Volunteer Monitoring Manual

Iowa Department of Natural Resources
Water Quality Bureau
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Des Moines, IA 50319

Website:
http://www.iowadnr.gov/Environmental-Protection/Water-Quality/Water-Monitoring/Volunteer-Water-Monitoring

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History

Volunteers have been monitoring water quality in Iowa for many years. With IOWATER, these efforts were unified as a coordinated, statewide approach. The program started in May of 1998, and citizen monitors helped contribute valuable data and reinforce the concept of public ownership of our environment. IOWATER supported this network of volunteers with on-site training workshops, standardized levels of testing, an online database to warehouse collected data, testing equipment, and tools for local advocacy on local water quality issues. Budget and staffing constraints have now limited the ability of the DNR to continue to implement the IOWATER program as it had been established, and an evaluation was undertaken to determine the most sustainable route to support volunteer monitoring into the future.

An evaluation of the previous IOWATER program revealed several themes:

- The team building and community aspects of IOWATER were some of the most useful takeaways and positives reported by participants.
- Regular, sustained participation and activity relied on team efforts and the teams valuing the data they generated.
- Water monitoring volunteers were much more likely to follow up and engage in other watershed-scale project activity such as planning or advocacy.

Each group had the flexibility to design its own program within the group's selected watershed. The DNR is now furthering that commitment to flexibility by changing the IOWATER program to the locally-led volunteer water monitoring program. Volunteer water monitoring is best able to inform local water quality goals if the decision-making and coordination is locally-led. With the help of the DNR to get started, interested communities, watersheds, counties, and regions have an opportunity to take ownership and derive more value from their locally-led volunteer water monitoring programs.

Water quality is one of our state’s top environmental concerns. In today's era of smaller, friendlier, and more efficient government programs, the role of volunteer citizen monitoring continues to evolve out of increased ability, respect, and need. Assisting those who are concerned about their natural resources will enable them to become involved in the protection and improvement of our environment.

Equal Opportunity

Federal Regulations prohibit discrimination on the basis of race, color, national origin, or handicap. If you believe that you have been discriminated against in any program, activity, or facility as described above, or if you desire further information, please write to: Director, Iowa Department of Natural Resources, Wallace State Office Building, 502 E. 9th St., Des Moines, Iowa 50319.

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CHAPTER 1

Water Quality in Iowa

The Water Cycle

One of the unique things about water on Earth is that it exists in all three phases: solid (ice), liquid, and gas (water vapor). Water continuously moves from place to place on Earth in something called the "water cycle" (see the figure below). As water moves from location to location, it may also change from liquid to solid or gas as it moves through the cycle, and the residence time (or length of time water stays in one of these forms) varies considerably from a few days in the vapor phase to potentially thousands of years in the solid phase.

The water cycle is driven by the energy from the sun, which heats the water and results in evaporation from the surface of the Earth. The major components of the water cycle are explained below:

Components of the Water Cycle

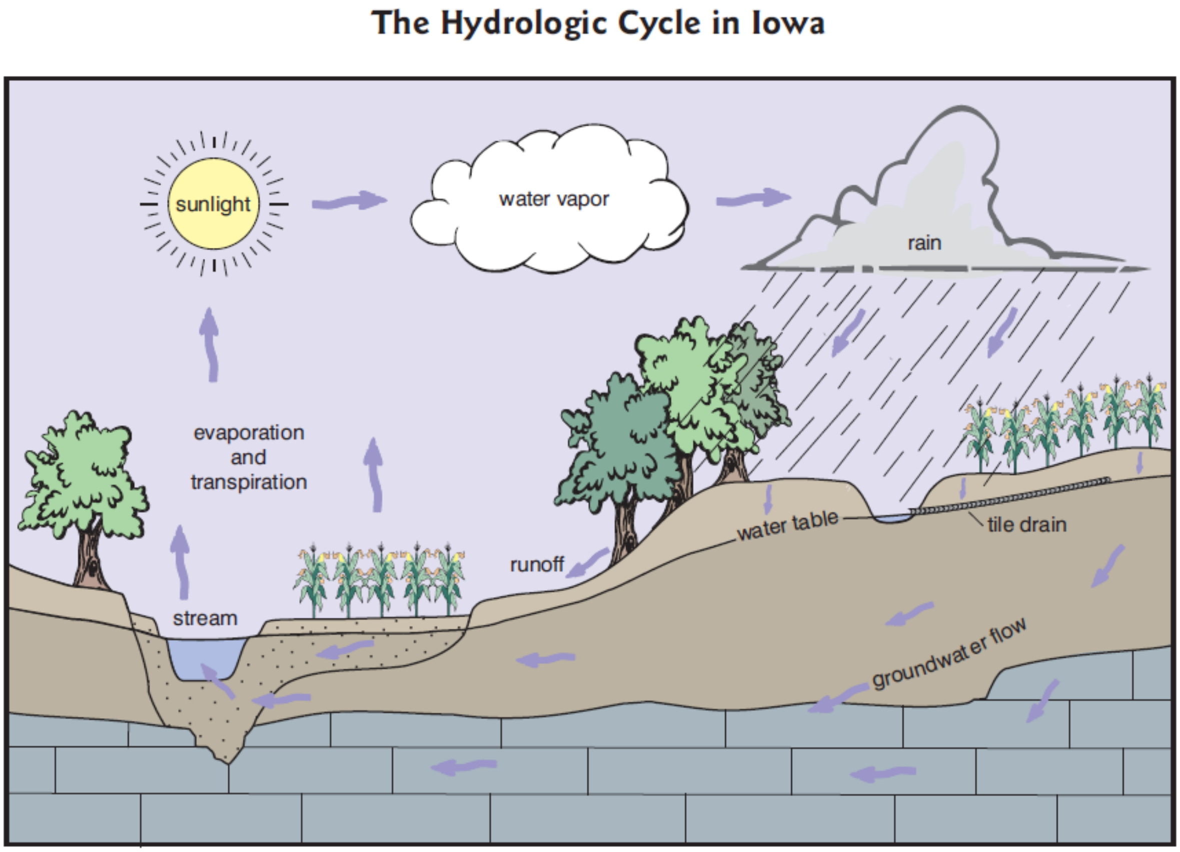
- Precipitation: Water that falls to the surface of the Earth. Can be in the form of rain, snow, hail, or sleet.
- Runoff: Water moving from the land surface to streams, lakes, or oceans.
- Infiltration: Water moving into the ground.
- Subsurface Flow: Water moving through the land to streams, springs, lakes, oceans
- Interception: Precipitation that is caught or "intercepted" on the surface of plants.
- Evapotranspiration: Water that evaporates and transpires from plants.

Average reservoir residence times	
Reservoir	Average residence time
Antarctica	20,000 years
Oceans	3,200 years
Glaciers	20 to 100 years
Seasonal snow cover	2 to 6 months
Soil moisture	1 to 2 months
Groundwater: shallow	100 to 200 years
Groundwater: deep	10,000 years
Lakes	50 to 100 years
Rivers	2 to 6 months
Atmosphere	9 days
Reference: PhysicalGeography.net	

Mechanisms of the Water Cycle

Precipitation falls from the sky as rain and snow and is either intercepted by plants (or other objects) or falls to the ground. Once on the ground, the water can infiltrate into the ground, become part of the snow pack in a glacier, or run off the surface to streams, lakes, or oceans. Water stored in glaciers can remain in solid form for thousands of years before the ice and snow melts resulting in runoff to streams, lakes, or oceans or infiltration to the underlying groundwater. Plants can pull water from the ground and release this water as vapor through evapotranspiration. Rising air currents take the water vapor up into the atmosphere where cooler temperatures cause it to condense into clouds. Air currents move water vapor around the globe eventually forming new clouds and resulting in precipitation again.

There are many human activities that can alter the water cycle including construction of dams, removal of groundwater for various purposes (industry, agriculture, and drinking water), removal of forests, urbanization, or other activities that remove or add water to the landscape. Since water quality is closely tied to the water cycle, it is important to understand how changes to the water cycle can have lasting water quality impacts.



The Hydrologic Cycle (Iowa's Groundwater Basics: https://www.iowadnr.gov/Portals/idnr/uploads/consites/groundwater_basics.pdf)

Iowa's Rivers & Streams

Iowa receives an average of 32 inches of precipitation in a typical year, providing ample surface water to nearly 72,000 miles of streams; 125,000 acres of **lakes**, reservoirs, and **ponds**; and 50,500 acres of marshes. During the most recent assessment of water quality in Iowa (2014), 571 of Iowa's waterways were considered impaired (partially supporting or not supporting designated uses; see full description of impairments on the Iowa DNR webpage at http://www.iowadnr.gov/Environmental-Protection/Water-Quality/Water-Monitoring/Impaired-Waters). Below the surface, Iowa's **groundwater** is abundant and of relatively high quality.

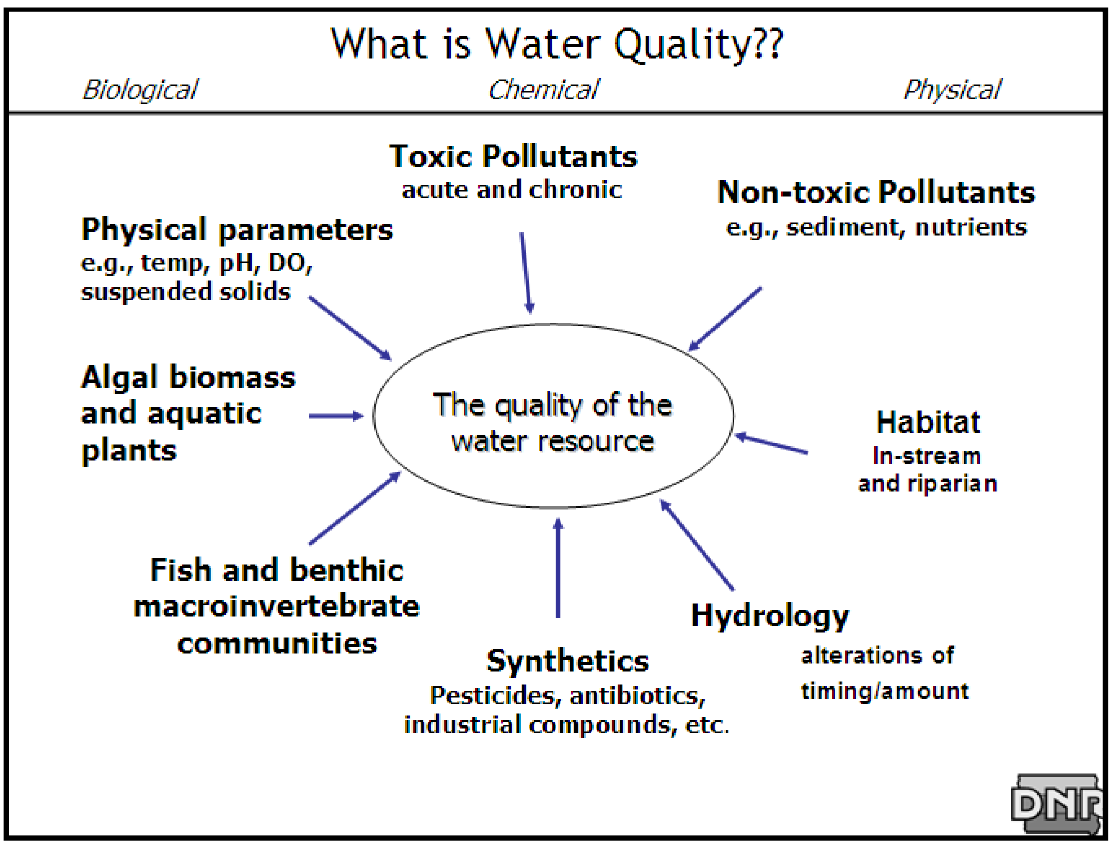
Of the estimated 71,665 stream miles, 26,630 are considered **perennial** (water present all year, often with **baseflow**), 42,957 miles are considered **intermittent** or **ephemeral** streams (water present most of the year or seasonally), and 1,418 miles are classified as drainage ditches. In addition, 660 river miles form the eastern and western borders of Iowa, a distinction that has spawned Iowa's nickname, "Land Between Two Rivers."

Iowa is very fortunate to have an abundance of water resources. Our surface waters provide many beneficial uses including drinking water, recreation, fish **habitat**, industrial processing, livestock watering, crop irrigation, and use by our many species of wildlife. Clean water ensures that human and ecological health are protected, and the need for costly water treatment is minimized.

Water Quality Monitoring

What is Water Quality?

When the DNR refers to water quality, we are referring to the collective biological, chemical, and physical health of water (see diagram below). Water quality is more than the amount of pollutant or chemical in streams, rivers, or lakes. Water quality encompasses the life forms that live in the water (fish, invertebrates, plants) and the way the water moves off the landscape. To understand the overall health of a waterbody, it is important to examine all of these factors, rather than just one or two. The volunteer monitoring program provides training in how to collect samples and analyze the water for many of these basic characteristics. For those characteristics that are beyond those basic characteristics, we provide links to resources and ideas for volunteers on how they may be able to collect this information using local, state, or federal agencies or nongovernmental partners.



Why Monitor Water Quality

Monitoring water quality is the only way that we know what the status of our water is and how this has changed through time (trends in water quality). While simply looking at the water can sometimes be helpful in determining if the stream is muddy or not, it rarely tells us all that we need to know about what is happening within the water body. Many chemicals do not cause visual changes to the water, but can only be detected with tests designed to measure them.

How to Monitor Water Quality

The first step in monitoring water quality is literally the first “step” – into the stream to collect the water for testing. The DNR generally recommends that water be collected from within the stream flow – where the water is well-mixed – rather from the side of the stream. Collecting water from the “middle” of the stream is the best representation of the overall quality of the stream as backwaters or areas close to the bank may be more stagnant or subject to impacts from the banks (soil falling down the bank). To prevent the water quality monitor from stirring up the bottom sediments or dirt, move slowly into the stream. Once in the stream (being careful to avoid dangerous high water conditions), face upstream or in the direction where the flow of the stream is coming toward you. Facing upstream ensures that your water sampling will not be affected by sediment that you may have stirred up while entering the stream. With most of the testing kits, you can “dip” your test strip or vial directly into the stream for testing. Again, always do this facing upstream and for the length of time specified on the bottle.

The volunteer monitoring program uses field tests or water quality testing procedures that can be completed at the stream in order to determine the chemical quality of the water. Most of these kits are colorimetric – in other words, they cause a color change on a test strip or in a vial that can be compared against a known or standard value. The precision of a colorimetric field test is generally not as high as the precision of a laboratory test, but it is still a good indicator of the general level of the chemical found in the stream. New technologies are being developed to read colorimetric field tests even more accurately with smart phone cameras and apps. Research is ongoing to determine their usability for Iowa’s volunteer monitoring procedures.

Understanding Test Results

Measurement of a chemical in water is generally expressed as the weight or mass of the chemical per volume of water. This is called the “concentration” of the chemical in a water quality sample. For example, when we measure dissolved oxygen in a stream we determine what mass of oxygen (milligrams or mg) is in a standard volume of water (1 liter or L). For a one liter sample of water containing 10 milligrams of dissolved oxygen, this would be expressed as 10 mg/L. Sometimes the concentration values are expressed as parts per thousand, parts per million, or parts per billion which is the mass ratio of the chemical to the mass of the water (this is only true at relatively low concentrations – below 7,000 mg/L). The table below shows the comparison of standard concentration values expressed in “parts per” language. In the case of some chemicals, the volunteer monitoring program does not have a field kit available for use. In these situations, groups can submit samples to a laboratory to run the tests on specialized machines. These tests tend to be more expensive than a field kit test and therefore are only advisable when a field test is not available or when more accurate results are needed than can be provided by a field test.

Testing for chemicals in Iowa's water requires the ability to detect very small amounts of chemical in the water; however, even though the amount of chemical might be very tiny (parts per billion), these amounts can also be significant to the aquatic life that inhabit the stream. In addition, what is a significant concentration of one chemical may not be significant for another chemical. For example, negative human health effects occur with concentrations of some pesticides in the parts per billion (ug/L) range, while the human health consequences of nitrate are in the parts per million (mg/L) range.

Concentration Units			
abbreviation	definition	mass ratio description	mass ratio
mg/L	milligrams per liter	parts per million	1:1,000,000
ug/L	micrograms per liter	parts per billion	1:1,000,000,000
ng/L	nanograms per liter	parts per trillion	1:1,000,000,000,000

Training Volunteers

The locally-led volunteer monitoring program will train local leaders or coordinators to then train other volunteers as they develop their programs. With the help of this manual and associated training presentation, this "train the trainers" format allows for more flexible training scheduling for local groups and a more rapid build-up of volunteers to accomplish local monitoring. Additional training for coordinators or individual volunteers interested in more rigorous testing, different monitoring parameters than the core course, or additional methods are available through other programs provided by the DNR, Iowa regents universities, and some non-profits. These programs include Stream and Watershed Integrated Management (SWIM), Master River Steward Program, and Iowa Learning Farms/Water Rocks! programs.

Pollution Sources in Iowa

Iowa's water quality today is different than it was a few decades ago. As recently as the early 1970s, Iowa's rivers were running red with wastes from slaughtering plants, communities were sending untreated sewage downstream, and high **nitrate** levels were plaguing many drinking water sources. With the passage of the landmark Clean Water Act of 1972, improved water treatment helped eliminate some of the most blatant **pollution** sources.

Much of the focus of the Clean Water Act to date has been on **point source pollution**. These pollution sources originate at a "point," such as a factory's wastewater pipe or a community's sewage treatment facility. These sources are monitored through a permit system by the Iowa DNR's Environmental Services Division. These **discharge permits** set the maximum amount of a pollutant that an entity is permitted to release into a water body, and are based on certain limits, or standards, as determined by the U.S. Environmental Protection Agency (EPA) and adopted by Iowa. While addressing point sources of pollution has helped to improve water quality, new challenges have emerged.

The most significant threat to Iowa's surface water today is **nonpoint source pollution**. This pollution does not come from a single point; rather, it comes from an entire watershed. **Runoff** from crop fields can add **sediment**, **nutrients**, and **pesticides** to Iowa's surface waters. Manure and improper septic systems can contribute ammonia, bacteria, and oxygen-demanding **organic matter**. Runoff from construction sites, lawns, parking lots, and streets can contribute a wide range of pollutants, including bacteria, heavy metals, nutrients, organic matter, pesticides, and **silt**. Sewage bypasses and overflows from combined **sanitary** and **storm water sewers** plague some communities that have outdated sewer lines or wastewater treatment plants.

Sediment

In Iowa, one of the biggest water quality concerns is soil **erosion**. Soil erosion carries fine particles of dirt, called sediment, to our streams during **runoff events** (heavy rains or spring snow melts). Sediment is also carried into our streams from eroding **stream banks**. The rate of stream bank erosion has increased in many streams as a result of **channelization.** These waterways have been straightened, and plants that anchor the banks have been removed in an attempt to drain areas as quickly as possible. This increases the speed of the water, and with minimal plant cover to retain the stream bank soil, the **streambed** erodes even more. A stream that is eroding more sediment than it is depositing is called a **degrading stream**.

Sediment can be carried by water until it settles to the bottom of a stream or lake **(sedimentation)**. A stream that is depositing more sediment then it is eroding is called an **aggrading stream**. A small amount of sedimentation is a natural process; it has always happened and always will. However, too much sediment is harmful to our lakes and streams. As it settles out of the water column, it covers up stream and lake bottoms, and thus harms the **aquatic communities** that live there. Many animals cannot feed and reproduce successfully because sediment clogs gills, smothers eggs, and destroys food supplies and habitat. Soil suspended in the water reduces light penetration, thereby slowing or preventing the growth of aquatic plants and reducing **photosynthesis**. This means less food and oxygen is available for aquatic wildlife. Additionally, sometimes harmful or unsightly algae species can take advantage of this reduced competition from rooted aquatic plants and become the dominant plant type, which is undesirable for many waterbodies.

Another way that sediment pollution can harm streams is by changing the types of habitat available. Sediment builds up in the bottom of streams and changes the shape of the streambed by filling in **riffle**, **run**, and **pool** areas. Habitat is lost as sediment fills in the spaces between rocks and other streambed substrates, thus increasing substrate **embeddedness**. As these streams get shallower, they tend to widen, warm, and slow down. This results in reduced **dissolved oxygen** levels in streams (warm water holds less oxygen than cool water) and increased stream bank erosion.

Nutrients

Nutrients, such as **nitrogen** and **phosphorus**, are essential to plant growth. On agricultural fields, they are necessary elements for crop production. In our waters, they contribute to overproduction of **algae**, which can give the water a greenish hue and sometimes a foul odor. A single pound of **phosphorus** in many waterbodies can produce as much as 500 pounds of **algae**!

Nutrient enrichment can start a serious chain of events during which the algal population explode (called an **algal bloom**). As they later die, the bacteria that decompose them deplete the water of oxygen, causing a condition called **hypoxia** (low oxygen). This can cause severe problems, even death, for fish and other aquatic animals. Hypoxia, to some extent, occurs within many of our lakes and streams every year, and occurs on a larger scale at the mouth of the Mississippi River in the Gulf of Mexico. We are all truly connected, from the rural Iowa farmer to the Louisiana shrimp boat captain.

Through sound watershed land use practices, runoff of sediment, nutrients and other nonpoint pollutants can be reduced. These practices include best management practices on agricultural fields, such as the construction of conservation buffers next to our streams. Best management practices also have applications in urban areas. Water runs off lawns, golf courses, streets, and parking lots; many people incorrectly believe that this runoff water is transported to a sewage treatment plant to be treated before entering a stream. Contrary to common belief, however, most of this runoff empties directly into streams, without undergoing any water treatment whatsoever. Overuse of fertilizers, dumping of contaminants, and even excess grass clippings in storm water runoff can contribute to water quality problems.

Current Monitoring Activities

Professional Sites

Around the state, the DNR monitors approximately 72 stream and river locations on a monthly basis, and 130 lake locations each summer. These sites comprise the "ambient" water monitoring network for the state of Iowa. These ambient sites tell us the condition of Iowa's water by selecting monitoring sites that are not targeted at problems, but rather provide the general water quality picture for the state. The mission of the ambient monitoring program, then, is to conduct an on-going assessment of the condition of Iowa's surface and groundwaters and to report this back to the citizens of Iowa and decision makers so that appropriate information is available to guide policy and resource managers. To meet the mission of the ambient water monitoring program, the following goals were established:

1. Define the condition of Iowa's water resources
2. Measure changes and identify trends in water quality
3. Provide information for designing abatement, control, and management programs.
4. Characterize existing and emerging issues by type, magnitude, and geographic extent.
5. Provide information to evaluate the effectiveness of natural resource management programs.
6. Report information in useful formats to inform the citizens of Iowa about the quality of their water resources
7. Involve citizens in monitoring to increase their appreciation and understanding of Iowa's natural water resources

The DNR's ambient monitoring program focuses on the chemical, physical and biological quality of streams. The 72 stream sites are monitored monthly for basic physical properties (dissolved oxygen, temperature, stream flow, and pH) along with nutrients (nitrogen and phosphorus) and basic chemical constituents such as chloride, sulfate, silica, total suspended solids, total dissolved solids, and others.

Volunteer Monitoring

With more than 72,000 miles of stream in Iowa, 130+ lakes, and an estimated 110,000 ponds, it is quite a task to monitor and assess all of the waters of the state. Locally-led volunteer monitoring teams can provide additional monitoring coverage and generate data on stream and pond sites that would rarely, if ever, have professional monitoring on them. Getting volunteers connected with their local waters and increasing their awareness of water quality issues in the state remains the primary goal of the volunteer water monitoring program, and the data generated is best used to advise local projects and policy. Since water quality does not remain the same from month to month or year to year, the ongoing monitoring of these volunteers can help to fill in a picture of Iowa's water quality for generations to come.

CHAPTER 2

Getting Started

The Why – Goals and Objectives

So you've attended a DNR "train the trainers" workshop or have been trained by your locally-led water monitoring project and know how to gather, record, and report data about water quality. Now, how do you go about setting up and maintaining a water monitoring plan? Monitoring is a long-term commitment. To be successful requires forethought and planning. To do this, you need to ask yourself some searching questions. Your answers will determine your goals and objectives.

- **Why do you want to monitor water?**
- **What do you plan to do with the information you gather?**

Answers to these questions can help establish your overall goals. The major steps needed to accomplish your goal are your objectives. Objectives can be measured and are accomplished within a given time period. These should be carefully thought out, since they will determine the entire set up of your monitoring program.

The What – Monitoring Parameters

What do you want to monitor? Based on your goals and objectives, you now need to decide which water quality parameters you will include in your monitoring plan. The following chapters will describe the parameters the volunteer monitoring program uses and the information each provides. The volunteer program chose these based on:

- The scientific value of assessments in the hands of citizen monitors
- The ease of doing tests in the field
- The low cost
- The safety of the methods

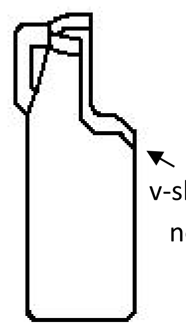
Other parameters can be monitored with kits or by lab analysis that monitoring groups can pursue; however, training, technical assistance, and state pricing options will most likely not be available for those parameters through this program. If these additional parameters are required to meet your objectives, seek out the appropriate experts to help you learn more about them and their associated test kits.

The Where – Monitoring Sites

Where are you going to monitor? Again, based on your goals and objectives, you will need to determine where you will monitor. If your goal is to preserve the health of your backyard stream, that's your monitoring site. If your goal is to compare two similar streams, find sites that are accessible and are located where you will not be trespassing. If you suspect a certain "source" is polluting your stream, you may need to set up monitoring sites upstream, at the "source," and downstream. If you need help determining where to sample, please contact your local monitoring coordinator who may be able to offer suggestions or DNR volunteer monitoring.

Monitoring Site Selection Guidelines:

- Cooperate with private landowners for access to sites that require crossing their property, even if the waterbody itself is publicly accessible. If the landowner does not agree to allow access, chose another site that avoids trespassing.
- Your monitoring site should be representative of your waterbody. In other words, do your best to locate a monitoring site that best represents the characteristics of your waterbody.
- If possible, establish your transect away from manmade structures such as bridges, which can provide 100% canopy cover all of the time and are not representative of the stream. If restricted to the right-of-way, however, monitoring at a bridge would be adequate.
    - o If monitoring at a bridge crossing, the DNR recommends that you sample from the upstream side of the bridge. If safety issues and/or landowner considerations exist on the upstream side err on the side of safety, respect private lands, and monitor on the downstream side of the bridge.
- Always monitor from within the waterbody, if possible (e.g., not on the bank). If safety, weather, stream discharge, accessibility issues, time constraints, or other such conditions prevent you from obtaining water samples directly from the stream or lake itself, you may collect water samples using a sampling device.



    - o *How to make a sample collection device*. Using a number two plastic jug (1/2 gallon milk jugs work great), cut from the opening down a few inches to the neck, then across and back up to the opening. Cut a v-shaped notch directly across from the handle. Tie a rope to the handle and your sampling device is complete.
    - o To conduct the sampling with this device, please follow these steps:
        - Avoid contamination by not allowing the sampling device or rope to touch the ground.
        - Lower the sampling device down to the stream on the upstream side of the bridge. If there are safety concerns, sampling may occur on the downstream side.
        - Partially fill the sampling device. If stream depth is adequate, you may need to bounce the sample device up and down a few times to allow water to enter. Be careful not to disturb the bottom sediments during this process.
        - Retrieve the sampling device, swish the water around, and empty it on the road behind you, not into the stream. Repeat this process a total of **3** times (triple rinsing).
        - Fill the device a fourth time and begin monitoring. Refill as needed to complete all of the assessments. For directions on using the equipment, please refer to the appropriate chapters in this manual.
- Perennial streams may occasionally dry up (in exceptionally dry years, due to sinkholes, etc.), leaving little to no water or flow, and in some cases only pools of water. Likewise, intermittent streams may dry up every year yet retain enough water to maintain **perennially pooled**

conditions. If your transect is dry, you can monitor the nearest pool (for chemical assessment) or all the pools in the stream reach (for biological assessment), but indicate in your records the status of the stream at time of sampling.

The When – Monitoring Frequency

When and how often are you going to monitor? Monitoring once represents a snapshot in time. To truly "know" a water body, you will need to monitor several times over the course of several years. Some things to consider:

- Time of year – Will you test all year or during a "season" (planting, fishing, summer when people are recreating, etc.)?
- Frequency – Do you need to monitor weekly, monthly, quarterly, etc.?
- Time of day – You should try to monitor the same time each day, preferably mid-day, although this may vary. For example, the lowest dissolved oxygen levels occur at dawn. Therefore, if this is a concern, perhaps you need to sample early in the morning.
- Weather conditions – Rain can dramatically affect water quality. Perhaps you need this "snapshot" in time for your monitoring plan. On the other hand, rain causes increased **stream flow**, making monitoring physically dangerous. **Never** put yourself in danger to monitor water. Rather than monitoring immediately after a rain, monitor a day or so later, or sample from a bridge or stream bank for safety.

The Who – The Monitoring Team

Who will do what? People start volunteer monitoring with different ideas of their "team." Some are interested as individuals or families, some as part of a previously established monitoring group, and some as coordinators of watershed projects. A volunteer monitoring coordinator can work with individuals or groups of volunteers to best take advantage of each's skills and comfort levels.

Monitoring as an individual is fine, although there are some definite advantages to working as part of a larger group. Having more people involved can increase the credibility of your data, lessen the work load, is safer (the DNR always recommends at least two people go out monitoring), and you'll have more fun! The volunteer monitoring program has long shown that the group and team building aspects of the program are some of the most important takeaways. Additionally, team-driven sampling led to increased participation and long-term dedication for participants. Teamwork works!

Plan Examples

Project in the rural Watershed Management Authority (WMA) of the West Nishnabotna River

Goal**:** I want to monitor the creek behind my house to make sure it's safe for my children to play in it. I plan to watch the trends from my monitoring to see if my creek is getting worse, better, or staying the same. I also want my data to contribute to the public knowledge about the health of the environment.

Objectives:

1. I plan to do a Habitat Assessment once a year in June.
2. I plan to do two Biological Assessments a year: once in May and once in August.
3. I plan to do a Physical/Chemical Assessment around the 1^{st} of each month.
4. I'm going to watch trends in my data as I do the monitoring and compare it to the previous year's data.
5. I plan on submitting my data to my volunteer monitoring coordinator from the WMA that will upload it to Environmental Protection Agency's Water Quality eXchange (EPA WQX) database.

Project in a Northeast Iowa watershed project, Yellow River Headwaters

Goal: I am concerned that some land use practices upstream of my favorite fishing spot on the Yellow River are hurting the fish population. I want to make sure the water quality remains high, and I plan to pay special attention to dissolved oxygen, which the fish need to survive. I plan to submit my data to the local watershed coordinator and report any unusually low dissolved oxygen levels to the local DNR Fisheries office and ask their advice.

Objectives:

1. I'm going to do a Habitat Assessment as soon as there is safe flow level in the spring and again during the year if there is a major land use change upstream.
2. I'm going to do three Biological Assessments per year: one as soon there is safe flow level in the spring, one about mid-summer and one in the fall.
3. I plan to do a complete Chemical/Physical Assessment the same time I do the Biological Assessments. I also plan to test for dissolved oxygen about every time I go out fishing (which hopefully will be about once every two weeks).
4. I plan to submit all my data to the watershed coordinator in the fall. If I have spare time during the "season," I'll be fishing!
5. I plan to graph my dissolved oxygen data with a few other parameters and see if I can see any trend in the data.

Project in Polk County, which has a volunteer water monitoring program

Goal: As a teacher, my goal is to educate students about the basic procedures used to gather information about water quality and compare two watersheds (the land area that drains to a water body). I plan to have the students analyze land use practices within the two watersheds and draw inferences about differences in water quality data from these analyses.

Objectives:

1. With the county's water monitoring coordinator, locate two watersheds of different size, topography, and/or land use.
2. Locate monitoring sites along two similar streams within these watersheds.
3. Map land use in each of the two watersheds.
4. Conduct Habitat, Biological, and Chemical/Physical Assessments once in the fall and once in the spring of each year.
5. Have students enter data into a classroom database or spreadsheet and generate summary statistics and graphs of the data. This will be done the week following each monitoring session.
6. Submit the data and summary statistics generated by the students to the county's volunteer water monitoring coordinator for upload to the EPA WQX database.
7. Work with our mass communications class to incorporate annual findings into a local news release.
8. Show students the results of the previous year's sampling efforts including entries in the WQX database and acknowledgement in the county's annual water quality report to help build confidence in their data and learn the value of their work.

Be sure to review and refine your program goals and objectives over time! A program can easily stagnate or even die if the original goals and objectives are met and new ones are not established.

CHAPTER 3

Watershed Mapping

What is a Watershed?

Before highways, post office boxes, and counties, people didn't have mailing addresses; they had "watershed addresses." A watershed**,** literally defined, is the region or area of land that drains into a body of water such as a lake, river, or stream. To truly know your waterway, and to discover how to plan your monitoring, you need to learn your own watershed address.

Water quality is a direct reflection of the surrounding watershed – our actions on the land are directly reflected in our streams, rivers, and lakes. If we manage our watersheds wisely, we can protect, preserve, and enjoy our aquatic resources forever.

Hydrologic Unit Codes (HUCs)

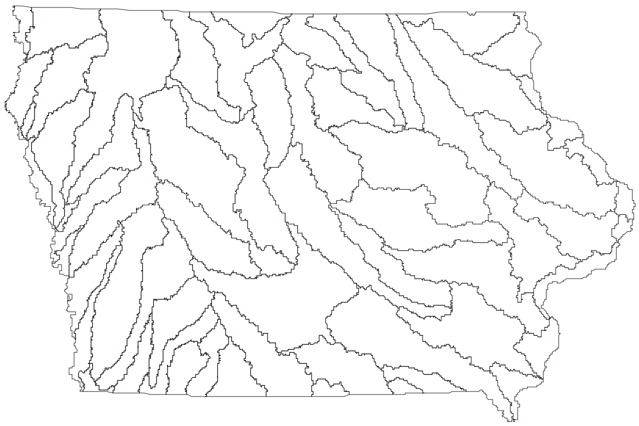
Scientists use watershed identification numbers, called **Hydrologic Unit Codes (HUCs)**, to describe the different scales of watersheds and identify specific watersheds. This measurement of scale can be useful in identifying what watershed you want to consider as you plan a locally-led project or to participate in one.

Within the HUC system, the United States is divided and sub-divided into successively smaller watersheds or **basins**. As the watersheds get smaller, the descriptive and unique HUC number gets larger. Iowa can be divided into 8-digit HUC, 10-digit HUC, and 12-digit HUC basins (see figure on the next page).

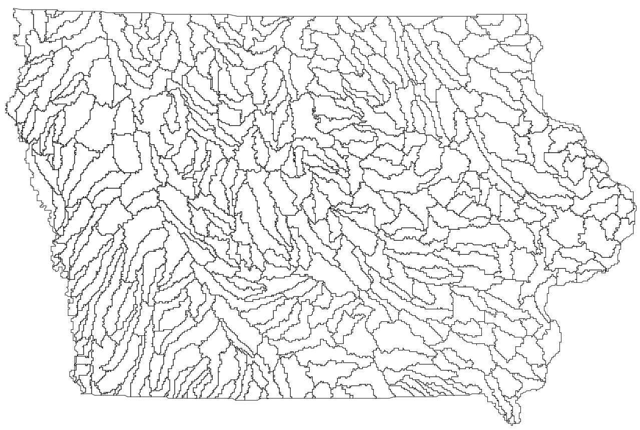
The focus of most of the previous volunteer water monitoring sites was typically at the 12-digit HUC, termed the subwatershed level and also known as HUC 12, or below. The HUC 12 classification is currently the smallest watershed division used within the state and consists of watersheds that range from 15 to 62 square miles in size.

