Community Collaborative Rain, Hail & Snow Network
1-855-999-8858 or (519) 352-5334 ext 222
C/o Weather Innovations Consulting LP, Po Box 23005, Chatham, ON, N7L 0B1

CoCoRaHS Canada & Indigenous Community-Based Climate Monitoring Program

Training Guide

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Welcome to the CoCoRaHS Canada Volunteer Precipitation Network

CoCoRaHS is an acronym that stands for Community Collaborative Rain Hail and Snow. It is a national grassroots, non-profit, community-based, high-density precipitation network made up of volunteers of all ages and backgrounds who take daily measurements of precipitation right in their own backyards.

History: CoCoRaHS originated with the Colorado Climate Center at Colorado State University in 1998 thanks in part to the Fort Collins flood a year prior. The CoCoRaHS Canada network began in Manitoba in December 2011 following a massive flood in Manitoba and parts of Saskatchewan as there was no effective way of tracking the variability of precipitation in the regions.

Precipitation is very variable even over the shortest distances. By having volunteers monitor precipitation in their area, we can better capture this variability. Precipitation measurements are essential for public safety, agriculture, forestry, and flood monitoring, just to name a few. In fact, in 2011, Manitoba and parts of Saskatchewan experienced the worst flooding in over 300 years resulting in hundreds of millions of dollars in damages to homes, farmland, and infrastructure. The engineers that predict and monitor flooding require accurate rainfall and snowfall data to assist them in their decision making when responding to these types of emergencies. By you being a volunteer, you are part of the solution as **"Every Drop Counts!"**

Installation and Maintenance of your gauge:

Congratulations on receiving your official 4" CoCoRaHS precipitation gauge! You may now be wondering how to install the gauge and begin reporting your observations to the network. Please read the guide below for more information and to get started.

What's included in your kit:

Mounting Bracket: Attach to a post using the 4 screws included (screwdriver required). Bracket is used to mount the gauge.

Outer Cylinder: Slide on to the bracket using the plastic guide pieces. Outer cylinder holds the inner tube and funnel and can capture overflow of rain from the inner tube.

Inner Tube: Sits in place inside the outer cylinder. Markings show increments of 0.2mm per line and are used to measure captured rain amount.

Funnel: Place on top of the outer cylinder with tip of funnel inside inner cylinder in the gauge. Funnel is used to help guide the rain water into the gauge

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Installation: Mount the gauge on a post that you walk past each day so you will be reminded to read and empty the gauge daily. Use the bracket and mounting screws included in your gauge to mount to the post. Attach the remaining parts of your gauge to the bracket by sliding the outer cylinder (with the inner measuring cylinder inside and funnel on top) onto the bracket to complete your gauge and be ready to begin collecting rain measurements. Ideally, the post should be a 4"x4" with the top cut at a 45 degree angle. Where possible do not mount near buildings or trees that would prevent rainfall from reaching the gauge. The gauge should be mounted so that the top of the gauge is level and is 6" higher than the top of the post.



Maintenance: The All-Weather Rain Gauge is a precision weather instrument and with minimal care it should provide years of satisfactory service. Guard against extremely rough usage and wash periodically with mild soap or detergent and warm water, using a household bottle brush. Do not use solvents or abrasives to clean the gauge and do not wash the gauge in your dishwasher. Do not allow accumulated water to freeze in the inner tube.


Measuring Precipitation:

Rain:

- Remove the top funnel from your gauge and the inner tube.
- Using the scale on the inner tube, read the measurement at the bottom of the **meniscus** (curved surface formed by the surface tension of a liquid in contact with sides of the tube).
- Measurements are in millimeters (mm). The scale measures 0.2mm per line and the top line of the inner cylinder when full is 25.4mm.
- If you receive heavy rains, the water in your inner cylinder may fill up and overflow into the outer cylinder. In this case, read what's in your inner tube, pour out the liquid and pour the liquid from the outer cylinder into the inner tube (you may have to do this more than once depending on the volume of water). Add the measurement from the inner tube to the measurement from the outer tube to get a total rain measurement. Ex. 25.4mm from inner tube +5mm from outer tube=30.4mm

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Snow:

During the winter season, only use the outer 4" CoCoRaHS cylinder to capture the snow water equivalent, a snow measuring board and snow ruler to capture snow depth and snow core are optional. Instruments should be in place before it snows.

