ROOT RIVER FIELD TO STREAM PARTNERSHIP

FIELD SOP

STANDARD OPERATING PROCEDURES

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Version 2

DEPARTMENT OF AGRICULTURE

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Acronyms and Abbreviations

Acronym/Abbreviation	Full Text
BMP	Best Management Practice
cfs	Cubic Feet per Second (ft^3/sec)
Cl	Chloride
CSG	Crest Stage Gage
CST	Central Standard Time
degF	Degrees Fahrenheit
DI	Deionized
DOP	Dissolved Orthophosphorus
EFI	Equal Flow Increment
ETI	Equal Time Increment
EOF	Edge-of-Field
GC-MS/MS	Gas Chromatography with tandem mass spectrometry
MDA	Minnesota Department of Agriculture
mL	milliliter
MRL	Method Reporting Limit
MS	Measured Stage
NH_3	Ammonia
NO_2+NO_3	Nitrate + nitrite
RRFSP	Root River Field to Stream Partnership
RP	Reference Point
SOP	Standard Operating Procedure
SWCD	Soil and Water Conservation District
TKN	Total kjeldahl nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
t-tube	Transparency Tube
v	Volt

Monitoring Station Site Codes

Code	Monitoring Station Site
SRT	South Branch of the Root River – EOF subsurface tile monitoring station
SRF	South Branch of the Root River – EOF overland surface monitoring station
SR3	South Branch of the Root River – Headwaters outlet
CFW	Crystal Creek watershed EOF monitoring station – west
CFE	Crystal Creek watershed EOF monitoring station – east
CCO	Crystal Creek Outlet
BCE	Bridge Creek watershed EOF monitoring station
BCT	Bridge Creek Transition monitoring station
BCO	Bridge Creek Outlet

SAMPLE COLLECTION
QUICK REFERENCE GUIDE

Once accustomed to the standard operating procedures for sampling at Root River edge-of-field and watershed outlet stations, the following Quick Reference Guide may be a useful checklist or reminder to assure all tasks are completed.

IN FIELD:

i. Observe site conditions, collect mental notes and record on datasheet
ii. Collect a measured stage reading
iii. Fill out the site inspection document with all relevant information
iv. Inspect equipment to make sure everything is in good working order
v. Take site photos
vi. Labels bottles and collect samples (if applicable), place on ice
vii. Replace used bottles with sanitized ones
viii. RESTART the automated sampler program
ix. Perform any necessary site maintenance (e.g., download data from pesticide site, other site maintenance)
x. Make sure enclosure box is locked

AT OFFICE:

i. Fill out MDA Log-in form, scan and e-mail to MDA coordinators
ii. Ship samples (next day) on ice to the MDA Laboratory in St. Paul
iii. Transfer field notes to excel spreadsheet, save as backup
iv. Download, rename and save pictures
v. Send out downloaded files from monitoring stations (if applicable)

ANALYTE PRIORITY
QUICK REFERENCE GUIDE

The following table was developed to serve as a reference for priority of samples to submit for analysis if only a partial bottle was collected. If all programmed pulses are collected per bottle, there should be approximately three liters (3,000 mL) in each one-gallon bottle. With adequate water volume, 2,000+ mL is needed to run the full suite of analytes at the outlet sites (sediment, nutrients and pesticides). If less than 16 pulses of water is present in the bottle (2,000 mL), submit samples according to their priority level in Table A. At EOF sites, approximately 1,000+ mL is needed to run all seven analytes (1 pulse from bottle 1, or 8+ pulses from bottles 2-4).

Table A: Priority samples to submit for the Root River Field to Stream Partnership project if adequate water volume does not exist after a storm event (for outlet and overland edge-of-field overland sites).

Priority Level	Parameter	Preferred Total Volume (mL)	Minimum Volume for Individual Analyte (mL)	Minimum Cumulative Total Volume for Multiple Analytes (mL)	Minimum Pulses of Water *
1	TSS	500	100+	100+	1-2
2	TP+DOP	250	250	375-500	3-4
3	NO_2+NO_3-N‡	125	100	500-625	4-5
4	NO_2+NO_3-N, TKN, NH_3 (full nitrogen suite)	500	500	875-1,000	7-8
5	Chloride	125	100	1,000-1,250	>8
6	Pesticide – GC analysis **	1,000	500-750	2,000	>16

* 1 pulse of water = 125 mL (Bottles 1-4 at watershed outlets, Bottles 2-4 at EOF sites)

** Pesticide analysis will only be collected at the outlet stations (SR3, CCO and BCO).

‡ Only submit if the full nitrogen suite cannot be collected.

i. As a general rule, never dump any water out.
    a. If you have a question about potentially dumping a sample, please contact MDA RRFSP personnel prior to dumping.

ii. If there is not enough water to submit for analysis of the full nitrogen suite (NO_2+NO_3-N, TKN, NH_3), then only submit for nitrite+nitrate (NO_2+NO_3-N).

iii. If multiple bottles are collected (2-4), but the last bottle is incomplete (<16 pulses of water collected), COMBINE the last bottle with the bottle before it and collect the suite of samples from the combined water.
    a. Be sure to thoroughly agitate the water to effectively mix the samples together.
    b. **Example 1**: Bottles 1 and 2 are complete; bottle 3 only has five pulses of water collected. Combine bottle 3 with bottle 2. Mix sample thoroughly.
        i. Make sure to list the "start" time for the combined sample as the 1st pulse of bottle 2 and the "end" time for the sample as the last pulse collected for bottle 3.

c. **Example 2**: Bottle 1, 2 and 3 are complete; bottle 4 has 10 pulses of water collected. The observer will not be able to mix directly into one bottle as the sample volume in bottles 3 and 4 is greater than the volume that a single container can fit. To adequately mix the sample, dump bottle 3 into 4, cap and shake; then dump the water from bottle 4 into 3, cap and shake. Complete this process several times to ensure complete mixing of bottles 3 and 4 then collect the sample
    i. Make sure to list the "start" time for the combined sample as the 1st pulse of bottle 3 and the "end" time for the sample as the last pulse collected for bottle 4.

iv. If bottle 1 is only partially filled, and there is not enough water to fill the GC glass amber bottle for pesticide analysis, collect a grab sample for pesticides.

v. **SUBSURFACE TILE (SRT only):** TSS is less of a priority with lack of open surface intakes at the subsurface tile monitoring station in Mower County. The order of analyte priority for SRT will be: **1). NO_2+NO_3-N (or full nitrogen suite), 2). LLTP+DOP 3). Chloride and finally 4). TSS.**

SAMPLER PULSING
QUICK REFERENCE GUIDE

Watershed Outlet: Programming

Station	Activation Stage* (Stg_min)	Volume Threshold (F_trig)	ISCO Programming
SR3	1.20 feet (typical range 1.00-1.60 feet)	200,000 ft^3	**One-part program** • 24 pulses/bottle | 125 mL each • All bottles can be mixed together if needed
CCO	0.60 feet (typical range 0.40 – 0.75 feet)	8,659 ft^3	**Two-part program** • Bottles 1-2: A (24 pulses/bottle | 125 mL each) • Bottles 3-4: B (24 pulses/bottle | 125 mL each) o Part B = every **10th** pulse o Bottles 2 and 3 CANNOT be mixed together
BCO	0.91 feet	7,000 ft^3	**Two-part program** • Bottles 1-2: A (24 pulses/bottle | 125 mL each) • Bottles 3-4: B (24 pulses/bottle | 125 mL each) o Part B = every **6th** pulse o Bottles 2 and 3 CANNOT be mixed together
BCT	0.00 feet	1,000 ft^3 – every 25 pulses	**One-part program** • 24 pulses/bottle | 125 mL each • All bottles can be mixed together if needed

* Activation stage is subject to change based on stream conditions.

EOF Monitoring Stations: Programming

Station	Activation Stage* (Fstg_min)	Volume Threshold (F_trig)	ISCO Programming
SRT (tile)	0.0 feet (Sampling occurs anytime stage > 0.0 feet)	2,500 ft^3 (range: 1,000-2,500)	**One-part program** • 24 pulses/bottle | 125 mL each • All bottles can be mixed together if needed
SRF	0.03 feet	950 ft^3	**Two-part program** • Bottles 1: A (3 pulses | 1,100 mL each) • Bottles 2-4: B (24 pulses/bottle | 125 mL each) o Bottles 1 and 2 CANNOT be mixed together
CFW	0.04 feet	665 ft^3	**Two-part program** • Bottles 1: A (3 pulses | 1,100 mL each) • Bottles 2-4: B (24 pulses/bottle | 125 mL each) o Bottles 1 and 2 CANNOT be mixed together
CFE	0.04 feet	3,485 ft^3	**Two-part program** • Bottles 1: A (3 pulses | 1,100 mL each) • Bottles 2-4: B (24 pulses/bottle | 125 mL each) o Bottles 1 and 2 CANNOT be mixed together
BCE	0.04 feet	775 ft^3	**Two-part program** • Bottles 1: A (3 pulses | 1,100 mL each) • Bottles 2-4: B (24 pulses/bottle | 125 mL each) o Bottles 1 and 2 CANNOT be mixed together

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PURPOSE

From farmers to policy makers, there is a growing desire to better understand the impacts of agricultural practices on water quality.

In 2009, a group of diverse organizations came together to form the Root River Field to Stream Partnership. This partnership is an unprecedented effort between agricultural businesses, state agencies, producers and landowners to address water quality issues in the Root River watershed. This unique group is the first of its kind in Minnesota and demonstrates the wide interest in helping to restore and protect water quality.

The Root River Field to Stream Partnership, comprised of agricultural producers, the Minnesota Department of Agriculture (MDA), Minnesota Agricultural Water Resources Center (MAWRC), The Nature Conservancy (TNC), Fillmore and Mower County Soil and Water Conservation Districts (SWCDs), Monsanto, and academic researchers, is conducting evaluations of water quality and land management at multiple scales using the latest tools and technology. Partners are looking at multiple angles to characterize the water quality within the Root River watershed and working together to restore and protect the health of this valuable water resource.

The purpose of this study is to conduct intensive surface and groundwater monitoring at multiple scales in order to provide a comprehensive assessment of pollution loads and sources and also determine the effectiveness of agricultural best management practices (BMPs). At the core of this project is a nested water quality monitoring design. This includes edge-of-field sites "nested" within sub-watersheds (or small areas within a larger watershed). Edge-of-field (EOF) sites provide information about the amount of soil and nutrients moving off a given field. Each EOF site captures water from an area between 18 and 96 acres in size. In-stream monitoring sites are located at the outlet of three small watersheds (South Branch of the Root River Headwaters, Crystal Creek and Bridge Creek). Each outlet site captures water from an area between 2,778 and 4,665 acres.

The nutrient and sediment losses observed at each scale within this nested design will provide valuable information about the relationship of nutrients and sediment measured at the edge-of-field to the sub-watershed outlet. Significant differences in losses measured at these scales (edge-of-field vs. in-stream) will provide insight into other non-point contributions within the area such as the non-field portions of the watersheds. There are many examples of nested designs using small watersheds monitored within larger watersheds but using EOF monitoring to complement sub-watershed monitoring is a unique aspect of this study that has very practical implications for measuring BMP effectiveness.

1.0 DATA COLLECTION

1.1 SITE INSPECTION & FIELD NOTES

1.1.1 SITE INSPECTION NOTES

A vital step to ensuring good quality data lies in the field notes collected by the observer during frequent site inspections. Detailed field notes should be collected during *every* site visit whether the visit was made for collection of a runoff event, base flow water quality sampling or scheduled site checkups and maintenance. If while at a monitoring site and have a question or an issue that cannot be resolved, please contact MDA personnel listed in Appendix A.

A site inspection document has been created specifically for the Root River Field to Stream Partnership (RRFSP) monitoring stations which outlines the necessary information that needs to be collected in the field. This document will also ensure data accuracy. An electronic version will also be provided to the project partners in a Microsoft Excel spreadsheet.

Prior to leaving the office for a site visit, field staff should visit the RRFSP website (http://rootriverfieldtostream.org/) to check on sites to be better prepared for what is expected at the site upon arrival (*e.g.*, number of pulses, battery voltage, erroneous sensor readings, etc.).

Upon arriving at the site, be observant! Take notes on the condition of the field, crop, equipment, water appearance, flow conditions, etc. Table 1 provides a checklist of items to consider for inclusion into notes when a site visit is being made. An example of the site inspection document is included in Appendix B.

Table 1. Site visit checklist for documentation.

TYPE	INFORMATION NEEDED / SITE CHECKLIST
Basic Notes	▪ Site ID (for ID format, refer to Figure 4) ▪ Date and Time (military – CST, Central Standard Time) ▪ Observer (first and last name or initials)
Field Msmts.	▪ Measured stage (MS) o Flume/Watershed outlets: staff gage reading (feet) | AgriDrain: (RP – tapedown measurement) = MS (feet) ▪ Transparency Tube measurement (cm) ▪ Crest Gage Stage reading (feet) ▪ Visit type (rain event/ snowmelt/baseflow sampling/ site maintenance checkup)
Datalogger Information	▪ Datalogger time (CST) ▪ Battery Voltage (v) ▪ Stage reading (feet) ▪ Flow (cfs) ▪ 24 hr Rainfall (inches) ▪ Cumulative Rainfall (inches) ▪ Soil Temperature (deg F) ▪ Soil Moisture (%) ▪ Water Temperature (deg C) ▪
Stage accuracy	▪ Determine the difference between the MS and the sensor stage reading ▪ Apply offset if applicable
Auto Sampler info	▪ Were samples collected? How many bottles completed? If samples were corrected, write down sample number(s). ▪ If currently sampling, what bottle is it on? What pulse # (out of 24) is it on? ▪ Sampler screen display message – any errors? ▪ Was the sampler program restarted after sample collection?
Current Weather Conditions	▪ Sunny, mostly sunny, partly sunny, partly cloudy, mostly cloudy, overcast. ▪ Is it raining? Have there been any significant rain events within the past 48 hours? If so, how many inches of rain fell in the area? Was it high intensity rainfall? Low intensity? Long soaker rain? Is there rain forecasted in the next few days? ▪ Wind speed and direction ▪ Current temperature ▪ **Example:** 78 degF, mostly sunny (10% clouds), 2.25" inches of rain fell over the last 36 hours, low intensity soaker rain, wind is 20-25mph out of the NE (with gusts up to 35mph). No rain is forecast for the next 7 days.
Current Agronomy Conditions	▪ Was the field recently tilled, planted, or harvested? ▪ Was the field recently treated/sprayed with anything? ▪ Manure recently applied? ▪ How tall is the crop – at what stage in the growing season is it? ▪ Is the soil saturated or dry, is ponded water present? Was overland flow observed in nearby fields or into ditches/ravines?
Flume & Channel Observations	▪ SUBSURFACE TILE o Is flow present in the tile: low, moderate, fast flow, turbulent? o Are backwater conditions present? ▪ FLUME o If dry, is the flume free from debris and sediment? o If flow is present, what are the conditions like? If no water or flow is present, record "no flow" o Low, moderate, fast flow, turbulent? o Are backwater conditions present? ▪ WATERSHED OUTLETS / TRANSITION SITE o If flow is present, describe conditions. If not flow is present, record "no flow" on the site inspection document. o Low, moderate, fast flow, turbulent? ▪ All sites: o Appearance of the water: very turbid, somewhat turbid, cloudy, clear, algal presence, crystal clear o If there is low / no flow, is there evidence of higher flows or real flow (through flume)? How do you know?

TYPE	INFORMATION NEEDED / SITE CHECKLIST
Maintenance Completion Notes	▪ Is the flume level, or does it need to be leveled? ▪ Was the flume cleaned of debris and sediment? ▪ Was there vegetation removed from around site? ▪ Is the rain gage unit level? Is the rain gage plugged? Was it unplugged and cleared of debris? Would the blockage have interfered with recent rainfall data? ▪ Is the solar panel clean, needs to be cleaned, cleaned (ok)? ▪ Was the desiccant replaced? Desiccant status: New, Good, Bad, Needs to be changed ▪ Was the stage adjusted in the datalogger? Was the Crest Stage Gage reset? ▪ Was the data downloaded? ▪ Was the battery changed out? ▪ Is the equipment functioning properly? ▪ Does the sampler tubing, sampler line, or bubbler line need to be replaced? ▪ Time-lapse Camera (field and flume cameras): Is the solar panel on? Is there sufficient battery voltage remaining? Is the SD card full? ▪ Are mice a nuisance in the enclosure box? ▪ If so, plug any obvious access holes into the box, purchase Decon/traps or a deterrent, remove any bedding or feces. Have they chewed through any of the cables or sampling tubing?
Bottle sample information	▪ If a sample is collected, indicate which bottle the sample was collected from (bottle # 1-4). If no sample was collected, note that no sample was collected. ▪ Record the sample ID for each sample collected (See section 1.3.1 for sample naming convention). ▪ Record the date and time for each pulse collected by the ISCO autosampler for each bottle.