Watershed projects in Iowa also take place at varying scales. Watershed Management Authorities (WMAs) are typically organized at the HUC8 scale, though there are many exceptions including HUC10 WMAs and groups of HUC12s, etc. Watershed projects, such as those funded by DNR Watershed Improvement Section funds (Clean Water Act Section 319 Grant) are similarly varied, with HUC12, multiple HUC12 (up to and including multiple HUC10s), and partial HUC12 projects. Coordination with local watershed projects or WMAs will help you chose which scale, specific HUC watershed, or stream area would best advance the project and contribute to overall monitoring.

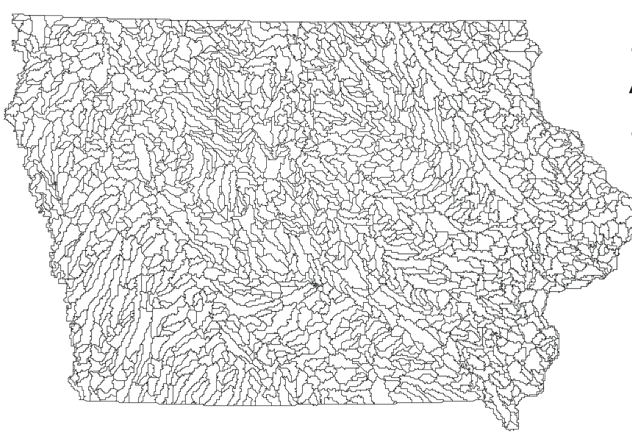
Hydrologic Unit Codes (HUCs)



8-digit HUCs
56 basins
390.6 - 1,953 mi^2



10-digit HUCs
Approximately 400 basins
62.5 - 390.6 mi^2



12-digit HUCs
Approximately 1,600 basins
15.6 - 62.5 mi^2

This figure illustrates 8-digit, 10-digit, and 12-digit Hydrologic Unit Codes (HUCs) for Iowa.

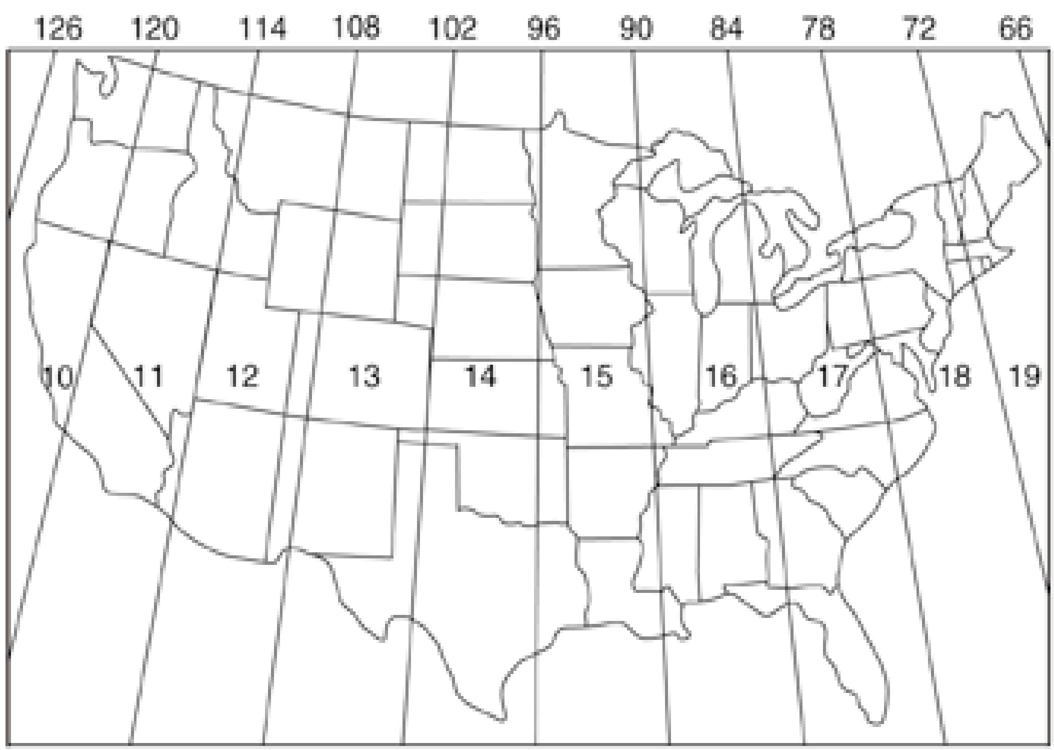
Universal Transverse Mercator (UTM) Projection

An important part of starting your monitoring program is to find out "where on Earth are you?" To register a monitoring location, you may want to know your "watershed address," which in this case is a description of the exact point along the stream where you are monitoring.

There are several ways to describe a point on the Earth. They include a physical description, a legal description (the township-range system), latitude/longitude, and the **Universal Transverse Mercator (UTM)** projection. The DNR uses the **UTM** system for point based locations in field work and for watershed assessments and mapping.

In the UTM system, the world is divided into 60 north-south zones, each covering a width six degrees of longitude, and each numbered 1 to 60 starting at 180°W longitude. The United States is covered by 10 zones (10-19), and most of Iowa is located in Zone 15. Parts of extreme western Iowa (Lyon, Sioux, Plymouth, Woodbury, Monona, Harrison, and Pottawattamie counties) are located in Zone 14.

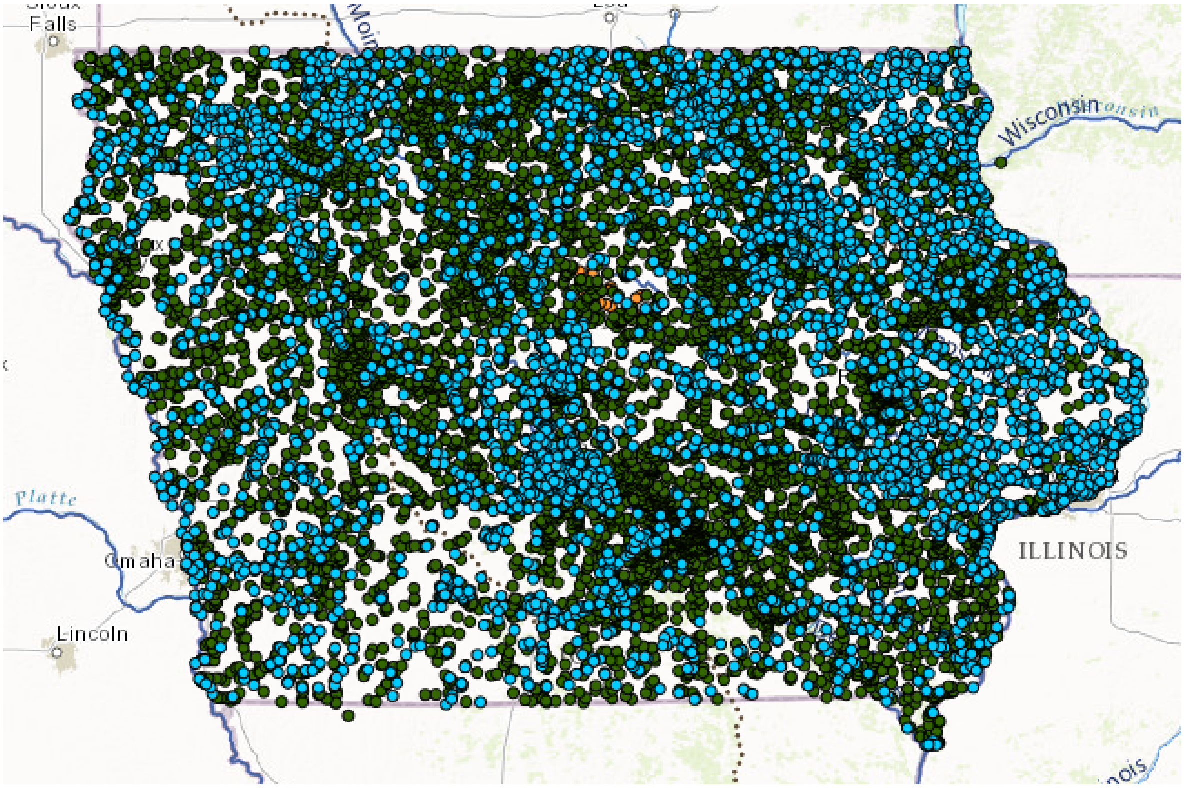
UTM coordinates are given as two numbers, called the X and Y coordinates. The X coordinate is a six-digit number that yields an east-west reading, and the Y coordinate is a seven-digit number that yields a north-south reading. The X coordinate represents the number of meters east of the western edge of the zone, and the Y coordinate represents the number of meters north of the equator. The former IOWATER program used X and Y UTM coordinates to register monitoring sites, and these sites can continue to be used - many represented on the WQX portal.



UTM Zones of the Continental United States. Figure from USGS: ***http://erg.usgs.gov/isb/pubs/factsheets/fs07701.html***

Finding a Site

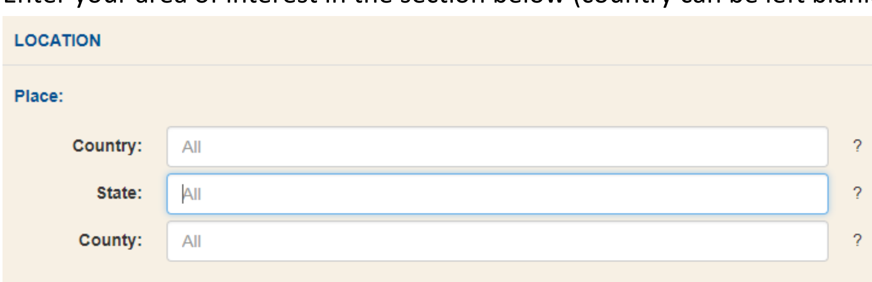
Existing sites with long-term datasets can be found in the WQX data portal (also known as WQP or Water Quality Portal). A geographical representation is available with UTM data for each. Several datasets are represented in the portal including: US Geological Survey (USGS), Agricultural Research Service (ARS), and STORET data (STOrage and RETreival) which includes IOWATER, SNAPSHOT, DNR monitoring, Lake Survey, some EPA data, and other sources.



Map of Iowa's existing water quality datapoints in the WQX database. Different color points indicate different databases. Location information is available in Lat/Long and/or UTM, depending on source. Conversion may be necessary for get UTM coordinates.

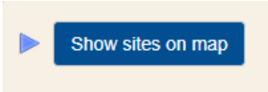
To use WQX to find site information

1. Navigate to https://www.waterqualitydata.us/portal/
2. Enter your area of interest in the section below (country can be left blank as default is US):

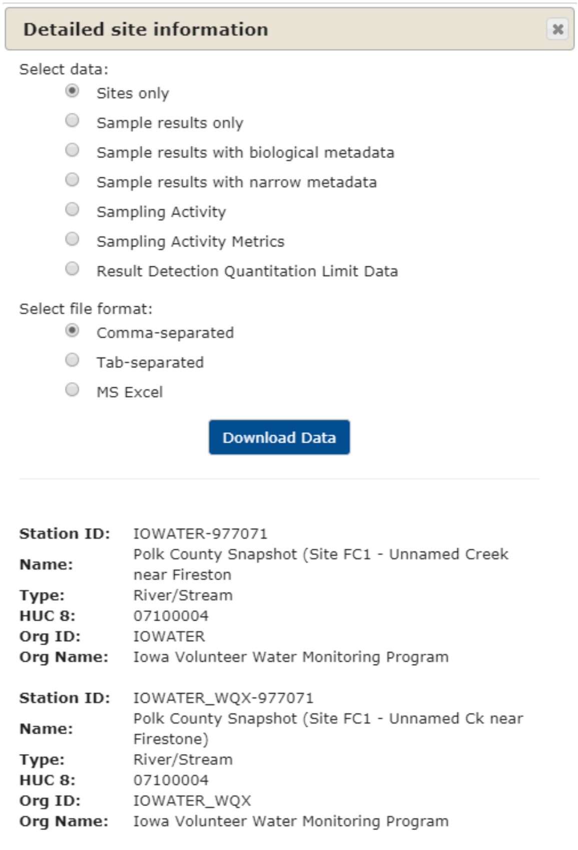


3. Additional information can be entered in Point Location, Bounding Box, Site Parameters, and Sampling Parameters to narrow your search

4. Scrolling down, click:



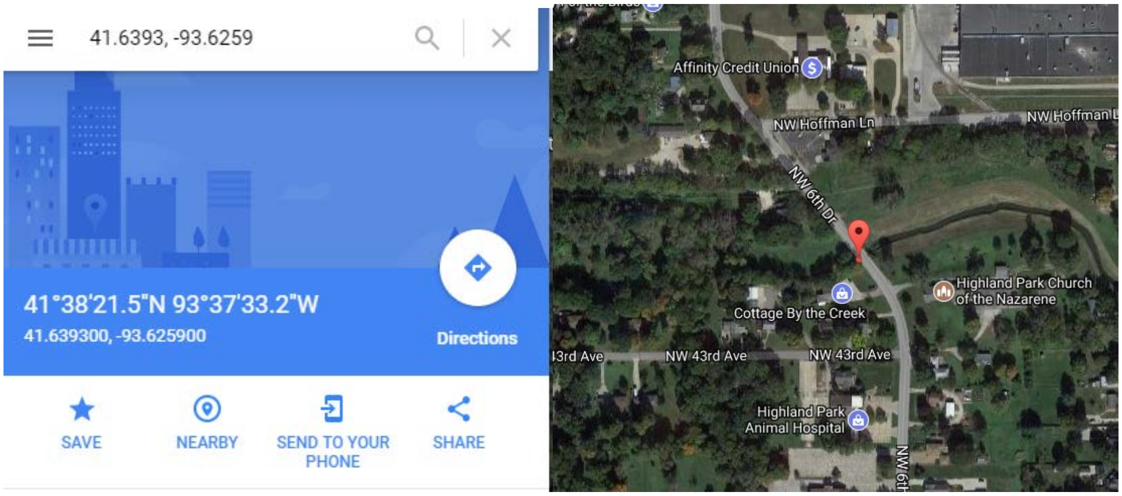
(this step may take several minutes to process)
5. Total site numbers listed from your criteria will be presented, click continue on the pop-up
6. After processing, a map will appear with sites in your selected region
7. Zoom in and click on a single dot on the map to learn more about the site or download data



8. Location information (in coordinates) is available in the downloaded “Sites only” spreadsheet
    a. Recommended/required: file unzipping software, spreadsheet software
    b. Expanding cells gives more information, such as more precise coordinates

C	D	E	F	G	H	I	J	K	L	M
Monitorin	Monitorin	Monitorin	Monitorin	HUCEight[	D	[	C	C	Latitude	Longitude
IOWATER-	Polk Coun	River/Stream		07100004					41.6393	-93.6259
IOWATER_	Polk Coun	River/Stream		07100004					41.6393	-93.6259

9. Search lat/long in Google Maps to get information about driving directions, etc.



Note to those using a Global Positioning System (GPS) in the field.

If you are using a Global Positioning System (GPS) to determine UTM or Latitude/Longitude coordinates, be sure your GPS unit is set to the system to display NAD83, not NAD27. NAD refers to the North American Datum. NAD27 is a reference system based on surveys. NAD83 represents an adjustment made to NAD27 using satellite data, which is more accurate. Paper copies of the U.S. Geological Survey **topographic maps** are on NAD27, whereas the topographic maps on the Iowa Geographic Image Map Server are on NAD83. The UTM Y coordinate on these two systems differs by about 200 meters, while the UTM X coordinate is the same.

Conversion from Latitude/Longitude to UTM

Conversion from Lat/Long coordinates to UTM is simple and there exists many tools that can do so, near instantly, online. Several can also convert batch files and import/export results to and from varying formats, and a Google search will provide you with options. A beta version of a conversion tool is available from the National Oceanic and Atmospheric Administration's (NOAA) National Geodetic Survey: https://beta.ngs.noaa.gov/gtkweb/

The Driving Tour

With your watershed map in hand, you are ready to "hit the road." Taking the time to familiarize yourself with your watershed will be time well spent as you begin your monitoring program. Doing this at the onset of your project will give you a firm sense of what factors in your watershed may impact water quality.

You should have at least two people in the car as you do this – one to drive safely and one to mark your map and take notes. It is helpful to go during a time of day when there may not be a lot of traffic. Do this in daylight, so you don't miss structures that may not be visible at night.

What should you be looking for and jotting down? The answer is ANYTHING that may affect your stream. Here's a list of a few things to pay attention to:

- Animal Feeding Operations – How many buildings? What kind of livestock? Are there any evident drainage ditches or waste lagoons?
- Golf Courses – How large are they? Do they have streams or drainage ditches? Are there buffers along these waterways? Any ponds?
- City or County or State Parks – How much mowed area is there? Are there areas of heavy pet use near waterways?
- **Row Crop** – Is there evidence of good conservation practices such as grassed waterways, terraces, contour cropping, or others? Are streams lined with conservation buffers or is there row crop to the water's edge?
- Residential Areas – Can you pinpoint where storm sewers enter streams? Are there construction areas? Are they using proper silt fencing? Are there efforts to plant trees along waterways? Where does the sewer district discharge, or are most houses on private septic systems?
- Retail or Industrial Areas – Are there large parking areas with drainage to a stream or to a storm sewer system which connects to a stream? Where does the sewer district discharge? Are there any water discharges of thermal differences, such as water used in cooling power plants or factories? Are there piles of "unidentified" barrels or waste tires?
- Other types of land use – What potential impacts do they pose? Are there any conservation practices in place?
- The number of animals and what types of animals are in the watershed?

This is a list of just a few things to look for and is not complete by any means. You need not answer every question listed here. They are meant only to start you down the road to considering what is in your watershed and what may impact water quality as you begin monitoring.

The information collected during your driving tour is for your use only. It is strongly recommended at the beginning of your monitoring, and an annual update may be useful if you can do it.

CHAPTER 5

Habitat Assessment

Introduction

A habitat assessment is an important step in tracking changes within the stream over time. Changes that take place slowly have a way of escaping our attention until the changes are dramatic in scope. How many of us remember our grandparents or other elders saying, "I remember what this stream looked like when I was a kid"? Even though these accounts are useful and entertaining, proper management of natural resources takes solid data and observations to document what's going on within a natural system. Even with these, it's still difficult to determine cause and effect within a complex natural system.

These observations need only be measured and recorded *once a year,* preferably in the summer, unless there is some significant land-use change that may affect stream characteristics in a very short period of time. Examples of this might be stream channelization, a large industrial development or housing development in a short period of time, or a catastrophic natural event such as a flood. In such cases, a second habitat assessment would be valuable.

Stream Transect and Stream Reach

Observations and parameters measured throughout the IOWATER assessments are done at two scales, the **stream transect** and the **stream reach**. A stream transect is the exact location across the stream that you are going to monitor. This is the location you want your UTM coordinates to pinpoint. The stream reach is defined as one set of riffle, run, and pool habitats. However, riffle, run, and pool habitats may not be present at all monitoring sites. In this case, you should define your stream reach as a set distance (25 meters upstream and 25 meters downstream) from your transect.

Measuring depth at the stream transect

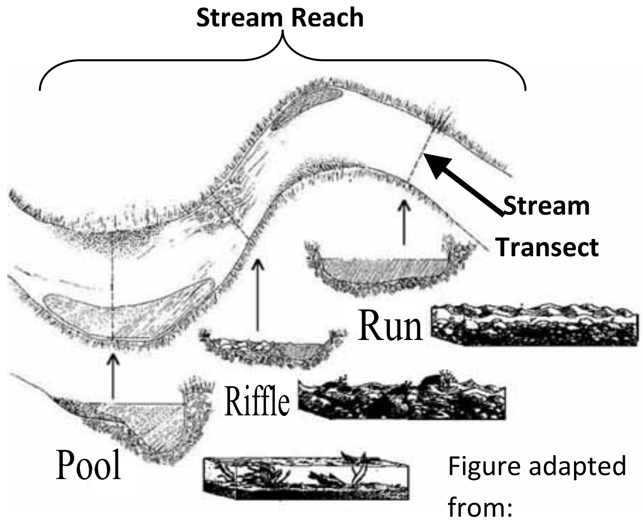


Figure adapted from:

Volunteer Stream

The level at which observations or measurements are made is outlined in the *Reporting Technique* section for each parameter.

Stream Habitat Type

A variety of habitats within a stream usually enhances the **diversity** of aquatic life that you may find there. Stream habitats are divided into three main types: riffles, runs, and pools. Healthy streams show alternating pool and riffle areas while lower quality streams generally consist of long, continuous runs.

A **riffle** is an area of the stream that has a swift moving current and water that is normally "bubbling" due to a rocky streambed. This habitat type promotes relatively high dissolved oxygen levels as the water tumbles over and around the rocks. Riffles typically have high numbers of **invertebrates** and the small fish that feed on them.

A **run** can be characterized as having a moderate current, medium depth, and a smooth water surface. Runs can have diverse mixtures of aquatic life, depending on the quality and quantity of the in-stream habitat (boulders, logs, root wads, etc.).

A **pool** has a relatively slow current and is usually found at stream channel bends, upstream of riffles, or on the downstream side of obstructions such as boulders or fallen trees. The stream bottom in a pool is often bowl shaped. Pools are great areas for fish such as bass, catfish, northern pike, and trout.

Reporting Technique: Check the habitat type that best describes your *stream transect*.

Streambed Substrate

The characteristics of the stream bottom are very important to habitat quality and the type of aquatic life you may find there. In general, a shifting sand or silt streambed will not support as diverse a population as more stable streambeds consisting of cobble, boulders, or fallen trees.

What a streambed is made up of is called the **substrate**. Although natural **geology** is responsible for the original substrate of Iowa streams, effects of human activities in the watershed, such as those that increase soil erosion rates, can cover the existing substrate with a layer of sand or silt. This covering of the original substrate is called embeddedness and it reduces biodiversity by destroying aquatic habitats. Fish and invertebrates need spaces between rocks where they can hide from **predators**, lay their eggs, and feed upon their favorite source of food. Algae and aquatic plants need a stable substrate to which they can attach.

Substrates are typed by size as follows:

Bedrock - large sheets of stone

Boulder - stones larger than 10 inches in diameter

Cobble - stones with a diameter between 2.5 and 10 inches

Gravel - 0.1 to 2 inch diameter

Sand - smaller than 0.1 inches

Mud / **Silt** - dirt or soil deposited on the bottom of the stream

Other - organic material like **leaf litter**, tree limbs, etc.

Bedrock – large sheets of rock

Boulders – larger than 10 inches

Reporting Technique: At the *stream transect*, estimate the percent area of the bottom of the streambed covered by each of the above. These should add up to 100% of the streambed substrate.

Test Yourself – What Substrates do you see?

Microhabitats

Smaller habitat areas, called **microhabitats**, exist within the larger stream habitat types (riffles, runs, or pools). These microhabitats consist of algae mats, **leaf packs**, logjams, rocks, root wads, undercut banks, fallen trees, weed beds (aquatic vegetation), silk/muck, sand, junk (tires, garbage), rip rap, overhanging vegetation and large rocks. Microhabitats ensure stream diversity by supporting a variety of aquatic life.

Algae Mats

Weed Beds / Aquatic Vegetation

Overhanging Vegetation

Logjam

Rip Rap

Rocks

Rootwad

Silt & Muck

Leaf pack

Junk

Fallen Tree

Undercut Bank

Reporting Technique: Record all of the different types of microhabitats that you see in your *stream reach*. Describe them as best as possible.

Test Yourself- How many microhabitats do you see?

Stream Banks

The shape and condition of stream banks can provide insight into the quality of the stream and the aquatic life it can support. Are the banks high crumbling walls or gently sloping banks with grass, shrubs, and trees growing on them? You can tell much about the stream's long-term stability by looking at the shape and condition of its banks.

A stable bank is a sign of a **stable stream**. All streams and rivers move within their **floodplains**, but a mature, stable stream will not move very rapidly. Bank sloughing, cut banks, and high-wall banks without trees or other soil-holding plants are signs of bank instability. A sloping bank covered with vegetation is more stable and indicates a healthier watershed. Not only do gently sloping banks offer better habitats for wildlife near the water's edge, they work to slow and filter watershed runoff.

So what determines whether a stream's bank is stable or not? Factors that can impact the stability of stream banks include:

- Channelization – Stream straightening means water moves faster so the stream can have extremely high flow at certain times during the year, often producing cut banks.
- Soil Types – The type of soil that the stream channel is cutting through will affect bank appearance. A stream cutting through soft **loamy soil** tends to produce eroding cut banks. A more stable soil such as clay usually will result in more stable **slopes**.
- Vegetation – A plant community of native **wetland** plants such as willow thickets at the water's edge will prevent or slow cut bank erosion, whereas row crop to the edge of a stream will increase erosion.
- Livestock – Cattle are one of the most erosive forces along stream banks, especially along "cow paths" or watering places.
- **Tiles** – Drainage tiles and storm sewer outlets can cause erosion at their outlets.

Cutbank - Eroding

Cutbank – Vegetated

Sloping Bank

Sand/Gravel Bar

Rip-Rap

Drainage Ditch

Reporting Technique: Record the condition of both left and right stream banks as you face upstream at your site's *stream transect*.

Canopy Cover

Canopy cover influences the amount of light that can filter through overhead vegetation before reaching the stream. It is made up of vegetation (tree branches, leaves, grasses, etc.) that hang over the stream. The canopy can help protect the stream from extreme fluctuations in water temperature.

If the canopy of a stream is reduced or eliminated, the health of the stream suffers. Elevated water temperatures resulting from solar heating may directly affect aquatic life. Warm water holds less dissolved oxygen than cold water, and thus reduces the oxygen available for fish and other aquatic life. Like clouds in the atmosphere, the canopy cover helps regulate fluctuations in water temperature. Without a good canopy cover, a stream's water temperature can fluctuate greatly and stress aquatic communities.

0-25 % Canopy Cover

25-50 % Canopy Cover

50-75 % Canopy Cover

75- 100 % Canopy Cover

Reporting Technique: At your *stream transect*, estimate **canopy cover** by what percentage of the area above the stream is covered by tree branches, leaves and/or grasses. Use your best estimate in 25% increments. If the trees do not have leaves on them, estimate the cover as if they did.

Riparian Zone

The stream's **riparian** zone is the area of land that is in “natural” vegetation directly adjacent to the stream banks. A healthy riparian area consists of trees, shrubs, and/or grasses. This zone is extremely important to the health and protection of the stream. This can include a planted buffer. Trees help stabilize the bank during flood events and may provide habitat for both aquatic and terrestrial organisms. Shrubs, grasses, and other plants can slow and filter runoff water before it enters the stream.

Planted Buffer Strip

Both Banks: Over 25 meter Riparian Zone

The yellow lines indicate the extent of the planted vegetation of the riparian zone

Both Banks: 0-5 meter Riparian Zone;

Left Bank: 5-25 meter Riparian Zone;

Both Banks: 0-5 meter Riparian Zone;

Left Bank: 5-25 meter Riparian Zone;

25% Trees, 10% Shrubs/Low Trees & 65% Grass/Low Plants

Test Yourself- How wide is the Riparian Zone? What is the Plant Cover of both banks?

Reporting Technique – each of the following should be measured at the *stream transect*:

- **Riparian Zone Width** – Facing upstream, estimate the width of the riparian zones along the **left** and **right banks** in increments of 0-5 meters, 5-25 meters, and over 25 meters. Consider the question “How wide is the “natural” buffer”?
- **Riparian Zone Plant Cover** – Facing upstream, estimate the percentage of plant cover (trees, shrubs, grass/low plants, other) in the left and right bank riparian zones. The percentages of each bank should add up to 100%.

Land Uses

It is important to document the land uses in the watershed that might influence water quality, especially those that exist in close proximity to your stream reach. Feedlots, wastewater treatment facilities, or city storm sewers can be sources of nutrients to nearby waters. Other important influences could include golf courses, roadways, parking lots, construction zones, dump sites, airports, and state or federally protected natural areas.

Adjacent Land Use - Wetland

Adjacent Land Use – Row Crop

Adjacent Land Use – Boating Access

Adjacent Land Use – Rural Residential Area

Adjacent Land Use - Pasture

Adjacent Land Use - Prairie

Adjacent Land Use - Urban

Adjacent Land Use - Park

Adjacent Land Use – Animal Feed Lot

Adjacent Land Use - Industrial

Adjacent Land Use – Steep Slopes

Adjacent Land Use – Stairs/Walkway

Reporting Technique – Check all those that apply along the *stream reach*:

- **Adjacent Land Use** – Check all land uses that you can see in the area adjacent to the riparian zones that apply. If you know of land use practices in the watershed that are upstream of your site but not immediately adjacent to your stream reach you can list and describe them in the "Record all other land use practices that potentially could affect the stream" section of the field form.

Human Use

Documenting human use, or even evidence of human use, is beneficial as it can help illustrate our physical connections to our aquatic resources.

Human Use - Swimming

Human Use - Fishing

Human Use - Tubing

Human Use - Wading

Human Use - Canoeing

Human Use – Kids Playing

Evidence of Human Use – Streamside Road

Evidence of Human Use – Livestock Watering

Evidence of Human Use – Evidence of Kids Play

Shoes along stream

Evidence of Human Use – Evidence of Kids Play

Toys in stream

Evidence of Human Use – Evidence of Kids Play

Drawings & mud balls under bridge

Evidence of Human Use – Footprints

Evidence of Human Use – Fire Pit

Evidence of Human Use – ATV Tracks

Evidence of Human Use – Fishing Tackle

Trotline

Evidence of Human Use – Fishing Tackle

Fish or Turtle Trap

Reporting Technique – Check all those that apply along the *stream reach*:

- **Human Use Activities** – Please check all activities you've either witnessed or participated in at this site.
- **Evidence of Human Use** – If there's any evidence of others using the stream, please check all uses that apply.

Defining Your Stream: Perennial and Intermittent Stream Classification

Iowa has many water bodies, ranging from large rivers, lakes, and wetlands to the vast network of small streams. Water bodies do not need to be large to support aquatic life, nor do they need flowing water throughout the year to provide enough habitat for plants and animals. In Iowa, stream segments are classified as either "perennial" or "intermittent," classifications that are based primarily on flow regimes of particular stream segments. Perennial streams have water nearly all of the time while intermittent streams tend to dry up on an annual basis.

Perennial streams *can be defined as a body of water flowing in a natural or human-made channel year-round, except during periods of drought*. Lakes and ponds that form the source of a perennial stream or through which a perennial stream flows are all characteristics of the stream. Generally, the water table is located above the streambed for most of the year and groundwater is the primary source for stream flow. In the absence of pollution or other human-made disturbances, a perennial stream is capable of supporting a variety of aquatic life. The wet season, which is typically March through May, represents the optimum time period during which you will be able to observe biological species under normal flow conditions. A stream that contains normal flow during the dry period is likely to be a perennial stream assuming that there are normal precipitation conditions.

Intermittent streams *contain flowing water for only part of the year*. During the dry season and periods of drought, these streams will not exhibit flow and are often completely dry. The flow of intermittent streams is influenced by many factors, both natural and human-made. The stream may be located above the water table, and therefore lacks the continuous presence of groundwater that provides flow within perennial streams. Human modification to the stream channel or the watershed may also disrupt the flow. In the absence of external limiting factors, such as pollution and human modification of the hydrology, there is a low diversity of aquatic organisms, and those present are tolerant to the constantly fluctuating conditions. The dry season, which is July through September, represents the ideal time to observe low-flow conditions. A stream that is observed to have no flow from the months of July through September is likely to be an intermittent stream section assuming that there were normal rain events throughout the year.

Intermittent streams may be particularly important as nursery areas for fish and amphibians because these sites support fewer predators than perennial channels. Some species may rear in the intermittent channels and then move downstream when they grow large enough to protect themselves. Because intermittent channels form a high proportion of the channel system, they can strongly influence downstream ecosystems through the input of sediment, water, woody debris, and nutrients to the rest of the channel system. These channels are also important contributors to downstream plants and animals.

Understanding the functions that intermittent streams serve can help Iowa fulfill its obligation to the Clean Water Act. One of the problems that we face as a state is a lack of data on many of our stream miles. Data gathered by IOWATER volunteers helps fill in gaps, and by providing information on these smaller, headwater, and oftentimes intermittent streams, the state can more accurately assess the status of our waters and move forward with field methodologies and protocol that will help ensure healthy aquatic systems well into the future.

Reporting Technique:

Once you are familiar with your stream, please classify it based on the above definitions on the IOWATER database.

Photographs

As the old adage goes, *a picture can be worth a thousand words*. Photographic documentation of stream habitat conditions along your stream reach is strongly encouraged and may prove to be extremely useful over time. You can upload photographs of your site to the IOWATER online database. These are extremely useful for tracking changes over time. Be sure to use landmarks to identify specific locations, so you can compare images from year to year.

To upload photographs to the IOWATER database, they must be in either JPEG (recommended) or GIF format; less than 1MB (1025kb) in size; and the photograph filename (including the file extension) needs to be less than 40 characters. It is also recommended that photos have a resolution of 300 dpi (dots per inch).

For technical assistance with resizing and uploading electronic photographs, please contact IOWATER.

CHAPTER 6

Chemical Assessment

Introduction

Water chemistry is perhaps the most complicated and least understood characteristic of streams, rivers and lakes. While some chemicals are absolutely necessary for life (such as nutrients), they can be harmful to the waterbody in large quantities. Other chemicals provide no benefit when found in water and are harmful to the system (such as pesticides). Some chemicals may not directly impact human health, while others (such as nitrate) can have harmful effects in our drinking water.

As you explore your stream's water chemistry, it is important to understand that water chemistry is very complex, and that extreme natural variation in some chemicals is not unusual but actually the norm. Some of these natural variations will be addressed in the following sections in this chapter.

The following are just a few examples of how environmental conditions can influence water chemistry (see the IOWATER chapter on data interpretation as well):

- Season of year – In late spring, nitrate and phosphate levels in streams may rise in response to bare soil, heavy rains, increased tilling, and chemical application to row crops and urban lawns.
- Time of day – Dissolved oxygen levels rise during sunlight hours due to increased photosynthesis in aquatic plants and algae. They decrease overnight when photosynthesis is not occurring and plants and algae are using up dissolved oxygen.
- Weather – Runoff from heavy rains can transport pollutants to streams, thus having a strong impact on nonpoint source pollution.

- Physical influences – Decreased canopy cover from riparian zone removal results in solar warming of the water, which can decrease dissolved oxygen levels.
- Land use – Increased development throughout a watershed can result in more curb-and-gutter storm sewer runoff.

IOWATER testing includes those chemicals of concern that can be effectively and feasibly assessed. These and many more complex chemical tests are being done on Iowa's streams, rivers, and lakes by other professional agencies, such as the Iowa DNR, the U.S. Geological Survey, and local drinking water supply agencies. These additional tests may include **alkalinity**, conductivity, dissolved solids, hardness, chlorophyll, metals (e.g., chromium, copper, iron, lead, zinc), and organic compounds (e.g., pesticides and petroleum compounds).