Tools you will need for Snow Measurements

4" CoCoRaHS outer cylinder

Flyswatter or spatula for snow cores

Snow Measuring Board
Ex. 16"x16" plywood

Snow Ruler or Yardstick in centimetres

Two Types of Snow Data That Volunteers Collect

Snow Water Equivalent	Snow Depth
Snow Water Equivalent (SWE) is a common snowpack measurement. It is the amount of water contained within the snowpack. It can be thought of as the depth of water that would theoretically result if you melted the entire snowpack instantaneously. We ask volunteers to report the SWE of new snow that has fallen over a 24 hour period to better understand the density of the snow in the area and the amount of rain liquid that has the potential to melt and go back into the earth's surface.	Snow depth is simply the total depth of snow on ground at your scheduled observation time. Snow depth is measured to the nearest 0.1cm. It includes both new and old snow, and should be reported even on days when no new snow has fallen. If necessary, take an average of several measurements. For example, if half the ground has 10cm of old snow and the other half of the ground is already bare, the average snow depth would be 5cm. Snow Depth is important for climate studies and can have an impact on water levels in streams, rivers and lakes.

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The Five Snow Measurements are:

1. Liquid water equivalent of new snow (in the gauge)

Use a flyswatter or paddle of some kind to push the snow sitting on top of the outer cylinder inside. What falls in the gauge is what is measured.

Melting Snowfall in your mounted outer cylinder

- Bring your outer cylinder in from outside and replace with your spare outer cylinder. This is why we include two in every kit!
- Add warm water to your inner cylinder so that it can melt the snow, carefully read and take note of how much warm water you've added. Make sure all snow is melted and in liquid form.
- Pour this liquid back into your inner cylinder and take note of the measurement at the bottom of the meniscus to the nearest 0.2mm. Note: you may have to empty the inner cylinder once or more depending on the amount of liquid to be measured.
- Take note of the final measurement and subtract the amount of warm water you've added to get your **Snow Water Equivalent**. For example:
  - ❖ Snow in 4"cylinder (unknown amount) + 20 mm (warm water to melt snow) = 25mm (measured in the inner cylinder)
  - ❖ 25mm (total water) – 20 mm (water added)=5mm (snow water equivalent)

Weighing the snowfall in your mounted outer cylinder (Optional Method)

1. Determine the weight of the empty dry gauge first. In this case the weight of the gauge is 458 g (grams). Note that your gauge will likely be a different weight – it could be 457 g for example.

2. Determine the weight of the gauge and snow. Be sure that the outside of the gauge is dry and has no snow stuck to it. In this case the gauge plus snow weighs 879 g.

3. Determine the weight of the snow. Subtract the known weight of the empty and dry gauge from the total weight. In this example, the weight of the snow is equal to:

- ❖ 879 g (gauge and snow combined) – 458 g (dry weight of gauge) = 421 g (snow weight)

Similar digital nutrition scales as the one shown in the picture can be purchased in store and online for about $20.00.

4. Now that you have the weight of the snow, **you will need to convert the weight to determine the Snow Water Equivalent (SWE)**.

Simply multiply the weight of the snow by the standard 4 inch gauge conversion factor using the example above:

- 421 g (snow weight) X 0.126 mm/g (4" conversion factor) = 53.0 mm (snow water equivalent)

*Note that we never measure the depth of the snow in the rain gauge itself. Any frozen precipitation in the rain gauge must first be melted and then measured.

2. Liquid water equivalent of new snow (on the ground)

The gauge may not always give an accurate measure of snow water content in new snow due to windy conditions. It may be necessary to take a snow core sample off your snowboard in an effort to ground truth your results. This measurement is important to understand the true density of the new snow on the ground.

Melting Snowfall from a core measurement

- Using your measuring stick, measure the depth of the snow from your board (or other hard surface).
- For example, if you determined the total depth of the new snow is 10cm, then take your core sample from an area where the depth of new snow is 10cm.
- Capture a core by inverting the outer cylinder and pushing straight down into the snow.
- Use something thin and sturdy to slide under the cylinder (spatula, flyswatter).
- Like in the previous example (Section 1 -Liquid water equivalent of new snow), calculate the snow water equivalent. Remember, this can be done by melting or weighing the snow sample.
- If using a snowboard, sweep it clean after taking a snow core and place it down on the existing location.

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Weighing the snowfall from a core measurement (Optional Method)

Weighing daily snowfall from a snow core is *exactly the same* as weighing the snow from your mounted gauge.

1. Determine the weight of the empty dry gauge first. In this case the weight of the gauge is 458 g (grams). Note that your gauge will likely be a different weight – it could be 457 g for example.

2. Determine the weight of the gauge and snow. Be sure that the outside of the gauge is dry and has no snow stuck to it. In this case the gauge plus snow weighs 879 g.

