



Volunteer Water Quality Monitoring to Protect Your Streams



Yellow Dog River, Marquette County

1 December 2011

Session 1: Why monitor? Project
design; Pollution pathways;
Methods, Data, QAPP

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The Water Sentinels Program
was created by the Sierra Club
to:

Focus attention on the nation's polluted and
threatened waterways...

...create connections between empowered &
inspired volunteers and places that they love...

...and encourage and help them to protect their
treasured places.

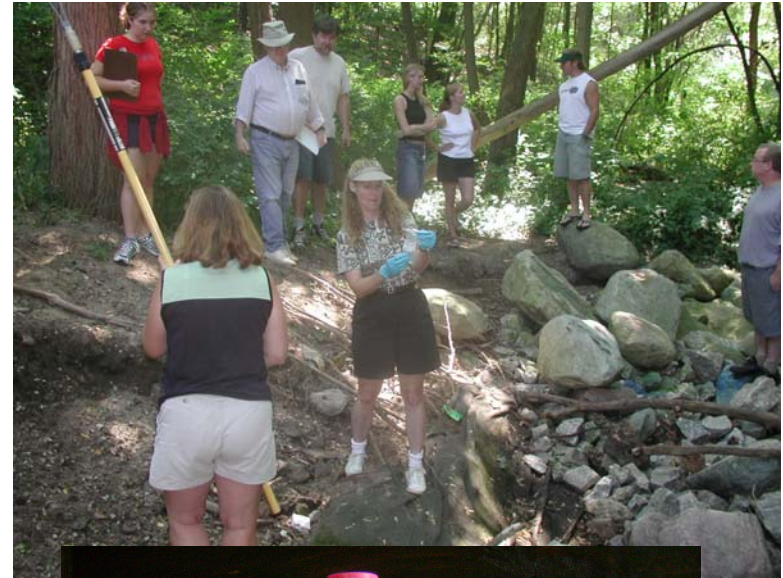
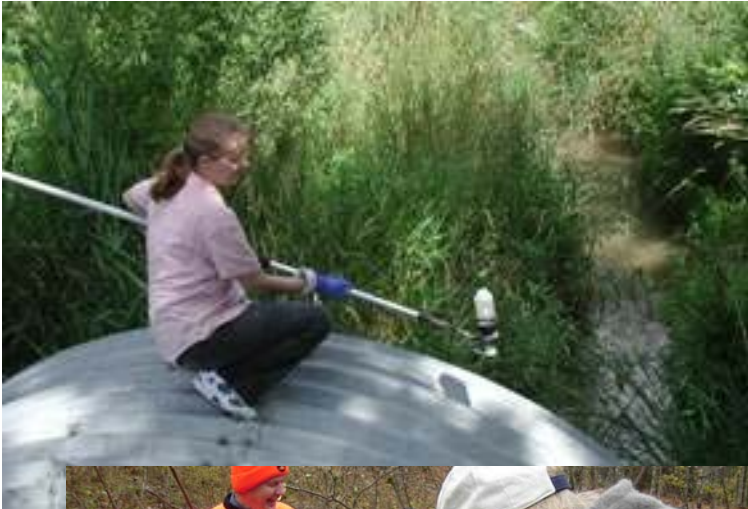


Sentinels are citizens who protect the public trust in our water.

Here, these 2 are getting a sample of this water discharge, to find out what it is and get it stopped.

And they did! It's one of the success stories, even though it all unfolded in a matter of days, from discovery to resolution.

The Water Sentinels' main work is to conduct water quality sampling, and use the info to protect our waters.



Why do people do this?

Why spend our valuable time doing this?

- Interest – the wonder of it all! This is really interesting stuff!
- Education – build a sense of stewardship in ourselves and others.
- Keep an eye on something – check for pollution.
- Establish current conditions – this is baseline monitoring.
- There are lots more reasons – what are they? (Plus we'll come back to this.)

- Ideally, our natural resource agencies would be watching the water for us. But in reality, they can't be everywhere at once.

- They certainly can't be there every day, so they probably don't KNOW a stream and its watershed the way that locals do.

- That's where we come in. We are the eyes and ears for our water, to observe and measure and keep track of what's going on. When we find something of concern, we get the data and get on the phone.

Watershed: working model of the hydrologic cycle

Water condenses from vapor and falls from the sky. It either runs off the land into surface water or infiltrates into the ground to flow with soil water that flows down to become groundwater. Both surface and groundwater carry along whatever is dissolved in it, either from the materials it flows through, or that it flows over.

