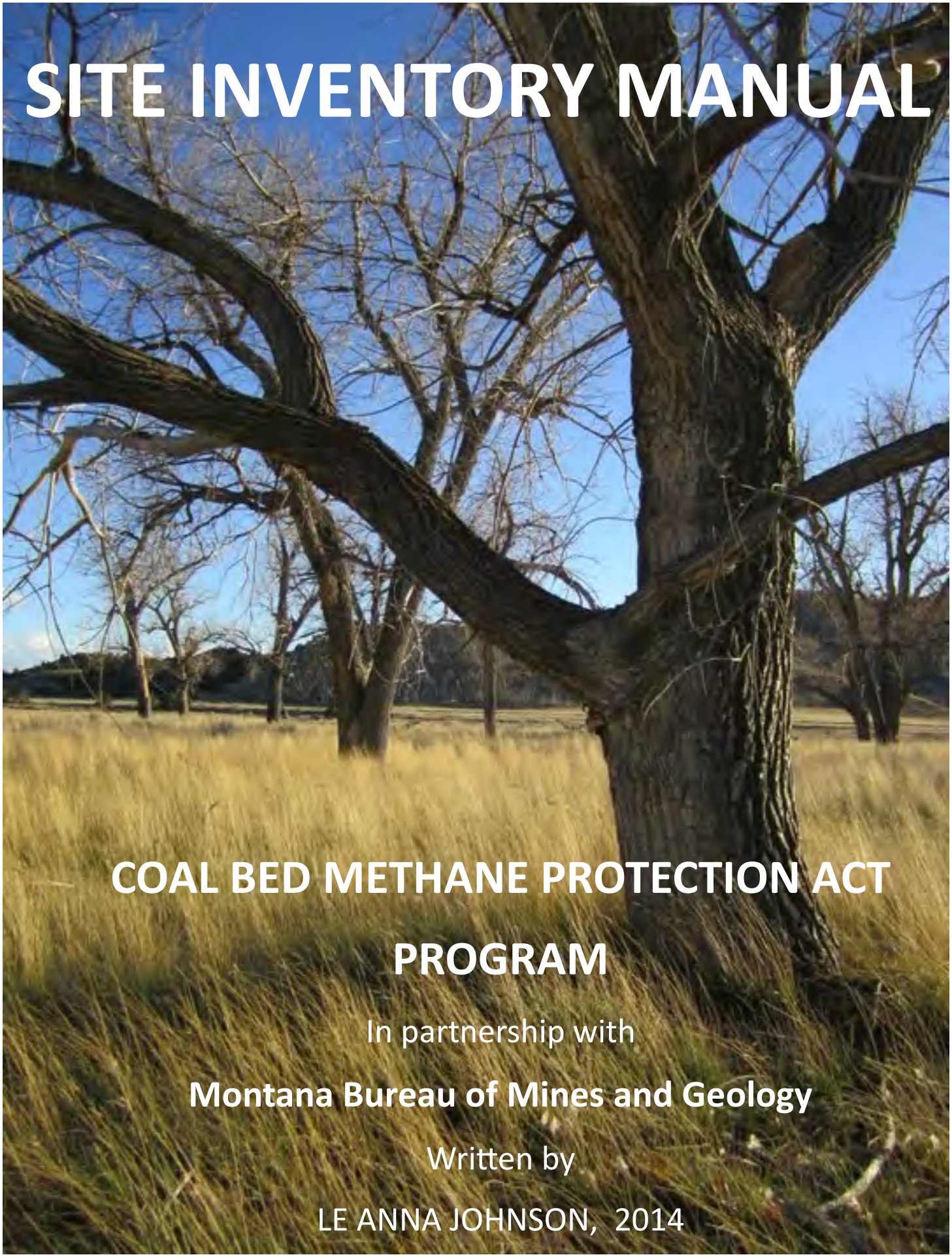

SITE INVENTORY MANUAL

COAL BED METHANE PROTECTION ACT PROGRAM

In partnership with

Montana Bureau of Mines and Geology

Written by

LE ANNA JOHNSON, 2014

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Table of Contents

Site Inventory Sheet 1-2

Introduction 3

Equipment 3-4

Understanding Your GPS 5

Site Inventory Techniques

- Opening the Well Head 6-7
- Examples of Well Heads 6,8
- Diagram of Conventional Well with Pit-less Adaptor 9
- Diagram of Entire Well 10

Equipment Techniques

- Specific Conductivity Techniques 11
- pH Meter Techniques 11
- Water Level Sounder Techniques 12
- Steel Tape Techniques 13
- Cleaning Your Equipment 13

A Note on Well Pits 14-15

A Note on Springs 16

Completing the Field Inventory

- Landowner Information 17
- Location 18
- Well Information 19-20
- Static Water Level 21-24
- Purging Parameters 25
- Pumping Water Level 26
- General Well Information 26-27
- Field Nitrate Test Strips 28

Field Chloride Test Strips 29
Site Map and Inventory Notes 30
Site Map Examples 31-32
Sample Information 33
Sample Technician Information 33
Glossary of Terms 34
Acronyms 34

☐ QAQC ☐ entered SAMPLE_____ ☐

Date _____ **SITE INVENTORY SHEET** Project No._____

GWIC Id: _____ Geocode_____Area Aquifer_____

Owner

Name_____

Address _____

_____

Phone _____

User/Resident (if different)

Name _____

Address_____

_____

Phone _____

LOCATION: T _____$^{N}_{S}$ R _____$^{E}_{W}$ S _____ Tract ___/___/___/___ Irreg. Sect? Y__N__

Latitude_____Longitude_____Datum_____ Geomethod_____

County_____ USGSMap7$^{1}/_{2}$'_____ Altitude _____

SITE NOTES: _____

_____

_____

WELL DETAILS

Water Use _____ Casing I.D. _____(in) Total Depth From Ground _____

Measuring Point (M.P.) _____ft(+ above, - below land surface) M.P. Elev._____

STATIC WATER LEVEL (E-Line___/Steel Tape___/Pressure Gauge___sonic sounder___&temp___)

Time	Depth Below M.P.	PSI	Head	Water level altitude	Remarks

PURGING PARAMETERS ORP Probe: Vol/Time Discharge

Time	Temp C°	S.C .(µS/cm)	pH	Redox (mv)	DO mg/L	gal/min	
FINAL							

PUMPING WATER LEVEL (E-Line___/Steel Tape___/Pressure Gauge___sonic sounder___&temp___)

Time	Depth Below M.P.	Water level altitude	Remarks

General condition of well and surface seal (Good ___ Fair ___ Poor ___)
Condition of water: Clear ___ Turbid ___ Other_____
Can sample be collected? Y___ N___, Before pressure tank? Y___ N___ Unknown ___
Before treatment? Y___ N___ Unknown ___, Comments_____

Water-Level Measuring Point Description:_____
Sampling-Point Description:_____

FIELD NITRATE (HACH)_____ (mg/L-N) **Comments**_____

SITE SKETCH MAP
Show location of well and sampling point. If necessary show site location in relation to roads.
^ North

INVENTORY NOTES:_____
_____
_____

SAMPLE: Standard (250 ml **RA** {H_2SO_4}, 250 ml **FU**, 500 ml **FA** {HNO_3}, 500 ml **RU**) ☐

Other (nitrate only, tritium, etc.) _____

ALKALINITY TITRATION **Bottle Number**_____

Vol. Of Sample	Total Vol. Titrated	Acid Conc.	Original pH	Digits to Reach 8.3 pH	Actual Endpoint	Digits to Reach 4.5 pH	Actual Endpoint	Total Digits

Alkalinity Concentration_____ (mg/L as CaCO3)_____

Name_____ **Agency** _____

INTRODUCTION

This manual is designed to help field technicians for the CBMPA grants, 1. properly fill out the Montana Bureau of Mines and Geology's (MBMG) site inventory sheet, 2. provide tips for conducting a site inventory, and 3. answer questions that may arise while out in the field. A site inventory is required the first time a well is visited or sampled.

The site inventory sheet guides the technician through the data collection process, and keeps all the data together in one location. It is also required for data input into the Groundwater Information Center (GWIC) database. Filling out the field inventory sheet correctly— and completely— is essential. Having all the information on one form allows for a smoother, faster data entry process. Even if the well is already in the GWIC database it is imperative to collect the data at each site for comparison purposes and/or to update GWIC with current information, such as well owner.

BEFORE HEADING TO THE FIELD

Please notify someone when and where you will be sampling, and an estimated return time. Many situations could arise while out in the field so please follow this safety precaution.

EQUIPMENT

Before heading to the field make sure you have the proper equipment and that the equipment has been calibrated according to the owners manual. For pH meters, this needs to be done the same day as the field inventories. See Equipment Techniques, page 11.