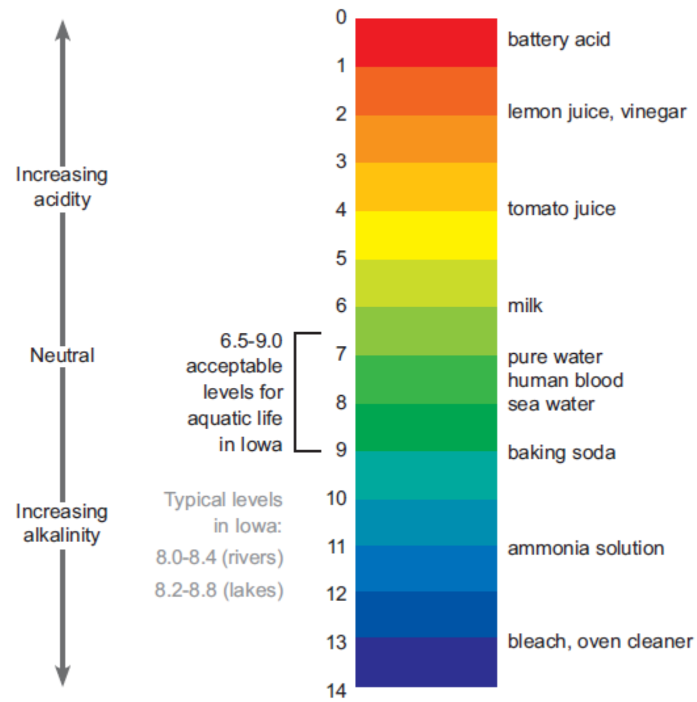
IOWATER chemical tests you will be doing include pH, dissolved oxygen, nitrate-/nitrate-N, phosphorus, and chloride. You will be measuring the **concentration** of each of these parameters in the water. All parameters but pH are measured in units of concentration called milligrams per liter (mg/L).

So how much is a mg/L. The University of Minnesota's ***Water on the Web*** (http://WaterOntheWeb.org) provides several analogies for what a mg/L represents. One mg/L is equivalent to:

- One inch in 16 miles
- One minute in two years
- One ounce in 32 tons
- One cent in $10,000
- One car in bumper-to-bumper traffic from Cleveland to San Francisco

pH

pH is a measure of a water's acid/base content and is measured in pH units on a scale of zero to 14. A pH of seven is neutral (distilled water), while a pH greater than seven is basic/alkaline and a pH less than seven is acidic.



The pH level of surface water is influenced by the concentration of acids in rain and the types of soils and bedrock in an area. The typical pH of rainfall in the U.S. is slightly acidic, ranging from 5.0 to 5.6. As rainwater falls, it dissolves carbon dioxide from the atmosphere, thus forming a weak carbonic acid and lowering the pH of the precipitation. Low pH levels (acidic) can have a harmful impact on the health of aquatic communities. Very acidic water or **acid rain** can directly harm aquatic life and can also allow toxic substances, such as ammonia and heavy metals, to leach from our soils and possibly be taken up by aquatic plants and animals (**bioaccumulation**).

Even with the natural inputs of acidic water, the pH of Iowa surface waters generally range from 8.0 to 8.4. The presence of alkaline (basic) soils and limestone bedrock in many areas of the state help neutralize the effect acidic precipitation might have on Iowa's streams and lakes. This is quite fortunate for Iowa since pH can influence many chemical and biological processes. Most aquatic organisms require habitats with a pH of 6.5 to 9.0.

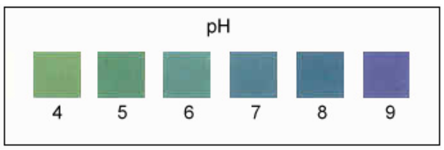
Extremely high or low pH values are rare in Iowa. Most values that exceed 9.0 (basic) are caused by excessive algal growth, a sign of nutrient enrichment. Very low (acidic) pH readings are generally near point sources of pollution.

Typical range for pH = 8.0 to 8.4 (rivers); 8.2 to 8.7 (lakes)

Iowa average = 8.2 (rivers); 8.5 (lakes)

Iowa's water quality standard - pH shall not be less than 6.5 nor greater than 9.0

** Based on 2000 through 2014 data collected by the Iowa DNR*



pH scale on the test strip vial

Reporting Technique: For use with Hach® pH test strips

1. Check the expiration date on the bottom of the bottle. If expired, **DO NOT USE**.
2. Facing upstream, in the area along your *transect* with the greatest flow, dip the test strip in the water and remove immediately. Hold strip level for **15 seconds**. **DO NOT SHAKE** excess water from the test strip.
3. Estimate pH by comparing test pad to color chart on test strip bottle. Remove sunglasses before reading the strip. ***The pad will continue to change color, so make a determination immediately after 15 seconds.***
4. Record results on the IOWATER Chemical / Physical Stream Assessment field form.
5. Dispose of test strip in waste container, which can be emptied into your household trash.

STORE AT ROOM TEMPERATURE

Dissolved Oxygen

Dissolved oxygen (DO) is necessary for nearly all aquatic life to survive. Certain processes add oxygen to a waterbody, while others remove or consume oxygen. Oxygen is added to a stream or lake from the atmosphere through mixing in turbulent areas. Plants also contribute oxygen through photosynthesis. Oxygen is removed in surface water by decomposition or organic material, respiration, and chemical processes. DO in waterbodies can be affected by:

- Water Temperature – Cold water holds more oxygen than warm water.
- Season – DO levels are higher in winter than in summer.
- Time of Day – On a sunny day, DO levels rise from morning through the afternoon as a result of photosynthesis, reach a maximum in late afternoon, and steadily fall during the night, reaching their lowest point before dawn.
- Stream Flow – DO will vary with the volume and **velocity** of water in a stream; faster moving water mixes readily with atmospheric oxygen, thus increasing DO.
- Aquatic Plants – Plant and algae growth in a stream will affect the oxygen contributed by photosynthesis during the day and depleted by plant **respiration** at night.
- Dissolved or Suspended Solids – Oxygen dissolves more readily in water that does not contain high amounts of salts, minerals, or other solids.
- Human Impacts – Lower DO levels may result from human impacts including organic enrichment, urban stormwater runoff, riparian corridor removal, stream channelization, and dams.

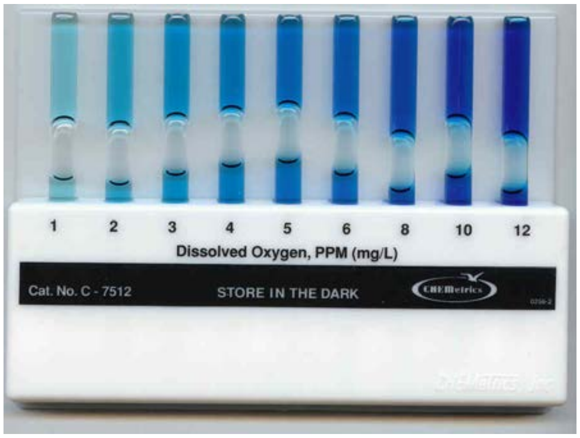
Dissolved oxygen is measured in milligrams per liter of water (mg/L). Iowa standards, which are set to protect aquatic life, call for a minimum of 5 mg/L of DO in warm water streams and 7 mg/L in coldwater streams.

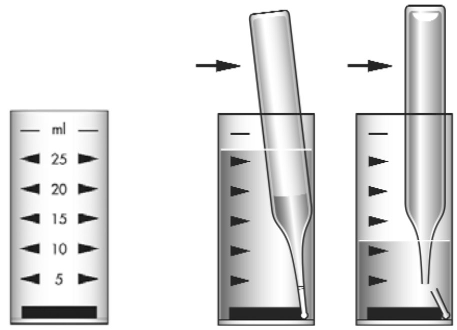
Typical range for dissolved oxygen = 8.8 to 12.9 mg/L (rivers); 7.2 to 10.4 mg/L (lakes)

Iowa average = 10.6 mg/L (rivers); 8.7 mg/L (lakes)

Iowa's water quality standard – 5 mg/L for warm water streams and 7 mg/L for cold water streams

** Based on 2000 through 2014 data collected by the Iowa DNR*





Reporting Technique: For use with the Chemetrics® dissolved oxygen test kit

1. Check the expiration date printed on the back or the front of the color comparator. The ampoules do not expire as long as they are kept in the dark at room temperature. If your equipment is expired, **DO NOT USE**.

2. Remove the 25 ml sample cup from the kit and rinse it **<u>three times</u>** with stream water.

3. Facing upstream, in the area along your *transect* with the greatest flow, fill the sample cup to 25 ml mark, mixing the water and air as little as possible.

    - Lower the sample cup down to wrist depth while holding it upside down. Turn the opening downstream so that the cup backfills with water, then turn the cup upstream and carefully remove cup and water sample from stream.

    - ***GENTLY*** tip the sample cup to pour off excess water.

4. Place the ampoule in the sample cup, tilting it so the tip is wedged in one of the spaces along the side of the sample cup.

5. Snap off the tip of the ampoule by pressing it against the side of the cup, allowing it to fill with water.

6. Remove the ampoule from the cup and mix the water by inverting the ampoule slowly several times. Be careful not to touch the broken end as it will be sharp.

7. **Two minutes** after you break off the ampoule tip, compare the ampoule to the color standards provided in the kit. ***Read the ampoule right at two minutes as the ampoule will continue to change color.*** Remove your sunglasses before making a determination.

8. Hold the comparator nearly flat while standing directly beneath a bright source of light. Place your ampoule between the color standards moving it from left to right until the best color match is found. Record your result on the IOWATER field form.

__Note__: The ampoule and ampoule tip may be disposed of in your household trash – be careful of the broken glass. Avoid breaking the ampoule open, as the contents may be mild skin and/or eye irritants. ***Keep color comparator and unused ampoules away from direct sunlight***, as they will change to a blue color and are no longer usable. **STORE IN THE DARK AT ROOM TEMPERATURE.**

Nitrate-N / Nitrite-N

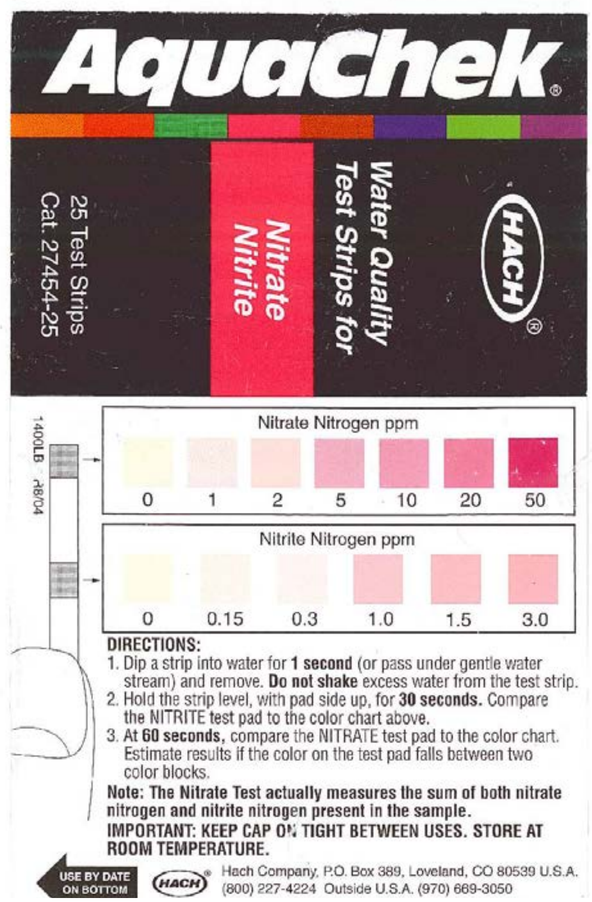
Nitrogen is an essential plant nutrient, but excess nitrogen can cause water quality problems. Too much nitrogen and phosphorus in surface waters causes nutrient enrichment, increasing aquatic plant growth and changing the types of plants and animals that live in a waterbody. This process, called **eutrophication,** can also affect other water quality parameters such as pH and dissolved oxygen.

Typical range for Nitrate + Nitrite-N = 2.6 to 7.9 mg/L (rivers); 0.05 to 0.84 mg/L (lakes)

Iowa average = 5.4 mg/L (rivers); 0.19

Iowa's drinking water quality standar

** Based on 2000 through 2014 data collectec*



Note finger holding the test strip to illustrate the two pads and how each relates to its corresponding color scale to the right

Nitrate and **nitrite** are two forms of nitrogen. Nitrate is very easily dissolved in water and is more common in streams. Sources of nitrate include soil organic matter, animal wastes, decomposing plants, sewage, and fertilizers. Because nitrate is very soluble in water it can move readily into streams. Nitrite is another form of nitrogen that is rare because it is quickly converted to nitrate or returned back to the atmosphere as nitrogen gas. Due to its instability, detectable levels of nitrite in streams and lakes are uncommon. Detectable nitrite levels in streams and lakes may indicate a relatively fresh source of ammonia.

The amount of nitrate or nitrite dissolved in water is reported as nitrate-N (nitrate expressed as the element nitrogen) or nitrite-N in milligrams per liter of water (mg/L). Iowa's drinking water standard for nitrate is 10 mg/L as nitrate-N. The concentration of nitrate-N in water may vary greatly depending on season and rainfall, fertilizer application rates, tillage methods, land use practices, soil types, and drainage systems. Consistently high nitrate readings (over 10 mg/L) may be cause for concern and warrant further investigation.

Reporting Technique: For use with Hach® nitrate-N / nitrite-N test strips

1. Check the expiration date on the bottom of the Nitrite-N/Nitrate-N bottle. If expired, **DO NOT USE**.
2. Facing upstream, in the area along your *transect* with the greatest flow, dip the test strip into the water for one second and remove. **DO NOT SHAKE** excess water from the test strip.
3. Hold the strip level, with pad side up, for **30 seconds.**
4. Compare the NITR**I**TE (lower) test pad to the nitrite-nitrogen color chart on test strip bottle, estimate the nitrite concentration in mg/L, and record your reading on the IOWATER field form (remove sunglasses before reading the strip). ***The pad will continue to change color, so make a determination immediately after 30 seconds***.
5. At **60 seconds** (or 30 seconds after estimating nitrite concentration), compare the NITR**A**TE (upper) test pad to the nitrate-nitrogen color chart on test strip bottle, estimate the nitrate concentration in mg/L, and record your reading on the IOWATER field form (remove sunglasses before reading the strip). ***The pad will continue to change color, so make a determination immediately after 60 seconds***.
6. Dispose of test strip in waste container, which can be emptied into your household trash.

STORE AT ROOM TEMPERATURE

Phosphate

Phosphorus is an essential nutrient for plants and animals and is usually present in natural waters attached to sediment, in organic material, and dissolved in the water. Plant growth in surface waters is generally limited by the amount of orthophosphate, the dissolved form of phosphorus, present. It is the simplest form of phosphorus found in natural waters and is most available for plants to use. In most waters, orthophosphate is present in very low concentrations. The amount of phosphate dissolved in water is expressed in milligrams per liter of water (mg/L). The test kits IOWATER uses measure **orthophosphate**, which will be referred to as simply "phosphate."

There are natural sources of phosphorus, such as certain soils and rocks, but most elevated levels of phosphorus are caused by human activities. These include human, animal, and industrial wastes, as well as runoff from fertilized lawns and cropland. Excess phosphorus in water speeds up plant growth, causes algal blooms, and can result in low dissolved oxygen, or hypoxic, conditions that can lead to the death of certain fish, invertebrates, and other aquatic animals.

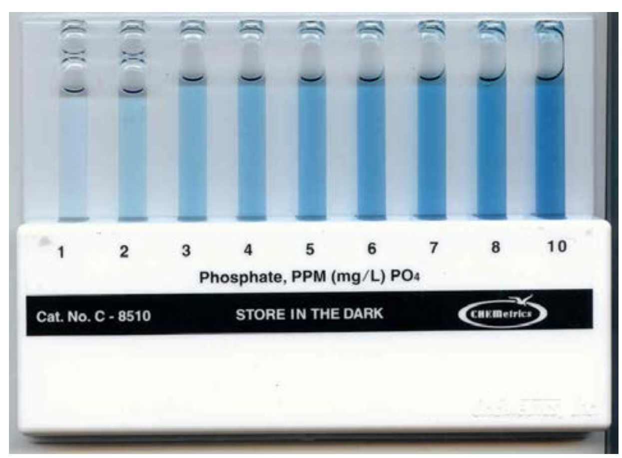
Typical range for total phosphorus = 0.11 to 0.32 mg/L (rivers); 0.05 to 0.13 mg/L (lakes)

Iowa average = 0.19 mg/L (streams); 0.08 mg/L (lakes)

** Based on 2000 through 2014 data collected by the Iowa DNR*

Reporting Technique: For use with Chemetrics® phosphate test kit

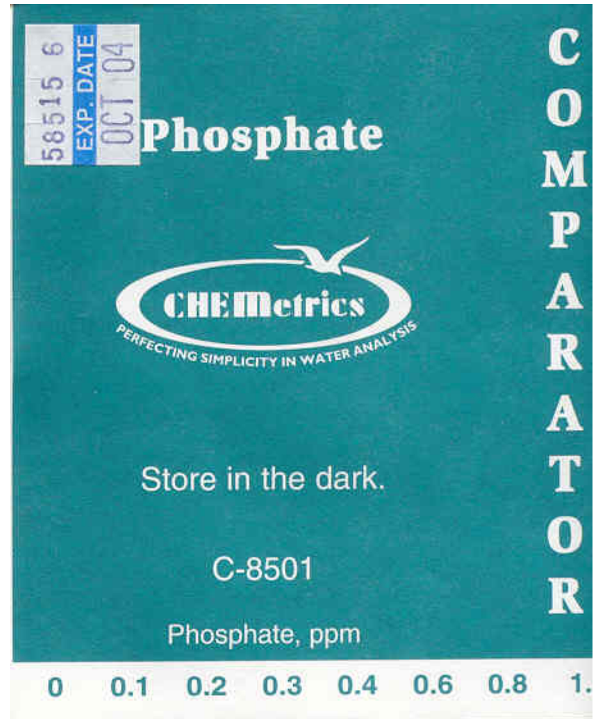
1. Check the expiration date printed on the back or the front of the color comparator in the lid, on the round color comparator, and on the activator solution. The ampoules do not expire as long as they are kept in the dark and at room temperature. If your equipment is expired, **DO NOT USE**.



2. Remove the 25 ml sample cup and black lid from the kit and rinse them **<u>three times</u>** with stream water.
    a. Facing upstream, in the area along your *transect* with the greatest flow, fill the sample cup to 25 ml mark, mixing the water and air as little as possible.

b. Lower the sample cup down to wrist depth while holding it upside down. Turn the opening downstream so that the cup backfills with water, then turn the cup upstream and carefully remove cup and water sample from stream.

3. ***GENTLY*** tip the sample cup to pour off excess water.



4. Add 2 drops of A-8500 Activator Solution, place black cap on sample cup, and shake to mix the contents.

5. Place the ampoule in the sample cup, tilting it so the tip is wedged in one of the spaces along the side of the sample cup.

6. Snap off the tip of the ampoule by pressing it against the side of the cup, allowing it to fill with water.

7. Remove the ampoule from the cup and mix the water in the ampoule by inverting it slowly several times. Be careful not to touch the broken end as it will be sharp.

8. **Two minutes** after you break off the ampoule tip, compare the ampoule to the color standards provided in the kit. ***Read the ampoule right at two minutes as the ampoule will continue to change color.*** Remove your sunglasses before making a determination.

9. Based on the color of your ampoule, use the appropriate color comparator to estimate the orthophosphate concentration.

   a. The low-range circular comparator measures concentrations ranging from 0 to 1 mg/L. To use the circular comparator, place your ampoule, flat end downward, into the center tube. Direct the top of the comparator up toward a good light source while viewing from the bottom. Rotate the comparator to match your ampoule to the standards, and record your results on the IOWATER field form.
   OR

   b. The high-range comparator in the lid of the kit measures concentrations ranging from 1 to 10 mg/L. Hold the high range comparator nearly flat while standing directly beneath a bright source of light. Place your ampoule between the color standards moving it from left to right until the best color match is found. Record your result on the IOWATER field form.

Note: ***Keep color comparator and unused ampoules away from direct sunlight***, as they will change to a blue color and are no longer usable. The ampoule and ampoule tip may be disposed of in your household trash – be careful of the broken glass. Avoid breaking ampoule open, as contents can be mild skin and eye irritants. Sample water should be disposed of by pouring down household drain, not back into the stream.

STORE IN THE DARK AT ROOM TEMPERATURE

If you notice that the ampoule color result is more green or brown than blue, and you have a difficult time matching it to the standards, please contact IOWATER for additional equipment to filter water samples to remove excess algae and/or sediment before running the test. Procedures for filtration will be sent with the filtering apparatus.

Chloride

Chloride is a chemical found in salts, which tend to dissolve easily in water. In natural waters, elevated levels of chloride may indicate inputs of human or animal waste, or inputs from fertilizers, many of which contain salts. During winter months, elevated chloride levels in streams may occur as a result of road salt runoff to nearby streams. Chloride can be used as a "conservative" measure of water contamination since other natural processes, such as breakdown by bacteria, do not affect it.

The amount of chloride dissolved in water is expressed in milligrams per liter of water (mg/L). Average chloride concentrations for Iowa streams range from 16 to 29 mg/L.

Typical range for chloride = 16 to 29 mg/L (rivers)

Iowa average = 22 mg/L (rivers)

No data available for lakes

** Based on 2000 through 2014 data collected by the Iowa*

DNR

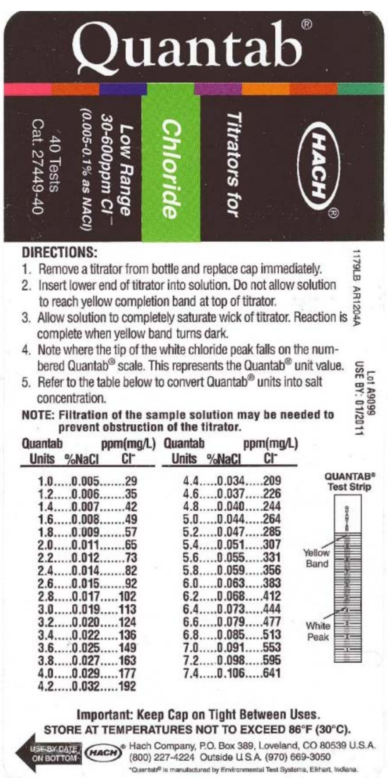
Reporting Technique: For use with Hach® chloride titrators and sample cup from one of the Chemetrics® test kits.

1. Check the expiration date on the bottom of the chloride bottle. If your equipment is expired, **DO NOT USE**.

2. Rinse the 25 ml Chemetrics® test kit sample cup three times with stream water.

3. Facing upstream, in the area along your *transect* with the greatest flow, fill the sample cup up to the 25 ml mark with stream water.

4. Remove a titrator from bottle and replace cap immediately.Insert the lower end of titrator into sample cup. Do not allow the yellow completion string located at the top of the titrator to become submerged in the water sample.



5. Allow water sample to completely saturate the wick of the titrator. There is no time limit for this test – the reaction is complete when yellow string turns dark (this will take about 5-10 minutes).

6. Note where the tip of the white chloride peak falls on the numbered Quantab® scale. This represents the Quantab® unit value.

7. Refer to the table on the Quantab® test strip bottle to **convert the Quantab® units into a chloride concentration** and record results on the IOWATER field form.

8. If the Quantab® unit is below 1.0, report the chloride concentration as < (less than) the lowest concentration listed on the test strip vial (which for data submission purposes is 25 mg/L).

9. Quantab® test strips may be disposed of with household trash. Sample water can be disposed of in the field.

STORE AT TEMPERATURES NOT TO EXCEED 86°F

Chloride concentrations at some sites have exceeded the upper limits of this test (which can be recorded as >600 mg/L). To obtain high range chloride strips, with a range of 300-6,000 mg/L, contact IOWATER.

Interrelationship among Chemical Parameters

The chemical parameters being measured as part of IOWATER are interrelated. See the IOWATER Data Interpretation Chapter for more information on how the chemical parameters, as well as the physical parameters, affect each other.

Chemical Assessment Review Questions

pH

1. What is pH?
2. What can affect pH?
3. What are typical pH levels in Iowa waters (rivers, lakes)?
4. Once wet, how long do you wait before reading the pH test strip?

Dissolved Oxygen

1. What is dissolved oxygen?
2. What can affect dissolved oxygen in water?
3. Why is dissolved oxygen important in water?
4. What are Iowa's dissolved oxygen water quality standards?

Nitrite/Nitrate-N

1. What is nitrate-N and nitrite-N?
2. What are sources of nitrogen in water?
3. How long do you wait before reading the nitrite/nitrate-N test strip?
4. How does nitrate differ from phosphorus?

Phosphorus

1. What is phosphorus?
2. What are sources of phosphorus in water?
3. How do you use the two color comparators in the kit?
4. How do you dispose of the ampoule?

Chloride

1. What is chloride?
2. What are sources of chloride in water?
3. Why are typical concentrations of chloride in Iowa's streams?
4. Describe the procedure for using the chloride test strip.

CHAPTER 7

Physical Assessment

Introduction

The physical characteristics of a stream will greatly influence what type of aquatic life a stream will support. Within the theatre that is the stream, the physical aspects make up the stage on which all life performs. The stage backdrop of width, depth, velocity, flow, and water temperature influences all of the chemical and biological aspects of the stream.

Weather

Weather may be at times the ONLY thing that matters. For example, a strong four-hour spring rain may result in most of the stream's annual sediment and pollution load. Long-term weather conditions can greatly affect our streams. Floods, droughts, or other climatic extremes can change the stream's physical and chemical characteristics quite dramatically (e.g., creating new stream channels or drainage patterns).

Other ways weather can impact streams are as follows:

- Cloudy weather may result in lower dissolved oxygen levels because of less plant photosynthesis.
- Recent rains reduce point source pollution impacts because of dilution.
- Recent rains increase nonpoint source pollution impacts because of increased surface water runoff and pollutant transport.
- Wind may raise dissolved oxygen levels by increasing turbulence.

- Temperature will affect many parameters, such as the stream's ability to retain dissolved oxygen.

Reporting Technique: Report the weather conditions at the time of your stream assessment. Use the thermometer to measure air temperature before you use it for water temperature. Use your own rain gauge or contact a local radio or newspaper to find out the amount of precipitation during the previous 24-hour period. Web-based resources for precipitation information may also be found at www.iowadnr.gov/iowater under the Database menu.

Water Color

The water's color can provide you immediate clues as to a stream's condition. Although clear water may or may not be of high quality, other colors may indicate certain conditions.

Reporting Technique: Estimate water color using these general guidelines.

- **Clear** – Clear water doesn't necessarily mean clean water, but it could indicate low levels of dissolved or suspended substances.
- **Brown** – Brown water is usually due to heavy sediment loads.
- **Green** – Green water is usually the result of excess algae growth.
- **Oily Sheen** – Oily sheens can be caused by petroleum or chemical pollution, or they may also occur naturally as byproducts of decomposition. To tell the difference between petroleum spills and natural oil sheens, poke the sheen with a stick. If the sheen swirls back together immediately, it's petroleum. If the sheen breaks apart and does not flow back together, it is from bacteria or plant or animal decomposition.
- **Reddish** – Reddish or orange colors are usually due to iron oxides.
- **Blackish** – Blackish water is usually is caused by a natural processes of leaf decomposition. Pigments leached from decaying leaves can cause the water to appear murky.
- **Milky** – A milky appearance may be caused by salts in the water.
- **Gray** – Gray water may be a result of natural or human-induced activities.

Water Odor

Water odor, like the water color, can provide immediate clues about potential problems in a stream.

Reporting Technique: Estimate water odor using these general guidelines.

- **None** – The water has no odor
- **Sewage/Manure** – These smells can be common in Iowa's air but should NOT be what our water smells like. It is important to differentiate whether the odor is coming from the water or the air.
- **Rotten Egg** – This odor can be caused by hydrogen sulfide gas, a by-product of **anaerobic decomposition** (rotting without oxygen). This is a natural process that occurs in areas that have large quantities of organic matter and low dissolved oxygen. It may be caused by excessive organic pollution.
- **Petroleum** – Any petroleum or chemical smells can indicate serious pollution problems from a direct source, such as industry or parking lot/storm sewer runoff.
- **Musky** – Musky odors may result from natural or human-induced activities.

Stream Flow

After visiting your site a few times, or by looking closely for high water marks on the land or trees, you will be able to assess stream flow (i.e., whether it's high, normal, or low).

Reporting Technique: Estimate stream flow using these general guidelines.

- High – Stream flow is higher than normal.
- Normal – Stream flow is normal.
- Low – Stream flow is lower than normal.
- Not sure – If normal stream flow is not known, stream flow cannot be estimated.

Stream Width

Stream width is measured from the edge of the water on one bank to the edge of the water on the opposite bank and recorded in meters.

Reporting Technique: To calculate the stream's width:

Facing upstream and starting from the left bank of your *stream transect*, measure the width of the stream in meters with the measuring tape. Make sure to measure the width at the same place each time you assess the stream! To complete stream depth and velocity measurements, you will need to either stake the tape across this stream in this position or monitor with others who can help hold the tape across the stream transect.

Stream Depth

Water depth is important for many fish. Most fish require deeper water areas for over-wintering, and shallow waters are important food production and feeding areas.

Reporting Technique: To calculate a stream's depth:

1. Measure the stream width (see the previous section).
2. Facing upstream and starting from the left bank of your *stream transect*, measure and record the depth of the water in meters at each one-meter increment. Remember to convert centimeters to meters. If your stream is less than two meters wide, measure one spot in the middle.

Maximum Stream Depth

Stream depth is not only important for aquatic life, but it is also important for recreation. Recording maximum stream depth can help provide a more accurate assessment of streams.

Reporting Technique: To calculate maximum stream depth:

Find the deepest spot in the stream along your *transect* and record the depth in meters.

Stream Velocity & Flow

A stream's velocity is a measurement of how fast the water is flowing. This information, along with the stream's water depth and width, is needed to calculate the **flow** (or stream **discharge** rate). This information can help us understand the effects of other parameters.

Reporting Technique: To calculate a stream's average velocity:

1. Measure stream width and depth at your *stream transect* (see the previous sections).
2. Hold the tennis ball (with one-meter string attached) with one hand and the end of the string in the other. Hold both of these directly below the one-meter mark on the tape measure (facing upstream, you should be one meter out from the left bank).
3. Have someone with a stopwatch say "GO," while you release the ball, but continue to hold the string at the one-meter mark.
4. When the ball floats to the end of the string (one meter), stop timing. Record in seconds the time it took the tennis ball to travel the one meter.
5. Repeat the procedure for each one-meter increment. If your stream is less than two meters wide, measure one spot in the middle.

Water Temperature

Many of the chemical, physical, and biological characteristics of a stream are directly affected by water temperature. Some species, such as trout, are quite sensitive to temperature changes. Water temperatures can fluctuate seasonally, daily, and even hourly.

Human activities can adversely raise stream temperatures in a variety of ways. **Thermal pollution** can be caused by:

- releasing warmed water into a stream from industry discharges or runoff from paved surfaces
- removing riparian corridors, which increases solar heating
- soil erosion, resulting in darker water, which can absorb more sunlight

Water temperature impacts:

- The amount of oxygen dissolved in water – cool water holds more oxygen than warm water

- The rate of photosynthesis by algae and aquatic plants – the rate of photosynthesis increases with higher temperatures
- The metabolic rates of aquatic animals, which increase with higher temperatures
- The sensitivity of organisms to diseases, parasites, and toxic wastes

Human impacts are most critical during the summer, when low flows and higher temperatures can cause greater stress on aquatic life. It is important to note that the temperature of some streams are normally higher than others, depending on groundwater flow into the stream, weather, and other factors.

Reporting Technique: At your *stream transect* place an aquatic thermometer directly into the stream, holding it underwater in the main flow of the stream (not in a pool) for at least two minutes so the reading can stabilize. Record the temperature on your datasheet.

Instructions for reuniting separated fluid in thermometers: Prepare a solution of shaved ice and salt water. Place the thermometer bulb only into the solution while keeping the thermometer in an upright position. When the liquid column has retreated into the bulb, swing the thermometer with the bulb down in an arc, which will release entrapped gas, permitting it to escape upward in the column. Allow thermometer to warm slowly in an upright position.

Transparency

Transparency is a measure of water clarity and is affected by the amount of material suspended in water. As more material is suspended, less light can pass through, making it less transparent. Suspended materials may include soil, algae, **plankton**, and microbes. Transparency is measured using a transparency tube and is measured in centimeters. It is important to note that transparency is different than turbidity; transparency is a measure of water clarity measured in centimeters, while turbidity measures how much light is scattered by suspended particles using NTUs (Nephelometric Turbidity Units).

Low transparency (or high number of suspended particles) is a condition that is rarely toxic to aquatic animals, but it indirectly harms them when solids settle out and clog gills, destroy habitat, and reduce the availability of food. Furthermore, suspended materials in streams promote solar heating, which can increase water temperatures (see *Water Temperature*), and reduce light penetration, which reduces photosynthesis, both of which contribute to lower dissolved oxygen. Sediment also can carry chemicals attached to the particles, which can have harmful environmental effects.

Sources of suspended particles include soil erosion, waste discharge, urban runoff, eroding stream banks, disturbance of bottom sediments by bottom-feeding fish (carp), and excess algal growth.

Reporting Technique:

1. Make sure the finger clamp on the hose is closed. Facing upstream, in the area along your *transect* with the greatest flow, fill the transparency tube.
2. Hold the tube upright and in the shade. Use your body to shade the tube if nothing else is available.
3. With your back to the sun, look directly into the tube from the open top and release water through the small hose, regulating the flow with the finger clamp until you are able to distinguish the black and white pattern (Secchi pattern) on bottom of the tube. Close the finger clamp.
4. Read the number on the outside of the tube that is closest to the water line. Record your reading in centimeters (cm).

*Note – Rinse the tube after each use so that the bottom Secchi pattern does not become dirty and clouded.

CHAPTER 8

Standing Water Assessment

Introduction

Iowa has 5,432 recognized "standing waters," including lakes, reservoirs, ponds, and wetlands, covering 161,366 acres. While the majority of these are farm ponds and small wetlands, 115 are significant publicly owned lakes, four are flood control reservoirs (Coralville, Red Rock, Rathbun, and Saylorville), and 67 are "**meandered**" lakes.

Lentic waters is a broad term that encompasses all standing waters. Lakes are either naturally formed or constructed. Naturally formed lakes include glacial lakes and **oxbow lakes**. Several advances of glacial ice into Iowa stagnated, depositing large blocks of ice on the landscape. **Glacial till**, unsorted glacial material, was deposited around these blocks of ice, and when the ice melted, kettle lakes were created. Oxbow lakes and backwater marshes form as meandering streams cut off their own meanders, leaving behind a body of standing water. Reservoirs, on the other hand, are formed by building a dam across a stream.

For the purposes of water monitoring, standing waters will be referred to as "lakes." Lakes serve as "sinks," or storage areas; everything (sediments, chemicals, nutrients, etc.) transported through watersheds eventually find their way into standing waters, where the pollutants may become concentrated and their effects can be observed. This is the natural function of standing waters – to collect water, clean it, and then release it. Therefore, lakes are direct reflections of the watersheds around them.

Site Selection

The number and location of your monitoring sites will be influenced by the goals and objectives of your monitoring program. A program designed primarily for public education, for example, may include sites for non-scientific reasons, such as their proximity to residential neighborhoods or convenience of access. Such a program may even include more monitoring sites in a lake than necessary for scientific goals so more volunteers can participate in monitoring.

A program that is designed to collect scientific data will focus on the most representative location of the lake for your monitoring site. In most cases, this will be in the deepest, open water area of your lake. Average conditions are best represented by a site of this nature. The deepest point in circular, natural lakes is usually near the middle. The deepest section of a human-made reservoir is usually near the dam. Lakes that have large arms or bays should be sampled in the deepest section of each individual arm or bay.

Other considerations for selecting lake monitoring sites:

- The location of the monitoring site needs to be consistent. In the field, identify and locate your sampling site location. Once identified, the site should be clearly marked on a lake map. This site should then be registered on the IOWATER database in the same manner as stream sites are registered.
- For shoreline or dock monitoring sites, finding the site will be less of a problem, but the location still needs to be documented.
- As with stream monitoring, background research and “The Driving Tour” of the watershed is recommended. Some sources of information for lakes could include:
    - Bathymetric (depth contour) maps or general knowledge of the location of maximum depth area of the lake. Soundings with a "depth finder" can be used and a suitable monitoring location identified. Many of Iowa's lakes have bathymetric maps available from the Iowa DNR.
    - Watershed and topographic maps that show the lake's major inflows and outflows.
    - Information on any current activities in the watershed, including point sources, such as water treatment discharges, storm drain overflows, or failing septic systems, and nonpoint sources, such as agricultural and urban land uses and construction areas that may affect sampling results.