1.1.2 SHELTER LOG

The shelter log is a sheet that remains in the shelter throughout the monitoring year and must be filled out on every visit. This shelter log will be used as a quick reference for field staff on-site, and will allow MDA to track and manage site visits. The shelter logs have columns for staff initials, date, time (CST), download period, measured stage, cumulative precipitation, flow condition, samples collected (yes or no), and the last sample bottle number. There will also be an area to document important notes, if necessary. The shelter log will allow for efficient site visits when completed by multiple project personnel.

1.2 FIELD MEASUREMENTS

During runoff events, it is vital to be on site (even if the automated sampler has not completed its sampling round) to check equipment, take notes, collect measured stage readings, a transparency tube measurement and site photos. If a problem is determined during an event, corrective action may be possible prior to the end of event to ensure high data quality. All field measurements and observations should be recorded on the field data sheet.

1.2.1 MEASURED STAGE

Measured stage is one of the most essential items to document while making a site visit and is a measurement of the instantaneous water level (or stage). These readings are used both on-site and at the conclusion of the monitoring season to verify that the equipment is or was reading accurately. RRFSP monitoring stations sample based on the stage of the water. Automated samplers begin collecting water samples once a site specific stage threshold is met. It is imperative that accurate

stage measurements are collected and that the datalogger remains on track with field stage measurements.

A measured stage reading should be collected during *every* site visit, regardless of the visit type (*e.g.*, sample collection or maintenance). On occasion, it may even be beneficial to collect two or more stage readings during a visit (*e.g.*, at the beginning and end of a visit during storm flow when stage has the potential to change drastically even over a few minutes). **It is important to also record the date and precise time, on the datalogger, associated with each measured stage reading**.

WATERSHED OUTLETS

Staff Gage (SR3, CCO, BCO)**:**

- A measured stage reading for the sub-watershed outlet sites are found by reading the staff gage installed at the site to the **nearest 0.01 feet**.

Tapedown Measurement (SR3, CCO, BCO, BCT)**:**

- If a staff gage is not installed on site (BCT only) or if there is an issue with the staff gage (e.g., bent, missing, etc.), the stage can be obtained by collecting a "tapedown" measurement from a known reference point (RP). The RP is assigned an arbitrary or surveyed value, and the distance between the RP and water surface is subtracted from the RP to acquire a measured stage to the **nearest 0.01 feet**. However, the DNR provides the RP values and are tied to their datum and not the stage as would be read off of the staff gage. In order to convert the DNR datum to the stream stage as would be read off of the staff gage, subtract the "conversion from assumed elevation to stream stage", in Table 2, from the tapedown measurement.
- Location of where to collect tapedown measurement:
  - SR3: edge of chiseled square, painted orange, into the concrete on the top of the downstream side of the north culvert.
  - CCO: edge of chiseled square, painted orange, on top of cement ledge on box culvert (downstream side).
  - BCT: edge of chiseled square, on top of cement ledge on top of culvert (downstream side).
  - BCO: edge of chiseled square, painted orange, on the top cement ledge of east box culvert (downstream side).

Table 2. Reference point elevations and conversion to stream stage for SR3, CCO, BCT, and BCO.

Site	Reference Point (assumed elevation; feet)	Staff gage zero assumed elevation (feet)*	Conversion from assumed elevation to stream stage (feet)*
SR3	50.00	42.54	7.46
CCO	40.00	35.15	4.85
BCT	TBD	TBD	TBD
BCO	40.00	25.45	14.55

*Values are as of 5/1/2017. These values can change on an annual basis. Please contact MDA RRFSP personnel for most up to date values.

EDGE-OF-FIELD

Flume (overland flow – SRF, CFW, CFE, BCE):

- A measured stage reading for overland flow through a standard H-flume is found by reading the staff gage mounted on the inside flume wall (Figure 1). The water level on the staff gage should be read to the **nearest 0.005 feet**. Double check the value and record it on the site inspection document.
- If no water or flow is present within the flume, record "**0.00**" or "**no flow**" on the site inspection document.

Agri Drain (subsurface tile - SRT):

- Agri Drain structures are typically used for conservation drainage projects, and are convenient because they allow easy access to the subsurface drainage water for monitoring purposes. Stop logs can be placed in the Agri Drain at variable heights to hold back tile water in the field. Stop logs will be placed to a height so that the upstream tile remains full when subsurface drainage is occurring. The top stop log board will have a v-notch weir which allows for greater stage resolution at lower flows. The stage of interest will be the height of water that is flowing through the v-notch weir. An area velocity sensor will be mounted in the upstream tile to measure both stage and velocity.
- To collect a measured stage, a Reference Point (RP) with an assigned value will be needed. The purpose will be to measure the distance between the known RP (top edge of Agri Drain structure) and the surface of the water, which is called a "tapedown." The "tapedown" value will then be subtracted from the RP to calculate the height of water through the v-notch. Figure 2 shows the surface view into an Agri Drain. For an example of how to calculate the Measured Stage for tile water in an Agri Drain, see Table 3.

Table 3. Example calculation of a Measured Stage in an Agri Drain structure.

KNOWN INFORMATION		MEASURED STAGE Calculation
SRT Reference Point	4.220 ft	(4.220 – 3.765) =
Tapedown measurement (RP to water surface)	3.765 ft	**0.455 feet**

Figure 1. Flume staff gage, read to the nearest 0.005 feet.

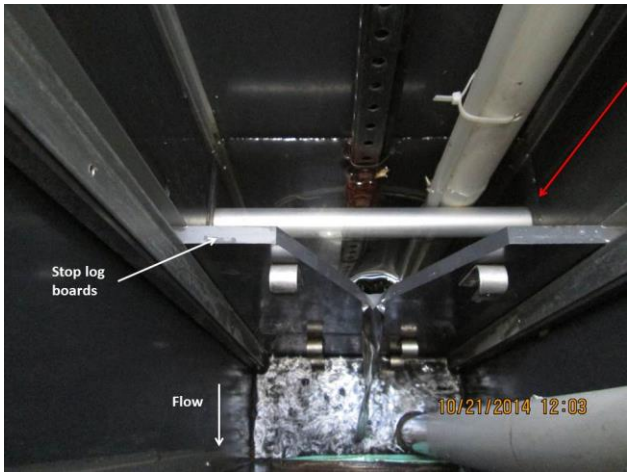

Figure 2. View into an Agri Drain structure with v-notch weir. The red arrow indicates where a tape measure should hit the water on the upstream side of the stoplog boards to collect a tapedown measurement.

1.2.1 TRANSPARENCY TUBE

Transparency tube (t-tube) readings are a quick and effective way to get a general sense of the instantaneous water clarity. Prior to collecting a reading, make sure the t-tube is thoroughly rinsed and clean of any residual sediment from a previous measurement. **Remember to remove sunglasses and keep your back to the sun**. Do not allow water to sit in the t-tube as particulates may begin to settle out; take the reading immediately. Slowly release the water through the valve until the white and black Secchi disk and/or screw are just barely visible on the bottom of the tube. If time permits, collect a second reading and take an average of the two. Record the value in the site inspection document to the nearest 0.2 cm. If subsurface water is also being monitored and the field has open tile intakes, a t-tube reading should always be collected (refer to section 1.3.3.4 for manually collecting a grab sample for t-tube readings).

Before dumping the runoff water out of the t-tube, take photos. Hold the t-tube in front of the camera with the numbers and water level clearly exposed. If possible, hold the t-tube in front of the runoff channel or flume so field conditions can also be seen in the background. Figure 3 shows a few examples.

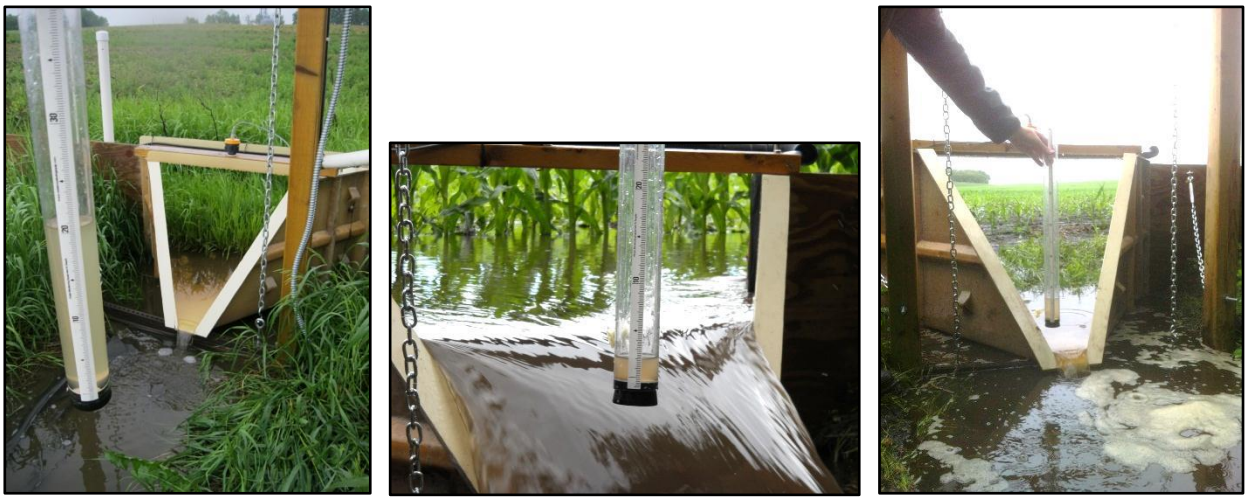

Figure 3. Example photos of transparency tube readings during surface runoff.

1.2.2 SITE PHOTOS

Time-lapse field cameras will be installed at each edge-of-field station and watershed outlet. Cameras are programmed to take multiple photos per day during daylight hours (see Section 2.11 for further description). The cameras are stationary and will be installed to capture a view of the downstream channel at watershed outlet stations and upstream field from the flume at edge-of-field monitoring locations. In addition, there will be a second time-lapse camera installed at the edge-of-field sites pointed at the staff gauge in the flume. These cameras will collect one picture every thirty minutes. The purpose of these photos is to document the stage within the flume as a backup and to assure the equipment is reading accurately.

Stationary photos are excellent for showing the changes in the adjacent vegetation conditions over time from winter snow conditions, snowmelt runoff, rain events, canopy development, drought and even fall harvest. Stationary photos, however, do not showcase the *entire* area of interest. Although photos are being collected on a daily basis, it is required that photos be collected by the observer during each site visit. Table 4 provides of list for potential photos of interest.

Table 4. Recommended photos to collect during site visits.

SITE PHOTOS
▪ Upstream channel/field ▪ Downstream channel/field ▪ View of entire flume with runoff occurring (if applicable) ▪ Overview of entire monitoring site ▪ Equipment photo ▪ Photo of collected sample bottles (mixed well) ▪ T-tube photo with flume/channel in the background ▪ Tile runoff / Agri Drain ▪ Crest Stage Gage pictures ▪ Before and after photo of any site maintenance (flume cleaning, vegetation removal, equipment alteration)

MDA staff will request copies of all relevant monitoring photos periodically. Photos should be organized by site (each site being in a different folder). Make sure that when taking pictures, the timestamp is correct on the camera. **It is very important that the time and date stamp on the camera are correct**, so the photo can be accurately correlated to the site visit and/or runoff event. Ensure that the timestamp is reading Central Standard Time (camera time may need to be adjusted if daylight savings time is being observed).

Photos collected by field staff should be named using a similar naming convention as the field data sheets with the addition of a description of the photo. Naming and describing the photo assists MDA personnel with understanding what the observer was taking a photo of as well as to make reviewing photos easier. The naming convention for photos is listed below:

Site_YYYY_MM_DD_photo description

Example: if a photo was taken on 3/11/2014 of a datalogger error at SR3 the naming convention would be: **SR3_2014_03_11_datalogger error.jpg**

1.2.3 CREST STAGE GAGE

One Crest Stage Gage (CSG) is installed at each site as a verification of the event-maximum stage. This value can be compared with the raw data to assure equipment was working properly. The CSG contains a long wooden dowel or PVC pipe with a small cup attached to the bottom. The small cup is filled with granulated cork and the dowel or PVC is housed in a two inch diameter PVC pipe capped on both ends (one side permanently). The CSG is mounted using U-brackets to the upstream wing wall near the flume (Figure 4) or culvert wall at the watershed outlets. On the bottom few inches, several holes are drilled to allow water movement into the housing, and at least one hole is drilled at the top to allow the air pressure to stabilize. When runoff occurs, the cork will float up through the enclosed unit and adhere to the wood or PVC as the water recedes. The level of the cork can then be measured with a tape measure, or along the staff gage in the flume, following a rain event and recorded to the **nearest 0.01 feet** in the site inspection document.

After a measurement has been gathered, take a photo of the CSG with cork (see Figure 4). Once done, brush off the granulated cork from the dowel or PVC and make sure there is adequate cork remaining in the small cup for the next event. A small plastic jar of granulated cork will be kept at each site for refills.

The bottom of the CSG will be surveyed in with the flume or channel staff gage, and an offset will be applied to compare the CSG measurement with the device level measurement.

Figure 4. CSG location on upstream wingwall and cork measurements following a runoff event.

1.3 SAMPLE COLLECTION

Water quality samples are an important part of the overall RRFSP project. Samples are collected using a variety of methods and into different bottles, depending on the laboratory analysis. This section describes how all samples should be labeled, the different methods used for sampling as well as the different bottles that need to be filled for laboratory analysis. No matter which sampling method is used or which bottles are collected, all samples should be placed immediately in an ice filled cooler following collection to ensure sample integrity. Additionally, Section 3 describes additional steps that need to be taken once the collector returns to their home office.

1.3.1 SAMPLE ID LABELING

Each sampling event will utilize a unique sample ID that will specify the Station ID (3 letter abbreviation), year (yy) and sample number for the specified year. Nutrient and sediment sample numbers will start with a zero as the first number in the series (001, 002, 003… to 099; Figure 5a) whereas pesticide samples will begin with five as the first number in the series (501, 502, 503,…to 599; Figure 5b).

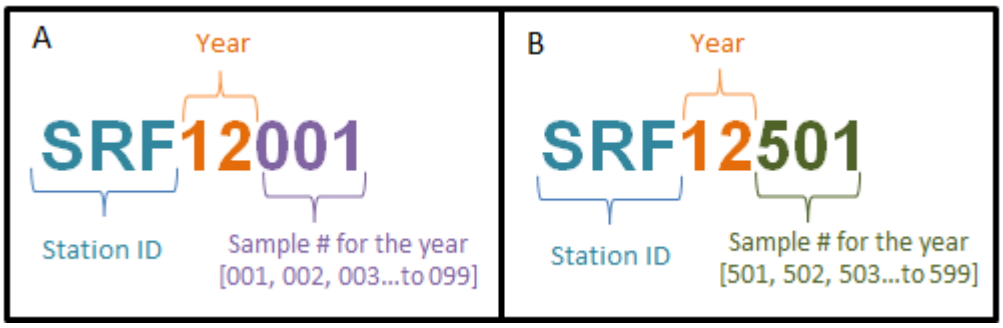

Figure 5. Sample ID labeling for nutrients and sediment (a) and pesticide (b) samples.

1.3.2 SAMPLE BOTTLE LABELING

Each sample bottle must be properly labeled before being submitted to the lab. Labels will be preprinted with the Sample ID, analyte and year. The user will need to fill in the month, day and sample time (military, Central Standard Time – CST; Figure 6). If the sample is a composite sample, the sample END time must be recorded on the label.

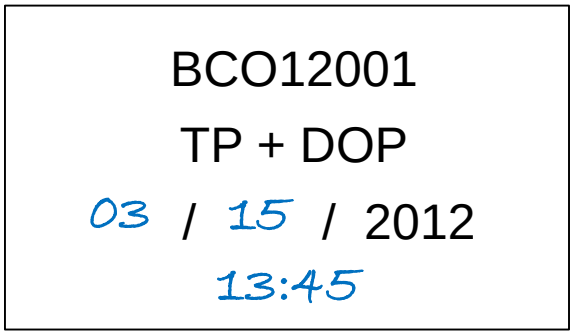

Figure 6. Example of sample bottle labels. Items in black are preprinted. Items in blue must be filled out at the time of sample collection

1.3.3 SAMPLE COLLECTION

1.3.3.1 SAMPLER KEYPAD BASICS

ISCO 6712 automatic samplers will be used for the collection of water quality samples. Figure 8 shows the 6712 keypad and Figure 7 highlights the functions. This can be found in the 6712 Portable Sampler Installation and Operation Guide.