Water Level Sounder

pH Meter

pH Buffer Kit

Conductivity Meter

EQUIPMENT CONTINUED

Equipment required to conduct a proper field inventory includes but is not limited to (identified in the pictures to the right);

- A clean one gallon bucket with quart designations
- Stop watch
- pH meter
- pH Buffer kit with a conductivity standard
- Conductivity meter
- Steel tape
- Pressure gauges and couplers (1-3)
- GPS unit (12)
- Hand mirror (14)
- Nitrate test strips (if not collecting a sample to be analyzed by lab, 13)
- Chloride test strips (if not collecting a sample to be analyzed by lab, 13)
- Batteries (all types for all electronic equipment such as 9V, AA, and AAA, 11).
- Adjustable wrench (4)
- A set of screw drivers (6)
- High powered flashlight
- Hammer(5)
- Bleach in a spray bottle
- Distilled water
- Clean rags
- Garden hose
- Camera
- Allen wrench set (8)
- Meter cleaning brush (10)

It is also recommended that you bring:

- Extra pens
- Electrical tape
- A sharpie
- Maps of the area
- Landowner's contact information (phone number)
- Pry bar
- Rain gear
- Cell phone
- Sunblock
- Bug repellent
- Electrical tape
- Duct tape
- Probe storage solution (9)
- Pliers (7)
- Well information from GWIC if known
- Leather gloves

Steel Tape

UNDERSTANDING YOUR GPS UNIT

Collecting GPS coordinates out in the field is more accurate than estimating from a map or Google Earth. Most GPS units are accurate to within 20 feet of your location, whereas a location from a map or Google Earth may be up to 100 feet from your location.

Familiarizing yourself with your GPS unit before going into the field is important. Your GPS unit may be different from the description here; however the GPS unit should show you if it is connecting to satellites. Turn on your GPS unit for 5 to 10 minutes before taking a latitude/longitude reading so that the unit is able to pick up as many satellites as possible. In Figure 1 you see a screen from a GPS unit that shows the battery charge remaining and a bar graph that shows the readiness of the unit. If the bar graph is red you should not take a latitude/ longitude reading. Figure 2 shows a bar graph when the GPS unit has not picked up a sufficient number of satellites, indicated by the white color of the graph. Figure 3 shows the GPS unit is ready and has had sufficient time to connect to satellites, (indicated by the green in the bar graph). Figure 4 shows the accuracy in feet to current location, and the strength of the satellites' signals. Notice those satellites are green now (GPS units vary, consult your GPS owner's manual). You can always double check your coordinates by marking a way point, walking away from the well and then watch the unit as you return to the well.

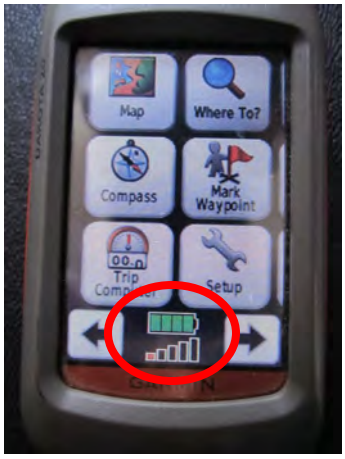


Figure 1

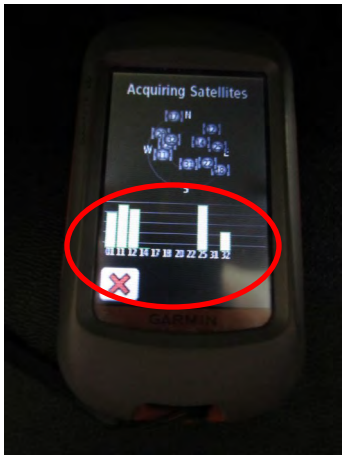


Figure 2

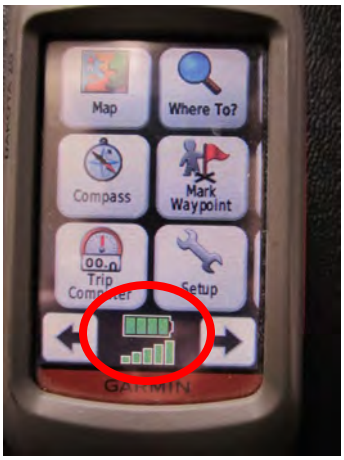


Figure 3

Figure 4

SITE INVENTORY TECHNIQUES

OPENING THE WELL HEAD

It is important to remember to treat all landowners and their property with respect. With that said, let's do some water sampling.

There are many different types of wellheads. Some are easier than others to get into. A variety of tools is helpful when trying to open various wells. An Allen wrench set, an adjustable wrench, and even a hammer can assist you with removing a well cap. The hammer is used sometimes to gently tap the well cap off after all the screws have been loosened sufficiently. When you have the well cap off there should be many wires towards the opening of the well.

An adjustable wrench can unscrew the multiple bolts holding this cap on.

An example of a flowing well which you do not open. A flowing well, also known as an artesian well, has water pressure which allows for the water to rise above ground surface.

Two adjustable wrenches are needed to access this well.

Picture provided by Clay Schwartz of MBMG.

This well head is attached to the pipe that runs water into a stock tank. There is no easy way to open the top of the well head; however, there are two small openings in the well cap. One opening has the electrical wires coming to the surface. The other opening has a bolt in it. If you remove the bolt there is an opening large enough to place a steel tape down the well for measurement. Some do not have a bolt but have enough room with the electrical wires to allow a steel tape down into the well to measure water level and depth. **Do not use a steel tape if electrical wires a exposed or frayed. And be careful not to cut wires with your steel tape.**

OPENING THE WELL HEAD CONTINUED

Before touching anything look for loose connectors or exposed copper wiring. Do not touch anything inside the well if wires are exposed. These can be dangerous and may electrocute you. There are rare instances where the copper wire is exposed and has electrified the well casing and also the stock tank. So be very careful. It is helpful to gently pull the wires out of the well casing so that your instruments do not get tangled. The pictures to the right show a small thin silver wire in with the larger black electrical wires. This silver wire should be gently moved out of the well casing to get it out of the way, however you do not want to pull on this wire because you could disconnect the pit-less adapter from the well casing. The drop pipe and the weight of the pump will be entirely on this little cable, so please be extremely careful when pulling excess wires out. There could be quite a few feet of electrical wiring that will come out of the top of the casing, so take your time.

It is important to look down the well before inserting any equipment into the well. I recommend using a hand mirror on a sunny day. You can reflect the sunlight down the well to see the inner casing (usually smaller in diameter). The inner casing has the pump down in it. Also you can see which side the pit-less adaptor might be on so that you avoid getting your equipment stuck. Some wells have various brackets down hole. Some brackets have space for your equipment, such as a sounder, to pass by. Other brackets do not allow a sounder to get by and you will need a steel tape for those. It is also important to see which side or where most of the wiring is so that you can avoid getting tangled by placing equipment on the other side of the casing.

The electrical wires are being gently pulled out of the casing which will permit access to the well for the water monitoring equipment. Notice the silver wire that connects to the pit-less adapter. **Do not pull this with force it can disconnect the pit-less adapter from the well casing.**

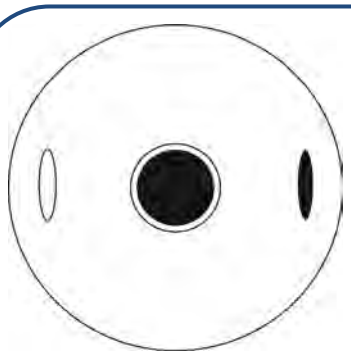


Diagram A

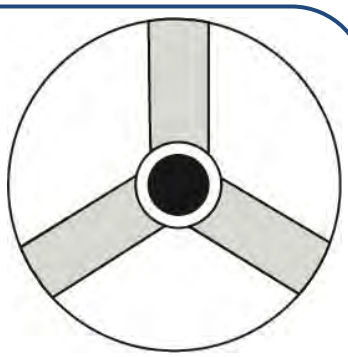


Diagram B

The diagrams above show possible plates that one might see when looking down into a well. These plates help hold up the pipes, pumps, and electrical wires. It is important to look down well to determine which side of the casing to lower your equipment down.

Diagram A has an oval on the right that is blackened. That is to signify that electrical wires coming out that side. The middle has the drop pipe connected to it. The oval on the left is usually open. This would be the side that you place the steel tape only, down for measurements.

Diagram B shows another type of plate that will be in wells. Usually wire comes up one side and equipment can be lowered down the other two parts of the plate. The drop pipe is in the middle of the plate.

MORE EXAMPLES OF WELL HEADS

This shows a well casing inside of a well pit. The steel tape can enter the well next to the large black wire, to gather the depth and water level information.

This is a well with a pump on the surface.

This is a close up of the well above. The access point has a red arrow pointing to it.

All left side pictures by Clay Schwartz, MBMG.

Picture by Clay Schwartz, MBMG.

Well head

This shows a well head in the background with a pump house in the foreground. The pump house stores the pressure tank so that the pressure tank will not freeze in the winter.

Close up of the above well head. You will need an Allen wrench to take the well cap off.