3. Determine the weight of the snow. Subtract the known weight of the empty and dry gauge from the total weight. In this example, the weight of the snow is equal to:

- ❖ 879 g (gauge and snow combined) – 458 g (dry weight of gauge) = 421 g (snow weight)

4. Now that you have the weight of the snow, **you will need to convert the weight to determine the Snow Water Equivalent (SWE)**. Simply multiply the weight of the snow by the standard 4 inch gauge conversion factor. Using the example above:

- ❖ 421 g (snow weight) X 0.126 mm/g (4" conversion factor) = 53.0 mm (snow water equivalent)

3. The depth of new snow (new snowfall)

- Find a nice, level place to measure where drifting or melting has not occurred (like a snow board).
- Slide your snow ruler into snow until it reaches the ground/board surface.
- Read value on snow ruler (value is always to nearest 0.1 cm).
- Take multiple new snow depth measurements and average, especially if it is windy.
- Other flat surfaces like driveways, picnic tables or the hard crust of the existing snow pack can be used to take the measurement of new snowfall.
- Measurements should be taken well away from structures like buildings and trees, at least as far away as those structures are tall.

4. The total depth of new snow & old snow/ice at observation time

Snow depth is the average depth of snow (including old snow and ice as well as new) that remains on the ground at observation time.

Measuring Total Snow on the Ground

- Snow is rarely the same depth everywhere, so take approximately five (5) snow depth measurements and average them to obtain your total depth of snow. Example:
  - 30cm+27cm+28cm+25cm+29cm=139cm
  - 139cm ÷ 5 = 27.8cm (average snow depth)
- Slide snow ruler through all layers of snow (new and old).
- Read value on snow ruler and record (values are to the nearest 0.1cm - like 4.2cm or 4.3cm).
- Don't measure artificial accumulations, such as plowed piles, large drifts, or shoveled snow.
- On some days snow will only partially cover the ground. To record this take an average of both covered and bare areas. If half the ground has 5cm and half the ground is 0cm (bare), then you would report:
  - 5cm + 0cm =5cm
  - 5cm ÷ 2 = 2.5 cm
- If more than half the ground is bare report T (trace) and mention the range of depths in your comments.
- If Possible, please report "total snow depth" every day that there is snow on the ground.

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5. Snow Water Equivalent (SWE) of total snow on the ground *(optional-only done on Monday's)*

This is a measurement that is useful to hydrologists and river forecasters. It provides an estimate of how much water is on the ground that can potentially run off into rivers and streams during spring melt which in extreme cases can cause flooding. The SWE of total snow tells us how much water is in the snow that accumulated over the course of the week where as the SWE of new snow shows how much water is in the snow that fell in 24hours.

Snow Cores in Shallow Snow

Measuring SWE basics:

- Take a core sample from the snow on the ground (not on your snow board).
- First find a representative location. The location should have not drifted, melted, or blown clear. For example, if you determined the total depth of the snow is 18cm, then take your core sample from an area where the depth of snow is 18cm.
- For shallow snow core samples, place gauge upside down and push down into the snow. Clear snow from around the gauge. Slide flyswatter (spatula works, too) under gauge.
- Carefully lift and flip the gauge.
- For deeper snow core samples, push your outer cylinder down into the snow, turn the cylinder and pull it out of the snow.
- For hard or deep snow pack, an ABS pipe can be used to collect snow core. (See Appendix A)

Snow Cores in Deeper Snow

Measuring SWE steps:

- Bring the core sample inside to melt/measure or weigh/convert the core sample to obtain the snow water equivalent as you would with the outer cylinder mounted outdoors. (See Section 2 - Liquid water equivalent of new snow (on the ground))

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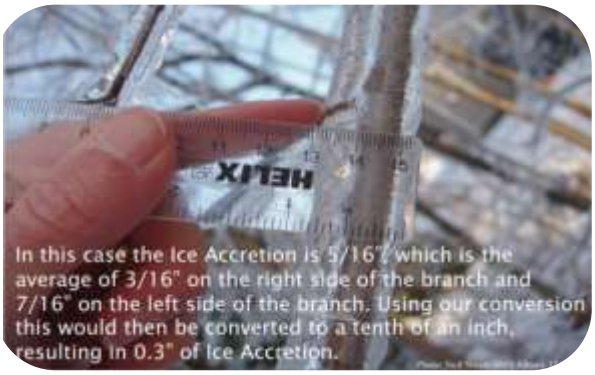
How to measure freezing rain

"Freezing Rain" is precipitation that falls in liquid form but freezes on contact with a surface

- Do NOT report freezing rain as "Snow".
- Melt and measure the moisture that has accumulated **inside** your gauge and report that as your daily precipitation amount. Remember to dry the outside of the cylinder.
- Report ZERO for your new snow amount (assuming that it all fell as freezing rain, and no sleet or snow fell or accumulated).
- Report the total depth of freezing rain remaining on the ground (or on a fence or branch) at time of observation and enter that in the "Total Snow on Ground" column. Make a note in your comments section so that we know it was freezing rain.