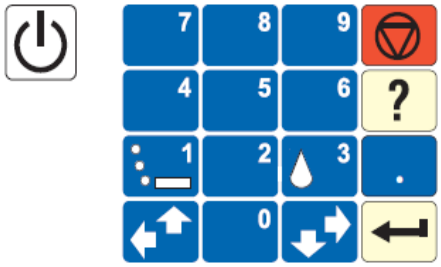

Figure 7. Autosampler keypad.

Key	Name	Function
	Standby	Turns sampler on or off.
	Stop	Stops the pump or distributor. Pauses a running sampling program. In programming screens, returns to a previous screen.
	Enter	Accepts a menu choice or number entry and goes to next screen.
?	Help	In programming screens, displays a brief help message.
	Down-Right Arrow	Selects the menu option right or below the current choice.
	Up-Left Arrow	Selects the menu option left or above the current choice.
0	Numbers	Types a number.
.	Decimal Point	Types a decimal point.
1	Pump Reverse	Press when at the main menu to run the pump in reverse.
3	Pump Forward	Press when at the main menu to run the pump forward.

Figure 8. ISCO autosampler keypad description.

1.3.3.2 EQUAL FLOW INCREMENTED SAMPLING (All analytical parameters)

The ISCO 6712 autosampler configuration will consist of four one-gallon glass bottles at the outlet sites, and four one-gallon polypropylene bottles at the EOF sites. Samples will be collected on an equal-flow increment (EFI) composite basis.

At EOF sites, once the flume or tile system reaches a predetermined level (> 0.00 feet in the Agri Drain and 0.04 feet in the flume), total water volume (in cubic feet) will begin to accumulate. When the cumulative volume reaches a predetermined threshold value (equal to one pulse every 0.01 inches of runoff), sampling will commence and the sampler will trigger one pulse of 1,100 mL into the first sample bottle. The amount of flow in the flume or tile system will dictate how fast the composite bottle is filled. After the volume threshold value is reached and the first pulse of water is collected, the cumulative counter will then start over, counting up from zero. When the threshold is reached again, another pulse of water will be collected into the bottle. Bottle 1 is a flow-composited sample with three pulses of 1,100 mL each. Bottles 2-4 will be a flow-composited sample with 24 pulses of 125 mL totaling 3 liters (0.80 gallons). When the bottle contains all programmed pulses, the sampler distributor arm will move to the next consecutive bottle. This process will continue until the fourth bottle is full or flow subsides. At the watershed outlets, the samplers are triggered based on an activation stage. The activation stage is adjusted throughout the monitoring season depending on site conditions and is typically set to 0.05 feet above the applicable baseflow stage so that rises in stage due to storm events trigger the volume accumulation.

At most sites the ISCO is programmed with a 2-part program. The 2-part program tells the ISCO to fill the one gallon collection bottles at different rates based on which bottle it is on and the site that the sampler is at. The 2-part program provides extended sampling during runoff events. For example, at BCO bottle 1 in the ISCO collects one pulse of water every time the sample volume threshold is achieved. For bottles 2-4 the ISCO collects a sample of water every sixth time the sample volume threshold is achieved. Without the 2-part program, there is a potential that the ISCO autosamplers would fill all four bottles prior to the event concluding during large or long duration events. Table 5 provides a description of the sites with the 2-part programming.

Table 5. ISCO 2-part program settings for RRFSP monitoring sites.

Site	Number of times the sample volume threshold is met before the ISCO collects one pulse of water		Notes
	ISCO Part A	ISCO Part B	
SR3	1	-	One-part program
CCO	1	10	Part A: Bottles 1-2, Part B: Bottles 3-4
BCO	1	6	Part A: Bottles 1-2, Part B: Bottles 3-4
BCT	1	-	One-part program
SRF	1	1	Part A: Bottle 1, Part B: bottles 2-4
CFW	1	1	Part A: Bottle 1, Part B: bottles 2-4
CFE	1	1	Part A: Bottle 1, Part B: bottles 2-4
BCE	1	1	Part A: Bottle 1, Part B: bottles 2-4

Once the automatic sampler has completed filling bottles following an event, the samples must be manually collected and processed. Because sites will be powered using solar panels, sample refrigeration will not be available on site, **prompt collection of samples following runoff will be required**, especially during warmer periods of the year. Holding times are also critical for dissolved (soluble) orthophosphorus and total suspended solids. Refer to Table 9 (Section 3.1.1) for associated holding times. When possible, an effort should be made to get out to the sites *during* runoff events to assure the equipment is operating properly and to capture runoff photos.

Table 6 was developed to serve as a reference for priority of samples to submit for analysis if only a partial bottle was collected. If all 24 pulses are collected per bottle, approximately three liters (3,000 mL) should be collected in each bottle. With adequate water volume, 2,000+ mL is needed to run the full suite of analytes. If less than 16 pulses of water are present in the bottle (2,000 mL), submit samples according to their priority level in the table.

Table 6. Priority samples to submit for the Root River Field to Stream Partnership project if adequate water volume does not exist following a storm event.

Priority Level	Parameter	Preferred Total Volume (mL)	Minimum Volume for Individual Analyte (mL)	Minimum Cumulative Total Volume for Multiple Analytes (mL)	Minimum Pulses of Water *
1	TSS	500	100+	100+	1-2
2	TP+DOP	250	250	375-500	3-4
3	NO_2+NO_3-N‡	125	100	500-625	4-5
4	NO_2+NO_3-N, TKN, NH_3 (full nitrogen suite)	500	500	875-1,000	7-8
5	Chloride	125	100	1,000-1,250	>8
6	Pesticide – GC analysis **	1,000	500-750	2,000	>16

* 1 pulse of water = 125 mL (Bottles 1-4 at outlet sites, Bottles 2-4 at EOF sites).

** Pesticide analysis will only be collect at outlet monitoring stations (BCO, CCO and SR3).

‡ Only submit if there is not enough volume of water for the full nitrogen suite.

i. As a general rule, never dump any water out.

ii. If there is not enough water to submit for analysis of the full nitrogen suite (NO_2+NO_3-N, TKN, NH_3), only submit for nitrite+nitrate (NO_2+NO_3-N).

iii. If multiple bottles are collected (bottles 2-4), but the last bottle is incomplete (<16 pulses of water collected), **COMBINE** the last bottle with the bottle before it and collect the suite of samples from the combined water.
   a. Be sure to thoroughly agitate the water to effectively mix the samples together.
   b. **Example**: Bottles 1 and 2 are complete; bottle 3 only has five pulses of water collected. Combine bottle 3 with bottle 2. Mix sample thoroughly.
      i. Make sure to list the "start" time for the combined sample as the 1st pulse of bottle 2 and the "end" time for the sample as the last pulse collected for bottle 3.

iv. If bottle 1 is only partially filled, and there is not enough water to fill the GC glass amber bottle for pesticide analysis, collect a grab sample for pesticides.

SUBSURFACE TILE (SRT only): TSS is less of a priority with lack of open surface intakes at the subsurface tile monitoring station in Mower County. The order of analyte priority for SRT is shown in Table 7.

Table 7. Priority samples to submit for the Root River Field to Stream Partnership project if adequate water volume does not exist following a storm event (SRT ONLY).

Priority Level	Parameter	Preferred Total Volume (mL)	Minimum Volume for Individual Analyte (mL)	Minimum Cumulative Total Volume for Multiple Analytes (mL)	Minimum Pulses of Water *
1	NO_2+NO_3-N‡	125	100	375-500	3-4
2	NO_2+NO_3-N, TKN, NH_3 (full nitrogen suite)	500	500	750-875	6-7
3	LLTP+DOP†	250	250	250-375	2-3
4	Chloride	125	100	875-1,000	7-8
5	TSS	500	100+	1,000+	>8

* 1 pulse of water = 125 mL

†LLTP = Low-level TP; This analysis is only applicable to SRT. All other sites received the TP analysis

‡ Only submit if there is not enough volume for the full nitrogen suite.

PROCEDURE FOR EQUAL FLOW INCREMENTED (EFI) SAMPLE COLLECTION:

i. Record the display message on the autosampler head in the field data sheet. Specify the number of completed bottles or any errors that occurred. If the sampler is still collecting, record the current bottle number and pulse.
   a. If any error messages are displayed, troubleshoot the equipment to fix the error. Call an MDA RRFSP representative if you have any questions.

ii. If a program is already running, you will need to stop the program by hitting the  (stop) button. This will push the program into a *manual pause*.

iii. The main screen has four options: RUN, PROGRAM, VIEW REPORT, OTHER FUNCTIONS. Arrow down to **VIEW REPORT**, hit the enter button  , select **VIEW DATA** from the next menu. Then, select **SAMPLING REPORT** from the third menu.
   a. VIEW REPORT → VIEW DATA → SAMPLING REPORT

iv. Once SAMPLING REPORT is selected, the sampler will run through the program sampling details, including start and stop times for each of the 24 pulses for bottles 1, 2, 3 and 4. The arrow keys can be used to toggle back and forth if a day or time is missed.
   a. Document any errors that occur for each pulse, such as "no liquid detected" with the associated date and time.

v. RECORD the start/stop date/time for each pulse and bottle on page 2 of the field data sheet (see Section 1.1 and Appendix B). Bottle start and stop times are the 1st and 24th pulse of each bottle (Figure 9).
   a. "1, Bottle 1" and "24, Bottle 1" ("1, Bottle 1" and "3, Bottle 1" for EOF sites)
   b. "1, Bottle 2" and "24, Bottle 2"
   c. "1, Bottle 3" and "24, Bottle 3"
   d. "1, Bottle 4" and "24, Bottle 4"

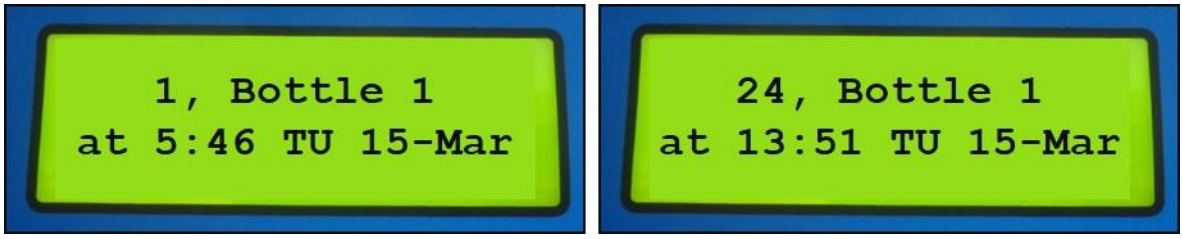

Figure 9. Pulse #, Bottle #, and sample date and time readout of the ISCO 6712 Automatic Sampler. The two images above represent the start (left) and stop times (right) for bottle #1 (outlet sites).

vi. If the sampler stopped collecting water before a bottle was completely filled, use the end date/time for the last pulse number collected. For example, if Bottle 3 only collected 17 pulses (out of 24), the start/stop time that would need to be recorded for that bottle would be listed under "1, Bottle 3" and "17, Bottle 3."

vii. Prepare and label the needed MDA Laboratory sample bottles. Four labels with the same sample ID, and four bottles will be needed for each one-gallon sampler bottle. A fifth bottle and label for pesticide analyses will also be needed at the watershed outlet sites (BCO, CCO and SR3). Pesticide sample numbers will differ from sediment and nutrient sample ID numbers (see Section 1.3.1 for sample ID labeling procedures).
   a. 500 mL – 2 bottles (TSS & Nitrogen-NO_2+NO_3, TKN, NH_3)
   b. 250 mL - TP + DOP
   c. 125 mL - Cl^-
   d. 1-liter glass amber bottle (pesticide sample)

viii. Unfasten the latches of the sampler head (three separate latches), and use the metal bar to hold the sampler head above the bottom carousel housing the samples. Carefully slide out the bottom carousel. If there is no bar to hold the sampler head, carefully remove the sampler head and set it on a clean surface (avoid muddy areas).

ix. Make sure to identify which bottle is which -- 1, 2, 3 and 4.

x. Nitrile or protective gloves are to be worn when handling water quality samples.

xi. Screw the lids tightly onto the one-gallon sample bottles. Aggressively shake each one-gallon sampler bottle individually for at least 30-60 seconds, making sure to invert the bottle numerous times. It is very important to adequately agitate the sample to assure that sediment particles have been evenly distributed and re-suspended.

xii. Upon shaking, immediately pour the representative sample into the appropriate labeled bottles.
   a. Ensure the pesticide sample bottles (glass amber bottle) is filled all the way to the bottom of the neck (Figure 10).

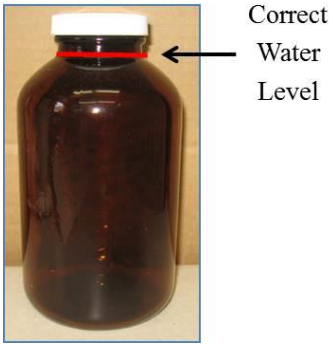

Figure 10. One-liter glass amber bottle for pesticide (GC) sample collection. Bottle must be filled to the bottom of the bottle neck.

xiii. Once samples have been collected, place bottles into an ice filled cooler.

xiv. Used one-gallon glass bottles can be washed on-site or taken back to the office to be rinsed and sanitized using a strong concentrated non-phosphate cleaning solution before being used again. Field and office washing procedures should be the same. A second full set of one-gallon sample bottles will be provided for each monitoring station to allow for swapping out sanitized/dirty bottles. Please refer to Section 2.3 for the bottle washing procedure.

xv. **IMPORTANT:** To prepare the autosampler for the next runoff event, it will need to be reset (or resumed) so that the program can start over again. Click on the (stop) button, and toggle to either **RUN** (or RESUME PROGRAM).

   a. RESUME PROGRAM will restart the sampler from the last bottle and pulse number that the sampler was on before the manual pause. This should only be used if the samples were not collected, otherwise the sampler program should always be restarted (run).

xvi. The next screen will ask you to select which bottle number you want the program to begin on so that the distributor arm moves to the correct location. Enter "1" for bottle 1, and hit enter . Figure 11 shows the default screen readout when the sampler has been resumed and is ready for the next runoff event.

Figure 11. Autosampler default display screen for a resumed/restarted program. The left image is the display screen at the watershed outlet sites, and the right image is the display screen for the EOF sites. These show that when triggered again from the datalogger, the sampler will begin with 1 of 24 pulses in bottle #1 (or 1 of 3 pulses in bottle #1).

1.3.3.3 EQUAL TIME INCREMENTED SAMPLING (Pesticides only)

As part of the Root River Pesticide project (beginning May 2012), pesticide samples will also be collected along with sediment and nutrients at the watershed outlet stations (SR3, CCO and BCO). A one-liter pesticide sample will be collected from the EFI bottles as well from a separate refrigerated ISCO Avalanche automated sampler which will collect equal time incremented samples (ETI). To ensure collected data is applicable to pesticide standards, the sampler will be set to collect a composite sample over a four-day period in a 2.5 gallon glass bottle. Once the sampler reaches the same trigger stage as the EFI sampler, it will begin collecting a predetermined volume of water (70-90 mL) at equally spaced time intervals (1 hour) over a 96 hour (4 day) period. At the end of the four days, the sampler will disable and a one-liter pesticide sample can be collected. In some cases, it may also be appropriate to collect a base flow grab sample while also at the outlet station (if water levels have fully returned to base flow conditions following the storm event).

IMPORTANT: If agricultural or other pesticide application is occurring near the sample collection location or if the odor of pesticides is present in the air, the person collecting the sample should consider leaving the area and returning at a later time to avoid possible contamination of the sample from nearby activities through the air.