The two pictures above by Destanie Melin, GCCD.

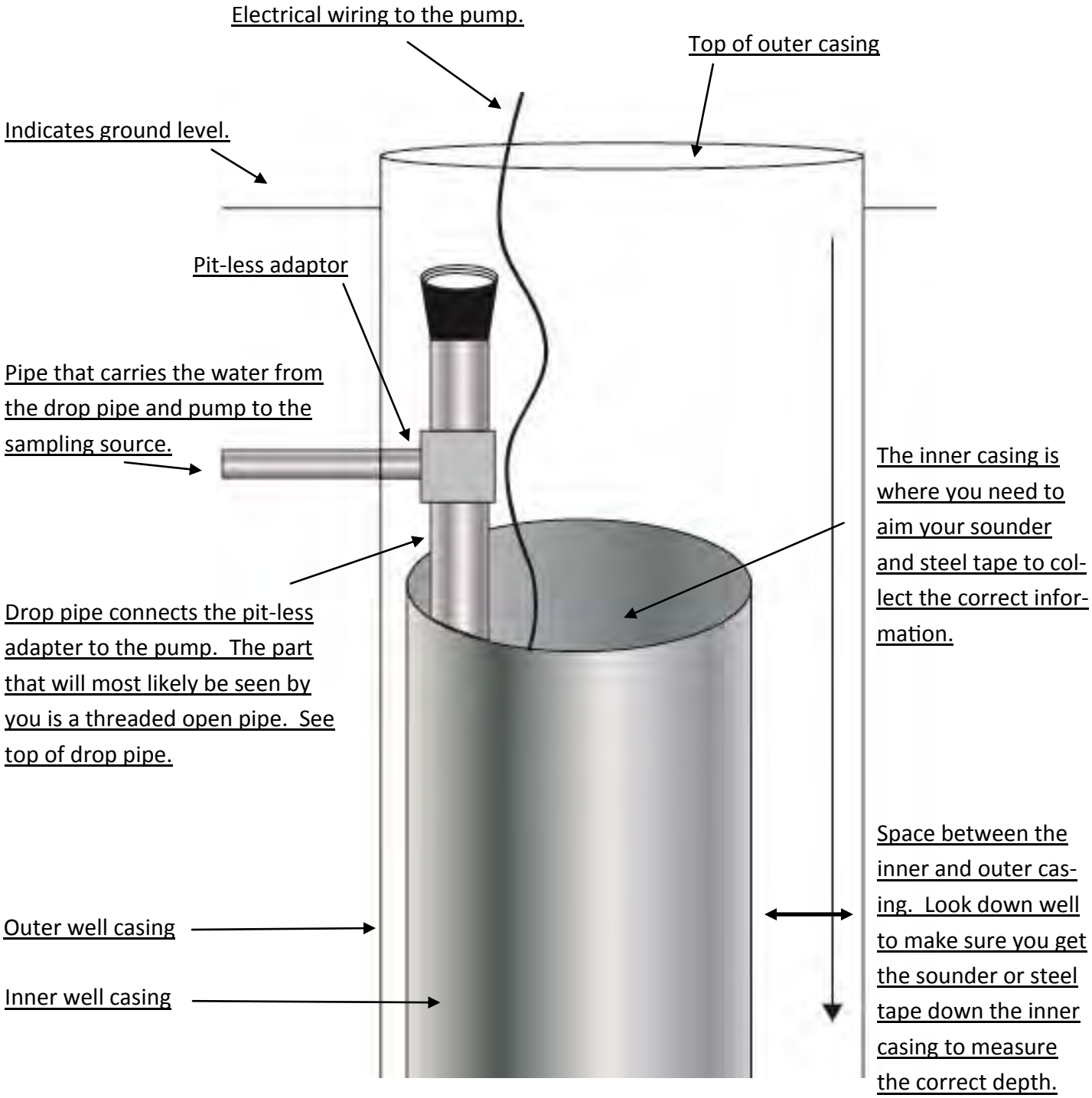


Diagram of a conventional well with a pit-less adaptor (near top of well).

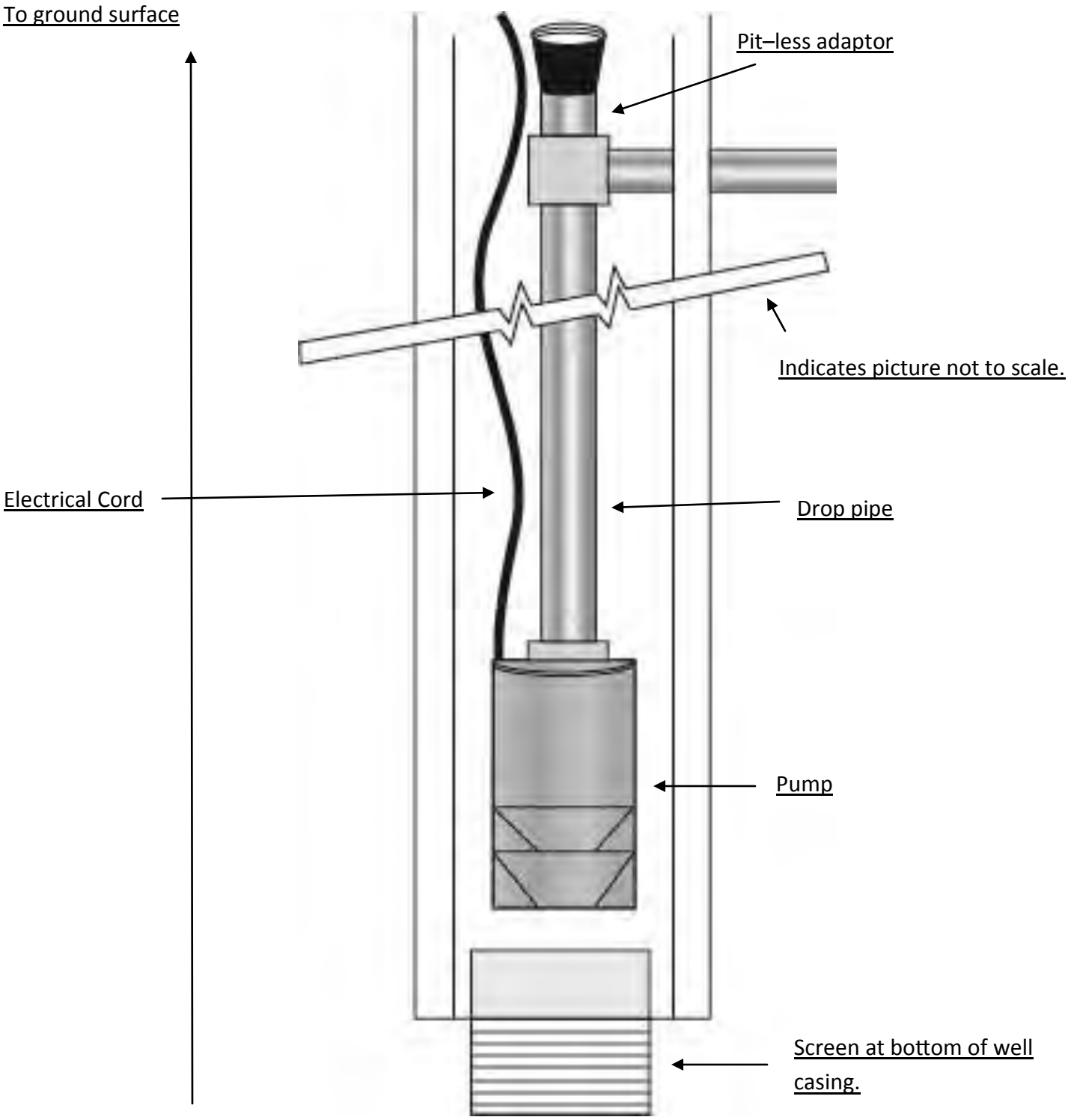


Diagram of entire well.

EQUIPMENT TECHNIQUES

SPECIFIC CONDUCTIVITY METER TIPS

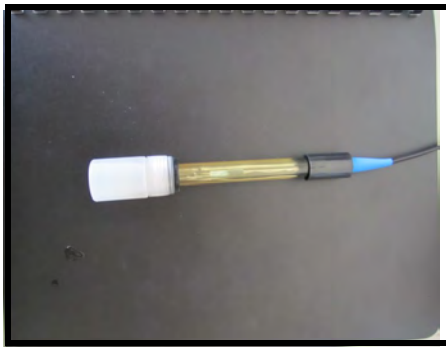
Before heading to the field make sure that your specific conductivity meter is working properly. The buffer kit should have a bottle of conductivity standard 1413 µS/cm (micro Siemens per centimeter). Place a small amount (enough to cover the probe) in a clean container. Place your probe in the solution and wait for the measurement to stabilize. The meter should read close to 1413 µS/cm. This test is only to make sure that your meter is within range of the standard (recommended to be within 10%) if the meter reads outside of this range refer to the instruments manual to adjust the reading. You do not need to calibrate this meter every time you go out to the field. Calibrate once a month when the meter is used often. Clean the probe when necessary with a probe brush and distilled water. Please refer to the owner's manual.