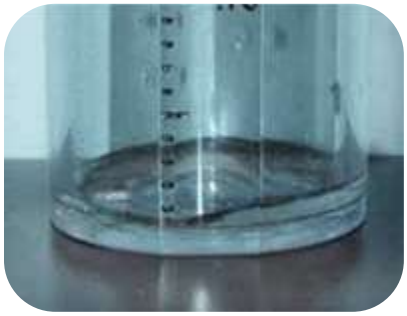
Reporting Zeros &Trace Precipitation

Please make sure to report your weather conditions and precipitation daily or as often as you can.

Zero's

- **Remember that reporting zero precipitation is just as important as the data can show dry areas or a potential drought.**
- Simply replace the NA and enter a "0" (zero) under rain or melted snow on either the website or the mobile app.
- Dew and frost can be traced back to condensation and are not considered precipitation.

Trace



- When there is a very small amount of water in the gauge and your surroundings show that it may have rained, you can enter a T for trace amount of precipitation.
- Even if there were just a few drops that do not accumulate in the gauge, you should still report a trace.
- If it's foggy but the ground is dry, report a zero. But if you can feel the mist and the ground is wet, call it precipitation as either a trace or a measureable amount.

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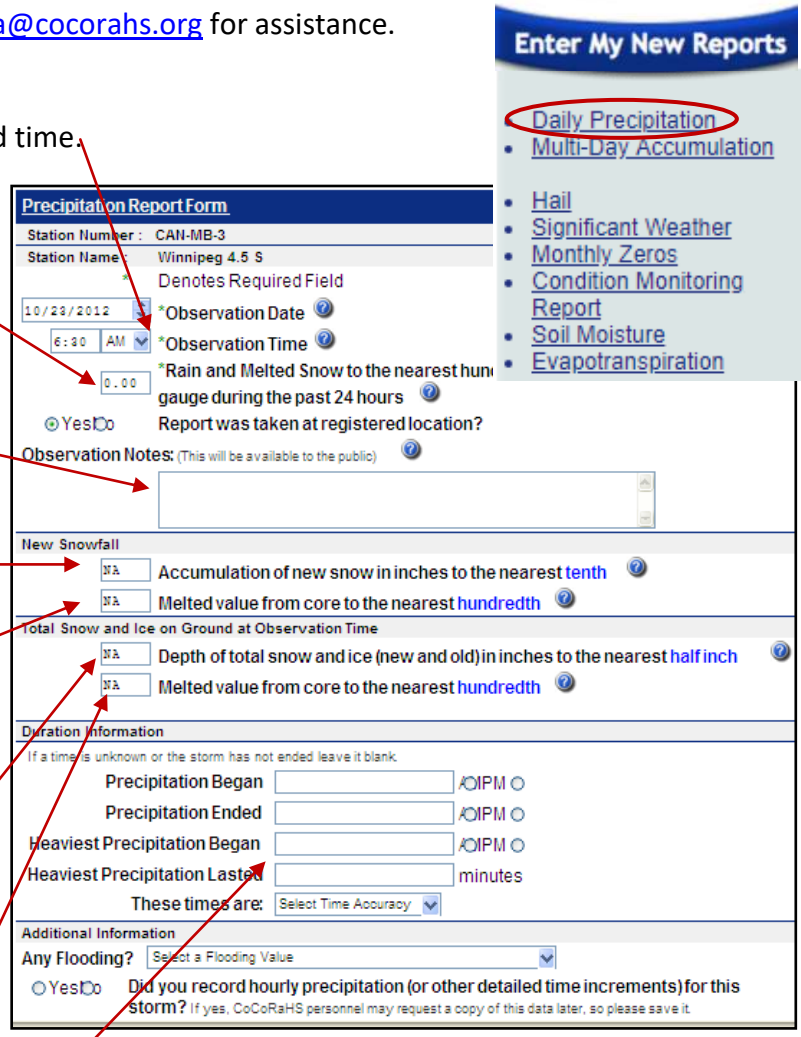
Reporting your data using the Website or Free Mobile Application

Website

Please visit www.cocorahs.org/Canada and login to your account using your login i.d and password you received when you first joined. If you forget your login, click on Find your Login info and enter either your station number or email and your details will be emailed to you. Alternatively you can email Canada@cocorahs.org for assistance.