PROCEDURE FOR EQUAL TIME INCREMENTED SAMPLE COLLECTION:

i. Record the display message on the autosampler head in the field notes. Specify the number of completed bottles or any errors that occurred. If the sampler is still collecting, record the current bottle number and pulse.
    a. If any error messages are displayed, troubleshoot the equipment to fix the error. Call an MDA RRFSP representative if you have any questions.

ii. The main screen has four options: RUN, PROGRAM, VIEW REPORT, OTHER FUNCTIONS. Arrow down to **VIEW REPORT**, hit the enter button ↵, select **VIEW DATA** from the next menu. Then, select **SAMPLING REPORT** from the third menu.
    a. VIEW REPORT → VIEW DATA → SAMPLING REPORT

iii. Once SAMPLING REPORT is selected, the sampler will run through the program sampling details, including start and stop times for each of the 96 pulses for the 2.5-gallon bottle. The arrow keys can be used to toggle back and forth if a day or time is missed.
    a. Document any errors that occur for each pulse, such as "no liquid detected" with the associated date and time.

iv. RECORD the start/stop date/time for the bottle. The start and stop time will be the 1st and 96th pulse of each bottle.
    a. "1, Bottle 1" and "96, Bottle 1"

v. On the field sheet, record the temperature of the Avalanche cooler displayed on the sampler head (FR-TEMP).

vi. Prepare and label the needed MDA Laboratory sample bottles:
    a. 1-liter glass amber bottle (pesticide sample)

b. The 1-liter bottle should be tripled rinsed with stream water prior to sample collection. **NOTE:** This process can be skipped for samples collected from the ETI or EFI sampler when there is not adequate water volume to allow for this procedure.

vii. Nitrile or protective gloves should be worn when handling water quality samples.

viii. Screw the lids tightly onto the 2.5-gallon sample bottle. Aggressively shake for at least 60 seconds, making sure to invert the bottle numerous times. It is very important to adequately agitate the sample to assure that sediment particles have been evenly distributed and re-suspended.

ix. Upon shaking, immediately pour the representative sample into the one-liter glass amber bottle. Place bottle into an ice filled cooler.

x. Used 2.5-gallon glass bottles can be field washed or taken back to the office to be rinsed and sanitized using a strong concentrated non-phosphate cleaning solution before being used again. Field and office washing procedures should be the same. A second 2.5-gallon sample bottle will be provided for each monitoring station to allow for swapping out sanitized/dirty bottles. Please refer to Section 2.3 for the bottle washing procedure.

xi. **IMPORTANT (CCO and BCO only):** To prepare the sampler for the next runoff event, it will need to be reset through the ISCO 2105 module so that the program can be triggered to start over again when the next runoff event occurs.

a. Use the ISCO 2100 series connect cable – attach to the top of the blue ISCO 2105 module. Use a laptop with Flowlink software (version 5.10 or later). Connect to 2100 series.

b. Under the "Measurements" tab, select "Sampler".

c. Under the Sampler screen, select the "**Reset Latch**" button (Figure 12). Make sure the latch is checked.

d. Accept changes and disconnect.

e. AFTER the Reset Latch button is selected, hit "**Run Program**" on the sampler. The sampler head display should read "Program Disabled" (Figure 13).

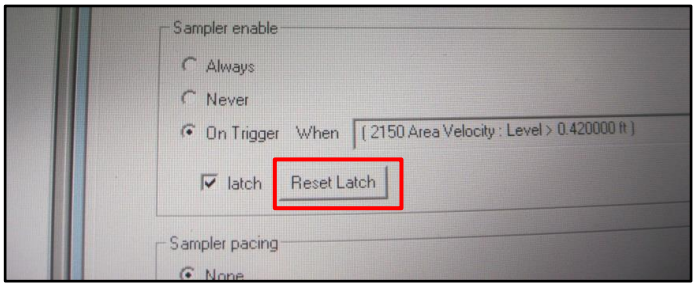

Figure 12. Layout of Flowlink screen used to reset the Latch button, which will allow the sampler programming to resume with the next runoff event. The red box shows the "Reset Latch" button that needs to be selected.

Figure 13. ISCO sampler head display at CCO and BCO when the Latch has been reset. The sampler is now disabled and ready to be activated once the predetermined stage is reached once again.

xii. **IMPORTANT (SR3 only):** Special Instructions are included for the operation of the equal-time based sample collection period. These fields include StageTimerActive, ISCO_Pulse_Counter, and ISCODelayTime on the datalogger and the ISCO sampler itself.

In ideal situations, the equal-time based program will begin when the stage in the ditch (Stage_avg) exceeds (>=) the activation stage (Act_Stage). This will trigger the equal-time based program on the datalogger (StageTimerActive) by changing the "False" to "True". Once "True", the datalogger will send a pulse to the ISCO sampler and record the pulse (ISCO_Pulse_Counter) with change of "0" to "1" (and so on). Once the pulse is sent, a timer (ISCODelayTime) is started and records the minutes since the last pulse was sent. When the timer (ISCODelayTime) exceeds (>) the equal time based sample interval (ETI_Interval), another pulse will be sent to the autosampler and the ISCO_Pulse_Counter will increase by one, and the timer (ISCODelayTime) will restart. This will continue until the pulse counter (ISCO_Pulse_Counter) exceeds (>) the number of desired ETI pulses (ETI_Pulses). After the number of desired ETI pulses has been met and if the stage in the ditch (stage_avg) is below (<) the activation stage (Act_Stage), the equal-time based program (StageTimerActive) will be turned off signaled by "False". The ISCO sampler can be interrogated to obtain pulse times and error codes, and then the ISCO program can be restarted.

A complete, four-day equal time based sample is highly preferred; however, there may be instances when a sample will be stopped before completion of the four-day sample period. Such instances may include resetting the sampler at the end of the week to ensure weekend sample coverage, forecasted rains from the end of the four-day window to the next planned site visit, non-project staff commitments, etc. Several scenarios on resetting or stopping the equal-time program are presented below.

Ending the equal time based sample before it finishes, and resetting immediately to start collection of a four-day equal time based sample.

1. On the ISCO sampler, review and record sample collection times and errors, select **Stop Program** to end current sample, and then select **Run Program** (Should read "Sample 1 of 96 after 1 pulse")
2. On CR850 datalogger, navigate to "Public" table and ensure the following:
    a. Stage_avg is higher (>) Act_stage.
        i. If Stage_avg is below (<) Act_stage, lower Act_Stage 0.1 foot below current Stage_avg
    b. Reset ISCO_Pulse_Counter to "0".
    c. Reset ISCODelayTime to "0"
    d. Highlight StageTimerActive and change it to False. The equal time based sample program will start on the next datalogger execution (every minute)
3. Stay at site until ISCO sampler collects a sample when StageTimerActive changes from FALSE to TRUE, to verify equipment is operational.

Ending the equal time based sample before it finishes, without immediately resetting an additional equal time based sample. This will prepare the system for the next run-off event.

1. On the ISCO sampler, review and record sample collection times and errors, select **Stop Program** to end current sample, and then select **Run Program** (Should read "Sample 1 of 96 after 1 pulse")
2. On CR850 datalogger, navigate to "Public" table and ensure the following:
    a. Stage_avg is lower (<) Act_stage.
        i. If Stage_avg is above (>) Act_stage, increase the Act_Stage to 0.1 foot above the current Stage_avg
    b. Reset ISCO_Pulse_Counter to "0".
    c. Reset ISCODelayTime to "0"
    d. Highlight StageTimerActive and change it to False. This should stay FALSE until the next event.
3. Stay at site to ensure that the ISCO sampler does not collect a sample for a few minutes.

The stream is still elevated above Act_Stage, but you don't want an additional four-day sample to start. This step can be completed during the on-going four-day equal time composite collection period.

1. On CR850 datalogger, navigate to "Public" table and ensure the following:
    a. Stage_avg is lower (<) Act_stage.
        i. If Stage_avg is above (>) Act_stage, increase the Act_Stage to 0.1 foot above the current Stage_avg
2. On the ISCO sampler, review and record sample collection times and errors, select **Stop Program** to end current sample, and then select **Run Program** (Should read "Sample 1 of 96 after 1 pulse")

Whenever collecting a four day equal time composite sample, always double check the StageActiveTimer (under "Public" table). If it is TRUE, the sampler will collect water immediately. If it is FALSE, it will not collect water until Stage_avg exceeds (>) Act_stage. Whenever the ISCO sampler is reset, ensure ISCO_Pulse_Counter and ISCODelayTime are both "0".

1.3.3.4 GRAB SAMPLE COLLECTION

It is important to not only collect runoff and storm event samples, but also to collect samples under low flow or base flow conditions to characterize all conditions. Base flow samples should be collected every **10-14 days** on average. An attempt should be made to collect 1-2 base flow samples between events to characterize conditions between storms.

Watershed Outlets (SR3, CCO, BCO)

Grab samples can be collected by various methods at the sub-watershed outlet stations. Nitrile or protective gloves should be worn when handling water quality samples. Make sure that the sampling apparatus has been properly cleaned and tripled rinsed with stream water prior to sample collection. The sample should be collected from a location in the channel that is well mixed and representative of the entire cross sectional area. Typical sample collection methods include:

- Bucket with rope attached – sampling from bridge or top of culvert
- Extendable rod w/dipper
- Wading
    - If you are wading, be sure to collect the sample upstream from where you are standing to assure that suspended solids are not captured from disturbing the channel bed.

After the grab sample(s) have been collected, immediately place the sample(s) into an ice filled cooler.

Subsurface Tile (SRT only)

To collect a baseflow sample from the tile via the automatic sampler, a "grab" sample will need to be collected.

STEPS FOR BASEFLOW GRAB SAMPLE COLLECTION AT SRT:

i. Prepare and label the needed MDA Laboratory sample bottles.
   a. 500mL – 2 bottles (TSS & Nitrogen-NO_2+NO_3, TKN, NH_3)
   b. 250mL (TP + DOP)
   c. 125mL (Cl-)

ii. Nitrile or protective gloves should be worn when handling water quality samples.

iii. Line the bottles up for preparation for sample filling.

iv. If a program is already running, you will need to stop the program by hitting the (stop) button. This will push the program into a *manual pause*. Toggle to **GRAB SAMPLE** from the paused screen. Once GRAB SAMPLE is selected, skip down to step vi below.
   a. When collection has been completed, be sure to select **RESUME PROGRAM**.

v. If there is no program currently running; select **OTHER FUNCTIONS** from the main screen on the autosampler.
   a. From OTHER FUNCTIONS → **MANUAL FUNCTIONS** → **GRAB SAMPLE**.

vi. Disconnect the pump tube from the bulkhead fitting.

vii. The screen will prompt you to enter a sample volume (in milliliters). Enter a number between **2500-3000 ml** and press the (enter) button.

viii. The sampler will purge the suction line before a sample is collected. The display will read "PUMPING_____ml" when the sample is being collected, and will purge again upon completion.

ix. Quickly put one sample bottle at a time under the pump tubing and fill all sample bottles.
   a. If the sampler head stops pumping prior to filling all sample bottles, go back to step iv. and follow steps again.

x. Once the sample is collected, reconnect the pump tube to the bulkhead fitting.

xi. Once the grab sample has been collected, immediately place the labeled bottles into an ice filled cooler.

1.3.3.5 TEMPERATURE BLANK

A temperature blank, filled with stream/river water, must be contained in each cooler upon arrival to the laboratory. The temperature blank should be filled to the top using a pre-labeled 125 mL bottle (Figure 14) with stream water at the first location of each trip. In instances with a limited amount of sample volume and no stream directly next to monitoring station (*e.g.*, composite samples at an edge-of-field site), the temperature blank can be filled at another location, with stream water, or tap water after immediately returning to the office. Do not use pre-chilled, dedicated temperature blanks. If sampling occurs over multiple days, the temperature blank should be filled on the first day of sampling. The temperature blank should stay in the same cooler as the samples and **be refrigerated** with the collected samples overnight in most circumstances. If all samples contained in a single cooler arrive at the MDA Laboratory frozen, the temperature blank should also be frozen.

Dedicated temperature blank bottles will be distributed and can be re-used when returned in coolers from the laboratory. If multiple coolers will be used for shipping, one temperature blank will be necessary for each cooler being used for shipment. Temperature blanks are not indicated on sample log-in submission forms. The MDA Laboratory will return the empty temperature blank bottles with the cooler.

1. During the first sample collection event each day, fill a dedicated "Temperature Blank" bottle with stream water.
2. Preserve samples on ice immediately following collection.

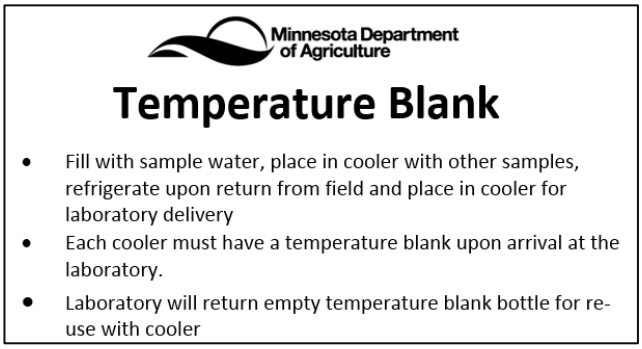

Figure 14. Temperature blank label.

2.0 SITE MAINTENANCE

2.1 DOWNLOADING DATALOGGERS

Dataloggers at the EOF, EFI outlet, and the ETI monitoring site at SR3 are downloaded on an hourly basis to a computer in the MDA Rochester office via cellular communication. The remaining sites (ETI samplers at CCO and BCO and the EFI sampler at BCT) do not have cellular communication and need to be downloaded manually by observers at each site. Sites that do not have cellular communication should be downloaded on a **monthly** basis during regular site visits throughout the growing season.

BCO, CCO and BCT utilize an ISCO 2105 interface module as the datalogger. This module collects and stores data collected by the ISCO 2150 area velocity probe. Since these sites do not have cellular communication, they must be downloaded on a regular basis to ensure proper working function and accurate data are being collected. The steps below provide a method for how to download the data.

1. Remove black cap on top of the ISCO 2105 by pulling straight up.
2. Connect the proper ISCO connect cable to the computer, using either the RS232 port or the USB port (dependent on which end is on the cable). Line up the large prong on the end that connects to the ISCO 2105. Push the cable down until you hear a "click."
3. Open Flowlink, make sure "Direct" is selected next to "Type" and click on the icon under "2100 Instruments"
4. Once the user is connected, press the "**Retrieve data**" button or hit "F8" on your computer and the data will download onto the user's computer.
5. **IMPORTANT!** Select "**Disconnect**" or hit the "F7" button on your computer and the computer will disconnect from the 2105 module.
6. Disconnect the cable from the top of the 2105 module and replace the black cap.

2.2 CHANGING VARIABLES IN THE DATALOGGER

Section 2.2 contains several processes that describe how to change different variables in the datalogger to ensure proper site management. All processes listed in Section 2.2 can also be found in Appendices C, D, and E.

2.2.1 CALIBRATION OF STAGE AND RESETTING CUMULATIVE FLOW

As previously mentioned, frequent site visits are important to ensure that the equipment is providing accurate data measurements. Measured Stage (MS) readings collected during site visits are crucial for correcting raw data from the level measurement device (via the datalogger). It is possible for a stage sensor to "drift" over time. Drift essentially means that the stage output has slowly *drifted* from the true value and is reading slightly incorrect. The datalogger is set to calculate flow based on provided equations for the flume and Agri Drain as well as rating equations provided by DNR at the outlet sites. These equations are heavily reliant on an accurate stage reading to calculate areas. It is very important to ensure that the stage readings are as accurate as possible.

As a general rule of thumb, if the difference between the MS and the current stage on the datalogger is greater than **0.02 feet**, the datalogger stage should be reset to what the current MS is currently reading. Prior to resetting any equipment, please verify that your MS value is accurate by taking one or more follow-up measurements. ***Always include notes in the site inspection document if the datalogger stage has been altered.***

If the equipment is showing drift repeatedly after being corrected during previous site visits, there may be another overlying issue. Please contact MDA staff to discuss these issues

2.2.1.1 CHANGING THE DATALOGGER STAGE / STAGE ADJUSTMENT (Outlet EFI and EOF sites)

1. Determine the difference between the MS and level instrument stage found on the datalogger. The difference in stage is the **correction value**.
    a. Outlet EFI: (MS-SFSTG) = correction value
    b. EOF EFI: (MS-Head_OTT) = correction value
        i. If APG is set to the default stage: (MS-Head_APG) = correction value
2. From the home screen of the datalogger select "**Processes**"
3. The variable for correction differs at the EOF and outlet sites. Choose the correct variable depending on the site and the sensor.
    a. At an EOF site select either **APGcorr** (for the APG ultrasonic Transducer) or **OTTcorr** (for the Ott bubbler)
    b. At an outlet site, select "**STGADJ**"
        i. Since there is an additional APG at the SR3 EFI sampler, there is also a **APGcorr** variable to adjust the stage that the APG is reading.
4. Press the "**Set**" button
5. Enter the new offset value
    a. If there is already an offset in place (other than 0.00), the new difference will need to be added or subtracted from the existing offset
6. Press the green check mark to accept
7. Press the green check mark when asked to set as a default power up value
8. Under current conditions, verify that the Head_APG, Head_OTT, SFSTG, or STG_APG (at SR3) are now reading correctly after a few minutes.

2.2.1.2 CHANGING THE DATALOGGER STAGE / STAGE ADJUSTMENT (BCO ETI, CCO ETI and BCT)

1. Determine the difference between the MS and level instrument stage displaying in Flowlink. Record the difference in the field notes. A correction value does not need to be determined for these sites because the desired stage value can simply be entered into Flowlink.
2. After connecting to the 2105 Interface module via Flowlink, select the "**Measurements**" tab.
3. Find "**Level**," hover over it and left click on "**Level**"

4. In the "**Adjust Level**" box, enter the current water level. Flowlink will adjust the level accordingly.
5. Select "**Apply**" on the bottom bar.
6. Go back to the "**Measurements tab**" and ensure that the level is reading accurately.
7. Always note on the field sheet when stage adjustments are made.