Groundwater outlets to become “baseflow” in a stream, while surface water also adds to stream flow. If either of these are contaminated, so too will be the stream.

Surface water vaporizes to the atmosphere, and the cycle begins again.

What Is a Watershed?

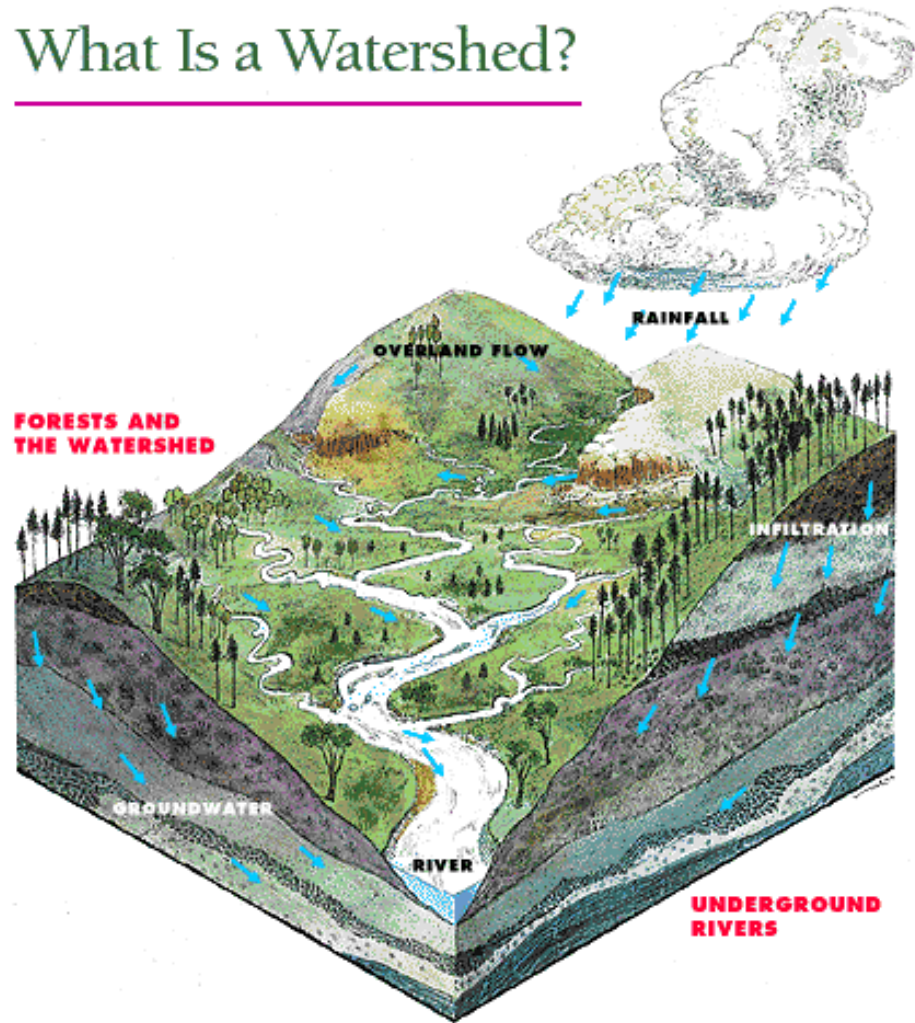


Image credit plus more really great information:

<http://www.co.berks.pa.us/conservation/cwp/view.asp?a=1360&q=447345>

The basics

Watersheds are 95% land. What happens on the land affects the water.

- **We learn of a stream that faces some threat, usually related to some major change in landuse – paving a parking lot, digging a really big hole (mine), new roads, truck traffic, fracking...**
- **We identify the threat and its characteristics, why it's a threat, what it may do to the water. Discussion.**
- **We figure out the best way to measure any associated changes to the water, or to the aquatic ecosystem. We figure out the “pathways” that pollution might follow to get to the water. Discussion.**
- **If the problem hasn't actually begun, we conduct “baseline” monitoring, so that we know where we're starting from.**
- **This is good for monitoring near proposed sulfide or uranium mining operations, or fracking sites, or CAFOs, or a new mall, or a new church, and actually just about any situation.**

Pollution pathways

- Consider the pollutants that may be released, or the changes that may occur – this means research on the Internet. Write it all down, take lots of notes. **Discussion.**
- Next, consider the pathways that the pollution may take to the surface water or to groundwater. Remember these are connected, so it could be both. **Discussion.**
- Next, get out your topographic maps! See where the water comes from and where it goes. Keep an open mind so you don't miss anything. See <http://www.terraser.com/> to see topos online for free. (Or google another source.) Either get paper copies, or print them out, and delineate your watershed to see exactly what is located where.