Daily Precipitation Report Form



- Select observation date and time.
- Enter your rain or melted snow measurement from inside your gauge.
- Enter any observation notes of your surroundings at the time of your measurement.
- Enter new snow depth measurement from snow board.
- Enter new snow core measurement (SWE) from snow board.
- Enter total snow depth on ground including old snow and new snow and any ice on the ground.
- Enter the total snow core measurement (SWE) on the ground (optional- done on Monday's).
- You may include duration information such as when the precipitation began and ended.
- Additional information you can include in your daily report such as if there was any flooding and it's severity.
- Once you are done filling out the appropriate information in your daily report, please click submit (note: rain and melted snow value required in order to submit).

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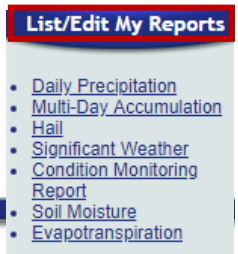
Multi-Day Accumulation Report Form

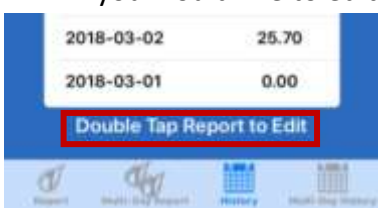
This reporting option is great for when you are away from the gauge for a period of time (more than 24 hours) and allows you to report what's in your gauge when you return.

- Select first day of accumulation period (usually the day after your last report was submitted).
- Select the date the gauge was emptied.
- Enter the time the gauge was emptied.
- Enter the rain or melted snow (SWE) measurement from your gauge.
- Enter total snow depth on ground including old snow and new snow and any ice.
- Enter the total snow core measurement (SWE).
- Enter any observation notes of your surroundings at the time of your measurement.
- Once you are done filling out the appropriate information in your multi-day accumulation report, please click submit (note: multi-day precipitation value required in order to submit)

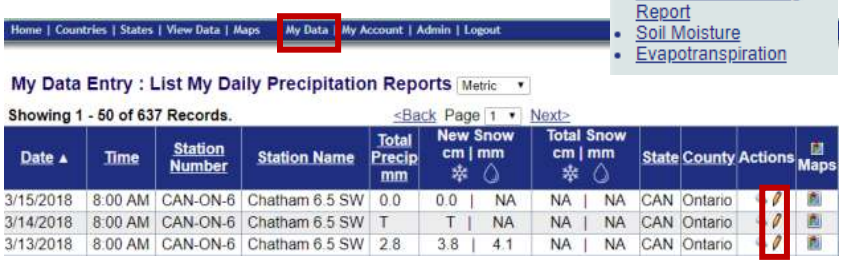
Editing your reports on the website and mobile app

- On the website, select "My Data" in the top toolbar and click on the type of report you would like to edit from the List/Edit My Reports tab. Click on the pencil icon on the report you wish to edit.
- On the mobile app, select history tab and double tap on the report you would like to edit.





Mobile App



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Mobile Application

CoCoRaHS has a free mobile application available to download on both the android and IOS app stores. The app offers a convenient way to submit your observations on the go using your smartphone.

App Store Links:

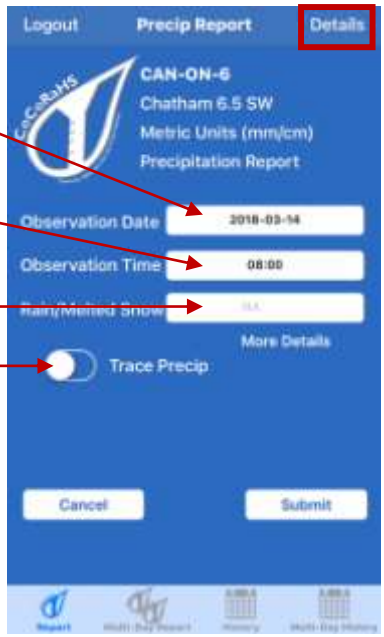
Android: https://play.google.com/store/apps/details?id=com.appcay.cocorahs&hl=en

IOS:https://itunes.apple.com/ca/app/cocorahs-observer/id827714558?mt=8

Daily Precipitation Report (home screen)

- Make sure the observation date is correct (app defaults to current date).
- Edit observation time if needed (app defaults to your preferred time).
- Enter the rain or melted snow (SWE) measurement from your gauge.
- If your measurement was a trace, select the Trace Precip toggle. Note: do not enter anything for rain/melted snow
- To include observation notes and to enter snow depth and core data on the IOS app, select the Details option in the top right corner, on the android app select specify snow and flooding info.