This shows the conductivity standards covering the whole probe of the conductivity meter, to check if the meter is reading properly.

Conductivity Standards

pH METER TIPS

Always calibrate your pH meter on the same day you will be doing the site inventories before the work has started. Follow your owner's manual on the calibration procedure. Make sure that your probe has a sufficient amount of storing solution in the probe protector. Reference your owner's manual for the type of storage solution needed. Every pH probe may have a different storage solution (storage solutions may include: KCl, pH 4 buffer, pH 7 buffer, or tap water). Make sure that you have extra storage solution on hand. It is easy to spill or leak from the probe protector. **Please inspect the probe once a month especially when NOT in use because the probe could become dry; this can cause permanent damage (some probes are supposed to be dry so consult the owner's manual).** Probes can last for many years with the proper care. A tool box or a tackle box makes the perfect protective carrying case for your meters.



Picture of a probe in storage solution. It is very important to keep moisture in the probe protector. Most probes need a small about of fluid so that the probe lasts.

TAKE CARE OF YOUR METERS AND PROBES. THEY ARE EXPENSIVE!!

EQUIPMENT TECHNIQUES CONTINUED

WATER LEVEL SOUNDER TIPS

It is important to understanding how your water level sounder works before going to the field. Figure 5 shows the instrument panel of the sounder; a. shows the battery test button with indicator light, b. shows the sensitivity knob, c. shows the battery case, and d. is the knob to roll up the tape. Before heading to the field test your battery to make sure that it works. You can turn down the sensitivity of the sounder to help alleviate problems with sensing water on the sides of the well casing during use.

Figure 6 shows how the battery come out of the water level sounder. The notch on the bottom of the battery case needs to be moved up with a screwdriver and then the case can slide out of the sounder. Figure 7 shows the battery case out of the sounder. The battery can slip out of the case once case is removed from the water level sounder.

The notch at the bottom of the battery case.

Figure 5, the instrument panel of the water level sounder.

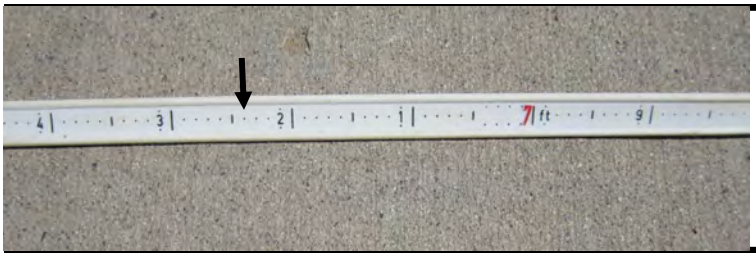
Figure 6, battery case in water level sounder.

Figure 7, the battery case removed.

The sounder should only be used for collecting the water levels. Do not use it to find the well depth; excessive pressure can ruin the sealed sensor on the sounder tip. A compromised seal can lead to mold growth in the sensor and the measuring tape of the sounder.

Always remember to lower and raise the sounder tape slowly to prevent tangling.

When measuring the water levels with the sounder, remember that the sounder beeps whenever it hits water. A series of short low beeps may indicate condensation on the side of the well casing. Sometimes the tape gets stuck to the well casing because of that condensation. You can adjust the sensitivity with the dial on the side of the sounder (Figure 5 b). Shake the sounder a little bit will help to get the tape off of the side of the casing. A true static water level reading is one that can be repeated over a minute. Read the measuring tape where the tape meets the top of the casing. Measurements are in 1/10th of an inch, unlike a carpenter's ruler.



Here is the measuring tape of the water level sounder. It reads in tens of an inch like the steel tape. Where the arrow is would be 7.24 feet. Picture not to scale.

EQUIPMENT TECHNIQUES CONTINUED

STEEL TAPE TIPS

When working with the steel tape always remember to be cautious with it. **DO NOT RELEASE THE STEEL TAPE QUICKLY DOWN WELL. DO NOT REEL THE STEEL TAPE UP QUICKLY.** This can cause the steel tape to get stuck on brackets, the pump, or wiring. Releasing or reeling in the steel tape quickly can also cut electrical wires that are in the well. Reeling the steel tape slowly and smoothly helps alleviate this problem. It may take a few minutes longer but it will save you time in the long run because your equipment will not get tangled. When checking total depth, write down where the tape is wet. This will help you when measuring the water level. If needed for safety reasons, the pump can be turned off when measuring with a steel tape. Consult the landowner about the depth of the well, to verify the depth measured is not the tape caught on something down the well. It is important to measure the depth to make sure the site inventory is being done on the correct well or to upload the site inventory to GWIC.

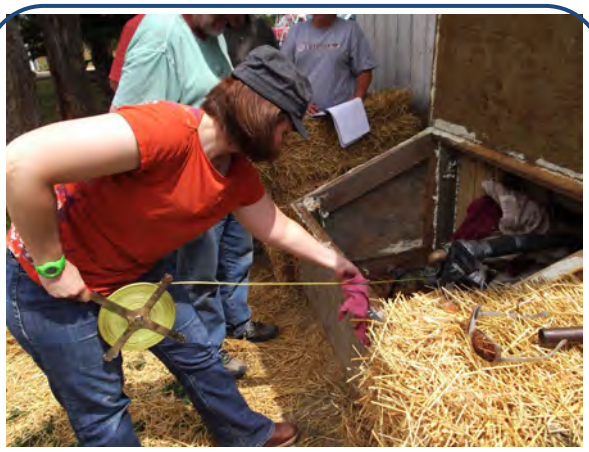
This is a close up of the back of the steel tape. It has been sanded down slightly so that chalk can be rubbed on it for better measurement of water level.

This displays how to chalk the steel tape to measure the water level.

Full water mark show the water level. If the tape shows inconsistent water marks that may be condensation from the well casing. Place finger on start of water mark, turn tape over, read measurement. Do this twice. If you have the same reading then you have an accurate water level. The difference between where you held the tape at the surface and the watermark is the SWL.

CLEANING YOUR EQUIPMENT

After placing any equipment down the well please clean it with a clean rag, water, and bleach. This is very important to do so that your equipment does not contaminate other wells. Make sure to do this every time the steel tape or sounder goes down a well, even if you are testing two wells with the same owner. Any well may have bacteria or other contaminates and you do not want to cross contaminate wells. Remember: this is someone's drinking water.



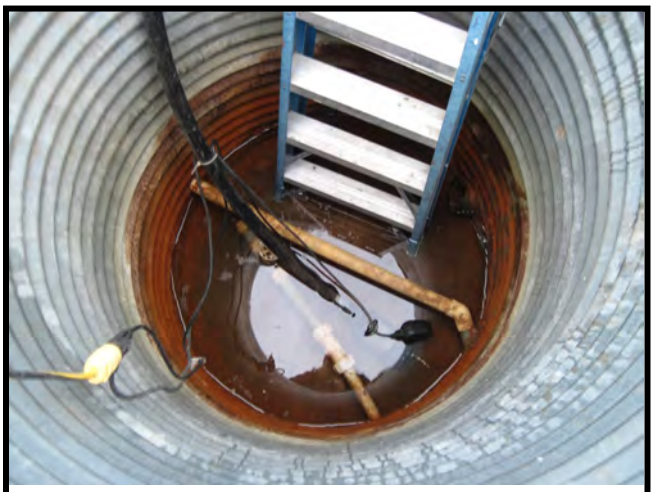
Using a clean rag with bleach on it helps prevent contamination of the well and your equipment.

A NOTE ON WELL PITS

Well pits are all over Montana and all can be potentially hazardous and deadly. Well pits are used for flowing wells or in place of pitless adapters. When approaching the pit look on the ground around the lid of the pit for snakes and sink holes. Be careful when taking the top off of the pit too, there might be spiders or snakes between the lid and the side of the pit. Some pits are easily accessible and clean however you should never go into a pit without someone near by. Carbon dioxide can collect in the pit and can present a danger (carbon dioxide is heavier than air). Another problem to keep in mind is that you might not be the only living thing in the pit. Before entering, you should shine a flash light into the pit. If there are mice keep in mind that there could be snakes too. Snakes, mice, salamanders, and spiders are usually the most common wildlife in pits.

Do not go into the well pits if there is nothing to help you out. There is a potential to get stuck in a well pit.

It is ultimately your judgment call when conducting a site inventory on well pits. If you do not feel comfortable do not go in them.



This well pit has flooded. Flooding can occur if it is a wet season. Water can collect easily in there because it is below ground surface. There might also be a leak somewhere within the pit, or the well is not sealed properly. No water level measurement can be taken because it would be inaccurate.

Clean well pit

Pictures taken by Kevin Chandler, MBMG.

A NOTE ON WELL PITS CONTINUED

This well pit does not have a ladder. Do not go into well pits that do not have ways to get out of them.

