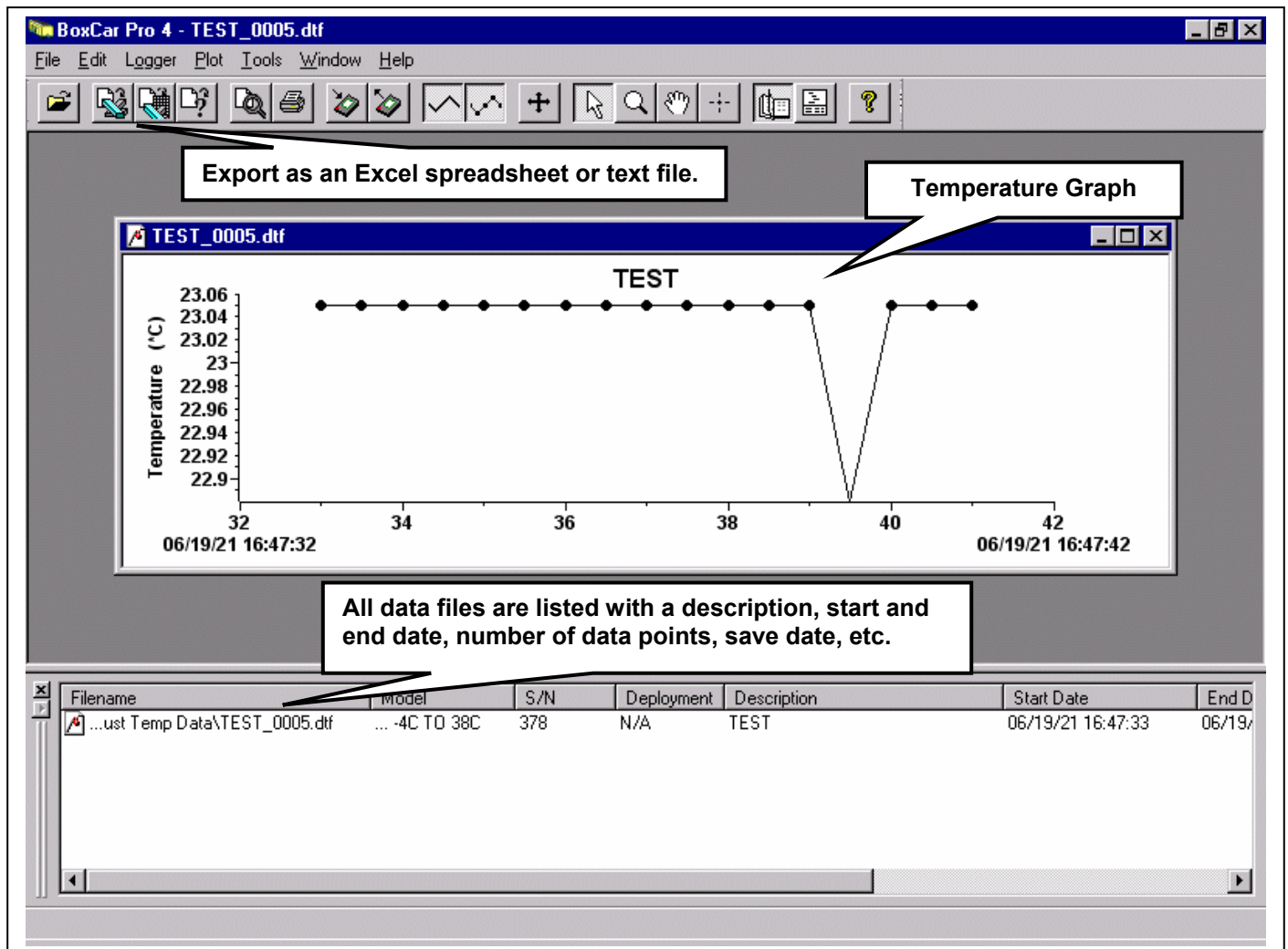
**Equipment:** PC or Laptop, Optic Base Station, Optic Coupler, Optic Shuttle, Connector Cable, Box Car Pro Software

1. Connect the Optic Base Station to the Optic Shuttle using the Optic Coupler.
2. Connect the Optic Base Station to the computer using the connector cable.
3. Start the BoxCar Pro software, and navigate to “Logger” then “Optic Shuttle Readout”.
4. Press the start button on the Optic Shuttle.
5. The Shuttle will offload all data files and display the download in progress.
6. The software will ask if you want to AutoSave files. This is recommended.
7. The software offers the feature of temperature data display in both degrees Fahrenheit and Celsius.
8. The software will automatically reset the Shuttle’s clock to local time.



The Optic Base Station

The following screen will appear:



9. The data files will originally be saved in .dtf format, but they can also be exported as an Excel spreadsheet or text file for easier manipulation. Be sure to save backup copies of the data to a location other than your PC's hard drive (CD, zip disk, flash drive, etc.).

### File Management and Data Computation

1. Data should be collected from Tidbits once per month to avoid data loss in the event the Tidbit becomes irretrievable.
2. Data should be uploaded to the SWIMS ([web address for SWIMS](#)) database within one week from field offloads.
3. Name the files with the station number and date of download.
4. Include metadata with each file. Include stream name, Waterbody Identification Code (WBIC), county code, location description, Township, Range, Section, Quarter, Quarter-Quarter (TRSQQQ), lat/long with datum, Tidbit serial number, date range, and the name of the person who collected data.
5. Compute daily: max, min, mean, max daily mean, median, range, and sample number.
6. Compute monthly: max, min, mean, median, range, and sample number.
7. Optional: Weekly max, min, and mean
  - Moving daily average
  - Warmest summer\* 7 day average
  - Coolest summer\* 7 day average
  - Frequency analysis by degree



### Questions?

Contact: Onset Computer Corporation (800) 564-4377  
Cindy Koperski, WI DNR (WCR) (608) 785-9984

The Box Car Pro Software

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\* The summer season consists of months June, July, and August. The winter season consists of months December, January, and February.