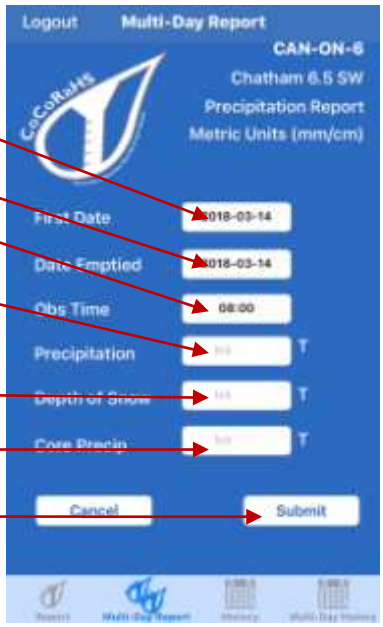
Android Application



IOS Application

Multi-Day Precipitation Report

- Select first day of accumulation period (usually the day after your last report was submitted).
- Select the date the gauge was emptied.
- Enter the time the gauge was emptied.
- Enter the rain or melted snow (SWE) measurement from your gauge.
- Enter total snow depth on ground including old snow and new snow and any ice.
- Enter the total snow core measurement (SWE).
- Once you are done filling out the appropriate information in your multi-day accumulation report, please click submit (note: multi-day precipitation value required in order to submit).



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Optional Reporting

The following Condition and Significant Weather reports are **optional but are encouraged** to all volunteers!

Condition Reporting

To understand the impacts of drought on plants, animals, and people, it is very helpful to monitor conditions regularly, whether the weather is wet or dry. This allows us to see how a drought year differs from a normal year, and we learn how different plants, animals and people respond to the onset, intensification, and recovery of drought. Regular condition monitoring can also help identify expected seasonal changes versus changes caused by unseasonably wet or dry conditions. This type of monitoring can also help to identify long-term or cumulative effects of drought.

Your knowledge about the local environment and how weather influences it can reveal much more than can be learned from recording daily rainfall alone.

There are seven categories of changing weather conditions to report.

Mildly Dry		**Mildly Wet**
Moderately Dry	**Near Normal**	**Moderately Wet**
Severely Dry		**Severely Wet**

Mildly Dry

- Growth may have slowed for plants, crops or pastures.
- Soil is somewhat dry.
- Local plants, pastures, or crops may have not fully recovered if conditions are changing from drier to wetter.
- Precipitation or water deficits may be present.



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Moderately Dry

- Plants may be brown due to dry conditions.
- Streams, reservoirs, or well water levels may be low.
- Voluntary water use restrictions may be in place.
- Water shortages may be present.
- Plants, crops, or pastures may be stressed.
- Soil is dry.



Severely Dry

- Ponds, lakes, streams and wells may be nearly empty or dry.
- Mandatory water restrictions may be in place.
- Soil moisture is absent.
- Crop or pasture losses may be experienced.
- Water shortages or water emergencies are present or possible.



Near Normal

- Observed conditions are expected for this time of year.



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Mildly Wet

- Local plants, crops, or pastures are healthy, recovering from dry conditions or draining from wet conditions.
- Soil moisture is above normal.


Moderately Wet

- Local plants, crops, or pastures are healthy and lush.
- Standing water may be present in low areas and ditches.
- Soil is very damp.
- Water bodies may be slightly more full than normal.
- The ground is partially saturated with water.



Severely Wet

- Water bodies are very elevated.
- Standing water is severe and abundant.
- Flooding may be present, leading to plant, crop, or pasture damage.
- Soil is wet.
- Ground is completely saturated with water.



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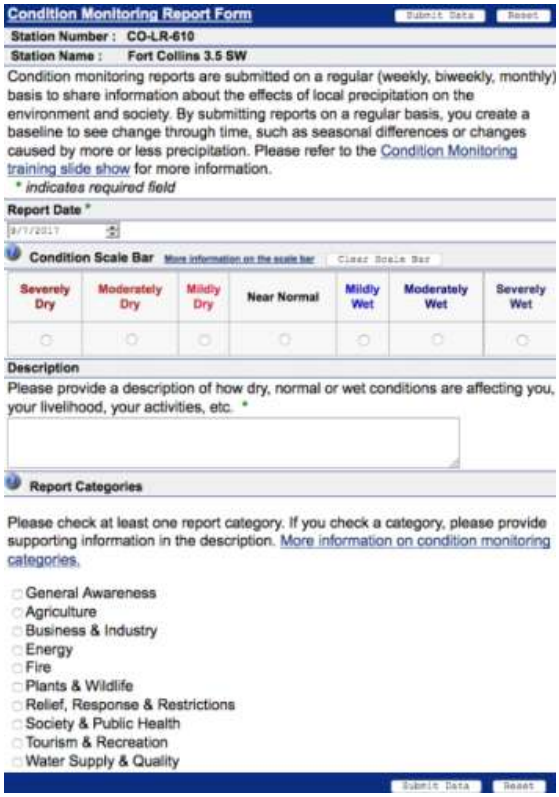
How to file a Condition Report

It's very easy to do … Just observe, then report!

