Protocols for Measuring Water Level & Streamflow

National Water Quality Monitoring Conference
Field Protocols Workshop

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Hydrology - outline

- Streamflow program in Massachusetts
- Measuring streamflow: an overview
- Measuring stage (water level)
  - Site selection
  - Equipment
  - Installation
  - Maintenance & documentation
  - Data retrieval and QA/QC
- Measuring discharge (streamflow)
  - Equipment
  - Techniques
  - Documentation & maintenance
State funded streamflow restoration program started in 2002
  • Initial focus on low-flow

Volunteers read staff gages, staff build rating curves
Transducers installed at most sites
QAPP, USGS technical guidance
Two staff
Major costs
  • Travel
  • Equipment
1. Measure stage at a fixed point
   • Staff gages
   • Pressure transducers
2. Relate stage measurements to discharge (streamflow).
Measuring water level

Staff gage (discrete data)

Pressure transducer (continuous data)
Staff gage allows check of pressure transducer data

Transducer data

Staff gage readings before transducer movement

Staff gage readings after transducer movement
Pressure transducers

Vented vs. non-vented transducers

Many different equipment options

Accuracy is a function of the operational range of the transducer

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Pressure Transducer</th>
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<tbody>
<tr>
<td>Durable</td>
<td>yes</td>
</tr>
<tr>
<td>Submersible/waterproof</td>
<td>yes</td>
</tr>
<tr>
<td>Programmable start time and date</td>
<td>yes</td>
</tr>
<tr>
<td>Minimum accuracy</td>
<td>≤0.015ft</td>
</tr>
<tr>
<td>Precision</td>
<td>±0.005%</td>
</tr>
<tr>
<td>Temperature range</td>
<td>-5 to 37°C</td>
</tr>
<tr>
<td>Stage range</td>
<td>Sufficient for the expected variation in stage at the site</td>
</tr>
<tr>
<td>Memory</td>
<td>Sufficient to last between site visits</td>
</tr>
<tr>
<td>Battery life</td>
<td>Sufficient to last between site visits</td>
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</tbody>
</table>
Vented pressure transducers

**Pros**
- Does not need to be removed from the stream to download
- Data are automatically corrected for barometric pressure

**Cons**
- Maintenance of the vented cable
  - Desiccant
  - Damage to cable
- Cable lengths are fixed
- Higher visibility than non-vented transducers
Non-vented pressure transducers

**Pros**
- Data loggers are internal
  - Less visible than vented transducers
- No vented cable or desiccant
  - Less maintenance

**Cons**
- Must deploy a second pressure transducer to collect barometric pressure
  - Data must be corrected post-download
- Transducer must be removed from the stream to download data
Site selection

- Pool with downstream control
- Underwater during low flows
- Avoid sites with excessive vegetation, unstable banks or streambed, beaver activity
- Nearby locations to measure discharge (low and high flows)
- Safe and accessible

If appropriate site conditions are not present where biologic sampling is taking place you can install anywhere upstream or downstream of the sampling as long as there is no water entering or leaving the stream
Staff gage installation

Fixed object
- May be more stable in high flow, high gradient & rocky streams
- Objects may include bridges, boulders, weirs

Streambed
- Best in high order streams with lower flow and limited debris
- Must be able to drive a pole/stake into streambed
Transducer Installation

Key considerations
• Should remain submerged when stream flowing
• Deeper pools may reduce ice impacts
• Calm pools yield less noisy data

Three methods
• Staff gage board
• Fixed object
• Streambed
Installing data logger for vented transducers & barometric transducer

Key considerations with data logger/transducer:
• Install in PVC housing for protection
• Should be above potential flood/snow line
• Should be relatively hidden to discourage vandalism
Basic Maintenance
  • Clean gage and transducer
  • Clear leaf litter and debris from control
  • Change batteries and desiccant (if necessary)

Gage readings
Elevation surveys
Elevation Surveys

- Important tool for detecting movement of transducers and staff gages
- Conduct surveys yearly after high spring flows/ice out or if movement is suspected
- Can use results to correct transducer data if movement is detected
Documentation

- Photos: gage, upstream, downstream (including control), & anything unusual at every site visit.
- Date, time, stage (from transducer and staff gage), battery status at every transducer download.
- Any changes to the calibration or location of the transducer.

Transducer Download Field Data Sheet

| Site: | Cold River at South County Road Florida, MA |
| Date: | 11/5/12 |
| Time: | 15:10 |
| Crew: | L. Parker, M. Chadock |
| Weather: | Overcast, light snow, calm |
| Gage (ft.): | 1.35 |
| Transducer (ft.): | 1.15 |
| Photos taken?: | Yes |
| Gage Survey?: | Yes |
| Batteries Changed?: | No |
| Notes: | Downloaded Transducer today. No apparent fouling or gage/transducer movement. |
| File name: | 2012.11.05 Cold River.csv |
• Frequent downloads minimize data loss
• Download approach varies based on transducer type
• QA/QC
Stage data on its own does not give quantitative information about the magnitude of streamflow.

Establishing a relationship between stage-discharge allows you to:

- Compare data from year to year
- Compare data from stream to stream
- Know the magnitude of streamflow – key attribute that may change with changing climate
Make discharge measurements over a wide range of flows
Plot stage vs. discharge and draw a curve through it – can estimate streamflow at a range of stages
Flow measurement

Equipment
• Flow meter
• Wading rod
• Measuring tape and stakes

Documentation
• Meter QA/QC
• Staff gage reading before and after measurement
• Notes on transect, control, gage pool, etc.
• Photos: gage, upstream, downstream (including control)
Flow measurement techniques

- Good cross-section
- At least twenty measurements, no more than 5% of flow should pass through a segment
- Paired measurements
Rating curve maintenance

Check rating curve:
• Annually (at an absolute minimum), preferably seasonally
  • Leaf buildup
  • Vegetation
  • Ice impacts
• After major storms
• After other channel-changing activities (bridge, culvert replacement)
Questions?

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