- Information on any current lake activities, like dredging, water level draw-downs, and chemical applications that may affect sampling results.

Point Sampling

To ensure consistency when conducting lake monitoring, a **point sampling** method (sampling from a specific depth) is used. Sampling from a specific depth, or point, in the lake water column is called point sampling. IOWATER's method of point sampling will be to a depth of approximately one-half meter, following these steps:

1. Rinse the sampling cup three times in an area away from where you will sample.
2. Submerge the sample cup upside-down into the water to elbow depth (1/2 meter).
3. Slowly turn the bottle right side up.
4. Gently lift the bottle out of the water.
5. Do chemical monitoring with sample.

IMPORTANT: Use a separate water sample for each chemical parameter monitored. This method will be used for pH, Nitrite-N / Nitrate-N, dissolved oxygen, phosphate, and chloride as discussed in the chemical assessment section of this chapter.

Frequency of Monitoring

IOWATER suggests beginning lake monitoring at spring ice-out and continue until fall freeze-over on a monthly schedule. If this is too rigorous of a schedule, or if the goals and objectives of your program don't require this frequency, set a schedule that works for you. The most important concept is <u>consistency</u>. If you sample the first week of May, July, and September, be sure to repeat this as closely as possible the next year.

In general, IOWATER recommends to conduct sampling between 10 a.m. and 3 p.m. Understand, however, that there is flexibility in both the day and time, especially in consideration of weather conditions. Use good judgment as to when to sample. IOWATER recommends that you not sample alone and be sure to let someone know when and where you are going out to sample. Under no circumstances should volunteers be on the water during rain or electrical storms, high winds (white caps), thin ice, or other unsafe conditions.

Habitat Assessment

Inlets/Outlets

It may be useful to your efforts to conduct IOWATER stream monitoring on all lake inlets and outlets. By monitoring water inlets, you may be able to distinguish if they are significant contributors of pollution, or if fluctuations in various parameters correlate with fluctuations in your lake assessments. For example, do "spikes" of inlet measurements in phosphate and nitrate and decreases in water clarity correlate with increased algal growth in your lake? Measuring outlet information may be useful in determining if the lake is contributing to downstream sediment or nutrient loading. It may also gage the effect your lake has on water quality as it passes through the system.

Use caution, here, when drawing conclusions of cause and effect. Many variables that are not measurable may be contributing to water quality, such as rainfall directly on the lake, groundwater flows from underground aquifers, leaking city sewers, and private septic systems. Your monitoring information can act as tools to identify trends or send up "red flags" to a potential problem, but it will probably not tell the full story of what is happening within your water body.

Lake Banks

Documenting the condition of the lake banks over time may be useful. On the IOWATER database, you will be able to give a written description of your lake bank assessment. Be sure to include approximate relative distances if possible (e.g., most of south shore is riprap covered, west shore from southern **riprap** to Eagle Point is the gently sloping grass bank of Swan State park, rest of west shore and whole north end is cattails with gently sloping bank, and east shore down to Smith property where the riprap starts is cut-bank eroding).

Adjacent Land Use

As with the lake bank description, adjacent land use will act as a narrative of the land use activities surrounding the lake. Using the same categories for this parameter as IOWATER Stream monitoring (agriculture, urban, light industrial, etc.), estimate the percentage of each type of adjacent land use. If you have had changes that will not be reflected in the above categories that you wish to document, please use the "Other Assessment Observations and Notes" section at the end of the assessment form.

Physical Assessment

Weather

Weather categories are the same as the IOWATER Stream Monitoring categories except for the addition of wind direction and wind speed. Wind direction refers to the direction the wind is coming from.

Water Clarity - Secchi Disc Transparency

A Secchi disc is used to measure water clarity, or how deep a person can see into the water. A Secchi disc is a circular disk, about 20 centimeters (8 inches) in diameter, painted with black and white quadrants. It is a standard piece of equipment used by scientists and volunteers since its development in 1865 by Professor P.A. Secchi.

There are many factors that affect water clarity. Do not assume algal density is directly measured by Secchi reading! How deep a person can see into the water can be affected by many natural and unnatural factors occurring both inside and outside the lake.

Inside the lake, water clarity can be reduced by:

- Organisms such as diatoms and plankton
- Dissolved materials that are natural or unnatural
- Sediment suspended in the water column

Outside the lake, water transparency can be misinterpreted by:

- Human error, such as the observer's eyesight
- Time of day, latitude, and season of the year, which affect the angle that sunlight strikes the lake surface
- Cloud cover, rain, and other weather conditions
- Conditions of water surface, such as waves, sun glare, and surface scum

Because of these factors, transparency measurements taken with the Secchi disc should only be considered a baseline. In order to prove a direct correlation between algae and a reduction in transparency, a direct measurement of the algal population must be made. A measurement of algal population would include sampling for **chlorophyll**, which is not a field test.

Secchi Disc Procedures

The following procedures are modified, with permission, from the Illinois Environmental Protection Agency and Northeastern Illinois Planning Commission's *Volunteer Lake Monitoring Program Training Manual* (April 1997):

1. Travel to your monitoring site. Remove sunglasses.
    a. If monitoring from a boat, carefully lower an anchor over the side until it reaches the bottom. The force of the anchor hitting the lake bottom will disrupt a certain amount of bottom sediment. Let out plenty of anchor line so that the boat drifts away from the sediment plume that may have been kicked up by the anchor.
2. Attach the Secchi disc to the tape measure. Lean over the shaded side of the boat/dock and slowly lower the Secchi disc into the water until it is no longer visible. In some cases, the following special circumstances may apply:
    a. In some shallow lakes, it is impossible to get a Secchi disc reading because the disk hits the bottom before vanishing from sight. This means the true Secchi disc reading is greater than the depth of the lake in that location. In this case, use a transparency tube to get a reading of water clarity and record results on the Standing Water field form.

   b. Sometimes the Secchi disc is lost from view because it "disappears" into the dense growth of rooted aquatic plants. Try moving a few feet away to improve sight of the Secchi disc through the vegetation. If this doesn't work, use a transparency tube to get a reading of water clarity and record the results.

3. When the disc is no longer in view, mark the tape measure with a paperclip.
4. Lower the disc a few more feet in the water, and slowly raise it back towards the surface. When the disc reappears, mark the tape measure at the water's surface with a paperclip. Bring the tape measure and disc back into the boat.
5. Form a loop between the two clothespins. Use a third clothespin to mark the center of the loop. This marks the "average" of the two readings and is considered to be the Secchi depth. Record the results on the IOWATER Standing Water Assessment field form.
6. Follow the procedures below to determine water color.

Water Temperature

Water temperature should be taken at a depth of approximately one-half meter (elbow depth).

Water Level

The categories IOWATER will use for water level in lakes are "normal," "low," or "high." Many of you may have access and the ability to more precisely measure the lake water level in terms of inches above or below "normal", and we encourage you to document this on your field form and in the IOWATER database if possible.

Water Odor

The water odor categories on the lake assessments form are the same as those used with stream monitoring, with the exclusion of the category "Musky" and addition of "Fishy."

Chemical Assessment

REMEMBER – Point Sampling! To collect water samples for chemical assessments submerge the sample cup upside-down into the water to elbow depth (1/2 meter), turn the cup right side up, and gently lift the cup out of the water. Use a separate water sample for each chemical parameter monitored.

pH

Very rarely do problems with pH occur within Iowa surface waters because of limestone bedrock and carbonate minerals in our soils. The average pH in Iowa lakes is 8.0. Except for the point sample collection procedure, IOWATER Stream Monitoring procedures apply. For more information on pH see Chapter 6 of this manual.

Nitrite-N and Nitrate-N

Except for the point sample collection procedure, IOWATER Stream Monitoring procedures apply. For more information on nitrogen in surface water, see Chapter 6 of this manual.

Phosphate

Phosphorus is essential to plant growth and reproduction. Plants and algae most readily take up a form of phosphorus known as orthophosphate, or "free phosphate," which is the simplest form of phosphorus found in natural waters. Orthophosphate is so quickly taken up by growing algal populations that, if present, it is typically found in low concentrations. Since phosphate is taken up more readily than nitrate, it is often regarded as a **limiting resource** for algal growth.

Except for the point sample collection procedure, IOWATER Stream Monitoring procedures apply.

Dissolved Oxygen

The amount of oxygen in water is an important indicator of lake health. Many experts consider dissolved oxygen to be the most important parameter used to characterize lake water quality, and DO plays a crucial role in determining the types of organisms that can live in a lake. Some species, such as many sport fish, need consistently high oxygen concentrations to survive. Other aquatic species are more tolerant of low or fluctuating concentrations of oxygen. Oxygen is supplied naturally to a lake through the diffusion of atmospheric oxygen into the water (enhanced by wind and waves) and the production of oxygen through photosynthesis by aquatic plants and algae.

Water temperature affects the capacity of water to retain dissolved oxygen. Cold water can hold more oxygen than warm water. Therefore, a lake will typically have a higher concentration of dissolved oxygen during the winter than the summer.

Algae and aquatic plants produce oxygen as a by-product of photosynthesis, but also take in oxygen for respiration. Respiration occurs all the time by both plants and animals but photosynthesis occurs only in the presence of light. Consequently, a lake that has a large population of algae or plants can experience a great fluctuation in dissolved oxygen concentration during a 24-hour period. In extreme cases, the oxygen in the water can become depleted during the late evening and pre-dawn hours because of plant and animal respiration.

Except for the point sample collection procedure, IOWATER Stream Monitoring procedures apply.

Chloride

Except for the point sample collection procedure, IOWATER Stream Monitoring procedures apply. **Remember to convert the Quantab Units into mg/L using the chart provided on the vial.**

CHAPTER 9

Data Submission

Data Review

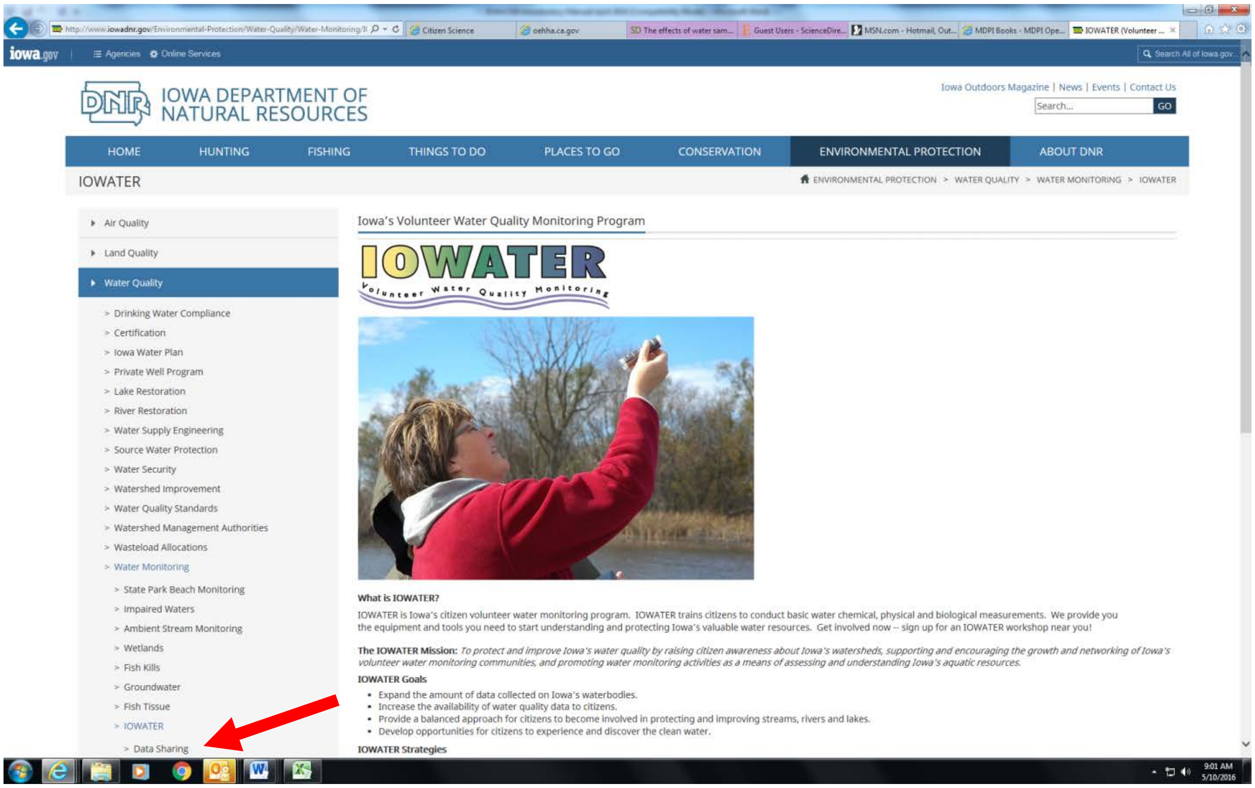
Once you've returned from your sampling site, it's important to review your data sheets. Review them right away while things are still fresh in your mind, even if you won't be entering the data until a later date. Be sure to include comments about anything unusual you noticed when you sampled. If you had to change your sampling location for some reason (flooding, construction, etc.), please note this. As you collect additional data about the stream, these comments will be valuable to see trends or explain an unusually high or low measurement.

Make sure to keep your field data sheets! You may need them several months later if you question a result. The problem may be a simple error in entering the sampling results into the database.

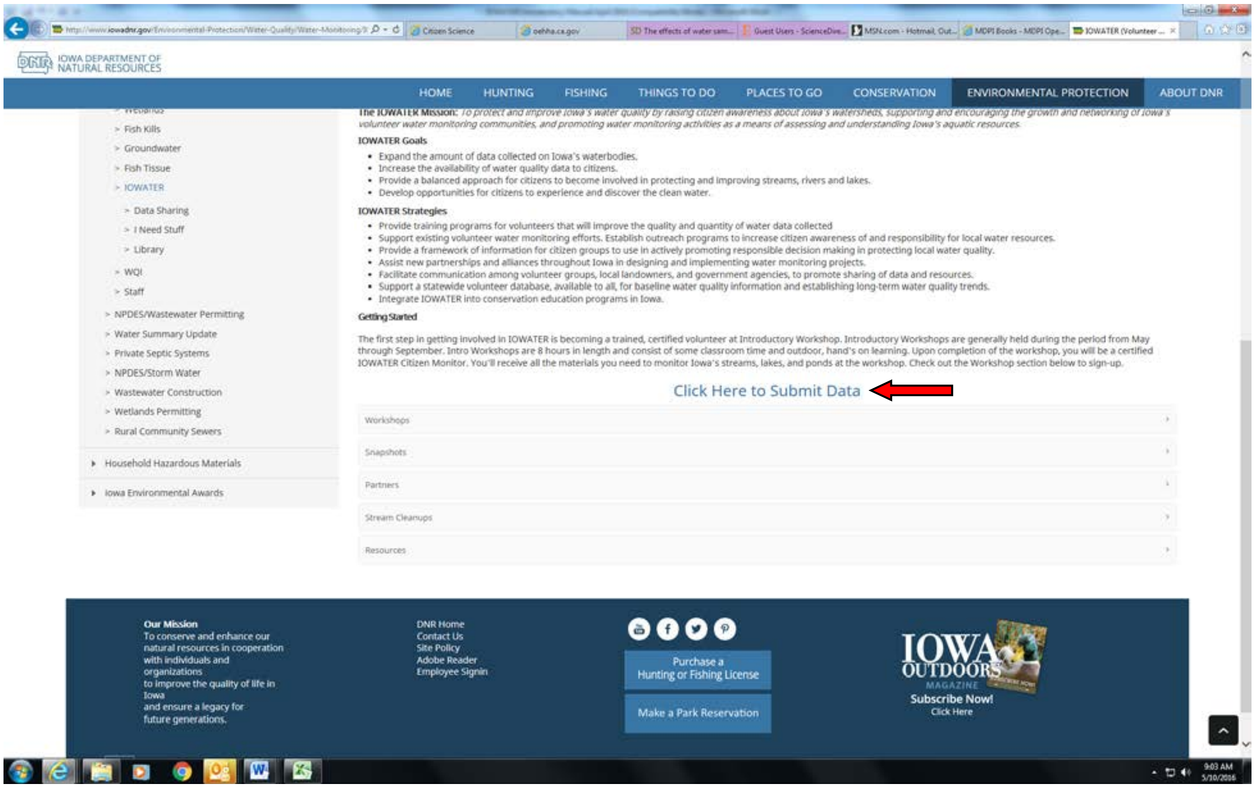
Monitor Identification and Password

Once you've completed an IOWATER workshop, you will be allowed to create a unique IOWATER monitor identification number and password. Both will allow you to register monitoring sites online and access the online database to enter data for your monitoring sites. Do not share them with others; you are responsible for the data submitted with your numbers. To create your monitor id and password, navigate to the IOWATER home page at www.iowadnr.gov/iowater. Click on "Data Sharing" on the left hand side of the page (see Red Arrow in picture below) or on the "Click Here to Submit Data" near the bottom of the main page (see the Red Arrow on the second picture). On the data sharing page, click on "IOWATER Database" (see Red Arrow in the third figure below). You should then be redirected to the IOWATER database page as seen in the fourth figure below.

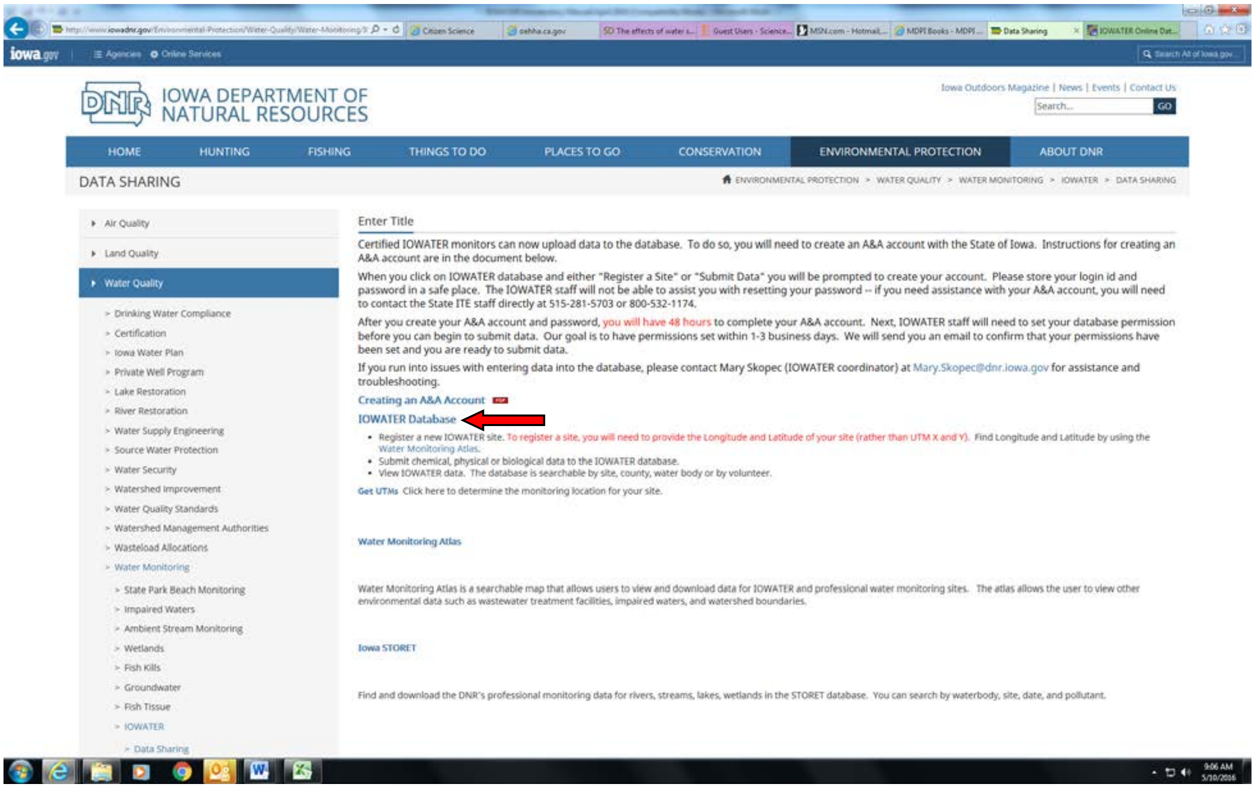
1. On the IOWATER Main Page, click on “Data Sharing” on the left hand navigation bar (see red arrow).



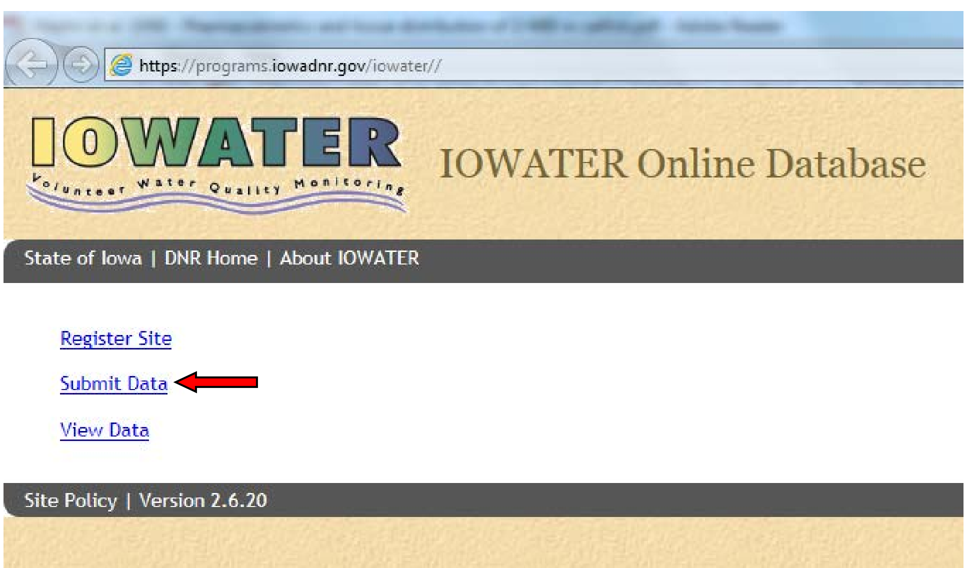
2. On the IOWATER Main Page, click on “Click Here to Submit Data” near the bottom of the page (see red arrow).



3. Click on “IOWATER Database” from the Data Sharing Page. (see red arrow below)

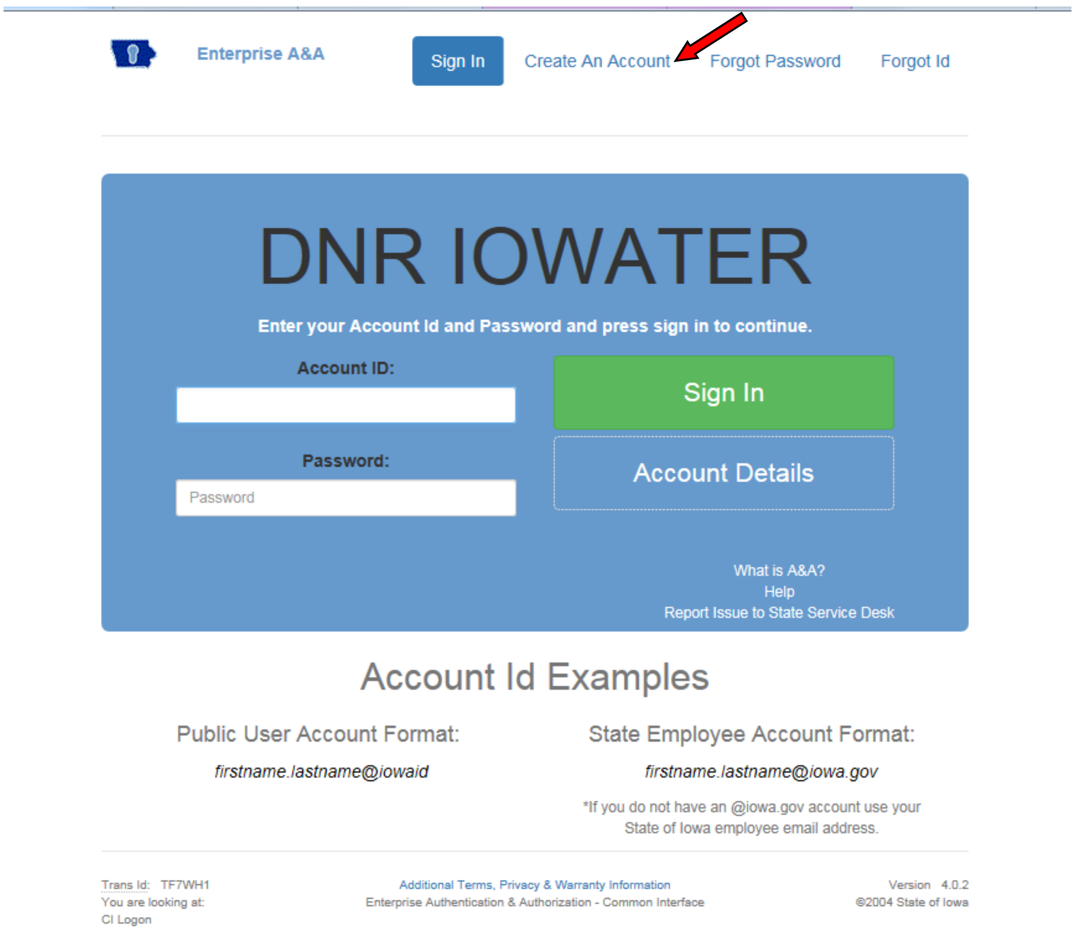


4. Click on "Submit Data" to start submitting data (see red arrow below).



At this point, the A&A log-in page pops up on your screen (see figure 5 below). Click on "Create An Account" to create your unique monitor identification number and password. Follow the steps on the webpage *exactly*. The A&A system will send you an email to finalize your account. You must finish the account within ***48 hours*** (using the same computer that you initiated the account on) or else the system will delete your account and you will need to start over.

5. Click on "Create An Account" to create your unique A&A Account ID and Password (see red arrow below).



Once your account has been established in A&A, the IOWATER team will link you to the IOWATER database and you will receive an email from the IOWATER team that you are ready to submit data. The whole process should take a day to complete. If you forget your A&A account id or password, you will need to work with the State Service Desk to reset your password. You can contact the State Service Desk at 515-281-5703 or 1-800-532-1174 or OCIO.ServiceDesk@iowa.gov.

Registering a Monitoring Site

In order to submit data for a monitoring site, the site needs to be registered. To register a site, complete the online registration form on the IOWATER website. To complete the form, you will need Latitude/Longitude coordinates for your site (see Chapter 4). A unique site number will be assigned for your site. After your site has been registered, a dropdown box will appear that contains the site, as well as any others you have registered. Select the site for which you want to submit data to continue. If you want to share a previously registered site, contact the IOWATER team at iowater@dnr.iowa.gov with the site number and a request to share the site.

Entering Data Online

IOWATER wants your data! You are encouraged to share your data by entering it into IOWATER's volunteer water quality database. You can access this database online at **www.iowadnr.gov/iowater.** This database is yours, giving you a location where you can store and retrieve your data, and allowing others to view your results. You may even discover that someone is collecting water quality information nearby, and you can compare results. It should be noted that IOWATER does not require you to share your data, although we strongly encourage you to do so. Once your site has been registered and you've received your site number, you can begin entering data.

Each field report form is menu driven. Once you have entered all of your data for a report form, hit the NEXT button. A confirmation page containing the information you entered will appear. Verify that the data is correct. If a change needs to be made, hit the Back Arrow key on your browser to return to the data entry form. Make the necessary change(s), hit NEXT again, and verify the changes. If all the data are correct, hit the FINAL SUBMIT button. Your data then will be submitted to the IOWATER database. If submitted successfully, you will receive a "Thank You" confirmation page.

If you notice an error with your data after it's been submitted, you will not be able to change it. Please contact IOWATER so the changes can be made.

Uploading Photo Records

Photograph requirements: The filename can not be more than 40 characters, including the file extension. Photographs must be in JPEG or GIF format. File size must be less then 1mb (1024kb). If you have questions about these requirements, please contact IOWATER at iowater@dnr.iowa.gov.

1. Go to the IOWATER website at **www.iowadnr.gov/iowater.** NOTE: This is process is designed to work with Internet Explorer – other browsers may not work.
2. Click on "Data Sharing" on the left menu bar. From the Data Sharing menu, select "IOWATER Database".
3. From the IOWATER Database menu, select "Submit Data".
4. Log in with your A&A account ID and Password. If you do not have an A&A account, go to steps in the previous section to create an account.
5. From the dropdown box, select the site for which you want to submit photos to and click the "Submit" button.
6. On the data entry menu, click on "Upload Photographic Records for this Site," which is highlighted in pink. This will take you to a data submission page.
7. Enter a title for the photo (must be less than 80 characters), the date it was taken, the photographer, and a caption (or description) for the photo.
8. Click the "Next" button to go to the confirmation page. Review the information you just entered – it is located in the green box on top of the page.
9. To select the photo you want to upload, click the "Browse" button in the middle of the page. This will open up a window that will allow you to find the location of your photo on your computer.

10. Once you locate the photo you want to upload, select it by clicking on it once and then click the “Open” button in the lower right-hand corner of the exploring window. This will place the path (or file extension) and file name in the “Select a photo to upload” box.
11. Click the “Upload” button to submit your photo. . If the upload was successful, you should be directed to a page that reads “Thank you for your upload.”

Field Report Forms Online

Additional copies of the Chemical/Physical Stream Assessment, Habitat Assessment, and Standing Waters Assessment field report forms can be downloaded from the IOWATER website at www.iowadnr.gov/iowater and click on “I Need Stuff” to download and print additional field forms.

CHAPTER 10

Data Interpretation Chapter

What is Normal?

In the beginning it will take you some time to know what is normal for your site and during this time it is especially important to collect data regularly to accurately characterize your site. Eventually you will know what to expect for the water quality of your site. You will also get an idea of how your site reacts to various conditions discussed below including land use, precipitation, season, and time of day. After you determine what is normal for your individual site, you may want to know if your site is normal when compared to other sites across the state. You might try to compare your site to other similar sites or compare sites above and below a potential pollution source to see if your site is impacted. This chapter will help you understand the data that you collect.

How often should you collect data?

This is a question that many volunteers ask themselves. Information about your site will only become apparent after you have collected data over a period of time under a variety of conditions. There is not a lot of data (or any in some cases) for most of the streams in Iowa. This is why you, the citizen monitor, are of vital importance in maintaining and improving our state's water quality. The more data that you collect, the more you will learn about the water quality of your waterbody. However collecting data more frequently requires a bigger investment of time for volunteers. At a minimum, IOWATER recommends that you collect samples monthly during the open water season.

Sampling a site just one time will give you a snapshot of water quality at that time, but depending on the conditions when you sample, the data you collect might not be representative of normal conditions at your site. If instead you collect samples monthly, you will get a broader picture of water quality at your site. You will have data from a variety of conditions: multiple seasons, dry weather and wet weather, cold and hot weather, influences from various land uses in the watershed, activities that may occur throughout the year, etc. In general, you will get a more complete picture of overall water quality at your site with increased sampling frequency. Sampling more frequently than monthly will further refine your picture of water quality at your site by allowing you to sample under a greater variety of conditions.

Sampling a site over a multi-year period gives you a better idea of the overall water quality at your site and allows you to see how your site has changed over time. After collecting multiple years of data, the results can be graphed and can show whether a certain parameter is increasing, decreasing, or staying the same. Figure 1 shows that transparency at the Montgomery Creek 1 Site shows a decreasing trend (transparency is getting worse) from 2001 through 2009. Figure 2 shows the nitrate trend for the same site is also decreasing (nitrate values are improving).

Figure 1. Transparency Trend at Montgomery Creek 1, Boone County

(Snapshot Site SC8, IOWATER Site 908019).

(NOTE: The black line in the following graphs represents the trend line using linear regression. The trend line shows whether the values for each parameter have increased, decreased, or stayed relatively the same. The trend lines below are not considered statistically significant; however, visual inspection can show changes in these parameters over time.)