First click on "My Data" from the menu at the top of the CoCoRaHS Web page

Choose "Condition Monitoring Report" from the "Enter My New Reports" panel.



Condition Monitoring Report Screen

Remember to:

- Enter your report date
- Select from the condition monitoring scale bar (Dry, Normal, Wet).
- Write a Condition Monitoring Description (Example: In the last four weeks I have recorded only 2mm of moisture. It has been very dry and the grasses in the fields are starting to turn brown. We've had an average daily temperature of 28 degrees Celsius).
- Last step; review the categories at the bottom of the report and select all that apply relating to your observations (General Awareness, Agriculture, Plants and Wildlife etc).

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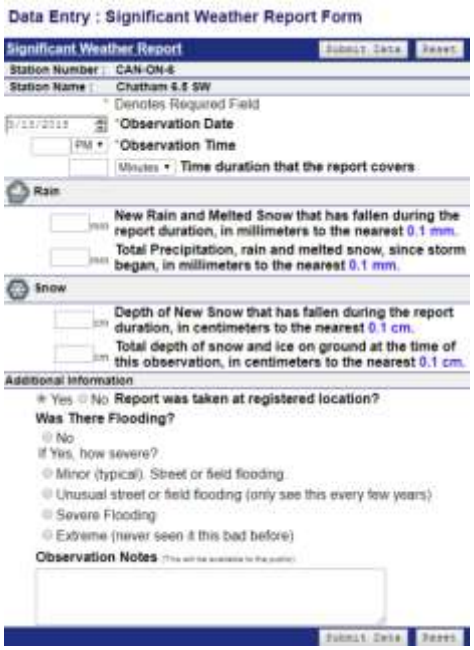
Significant Weather Reports

This report requires a little more observation time and detail and specifically focuses on significant rain and snow events. Significant weather reports are important to indicate potential flooding and or hazardous conditions.

How to report Significant Weather

First click on "My Data" from the menu at the top of the CoCoRaHS Web page.

Choose "Significant Weather" from the "Enter My New Reports" panel.



Significant Weather Report Screen

Remember to:

- Enter your report date, time and duration of the storm in minutes or hours.
- Report any new rain and melted snow that fell during the report duration (nearest 0.1 mm).
- Report the total precipitation, rain and melted snow, since the storm began (nearest 0.1 mm).
- Report the depth of new snow that fell during the report duration (nearest 0.1 cm).
- Report the total depth of snow and ice on the ground at the time of this observation (nearest 0.1 cm).
- Answer if there was any flooding and the severity as well as any observation notes.

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C/o Weather Innovations Consulting LP, Po Box 23005, Chatham, ON, N7L 0B1

Frequently Asked Questions

What happens if my gauge overflows while I'm away or before I can take a reading?

If your gauge has completely overflowed, you no longer have an accurate measurement. Please enter NA in the precipitation field. Then enter any comments, estimates or anything else pertinent to the storm in the section titled "Observation Notes".

What should I enter in the comments field?

Leave this blank unless you have additional weather observations to make. This can include any other weather related information such as wind conditions or temperature. Don't enter any information such as vacation plans, the comments can be viewed by anyone over the Internet.

What is a Trace?

Any precipitation that is seen or felt that is not a measurable amount is entered as a trace (T). If you see a drop on the pavement or feel one on your skin, that is a trace.

When I melt my snow, the gauge amount and core amount don't match, which one should I report as my precipitation?

The amount will rarely match but both are valid data. In general, the higher of the two is usually the best "estimate" of the amount of precipitation that fell. If you use your core measurement as your daily precipitation amount, be sure that you report your gauge catch amount in the comments.

What if some of the snow melts before my morning observation?

If 5cm of snow fell on the previous day, but in the morning there was only 1.3cm left on the ground due to melting or settling, the New Snow amount should be 5 and the Total Depth of Snow on the ground should be reported as 1.3cm.

Do I have to check my rain gauge at 7am EST?

No, but we would prefer it if you did. If you check your gauge at other times, your data may not be directly comparable to other data. If you check your gauge at night, your data will be in our reports but won't show up on our maps. We only map data that is collected and entered by 10am EST each day.

Who do I contact if I have any questions about the CoCoRaHS Canada network?