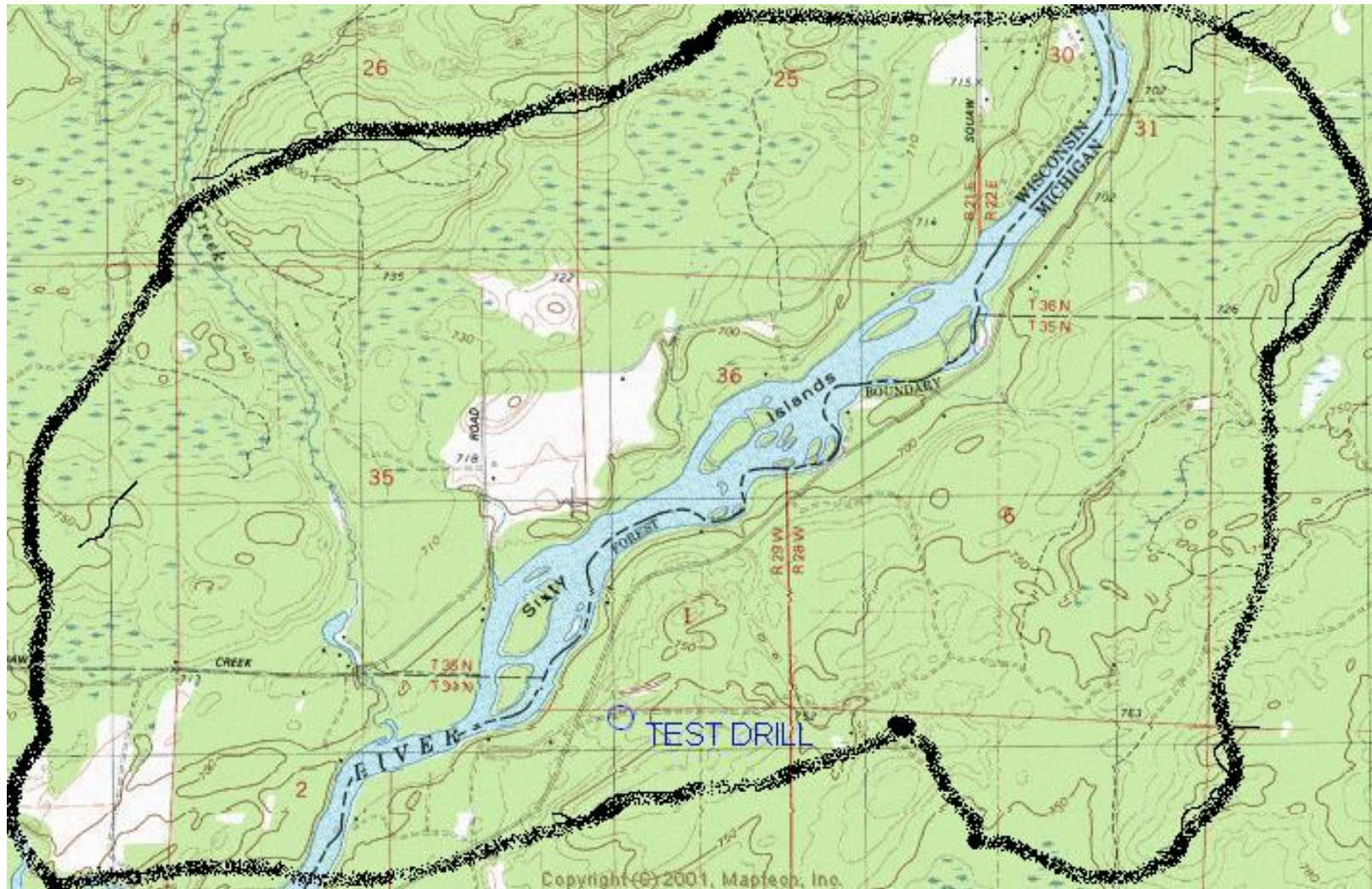
Exercise: Watershed Delineation

See your handout for this exercise!

- Use a topo map at the correct scale, so that you can see all the little feeder streams and drains. A USGS 7.5 minute quadrangle at 1:24,000 scale will give you what you want.
- Find all the high places on the map around the stream you're interested in, and then connect them by drawing pencil lines through them, right down the center of the landforms. (It's very possible that one 7.5 minute topo will not contain the whole watershed, it may overlap onto adjacent maps.)
- Once you can see the shape of the watershed, the pollution pathways will become more clear.