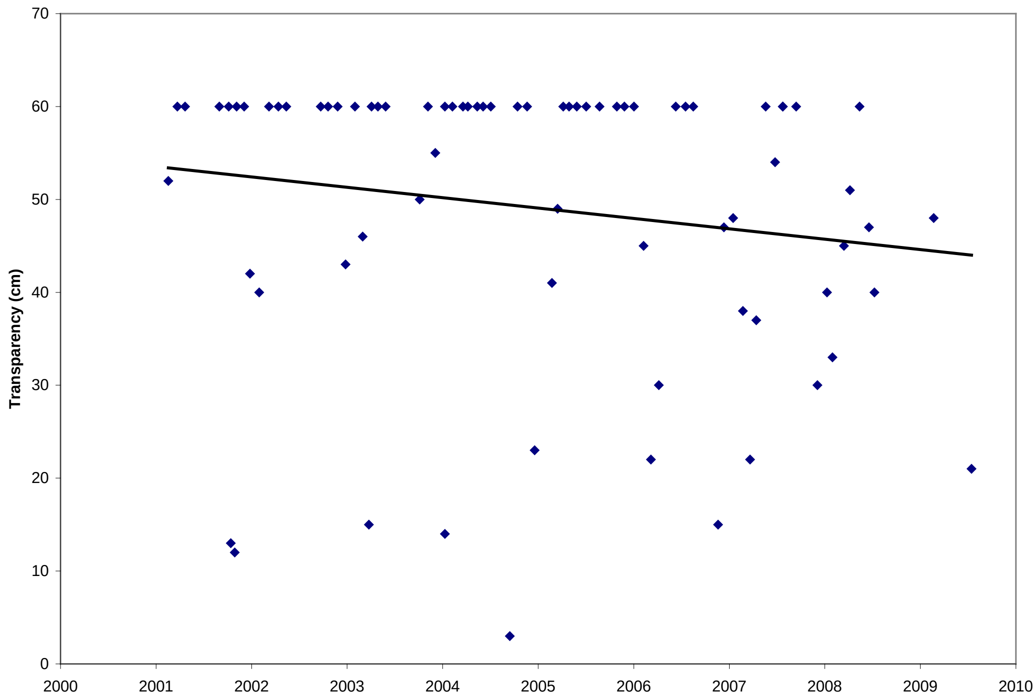
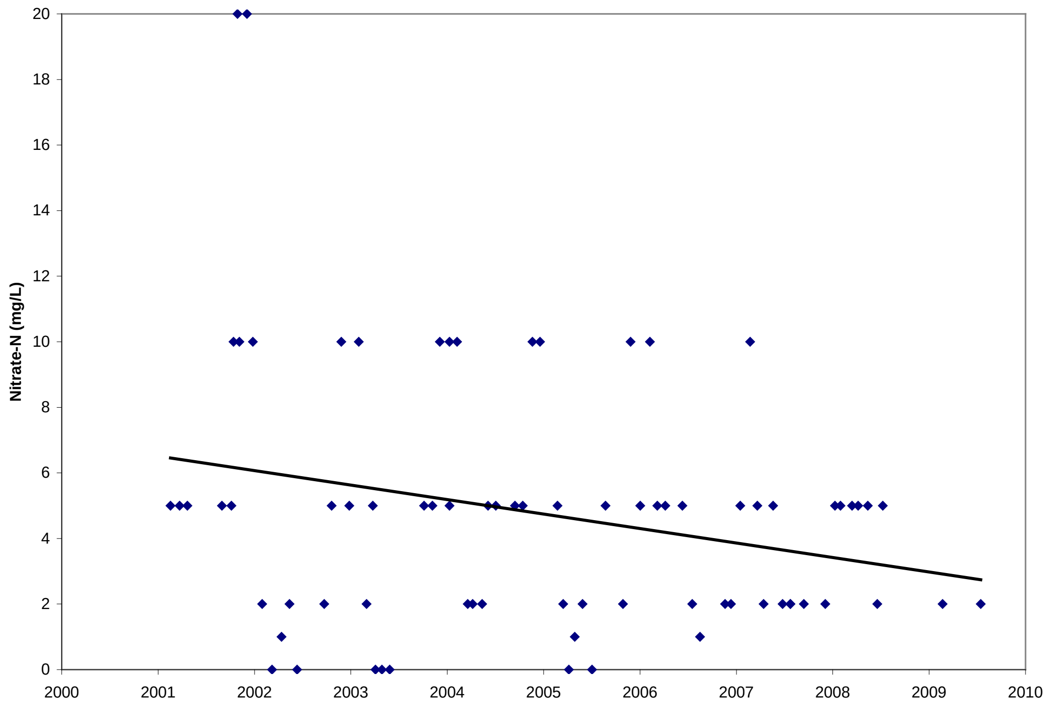


Figure 2. Nitrate Trend at Montgomery Creek 1, Boone County

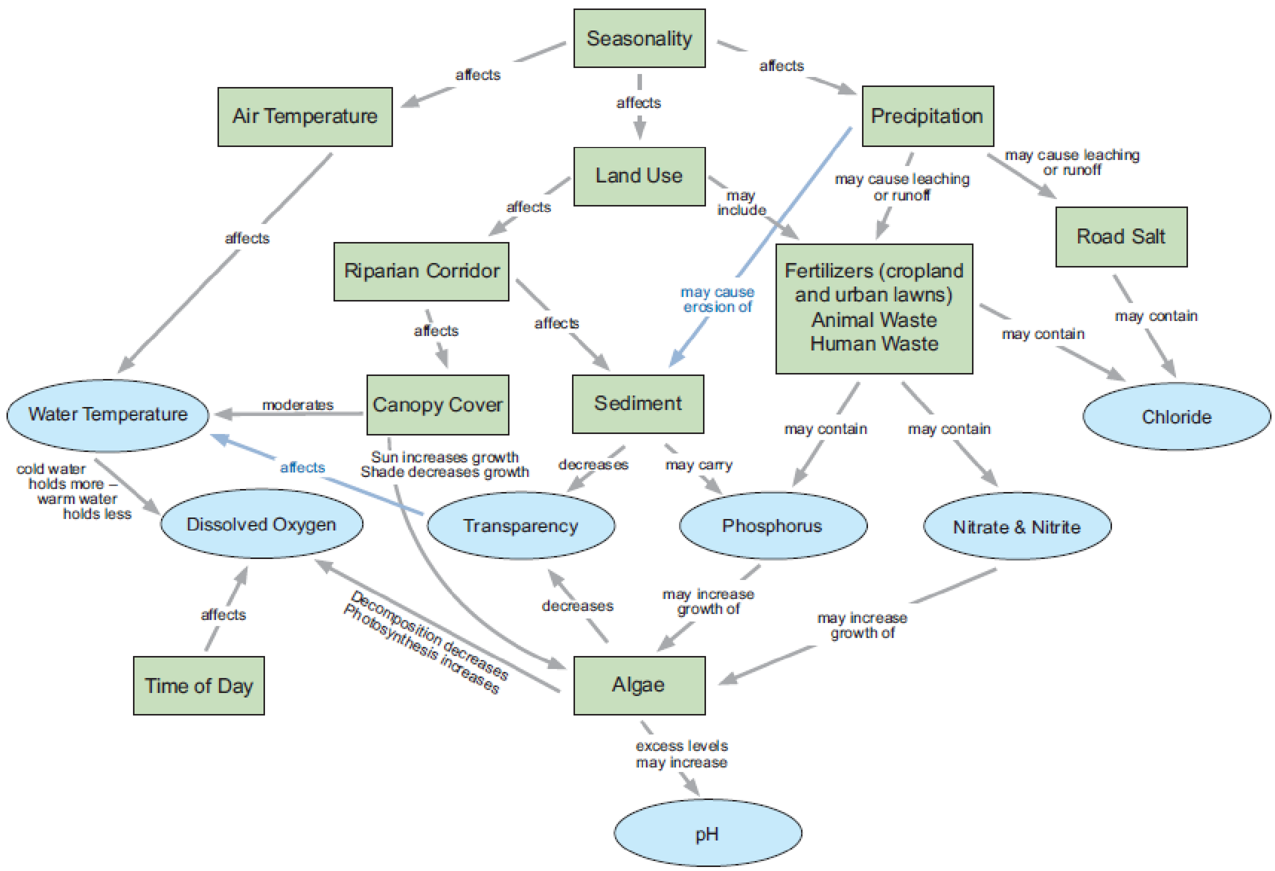
(Snapshot Site SC8, IOWATER Site 908019).



Water Quality Parameters are Connected

Aquatic chemistry is complex and is influenced by many interrelated factors. The results that you get are one piece of a complex web of interactions that includes inputs from the watershed, physical factors at the time you sample, such as weather, and the chemistry of your water body. The diagram below illustrates the complexity of these interactions.

Interrelationship among Chemical and Physical Parameters



Land Use and Water Quality

In Iowa, almost all of our land has been developed for agricultural, commercial, or residential purposes. In Iowa, 98% of the land is in private ownership. The private ownership of land, different land uses, and different land types across the state all have implications for water quality of rivers, streams, lakes, and ponds. The land use directly surrounding and in the watershed of your sampling site can have a significant effect on the water quality at your site. For example, streams and lakes with mainly corn and soybean fields in their watershed tend to have higher levels of nutrients (nitrogen and phosphorus) than waterbodies surrounded by forests or prairies. Streams within cities, or those that have cities in their watershed, tend to have higher levels of chloride in their water. While, the majority of Iowa's landscape is used for the production of corn and soybeans, notable exceptions include the northeast corner of the state that is dominated by rugged topography and bedrock outcrops, the pasturelands of southern Iowa, and some areas of the Loess Hills along Iowa's western border. Below are some general characteristics of streams and lakes in different areas of the state. It is important to remember, however, that each waterbody is unique and that these are only general trends seen when comparing different areas of the state.

Northeast Iowa

The northeastern portion of the state is characterized by rugged topography and bedrock outcrops. The area has many spring-fed streams that maintain cool water temperatures year round. The land uses in this area include forest, pasture, and row crop. In general, water quality tends to be slightly better in this area of the state with lower levels of suspended sediment in the water (i.e., higher transparency) and low to moderate levels of nitrogen and phosphorus.

North-Central Iowa

The north-central part of the state is characterized by flat topography. Land use in this area is dominated by row crop. This area is also characterized by large tile drainage systems that make the area suitable for row crop agriculture. Most of the natural lakes in Iowa are located in this region. In general, water quality in this region is variable. Nitrogen and phosphorus levels tend to be high, while suspended sediment can be moderate to high (lower transparency). The natural lakes in this region are mainly shallow systems with the exception of West Okoboji Lake, which is extremely deep. The water quality in these lakes varies from clear, low nutrient water like that in West Okoboji Lake to turbid, nutrient-rich water that is characteristic of the more common shallow natural lakes of this region.

Western Iowa

The western portion of the state is best known for the Loess Hills and rolling irregular plains. Land use in this area is mainly cropland with forests and grassland on the hills. The soil in this portion of the state tends to be highly erodible. In general, water quality in this area tends to be poor to moderate. This area has the highest levels of suspended sediment (i.e., low transparency) in the state and also has relatively high nitrogen levels.

Southern Iowa

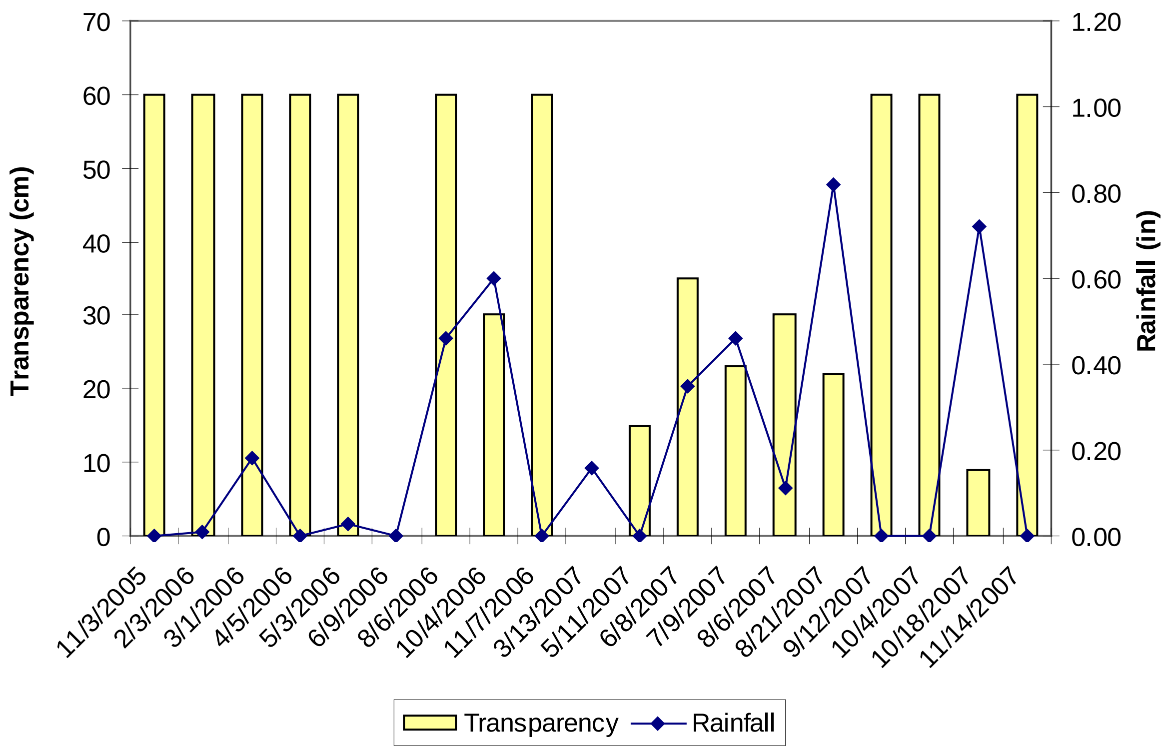
The southern portion of the state is characterized by irregular plains and open low hills. Land use in this area consists of a mix of forest, pasture, and row crop. In general, water quality in this area tends to vary depending on the parameter. Suspended sediment tends to be moderate, while nitrogen levels tend to be low.

Precipitation and Water Quality

Some parameters are sensitive to rain. Rain can cause dramatic changes in chemical levels. Changes in water quality after rain events are important to document and can tell you about your site's overall water quality, but are not generally a cause for an "emergency response." Rain can also tell you something about the source of pollution to your site. If your tests show higher levels of contaminants after rainfall, it tends to indicate that those contaminants are coming from non-point sources. If your tests show higher levels of contaminants at low flow (during dry times), it tends to indicate that the contaminants are related to point sources.

Figure 3. Transparency and Rainfall at the Highway 7 Bridge Site on Powell Creek

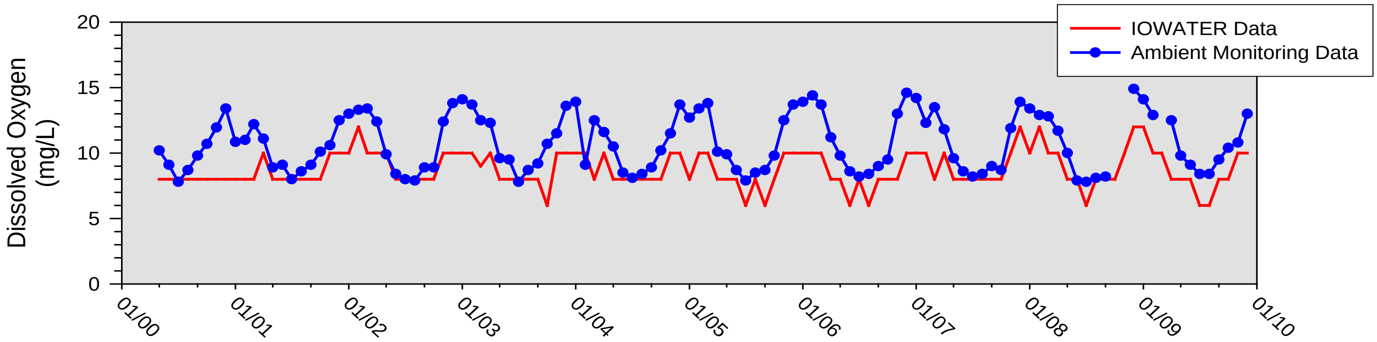
(Site Number 911021; Buena Vista County).

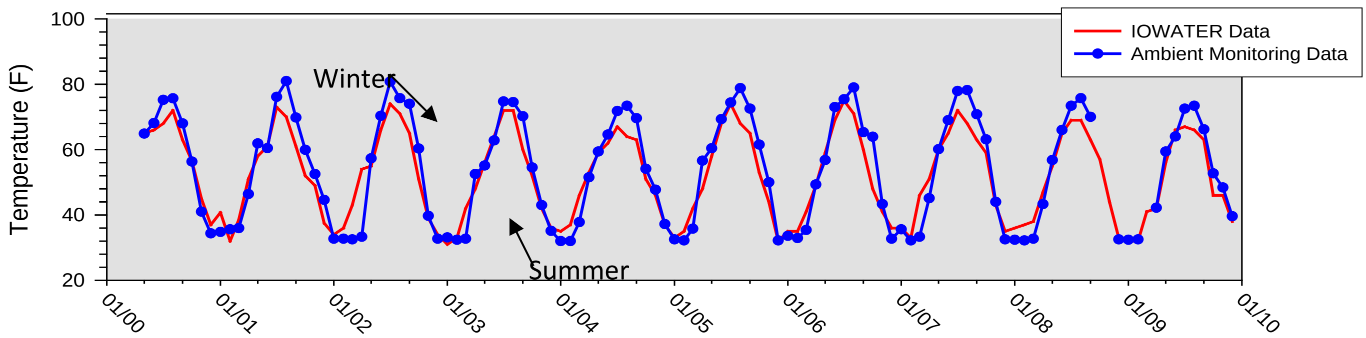


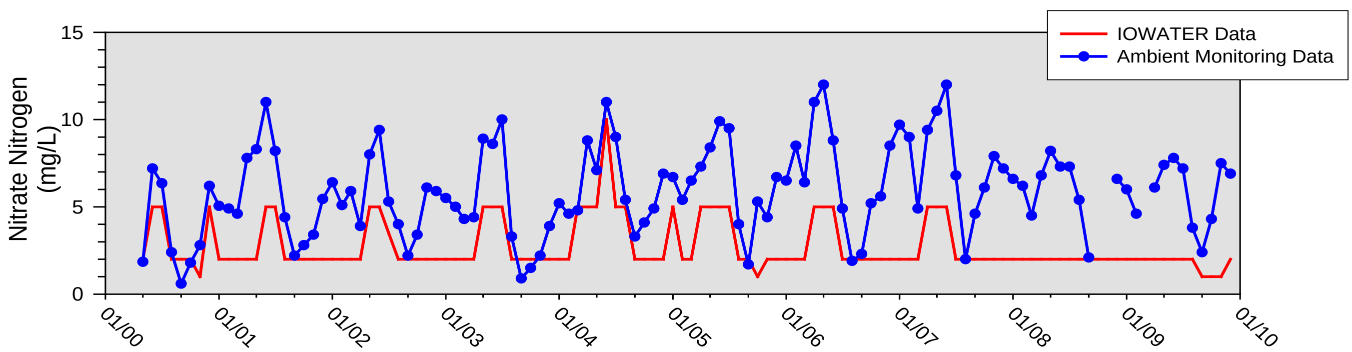
Seasonal Shifts in Water Quality

Many parameters will exhibit seasonal shifts. For example, water temperatures in many streams generally increase through the summer and decrease again in the fall. At the same time, dissolved oxygen concentrations tend to decrease through the summer and increase in the winter in Iowa's streams and rivers because cold water is able to hold more oxygen than warmer water. Nitrate and nitrite levels are generally higher in the spring when fertilizer is applied and rainfall is greater. Figure 4 shows the changes in temperature, dissolved oxygen, and nitrate nitrogen each year from 2000 through 2009. Illustrated in Figure 4 are the median values for IOWATER collected data, as well as ambient monitoring data collected by the Iowa DNR from a network of 75 to 84 streams statewide that are monitored monthly.

Figure 4. IOWATER Data and Ambient River and Stream Monitoring Data 2000-2009.







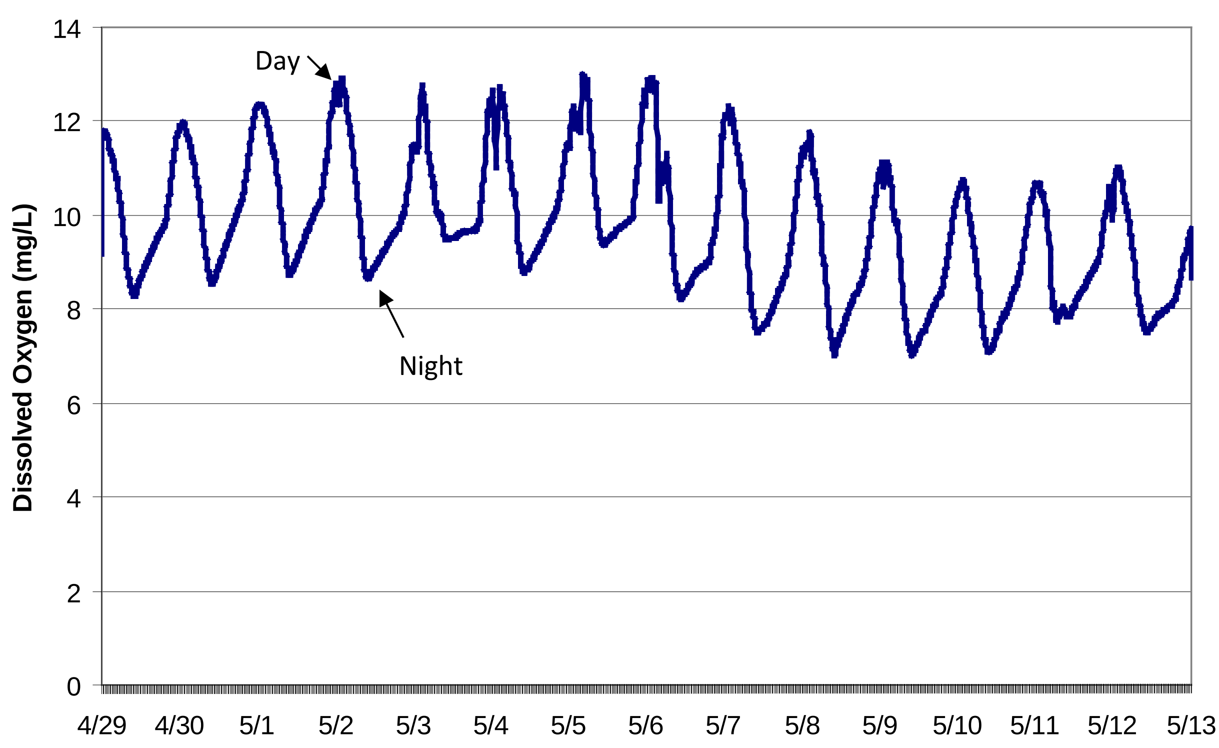
Daily Shifts in Water Quality

Some parameters even change depending on what time of day you measure them. For example temperature begins to increase when the sun comes up with the highest temperature generally occurring in mid to late afternoon. The temperature then falls after sunset.

Dissolved oxygen also is affected by the time of day. Dissolved oxygen levels are highest during the day when the sun is out. Dissolved oxygen increases during the day because plants and algae begin the process of photosynthesis which creates oxygen. When the sun goes down, the plants and algae don't have that energy source and stop doing photosynthesis. However, they continue to use oxygen, which leads to a net loss of oxygen in the water. Furthermore, bacteria in the water continue to break down dead plant and animal matter, consuming some of the oxygen found dissolved in the water. This can cause large swings in dissolved oxygen over the course of a day. As shown in Figure 5, it is not uncommon for dissolved oxygen to shift 4 mg/L or more during a 24 hour period.

Figure 5. Dissolved Oxygen Concentrations at Hecker Creek, Allamakee County, Iowa

April 30 through May 14, 2007.



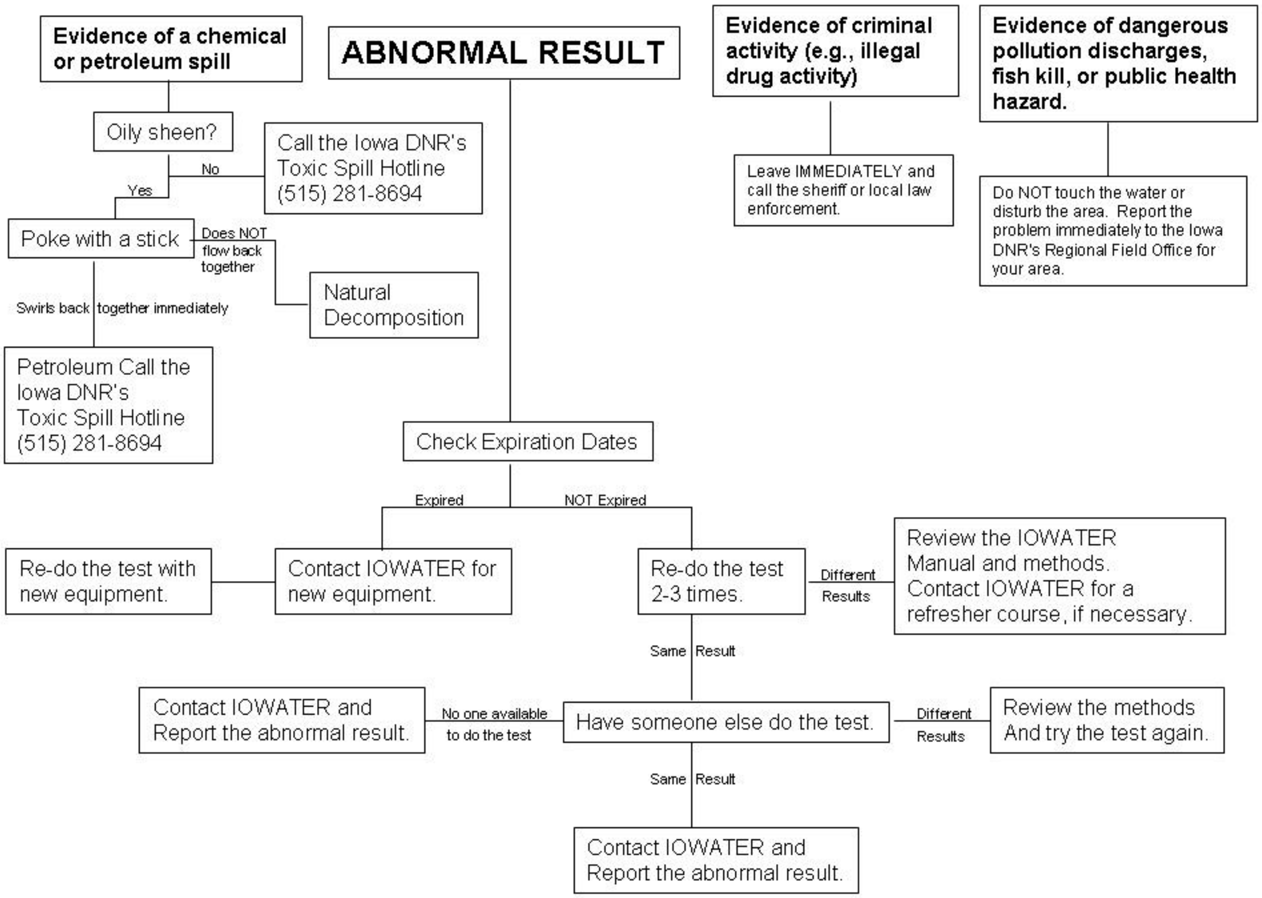
Physical Influences on Water Quality

When trees are removed from stream, river, or lake banks the amount of shading or canopy cover in the riparian zone decreases, allowing more sunlight to reach the stream, river, or lake. This causes the water to warm, which can decrease dissolved oxygen levels. Removing canopy cover also reduces the amount of habitat available in water bodies.

Abnormal Results

As you probably realize by this point, water quality is affected by many variables and can be challenging to interpret. As a citizen monitor, you may measure a water quality parameter value that is unusual or exceeds water quality criteria. There are many factors that determine whether there is a water quality problem or if a water quality violation has occurred. Always consider contacting IOWATER if you think you have abnormal results. Included in this section is a flow chart of steps to take when you think you have an abnormal result. While the values below might not be abnormal for your site, they are some guidelines as to what could be considered abnormal for each of the chemical/physical parameters:

- Nitrite values of 0.3 or greater (0.3, 1.0, 1.5, & 3.0 mg/L)
- Nitrate values of 20 or greater (20 or 50 mg/L)
- Phosphate values of 0.6 or greater (0.6, 0.8, 1.0-8.0, 10 mg/L)
- Dissolved Oxygen values of 5 or less (1-5 mg/L)
- pH values of 6 or less (4, 5, 6)
- Chloride values of 100 or greater (100 - >600 mg/L) – “>” means “greater than”



Please remember that if there is evidence of a criminal activity (i.e., illegal drug activity) that is immediately dangerous to leave IMMEDIATELY and call the sheriff or local law enforcement. If there is evidence of dangerous pollution discharges, fish kills, or public health hazards, report immediately to the Iowa DNR's Environmental Services Division Field Office for your area (see last page of the manual for contact information). Be sure to document the location and visual information about the problem, but do not disturb the area. If there is evidence of chemical or petroleum inputs and the input could result in an immediate hazard, call the Iowa DNR's Toxic Spill Hotline at (515) 281-8694. If an oily sheen is present, you can determine if the sheen is a natural occurrence by simply poking the sheen with a stick. If the sheen swirls back together immediately, it's petroleum. If the sheen breaks apart and does not flow back together, it is from bacteria or plant or animal decomposition. REMEMBER: If you have any questions, please contact IOWATER for assistance.

The Power of Volunteers

After some time monitoring your site, you may begin to wonder why you continue to monitor every month/week/day. Has your monitoring helped to improve water quality and/or helped further your understanding of water quality at your site? The case studies below illustrate a few examples of why it is important to monitor consistently and over a long period of time. These volunteers have helped solve water quality problems in their communities, but it's important to note that in neither case did volunteers set out to identify and solve problems – they simply wanted to gain a better understanding of the aquatic resources that were important to them. In both cases, however, continued and persistent monitoring was vital to water quality protection and improvement.

<u>Squaw Creek, Story County</u>

IOWATER volunteer Erv Klaas has been doing monthly monitoring at two sites on Squaw Creek in Ames, IA for IOWATER chemical/physical parameters since November 2001. The two sites are located about 1.5 miles apart. At the downstream site, a storm drain discharges to Squaw Creek just upstream of where the stream is monitored.

In early 2004, Erv added *E. coli* bacteria monitoring to his monitoring. After 6 years or *E. coli* monitoring Erv had a good understanding of what was normal for his sites. So, when he sampled in September of 2009, he knew something was different with the downstream site. When he poured his water sample onto the three downstream bacteria plates, they would not solidify and turned a solid dark color. The plates from the upstream site, however, solidified and reacted similarly to past samples from that site.

Concerned about these results, Erv contacted IOWATER staff to tell them about the strange bacteria samples from the downstream sites. IOWATER staff had never seen bacteria plates react like this before so they contacted the maker of the bacteria plates, Micrology Laboratories. Micrology Laboratories requested that Erv send in the downstream plates for further investigation and determined that the samples submitted by Erv were heavily contaminated with fecal contamination. Staff at the laboratories subsequently determined that *E. coli* levels approached 9 million Colony Forming Units/100 milliliters (CFU/100 ml). The E. coli bacteria water quality standard for Iowa's surface waters is 235 CFU/100 ml.

Staff at the City of Ames Public Works Department were then contacted and informed of the elevated *E. coli* bacteria at the downstream site. Erv shared the results of his monthly monitoring at both sites to show the City of Ames staff that this was a highly unusual result for this site. The City of Ames staff agreed and investigated the storm pipe upstream of the site. The Ames crew found sewer odors in the stormwater pipe and decided to do dye testing and use a camera to investigate the storm sewer line and the sanitary sewer line that sits above the storm line. A crack and hole was found in the sanitary sewer line and sewage was leaking into the storm line and discharging to Squaw Creek just above Erv's sampling location.

The City of Ames repaired both the storm and sanitary lines, and Erv has since been out and sampled both sites and bacteria levels at the downstream site have returned to more typical levels. If Erv had not been monitoring this site regularly, this problem may have gone undetected. Erv's regular monitoring and knowledge of normal conditions for his site, coupled with the City of Ames' willingness to investigate and address this issue allowed this problem to be fixed.

"The IOWATER Program is a great tool which helps us to identify this type of problem." - Ames Public Works Department Staff.

<u>Clear Creek, Johnson and Iowa Counties</u>

The story of Clear Creek began in 2003 when IOWATER volunteer Dave Ratliff of the Johnson and Iowa County Watershed Coalition organized the first snapshot event of streams in the two counties. Clear Creek begins in Iowa County and continues east into Johnson County where it empties into the Iowa River in Coralville and was sampled as part of this snapshot event.

Results from the September 2003 snapshot indicated elevated chloride levels (>600 mg/L – the average chloride concentration for Iowa streams is 23 mg/L) at the farthest upstream site on Clear Creek. Because the results were abnormal, the site was re-sampled on the same day and the high value was confirmed.

In the months following the September 2003 snapshot, 5 tile lines were located one mile upstream from the site with the high results. Three tile lines were located in a north junction box; two additional tile lines were located in a south junction box. These sites were sampled in

January 2004 and it was found that the south junction box was the primary source of the high chloride levels.

Determined to get to the source of the high chloride values, Dave Ratliff discovered that the tile line that fed the south junction box began near a Department of Transportation (DOT) facility. A pile of sand mixed with salt used on roads during the winter was stored outdoors and was slowly leaching into the tile line. Dave alerted the DOT to the water quality concern. In response, the DOT staff built a storage structure to enclose the sand pile and reduce leaching.

The Clear Creek story, however, doesn't end there. The Johnson and Iowa County Snapshot continued in May 2004 with the inclusion of both the north and the south tile junction boxes. Volunteers who sampled the north junction box that day noted what appeared to be toilet paper coming out of the north tile line along with a slight sewage odor. The IOWATER test kit results from that site, however, did not differ much from the other tile lines that were sampled.

In July 2004, the Clear Creek headwater sites were sampled again as part of a snapshot. Again toilet paper fragments, sewage odor and this time elevated chloride levels were noted at the north junction box. In August 2004, the Iowa County Health Department and DNR Field Office were contacted about the water quality concern. During the next few months volunteers continued to document the problem through water testing and pictures at these tile lines.

In January 2005, Don Lund and Dave Ratliff designed and installed a trap at the outlet of the north tile line. Within 24 hours the trap was 100% coated with sewer sludge, toilet paper, and feces. Photographs of the trap were shown to IOWATER staff and sent to the DNR Field Office. These photographs provided substantial evidence of the problem and in January 2005, the Iowa County Board of Health was informed by the Iowa DNR that they would be receiving a Notice of Violation concerning the problem and would be required to address it.

The community of Conroy is near the north tile box. It was found that several septic systems in that community were connected to, and illegally discharging into the north tile line. Plans were developed to construct a centralized wastewater treatment system to replace the individual septic systems in Conroy. In December 2008 the wastewater treatment system was completed.

The story of Clear Creek and Conroy can be considered a success, not only because it fixed a long-term problem in that location, but also brought statewide attention to the issue of failing or illegally discharging septic systems in Iowa. On July 1, 2009, a new law was implemented that now requires pre-sale inspections for buildings with septic tanks. It is hoped that the new inspections at the time of property transfer will help eliminate the estimated more than 100,000 substandard septic systems in Iowa.

CHAPTER 11

IOWATER Field Report Forms

Habitat Assessment

Chemical/Physical Assessment

Standing Water Assessment

Habitat Assessment

*** Recommended frequency – yearly, in the summer ***

*** Photographic documentation is recommended and strongly encouraged ***

Revised May 2010

Date ___________ **Time ___________**

IOWATER Monitor ______________________ # of Adults (*incl. you*) **_______**

Site Number ____________________________ # of under 18 ______

Other Volunteers Involved ____

Was the stream dry when it was monitored? Yes _____ No _____

<u>Stream Habitat Type</u> (*at transect – check one*)

Riffle _____ **Run _____** **Pool _____**

<u>Streambed Substrate</u> (*along transect – estimate percentages*)

_____ % Bedrock – large sheets of stone.

_____ % Boulder – stones larger than 10 inches in diameter

_____ % Cobble – stones, diameter between 2.5 and 10 inches

_____ % Gravel – 0.1 to 2 inch diameter

_____ % Sand – smaller than 0.1 inches

_____ % Mud/Silt – dirt or soil deposited on bottom of the stream

_____ % <u>Other – organic material like leaf litter, tree limbs, etc</u>.

100% **TOTAL**

<u>Microhabitats</u> (*check all present in stream reach*)

____ Algae Mats ____ Root Wads ____ Silt/Muck

____ Logjams ____ Fallen Trees ____ Sand

____ Junk (tires, garbage, etc.)

____ Leaf Packs

____ Rocks

____ Weed Beds

____ Undercut Banks

____ Rip Rap

____ Overhanging Vegetation

____ Other (*describe*) __________

<u>Stream Banks</u> (*at transect – check all that apply*)

Left Bank (*facing upstream*)

_____ Cut Bank – Eroding

_____ Cut Bank – Vegetated

_____ Sloping Bank

_____ Sand/Gravel Bar

_____ Rip/Rap

_____ Constructed Bank (i.e., drainage ditch)

_____ Other: __________________

Right Bank (*facing upstream*)

_____ Cut Bank - Eroding

_____ Cut Bank – Vegetated

_____ Sloping Bank

_____ Sand/Gravel Bar

_____ Rip/Rap

_____ Constructed Bank (i.e., drainage ditch)

_____ Other: __________________

<u>Canopy Cover</u> (*over transect – check one*)

0-25%_____ 25-50%_____ 50-75%_____ 75-100%_____

<u>Riparian Zone Width</u> (*at transect – check one for each bank*)

Left Bank (*facing upstream*)

_____ 0-5 meters

_____ 5-25 meters

_____ Over 25 meters

Right Bank (*facing upstream*)

_____ 0-5 meters

_____ 5-25 meters

_____ Over 25 meters

<u>Riparian Zone Plant Cover</u> (*at transect – estimate percentage of each*)

<u>Left Bank</u> (facing upstream)

____ % Trees

____ % Shrubs / Low Trees

____ % Grass / Low Plants

____ % Exposed Soil

____ % <u>Other (rip rap, concrete, etc.)</u>

100% TOTAL

<u>Right Bank</u> (facing upstream)

____ % Trees

____ % Shrubs / Low Trees

____ % Grass / Low Plants

____ % Exposed Soil

____ % <u>Other (rip rap, concrete, etc.)</u>

100% TOTAL

<u>Adjacent Land Use</u> (*along stream reach – check all that apply*)

____ Row Crop	____ Wetland	____ Boating Accesses	____ Rural Residential Areas
____ Pasture	____ Prairie	____ Nature Trails	____ Conservation Lands
____ Urban	____ Park	____ Fence	____ Animal Feeding Operations/Lots
____ Industrial	____ Playground	____ Steep Slopes	____ Other ________________
____ Timber	____ Campground	____ Stairs/Walkway	

Revised May 2010

Human Use Activities (*along stream reach – check all that apply*)

Please check activities you've participated in or witnessed at this site.