This is a dirty well pit. Notice the dead mouse on top of the ladder, a dead rabbit at the bottom of the pit, and the amount of water in the pit.

Picture by Kevin Chandler, MBMG.

A NOTE ON SPRINGS

When conducting a site inventory for a spring all information is gathered as instructed by this manual; however, the static water level, depth, and the pressure gauge reading will not be taken. Do take note of the landowner's name for the spring that you are testing, whose land it is on, document the location of the spring (latitude/ longitude), collect the flow rate, document the purging parameters (even when the spring is constantly flowing it is good to get some documentation of the water chemistries before a sample is taken), description of the sampling point, sketch a map of the location, and any other site or inventory notes that will help. Also indicate if it is developed (example: the spring water comes out of a pipe and into a stock tank) or non-developed spring (example: the water comes straight out of the ground or hillside).

When measuring the field parameters and collecting the sample, take the fresh water directly out of the pipe or hillside not from the standing water pooled around the non– developed spring. Do not take water from a stock tank. Fresh water is measured and sampled only.

Do not put a pressure gauge on a developed spring. The pressure build up could alter (or damage) the spring flow. The landowner may not appreciate that.

Late winter or early spring is a good time to look for springs because of ice build up around springs. After the snow melts, ice will remain for a longer period of time around springs.

This shows a developed spring. The landowner has harnessed the water and has directed it to a stock tank.

Picture of a semi- undeveloped spring. The spring makes the immediate area muddy.

Pictures on this page provided by the Montana Bureau of Mines and Geology.

COMPLETING THE FIELD INVENTORY

When filling out the site inventory please write legibly. It is important for people to be able to read the inventory, and enter correct data into the database. Please make sure to use the most current version of the site inventory sheet.

Before starting your first inventory of the day make sure to calibrate your pH. Follow the pH meter calibration instructions in the pH meter manual. Check to make sure all equipment is working properly.

LANDOWNER INFORMATION

A The date that the well was visited and inventoried, goes here.

- Do not worry about the project number, area aquifer, QA/QC, or entered. Those are part of the data entry process. Only list Geocode if the landowner knows this information.

B The sample is a description of what type of sample. An example would be domestic, livestock, inorganic, nitrate, radon. Also write in where the sample is going (i.e. Energy Labs, Pace).

C This space is for the GWIC ID number of the well you are monitoring. You may or may not know it. Fill it in if it is known.

D This is for the owner of the well or land that the well or spring is located on. Please make a note if the address is a mailing or physical address. It is important to get the owner's phone number in case there are questions regarding the site inventory (during the data entry process).

E If a renter occupies the residence at the well, it is important to get their address and phone number, too. This can help with future access requests or to ask about well usage.

LOCATION

LOCATION: T ___ F ___ $^{N}_{S}$ R ___ F ___ $^{E}_{W}$ S ___ F ___ Tract ___/ F ___/___ Irreg. Sect? Y__N__

Latitude ___ G ___ Longitude ___ G ___ Datum ___ H ___ Geomethod ___ I ___

County ___ J ___ USGSMap7$^{1}/_{2}$' ___ Altitude ___ K ___

SITE NOTES: ___ L ___

F This part of the location is Township, Range, Section and Tract and may be known by the landowners. Please circle either the north or south for township. Circle either east or west for range. The tract is the quarter sections of the section the well is located in. If you do not know this it will be filled in during the data entry process.

- Do not worry about USGS map 7 1/2 or Irreg. Sect., this is part of the data entry process.

G This is for the latitude and longitude of the well head. **It is important to get a latitude/ longitude reading from a GPS unit while out in the field, at the well head.** Record Lat/Long in decimal degrees using the datum NAD 83. Place the GPS unit right next to the well head on the ground for program consistency.

H Primary datums are: NAD 27, NAD 83, and WGS84. GPS units can display the lat/_long in any of these, for the field inventory use NAD 83.

I The geomethod is asking what method have you used to get your location. Is it from a map, or GPS unit? It is important to say what kind of map you used. However, with few exceptions, you should get GPS coordinates with a GPS unit at the well head.

J Please fill in what county the well is located in.

K It is important to collect an altitude/ elevation reading from the GPS unit at the well head. Placing the GPS unit next to the well head on the ground allows for a consistent elevation reading throughout the program. This reading allows the data enterer to compare this well to other wells in the area.

L The site notes pertain to giving directions to the property where the well is located. An example: head east from Jordan, MT for 25 miles, turn left onto Blue Creek Road. Drive for 2 miles, turn right, house and barn are on left side of two track about 1 mile in from Blue Creek Road. Also give a brief direction on how to get to the well from a distinctive landmark. Sometimes over growth can cover the well leaving it hard to find, so more descriptions are better. Also mention if the site is a fair weather site only.

WELL INFORMATION

WELL DETAILS

Water Use ____M____ Casing I.D. ____N____(in) Total Depth From Ground ____O____

Measuring Point (M.P.) ____P____ft(+ above, - below land surface) M.P. Elev._____

M The well usage is documented here. A well can be domestic, stock, irrigation, monitoring, industrial, or any combination of the above.

N Fill in the inside casing diameter here. The picture top right on this page, shows how to measure the casing diameter properly.

O The total depth is measured with the steel tape. The measurement is from the top of the casing to the bottom of the well. Place the steel tape into the well, preferably on the side without the electrical wiring (this is where the hand mirror comes in handy). When you feel slack on the steel tape fish it up and down to see if you are hung up on something (like the pump) or if you truly hit the bottom. If you still feel slack, take the measurement at the point where the slack is not felt in the steel tape. Read the tape measurement at the top of the casing.

Ask the landowner for the approximate depth. This will help you know if you are stuck on something down well (pump or bracket) or if you are close to the bottom.

DO NOT RELEASE OR REEL UP THE STEEL TAPE QUICKLY.

This depicts how to properly measure the casing ID. Common dimensions are 2” (0.16’), 4” (0.33’), 5” (0.42’), and 6” (0.5’). Remember the steel tape is in 10ths of an inch. The steel tape is shown above.

DON’T FORGET TO CLEAN ALL YOUR EQUIPMENT AFTER IT HAS BEEN IN THE WELL.

Picture provided by Kodie Olsen, LBCD.

WELL INFORMATION CONTINUED

WELL DETAILS

Water Use ____M____ Casing I.D. ____N____(in) Total Depth From Ground ____O____

Measuring Point (M.P.) ____P____ft(+ above, - below land surface) M.P. Elev.____

This is how to measure the measuring point. Measure from the ground surface to the top of the casing.

P The measuring point (M.P.) refers to the measurement from the ground surface to the top of the casing (where you take measurement for the depth and water level). This is important to collect because it tells us the elevation of the water level inside the well.

The measuring point is subtracted from the static water level, which gives you the proper measurement for the water level (the subtraction is done by the database once all data is entered. Do not worry about the subtraction in the field).

When collecting the measuring point of a flowing well, measure from the pressure gauge to the ground surface.

If the casing is above ground, circle the "+above", however, if you are measuring a well in a well pit you should get the measurement from the top of the well casing to the estimated ground level, and circle "–below land surface."

- Do not worry about the measuring point elevation. That can be done during the data entry process.

Pressure gauge

To collect the measuring point from this flowing well, measure from the pressure gauge to the estimated ground surface (which may be a negative number with a well pit).

To collect the measuring point in this flowing well, measure the distance from the pressure gauge connection to the ground surface. This is critical for a correct reading.

STATIC WATER LEVEL

STATIC WATER LEVEL (E-Line___/Steel Tape___/Pressure Gauge___sonic sounder___&temp___)

Time	Depth Below M.P.	PSI	Head	Water level altitude	Remarks

Q On top of the static water level section, there appears E-Line (water level sounder), Steel Tape, Pressure Gauge, Sonic Sounder, and Temp. These indicate what instrument was used to gather the static water level. It is important to distinguish between the steel tape and the sounder because it not only lets future technicians know what was used but it also documents how the measurements were taken.

This displays how to chalk the steel tape to measure the water level.

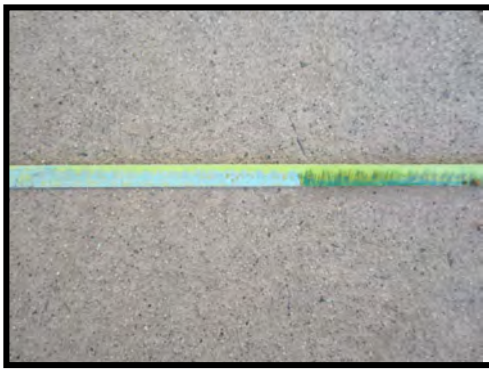
R Record the time that the static water level was taken. This is important because the static water level naturally fluctuates in a day's time. Noting the time helps with understanding this fluctuation and the hydrogeology in the region.

Measuring a water level with a steel tape.

Picture provided by Kodie Olsen, LBCD.