2.2.1.3 CHANGING THE DATALOGGER STAGE FOR SUBSURFACE TILE (SRT and SR3 ETI)

1. Determine the difference between the MS and instrument stage for the pressure transducer (SRT inlet stage= SRT_IStg; SRT outlet stage=SRT_OStg; SR3 ETI stage= Stage). If the difference is greater than +/- 0.02 feet, follow the steps below.
2. From the home screen of the Campbell Scientific datalogger, press "Enter" once.
3. Use arrows to move to "Configure, Settings". Press "Enter".
4. Use arrows to move to "Public table". Press "Enter".
5. Use arrows to move to the proper variable listed below and press "Enter"
    a. SRT inlet: Tapedown_in
    b. SRT outlet: Tapedown_out
    c. SR3 ETI: Staff_Gage_Obs"
6. Enter the current observed tapedown water level (SRT) or staff gage reading (SR3 ETI) and press "Enter". The offset will automatically be changed to reflect the actual stage.
7. Double check that the water level / stage is reading correctly prior to leaving site.
8. Press "Esc" to get back to the home screen.

For more details regarding changing variables at the subsurface tile site (SRT), see Appendix D, or at the SR3 ETI site, see Appendix E.

2.2.2 CHANGE ACTIVATION STAGE

The activation stage is the water level at which flow will begin to calculate.

2.2.2.1 EOF SITES

For RRFSP, we are using an activation stage of 0.04 feet. **This should not be altered unless directed by the appropriate MDA staff**.

1. Select "**Processes**" from the main screen on the datalogger.
2. Select "**Fstg_min**"
3. Select "**Set**"
4. Enter the new activation stage value
5. Select the green check mark to accept
6. Click the green check mark when asked to set as a Default Power Up value

2.2.2.2 EFI OUTLET SITES

Activation stages at the RRFSP outlet sites vary based on site and potentially throughout the season based on current hydrologic condition.

1. Select "**Processes**" from the main screen on the datalogger.
2. Select "**Stg_min**"
3. Select "**Set**"
4. Enter the new activation stage value
5. Select the green check mark to accept
6. Click the green check mark when asked to set as a Default Power Up value

2.2.2.3 ETI OUTLET SITES

At SR3 and CCO, the ETI activation stage should always be at the same stage as the EFI activation stage (Stg_min). If the EFI activation stage changes, so should the ETI activation stage. At BCO, the activation stage will be slightly different in order to account for the differences in elevation of the stage monitoring equipment for the EFI and ETI samplers. Activation stage at BCO should be set at 0.05 feet above the current stage **in the culvert** (not what the staff gage is reading downstream of the culvert).

1. Connect to the 2105 Interface module via Flowlink and select the "**Measurements**" tab.
2. Hover over and select "**Sampler**"
3. Click on "**Set Equation**"
4. Highlight "**Condition A. xxxxx**" and select "**Edit Condition**"
5. In the far right box, enter the new activation stage value
6. Select "OK" on the Condition Builder box and "OK" again on the Equation Builder Box

2.2.2.4 SUBSURFACE TILE SITE (SRT)

1. Activation stage for SRT will typically be set to zero. If changes need to be made, MDA staff will remotely make this change.

2.2.3 RESETTING OR ZEROING THE CUMULATIVE VOLUME

CumVolume: This value is the total cumulative water volume that has passed through the monitoring site and begins to calculate once the activation stage is achieved. This value is used to trigger the sampler once the site specific volume threshold (F_trig) has been achieved.

2.2.3.1 EOF sites

After a runoff event at an EOF site, the cumulative volume needs to be reset to 10 cubic feet below the current volume threshold (F_trig). This process needs to be completed to ensure a pulse of water is collected by the autosampler shortly after flow begins. This is done to ensure that water is collected even during small, short duration runoff events.

1. Select "**Processes**" from the main screen on the datalogger.

2. Select "**CumVolume**"
3. Select "**Set**"
4. Using the touchscreen,
    a. Clear the numbers that are currently listed (using the backspace)
    b. Enter 10 cubic feet below the current F_trig value (reference Table 8 for current F_trig values).
5. Select the green check mark to accept
6. Click the green check mark when asked to set as a Default Power Up value

Table 8. RRFSP EOF monitoring sites activation stage, volume threshold to trigger a pulse and associated ISCO autosampler programming.

Station	Activation Stage* (Fstg_min)	Volume Threshold (F_trig)	ISCO Programming
SRT (tile)	0.0 feet (Sampling occurs anytime stage > 0.0 feet)	2,500 ft^3 (range: 1,000-2,500)	**One-part program** • 24 pulses/bottle | 125 mL each • All bottles can be mixed together if needed
SRF	0.03 feet	950 ft^3	**Two-part program** • Bottles 1: A (3 pulses | 1,100 mL each) • Bottles 2-4: B (24 pulses/bottle | 125 mL each) o Bottles 1 and 2 CANNOT be mixed together
CFW	0.04 feet	665 ft^3	**Two-part program** • Bottles 1: A (3 pulses | 1,100 mL each) • Bottles 2-4: B (24 pulses/bottle | 125 mL each) o Bottles 1 and 2 CANNOT be mixed together
CFE	0.04 feet	3,485 ft^3	**Two-part program** • Bottles 1: A (3 pulses | 1,100 mL each) • Bottles 2-4: B (24 pulses/bottle | 125 mL each) o Bottles 1 and 2 CANNOT be mixed together
BCE	0.04 feet	775 ft^3	**Two-part program** • Bottles 1: A (3 pulses | 1,100 mL each) • Bottles 2-4: B (24 pulses/bottle | 125 mL each) o Bottles 1 and 2 CANNOT be mixed together

2.2.3.2 Outlet EFI sites

1. Select "**Processes**" from the main screen on the datalogger.
2. At an Outlet site, Select "**TFLOW**"
    a. IMPORTANT: Make sure to select the variable with all caps (NOT tflow)
3. Select "**Zero**"
4. Select the green check mark to accept
5. Click the green check mark when asked to set as a Default Power Up value

2.2.3.3 Subsurface Tile (SRT only)

The activation stage at SRT is currently set at zero. That means the volume is always accumulating while there is flow though the v-notch stop log in the AgriDrain. As the system is currently set-up, the cumulative volume will only need to be reset after flow has stopped.

1. From the home screen of the Campbell Scientific datalogger, press "Enter" once.
2. Use arrows to move to "Configure, Settings". Press "Enter".
3. Use arrows to move to "Public table". Press "Enter".
4. Use the arrows to select "**SRT_CFLO**" and press "Enter"
5. Use the keypad to enter "0" (zero) and press "Enter"

2.2.4 CHANGE THE VOLUME THRESHOLD TRIGGER (EOF and outlet sites)

F_trig: This value is the water volume threshold at which the sampler will trigger. As an example, if the threshold was set to 300 cubic feet, the **CumVolume** (EOF sites) or **TFLOW** (outlet sites) would accumulate up to 300 cubic feet and then trigger a pulse of water to be collected into the bottle. Once done, the CumVolume/TFLOW will reset and begin to cumulate up to 300 cubic feet again from zero. Once the threshold is hit again, the sampler will trigger another pulse, etc. This continues until the bottles are full, or stage falls below the activation stage.

1. Select "**Processes**" from the main screen on the datalogger.
2. Select "**F_trig**"
3. Select "**Set**"
4. Enter the new volume threshold value
5. Select the green check mark to accept
6. Click the green check mark when asked to set as a Default Power Up value

2.2.5 RESET PULSE COUNT (EOF and outlet sites)

The **Fisco_cnt** (EOF sites) or **ISCO_cnt** (outlet sites) is the process that counts up the number of pulses that have been collected. It is helpful to reset this number back to zero after each runoff event so that project personnel know the number of times the sampler pulsed during the next event.

1. Select "**Processes**" from the main screen on the datalogger.
2. Variable at EOF and outlet sites are slightly different
    a. At an EOF site, Select "**Fisco_cnt**"
    b. At SRT, Select "**SRT_SamN**"
    c. At an Outlet site, Select "**ISCO_cnt**"
3. Select "**Zero**"

2.2.6 CHANGE BETWEEN THE BUBBLER AND APG (EOF sites and SR3 only)

As a default, the datalogger should be set to the OTT bubbler (EOF sites) or the CS450 pressure transducer (at SR3) because it is a more reliable and accurate instrument. If the OTT or CS450 were to experience issues, the user has the ability to switch the datalogger to the APG ultrasonic. The CumVolume will then be calculated based off the stage data from the APG versus the OTT or CS450.

1. Select "**Processes**" from the main screen on the datalogger.
2. Flow select:
    a. At EOF sites, select "**Fflow_sel**"
    b. AT SR3, select "**Flow_sel**"
3. Select "**Set**"
4. Enter **0** for OTT/CS450 or **1** for APG
5. Select the green check mark to accept
6. Click the green check mark when asked to set as a Default Power Up value

2.3 BOTTLE CLEANING

Bottle washing is a necessary step to eliminate sampling bias, reduce sample variability and to produce comparable data. Properly cleaned and sanitized bottles should be used after every runoff event or when the integrity of the bottles is in question.

Supplies needed:

- Non-phosphate detergent (*e.g.*, 7X, liquinox)
- De-ionized (DI) or distilled water
- Cleaning brushes
- Cleaning basin (plastic or stainless steel)
- Nitrile gloves

Bottles and Lids

1. Mix detergent according to label in a large basin with warm tap water.
2. Place bottles in basin and allow the solution to soak.
3. Use a bottle brush to mechanically remove any particles attached to the bottle.
4. Rinse at least three times with hot tap water, followed by triple rinsing with de-ionized or distilled water.
5. Allow bottles to air dry while inverted.
6. Once dry, visually inspect the bottles for spots indicating insufficient washing. If necessary, repeat cleaning process.
7. Cap bottle with a clean lid.

2.4 WINTER MAINTENANCE

Winter runoff in Minnesota is infrequent, but it is imperative to keep a keen eye on the weather conditions throughout the winter months and especially prior to anticipated snowmelt runoff. Generally, during winter months it will take a few consecutive days of above-freezing temperatures to generate any runoff. If these conditions are foreseen, it should be a top priority to get out and prepare the site for potential runoff.

Flumes will drift and fill in with snow over the winter. It is also very possible for ice to accumulate and freeze on the bottom of the flume. Ice buildup blocks the sampler and bubbler lines causing them to freeze and read erroneously high, potentially causing the automated sampler to falsely trigger. Prior to *any* winter runoff events, the flume will need to be cleared of snow and ice (Figure 15).

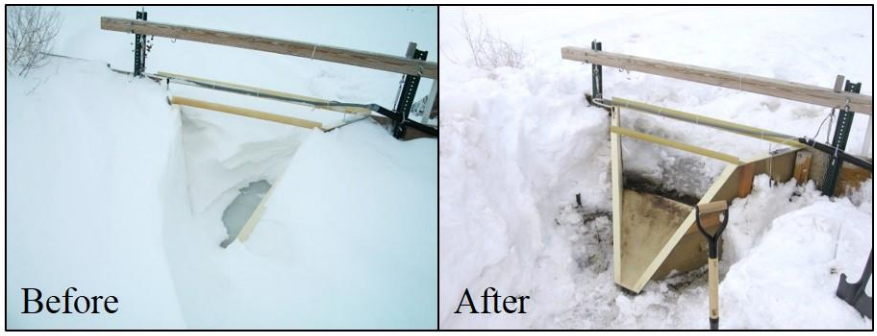

Figure 15. Flume before and after winter snow and ice removal.

Flumes are not constructed to withstand significant weight. Take care and do not stand inside of the flume if possible as this could also lead to the flume cracking or causing it to become out of level. Snow removal is fairly easy and can be done with a shovel. Ice removal works best with manual labor and slowly chipping away at the buildup using hand tools (such as a rock hammer, regular hammer or chisel). Again, the fiberglass flume is *very* delicate. **Please be very careful when chipping ice in the flume.**

Propane heaters (paired with a canvas tarp) may also be used in cases with significant ice accumulation. A consistent heat source can prove useful to create small flowing channels of water on top of the ice. The water can help lubricate and aid in the ice removal, though extreme care must be taken with the heat sources around the fiberglass. Please refer any questions about winter maintenance to MDA staff.

In addition to snow and ice removal within the flume, snow will also need to be removed upstream and downstream from the flume. An adequate channel (generally 20-30 feet, or longer) needs to be cleared downstream from the flume to eliminate the probability for backwater (Figure 16). The hand dredged channel length and width will vary and be site specific depending on the slope away from the flume and potential for backwater. Backwater conditions need to be avoided as they will cause

the stage to read inaccurately high. This also slows the water velocity considerably making flow calculations incorrect.

On the upstream side of the flume, snow must be cleared out of at least a three to five foot cone (Figure 17). This prevents melt water from cascading over the snowpack and into the flume creating turbulent conditions. The cleared area allows for water velocities to stabilize, and creates laminar flow. Often times, the snowpack upstream from the flume may be a layered mix of compacted snow and ice. A large chisel and/or mattock and scoop shovel work the best for clearing this area.

Figure 16. Snow removal in the channel downstream from flumes to eliminate backwater conditions during snowmelt runoff.

Figure 17. Snow removal upstream from the flume to eliminate turbulent conditions. A three to five foot cone should be dug out prior to anticipated snowmelt runoff.

2.5 FLUME CLEANING

After a runoff event, sediment and debris will likely remain on the floor of the flume (Figure 18). This residual sediment must be properly cleaned to prevent clogging or contamination of sample water during the *next* runoff event. Small handheld squeegees (with a small amount of DI water) can be used to pull the water and debris out of the flume. Repeat as necessary. If the sediment is

very dry, water may not be needed. A bubbler and sampler line purge should be completed following cleaning of the flume.

Figure 18. Flume after runoff (left), and after cleaning (right).

2.6 RAIN GAGE MAINTENANCE

During each field visit, the rain gage should be closely inspected to make sure that debris has not clogged the water intake. The rain gages have screens installed in the top of the rain gage to prevent clogging and needles and/or nails are around the crown of the water intake to keep birds from perching on the rain gages. If debris is present, it should be immediately cleared out and noted on the site inspection document. In addition, if there was rain the day before, make sure the datalogger recorded a value (**Rain24** at EOF sites, and **Rain** at outlet sites). This value is only updated at midnight every day, so only the rain before midnight of the current day would be displayed.

Rain gage levelness should also be checked on a frequent basis by using a level. Automatic tipping bucket rain gages are calibrated while level and if the gage is not level, measurement may be erroneous. In addition, all rain gages are removed every two years in the fall and sent to the Minnesota Department of Natural Resources for calibration.

2.7 VEGETATION MAINTENANCE

During the growing season, vegetation or debris immediately upstream and downstream from the flume could interfere with runoff leaving the monitoring station, and could cause turbulent flow or backwater (submergence) issues. It is necessary to maintain vegetation around the monitoring station (Figure 19). In addition, ensure to remove vegetation that is currently or may obstruct the view of the flume (and runoff) from the on-site camera(s).

Vegetation or debris that has built up within the small watershed outlet channel must also be cleared from areas around the submersible pressure transducers, area velocity meters and turbidity meters so that they do not interfere with stage, velocity, or turbidity readings.

Figure 19. Looking downstream (left) towards a flume dominated by thick ragweed. On the right, is the same site (looking upstream) after vegetation removal.

2.8 PUMP TUBING REPLACEMENT

New silicone sampler tubing will be installed annually or on an as-needed basis in consultation with MDA staff. Only sampler tubing made specifically for ISCO 6712 autosamplers will be used. Tubing must be inspected frequently to check for cracks or significant wear. It is important to replace tubing *before* it fails because debris could be pushed into the pump shaft seal degrading it over time or samples could be missed due to inadequate pressure to collect a sample. Equipment blanks (see Section 4.2) will assess contamination problems from sample tubing. Refer to ISCO's 6712 Portable Samplers Installation and Operation Guide for specific directions on pump tubing replacement (http://www.isco.com/pcfiles/PartPDF/SL000005/UP001ART.pdf).

IMPORTANT: When replacing the pump tubing, ensure that the correct end of the pump tubing connected to the sample line and the correct end is connected to the carousel (Figure 19). Reversing these will cause the sampler to not collect samples.