____ Swimming	____ Wind Surfing	____ Wading	____ Fishing
____ Tubing	____ Canoeing/Kayaking	____ Rafting	____ Kids Playing
____ Water Skiing	____ Boating	____ Hunting/Trapping	____ Other ________

Evidence of Human Use (*along stream reach – check all that apply*)

Please check evidence of human use you've witnessed at this site.

____ Streamside Roads	____ Livestock Watering	____ Camping Sites	____ Evidence of Kid's Play
____ Footprints or Paths	____ ATV/ORV Tracks	____ Fire Pit/Ring	____ Other _______
____ Dock/Platform	____ Rope Swings	____ Fishing Tackle	

Is this stream Intermittent or Perennial? (*along stream reach- check one)*

Intermittent _____ Perennial _____

Record all other land use practices that potentially could affect the stream.

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IOWATER

Volunteer Water Quality Monitoring

Revised May 2010

Habitat Assessment

*** Recommended frequency – yearly, in the summer ***

*** Photographic documentation is recommended and strongly encouraged ***

Date __________ **Time __________**

IOWATER Monitor ____________________ # of Adults (*incl. you*) **______**

Site Number _________________________ # of under 18 ______

Other Volunteers Involved ____

Was the stream dry when it was monitored? Yes _____ No _____

Stream Habitat Type (*at transect – check one*)

Riffle _____ **Run _____** **Pool _____**

Streambed Substrate (*along transect – estimate percentages*)

_____ % Bedrock – large sheets of stone.

_____ % Boulder – stones larger than 10 inches in diameter

_____ % Cobble – stones, diameter between 2.5 and 10 inches

_____ % Gravel – 0.1 to 2 inch diameter

_____ % Sand – smaller than 0.1 inches

_____ % Mud/Silt – dirt or soil deposited on bottom of the stream

_____ % Other – organic material like leaf litter, tree limbs, etc.

100% **TOTAL**

<u>Microhabitats</u> (*check all present in stream reach*)

____ Algae Mats

____ Logjams

____ Root Wads

____ Fallen Trees

____ Silt/Muck

____ Sand

____ Junk (tires, garbage, etc.)

____ Leaf Packs

____ Rocks

____ Weed Beds

____ Undercut Banks

____ Rip Rap

____ Overhanging Vegetation

____ Other (*describe*) __________

<u>Stream Banks</u> (*at transect – check all that apply*)

Left Bank (*facing upstream*)

_____ Cut Bank – Eroding

_____ Cut Bank – Vegetated

_____ Sloping Bank

_____ Sand/Gravel Bar

_____ Rip/Rap

_____ Constructed Bank (i.e., drainage ditch)

_____ Other: __________________

Right Bank (*facing upstream*)

_____ Cut Bank - Eroding

_____ Cut Bank – Vegetated

_____ Sloping Bank

_____ Sand/Gravel Bar

_____ Rip/Rap

_____ Constructed Bank (i.e., drainage ditch)

_____ Other: __________________

<u>Canopy Cover</u> (*over transect – check one*)

0-25%_____ 25-50%_____ 50-75%_____ 75-100%_____

<u>Riparian Zone Width</u> (*at transect – check one for each bank*)

Left Bank (*facing upstream*)	**Right Bank** (*facing upstream*)
_____ 0-5 meters	_____ 0-5 meters
_____ 5-25 meters	_____ 5-25 meters
_____ Over 25 meters	_____ Over 25 meters

<u>Riparian Zone Plant Cover</u> (*at transect – estimate percentage of each*)

<u>Left Bank</u> (facing upstream)		**<u>Right Bank</u> (facing upstream)**	
____ % Trees		____ % Trees	
____ % Shrubs / Low Trees		____ % Shrubs / Low Trees	
____ % Grass / Low Plants		____ % Grass / Low Plants	
____ % Exposed Soil		____ % Exposed Soil	
____ % <u>Other (rip rap, concrete, etc.)</u>		____ % <u>Other (rip rap, concrete, etc.)</u>	
100%	**TOTAL**	**100%**	**TOTAL**

<u>Adjacent Land Use</u> (*along stream reach – check all that apply*)

____ Row Crop	____ Wetland	____ Boating Accesses	____ Rural Residential Areas
____ Pasture	____ Prairie	____ Nature Trails	____ Conservation Lands
____ Urban	____ Park	____ Fence	____ Animal Feeding Operations/Lots
____ Industrial	____ Playground	____ Steep Slopes	____ Other ________________
____ Timber	____ Campground	____ Stairs/Walkway	

Human Use Activities (*along stream reach – check all that apply*)

Please check activities you've participated in or witnessed at this site.

____ Swimming	____ Wind Surfing	____ Wading	____ Fishing
____ Tubing	____ Canoeing/Kayaking	____ Rafting	____ Kids Playing
____ Water Skiing	____ Boating	____ Hunting/Trapping	____ Other ________

Evidence of Human Use (*along stream reach – check all that apply*)

Please check evidence of human use you've witnessed at this site.

____ Streamside Roads	____ Livestock Watering	____ Camping Sites	____ Evidence of Kid's Play
____ Footprints or Paths	____ ATV/ORV Tracks	____ Fire Pit/Ring	____ Other ________
____ Dock/Platform	____ Rope Swings	____ Fishing Tackle	

Is this stream Intermittent or Perennial? (*along stream reach- check one)*

Intermittent _____   Perennial _____

Record all other land use practices that potentially could affect the stream.

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IOWATER
Volunteer Water Quality Monitoring

Revised May 2010

<u>Habitat Assessment</u>

*** Recommended frequency – yearly, in the summer ***

*** Photographic documentation is recommended and strongly encouraged ***

Date __________ **Time __________**

IOWATER Monitor ____________________# of Adults (*incl. you*) **______**

Site Number _________________________# of under 18 ______

Other Volunteers Involved ____

Was the stream dry when it was monitored? Yes _____ No _____

<u>Stream Habitat Type</u> (*at transect – check one*)

Riffle _____ **Run _____** **Pool _____**

<u>Streambed Substrate</u> (*along transect – estimate percentages*)

_____ % Bedrock – large sheets of stone.

_____ % Boulder – stones larger than 10 inches in diameter

_____ % Cobble – stones, diameter between 2.5 and 10 inches

_____ % Gravel – 0.1 to 2 inch diameter

_____ % Sand – smaller than 0.1 inches

_____ % Mud/Silt – dirt or soil deposited on bottom of the stream

_____ % <u>Other – organic material like leaf litter, tree limbs, etc</u>.

100% **TOTAL**

<u>Microhabitats</u> (*check all present in stream reach*)

____ Algae Mats	____ Sand	____ Undercut Banks
____ Logjams	____ Junk (tires, garbage, etc.)	____ Rip Rap
____ Root Wads	____ Leaf Packs	____ Overhanging Vegetation
____ Fallen Trees	____ Rocks	____ Other (*describe*) __________
____ Silt/Muck	____ Weed Beds	

<u>Stream Banks</u> (*at transect – check all that apply*)

Left Bank (*facing upstream*)	**Right Bank** (*facing upstream*)
_____ Cut Bank – Eroding	_____ Cut Bank - Eroding
_____ Cut Bank – Vegetated	_____ Cut Bank – Vegetated
_____ Sloping Bank	_____ Sloping Bank
_____ Sand/Gravel Bar	_____ Sand/Gravel Bar
_____ Rip/Rap	_____ Rip/Rap
_____ Constructed Bank (i.e., drainage ditch)	_____ Constructed Bank (i.e., drainage ditch)
_____ Other: __________________	_____ Other: __________________

Canopy Cover (*over transect – check one*)

0-25%_____ 25-50%_____ 50-75%_____ 75-100%_____

Riparian Zone Width (*at transect – check one for each bank*)

Left Bank (*facing upstream*)

_____ 0-5 meters

_____ 5-25 meters

_____ Over 25 meters

Right Bank (*facing upstream*)

_____ 0-5 meters

_____ 5-25 meters

_____ Over 25 meters

Riparian Zone Plant Cover (*at transect – estimate percentage of each*)

Left Bank (facing upstream)

____ % Trees

____ % Shrubs / Low Trees

____ % Grass / Low Plants

____ % Exposed Soil

____ % Other (rip rap, concrete, etc.)

100% TOTAL

Right Bank (facing upstream)

____ % Trees

____ % Shrubs / Low Trees

____ % Grass / Low Plants

____ % Exposed Soil

____ % Other (rip rap, concrete, etc.)

100% TOTAL

Adjacent Land Use (*along stream reach – check all that apply*)

____ Row Crop

____ Pasture

____ Urban

____ Industrial

____ Timber

____ Wetland

____ Prairie

____ Park

____ Playground

____ Campground

____ Boating Accesses

____ Nature Trails

____ Fence

____ Steep Slopes

____ Stairs/Walkway

____ Rural Residential Areas

____ Conservation Lands

____ Animal Feeding Operations/Lots

____ Other _________________

Human Use Activities (*along stream reach – check all that apply*)

Please check activities you've participated in or witnessed at this site.

____ Swimming	____ Wind Surfing	____ Wading	____ Fishing
____ Tubing	____ Canoeing/Kayaking	____ Rafting	____ Kids Playing
____ Water Skiing	____ Boating	____ Hunting/Trapping	____ Other ________

Evidence of Human Use (*along stream reach – check all that apply*)

Please check evidence of human use you've witnessed at this site.

____ Streamside Roads	____ Livestock Watering	____ Camping Sites	____ Evidence of Kid's Play
____ Footprints or Paths	____ ATV/ORV Tracks	____ Fire Pit/Ring	____ Other ________
____ Dock/Platform	____ Rope Swings	____ Fishing Tackle	

Is this stream Intermittent or Perennial? (*along stream reach- check one)*

Intermittent _____ Perennial _____

Record all other land use practices that potentially could affect the stream.

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IOWATER
Volunteer Water Quality Monitoring

Revised May 2010

<u>Habitat Assessment</u>

*** Recommended frequency – yearly, in the summer ***

*** Photographic documentation is recommended and strongly encouraged ***

Date __________ **Time __________**

IOWATER Monitor ____________________# of Adults (*incl. you*) **______**

Site Number _________________________# of under 18 ______

Other Volunteers Involved ____

Was the stream dry when it was monitored? Yes _____ No _____

<u>Stream Habitat Type</u> (*at transect – check one*)

Riffle _____ **Run _____** **Pool _____**

<u>Streambed Substrate</u> (*along transect – estimate percentages*)

_____ % Bedrock – large sheets of stone.

_____ % Boulder – stones larger than 10 inches in diameter

_____ % Cobble – stones, diameter between 2.5 and 10 inches

_____ % Gravel – 0.1 to 2 inch diameter

_____ % Sand – smaller than 0.1 inches

_____ % Mud/Silt – dirt or soil deposited on bottom of the stream

_____ % <u>Other – organic material like leaf litter, tree limbs, etc</u>.

100% **TOTAL**

Microhabitats (*check all present in stream reach*)

____ Algae Mats ____ Sand ____ Undercut Banks

____ Logjams ____ Junk (tires, garbage, etc.) ____ Rip Rap

____ Root Wads ____ Leaf Packs ____ Overhanging Vegetation

____ Fallen Trees ____ Rocks ____ Other (*describe*) __________

____ Silt/Muck ____ Weed Beds

Stream Banks (*at transect – check all that apply*)

Left Bank (*facing upstream*)

_____ Cut Bank – Eroding

_____ Cut Bank – Vegetated

_____ Sloping Bank

_____ Sand/Gravel Bar

_____ Rip/Rap

_____ Constructed Bank (i.e., drainage ditch)

_____ Other: ___________________

Right Bank (*facing upstream*)

_____ Cut Bank - Eroding

_____ Cut Bank – Vegetated

_____ Sloping Bank

_____ Sand/Gravel Bar

_____ Rip/Rap

_____ Constructed Bank (i.e., drainage ditch)

_____ Other: ___________________

<u>Canopy Cover</u> (*over transect – check one*)

0-25%_____ 25-50%_____ 50-75%_____ 75-100%_____

<u>Riparian Zone Width</u> (*at transect – check one for each bank*)

Left Bank (*facing upstream*)	**Right Bank** (*facing upstream*)
_____ 0-5 meters	_____ 0-5 meters
_____ 5-25 meters	_____ 5-25 meters
_____ Over 25 meters	_____ Over 25 meters

<u>Riparian Zone Plant Cover</u> (*at transect – estimate percentage of each*)

<u>Left Bank</u> (facing upstream)	**<u>Right Bank</u> (facing upstream)**
____ % Trees	____ % Trees
____ % Shrubs / Low Trees	____ % Shrubs / Low Trees
____ % Grass / Low Plants	____ % Grass / Low Plants
____ % Exposed Soil	____ % Exposed Soil
____ % <u>Other (rip rap, concrete, etc.)</u>	____ % <u>Other (rip rap, concrete, etc.)</u>
100% TOTAL	**100% TOTAL**

<u>Adjacent Land Use</u> (*along stream reach – check all that apply*)

____ Row Crop	____ Wetland	____ Boating Accesses	____ Rural Residential Areas
____ Pasture	____ Prairie	____ Nature Trails	____ Conservation Lands
____ Urban	____ Park	____ Fence	____ Animal Feeding Operations/Lots
____ Industrial	____ Playground	____ Steep Slopes	____ Other _________________
____ Timber	____ Campground	____ Stairs/Walkway	

Human Use Activities (*along stream reach – check all that apply*)

Please check activities you've participated in or witnessed at this site.

____ Swimming	____ Wind Surfing	____ Wading	____ Fishing
____ Tubing	____ Canoeing/Kayaking	____ Rafting	____ Kids Playing
____ Water Skiing	____ Boating	____ Hunting/Trapping	____ Other ________

Evidence of Human Use (*along stream reach – check all that apply*)

Please check evidence of human use you've witnessed at this site.

____ Streamside Roads	____ Livestock Watering	____ Camping Sites	____ Evidence of Kid's Play
____ Footprints or Paths	____ ATV/ORV Tracks	____ Fire Pit/Ring	____ Other _______
____ Dock/Platform	____ Rope Swings	____ Fishing Tackle	

Is this stream Intermittent or Perennial? (*along stream reach- check one)*

Intermittent _____ Perennial _____

Record all other land use practices that potentially could affect the stream.

____

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IOWATER

Volunteer Water Quality Monitoring

Revised May 2010

Habitat Assessment

*** Recommended frequency – yearly, in the summer ***

*** Photographic documentation is recommended and strongly encouraged ***

Date __________ **Time __________**

IOWATER Monitor ____________________ # of Adults (*incl. you*) **______**

Site Number _________________________ # of under 18 ______

Other Volunteers Involved ____

Was the stream dry when it was monitored? Yes _____ No _____

Stream Habitat Type (*at transect – check one*)

Riffle _____ **Run _____** **Pool _____**

Streambed Substrate (*along transect – estimate percentages*)

_____ % Bedrock – large sheets of stone.

_____ % Boulder – stones larger than 10 inches in diameter

_____ % Cobble – stones, diameter between 2.5 and 10 inches

_____ % Gravel – 0.1 to 2 inch diameter

_____ % Sand – smaller than 0.1 inches

_____ % Mud/Silt – dirt or soil deposited on bottom of the stream

_____ % Other – organic material like leaf litter, tree limbs, etc.

100% **TOTAL**

<u>Microhabitats</u> (*check all present in stream reach*)

____ Algae Mats
____ Logjams
____ Root Wads
____ Fallen Trees
____ Silt/Muck
____ Sand
____ Junk (tires, garbage, etc.)
____ Leaf Packs
____ Rocks
____ Weed Beds
____ Undercut Banks
____ Rip Rap
____ Overhanging Vegetation
____ Other (*describe*) __________

<u>Stream Banks</u> (*at transect – check all that apply*)

Left Bank (*facing upstream*)

_____ Cut Bank – Eroding
_____ Cut Bank – Vegetated
_____ Sloping Bank
_____ Sand/Gravel Bar
_____ Rip/Rap
_____ Constructed Bank (i.e., drainage ditch)
_____ Other: __________________

Right Bank (*facing upstream*)

_____ Cut Bank - Eroding
_____ Cut Bank – Vegetated
_____ Sloping Bank
_____ Sand/Gravel Bar
_____ Rip/Rap
_____ Constructed Bank (i.e., drainage ditch)
_____ Other: __________________

<u>Canopy Cover</u> (*over transect – check one*)

0-25%_____ 25-50%_____ 50-75%_____ 75-100%_____

<u>Riparian Zone Width</u> (*at transect – check one for each bank*)

Left Bank (*facing upstream*)	**Right Bank** (*facing upstream*)
_____ 0-5 meters	_____ 0-5 meters
_____ 5-25 meters	_____ 5-25 meters
_____ Over 25 meters	_____ Over 25 meters

<u>Riparian Zone Plant Cover</u> (*at transect – estimate percentage of each*)

<u>Left Bank</u> (facing upstream)		**<u>Right Bank</u> (facing upstream)**	
____ % Trees		____ % Trees	
____ % Shrubs / Low Trees		____ % Shrubs / Low Trees	
____ % Grass / Low Plants		____ % Grass / Low Plants	
____ % Exposed Soil		____ % Exposed Soil	
____ % <u>Other (rip rap, concrete, etc.)</u>		____ % <u>Other (rip rap, concrete, etc.)</u>	
100%	**TOTAL**	**100%**	**TOTAL**

<u>Adjacent Land Use</u> (*along stream reach – check all that apply*)

____ Row Crop	____ Wetland	____ Boating Accesses	____ Rural Residential Areas
____ Pasture	____ Prairie	____ Nature Trails	____ Conservation Lands
____ Urban	____ Park	____ Fence	____ Animal Feeding Operations/Lots
____ Industrial	____ Playground	____ Steep Slopes	
____ Timber	____ Campground	____ Stairs/Walkway	____ Other _______________

Revised May 2010

Human Use Activities (*along stream reach – check all that apply*)

Please check activities you've participated in or witnessed at this site.

____ Swimming	____ Wind Surfing	____ Wading	____ Fishing
____ Tubing	____ Canoeing/Kayaking	____ Rafting	____ Kids Playing
____ Water Skiing	____ Boating	____ Hunting/Trapping	____ Other ________

Evidence of Human Use (*along stream reach – check all that apply*)

Please check evidence of human use you've witnessed at this site.

____ Streamside Roads	____ Livestock Watering	____ Camping Sites	____ Evidence of Kid's Play
____ Footprints or Paths	____ ATV/ORV Tracks	____ Fire Pit/Ring	____ Other ________
____ Dock/Platform	____ Rope Swings	____ Fishing Tackle	

Is this stream Intermittent or Perennial? (*along stream reach- check one)*

Intermittent _____ Perennial _____

Record all other land use practices that potentially could affect the stream.

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IOWATER

Volunteer Water Quality Monitoring

Habitat Assessment

*** Recommended frequency – yearly, in the summer ***

*** Photographic documentation is recommended and strongly encouraged ***

Date __________ **Time __________**

IOWATER Monitor ____________________# of Adults (*incl. you*) **______**

Site Number _________________________# of under 18 ______

Other Volunteers Involved ____

Was the stream dry when it was monitored? Yes _____ No _____

Stream Habitat Type (*at transect – check one*)

Riffle _____ **Run _____** **Pool _____**

Streambed Substrate (*along transect – estimate percentages*)

_____ % Bedrock – large sheets of stone.

_____ % Boulder – stones larger than 10 inches in diameter

_____ % Cobble – stones, diameter between 2.5 and 10 inches

_____ % Gravel – 0.1 to 2 inch diameter

_____ % Sand – smaller than 0.1 inches

_____ % Mud/Silt – dirt or soil deposited on bottom of the stream

_____ % Other – organic material like leaf litter, tree limbs, etc.

100% **TOTAL**

<u>Microhabitats</u> (*check all present in stream reach*)

____ Algae Mats

____ Logjams

____ Root Wads

____ Fallen Trees

____ Silt/Muck

____ Sand

____ Junk (tires, garbage, etc.)

____ Leaf Packs

____ Rocks

____ Weed Beds

____ Undercut Banks

____ Rip Rap

____ Overhanging Vegetation

____ Other (*describe*) __________

<u>Stream Banks</u> (*at transect – check all that apply*)

Left Bank (*facing upstream*)

_____ Cut Bank – Eroding

_____ Cut Bank – Vegetated

_____ Sloping Bank

_____ Sand/Gravel Bar

_____ Rip/Rap

_____ Constructed Bank (i.e., drainage ditch)

_____ Other: __________________

Right Bank (*facing upstream*)

_____ Cut Bank - Eroding

_____ Cut Bank – Vegetated

_____ Sloping Bank

_____ Sand/Gravel Bar

_____ Rip/Rap

_____ Constructed Bank (i.e., drainage ditch)

_____ Other: __________________

Canopy Cover (*over transect – check one*)

0-25%_____ 25-50%_____ 50-75%_____ 75-100%_____

Riparian Zone Width (*at transect – check one for each bank*)

Left Bank (*facing upstream*)	**Right Bank** (*facing upstream*)
_____ 0-5 meters	_____ 0-5 meters
_____ 5-25 meters	_____ 5-25 meters
_____ Over 25 meters	_____ Over 25 meters

Riparian Zone Plant Cover (*at transect – estimate percentage of each*)

Left Bank (facing upstream)	**Right Bank (facing upstream)**
____ % Trees	____ % Trees
____ % Shrubs / Low Trees	____ % Shrubs / Low Trees
____ % Grass / Low Plants	____ % Grass / Low Plants
____ % Exposed Soil	____ % Exposed Soil
____ % Other (rip rap, concrete, etc.)	____ % Other (rip rap, concrete, etc.)
100% TOTAL	**100% TOTAL**

Adjacent Land Use (*along stream reach – check all that apply*)

____ Row Crop	____ Wetland	____ Boating Accesses	____ Rural Residential Areas
____ Pasture	____ Prairie	____ Nature Trails	____ Conservation Lands
____ Urban	____ Park	____ Fence	____ Animal Feeding Operations/Lots
____ Industrial	____ Playground	____ Steep Slopes	____ Other _______________
____ Timber	____ Campground	____ Stairs/Walkway	

Human Use Activities (*along stream reach – check all that apply*)

Please check activities you've participated in or witnessed at this site.

____ Swimming	____ Wind Surfing	____ Wading	____ Fishing
____ Tubing	____ Canoeing/Kayaking	____ Rafting	____ Kids Playing
____ Water Skiing	____ Boating	____ Hunting/Trapping	____ Other ________

Evidence of Human Use (*along stream reach – check all that apply*)

Please check evidence of human use you've witnessed at this site.

____ Streamside Roads	____ Livestock Watering	____ Camping Sites	____ Evidence of Kid's Play
____ Footprints or Paths	____ ATV/ORV Tracks	____ Fire Pit/Ring	____ Other _______
____ Dock/Platform	____ Rope Swings	____ Fishing Tackle	

Is this stream Intermittent or Perennial? (*along stream reach- check one)*

Intermittent _____ Perennial _____

Record all other land use practices that potentially could affect the stream.

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IOWATER

Volunteer Water Quality Monitoring

Revised May 2010

Chemical / Physical Assessment

*** Recommended frequency – monthly ***

Date __________ **Time ___________**

IOWATER Monitor ____________________# of Adults (*incl. you*) **______**

Site Number _________________________# of under 18 ______

Other Volunteers Involved ____

Was the stream dry when it was monitored? Yes _____ No _____

Weather (*check all that apply*)

Sunny ____ Partly Sunny ____ Cloudy ____ Rain/Snow ____ Windy ____ Calm ____

Water Color (*check all that apply*)

Clear ___ Brown ___ Green ___ Oily ___ Reddish ___ Blackish ___ Milky ___ Gray ___

Water Odor (*check all that apply*)

None ___ Sewage/Manure ___ Rotten Eggs ___ Petroleum ___ Musky ___

Revised March 2006

<u>Air Temperature</u> _______ °Fahrenheit

<u>Precipitation</u> _______ inches over the last 24 hours

<u>Transparency</u> (*record whole numbers only – no tenths*)

________ centimeters

<u>pH</u>

Expiration date on bottom of bottle _______

check one – **4 ____ 5 ____ 6 ____ 7 ____ 8 ____ 9 ____**

<u>Nitrite-N</u> (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ____ 0.15 ____ 0.3 ____ 1.0 ____ 1.5 ____ 3 ____**

<u>Nitrate-N</u> (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ___ 1 ___ 2 ___ 5 ___ 10 ___ 20 ___ 50 ___**

<u>Dissolved Oxygen</u> (*mg/L*)

Expiration date on back of color comparator _______

check one – **1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 8 ___ 10 ___ 12 ___**

Phosphate (*mg/L*)

Expiration date on back of color comparator _______

Expiration date on round color comparator _______

Expiration date on activator solution _______

check one – **0 ___ 0.1___ 0.2___ 0.3___ 0.4___ 0.6___ 0.8___**

1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 10 ___

Chloride

Expiration date on bottom of bottle _______

____________ mg/L **–** *Convert Quantab Units to mg/L using the chart provided on the bottle*

Water Temperature

_______ °Fahrenheit

Stream Width

____._____ meters

Maximum Stream Depth (*along your transect*)

____.________ meters

Stream Flow (*along your transect*)

_______ high **_______** normal **_______** low **_______** not sure

Stream Depth (*in meters, don't forget to convert from cm to m, 1 cm = 0.01 m*)

1st Spot ____.______   5th Spot ____.______   9th Spot ____.______   13th Spot ____.______

2nd Spot ____.______   6th Spot ____.______   10th Spot ____.______   14th Spot ____.______

3rd Spot ____.______   7th Spot ____.______   11th Spot ____.______   15th Spot ____.______

4th Spot ____.______   8h Spot ____.______   12th Spot ____.______

Stream Velocity (*in seconds*)

1st Spot ______   5th Spot ______   9th Spot ______   13th Spot ______

2nd Spot ______   6th Spot ______   10th Spot ______   14th Spot ______

3rd Spot ______   7th Spot ______   11th Spot ______   15th Spot ______

4th Spot ______   8th Spot ______   12th Spot ______

Other Stream Assessment Observations and Notes____

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IOWATER

Volunteer Water Quality Monitoring

Chemical / Physical Assessment

*** Recommended frequency – monthly ***

Revised March 2006

Date __________ **Time ___________**

IOWATER Monitor ____________________# of Adults (*incl. you*) **______**

Site Number _________________________# of under 18 ______

Other Volunteers Involved ____

Was the stream dry when it was monitored? Yes _____ No _____

Weather (*check all that apply*)

Sunny ____ Partly Sunny ____ Cloudy ____ Rain/Snow ____ Windy ____ Calm ____

Water Color (*check all that apply*)

Clear ___ Brown ___ Green ___ Oily ___ Reddish ___ Blackish ___ Milky ___ Gray ___

Water Odor (*check all that apply*)

None ___ Sewage/Manure ___ Rotten Eggs ___ Petroleum ___ Musky ___

Air Temperature _______ °Fahrenheit

Precipitation _______ inches over the last 24 hours

Transparency (*record whole numbers only – no tenths*)

________ centimeters

pH

Expiration date on bottom of bottle _______

check one – **4 ____ 5 ____ 6 ____ 7 ____ 8 ____ 9 ____**

Nitrite-N (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ____ 0.15 ____ 0.3 ____ 1.0 ____ 1.5 ____ 3 ____**

Nitrate-N (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ___ 1 ___ 2 ___ 5 ___ 10 ___ 20 ___ 50 ___**

Dissolved Oxygen (*mg/L*)

Expiration date on back of color comparator _______

check one – **1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 8 ___ 10 ___ 12 ___**

Phosphate (*mg/L*)

Expiration date on back of color comparator _______

Expiration date on round color comparator _______

Expiration date on activator solution _______

check one – **0 ___ 0.1___ 0.2___ 0.3___ 0.4___ 0.6___ 0.8___**

Revised March 2006

1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 10 ___

Chloride

Expiration date on bottom of bottle _______

____________ mg/L – *Convert Quantab Units to mg/L using the chart provided on the bottle*

Water Temperature

_______ °Fahrenheit

Stream Width

____._____ meters

Maximum Stream Depth (*along your transect*)

____.________ meters

Stream Flow (*along your transect*)

_______ high _______ normal _______ low _______ not sure

Stream Depth (*in meters, don't forget to convert from cm to m, 1 cm = 0.01 m*)

1st Spot ____.______ 5th Spot ____.______ 9th Spot ____.______ 13th Spot ____.______

2nd Spot ____.______ 6th Spot ____.______ 10th Spot ____.______ 14th Spot ____.______

3rd Spot ____.______ 7th Spot ____.______ 11th Spot ____.______ 15th Spot ____.______

4th Spot ____.______ 8h Spot ____.______ 12th Spot ____.______

Revised March 2006

<u>Stream Velocity</u> (*in seconds*)

1st Spot ______ 5th Spot ______ 9th Spot ______ 13th Spot ______

2nd Spot ______ 6th Spot ______ 10th Spot ______ 14th Spot ______

3rd Spot ______ 7th Spot ______ 11th Spot ______ 15th Spot ______

4th Spot ______ 8th Spot ______ 12th Spot ______

<u>Other Stream Assessment Observations and Notes</u>____

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IOWATER

Volunteer Water Quality Monitoring

<u>Chemical / Physical Assessment</u>

*** Recommended frequency – monthly ***

Date ___________ **Time** ____________

IOWATER Monitor ______________________ **# of Adults** (*incl. you*) ______

Revised March 2006

Site Number __________________________# of under 18 ______

Other Volunteers Involved ____

Was the stream dry when it was monitored? Yes _____ No _____

Weather (*check all that apply*)

Sunny ____ Partly Sunny ____ Cloudy ____ Rain/Snow ____ Windy ____ Calm ____

Water Color (*check all that apply*)

Clear ___ Brown ___ Green ___ Oily ___ Reddish ___ Blackish ___ Milky ___ Gray ___

Water Odor (*check all that apply*)

None ___ Sewage/Manure ___ Rotten Eggs ___ Petroleum ___ Musky ___

Air Temperature _______ °Fahrenheit

Precipitation _______ inches over the last 24 hours

Transparency (*record whole numbers only – no tenths*)

________ centimeters

pH

Expiration date on bottom of bottle _______

Revised March 2006

check one – **4 ____ 5 ____ 6 ____ 7 ____ 8 ____ 9 ____**

<u>Nitrite-N</u> (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ____ 0.15 ____ 0.3 ____ 1.0 ____ 1.5 ____ 3 ____**

<u>Nitrate-N</u> (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ___ 1 ___ 2 ___ 5 ___ 10 ___ 20 ___ 50 ___**

<u>Dissolved Oxygen</u> (*mg/L*)

Expiration date on back of color comparator _______

check one – **1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 8 ___ 10 ___ 12 ___**

<u>Phosphate</u> (*mg/L*)

Expiration date on back of color comparator _______

Expiration date on round color comparator _______

Expiration date on activator solution _______

check one – **0 ___ 0.1___ 0.2___ 0.3___ 0.4___ 0.6___ 0.8___**

1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 10 ___

<u>Chloride</u>

Expiration date on bottom of bottle _______

Revised March 2006

____________ mg/L – *Convert Quantab Units to mg/L using the chart provided on the bottle*

Water Temperature

_______ °Fahrenheit

Stream Width

____._____ meters

Maximum Stream Depth (*along your transect*)

____.________ meters

Stream Flow (*along your transect*)

_______ high _______ normal _______ low _______ not sure

Stream Depth (*in meters, don't forget to convert from cm to m, 1 cm = 0.01 m*)

1st Spot ____.______ 5th Spot ____.______ 9th Spot ____.______ 13th Spot ____.______

2nd Spot ____.______ 6th Spot ____.______ 10th Spot ____.______ 14th Spot ____.______

3rd Spot ____.______ 7th Spot ____.______ 11th Spot ____.______ 15th Spot ____.______

4th Spot ____.______ 8h Spot ____.______ 12th Spot ____.______

Stream Velocity (*in seconds*)

1st Spot ______ 3rd Spot ______ 5th Spot ______ 7th Spot ______

2nd Spot ______ 4th Spot ______ 6th Spot ______ 8th Spot ______

9^{th} Spot ______ 11^{th} Spot ______ 13^{th} Spot ______ 15^{th} Spot ______

10^{th} Spot ______ 12^{th} Spot ______ 14^{th} Spot ______

Other Stream Assessment Observations and Notes____

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IOWATER

Volunteer Water Quality Monitoring

Chemical / Physical Assessment

*** Recommended frequency – monthly ***

Date __________ **Time** ___________

IOWATER Monitor ____________________ **# of Adults** (*incl. you*) ______

Site Number _________________________ **# of under 18** ______

Other Volunteers Involved ____

Revised March 2006

Was the stream dry when it was monitored? Yes _____ No _____

<u>Weather</u> (*check all that apply*)

Sunny ____ Partly Sunny ____ Cloudy ____ Rain/Snow ____ Windy ____ Calm ____

<u>Water Color</u> (*check all that apply*)

Clear ___ Brown ___ Green ___ Oily ___ Reddish ___ Blackish ___ Milky ___ Gray ___

<u>Water Odor</u> (*check all that apply*)

None ___ Sewage/Manure ___ Rotten Eggs ___ Petroleum ___ Musky ___

<u>Air Temperature</u> _______ °Fahrenheit

<u>Precipitation</u> _______ inches over the last 24 hours

<u>Transparency</u> (*record whole numbers only – no tenths*)

________ centimeters

<u>pH</u>

Expiration date on bottom of bottle _______

check one – **4 ____ 5 ____ 6 ____ 7 ____ 8 ____ 9 ____**

<u>Nitrite-N</u> (*mg/L***)**

Expiration date on bottom of bottle _______

check one – **0 ____ 0.15 ____ 0.3 ____ 1.0 ____ 1.5 ____ 3 ____**

<u>Nitrate-N</u> (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ___ 1 ___ 2 ___ 5 ___ 10 ___ 20 ___ 50 ___**

<u>Dissolved Oxygen</u> (*mg/L*)

Expiration date on back of color comparator _______

check one – **1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 8 ___ 10 ___ 12 ___**

<u>Phosphate</u> (*mg/L*)

Expiration date on back of color comparator _______

Expiration date on round color comparator _______

Expiration date on activator solution _______

check one – **0 ___ 0.1___ 0.2___ 0.3___ 0.4___ 0.6___ 0.8___**

1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 10 ___

<u>Chloride</u>

Expiration date on bottom of bottle _______

____________ mg/L **–** *Convert Quantab Units to mg/L using the chart provided on the bottle*

<u>Water Temperature</u>

_______ °Fahrenheit

Revised March 2006

Stream Width

____._____ meters

Maximum Stream Depth (*along your transect*)

____.________ meters

Stream Flow (*along your transect*)

_______ high _______ normal _______ low _______ not sure

Stream Depth (*in meters, don't forget to convert from cm to m, 1 cm = 0.01 m*)

1st Spot ____.______	5th Spot ____.______	9th Spot ____.______	13th Spot ____.______
2nd Spot ____.______	6th Spot ____.______	10th Spot ____.______	14th Spot ____.______
3rd Spot ____.______	7th Spot ____.______	11th Spot ____.______	15th Spot ____.______
4th Spot ____.______	8h Spot ____.______	12th Spot ____.______	

Stream Velocity (*in seconds*)

1st Spot ______	5th Spot ______	9th Spot ______	13th Spot ______
2nd Spot ______	6th Spot ______	10th Spot ______	14th Spot ______
3rd Spot ______	7th Spot ______	11th Spot ______	15th Spot ______
4th Spot ______	8th Spot ______	12th Spot ______	

Revised March 2006

Other Stream Assessment Observations and Notes____
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IOWATER
Volunteer Water Quality Monitoring