S This is where the static water level is logged, whether is was measured with a steel tape or sounder.

Before starting you want to listen to the well to hear if the pump is running or not. If you hear a muffled whine, this measurement is not a true static water level and should be recorded in the pumping water level space. See notes for sounder on page 12, referring to collection of a static reading.



Water mark shows the water level. Place finger on mark, turn tape over, and read the measurement.

DON'T FORGET TO CLEAN ALL YOUR EQUIPMENT AFTER IT HAS BEEN IN THE WELL.

STATIC WATER LEVEL CONTINUED

STATIC WATER LEVEL (E-Line___/Steel Tape___/Pressure Gauge___sonic sounder___&temp___)

Time	Depth Below M.P.	PSI	Head	Water level altitude	Remarks

S **CONTINUED:** When measuring with a steel tape, chalk up the back side of the tape, where the backing has been sanded off. Send the steel tape down the well to about where you had seen the water on the tape (when measuring total depth). Hold the tape at the top of the casing (and record that number, this is your hold value) and bring the steel tape to the surface. Note where the water cut mark becomes solid on your tape (see page 13) record this number. This is your cut value. The difference between the hold and cut values is the water level. Say you hold steel tape at the top of the casing at 100 feet, when you reference the tape there is water from the end of your steel tape to 34 feet. You take the 100 feet subtract 34 feet and you get 66 feet. So that means that the static water level is 66 feet from the top of the casing. See notes on page 14 about what a "static" reading is.

Make sure if you turned pump off to turn the pump back on. When you measure with a sounder send the sounder down until you hear a consistent beep. Read the tape where it meets the top of the casing.

An example of a flowing well. See page 23 to properly measure a flowing well.

An example of where to place the pressure gauge. The knob on the left opens to allow water to flow (once pressure gauge is on snug). A pair of pliers will open the valve. Make sure to open slowly.

STATIC WATER LEVEL CONTINUED

STATIC WATER LEVEL (E-Line___/Steel Tape___/Pressure Gauge___sonic sounder___&temp___)

Time	Depth Below M.P.	PSI	Head	Water level altitude	Remarks

T This is where you record the pressure in pounds per square inch if you are testing a flowing well. A flowing well is inaccessible to collect a water level or depth; however, getting the pressure reading can be just like a water level reading with a simple equation that is done during the data entry process. You must make sure that the system is not using water (i.e. the house washing machine is running) because this can give you a false reading. If there is water being used please make a note of this. On page 4, items 1,2, and 3 show different pressure gauge set ups. You want to attach the gauge to a sampling point (spigot) that is as close as possible to the well. Make sure the pressure tank is off or the valve to it is bypassed for a pressure reading.

You must make sure that the system is closed. Place your pressure gauge on a hydrant, spigot, or pipe. Tighten the coupling as tight as possible to eliminate any leaks. Slowly turn on the water from the hydrant or spigot until it is turned completely on (this allows for an accurate reading).

The pressure needs to stabilize before you take a reading. This can take up to 30 minutes. Watching the gauge is important.

Digital pressure gauge on hydrant that is fully open. **The height at which the gauge is held will affect the pressure reading.**

- Be careful when using gauges in extremely cold weather. Gauges without glycerin in them may freeze during the winter months.
- **Do not use the gauge face to loosen or tighten onto spigot or hydrant. You can break the internal seal and render the gauge worthless.**

A pressure gauge on a spigot on the side of a house. This gauge reads 40 psi.

Place wrench here to loosen or tighten pressure gauge. Do not use the gauge face to loosen it.

STATIC WATER LEVEL CONTINUED

STATIC WATER LEVEL (E-Line___/Steel Tape___/Pressure Gauge___sonic sounder___&temp___)

Time	Depth Below M.P.	PSI	Head	Water level altitude	Remarks
R	S	T			U

T **CONTINUED:** The pressure gauge can slowly continue to increase (keep track of the time you allow the system to stabilize).

When you have recorded the psi, turn off the hydrant or spigot. Slowly unscrew the gauge from the faucet so that pressure is released before completely disconnecting. If an unvalved pipe from the stock tank is the only sample point, then slowly unscrew the fitting from the pipe to alleviate pressure (you may get wet in the process). Unscrew the fitting from the pipe completely and allow flow back into the stock tank.

U This is where you would put any comments regarding your static water level, or your pressure reading. If you have a problem with your equipment working, write it down so that others know what problems you faced.

If there was a leak in the connection with your pressure gauge write it down so that it is known. If you do use a pressure gauge to gather data, record the amount of time you let the pressure gauge stabilize (also known as shut in time) on the spigot, hydrant, or pipe.

U **CONTINUED:** You can add in if there was a specific fittings that was needed for the pressure gauge.

An example of a flowing well with a pressure gauge already attached to it by the landowner. You just need to close the system with the valve on the pipe next to the gauge and wait for the pressure to build. You may want to measure the accuracy of the landowner's pressure gauge before using it for the first time.

Above shows purging parameter with a pH meter and conductivity meter. Fresh water is flowing into the one gallon bucket where the probes of the meters are measuring the water chemistries. For more on purging parameters see page 25.

PURGING PARAMETERS

PURGING PARAMETERS				ORP Probe:		Vol/Time	Discharge
Time	Temp C°	S.C .(µS/cm)	pH	Redox (mv)	DO mg/L	gal/min	
V						X	
FINAL	W						

V This space is for the field parameters. Record the time, the temperature (in degrees Celsius), the specific conductivity (micro Siemens per centimeter, µS/cm), and the pH of the water. If your meter also measures the redox or the dissolved oxygen, record that as well. If you record the redox please record the type of ORP probe (in case you or someone using your data wants to correct the value). When purging begins record an initial measurement immediately so that you can establish a stabilization trend. Also go back to the well head and listen for the pump working. If you don't hear a low whining noise (the pump) the sample point may not be connected to the well, you thought it was.

Every five minutes or so write down the field parameters. Allow for the well to purge for at least 15 minutes or until the parameters stabilize (parameters stay within 10% of each other). If the well has not been used recently you may need to purge for 30 minutes or more. Parameters are stable when all measurements

V **CONTINUED:** (pH, salinity, temperature) have consistently stayed in a small range for at least 10 minutes.

Purging the well is important so that a water chemistry trend (15 +minutes) is recorded. The goal is to measure fresh aquifer water. In order to do that the water in the well casing must be purged out so that fresh water may enter the well casing.

W When you have deemed all parameters to be stable your final parameter reading should go here. Make sure the final time is recorded here too.

X This is where the flow rate goes. You first need to turn on the water source. Make sure the water source is on and open fully. Take the measurement with a stop watch and a one gallon bucket. Collect at least three flow rates and record all three here.

Often times, if there is a pressure tank on the system, despite discharge volume or outlet chosen, the pump will cycle. Temperature and pH may fluctuate with cycle. It is best to take the measurement when pump is on.

PUMPING WATER LEVEL

PUMPING WATER LEVEL (E-Line___/Steel Tape___/Pressure Gauge___sonic sounder___&temp___)

Time	Depth Below M.P.	Water level altitude	Remarks
			If the pump is cycling it needs to be noted here.

Y When purging you will also be checking the pumping water level. This is important because this measures the amount of draw down of water in the well casing, and what the aquifer can sustain. This measurement is to understand the recharge rate of the aquifer into the well, which is important for understanding the quantity of water. You want to record what equipment was used to collect the pumping water level (i.e. sounder, or steel tape).

Z The time the purging water level measurement was taken goes here.

AA This is where the pumping water level measurement is recorded. Write down the measurement from the top of the casing to the water in the well.

- Don't worry about water level altitude. That can be done in the entry process.
- You can do multiple static water levels and pumping water levels in rapid succession to get better data, and to determine if the water level is changing.

GENERAL WELL INFORMATION

General condition of well and surface seal (Good ___ Fair ___ Poor ___)

Condition of water: Clear ___ Turbid ___ Other_____

Can sample be collected? Y___ N___, Before pressure tank? Y___ N___ Unknown ___

Before treatment? Y___ N___ Unknown ___, Comments_____

Water-Level Measuring Point Description:_____

Sampling-Point Description:_____

BB When looking at the well itself, check good, fair, or poor. This is important to record because a good well cap that seals the well from the outside world is important for the reduction of contamination. There should be a good surface seal with no caving near the well.

CC When well is purging the first few minutes, there may be debris or rust in the water. This could be due to the equipment entering the well. However if the water still has color or sediment when you take the final purged parameter reading make a note of it here.

GENERAL WELL INFORMATION CONTINUED

General condition of well and surface seal (Good ___ Fair ___ Poor ___) BB
Condition of water: Clear ___ Turbid ___ Other_____ CC
Can sample be collected? Y___ N___, Before pressure tank? Y___ N___ Unknown ___ DD
Before treatment? Y___ N___ Unknown ___, Comments_ EE _____

Water-Level Measuring Point Description: FF _____
Sampling-Point Description:_____ GG _____

DD This is for future reference if a sample can be collected. If it has a pressure tank or not. And also if there is a proper sampling point.