This is a not-very well drawn and incomplete example of watershed delineation. See the black lines? To do this correctly, the lines would all be connected. But this map isn't large enough to show everything. ¹⁰



So we'll pretend for our purposes that this is our watershed! This means that any precipitation that falls onto this land area will flow into the Menominee River. It may flow into the smaller feeder streams first, or into the wetlands, but eventually it will flow to the larger river, that will in turn flow to Lake Michigan. See the test drill site? It's inside the watershed.

What happens on the land affects the water: Discussion

Table 3. Common water quality impacts potentially associated with selected land uses

Source	Common Pollutants / Impacts
Cropland	Turbidity, total solids, nutrients, thermal impacts, pesticides
Grazing land	Fecal bacteria, turbidity, nutrients, thermal impacts
Forestry	Turbidity, total solids, thermal impacts
Mining	Alkalinity, pH, total dissolved solids
Industrial/commercial discharge	Turbidity, total solids, conductivity, pH, toxics
Sewage treatment plants	Dissolved oxygen/biochemical oxygen demand, turbidity, total solids, conductivity, nutrients, fecal bacteria, thermal impacts, pH
Construction	Turbidity, total solids, thermal impacts, dissolved oxygen/biochemical oxygen demand, toxics
Suburban/Urban runoff	Turbidity, nutrients, thermal impacts, conductivity, dissolved oxygen/biochemical oxygen demand, bacteria, metals, petroleum hydrocarbons
Lawns/golf courses	Nutrients, turbidity, total solids, bacteria, toxics
Septic systems	Fecal bacteria, nutrients, dissolved oxygen/biochemical oxygen demand, conductivity, thermal impacts
Marinas/boat usage	Nutrients, bacteria, toxics

Water Monitoring Methods to Consider:

Take a look at ***Designing Your Monitoring Strategy: Basic Questions and Resources to Help Guide You***, found here:

<http://www.usawaterquality.org/volunteer/pdf/GuideBook/DesigningYourStrategyIV.pdf>

There are lots of ways to monitor water, it depends on the information you want to collect.

- Water chemistry – kits or meters or lab samples
- Collect & I.D. & track aquatic bugs or benthic macroinvertebrates
- Habitat assessment
- Equipment – what you need, where to find it (websites), what it may cost, maybe you can build it
- The most appropriate monitoring methods for your project will be dependent on the water quality threat or situation, your funding available, experts, partners, training, time available, etc.

From Designing Your Strategy IV:

Table 1: Types of Environments

River / Stream	Land	Marine
Lake / Pond	Reservoir	Coral reef
Wetland	Beach	Air
Estuary	Groundwater / well	



various macroinvertebrate species could also be assessed, especially if the water quality were found adequate for trout survival and reproductive success.

Table 2: Potential Monitoring Parameters

Watershed Assessments

Land use survey	Construction site inspection
Photographic survey	Habitat assessment

Physical / chemical Parameters

Temperature	Dissolved oxygen
Alkalinity	pH
Salinity	Phosphorus
Nitrogen	Hardness
Flow/water level	Chloride
Turbidity	Metals
Secchi transparency	Pesticides
Rainfall	Hydrocarbons
Conductivity	Toxicity
Stream channel morphology	
Biological oxygen demand (BOD.)	
Total suspended or dissolved solids (TSS/TDS)	

Biological Parameters

Macroinvertebrates	Wildlife
Bacteria	Chlorophyll
Phytoplankton	Fish
Shellfish	Exotic/invasive species
Aquatic or terrestrial vegetation	

Collect, I.D., Count, Track aquatic bugs or benthic macroinvertebrates



Group above is using several bug-counting tools: dish pan as sorting pan, pipettes (bug sucker-uppers), bug i.d. sheets, storage jars & alcohol as preservative, magnifying lens.



The ever-popular white bucket, great for hauling bugs, equipment, or sludge.



Volunteer left using D-frame kick-net, and above I'm rinsing bugs out of it into sorting tray.

- D-frame kick net
- Dichotomous key
- Magnifying lenses
- Pipettes (bug sucker-uppers)
- Forceps (bug grabbers)
- White plastic spoons (bug trappers)
- White bucket
- White Dish pan/sorting tray
- Jars & lids & alcohol to store bugs
- Gloves
- Forms, pens, pencils
- Wrist watch, timepiece

Habitat Assessment

A habitat assessment involves measuring and observing the riparian habitat of the stream being monitored, and keeping track of changes from one year to the next. It's important no matter what type of water monitoring you do – because what happens on the land affects the quality of the stream. If this year's monitoring team doesn't document conditions then next year's team may miss something that's different.