Any questions can be directed to the National Volunteer Coordinator: canada@cocorahs.org

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Appendix A – ABS Snow Cores

The standard CoCoRaHS procedure for measuring the water content of the snow pack (total snow depth) is to take a snow core using the outer portion of your CoCoRaHS precipitation gauge. This measurement is taken once per week on Mondays and is a very valuable measurement to understand the changes in the water content of the snow pack which is required by flood forecast agencies. The CoCoRaHS 4 inch gauge works OK early in the winter before the snow pack is deep and or becomes icy but later in the season this can be a difficult task as the snow pack becomes deeper. A good solution that we have developed is to use a section of 2 inch ABS (black plastic) drain pipe to take the core. This is a new approach which is not yet covered in the CoCoRaHS training material and these are not yet available for purchase….but you can, however, make your own gauge with some basic low cost materials and about 20 minutes work. Here's how….

Making The Snow Core Tube

Part 1. We recommend purchasing a length of 2 inch (diameter) ABS black plastic pipe to make this tool. The 2 inch pipe is easier to handle and somewhat more effective than 4 inch pipe. Be sure that the pipe has a 2 inch inner diameter (not outer). ABS pipe can be purchased at most hardware or plumbing supply stores and in many cases the pipe is available in pre-cut shorter lengths like 3, 4 or 5 feet or the store may cut it for you. Don't substitute with 2 inch PVC white plastic pipe.

Part 2. You will also need to purchase a blue plastic 2 inch Test Cap for the ABS pipe normally available in the same plumbing section of the store. A black ABS cap can also be used but is a bit more expensive and not required. The cap is required to keep your snow sample from falling out of the tube. Finally you will require a small triangular shaped file (for metal) commonly available at most hardware stores. This will be used to create the cutting teeth on one end of the pipe. Note: If you do not have a triangular file, you can use a hacksaw instead.

Part3.

1. Cut your pipe to the required length (be sure the end is cut-off square and not at an angle). The length is up to you but should be long enough to do a full core of the normal maximum winter snow depth in your area. For most parts of Canada a length of 3 to 5 feet should be sufficient.

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Appendix A - ABS Snow Cores Continued

2. Use your triangle file to cut teeth into one end of the pipe with the flat side of the file facing up toward you. Hold the file at a compound angle as shown in the photos. You will need to support one side of the pipe against a bench or some other rigid object so the pipe will not move too much when filing.

3. Continuing filing until the file reaches it's full depth (top side of the file even with the top of the pipe).

4. Begin the next cut for the 2nd tooth by using the full width of the file to measure the distance to the next cut in point.

5. Continue this process working your way around the pipe until you have filed all the teeth. It doesn't need to be perfect!

When you have finished it should look something like the above two photos.
The process will take you 15 to 20 minutes.

6. Place the blue test cap on the other end of the pipe (not too tightly) and you're done with construction! Do not glue the test cap on the pipe as you need to be able to remove it when coring.

7. Wipe the tube down to ensure it is clean and dry. Weigh the empty tube on your digital nutrition scale to determine the dry weight in grams…you'll need that later.

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Appendix A - ABS Snow Cores Continued

Using Your Snow Core Tube

1. When taking the once per week snow cores hold the 2 inch snow core tube vertically and press it into the snow pack with a twisting motion. Harder layers of snow and ice will require more twisting motion to cut through the snow pack (this is why you created teeth on the end of the tube). It is important not to push down too forcefully as harder layers of ice can block the tube and prevent you from getting a full core. Also be sure to remove the end cap before you begin coring otherwise you may not get a full core.

2. Be sure you take your measurement in a spot where the snow depth is representative of your average total snow depth.

3. Keep going until you are fairly sure you have reached the ground level. If the snow is dry you may be able to lift the tube straight out and retain the core.

4. In most cases you will have to remove some snow from one side of the tube so it can be tilted over on an angle and you can get your snow paddle or hand over the bottom end. If the snow is deep and or hard packed you may need to use a shovel.

5. Place the blue end cap back on the pipe snugly then lift up the tube and flip it over so the open end is facing up.

Bring your 2 inch snow tube inside and place it on the scale. Be sure to first remove any snow or moisture on the outside of the tube:

1. Determine the weight of the tube and snow. In this case the total weight is 1050 g (grams).

2. Subtract the weight of the empty and dry tube. In this case the dry tube weighs 610 g (note that your tube (gauge) will be a different weight). Weight of the snow = 1050 g (total weight) – 610 g (gauge weight) = 440 g (weight of snow)

3. Now simply multiply the weight of the snow by the standard 2 inch pipe conversion factor to determine the water content: 440 g (weight of snow) X 0.500 mm/g (conversion factor) = 220.0 mm (snow water equivalent). You may have noticed that the conversion factor is different from calculating the snow water equivalent from the mounted gauge – this is because the inner diameter is different.

Note that if you choose to melt the core and measure with the graduated cylinder you must multiply the measured amount by 3.97 as the graduated cylinder is calibrated for the CoCoRaHS 4 inch gauge.