Chemical / Physical Assessment

*** Recommended frequency – monthly ***

Date __________ **Time** ___________

IOWATER Monitor _____________________ **# of Adults** (*incl. you*) ______

Site Number __________________________ **# of under 18** ______

Other Volunteers Involved ____

Was the stream dry when it was monitored? Yes _____ **No** _____

Weather (*check all that apply*)

Sunny ____ Partly Sunny ____ Cloudy ____ Rain/Snow ____ Windy ____ Calm ____

Water Color (*check all that apply*)

Clear ___ Brown ___ Green ___ Oily ___ Reddish ___ Blackish ___ Milky ___ Gray ___

Water Odor (*check all that apply*)

None ___ Sewage/Manure ___ Rotten Eggs ___ Petroleum ___ Musky ___

Air Temperature _______ °Fahrenheit

Precipitation _______ inches over the last 24 hours

Transparency (*record whole numbers only – no tenths*)

________ centimeters

pH

Expiration date on bottom of bottle _______

check one – **4 ____ 5 ____ 6 ____ 7 ____ 8 ____ 9 ____**

Nitrite-N (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ____ 0.15 ____ 0.3 ____ 1.0 ____ 1.5 ____ 3 ____**

Nitrate-N (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ___ 1 ___ 2 ___ 5 ___ 10 ___ 20 ___ 50 ___**

Dissolved Oxygen (*mg/L*)

Expiration date on back of color comparator _______

check one – **1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 8 ___ 10 ___ 12 ___**

Phosphate (*mg/L*)

Expiration date on back of color comparator _______

Expiration date on round color comparator _______

Expiration date on activator solution _______

check one – **0 ___ 0.1___ 0.2___ 0.3___ 0.4___ 0.6___ 0.8___**

1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 10 ___

Chloride

Expiration date on bottom of bottle _______

____________ mg/L – *Convert Quantab Units to mg/L using the chart provided on the bottle*

Water Temperature

_______ °Fahrenheit

Stream Width

____._____ meters

Maximum Stream Depth (*along your transect*)

___.________ meters

Stream Flow (*along your transect*)

_______ high _______ normal _______ low _______ not sure

Stream Depth (*in meters, don't forget to convert from cm to m, 1 cm = 0.01 m*)

1st Spot ____.______ 5th Spot ____.______ 9th Spot ____.______ 13th Spot ____.______

2nd Spot ____.______ 6th Spot ____.______ 10th Spot ____.______ 14th Spot ____.______

3rd Spot ____.______ 7th Spot ____.______ 11th Spot ____.______ 15th Spot ____.______

4th Spot ____.______ 8h Spot ____.______ 12th Spot ____.______

Stream Velocity (*in seconds*)

1st Spot ______ 5th Spot ______ 9th Spot ______ 13th Spot ______

2nd Spot ______ 6th Spot ______ 10th Spot ______ 14th Spot ______

3rd Spot ______ 7th Spot ______ 11th Spot ______ 15th Spot ______

4th Spot ______ 8th Spot ______ 12th Spot ______

Other Stream Assessment Observations and Notes____

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Revised March 2006

IOWATER

Volunteer Water Quality Monitoring

Chemical / Physical Assessment

*** Recommended frequency – monthly ***

Date ___________ **Time ____________**

IOWATER Monitor ______________________# of Adults (*incl. you*) **______**

Site Number ___________________________# of under 18 ______

Other Volunteers Involved ____

Was the stream dry when it was monitored? Yes _____ No _____

Weather (*check all that apply*)

Sunny ____ Partly Sunny ____ Cloudy ____ Rain/Snow ____ Windy ____ Calm ____

Water Color (*check all that apply*)

Clear ___ Brown ___ Green ___ Oily ___ Reddish ___ Blackish ___ Milky ___ Gray ___

Water Odor (*check all that apply*)

None ___ Sewage/Manure ___ Rotten Eggs ___ Petroleum ___ Musky ___

Air Temperature _______ °Fahrenheit

Precipitation _______ inches over the last 24 hours

Transparency (*record whole numbers only – no tenths*)

________ centimeters

pH

Expiration date on bottom of bottle _______

check one – **4 ____ 5 ____ 6 ____ 7 ____ 8 ____ 9 ____**

Nitrite-N (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ____ 0.15 ____ 0.3 ____ 1.0 ____ 1.5 ____ 3 ____**

Nitrate-N (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ___ 1 ___ 2 ___ 5 ___ 10 ___ 20 ___ 50 ___**

<u>Dissolved Oxygen</u> (*mg/L*)

Expiration date on back of color comparator _______

check one – **1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 8 ___ 10 ___ 12 ___**

<u>Phosphate</u> (*mg/L*)

Expiration date on back of color comparator _______

Expiration date on round color comparator _______

Expiration date on activator solution _______

check one – **0 ___ 0.1___ 0.2___ 0.3___ 0.4___ 0.6___ 0.8___**

1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 10 ___

<u>Chloride</u>

Expiration date on bottom of bottle _______

____________ mg/L – *Convert Quantab Units to mg/L using the chart provided on the bottle*

<u>Water Temperature</u>

_______ °Fahrenheit

<u>Stream Width</u>

____._____ meters

<u>Maximum Stream Depth</u> (*along your transect*)

____.________ meters

Revised March 2006

Stream Flow (*along your transect*)

_______ high _______ normal _______ low _______ not sure

Stream Depth (*in meters, don't forget to convert from cm to m, 1 cm = 0.01 m*)

1st Spot ____.______	5th Spot ____.______	9th Spot ____.______	13th Spot ____.______
2nd Spot ____.______	6th Spot ____.______	10th Spot ____.______	14th Spot ____.______
3rd Spot ____.______	7th Spot ____.______	11th Spot ____.______	15th Spot ____.______
4th Spot ____.______	8h Spot ____.______	12th Spot ____.______	

Stream Velocity (*in seconds*)

1st Spot ______	5th Spot ______	9th Spot ______	13th Spot ______
2nd Spot ______	6th Spot ______	10th Spot ______	14th Spot ______
3rd Spot ______	7th Spot ______	11th Spot ______	15th Spot ______
4th Spot ______	8th Spot ______	12th Spot ______	

Other Stream Assessment Observations and Notes____

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Chemical / Physical Assessment

*** Recommended frequency – monthly ***

Date ___________ **Time ____________**

IOWATER Monitor ______________________# of Adults (*incl. you*) **______**

Site Number ___________________________# of under 18 ______

Other Volunteers Involved ____

Was the stream dry when it was monitored? Yes _____ No _____

Weather (*check all that apply*)

Sunny ____ Partly Sunny ____ Cloudy ____ Rain/Snow ____ Windy ____ Calm ____

Water Color (*check all that apply*)

Clear ___ Brown ___ Green ___ Oily ___ Reddish ___ Blackish ___ Milky ___ Gray ___

Revised March 2006

Water Odor (*check all that apply*)

None ___ Sewage/Manure ___ Rotten Eggs ___ Petroleum ___ Musky ___

Air Temperature _______ °Fahrenheit

Precipitation _______ inches over the last 24 hours

Transparency (*record whole numbers only – no tenths*)

________ centimeters

pH

Expiration date on bottom of bottle _______

check one – **4 ____ 5 ____ 6 ____ 7 ____ 8 ____ 9 ____**

Nitrite-N (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ____ 0.15 ____ 0.3 ____ 1.0 ____ 1.5 ____ 3 ____**

Nitrate-N (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ___ 1 ___ 2 ___ 5 ___ 10 ___ 20 ___ 50 ___**

Dissolved Oxygen (*mg/L*)

Expiration date on back of color comparator _______

check one – **1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 8 ___ 10 ___ 12 ___**

Phosphate (*mg/L*)

Expiration date on back of color comparator _______

Expiration date on round color comparator _______

Expiration date on activator solution _______

check one – **0 ___ 0.1___ 0.2___ 0.3___ 0.4___ 0.6___ 0.8___**

1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 10 ___

Chloride

Expiration date on bottom of bottle _______

____________ mg/L – *Convert Quantab Units to mg/L using the chart provided on the bottle*

Water Temperature

_______ °Fahrenheit

Stream Width

____._____ meters

Maximum Stream Depth (*along your transect*)

____.________ meters

Stream Flow (*along your transect*)

_______ high _______ normal _______ low _______ not sure

Stream Depth (*in meters, don't forget to convert from cm to m, 1 cm = 0.01 m*)

1st Spot ____.______ 5th Spot ____.______ 9th Spot ____.______ 13th Spot ____.______

2nd Spot ____.______ 6th Spot ____.______ 10th Spot ____.______ 14th Spot ____.______

3rd Spot ____.______ 7th Spot ____.______ 11th Spot ____.______ 15th Spot ____.______

4th Spot ____.______ 8h Spot ____.______ 12th Spot ____.______

Stream Velocity (*in seconds*)

1st Spot ______ 5th Spot ______ 9th Spot ______ 13th Spot ______

2nd Spot ______ 6th Spot ______ 10th Spot ______ 14th Spot ______

3rd Spot ______ 7th Spot ______ 11th Spot ______ 15th Spot ______

4th Spot ______ 8th Spot ______ 12th Spot ______

Other Stream Assessment Observations and Notes____

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IOWATER
Volunteer Water Quality Monitoring

Revised March 2006

Chemical / Physical Assessment

*** Recommended frequency – monthly ***

Date __________ **Time ___________**

IOWATER Monitor _____________________# of Adults (*incl. you*) **______**

Site Number __________________________# of under 18 ______

Other Volunteers Involved ____

Was the stream dry when it was monitored? Yes _____ No _____

Weather (*check all that apply*)

Sunny ____ Partly Sunny ____ Cloudy ____ Rain/Snow ____ Windy ____ Calm ____

Water Color (*check all that apply*)

Clear ___ Brown ___ Green ___ Oily ___ Reddish ___ Blackish ___ Milky ___ Gray ___

Water Odor (*check all that apply*)

None ___ Sewage/Manure ___ Rotten Eggs ___ Petroleum ___ Musky ___

<u>Air Temperature</u> _______ °Fahrenheit

<u>Precipitation</u> _______ inches over the last 24 hours

<u>Transparency</u> (*record whole numbers only – no tenths*)

________ centimeters

<u>pH</u>

Expiration date on bottom of bottle _______

check one – **4 ____ 5 ____ 6 ____ 7 ____ 8 ____ 9 ____**

<u>Nitrite-N</u> (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ____ 0.15 ____ 0.3 ____ 1.0 ____ 1.5 ____ 3 ____**

<u>Nitrate-N</u> (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ___ 1 ___ 2 ___ 5 ___ 10 ___ 20 ___ 50 ___**

<u>Dissolved Oxygen</u> (*mg/L*)

Expiration date on back of color comparator _______

check one – **1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 8 ___ 10 ___ 12 ___**

Revised March 2006

Phosphate (*mg/L*)

Expiration date on back of color comparator _______

Expiration date on round color comparator _______

Expiration date on activator solution _______

check one – **0 ___ 0.1___ 0.2___ 0.3___ 0.4___ 0.6___ 0.8___**

1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 10 ___

Chloride

Expiration date on bottom of bottle _______

____________ mg/L – *Convert Quantab Units to mg/L using the chart provided on the bottle*

Water Temperature

_______ °Fahrenheit

Stream Width

____._____ meters

Maximum Stream Depth (*along your transect*)

____.________ meters

Stream Flow (*along your transect*)

_______ high _______ normal _______ low _______ not sure

Stream Depth (*in meters, don't forget to convert from cm to m, 1 cm = 0.01 m*)

1st Spot ____.______	5th Spot ____.______	9th Spot ____.______	13th Spot ____.______
2nd Spot ____.______	6th Spot ____.______	10th Spot ____.______	14th Spot ____.______
3rd Spot ____.______	7th Spot ____.______	11th Spot ____.______	15th Spot ____.______
4th Spot ____.______	8h Spot ____.______	12th Spot ____.______	

Stream Velocity (*in seconds*)

1st Spot ______	5th Spot ______	9th Spot ______	13th Spot ______
2nd Spot ______	6th Spot ______	10th Spot ______	14th Spot ______
3rd Spot ______	7th Spot ______	11th Spot ______	15th Spot ______
4th Spot ______	8th Spot ______	12th Spot ______	

Other Stream Assessment Observations and Notes____

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IOWATER

Volunteer Water Quality Monitoring

Chemical / Physical Assessment

*** Recommended frequency – monthly ***

Revised March 2006

Date __________ **Time** ___________

IOWATER Monitor ____________________ **# of Adults** (*incl. you*) ______

Site Number _________________________ **# of under 18** ______

Other Volunteers Involved ____

Was the stream dry when it was monitored? Yes _____ **No** _____

Weather (*check all that apply*)

Sunny ____ Partly Sunny ____ Cloudy ____ Rain/Snow ____ Windy ____ Calm ____

Water Color (*check all that apply*)

Clear ___ Brown ___ Green ___ Oily ___ Reddish ___ Blackish ___ Milky ___ Gray ___

Water Odor (*check all that apply*)

None ___ Sewage/Manure ___ Rotten Eggs ___ Petroleum ___ Musky ___

Air Temperature ______ °Fahrenheit

Precipitation ______ inches over the last 24 hours

Transparency (*record whole numbers only – no tenths*)

Revised March 2006

________ centimeters

pH

Expiration date on bottom of bottle _______

check one – **4 ____ 5 ____ 6 ____ 7 ____ 8 ____ 9 ____**

Nitrite-N (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ____ 0.15 ____ 0.3 ____ 1.0 ____ 1.5 ____ 3 ____**

Nitrate-N (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ___ 1 ___ 2 ___ 5 ___ 10 ___ 20 ___ 50 ___**

Dissolved Oxygen (*mg/L*)

Expiration date on back of color comparator _______

check one – **1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 8 ___ 10 ___ 12 ___**

Phosphate (*mg/L*)

Expiration date on back of color comparator _______

Expiration date on round color comparator _______

Expiration date on activator solution _______

check one – **0 ___ 0.1___ 0.2___ 0.3___ 0.4___ 0.6___ 0.8___**

Revised March 2006

1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 10 ___

Chloride

Expiration date on bottom of bottle _______

____________ mg/L – *Convert Quantab Units to mg/L using the chart provided on the bottle*

Water Temperature

_______ °Fahrenheit

Stream Width

____._____ meters

Maximum Stream Depth (*along your transect*)

____.________ meters

Stream Flow (*along your transect*)

_______ high _______ normal _______ low _______ not sure

Stream Depth (*in meters, don't forget to convert from cm to m, 1 cm = 0.01 m*)

1st Spot ____.______ 5th Spot ____.______ 9th Spot ____.______ 13th Spot ____.______

2nd Spot ____.______ 6th Spot ____.______ 10th Spot ____.______ 14th Spot ____.______

3rd Spot ____.______ 7th Spot ____.______ 11th Spot ____.______ 15th Spot ____.______

4th Spot ____.______ 8h Spot ____.______ 12th Spot ____.______

Revised March 2006

Stream Velocity (*in seconds*)

1st Spot ______ 5th Spot ______ 9th Spot ______ 13th Spot ______

2nd Spot ______ 6th Spot ______ 10th Spot ______ 14th Spot ______

3rd Spot ______ 7th Spot ______ 11th Spot ______ 15th Spot ______

4th Spot ______ 8th Spot ______ 12th Spot ______

Other Stream Assessment Observations and Notes____

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IOWATER

Volunteer Water Quality Monitoring

Chemical / Physical Assessment

*** Recommended frequency – monthly ***

Date ___________ **Time** ____________

IOWATER Monitor ______________________ **# of Adults** (*incl. you*) ______

Revised March 2006

Site Number _________________________# of under 18 ______

Other Volunteers Involved ____

Was the stream dry when it was monitored? Yes _____   No _____

<u>Weather</u> (*check all that apply*)

Sunny ____ Partly Sunny ____ Cloudy ____ Rain/Snow ____ Windy ____ Calm ____

<u>Water Color</u> (*check all that apply*)

Clear ___ Brown ___ Green ___ Oily ___ Reddish ___ Blackish ___ Milky ___ Gray ___

<u>Water Odor</u> (*check all that apply*)

None ___ Sewage/Manure ___ Rotten Eggs ___ Petroleum ___ Musky ___

<u>Air Temperature</u> _______ °Fahrenheit

<u>Precipitation</u> _______ inches over the last 24 hours

<u>Transparency</u> (*record whole numbers only – no tenths*)

________ centimeters

<u>pH</u>

Expiration date on bottom of bottle _______

Revised March 2006

check one – **4 ____ 5 ____ 6 ____ 7 ____ 8 ____ 9 ____**

<u>Nitrite-N</u> (*mg/L***)**

Expiration date on bottom of bottle _______

check one – **0 ____ 0.15 ____ 0.3 ____ 1.0 ____ 1.5 ____ 3 ____**

<u>Nitrate-N</u> (*mg/L***)**

Expiration date on bottom of bottle _______

check one – **0 ___ 1 ___ 2 ___ 5 ___ 10 ___ 20 ___ 50 ___**

<u>Dissolved Oxygen</u> (*mg/L***)**

Expiration date on back of color comparator _______

check one – **1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 8 ___ 10 ___ 12 ___**

<u>Phosphate</u> (*mg/L*)

Expiration date on back of color comparator _______

Expiration date on round color comparator _______

Expiration date on activator solution _______

check one – **0 ___ 0.1___ 0.2___ 0.3___ 0.4___ 0.6___ 0.8___**

1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 10 ___

<u>Chloride</u>

Expiration date on bottom of bottle _______

____________ mg/L – *Convert Quantab Units to mg/L using the chart provided on the bottle*

Water Temperature

_______ °Fahrenheit

Stream Width

____.______ meters

Maximum Stream Depth (*along your transect*)

____.________ meters

Stream Flow (*along your transect*)

_______ high _______ normal _______ low _______ not sure

Stream Depth (*in meters, don't forget to convert from cm to m, 1 cm = 0.01 m*)

1st Spot ____.______	5th Spot ____.______	9th Spot ____.______	13th Spot ____.______
2nd Spot ____.______	6th Spot ____.______	10th Spot ____.______	14th Spot ____.______
3rd Spot ____.______	7th Spot ____.______	11th Spot ____.______	15th Spot ____.______
4th Spot ____.______	8h Spot ____.______	12th Spot ____.______	

Stream Velocity (*in seconds*)

1st Spot ______	3rd Spot ______	5th Spot ______	7th Spot ______
2nd Spot ______	4th Spot ______	6th Spot ______	8th Spot ______

9th Spot ______ 11th Spot ______ 13th Spot ______ 15th Spot ______

10th Spot ______ 12th Spot ______ 14th Spot ______

Other Stream Assessment Observations and Notes____
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IOWATER
Volunteer Water Quality Monitoring

Chemical / Physical Assessment

*** Recommended frequency – monthly ***

Date __________ **Time** ___________

IOWATER Monitor ____________________ **# of Adults** (*incl. you*) ______

Site Number _________________________ **# of under 18** ______

Other Volunteers Involved ____

Revised March 2006

Was the stream dry when it was monitored? Yes _____ No _____

<u>Weather</u> (*check all that apply*)

Sunny ____ Partly Sunny ____ Cloudy ____ Rain/Snow ____ Windy ____ Calm ____

<u>Water Color</u> (*check all that apply*)

Clear ___ Brown ___ Green ___ Oily ___ Reddish ___ Blackish ___ Milky ___ Gray ___

<u>Water Odor</u> (*check all that apply*)

None ___ Sewage/Manure ___ Rotten Eggs ___ Petroleum ___ Musky ___

<u>Air Temperature</u> _______ °Fahrenheit

<u>Precipitation</u> _______ inches over the last 24 hours

<u>Transparency</u> (*record whole numbers only – no tenths*)

________ centimeters

<u>pH</u>

Expiration date on bottom of bottle _______

check one – **4 ____ 5 ____ 6 ____ 7 ____ 8 ____ 9 ____**

<u>Nitrite-N</u> (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ____ 0.15 ____ 0.3 ____ 1.0 ____ 1.5 ____ 3 ____**

Nitrate-N (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ___ 1 ___ 2 ___ 5 ___ 10 ___ 20 ___ 50 ___**

Dissolved Oxygen (*mg/L*)

Expiration date on back of color comparator _______

check one – **1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 8 ___ 10 ___ 12 ___**

Phosphate (*mg/L*)

Expiration date on back of color comparator _______

Expiration date on round color comparator _______

Expiration date on activator solution _______

check one – **0 ___ 0.1___ 0.2___ 0.3___ 0.4___ 0.6___ 0.8___**

1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 10 ___

Chloride

Expiration date on bottom of bottle _______

____________ mg/L – *Convert Quantab Units to mg/L using the chart provided on the bottle*

Water Temperature

_______ °Fahrenheit

Stream Width

____._____ meters

Maximum Stream Depth (*along your transect*)

____.________ meters

Stream Flow (*along your transect*)

_______ high _______ normal _______ low _______ not sure

Stream Depth (*in meters, don't forget to convert from cm to m, 1 cm = 0.01 m*)

1st Spot ____.______	5th Spot ____.______	9th Spot ____.______	13th Spot ____.______
2nd Spot ____.______	6th Spot ____.______	10th Spot ____.______	14th Spot ____.______
3rd Spot ____.______	7th Spot ____.______	11th Spot ____.______	15th Spot ____.______
4th Spot ____.______	8h Spot ____.______	12th Spot ____.______	

Stream Velocity (*in seconds*)

1st Spot ______	5th Spot ______	9th Spot ______	13th Spot ______
2nd Spot ______	6th Spot ______	10th Spot ______	14th Spot ______
3rd Spot ______	7th Spot ______	11th Spot ______	15th Spot ______
4th Spot ______	8th Spot ______	12th Spot ______	

Other Stream Assessment Observations and Notes____

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Chemical / Physical Assessment

*** Recommended frequency – monthly ***

Date ___________ **Time** ___________

IOWATER Monitor ______________________ **# of Adults** (*incl. you*) ______

Site Number ___________________________ **# of under 18** ______

Other Volunteers Involved ____

Was the stream dry when it was monitored? Yes _____ **No** _____

Weather (*check all that apply*)

Sunny ____ Partly Sunny ____ Cloudy ____ Rain/Snow ____ Windy ____ Calm ____

Water Color (*check all that apply*)

Clear ___ Brown ___ Green ___ Oily ___ Reddish ___ Blackish ___ Milky ___ Gray ___

Water Odor (*check all that apply*)

None ___ Sewage/Manure ___ Rotten Eggs ___ Petroleum ___ Musky ___

Air Temperature _______ °Fahrenheit

Precipitation _______ inches over the last 24 hours

Transparency (*record whole numbers only – no tenths*)

________ centimeters

pH

Expiration date on bottom of bottle _______

check one – **4 ____ 5 ____ 6 ____ 7 ____ 8 ____ 9 ____**

Nitrite-N (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ____ 0.15 ____ 0.3 ____ 1.0 ____ 1.5 ____ 3 ____**

Nitrate-N (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ___ 1 ___ 2 ___ 5 ___ 10 ___ 20 ___ 50 ___**

Dissolved Oxygen (*mg/L*)

Expiration date on back of color comparator _______

check one – **1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 8 ___ 10 ___ 12 ___**

Phosphate (*mg/L*)

Expiration date on back of color comparator _______

Expiration date on round color comparator _______

Expiration date on activator solution _______

check one – **0 ___ 0.1___ 0.2___ 0.3___ 0.4___ 0.6___ 0.8___**

1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 10 ___

Chloride

Expiration date on bottom of bottle _______

____________ mg/L – *Convert Quantab Units to mg/L using the chart provided on the bottle*

Water Temperature

_______ °Fahrenheit

Stream Width

____._____ meters

Maximum Stream Depth (*along your transect*)

___.________ meters

Stream Flow (*along your transect*)

_______ high _______ normal _______ low _______ not sure

Stream Depth (*in meters, don't forget to convert from cm to m, 1 cm = 0.01 m*)

1st Spot ____.______	5th Spot ____.______	9th Spot ____.______	13th Spot ____.______
2nd Spot ____.______	6th Spot ____.______	10th Spot ____.______	14th Spot ____.______
3rd Spot ____.______	7th Spot ____.______	11th Spot ____.______	15th Spot ____.______
4th Spot ____.______	8h Spot ____.______	12th Spot ____.______	

Stream Velocity (*in seconds*)

1st Spot ______	5th Spot ______	9th Spot ______	13th Spot ______
2nd Spot ______	6th Spot ______	10th Spot ______	14th Spot ______
3rd Spot ______	7th Spot ______	11th Spot ______	15th Spot ______
4th Spot ______	8th Spot ______	12th Spot ______	

Other Stream Assessment Observations and Notes____

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Revised March 2006

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IOWATER
Volunteer Water Quality Monitoring

Standing Water Assessment

*** Recommended frequency: monthly from ice-out to freeze-over ***

Date __________ **Time ___________**

IOWATER Monitor ______________________ **# of Adults** (*incl. you*) **______**

Site Number ___________________________ **# of under 18 ______**

Other Volunteers Involved ____

Physical Assessment

Weather (*check all that apply*)

Sunny ____ Partly Sunny ____ Cloudy ____ Rain/Snow ____ Windy ____ Calm ____

Air Temperature ______ °Fahrenheit

Precipitation ______ inches over the last 24 hours

Wind Direction (*check one*) **Wind Speed** (*check one*)

____ Not applicable ____ North ____ South

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____ East ____ Northeast ____ Calm (0-5 mph, felt on face, leaves rustle)

____ West ____ Northwest ____ Breezy (sustained 5-15 mph, small branches move)

____ Southeast ____ Strong (sustained over 15 mph, small trees sway continuously, waves form)

____ Southwest

____ Gusty (gust over 15 mph, small trees sway occasionally)

Site Location ____ Open Water ____ Shore or Dock

Secchi Disc Depth ____.____ meters

OR Transparency Tube _________ cm (*record whole numbers only – no tenths*)

Water Temperature ____ °Fahrenheit

Water Level (*check one*)

Above Normal ____ Normal ____ Below Normal ____

If lake is not at normal level, and you have means to measure, please specify:

inches above _______ or below _______ normal

Water Odor (*check all that apply*)

None ____ Sewage/Manure ____ Rotten Eggs ____ Petroleum ____ Fishy ____

Chemical Assessment

IMPORTANT: Use Point Sampling technique!

pH

Expiration date on bottom of bottle _______

check one – **4 ____ 5 ____ 6 ____ 7 ____ 8 ____ 9 ____**

Nitrite-N (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ____ 0.15 ____ 0.3 ____ 1.0 ____ 1.5 ____ 3 ____**

Nitrate-N (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ___ 1 ___ 2 ___ 5 ___ 10 ___ 20 ___ 50 ___**

Dissolved Oxygen (*mg/L*)

Expiration date on back of color comparator _______

check one – **1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 8 ___ 10 ___ 12 ___**

Phosphate (*mg/L*)

Expiration date on back of color comparator _______

Expiration date on round color comparator _______

Expiration date on activator solution _______

check one – **0 ___ 0.1___ 0.2___ 0.3___ 0.4___ 0.6___ 0.8___**

1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 10 ___

Chloride

Expiration date on bottom of bottle _______

___________ mg/L – *Convert Quantab Units to mg/L using the chart provided on the bottle*

Biological Assessment

Water Color – Is there an obvious algal bloom? (algal mats present, water appears green or scummy) ____ No ____ Yes (*if yes, please submit a photo record*)

Habitat Assessment

*** Conduct only once per year, preferably in July, or if a major land use change occurs ***

Describe Lake Banks____

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Describe Adjacent Land Use ____

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Other Observations and Notes:

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Standing Water Assessment

*** Recommended frequency: monthly from ice-out to freeze-over ***

Date __________ **Time** ___________

IOWATER Monitor _______________________ **# of Adults** (*incl. you*) ______

Site Number ____________________________ **# of under 18** ______

Other Volunteers Involved ____

Physical Assessment

Weather (*check all that apply*)

Sunny ____ Partly Sunny ____ Cloudy ____ Rain/Snow ____ Windy ____ Calm ____

Air Temperature ______ °Fahrenheit

Precipitation ______ inches over the last 24 hours

Wind Direction (*check one*) **Wind Speed** (*check one*)

____ Not applicable ____ South ____ West

____ North ____ East

Revised March 2006

____ Northeast ____ Northwest ____ Southeast ____ Southwest	____ Calm (0-5 mph, felt on face, leaves rustle) ____ Breezy (sustained 5-15 mph, small branches move) ____ Strong (sustained over 15 mph, small trees sway continuously, waves form) ____ Gusty (gust over 15 mph, small trees sway occasionally)

Site Location ____ Open Water ____ Shore or Dock

Secchi Disc Depth ____.____ meters

OR Transparency Tube _________ cm (*record whole numbers only – no tenths*)

Water Temperature ____ °Fahrenheit

Water Level (*check one*)

Above Normal ____ Normal ____ Below Normal ____

If lake is not at normal level, and you have means to measure, please specify:

inches above _______ or below _______ normal

Water Odor (*check all that apply*)

None ____ Sewage/Manure ____ Rotten Eggs ____ Petroleum ____ Fishy ____

<u>Chemical Assessment</u>

IMPORTANT: Use Point Sampling technique!

<u>pH</u>

Expiration date on bottom of bottle _______

check one – **4 ____ 5 ____ 6 ____ 7 ____ 8 ____ 9 ____**

<u>Nitrite-N</u> (*mg/L***)**

Expiration date on bottom of bottle _______

check one – **0 ____ 0.15 ____ 0.3 ____ 1.0 ____ 1.5 ____ 3 ____**

<u>Nitrate-N</u> (*mg/L***)**

Expiration date on bottom of bottle _______

check one – **0 ___ 1 ___ 2 ___ 5 ___ 10 ___ 20 ___ 50 ___**

<u>Dissolved Oxygen</u> (*mg/L***)**

Expiration date on back of color comparator _______

check one – **1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 8 ___ 10 ___ 12 ___**

<u>Phosphate</u> (*mg/L*)

Expiration date on back of color comparator _______

Expiration date on round color comparator _______

Expiration date on activator solution _______

check one – **0 ___ 0.1___ 0.2___ 0.3___ 0.4___ 0.6___ 0.8___**

1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 10 ___

<u>Chloride</u>

Expiration date on bottom of bottle _______

___________ **mg/L –** *Convert Quantab Units to mg/L using the chart provided on the bottle*

Biological Assessment

Water Color – Is there an obvious algal bloom? (algal mats present, water appears green or scummy) ____ No ____ Yes (*if yes, please submit a photo record*)

Habitat Assessment

*** Conduct only once per year, preferably in July, or if a major land use change occurs ***

Describe Lake Banks____

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Describe Adjacent Land Use ____

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Other Observations and Notes:

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IOWATER
Volunteer Water Quality Monitoring

Standing Water Assessment

*** Recommended frequency: monthly from ice-out to freeze-over ***

Date __________ **Time** ___________

IOWATER Monitor _______________________ **# of Adults** (*incl. you*) ______

Site Number ____________________________ **# of under 18** ______

Other Volunteers Involved ____

Physical Assessment

Weather (*check all that apply*)

Sunny ____ Partly Sunny ____ Cloudy ____ Rain/Snow ____ Windy ____ Calm ____

Air Temperature ______ °Fahrenheit

Precipitation ______ inches over the last 24 hours

Wind Direction (*check one*) **Wind Speed** (*check one*)

____ Not applicable ____ South ____ West

____ North ____ East

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____ Northeast ____ Northwest ____ Southeast ____ Southwest	____ Calm (0-5 mph, felt on face, leaves rustle) ____ Breezy (sustained 5-15 mph, small branches move) ____ Strong (sustained over 15 mph, small trees sway continuously, waves form) ____ Gusty (gust over 15 mph, small trees sway occasionally)

Site Location ____ Open Water ____ Shore or Dock

Secchi Disc Depth ____.____ meters

OR Transparency Tube _________ cm (*record whole numbers only – no tenths*)

Water Temperature ____ °Fahrenheit

Water Level (*check one*)

Above Normal ____ Normal ____ Below Normal ____

If lake is not at normal level, and you have means to measure, please specify:

inches above _______ or below _______ normal

Water Odor (*check all that apply*)

None ____ Sewage/Manure ____ Rotten Eggs ____ Petroleum ____ Fishy ____

Chemical Assessment

IMPORTANT: Use Point Sampling technique!

pH

Expiration date on bottom of bottle _______

check one – **4 ____ 5 ____ 6 ____ 7 ____ 8 ____ 9 ____**

Nitrite-N (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ____ 0.15 ____ 0.3 ____ 1.0 ____ 1.5 ____ 3 ____**

Nitrate-N (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ___ 1 ___ 2 ___ 5 ___ 10 ___ 20 ___ 50 ___**

Dissolved Oxygen (*mg/L*)

Expiration date on back of color comparator _______

check one – **1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 8 ___ 10 ___ 12 ___**

Phosphate (*mg/L*)

Expiration date on back of color comparator _______

Expiration date on round color comparator _______

Expiration date on activator solution _______

check one – **0 ___ 0.1___ 0.2___ 0.3___ 0.4___ 0.6___ 0.8___**

1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 10 ___

Chloride

Expiration date on bottom of bottle _______

___________ mg/L – *Convert Quantab Units to mg/L using the chart provided on the bottle*

Biological Assessment

Water Color – Is there an obvious algal bloom? (algal mats present, water appears green or scummy) ____ No ____ Yes (*if yes, please submit a photo record*)

Habitat Assessment

*** Conduct only once per year, preferably in July, or if a major land use change occurs ***

Describe Lake Banks____

____

____

____

Describe Adjacent Land Use ____

____

____

Other Observations and Notes:

____

____

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IOWATER

Volunteer Water Quality Monitoring

Standing Water Assessment

*** Recommended frequency: monthly from ice-out to freeze-over ***

Date __________ **Time** ___________

IOWATER Monitor _______________________ **# of Adults** (*incl. you*) ______

Site Number ____________________________ **# of under 18** ______

Other Volunteers Involved ____

Physical Assessment

Weather (*check all that apply*)

Sunny ____ Partly Sunny ____ Cloudy ____ Rain/Snow ____ Windy ____ Calm ____

Air Temperature ______ °Fahrenheit

Precipitation ______ inches over the last 24 hours

Wind Direction (*check one*) **Wind Speed** (*check one*)

____ Not applicable ____ South ____ West

____ North ____ East

Revised March 2006

____ Northeast ____ Northwest ____ Southeast ____ Southwest	____ Calm (0-5 mph, felt on face, leaves rustle) ____ Breezy (sustained 5-15 mph, small branches move) ____ Strong (sustained over 15 mph, small trees sway continuously, waves form) ____ Gusty (gust over 15 mph, small trees sway occasionally)

Site Location ____ Open Water ____ Shore or Dock

Secchi Disc Depth **____.____** meters

OR Transparency Tube _________ cm (*record whole numbers only – no tenths*)

Water Temperature ____ °Fahrenheit

Water Level (*check one*)

Above Normal ____   Normal ____   Below Normal ____

If lake is not at normal level, and you have means to measure, please specify:

inches above _______ or below _______ normal

Water Odor (*check all that apply*)

None ____   Sewage/Manure ____   Rotten Eggs ____   Petroleum ____   Fishy ____

Chemical Assessment

IMPORTANT: Use Point Sampling technique!

pH

Expiration date on bottom of bottle _______

check one – **4 ____ 5 ____ 6 ____ 7 ____ 8 ____ 9 ____**

Nitrite-N (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ____ 0.15 ____ 0.3 ____ 1.0 ____ 1.5 ____ 3 ____**

Nitrate-N (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ___ 1 ___ 2 ___ 5 ___ 10 ___ 20 ___ 50 ___**

Dissolved Oxygen (*mg/L*)

Expiration date on back of color comparator _______

check one – **1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 8 ___ 10 ___ 12 ___**

Phosphate (*mg/L*)

Expiration date on back of color comparator _______

Expiration date on round color comparator _______

Expiration date on activator solution _______

check one – **0 ___ 0.1___ 0.2___ 0.3___ 0.4___ 0.6___ 0.8___**

1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___ 10 ___

Chloride

Expiration date on bottom of bottle _______

___________ **mg/L –** *Convert Quantab Units to mg/L using the chart provided on the bottle*

Biological Assessment

Water Color – Is there an obvious algal bloom? (algal mats present, water appears green or scummy) ____ No ____ Yes (*if yes, please submit a photo record*)

Habitat Assessment

*** Conduct only once per year, preferably in July, or if a major land use change occurs ***

Describe Lake Banks____

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Describe Adjacent Land Use ____

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Other Observations and Notes:

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IOWATER

Volunteer Water Quality Monitoring

Standing Water Assessment

*** Recommended frequency: monthly from ice-out to freeze-over ***

Date __________ **Time ___________**

IOWATER Monitor ______________________ **# of Adults** (*incl. you*) **______**

Site Number ___________________________ **# of under 18 ______**

Other Volunteers Involved ____

Physical Assessment

Weather (*check all that apply*)

Sunny ____ Partly Sunny ____ Cloudy ____ Rain/Snow ____ Windy ____ Calm ____

Air Temperature ______ °Fahrenheit

Precipitation ______ inches over the last 24 hours

Wind Direction (*check one*) **Wind Speed** (*check one*)

____ Not applicable ____ South ____ West

____ North ____ East

Revised March 2006

_____ Northeast _____ Northwest _____ Southeast _____ Southwest	_____ Calm (0-5 mph, felt on face, leaves rustle) _____ Breezy (sustained 5-15 mph, small branches move) _____ Strong (sustained over 15 mph, small trees sway continuously, waves form) _____ Gusty (gust over 15 mph, small trees sway occasionally)

Site Location _____ Open Water _____ Shore or Dock

Secchi Disc Depth _____._____ meters

OR Transparency Tube _________ cm (*record whole numbers only – no tenths*)

Water Temperature _____ °Fahrenheit

Water Level (*check one*)

Above Normal ____ Normal ____ Below Normal ____

If lake is not at normal level, and you have means to measure, please specify:

inches above _______ or below _______ normal

Water Odor (*check all that apply*)

None ____ Sewage/Manure ____ Rotten Eggs ____ Petroleum ____ Fishy ____

Chemical Assessment

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Expiration date on bottom of bottle _______

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Nitrate-N (*mg/L*)

Expiration date on bottom of bottle _______

check one – **0 ___ 1 ___ 2 ___ 5 ___ 10 ___ 20 ___ 50 ___**

Dissolved Oxygen (*mg/L*)

Expiration date on back of color comparator _______

check one – **1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 8 ___ 10 ___ 12 ___**

Phosphate (*mg/L*)

Expiration date on back of color comparator _______

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Expiration date on activator solution _______

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Chloride

Expiration date on bottom of bottle _______

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Revised March 2006

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_____ Calm (0-5 mph, felt on face, leaves rustle)

_____ Breezy (sustained 5-15 mph, small branches move)

_____ Strong (sustained over 15 mph, small trees sway continuou sly, waves form)

_____ Gusty (gust over 15 mph, small trees sway occasionall y)

<u>Site Location</u> _____ Open Water _____ Shore or Dock

<u>Secchi Disc Depth</u> _____._____ meters

<u>OR</u> Transparency Tube _________ cm (*record whole numbers only – no tenths*)

<u>Water Temperature</u> _____ °Fahrenheit

<u>Water Level</u> (*check one*)

Above Normal ____ Normal ____ Below Normal ____

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Expiration date on back of color comparator _______

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Revised March 2006

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IOWATER Monitor _______________________ **# of Adults** (*incl. you*) **______**

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CHAPTER 12

Glossary and References

Glossary

Acid Rain: Rain with a pH of 4.5 or less.