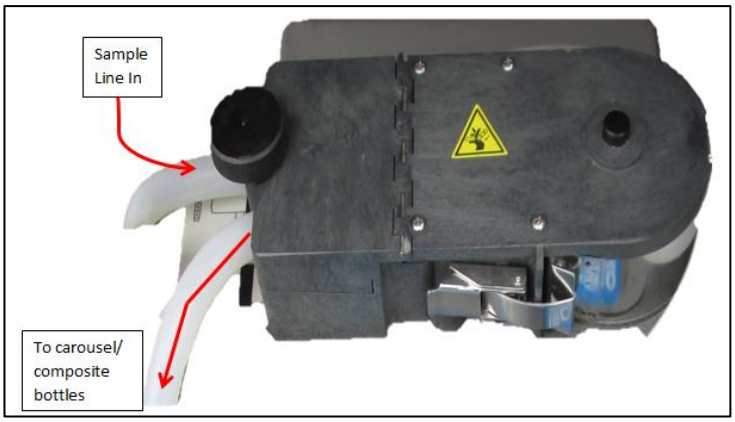

Figure 19. Correct orientation of pump tubing to the sample line and the carousel.

2.9 DESICCANT

Desiccant is used to maintain dryness in a sealed container for equipment that is sensitive to moisture. Because moisture can damage expensive equipment, it is necessary to check the desiccant during each site visit to make sure that it is not compromised. Desiccant that needs replacing will typically change colors from the original state.

Submersible pressure transducers (SR3, CCO and BCO) will either have an attached desiccant tube or desiccant box (Figure 20). ISCO 2100 series equipment (used for pesticide sampling at BCO and CCO) will have a desiccant tube that can be unscrewed from the blue housing (Figure 21).

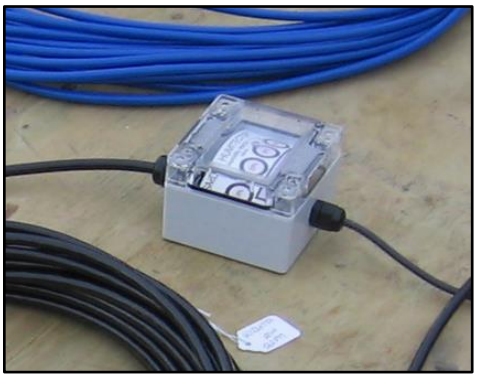

Figure 20. Desiccant box on FTS submersible pressure transducers. A blue color on the humidity indicator card is good; pink indicates the desiccant needs to be replaced.

Figure 21. Desiccant tubes on ISCO 2100 series equipment. Orange or blue/purple color is good; pink or green indicates the need to replace.

A humidity indicator is located on the ISCO 6712 auto sampler face (Figure 22). Blue color in all three pies indicates that the sampler control box is dry and clear of excess moisture. If moisture does build up within the sealed control box, the indicator will begin to turn pink (or white) beginning with the "20" pie. This means that the relative humidity inside of the box is at 20%. The 30 and 40 pies will turn pink next indicating 30 and 40% relative humidity, respectively. Once the 30 turns pink, the desiccant should be replaced by opening the controller case and replacing the desiccant bag (within the desiccant box) provided by MDA RRFSP staff (Figure 23).

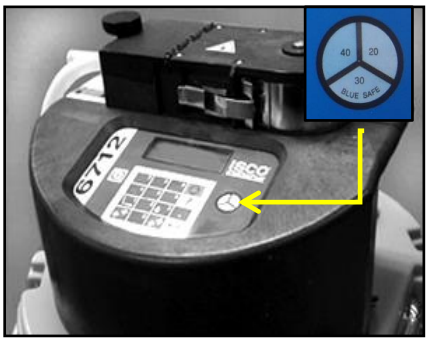

Figure 22. Location of the humidity indicator card on the ISCO 6712 automated sampler.

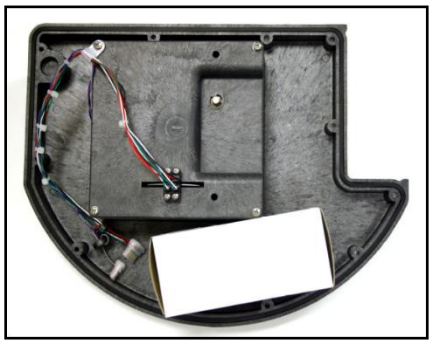

Figure 23. Location of desiccant box under the ISCO 6712 sampler head.

2.10 SURVEYS

2.10.1 FLUME LEVELNESS

Determining the levelness of the flume is critical to acquiring accurate stage measurements. Flumes must be level from front to back and side to side, however, this can be difficult to maintain with the freeze-thaw cycles of Minnesota winters. The Wisconsin Discovery Farms program has found that a tilt of just 0.02 feet from front to back can cause discharge measurements to be underestimated by 10 percent. Flume levelness will need to be determined from front to back and side to side.

Flumes should be checked frequently for levelness using a level (Figure 24). Additionally, every three months, and following large run-off events, an elevation survey should be conducted using laser level survey equipment or VRS GPS equipment to check for flume levelness following the SOP for RRFSP elevation surveys. Figure 25 describes the measurement points needed to be collected during a flume survey. These measurements collected should be recorded on an elevation survey field datasheet. An example of a survey field datasheet can be found in Appendix B.

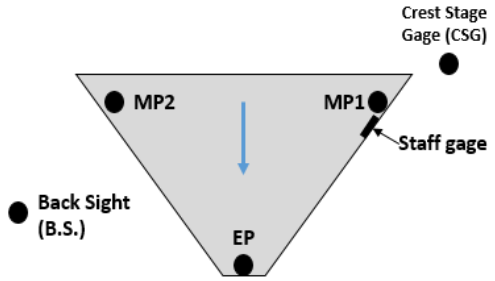

Figure 24. Measurements necessary during a flume survey.

Measurements

- Back sight prior to measurements (BS1)
- Measurement point 1 (MP1) – near staff gage
- Measurement point 2 (MP2) – opposite staff gage
- Exit point of flume (EP)
- Crest stage gage (CSG)
- Back sight after measurements (BS2)

On an as needed basis, an attempt will be made to level un-level flumes as best as possible by tightening or loosening turn buckles attached to the wingwall and 4x4s supporting the flume. The time period for data collected with an un-level flume will be corrected using an equation developed by the Wisconsin United States Geological Survey to adjust for flume tilt. Contact MDA personnel with any questions regarding flume levelness. Additional information on conducting an elevation flume survey can be found in the SOP for RRFSP elevation surveys (available upon request from MDA personnel).

2.10.2 WINGWALL SURVEY

Acquiring the elevation of the top of the wingwall is important so that estimates can be made of the volume of water that did not go through the flume during overtopping events and to ensure the wingwalls themselves do not move. The wingwalls for this project at EOF sites are made of plywood, sunk into the ground and supported in the back with heavy duty D-posts and thus can shift due to freeze thaw cycles and large rain events that overtop the wingwalls. Wingwall surveys should follow the procedures outlined in the standard operating procedures for RRFSP elevation surveys (available upon request from MDA personnel). Measurements and notes collected during the survey should be recorded on an elevation survey field datasheet. An example of a survey field datasheet (elevation survey log) can be found in Appendix B.

2.10.3 SEDIMENT DEPOSITION AND BULK DENSITY SURVEYS

Sediment deposition may occur upstream of the wing wall due to water ponding during large run-off events. In order to account for the sediment that has been deposited, overland surveys of the area upstream of the flume should be completed twice a year to determine the amount of sediment that is deposited. Overland surveys for sediment deposition should follow the procedures outlined in the SOP for RRFSP elevation surveys (available upon request from MDA personnel). Measurements and notes collected during the survey should be recorded on an elevation survey field datasheet. An example of a survey field datasheet can be found in Appendix B.

In conjunction with sediment deposition surveys, bulk density measurements must be taken in order to calculate a mass (ton) of sediment. The compliant cavity method should be utilized to estimate bulk density of alluvial sediment deposition. See Appendix F for further information.

2.11 FIELD CAMERAS

One stationary field camera is installed at each outlet site and two are installed at the EOF sites (Figure 26). Field cameras are time-lapse cameras and are housed in weatherproof enclosures. At all sites, one camera is set to collect a photo every three hours during the daylight period and ideally positioned to collect photos with a view of the upstream field and flume or downstream channel at watershed outlet sites. At the EOF sites, one camera is set to collect a photo every 30 minutes 24 hours a day and is positioned to take a photo of the staff gage. These photos assist in ensuring the stage being read by the sensors is accurate. During each field visit, make sure that the viewing glass on both camera enclosures is cleaned of dust, dirt and water droplets that may interfere with the clarity of the photos.

The cameras are equipped with a 12V solar power panel and six C batteries (new models take AA batteries). The solar panel has a digital display which provides the internal charge of the battery. If the charge value drops below "90", notify MDA field staff, as repositioning of the solar panel may be necessary. AA or C batteries should be replaced once per year.

When not in use, the camera is in standby mode; the screen will be clear. If the "OK" button is quickly depressed, the camera status will be displayed for 10 seconds (Figure 27). Frequently check camera status to assure adequate storage volume remains on camera and that the battery charge indicator is above 90%. The cameras are mounted on a support that is static. Although these supports should not move, check to make sure the cameras are still pointing in the target direction and the supports are secure.

Figure 25. Time-lapse field camera.

Figure 26. Time-lapse camera status display. "TL countdown" indicates the time to next photo collection. "Battery" indicates the amount of battery life remaining. "Estimated days" indicates the number of days that photos will be collected with the space on the SD card and battery life. "0629/4084" shows the number of photos taken (629) out of the number of photos that will fit on the SD card (4084).

On site, photos are stored on an 8 gigabyte memory card. RRFSP project partners will be responsible for downloading and organizing site photos transferring these data to MDA personnel. Camera SD cards should be removed and downloaded every one to two months. Cameras must be powered off when removing the SD card out. Remember to power the camera back on after inserting a new SD card.

2.12 PARKING AT SRF AND SRT

Upon arriving at site SRT/SRF, vehicles should be parked at least 50 feet away from the windmill and **NOT** in front of the windmill door. Upon rare occurrence at other locations, the heavy metal doors have blown off of the windmill structure and can potentially cause bodily harm or damage. Parking in the recommended areas reduces the chance that a person or equipment would be injured if the door ever blew off. Additionally, when visiting SRT / SRF it is recommended to wear a hardhat. This safety precaution is in place to protect the field personnel from debris that may eject off of the windmill located near the site. If you are unsure where to park, immediately contact MDA project personnel. Contacts can be found in Appendix A.

2.13 SYNC'ING CLOCKS

It is important that the datalogger, autosampler(s) and camera date/times are all sync'd so that sample start/stop time and time-lapse camera pictures match up with the stage value from the datalogger. Syncing the time to your cell phone is the most consistent method. If you do not have a cell phone, sync all time values to the datalogger. Stage values can fluctuate greatly even over a one minute period during large runoff events. It has become apparent that especially for the time-lapse cameras, the time can begin to lag over time. As a general rule, the time on all instruments should be checked

at least once per month and should be set to military, Central Standard Time (CST). Make sure to note on the field sheet form how many minutes fast or slow each instrument was (see below for an example):

Example (include in the "Maintenance Completed" section of your field sheet)**:**

- Cell phone = 15:15, datalogger = 15:17. Datalogger was 2 minutes fast, reset time to 15:15.
- Cell phone = 15:18, tile ISCO sampler = 15:18. Times are sync'd, no changes needed.
- Cell phone = 15:20, flume ISCO sampler = 15:15. Flume sampler is 5 minutes slow, changed time to 15:20.
- Cell phone = 15:23, flume timelapse camera = 15:17. Camera is 6 minutes slow, changed to 15:23.
- Cell phone = 15:25, field timelapse camera = 15:24. Camera is 1 minute slow, changed to 15:25.

Instruments:

- FTS H2 Axiom Datalogger
- ISCO 6712 Autosampler
- BirdCam Pro timelapse camera ("field" and "flume")

2.13.1 FTS H2 Axiom Datalogger

1. From the home screen on the datalogger, select "**Service**" → "**Set Date/Time**" (Figure 28 and Figure 29).
2. Enter the date, time and time zone values. You can click on the hh or mm time values with the stylus pen to highlight them. Then, click the left and right arrows to increase or decrease values (Figure 30).
3. Select the green check mark (OK) to accept the changes when finished, or click on the red X to cancel.

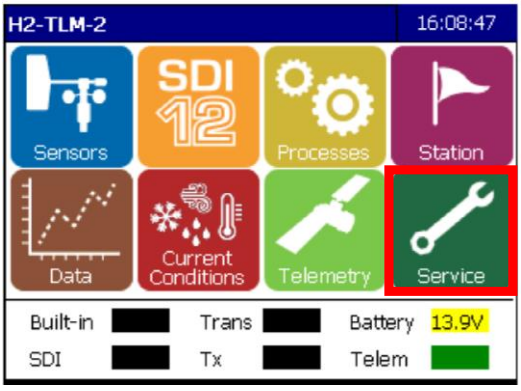

Figure 27. Forest Technology Systems H2 datalogger "Home" screen.

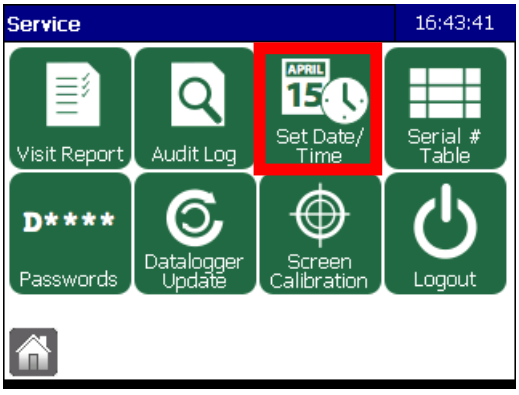

Figure 28. H2 datalogger "Service" screen.

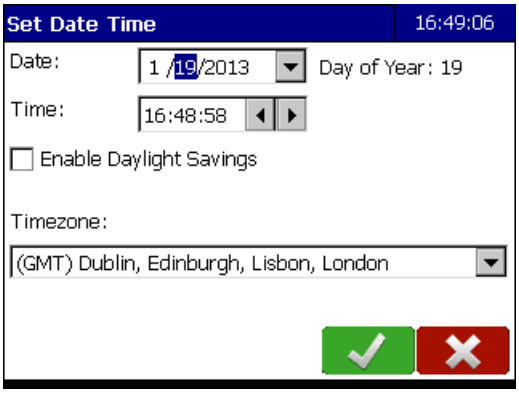

Figure 29. H2 datalogger "Set Date/Time" screen.

2.13.2 ISCO 6712 Autosampler

1. From the sampler screen main menu, follow the directions below (OTHER FUNCTIONS → MAINTENANCE → SET CLOCK). Note: You may need to "stop" the program first.
2. **DO NOT forget to <u>restart/resume</u> the program after the clock has been set.**

Table 8-1 Setting the Clock and Calendar

1	RUN PROGRAM VIEW REPORT **OTHER FUNCTIONS**	Select OTHER FUNCTIONS.
2	**MAINTENANCE** MANUAL FUNCTIONS PROGRAMMING STYLE	Select MAINTENANCE.
3	**SET CLOCK** PUMP TUBE ALARM INTERNAL BATTERY DIAGNOSTICS	Select SET CLOCK.
4	ENTER TIME AND DATE: HH:MM DD-MON-YY **14:00 22-JAN-01**	Enter the time and date.
5	SET CLOCK PUMP TUBE ALARM INTERNAL BATTERY DIAGNOSTICS	Press STOP to return to the main menu.

Figure 30. Directions from the ISCO 6712 Autosampler on resetting the sampler clock and calendar date.

2.13.3 TimeLapseCam Pro

1. Turn the small switch from "**ON**" to "**SETUP/PLAYBACK**" (middle option)
2. Press the right arrow button (OPTIONS >)
    a. The first option will be the "DATE & TIME"
    b. You may need to scroll through multiple options if this isn't the first option
3. Press the down (-) button to highlight the month. Continue pressing the up (+) or down (-) buttons to increase/decrease the number values. Press the right (>) and left (<) arrows to move to the day, year, hour and minutes (or press "OK").
4. **IMPORTANT:** When the correct date and time have been entered, move the small switch from "**SETUP/PLAYBACK**" back to "**ON**"
    a. The camera will do an automatic 30 second countdown before taking the first picture and resuming the programmed photo-taking interval
    b. May need to press the right arrow button ">" to initiate the time-lapse program.
5. Don't forget to sync the times on BOTH cameras at the EOF sites
6. **NOTE:** Multiple variations of these Wingscapes brand cameras have come out over the years, and each batch seems to be slightly different in appearance and functionality. Use the steps above as a guide only. See Figure 32 and Figure 33 for examples.