Example: In Michigan we have Drain Commissioners who maintain our drainage ditches in order for fields to drain quickly and be suitable for agriculture or for development. One of the ways they “maintain” the drains is to remove all vegetation along a stretch (or the whole thing). But removing trees allows the sun to get in and warm the water, meaning it holds less oxygen for fish and for macroinvertebrates. There's usually more sediment as well, further warming the water. But if no one documented the change, we may not know why all of a sudden there's no bugs or fish.

More habitat assessment

You'll need:

- 100 ft measuring tape, to measure the length of the stream study area (Michigan protocols generally survey 300 feet), and to measure width of the stream
- Apple or orange, something to measure 10 feet, and a time piece, to measure water velocity



- Measuring stick, to measure water depth (hard to use the tape for this)
- Most of the rest is Observations – of the bottom or substrate materials, turbidity, stream bank erosion, highest water level, weather, trash, etc.
- A form to write it all down! <http://www.Micorps.net> has a very nice easy form to use, plus instructions for how to use it.
- A camera to record all observed conditions, ideally with date stamp.

See this *Volunteer Monitor* newsletter issue for information about Bacteria monitoring:

<http://www.epa.gov/owow/monitoring/volunteer/newsletter/volmon18no1.pdf>

Winter 2006 - Bacteria Monitoring (24 pp, 418K)
Methods Comparison Study - Oregon Validation Study - Guide to Bacteria Testing Methods - Kids Conduct "Poop Study" - Microbial Source Tracking - MST Methods - Low-Tech Source Tracking - Monitoring Runoff from CAFOs - Simple Approaches - Texas Volunteers Earn Respect

Here's the Fall 2009 20th Anniversary Issue!

<http://www.epa.gov/owow/monitoring/volunteer/newsletter/Volmon20no2.pdf> (16 pp, 1.3MB)

Celebrating Volunteers & Innovation

Amazing Volunteers – Homemade Water samplers – Extendable rod – DO bottle manipulator – bucket sampler – syringe pump – PVC integrated sampler – Hose sampler – Macroinvertebrate equipment – Kick net supports – net spoon – Sieve bucket – Bug rack – International lessons – cooperative extension project

How to find pre-existing data

And why would you want to?

Say you got there too late to do baseline monitoring, that the mining, oil drilling, mall building, paving, is already happening.

Sure would be nice to have other data to compare to, for example, if you can't do your own baseline study.

Freedom of Information Act

- FOIA – just about all agency information about our environment is public information, and you have the right to see it.
- This means you can look for and ask for information at natural resource agencies – though be warned, you may have to pay for copies. <http://www.rcfp.org/fogg/index.php?>
- Each agency has their own procedure, all variations on a theme. Check their websites for instructions, oh -- and be real polite! You get way more with honey than with onions. The best approach is to write an email for permission, asking to come and read through their files, and tagging only the ones you really want copies of.
- Consider the USEPA, (including STORET not just the website), USFWS, Forest Service, state natural resource agencies, the Extension offices, etc. (though universities are likely not subject to FOIA.)

More on existing data & information

- Google it! You can Google questions, did you know that?
- Check out watershed councils' webpages
- Non-profits that may have projects (like Sierra Club Water Sentinels) 😊
- Some non-profits put out a lot of reports!
- Land conservancies, nature centers
- Universities, colleges
- Local high school biology classes (let me know if you want Pinnebog River data)

QAPPs -- Quality Assurance Project Plans are Critical!

Why are they important?

- Because your credibility is at stake. You want to be just as credible as the mining company's environmental consulting firm.
- Because you want to be correct so you can trust your own assumptions as you conduct monitoring over time. If you do things the same way every time, you can trust your results.
- Being repeatable is what makes it science! **Discussion!**
- QAPP resources: <http://www.micorps.net/resourcesqa.html>
- <http://MiCorps.net> - has a Michigan online database to use, only if you have an approved QAPP
- There's also EPA's STORET database – available to use if you have an approved QAPP, for all states.



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Next time: Recruiting; Funding; Outreach;
Media; Data: Photo Documentation: and
Writing a PLAN!

Thank you!

If you want to help monitor water in Michigan,
please contact Rita Chapman at the Sierra Club
Michigan Chapter office at 517-484-2372
109 E. Grand River Avenue
Lansing, Michigan 48906

<http://www.michigan.sierraclub.org>

<http://www.sierraclub.org/watersentinels>

or send email to:

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