Aerobic: Life or processes that depend on the presence of oxygen.

Aggrading Stream Reach: Deposition is greater than erosion within the stream reach.

Algae: Green plants that occur as microscopic forms suspended in water (phytoplankton), and as unicellular or filamentous forms attached to rocks and other substrates. These plants lack roots, stems, flowers, and leaves, live mainly in water and use the sun as an energy source.

Algal Bloom: A sudden increase in the abundance of suspended (planktonic) algae, especially at or near the water surface, producing a green appearance to the water. Excess nutrient can cause an algal bloom.

Alkalinity: A measure of water's ability to neutralize acid.

Ampoule: A sealed bulbous glass tube that contains a liquid product. Ampoules are used in the orthophosphate and dissolved oxygen field kits.

Anaerobic: Life or processes that occur in the absence of oxygen.

Anaerobic Decomposition: The breakdown of organic material without oxygen.

Anoxia: A condition of no oxygen in the water. Often occurs near the bottom of eutrophic, stratified lakes in summer, under ice in winter.

Aquatic Community: All the groups of plants and animals occupying a common body of water.

Banks: The portion of the stream channel which restricts the movement of water out of a channel during times of normal water depth. This area is characterized as being the exposed areas on either sides of the stream above water's level.

Baseline: A level or concentration that is the norm.

Baseflow: That portion of stream flow originating from groundwater discharging into the stream.

Basin: Another name for a watershed.

Benthic Zone: The zone on the bottom of moving or standing waters.

Bioaccumulation: The build-up of toxic substances in animal flesh.

Biodiversity: Biological diversity in an environment as indicated by numbers of different species of plants and animals.

Biomass: Living things and their byproducts.

Canopy Cover: Overhanging vegetation that provides shade to a stream.

Carrying Capacity: The number of individuals the resources of a given area can support.

Channelization: The straightening of streams by eliminating the meanders or bends. A channelized stream resembles a ditch with few or no meanders.

Chemical Weathering: Erosion caused by chemical reactions (e.g., rainwater dissolving limestone).

Chlorophyll: Green pigments found in plants which are necessary for photosynthesis; may be used as an indicator of algal population levels in a stream or lake.

Confined Aquifer: An aquifer that is protected by an impervious layer of rock.

Cultural Eutrophication: The accelerated enrichment of waters due to human activities. Excess nutrients from agricultural runoff, sewage, or other sources allow waters to support a higher amount of plant and animal matter than they would naturally.

Dead Zone: An area of the Mississippi River delta that cannot support aquatic life during certain times of the year due to low dissolved oxygen levels.

Degrading Stream Reach: A stream reach where erosion is greater than deposition.

Denitrification: The process of converting nitrate nitrogen into nitrite nitrogen (NO_2^-), which can convert to nitrogen gas (N_2) and escape into the atmosphere.

Discharge, Flow: A measure of how much water passes a given point in a given time (m^3/s).

Discharge Permits: The maximum amount of a pollutant that an entity is permitted to release into a water body.

Dissolved Oxygen: The amount of oxygen dissolved in water. Higher amounts of oxygen can be dissolved in colder waters than in warmer waters. Dissolved oxygen is necessary to support fish and other aquatic organisms.

Diversity: Having a large variety of organisms.

Dysotrophic: Low in nutrients, highly colored with dissolved humic organic matter.

Ecology: The study of relationships among living and nonliving things.

Ecoregion: Large areas within which local ecosystems reoccur in a more or less predictable patterns. Ecoregions provide a spatial framework for ecosystem assessment, research, inventory, monitoring, and management.

Ecosystem: A community of animals, plants, and microorganisms interacting within the physical and chemical environment.

Embeddedness: The degree that larger particles (boulders or gravel) in a stream are surrounded or covered by fine sediment.

Emergent Vegetation: Plants living along the edges (or banks) of a stream that are rooted in sediment but grow above the water's surface.

Ephemeral Stream: A stream that flows during the wet season and is dry in the dry season.

Erosion: The wearing down and removal of soil, rock fragments and bedrock through the action of running water, wind, moving ice, and gravitational creep (or mass movement).

<u>E. coli (Escherichia coli)</u>*:* A bacterium of the intestines of warm-blooded organisms, including humans, that is used as an indicator of water pollution for disease causing organisms.

Eutrophic: A term used to describe very productive or enriched lakes. These lakes tend to exhibit some or all of the following characteristics: an abundance of rooted plants; elevated turbidity levels due to high algal populations; loss of oxygen in bottom waters during the summer months; rapid accumulation of soft bottom sediments; and abundant fish, which may include stunted and/or rough species in the most fertile lakes.

Eutrophication: A gradual increase in the productivity of a lake ecosystem due to enrichment with plant nutrients, leading to changes in the biological community as well as physical and chemical changes. This is a natural process, but can be greatly accelerated by humans (see cultural eutrophication).

Fecal Coliform Bacteria: The portion of the coliform group which is present in the gut or feces of warm-blooded organisms. The presence of fecal coliform bacteria in water is an indication of pollution and potential human health problems.

Filamentous: Cells, recognizable as attached, hair-like growths, often appearing as waving strands in the water.

Floodplain: An area on both sides of a stream where flood waters spread out during high rains. The surface may appear dry for most of the year, but it is generally occupied by plants adapted to wet soils.

Flow, Discharge: A measure of how much water passes a given point in a given time (m^3/s).

Gaining Stream: A stream that receives its baseflow from the groundwater system.

Geographic Information System: A mapping application that uses different overlaid layers of information to represent the Earth surface.

Geography: Study of land (what it looks like, what it's used for, etc.), the things living there, the people (who they are and what they do), how all of these things interact with each other, and where they are located.

Geology: The study of Earth's history, the materials that make up the earth, and the processes that act on the earth.

Glacial Till: Unsorted material deposited by a glacier.

Groundwater: Water found beneath the earth's surface.

Habitat: The place where a plant or animal lives, which has all of the conditions necessary to support its life and reproduction.

Habitat Diversity: The range of habitats within a region.

Hydrogeology: The effect geology has on water quality and stream morphology.

Hydrologic Unit Codes (HUC): A measurement of watersheds that indicates size and location of particular watersheds; a watershed address.

Hydrologic Cycle: The continuous movement of water among the oceans, air, and the earth in the form of precipitation, percolation, evapotranspiration, and stream discharge.

Hydrology: How water flows on top of, and below, the Earth's surface.

Hypereutrophic: Murky, highly productive waters, closest to the wetlands status. Many clearwater species cannot survive.

Hypoxia: Low dissolved oxygen levels in a water body that can result from the decay of plants and algae.

Immobilization: The process of converting usable, inorganic forms of nitrogen into unusable, organic forms.

Impervious: Water cannot pass through; waterproof.

Indicator Species: Groups or types of organisms used to assess the environmental health of a water body.

Infiltration Rate: The rate at which water soaks into the soil.

Inorganic: Any compound not containing carbon.

Intermittent Stream: A stream that flows when there is adequate precipitation and is dry when there's not. The stream does not flow continuously.

Lake: A large body of water that has water all year long.

Lake Turnover: The circulation of the entire water column that occurs in spring and autumn when the thermocline is eliminated.

Leaf Litter: Plants and plant parts that have recently fallen and are partially or not at all composed.

Leaf Pack: Any cluster or gathering of leaves and organic debris normally found on the edges of streams, or found washed up on the upstream side of large rocks, fallen trees or logs in the stream.

Left Bank: When facing upstream, the bank to your left.

Lentic Water: Standing water, such as lakes, ponds and wetlands.

Limiting Resource: A resource that limits the abundance of an organism.

Loamy soil: Material composed primarily of sand and silt particles with some clay present.

Losing Stream: A stream that loses flow to the groundwater system.

Lotic Water: Flowing water, such as rivers and streams.

Meander: A bend in a stream.

Mesotrophic: A term used to describe lakes which are moderately productive. These waters contain more nutrients and, therefore, more biological activity.

Metamorphosis: A series of changes in body structure (form) from egg to adult.

Methemoglobinemia: The presence of methemoglobin in blood is caused by poisoning by certain substances, such as nitrate. Young babies (less than 6 month) are particularly susceptible to methemoglobinemia, leading to a condition known as "blue baby syndrome" which if untreated can cause death.

Microhabitat: Local conditions which immediately surround an organism. Microhabitats include algae mats, leaf packs, logjams, rock piles, root wads, undercut banks, and weed beds.

Mineralization: The process of decomposition and transformation of organic nitrogen found in plant parts and animal manure into available forms of inorganic nitrogen.

Niche: The function or position of an organism or population within an ecological community or the particular area within a habitat occupied by an organism.

Nitrate: A form of nitrogen. Nitrate is water soluble and is the most common form of nitrogen found in streams and lakes.

Nitrogen: An element necessary for the growth of aquatic plants; may be found in several forms, including nitrates, nitrites, and ammonia. Nitrogen is considered to be limiting because it is needed by plants and animals in the stream in moderate amounts. When present in higher amounts, such as large amounts of fertilizer runoff from local farm fields or urban lawns, large algal blooms occur which can result in a depletion of dissolved oxygen.

Nitrogen Cycle: The uptake of inorganic nitrogen by plants that convert it to organic forms, which are used by animals and transformed back into inorganic nitrogen by bacteria.

Nitrification: The process of converting ammonium nitrogen into nitrate nitrogen.

Nonpoint Source Pollution: A type of pollution whose source is not readily identifiable as any one particular point, such as pollution caused by runoff from streets, agricultural land, construction sites, and parking lots. Polluted runoff and pollution sources not discharged from a single point.

Nutrient: Any of a group of elements necessary for the growth of living organisms, such as nitrogen and phosphorus. Excess supplies of phosphorus or nitrogen, however, may enhance plant growth in surface waters.

Nutrient Enrichment: Elevated levels of nitrogen and/or phosphorus in a water body that result in nuisance growth of algae or other aquatic plants.

Organic Matter: Decomposing plant and animal material.

Organic Phosphate: Phosphates that are found in plant and animal tissue, waste solids, or other organic matter.

Orthophosphate: Inorganic form of phosphorus.

Oxbow Lake: Lake formed when a river meander is completely cut off from the river.

Pathogen: An organism capable of causing disease.

Pathogenic: Capable of causing disease.

Perennial Stream: Stream that flows nearly all year long.

Periphyton: Organisms attached to or clinging to the stems and leaves of plants or other objects projecting above the bottom of sediments of freshwater ecosystems. This may be in the form of algae attached to large rocks. Tiny plants and animals living on surfaces below water.

Perennially Pooled Conditions: Intermittent streams may cease to flow from year to year, but those that don't dry up completely often maintain pools of water throughout the year.

Pervious: Allows water to pass through.

Pesticides: A pesticide is any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest. Though often misunderstood to refer only to insecticides, the term pesticide also applies to herbicides, fungicides, and various other substances used to control pests.

pH: A measure of acidity or alkalinity on a scale of 0 to 14. A pH of 7 is neutral, less than 7 is acidic, and greater than 7 is alkaline (basic).

Phosphorus: An element necessary for the growth of aquatic plants. Elevated levels of phosphorus can affect water quality by increasing the production of algae and rooted plants. This can lead to eutrophication of water bodies.

Phosphorus Cycle: The process of orthophosphate being converted to organic phosphate when it used by plants and animals and being converted back to inorganic phosphate and recycled when they die and decay.

Photosynthesis: The process by which green plants produce oxygen from sunlight, water, and carbon dioxide.

Physical Weathering: Erosion caused by mechanical forces (e.g., water expanding as it freezes and breaking apart rocks).

Phytoplankton: Algae that are microscopic and suspended in water.

Plankton: The community of microorganisms consisting of plants (phytoplankton) and animals (zooplanton) inhabiting open-water regions of lakes and rivers.

Point Sampling: Sampling from a specific depth, or point, in the lake water column.

Point Source Pollution: Pollutants originating from a "point" source, such as a pipe, vent, or culvert.

Point Source Contamination: Contamination stemming from a single, isolated source, such as a drainpipe or an underground storage tank.

Pollution: An undesirable change in the environment, usually the introduction of abnormally high concentrations of hazardous or detrimental substances, such as nutrients or sediment. The presence of any substance that harms the environment.

Pollution Sensitive Organisms: Organisms that cannot withstand the addition of pollution to their aquatic environment.

Pollution Tolerant Organisms: Organisms that can withstand polluted environments.

Pond: Body of water that has water in it year round, but that is smaller than a lake.

Pool: That portion of a stream that is deep and slow moving. Often follows a riffle area.

Producers: Organisms that produce their own food through photosynthesis.

Recharge Areas: Areas that allow surface water to infiltrate and recharge groundwater.

Respiration: Oxygen consumption.

Riffle: That portion of a stream that is shallow and fast moving. An area of the stream where shallow water flows swiftly over completely or partially submerged rocks or other debris.

Right Bank: When facing upstream, the bank to your right.

Riparian Zone: An area, adjacent to and along a watercourse, which is often vegetated and constitutes a buffer zone between the nearby lands and the watercourse. The natural plant community adjacent to a stream.

Riprap: Any material (such as concrete blocks, rocks, car tires, or log pilings) that is used to protect or stabilize a stream bank from erosion.

Row Cropping: A method of farming used in the production of corn and beans.

Run: A stream habitat type characterized as having a moderate current, medium depth, and a smooth water surface.

Runoff: Water from rain, snowmelt, or irrigation that flows over the ground surface and runs into a water body.

Sanitary Sewer: A pipe that carries food and human wastewater to a municipal sewer system or a septic system.

Stormwater Sewer: A pipe that transports stormwater and meltwater runoff from roads and parking lots to streams and lakes. Stormwater sewers rarely lead to any type of treatment facility – the water is piped directly to streams and lakes.

Secchi Disc: A device used to measure the depth of light penetration in water.

Sediment: Eroded soil particles (soil, sand, and minerals) transported by water.

Sedimentation: The process by which soil particles (sediment) enter, accumulate, and settle to the bottom of a water body. The addition of soils to lakes or streams.

Sewage algae: A slimy matrix of bacteria, fungi and protozoa that form extensive cotton-wool-like plumes of white, grey, black or brown filamentous mats.

Silt: Fine particles of soil and minerals formed from erosion of rock fragments that accumulate on the bottom of stream, rivers, and lakes.

Siltation: The process of silt settling out of water and being deposited as sediment.

Slope: Change in elevation over a given distance.

Stable Stream Reach: A stream segment where sediment deposition is equal to erosion (i.e., no net gain or loss of sediment within the reach).

Streambed: The bottom of a stream where the substrate and sediments lay.

Stream Bank: The sides of the stream that contain the flow, except during floods.

Stream Depth: A measurement of the depth of a stream from the water's surface to the stream bed.

Stream Energy: Erosion potential of a stream.

Stream Flow: The amount of water moving in a stream in a given amount of time.

Stream Morphology: The shape of a stream.

Stream Order: Stream classification system.

Stream Reach: A specified length of stream.

Stream Transect: An imaginary line drawn from water's edge to water's edge, perpendicular to the flow of the stream.

Substrate: The surface upon which an organism lives or is attached. The material making up the bottom of the streambed.

Suspended Load: Sediment that is transported in suspension.

Thermal Pollution: The raising of water temperatures by artificial means that interferes with the functioning of aquatic ecosystems. Sources of thermal pollution include removal of trees along streams, introduction of cooling water from power plants or other industrial facilities, or runoff from hot paved surfaces to a water body.

Tile Lines: Drainage pipes used to remove water from an area.

Tolerant Species: An organism that can exist in the presence of a certain degree of pollution.

Topographic Map: A map representing the surface features of a particular area. Features illustrated include streams, lakes, roads, cities, and elevation.

Topography: What the surface of the earth looks like.

Total Coliform Bacteria: A group of bacteria that are used as an indicator of drinking water quality. The presence of total coliform bacteria indicates the possible presence of disease-causing bacteria.

Transparency: The measure of water clarity. Transparency is affected by the amount of material suspended in water (i.e., sediment, algae, and plankton).

Trophic status: The level of growth or productivity of a lake as measured by phosphorus content, algae abundance, and depth of light penetration.

Turbidity: The presence of sediment in water, making it unclear, murky or opaque.

Universal Transverse Mercator (UTM): A grid system which divides the globe into 60 north-south zones, each covering a strip 6° wide in longitude. In each zone, coordinates are measured north and east in meters. The coordinates, known as UTM coordinates, are made up of one 6-digit X number and one 7-digit Y number, which describe how far north the point is from the equator and how far east it is from the next zone to the west.

Velocity: The speed at which water moves.

Vertical Stratification: Inadequate mixing of water in a water body.

Water Cycle: The continuous circulation of water in systems throughout the Earth involving condensation, precipitation, runoff, evaporation, and transpiration.

Water Ecology: The study of aquatic environments and the relationships among the living and nonliving things associated with those environments.

Water Quality: The condition of the water with regard to the presence or absence of pollution.

Watershed: A region or area of land that drains into a body of water such as a lake, river, or stream.

Wetland: Shallow body of water that may not have water in it year round.

Zooplankton: Microscopic animals.

References

Murdoch, Tom, Martha Cheo, and Kate O'Laughlin. Streamkeeper's Field Guide: Watershed Inventory and Stream Monitoring Methods. Everett: Adopt a Stream Foundation, 1996.

Simpson, J. T. (1991). *Volunteer Lake Monitoring: A Methods Manual*. EPA 440/4-91-002.

United States Geological Survey. "The Universal Transverse Mercator (UTM) Grid" Fact Sheet 077-01 (August 2001). Updated December 31, 2002. Retrieved February 26, 2003. http://erg.usgs.gov/isb/pubs/factsheets/fs07701.html**.**

CHAPTER 13

Appendices

IOWATER Liability Waiver (copy)

Resupply Policy

Calculating Stream Flow, Average Depth, and Average Velocity

Iowa DNR Environmental Services Division

Safety Information, Release & Waiver Of Liability

The Iowa Department of Natural Resources intends that citizen monitors participating in the IOWATER program are not acting on behalf of the Iowa Department of Natural Resources in any official capacity. As such, it is the Department's intent that citizen monitors are not authorized to be considered agents, employees, or authorized representatives of the Department for any purpose, and that citizen monitors are not entitled to the same benefits enjoyed by the Department employees.

Citizen monitors must recognize the potential for injury to themselves and their real and personal property, and to other persons and their real and personal property, which may result from citizen volunteer activities conducted under the IOWATER Volunteer Water Quality Monitoring Program. The Department intends that citizen monitors expressly assume all risks and liability for any injuries to, or caused by citizen monitors under the IOWATER program.

Citizen monitors will be instructed in proper sampling techniques and handling of all equipment offered through the IOWATER program. They also will be cautioned that if there is ever any doubt, they should give safety priority over sampling. Every participant also will receive a copy of the IOWATER manual and the stream assessment procedures.

This affects any rights you may have if you are injured or otherwise suffer damages while participating in any activity in conjunction with activities sponsored by IOWATER.

Are you 18 years old or over? ☐ Yes ☐ **No** – ***a legal parent/guardian must also sign this form***

The volunteer and parent/legal guardian(s), by signing below, recognize that the IOWATER program involves some risk and that she/he takes responsibility for all action or injury that may result in participating in water monitoring activities. **All children under 18 must have a parent/legal guardian signature(s) below.**

I, _____________________ (volunteer name) and _______________________ (parent/legal guardian name), hereby release, waive, discharge and covenant not to sue the State of Iowa, Iowa Department of Natural Resources, county or other agencies, partners, cooperating landowners, event volunteers and coordinators, sponsors, and any of the offices, servants, agents and employees of the above-mentioned entities (hereinafter referred to as "RELEASEES") for any liability, claim and/or cause of action arising out of or related to any loss, damage or injury, including death, that occurs as a result of _____________________'s (volunteer name) participation in IOWATER monitoring activities.

I agree to indemnify and hold harmless the RELEASEES whether injury is caused by _____________________'s (volunteer name) negligence, the negligence of the RELEASEES or the negligence of any third party. I further agree that this Release and Waiver of Liability shall bind the members of my family and spouse, if I am alive, and my heirs, assigns and personal representatives, if I am deceased, and shall be deeded as a RELEASE, WAIVER, DISCHARGE AND COVENANT NOT TO SUE the above-named RELEASEES. I hereby further agree that this Release and Waiver of Liability shall be construed in accordance with the laws of the State of Iowa.

I understand that photographs may be taken during IOWATER activities may be used in the future to chronicle and publicize the program.

By signing this Release and Waiver of Liability,

I state that I have read and understood the conditions set forth in this Release

and that I agree to all conditions set forth herein, and that I sign this voluntarily.

____

Signature of Volunteer	**Printed Name of Volunteer**	**Date**

____

Signature(s) of Parent/Legal Guardian	**Printed Name(s) of Parent/Legal Guardian**	**Date**

IOWATER Resupply Policy

Due to the IOWATER program's need to justify the expense of resupplying materials, we have created "IOWATER Program Criteria for Receiving Additional Monitoring Equipment and Supplies."

To receive additional IOWATER monitoring supplies, you must submit a minimum of **three chemical/physical assessments within the past 12 months from the date of your request.**

However, it is the policy of the IOWATER program to encourage volunteers to monitor. If you wish to receive additional supplies or replace expired materials and do not meet the above policy, please answer the following questions to help determine your resupply eligibility. Decisions will be made on a case-by-case basis and IOWATER staff may contact you to discuss your individual situation.

1. Will this equipment be used for educational purposes? Yes ☐ No ☐
2. Are you monitoring as part of a "special project"? Yes ☐ No ☐
    a. Enter the name of the project and the name of the project contact (examples: Walnut Creek Watershed, iGISST):____
3. Are you a returning volunteer? (who has been inactive for more than 1 year) Yes ☐ No ☐

All supply requests will be handled under the sole discretion of IOWATER staff and may be contingent upon availability of requested materials. The IOWATER program may discontinue this policy at any point in time, especially due to financial constraints.

If you have expired equipment that you are no longer using please return it to the IOWATER program at Iowa DNR – IOWATER; 502 E. 9th St.; Des Moines, IA 50319

Equipment Request Form

Name: _______________ IOWATER ID: __________ Site Number(s):_______

Address: ________________________ City: _________ State: ____ Zip:_____

Email: _____________________________ phone number: _________________

Equipment (please fill in quantities needed):

_____ CHEMets® Phosphate Ampoules

_____ CHEMets® Phosphate Color Comparator

_____ CHEMets® Phosphate Activator Solution

_____ Hach® Nitrite-N/Nitrate-N test strips

_____ Coliscan Easygel® Media Bottles

_____ Eyedroppers

_____ CHEMets® Dissolved Oxygen Ampoules

_____ CHEMets® Dissolved Oxygen Color Comparator

_____ Hach® Chloride titrators

_____ Hach® pH test strips

_____ Petri Dishes

Other: ____

Please fill out this form and send it to Iowa DNR – IOWATER; 502 E. 9th St.; Des Moines, IA 50319.

This form is also available online at http://www.iowadnr.gov/Environment/WaterQuality/WaterMonitoring/IOWATER.aspx and can be submitted by email.

Calculating Stream Flow, Average Depth, and Average Velocity

When stream width, depth, and velocity measurements are submitted to the IOWATER database, average stream depth and velocity, and total flow are automatically calculated for you. During the IOWATER workshops, a number of people have requested that we provide the formulas used for calculating average stream depth, average stream velocity, and total flow. Below are the calculations:

SD = stream depth (meters; SD_1 is the stream depth at spot 1)

1, 2, etc = spots along the stream transect

n = number of spots along the transect

W = width of box at each spot; 1 meter is used

SV = stream velocity (1 meter divided by seconds measured; meters per second)

* = multiplier

÷ = divider

Average Stream Depth (meter)

Average Stream Depth = $[SD_1 + SD_2 + SD_n] \div n$

NOTE: Be sure to convert the measurement from centimeters to meters.

Total Flow (cubic meters per second or m^3/s)

For total flow, imagine a box placed around each spot on your stream transect. A flow is determined for each box and summed for all boxes. Flow associated with each box is calculated by multiplying the width of the box at each spot (1 meter) by stream depth (which you measure) by the velocity of the spot (in the field you measure the number of seconds it takes for the tennis ball to travel one meter; velocity is one meter divided by the number of seconds). The flow of each box is in cubic meters per second (m^3/s). The flow of each box is added together to give total flow.

Total Flow = $(W_1*SD_1*SV_1) + (W_2*SD_2*SV_2) + (W_n*SD_n*SV_n)$

Average Stream Velocity (meters per second or m/s)

Average stream velocity is calculated by dividing total flow by the cross-sectional area of your transect. The cross-sectional area is determined by calculating a cross-sectional area for the box at each spot of your transect and then summing the cross-sectional areas.

Average Stream Velocity = Total Flow $\div[(W_1*SD_1) + (W_2*SD_2) + (W_n*SD_n)]$

EXAMPLE: Sally and Bill measure stream width, depth, and velocity for Jack Creek. Jack Creek is 4.2 meters wide.

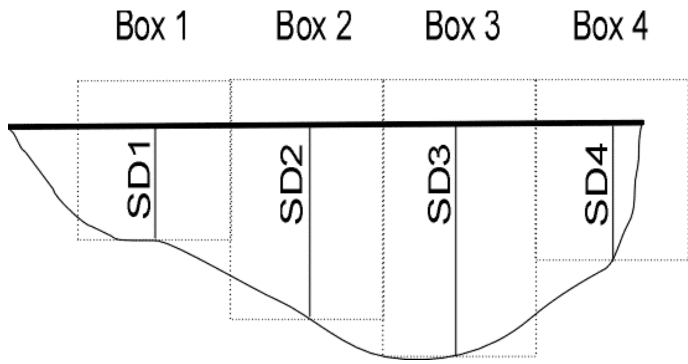
	Stream Depth (meters)	Stream Velocity (meters/seconds)
Spot 1	0.21	1 meter/8 seconds (0.125)
Spot 2	0.45	1 meter/4 seconds (0.25)
Spot 3	0.62	1 meter/3 seconds (0.33)
Spot 4	0.35	1 meter/7 seconds (0.143)

Average Stream Depth = (0.21 m + 0.45 m + 0.62 m + 0.35 m) ÷ 4 = 0.41 m

Total Flow = (1 m * 0.21 m * 0.125 m/s) + (1 m * 0.45 m * 0.25 m/s) + (1 m * 0.62 m * 0.33 m/s) + (1 m * 0.35 m * 0.143 m/s) = 0.39 m^3/second

Average Stream Velocity = Total Flow ÷ Cross-Sectional Area

Average Stream Velocity = 0.39 m^3/second ÷ [(1 m * 0.21 m) + (1 m * 0.45 m) + (1 m * 0.62 m) + (1 m * 0.35 m)] = 0.24 m/s



Cross-sectional view of a stream

Iowa Department of Natural Resources

Environmental Services Division Field Offices

The Compliance and Enforcement Bureau includes six field offices throughout the state. They are local representatives of the Environmental Services Division, and a primary task for them is helping people to understand environmental services programs.

They conduct routine inspections of all facilities permitted by the Environmental Services Division. Staff in the field help individuals and businesses understand when to apply for a permit and how to meet permit requirements. Field staff also respond to spills and handle complaints from the public, often resolving disputes between neighbors. If technical assistance and cooperative activities do not resolve a problem, the field office staff may recommend more formal measures to seek compliance.

www.iowadnr.gov – Field Offices/Services

http://www.iowadnr.gov/Environmental-Protection/Land-Quality/Emergency-Planning-EPCRA/Spill-Reporting

24 – hour Emergency Spill Response: **515-725-8694**

Field Office 1
909 West Main Suite #4
Manchester, IA 52057
Phone: (563) 927-2640

Field Office 2
2300 15th Street SW
Mason City, IA 50401
Phone: (641) 424-4073

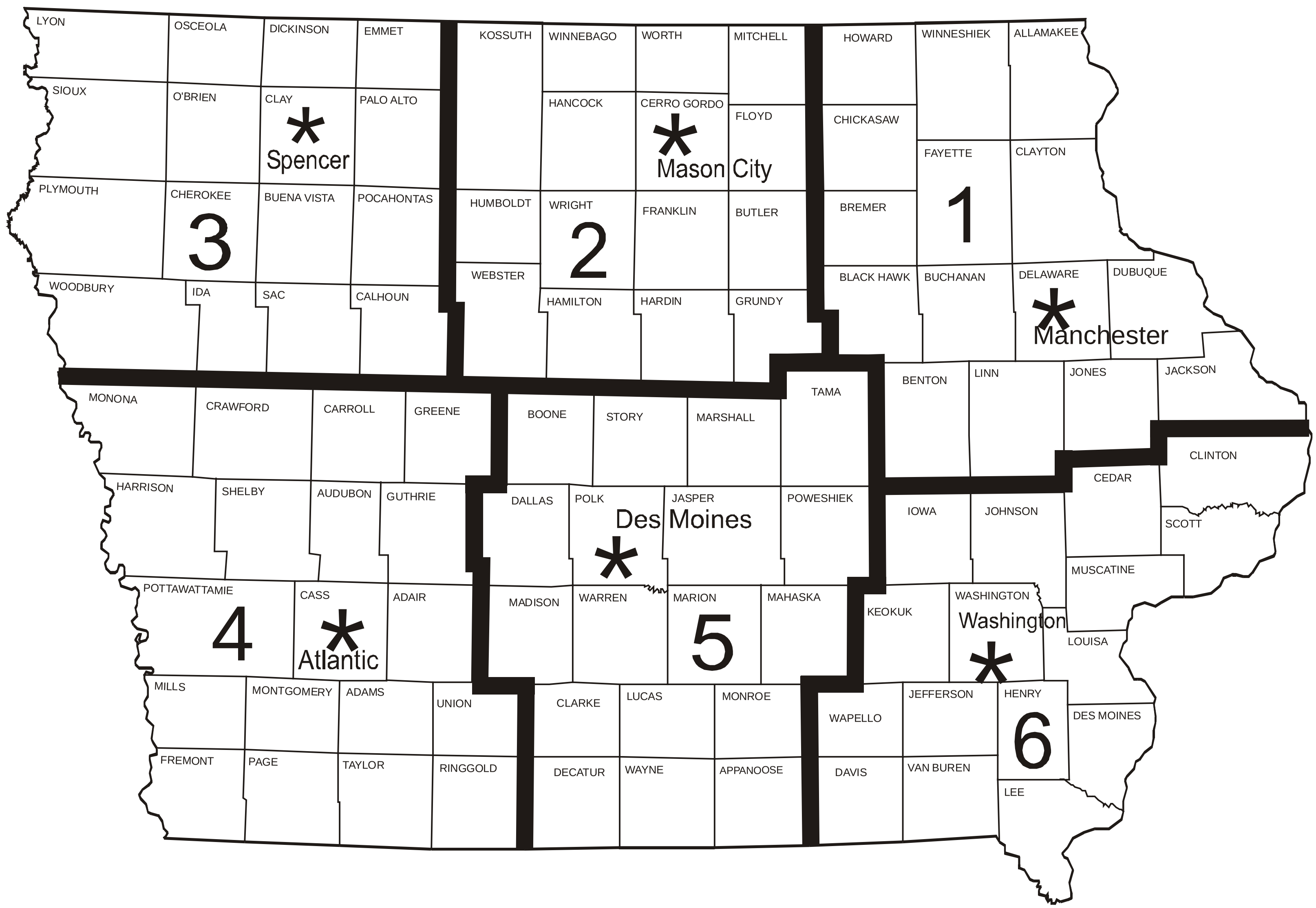
Field Office 3
1900 North Grand Avenue
Spencer, IA 51301
Phone: (712) 262-4177

Field Office 4
1401 Sunnyside Lane
Atlantic, IA 50022
Phone: (712) 243-1934

Field Office 5
401 SW 7th, Suite 1
Des Moines, IA 50309

Phone: (515) 725-0268

Field Office 6
1023 West Madison Street
Washington, Iowa 52353-1623
Phone: (319) 653-2135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OSCEOLA
DICKINSON
EMMET
KOSSUTH
WINNEBAGO
WORTH
MITCHELL
HOWARD
WINNESHIEK
ALLAMAKEE
SIOUX
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CLAY
PALO ALTO
HANCOCK
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CHEROKEE
BUENA VISTA
POCAHONTAS
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JACKSON
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SHELBY
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POLK
JASPER
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