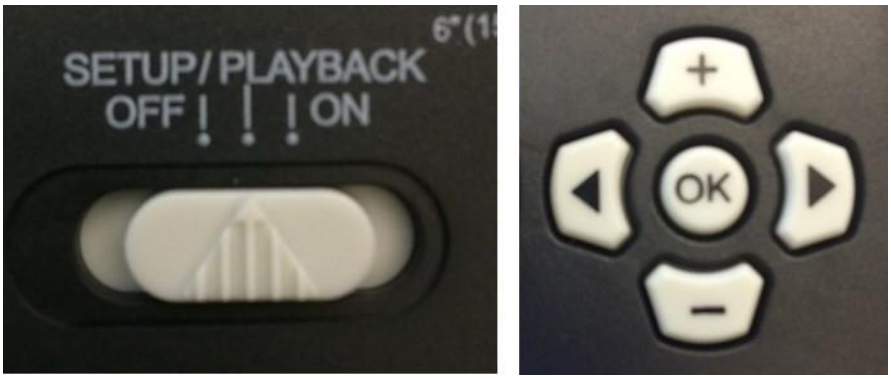

Figure 31. Wingscapes time-lapse camera "on/off" slider (left) and "+/-/>/<" buttons to adjust settings (right).

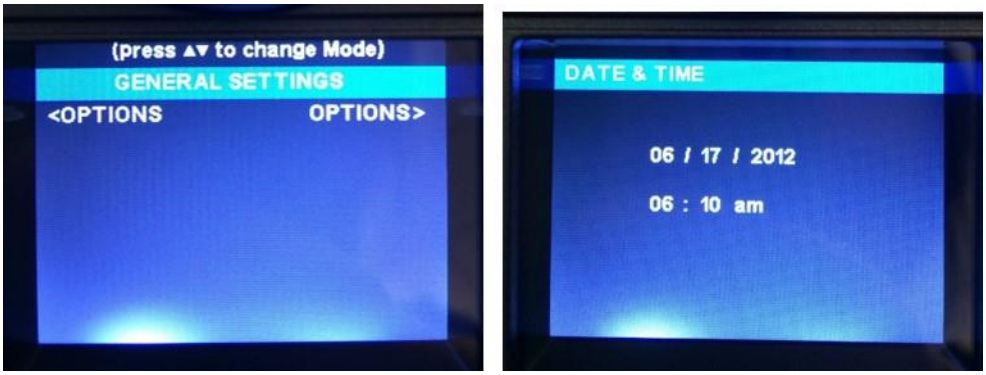

Figure 32. Wingscapes time-lapse camera main "setup" screen (left) and "Date & Time" screen (right).

3.0 SAMPLE PROCESSING AND DATA MANAGEMENT

3.1 LOG-IN FORM, SAMPLE PROCESSING AND SHIPPING

3.1.1 LOG-IN FORM

The sample log-in form is critical documentation for the MDA laboratory. It is *the* paper trail and is required for each round of samples coming into the lab. The log-in contains important information such as the sample location, dates/times, sample IDs, parameters to analyze and contact information. An electronic Excel spreadsheet will be provided by MDA for project partners to fill out and print once completed to be sent to the lab in the cooler with the associated samples. There is one log-in for nutrients and sediment and one log-in for pesticides. Log-ins should be checked several times before shipping to ensure it is accurately and completely filled out. Once the login is completed, the completed Excel file should be saved following the naming convention described below. See Appendix G completed example log-in form.

Nutrient sample log-in: YYYY_MM_DD_*Entity*_login_nutrients
(*e.g.*, 2017_05_23_MDA_Login_nutrients)

Pesticide sample log-in: YYYY_MM_DD_*Entity*_login_pesticides
(*e.g.*, 2017_05_23_MDA_Login_pesticides)

A list of analytes to be analyzed with each sample is included in Table 9 and Appendix H. With the exception of SRT, the same suite of analytes will be analyzed for each sample collected following the guidelines listed in Section 1.3. SRT will utilize a low-level TP method developed by the MDA lab. This provides a more detailed assessment of water that historically have a lower concentration of total phosphorus. A list of pesticide compounds collected as part of the Root River Pesticide Pilot Project can be found in Appendix I.

Table 9. Laboratory analytes, holding times, minimum detection levels, analytical method numbers and uncertainty for the Minnesota Department of Agriculture Laboratory.

Analyte	**Holding Time**	**Minimum Detection Level**	**Method #**	**Uncertainty** (based on 2016 MDA data)
Total Suspended Solids (TSS)	7 days	0.100 mg/L	SM 2540 D	5%
Ammonia-N (NH_3)	28 days	0.020 mg/L	SM 4500 NH3-D	12%
Nitrate+Nitrite (NO_2+NO_3)	28 days	0.40 mg/L	SM 4500 NO3-F	10%
Total Kjeldahl Nitrogen (TKN)	28 days	0.50 mg/L	EPA 351.2	Unknown*
Total Phosphorus (TP)	28 days	0.010 mg/L	EPA 365.1	8%
Total Phosphorus – Low Level (TP)**	28 days	0.005 mg/L	EPA 365.1	--
Dissolved Orthophosphorus (DOP)	48 hours	0.005 mg/L	EPA 365.1	6%
Chloride (Cl-)	28 days	0.50 mg/L	EPA 300.0	11%

* Switched method in early 2017, insufficient data | ** Only analyzed at SRT

3.1.2 SAMPLE PROCESSING

Immediately following sample collection, samples must be placed in ice chests (coolers) containing ice or ice substitutes. While transporting samples, samples should remain cooled to a temperature of 6 degrees Celsius if possible. A general rule of thumb is "the cooler the better."

Prior to shipment of samples to MDA's laboratory, the 250mL phosphorus bottle (TP+DOP) and 500mL nitrogen bottle (NO_2+NO_3, TKN, NH_3) MUST be frozen as a process to preserve sample integrity. Ensure there is enough head room in the 250mL and 500mL bottles to allow for expansion of water during freezing. Do not freeze 1-liter glass amber pesticide samples, 500 mL TSS or 125 mL chloride bottles.

Cooler Packing Tips

These guidelines should be used for all shipments to the MDA Laboratory. Example photographs should be used to guide cooler packing procedures (Table 10).

Supplies

- Cooler (> 3 day ice holding rating)
- Bulk bubble wrap (1/2 inch) for cooler lining
- Bubble wrap bags for all glass amber bottles
- Sealable plastic bags for each sample set
- Temperature blank (empty bottles provided)
- Cooler liner bag
- Zip ties
- Wet ice
- Completed sample log-in form in sealed bag

Table 10. Cooler packing procedures and associated pictures.

Cooler Packing Procedures:	**Example photographs:**
1. Properly chill/refrigerate or freeze samples following standard operating procedures prior to preparing shipment to the MDA Laboratory. Shipping samples at ambient temperatures will quickly melt the ice in the cooler, and may affect the acceptance of samples at the MDA Laboratory.	
2. Line the bottom of the cooler with bulk bubble wrap.	
3. Line the cooler with cooler liner bag.	
4. Prepare samples for shipping: a. Place amber glass bottles into bubble wrap bag and seal it. b. Place amber glass bottles and associated plastic bottles into sealed plastic bag.	
5. Place sealed bags of samples upright inside cooler liner bag. Do not lay samples on their side or double stack. If possible, pack sealed bags limiting direct contact between glass bottles.	
6. Insert the temperature blank into the cooler liner bag. One temperature blank is required in each cooler, and should be collected following standard operating procedures.	
7. Fill the cooler liner with wet ice, ensuring wet ice is in contact with the sides and overtop of the sealed bags of samples. Ice should fill approximately 1/3 to 1/2 of the cooler. (A 28 quart cooler will require at least 8 pounds of ice; a 50 quart cooler will require at least 20 pounds of ice.)	

Cooler Packing Procedures:	**Example photographs:**
8. Twist cooler liner top to close it and use the provided plastic zip tie to close the cooler liner bag.	
9. If there is space between the cooler liner bag and the sides or top of the cooler, add additional bulk bubble wrap between the cooler liner bag and the cooler. Add enough bubble wrap to prevent any movement of the cooler liner bag inside the cooler during shipping.	
10. Place sample log-in form in a sealed plastic bag and tape it to the bottom of the cooler lid.	
11. Seal the cooler with packing tape: a. Tape along cooler where the lid meets the cooler. b. Tape completely around the cooler in two locations preventing the cooler lid from opening. c. Cooler handle should be taped down to avoid handle breakage / dropping during shipping. d. Tape over the delivery address to protect it from falling off or getting wet (shown in step 12 photo).	
12. Keep packed cooler in a climate controlled, well shaded location prior to shipment pick-up by a commercial carrier.	
13. Do not ship on Fridays as the MDA Laboratory does not accept samples on weekends.	
14. The MDA Laboratory will return some materials (large bubble wrap and black plastic bag) and temperature blank bottle with the cooler.	

3.1.3 SAMPLE SHIPPING

Efforts should be made get samples to the laboratory within 48 hours to abide by laboratory holding times. Samples must be shipped on ice with the completed log-in form. The form should be placed in a sealed Ziploc bag and placed on top of the black cooler liner inside the cooler (or taped to the underside lid of the cooler). Lids to the bottles should be double checked to make sure they are properly tightened and lids to the coolers should be secured with packaging tape.

INSTRUCTIONS FOR SHIPPING:

Day 1: **BY 3:00 PM FOR ANY PICK-UP THE NEXT DAY** send email to: Joyce.Walkosz@state.mn.us, Debra.Gennow@state.mn.us and Julie.Schmidt@state.mn.us. Joyce and Deb handle the ordering of shipments while Julie is the person who tracks and actually charges the shipping costs. All three should be included on the email in case one is out of the office. You can also call Joyce (651-201-6155) or Deb (651-201-6153; if Joyce is not available) and they can issue the call pick up tag for you using our MDA Spee Dee account #**2-892**. Be sure you provide the information noted below. Figure 34 provides an example e-mail to Joyce / Deb for requesting a shipment.

1. Your name and address where the package will be picked up from
2. Which building it is going to – MDA Laboratory
3. How many packages?
4. Approximate weight of each package
5. Funding string which should be charged:
   i. Root River Project String is: **2302** | **B0431CR7** | **B041W06**

Joyce and/or Deb:

I would like to place a Spee Dee pick up request (account # 2-892) for tomorrow (***fill in date – mm/dd*).**

- **PICK UP LOCATION**: MDA (Kevin Kuehner), 912 Houston Street NW, Preston, MN 55965
- **SHIP TO LOCATION**: MDA St. Paul Laboratory (601 Robert St. N., St. Paul, MN 55155)
- **NUMBER OF PACKAGES**: 1 cooler
- **WEIGHT OF PACKAGE(s)**: Approx. 60 lbs.
- **FUNDING STRING**: 2302 / B0431CR7 / B041W06

Please acknowledge receipt of this email.

Thanks, *Your Name*

Figure 33. Example e-mail for RRFSP sample shipment request.

Day 1: By 3:00 pm, send a pick-up request to Joyce, Deb and Julie.
Day 2: Project partner packages samples into coolers using the guidelines described in Section 3.1.2; Spee Dee picks up package from you (the sender).
Day 3: Package delivered to MDA Laboratory in St. Paul, Minnesota.

3.2 FIELD DATA SHEETS

Upon returning from the field, field sheets are to be reviewed for accuracy and add any additional notes that may have been forgotten to document on the field sheet while at the site. After field sheets have been reviewed, data on the field sheets must be transferred from the paper document into the Excel file provided by MDA and saved as a backup. The field sheets must be scanned, renamed and sent to MDA personnel in a PDF format. Scanned datasheets are to be renamed using the following standard naming convention:

Site_YYYY_MM_DD_Fieldsheet (*e.g.*, BCO_2017_05_11_Fieldsheet)

If multiple data sheets exist from the same day, use an underscore with a sheet number starting with one (*e.g.,* BCO_2017_07_17_Fieldsheet1 and BCO_2017_07_17_Fieldsheet2)

This standardized naming convention assists MDA personnel with field data sheet organization. The original hard copy datasheets are to be kept by the field staff that made the field visit and the hard copies will be retrieved from MDA personnel at the conclusion of each monitoring season. MDA staff will also periodically request updated versions of the Excel spreadsheets that contain the data recorded on the field data sheets.

3.3 SITE PHOTOGRAPHS

Photographs collected by project personnel or MDA personnel need to be downloaded and renamed after each site visit. Renaming the photos provides MDA personnel with a way to organize and understand what each photograph is being taken of. Photographs collected by field staff are to be renamed using the following standard naming convention.

Site_YYYY_MM_DD_Description of photo

(e.g., BCE_2017_03_12_staff gauge after cleanout, SRF_ 2017_06_12 _stormflow looking downstream, CFE_2017_07_12_ erosion near wingwall, etc.)

Photographs collected by the field and flume time-lapse cameras do not need to be renamed following the nomenclature described above. These photographs should be kept organized by site on a local computer until transferred to the USB hard drive that is used for transferring photos to MDA personnel.

One external USB hard drive (drive) will be used as a master repository for all site visit, field time-lapse and staff gage time-lapse pictures as well as field data sheets associated with the RRFSP. The pictures and field sheets stored on this drive are incredibly important for helping correct data, documenting storm events and farming practices at the EOF sites.

1. Download all site photos and organize accordingly in the appropriate folder on the MDA transfer hard drive. Below is the file structure of the transfer hard drive. The transfer hard drive should be sent to MDA personnel on the last day of even numbered months.
    a. Time-lapse Camera Pictures to be organized= *misc photos that need to get organized. This will get renamed and re-organized. Do not use for now.*
    b. Site
        i. Year
        ii. Personnel Site Photos= *Pictures taken by MDA and SWCDs when visiting the sites.*
        iii. Updated Plant Camera Photos=*Master file location for all plant camera pictures (these photos do not need to be renamed)*
        iv. Updated Staff Gage Camera Photos= *Master file location for all staff gage camera pictures (these photos do not need to be renamed)*
        v. Field data sheets= *Master file location for all scanned field datasheets (field sheets should be renamed following nomenclature described in Section 1.1)*
        vi. Raw Downloaded Data=*Master file location for data that are downloaded by field staff.*

    Files will be uploaded on an external storage device every two months (end of even numbered months) by partners and shipped to Katie Rassmussen via Spee Dee Delivery. Fillmore and Mower SWCD's will be provided with an external storage device to use for maintaining photos and field data sheets. Fillmore and Mower SWCDs will upload and organize files (photos and field data sheets) using the correct naming convention and placing into the correct folder noted by the organizational tree above.

3.4 POST-SAMPLING (or site visit) PROCEDURES

Once samples have been processed and shipped, or a site visit has been completed, a few more steps must be taken to complete the process:

1. Review field sheets for accuracy and any notes that may have been forgotten to write down while at site.
2. If samples are collected, send completed Excel log-in forms to MDA staff. Each log-in form should be renamed using the nomenclature described in Section 3.1
3. Send scanned field sheet to MDA personnel. Make sure to rename the file using the standardized nomenclature for renaming field sheets described in Section 3.2.
4. Download all site photos and organize accordingly on a local computer until uploaded to the in the appropriate folder on the MDA external USB hard drive (see Section 3.3).

5. Organize and save downloaded raw data into the appropriate folder and send to MDA staff.
6. Send a summary email to MDA personnel of tasks completed including:
    a. Maintenance completed, or what is needed, outstanding issues or equipment problems.
    b. Summary of sample collection and how many samples were collected.
    c. General site observations.
    d. Attach field sheets and log-ins, if applicable.

4.0 QUALITY ASSURANCE AND QUALITY CONTROL

4.1 FIELD DUPLICATE / FIELD REPLICATE SAMPLES

Duplicate samples are collected simultaneously with a sample from the same source under identical conditions into separate sample containers. Duplicate samples are collected from a composite sample and must be well-mixed at the time of collection. A duplicate will assess if the autosampler bottles or stream samples are being properly mixed prior to pouring into laboratory bottles. A duplicate is also a quality control measure over the laboratory performance.

Field replicate samples are collected at the same time during a grab sample event. Samples are to be collected directly from the stream. When filling sample bottles, the routine sample and replicate of the same analysis must be filled simultaneously.

i. A separate sample number, typically the following sequential sample number for that station, will be assigned to each duplicate/replicate (*i.e.*, CCO12014 would be the duplicate of CCO12013).
ii. When collecting the duplicate/replicate sample, samples should be filled in an alternating fashion between the routine sample and the field duplicate (filled approximately 25 percent between switching bottles) for each paired analysis.
iii. Duplicates and replicates will be submitted blind to the laboratory. Once collected, a duplicate/replicate sample is treated independently of its counterpart in order to assess laboratory performance through comparison of the results.
iv. The entire suite of nutrient and sediment parameters listed in Table 7 for which a standard sample is analyzed will also be evaluated with field duplicate/replicate samples. In addition, pesticides will also be analyzed for pesticide field duplicates/replicates for the analytes noted in Appendix I.
v. Duplicates/replicates will be preserved, stored, transported and submitted in the same manner as other water samples.
vi. It must be noted in the site inspection document when a field duplicate or replicate sample is collected. The sample IDs for the duplicates/replicate and their respective counterparts will also be written in the document.
vii. The first sample collected for the water year should be run as a duplicate. A duplicate/replicate should be collected every 10^{th} composite sample. As a general guideline, at least **10 percent** of composite samples submitted to the MDA laboratory should be duplicates/replicates and/or equipment blanks.