EE This is just a note so that when sampling, one knows that the sample may have gone through a water softener or other treatment before the sample was taken. Different types of treatments might have an affect on water chemistry. **Always collect samples <u>before treatment.</u>**

FF This is a spot for a good description of the water level measuring point. An example would be, from the top of the outer casing of the well head to ground surface on the north side of well casing.

GG The sampling point may not always be next to the well. If there is significant distance or if the sampling point is out of sight from the well head, write a detailed description, with landmarks here. An example: the hydrant is on the northeast corner of the shed about 10 feet away, shed is about 100 feet due east from the well head. Remember it is always better to sample from a point closest to the well to reduce possible contamination and purge time. If there is significant distance or if there is any potential confusion add a latitude or longitude for the sampling point here.

FIELD NITRATE TEST STRIPS

FIELD NITRATE (HACH) HH (mg/L-N) **Comments** II

HH If you are conducting the field inventory only (or if lab test does not include nitrate please follow these instructions), this is where you enter your field nitrate and nitrites. Example:

FIELD NITRATE (HACH) nitrite #, Nitrate # (mg/L-N) Follow the instructions on the bottle of nitrate strips.

If you are collecting water samples for the lab to analyze do not worry about this section.

1. Nitrate test strips recommended brand

2. Place nitrate strip into water for only a second (water that has been purged) . Follow the instructions on the bottle to properly test for nitrates and nitrites .

3. Close up of nitrate strip that has been used for a test(in this sample there are nitrates and nitrites present).

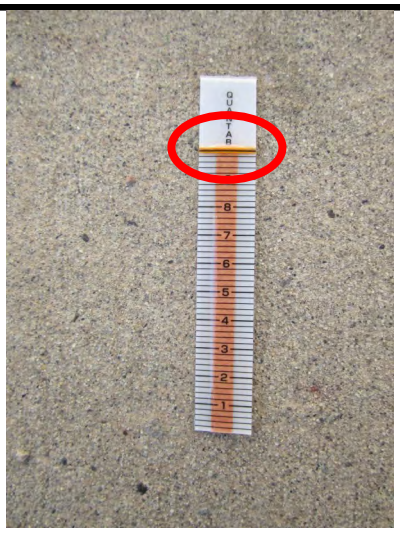
4. On the back of the nitrate bottle you can read the results of the test strip with this user friendly guide.

FIELD CHLORIDE TEST STRIPS

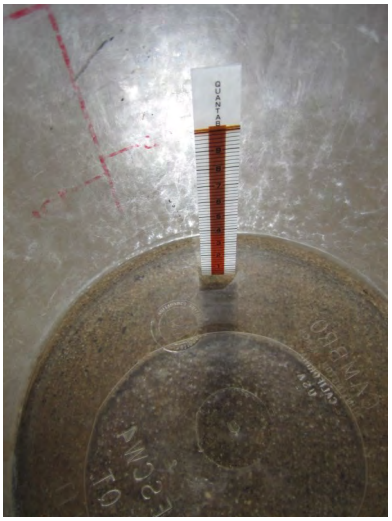
FIELD NITRATE (HACH) **HH** (mg/L-N) **Comments** **II**

II If you are conducting the field inventory only (or if lab does not test for chloride please follow these instructions), record the chloride strip field analysis here. An example: Comments CHLORIDE: <28ppm. Follow the instructions on the bottle of chloride strips. If you are collecting a water sample for the lab to analyze then do not worry about this section.

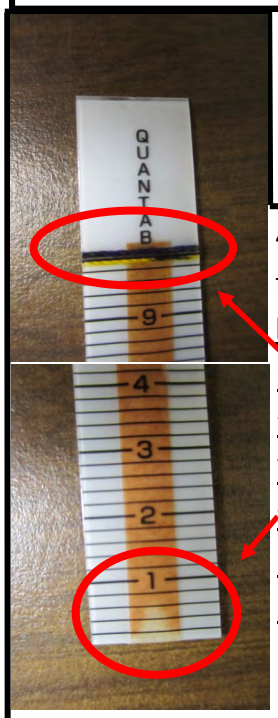
1. Chloride test strips recommended brand.



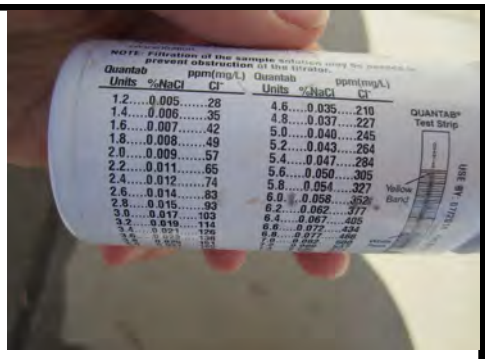
2. This is an unused chloride strip. Notice the thin black line at the top of the strip with larger more pronounced orange lines. The orange lines indicate a new strip.



3. After purged water chemistry is stable, place a very small amount of water in a clean container. Place strip into water and allow water to wick up the strip. Do not place strip in large amount of water this can affect the results. It can take up to 8 minutes for the results.



4. Example of chloride strip after testing water. The thick black line at the top of the strip (below where it says Quantab) indicates that the strip is ready to be read. This strip has a cone of white that has climbed the strip (located towards the bottom of strip). To read the strip properly, read the top of the white triangle Each line is considered .2 Quantab units. The top of the white triangle is at 0.6 Quantab Units.



5. The back of the chloride bottle has a conversion for the Quantab Units to parts per million (ppm). Looking on the back there is no conversion for 0.6. The lowest is 1.2, which equals 28 ppm. So the measurement for this strip would be <28ppm.

SITE MAP AND INVENTORY NOTES

SITE SKETCH MAP
Show location of well and sampling point. If necessary show site location in relation to roads.
^ North

JJ

INVENTORY NOTES: **KK**

JJ The site sketch map should include enough detail to instruct a person that has never been to the well on how to locate the well. Details should include the roads used to get to the site, the mileage on each road, the location of the well in relation to any buildings or other geographic landmarks, the sampling point in relation to the well, trees, fences, barns, and the direction to the closest town. Also note the other wells or springs on the property.

On pages 31and 32 there is an example of both a great site map and a poor site map.

KK The inventory notes are notes about the inventory being conducted. If there are issues with getting into the well head, tools needed for either the well or the sampling point, if there were issues with the water (smell, appearance), information on the well house, or the name of the well/ spring that the owner uses to identify that particular well. It is helpful to make a note of what the landowner has named that specific well. Landowners with large amounts of property usually have a large number of wells. When asking them questions about their well it is easier to communicate if you know what that landowner calls that site.

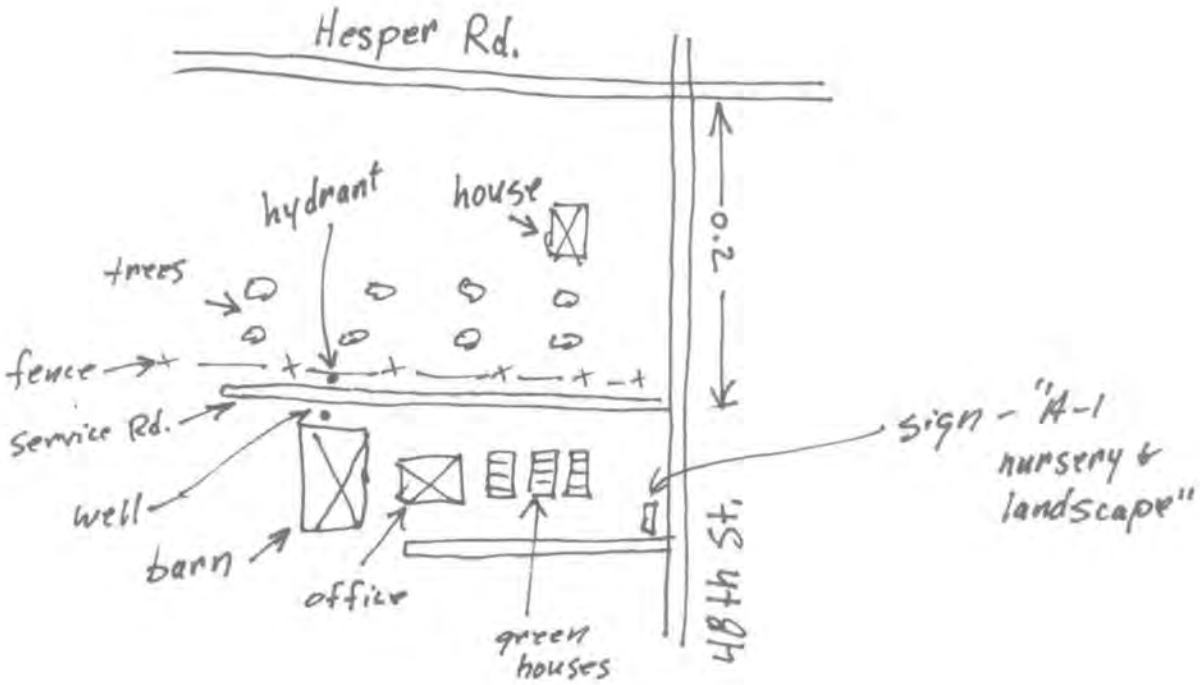
- **The bottom line is that the more information we have the better. If you need to write outside the blocks, please do so. Write pertinent information anywhere you can on the inventory sheet.**

SITE MAP EXAMPLES

SITE SKETCH MAP

Show location of well and sampling point. If necessary show site location in relation to roads.

^ North

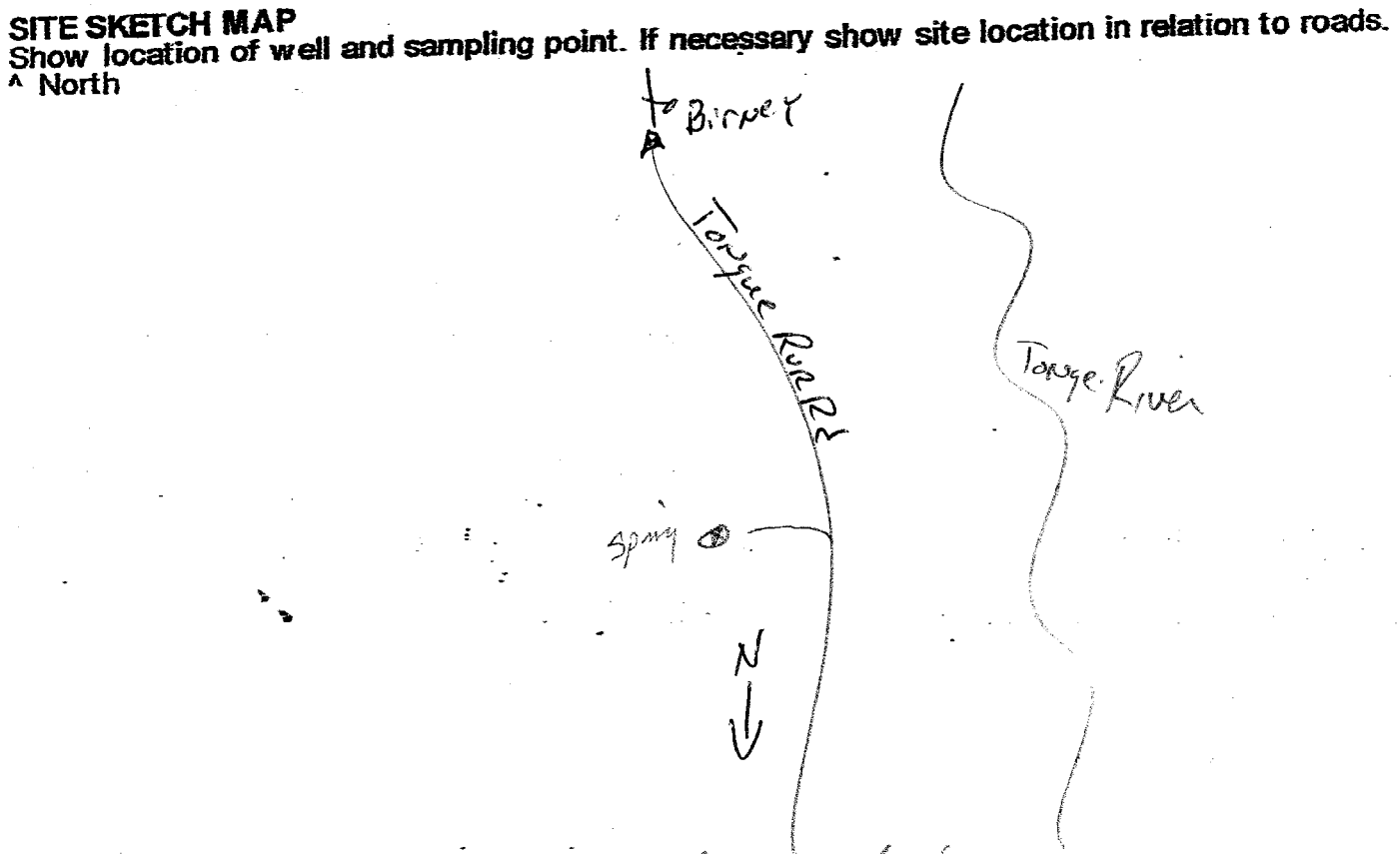


This example of a site sketch map is done correctly and is very helpful for understanding the site layout for the data enterer and for future technicians to water monitor.

<u>Reasons that this is a great map:</u>

- The cross streets are helpful for a general location. Easy to look up on maps or the internet.
- The distance of 0.2 miles from the intersection of Hesper and 48th Street is helpful and indicates where the "A-1 Nursery and Landscape" sign appears.
- Drawing quite a bit of recognizable landmarks like the fence, green houses, barn, offices, and trees.
- This map indicates where the well and sampling point (hydrant) are in relation to other landmarks which is very helpful.

SITE MAP EXAMPLES CONTINUED



This example is of a site sketch map that is incomplete. This is not helpful for future water monitoring because there is not enough information to find this spring.

Reasons that this is a poor map:

- There is not mileage stating how far Birney is from the turn off to the spring.
- There is no detail about the turn off to the spring (i.e. if it is a two track, county dirt road, or if it is just a field with a spring located in it).
- There are no landmarks, besides the river, located on the map (even in the most desolate of country side there might be a cottonwood tree, fence, stock tank, mile marker sign, rock formation that can give a person a sense of where the spring might be located). Mileage is handy to have if there are no landmarks and also helps with the data entry process. If necessary add this information back at the office using maps or online tools such as Google Earth. The more information provided the more useful the site inventory is.

SAMPLE INFORMATION

SAMPLE: Standard (250 ml **RA** {H_2SO_4}, 250 ml **FU**, 500 ml **FA** {HNO_3}, 500 ml **RU**) ☐

Other (nitrate only, tritium, etc.) _____

ALKALINITY TITRATION **Bottle Number**_____

Vol. Of Sample	Total Vol. Titrated	Acid Conc.	Original pH	Digits to Reach 8.3 pH	Actual Endpoint	Digits to Reach 4.5 pH	Actual Endpoint	Total Digits

Alkalinity Concentration ☐ (mg/L as CaCO3)_____

Do not worry about this part of the site inventory sheet.

SAMPLE TECHNICIAN INFORMATION

Name_____ LL _____ **Agency** _____ MM _____

LL When you are done with the site inventory please print your name legibly. This is important so that it is known who conducted the site inventory.

MM Write legibly the agency or conservation district that you work for.

GLOSSARY OF TERMS

AQUIFER- Any geological formation that is porous, such as sandstone, containing or conducting groundwater.

CASING - A pipe (steel, pvc) that forms and secures the well.

DEPTH TO WATER - The length (in feet) from the ground surface or measuring point to the water level in the well.

FLOWING WELL - A well in which water rises under pressure from a permeable stratum overlaid by impermeable rock. The flowing well is sometimes also known as an artesian well.

pH - A measurement of how acidic or basic water is. Water with the pH of 7 is neutral, less than 7 is acidic, and greater than 7 is basic. Low values of pH, particularly below pH 4, indicate corrosive water. High values, above 8.5 indicate alkaline water. Values between 6.5 and 8.5 are usually considered fit for consumption.

PITLESS ADAPTER - Pitless adapters are devices which allow users to connect water pipes drawn from a water well pump from an underground source into the house. It allows the pipe to pass horizontally through the casing so that no pipe is exposed above ground where it could freeze.

PURGE - Pumping water from a well to remove stagnant water from the water column within the well casing. This allows fresh water from the aquifer to enter into the well for testing. A well is considered "purged" after three casing volumes have been removed or when the field parameters are stable (+/-10%) for a volume of water equal to one casing volume.

SPECIFIC CONDUCTANCE - A measure of how easily water conducts electricity and provides an indication of the amount of minerals in the water. When minerals dissolve in water they form ions that can conduct electricity. The more minerals dissolved in water the greater the conductance. The drinking water recommendations for humans is less than 1000 micro Siemens.

STATIC WATER LEVEL - The undisturbed level of water in the well before pumping.

TEMPERATURE - The temperature is measure in Celsius for the site inventory.

Conversions: Fahrenheit° to Celsius° is subtract 32, then multiply by 5, then divide by 9.

Celsius° to Fahrenheit° is multiply by 9, then divide by 5, and then add 32.

ACRONYMS

CBMPA - Coal Bed Methane Protection Act

GPM - Gallon Per Minute

GWIC - Groundwater Information Center

MBMG - Montana Bureau of Mines and Geology

MP - Measuring Point

PSI - Pounds per Square Inch

PWL - Pumping Water Level

SC - Specific Conductance

SWL - Static Water Level

TD - Total Depth