4.2 EQUIPMENT BLANK

Equipment blanks will be collected to evaluate whether contaminants have been introduced in the samples during the sampling process via the sampler tubing and collection bottles. Deionized (DI) water will be pumped from the sampler intake into the composite sample bottle using the same rinse and purge cycle used for standard runoff-event samples. For pesticide sampling equipment blanks, High Performance Liquid Chromatography (HPLC) grade water must be used. The water is then poured into laboratory bottles for analysis.

i. A separate sample number, typically the following sequential sample number for that station, will be assigned to each equipment blank.
ii. Equipment blanks will be submitted blind to the laboratory.
iii. The entire suite of nutrient and sediment parameters listed in Table 7 for which a standard sample is analyzed will also be evaluated with equipment blank samples. In addition, pesticides will also be analyzed for pesticide equipment blanks for the analytes noted in Appendix I.
iv. Equipment blanks will be preserved, stored, transported and submitted in the same manner as other water samples.
v. The sample ID for the equipment blank will be written in the site inspection document when collected.
vi. As a general guideline, one equipment blank per year will be collected at each sampling setup (watershed outlet, edge-of-field and tile sites). MDA staff will be responsible for the collection of equipment blanks.

4.3 RAIN GAGE CALIBRATION

Rain gage calibration will be conducted once every two years by the Minnesota Department of Natural Resources (MNDNR). Rain gages will be removed by project personnel, collected by MDA personnel and transported to MNDNR in St. Paul who will calibrate the rain gages and note if parts need to be replaced.

4.4 EQUIPMENT ASSESSMENTS / CALIBRATION

Monitoring equipment needs to be checked on a frequent basis to ensure sensors are accurately reading or collecting data at proper intervals. This section describes equipment assessments that should be completed on a routine basis.

4.4.1 ISCO AUTOSAMPLER

When the datalogger sends a signal to the ISCO autosampler to collect a sample, the ISCO autosampler runs through its cycle of purging and collecting a sample of water. The ISCO is programmed by the user to collect a specified volume of water (*i.e.*, one pulse of water) and deposit

the pulse into the collection bucket to collect a single composite sample. The process outlined below describes how to calibrate the volume of water collected with each pulse of water.

i. Items needed: DI water, extra sample bottle, 500 or 1,000 mL graduated cylinder,
ii. Press the  (stop) button on the sampler head to put the sampler into a manual pause.
iii. Disconnect the sampler tubing coming out of the sampler head into the sampling carousel.
iv. If the ISCO is at an outlet site, go to step v. The user will be able to use the water from the stream to calibrate the sampler. If the ISCO is at an EOF site, continue below.
    a. Make sure the sample line is free in the flume.
    b. Place the end of the sample line into an extra sample bottle filled with at least 500 mL of DI water.
v. On the sampler head navigate to: Other Functions > Manual Functions > Calibrate volume
    a. The user will be prompted to enter a sample volume that is desired to be collected. Use the keypad to enter the volume of water in milliliters (use 125 mL).
vi. With the pump tubing coming out of the sampler head in the graduated cylinder, press  (enter). This will tell the sampler to run through its sampling procedure and collect a single pulse.
vii. When the pumping has stopped, the sampler will prompt for the volume delivered. Using the keypad, enter the volume of water that was pumped into the graduated cylinder. The sampler will recalibrate itself based on the amount of water that was received.
viii. Repeat steps v – vii to ensure that the correct volume was pumped into the graduated cylinder. If a different volume was pumped than what was requested by the user (after calibration), notify MDA personnel as this may indicate an issue with the ISCO autosampler.
ix. Reconnect the pump tubing going from the sampler head to the sample collection carousel (bottom portion of the ISCO autosampler).
x. If the sample line was removed from inside the flume, reconnect the sample line in the flume and make sure the sample line is secured close to the bottom of the flume.

Autosamplers should be calibrated at least twice per year, if pump tubing is replaced or if sample lines are replaced.

4.4.2 ULTRASONIC TRANSDUCER (EOF sites only)

The readings from ultrasonic transducers can "drift" overtime. As a way to ensure the sensors are reading accurately, an assessment of the ultrasonic transducer will be conducted on a routine basis. Several flat objects are to be placed below the ultrasonic sensor at various heights to assess the accuracy of the sensor. The process outlined below describes how to assess if the ultrasonic transducer is reading accurately.

i. Items needed: at least five flat objects of varying thickness (*e.g.*, box, ratchet set case, power drill case, bucket, etc.)
ii. Measure the thickness of each flat object (the staff gage can be used to measure these objects)
iii. Use an equipment calibration field sheet while completing this task.
iv. Record that that sensor is reading zero prior to adding objects below the sensor.

v. Place one object at a time under the ultrasonic. Record the actual height (thickness of the object) versus what is being read by the senor (see the datalogger for sensor value).
vi. Repeat this process until there are five points tested (Table 11).
    a. Multiple objects can be stacked upon each other to create a taller object height.
vii. If sensor readings are greater than +/- 0.02 feet of the actual object height, contact MDA RRFSP personnel to help troubleshoot.

Table 11. Example table for assessing ultrasonic transducer accuracy.

Actual object height (ft.)	Total height (ft.)*	Sensor reading (ft.)	Difference (ft.)
0.00	*0.00*	*0.00*	*0.00*
0.25	*0.25*	*0.25*	*0.00*
0.28	*0.53*	*0.52*	*-0.01*
0.47	*1.00*	*1.01*	*0.01*
0.47	*1.47*	*1.50*	*0.00*
0.83	*2.32*	*2.34*	*0.02*

*Cumulative height of objects placed on top of each other.

4.4.3 BUBBLER (EOF sites only)

Assessing the accuracy of the bubbler ensures the sensor is reading properly. In order to assess the bubbler's accuracy, follow the procedure listed below.

i. Items needed: tall bucket or tall clear tube (a t-tube will work well), enough water to fill the bucket/clear tube.
ii. Remove the tape / clips holding the bubbler line to the flume wall and pull the bubbler line away from the flume wall.
    a. Be CAREFUL not to bend, kink or break bubbler tube. If tube does kink or bend, the bubbler tube will need to be replaced.
iii. Put the bubbler line into the bucket/tube and secure it with tape. The bubbler line should be within one quarter of an inch away from the bottom of the bucket / tube.
iv. Record the value being read by the datalogger.
v. Fill the bucket with a small amount of water (approximately 0.25 feet) and record the actual height of water.
vi. Record the value being read by the datalogger
vii. Repeat steps v and vi incrementally at five different water levels. Table 12 provides an example of the data needed for assessing the bubbler accuracy.

Table 12. Example table for assessing bubbler accuracy.

Water height /stage (ft.)	Bubbler reading (ft.)	Difference (ft.)
0.00	*0.00*	*0.00*
0.25	*0.25*	*0.00*
0.73	*0.72*	*-0.01*
1.04	*1.02*	*-0.02*
1.55	*1.55*	*0.00*
2.30	*2.31*	*0.01*

APPENDIX A. PROJECT CONTACT INFORMATION

	STAFF	ADDRESS	CONTACT INFORMATION
MINNESOTA DEPARTMENT OF AGRICULTURE	**1*** **Katie Rassmussen**, Hydrologist	MN Dept. of Agriculture 625 Robert Street North St. Paul, MN 55155	**Office**: 651-201-6331 **Cell**: 218-343-4159 **Email**: katie.rassmussen@state.mn.us
	2 **Matt Ribikawskis**, Hydrologist	MN Dept. of Agriculture 3555 9th Street NW, Suite 350 Rochester, MN 55901	**Office**: 507-206-2884 **Cell**: 708-902-6300 **Email**: matthew.ribikawskis@state.mn.us
	3 **Kevin Kuehner,** Soil Scientist 2	MN Dept. of Agriculture 912 Houston Street NW Preston, MN 55965	**Office**: 507-765-4530 **Cell**: 507-429-0928 **Email**: kevin.kuehner@state.mn.us
	4 **Dave Tollefson**, Hydrologist	MN Dept. of Agriculture 3555 9th Street NW, Suite 350 Rochester, MN 55901	**Office**: 507-206-2882 **Cell**: 507-461-1955 **Email**: david.tollefson@state.mn.us

	STAFF	ADDRESS	CONTACT INFORMATION
FILLMORE COUNTY SWCD	**1*** **Caleb Fischer,** Water Management Coordinator	Fillmore SWCD 900 Washington Street NW Preston, MN 55965	**Office**: 507-765-3878 ext. 3 **Cell**: 507-475-3671 **E**: caleb.fischer@fillmoreswcd.org
	2 **Scott Christenson,** Conservation Technician	Fillmore SWCD 900 Washington Street NW Preston, MN 55965	**Office**: 507-765-3878 ext. 3 **Email:** scott.christenson@fillmoreswcd.org

	STAFF	ADDRESS	CONTACT INFORMATION
MOWER COUNTY SWCD	**1*** **James Fett,** Watershed Technician	Mower SWCD 1408 21st Avenue NW Austin, MN 55912	**Office**: 507-434-2603 **Cell**: 507-521-3388 **Email**: james.fett@mowerswcd.org
	2 **Steve Lawler,** Resource Specialist	Mower SWCD 1408 21st Avenue NW Austin, MN 55912	**Office**: 507-434-2603 **Email**: steve.lawler@mowerswcd.org
	3 **Larry Callahan,** District Technician	Mower SWCD 1408 21st Avenue NW Austin, MN 55912	**Office**: 507-434-2603 **Email**: larry.callahan@mn.nacdnet.net

***** Numbers indicate order to call, by agency or office.

APPENDIX B. SITE INSPECTION FORMS

B.1 Edge-of-Field (flume):

Root River Field to Stream Partnership
Edge-of-Field Site Visit Log

MINNESOTA DEPARTMENT OF AGRICULTURE

SITE NAME	DATE (mm/dd/yy)	TIME (CST)	STAFF

FIELD MEASUREMENTS

FLUME STAFF GAGE Measured Stage (ft)	FLUME T-Tube (cm)	CREST STAGE GAGE HEIGHT	VISIT TYPE	Photos taken	TimeLapse Camera Checked?	TimeLapse Camera SD card downloaded?
		ft	Rain event | Snowmelt Runoff Base flow sampling Site Maintenance/check up	Yes No	Yes No	Yes No

DATALOGGER INFORMATION

TIME (military, CST)	OTT STAGE (Head_OTT)	APG STAGE (Head_APG)	FLOW	BATTERY VOLTAGE
	ft	ft	cfs	volts

CUMULATIVE RAIN	24hr RAINFALL	SOIL TEMPERATURE 8 inches	SOIL TEMPERATURE 24 inches	SOIL MOISTURE 8 inches	SOIL MOISTURE 24 inches	CULMULATIVE FLOW
in	in	degF	degF	%	%	ft³

RESET Flsco_cnt	ISCO_cnt value	RESET CumVolume		Adjustment/Notes:
Yes | No	#	Yes | No	10 ft³ below current E_orig value	

STAGE ACCURACY

DIFFERENCE (FLUME) = [Measured Stage – Datalogger Stage]	IS DIFFERENCE > +/- 0.02 FT	CURRENT OFFSET (QTTcorr / APGcorr)	NEW OFFSET (QTTcorr / APGcorr)	CORRECTED STAGE
	Yes (new offset) No	ft	ft	ft

ISCO 6712 AUTOSAMPLER NOTES

Current Bottle#	Bottle 1: START Date/Time	Bottle 2: START Date/Time	Bottle 3: START Date/Time	Bottle 4: START Date/Time
Pulse#	END Date/Time	END Date/Time	END Date/Time	END Date/Time

QA/QC Sample Collected	QA/QC Sample Label (specify associated bottle #, or grab sample)
DUPLICATE | REPLICATE | EQUIPMENT BLANK | NONE	

Notes:

WEATHER CONDITIONS

Temperature, % cloud cover, wind speed, recent weather conditions (Rain event? Dry?)

CURRENT AGRONOMY CONDITIONS

Crop and field conditions, crop height, snow coverage, moisture conditions

FLUME & CHANNEL OBSERVATIONS

Water appearance (clear, sediment, debris, etc), flow conditions

MAINTENANCE COMPLETION or MAINTENANCE NEEDED NOTES

FLUME LEVELNESS:	FLUME CLEANING:	VEGETATION REMOVAL NEEDED:
Good | Needs to be leveled | Leveled	Good | Cleared of sediment/debris | Will need to be cleaned	Yes | No | Completed
RAIN GAGE:	**SOLAR PANEL:**	**DESICCANT:**
Clear | Plugged | Level	Clean | Cleaned | Needs to be cleaned	New | Good | Bad | Needs to be changed

EDGE – OF – FIELD

B.2 Edge-of-Field (subsurface tile):

Root River Field to Stream Partnership
Tile Edge-of-Field Site Visit Field Log

MINNESOTA DEPARTMENT OF AGRICULTURE

SITE NAME	DATE (mm/dd/yy)	TIME (CST)	STAFF

	AGRI DRAIN TAPEDOWN MEASUREMENT [Measure of distance from RP to water surface]	SUBSURFACE TILE Measured Stage (ft) [4.220 – tapedown]	TILE T-Tube (cm)	VISIT TYPE	Photos taken
FIELD MEASUREMENTS				Rain event | Snowmelt Runoff Base flow sampling Site Maintenance/check up	Yes No

	TIME (military, CST)	STAGE (SRT_lStg)	FLOW (SRT_Flow)	CUMULATIVE FLOW (SRT_CFLO)	RESET CUMULATIVE FLOW?
DATALOGGER INFORMATION		ft	cfs	ft³	Yes | No
	BATTERY VOLTAGE (Batt_Volt)	**OUTLET STAGE** (SRT_OStg)	**CONDUCTIVITY** (Cond)	**SAMPLE NUMBER** (SRT_SamN)	**WATER TEMP** (Temp_C)
	volts	ft	ms/cm		degC
	DOWNLOAD START (date / time)	**DOWNLOAD END** (date / time)	Adjustment/Notes:		

	DIFFERENCE (TILE) = [Tile Measured Stage – Datalogger Stage (SRT_lStg)]	IS DIFFERENCE > +/-0.02 FT	CORRECTED STAGE
STAGE ACCURACY		Yes (change Tapedown_In) No	ft

ISCO 6712 AUTOSAMPLER NOTES	Current Bottle#	Bottle 1:	START Date/Time	Bottle 2:	START Date/Time	Bottle 3:	START Date/Time	Bottle 4:	START Date/Time
	Pulse#		END Date/Time		END Date/Time		END Date/Time		END Date/Time

QA/QC Sample Collected	QA/QC Sample Label (specify associated bottle #, or grab sample)
| FIELD DUPLICATE | EQUIPMENT BLANK | NONE |	

Notes:

WEATHER CONDITIONS	Temperature, % cloud cover, wind speed, recent weather conditions (Rain event? Dry?)
CURRENT AGRONOMY CONDITIONS	Crop and field conditions, crop height
FLUME & CHANNEL OBSERVATIONS	Water appearance (clear, sediment, debris, etc), flow conditions

MAINTENANCE COMPLETION or MAINTENANCE NEEDED NOTES			
	FLUME LEVELNESS: Good | Needs to be leveled | Leveled	**FLUME CLEANING:** Good | Cleared of sediment/debris | Will need to be cleaned	**VEGETATION REMOVAL NEEDED:** Yes | No | Completed
	RAIN GAGE: Clear | Plugged | Level	**SOLAR PANEL:** Clean | Cleaned | Needs to be cleaned	**DESICCANT:** New | Good | Bad | Needs to be changed

B.3 Watershed Outlet:

Root River Field to Stream Partnership
Watershed Outlet Site Visit Log

MINNESOTA DEPARTMENT OF AGRICULTURE

SITE NAME	DATE (mm/dd/yy)	TIME (CST)	STAFF

FIELD MEASUREMENTS

STAFF GAGE (ft)	T-Tube (cm)	VISIT TYPE	CHANNEL CONTROL	Photos taken	TimeLapse Camera Checked?	TimeLapse Camera SD card downloaded?
		Rain event | Snowmelt Runoff Base flow sampling Site Maintenance/check-up	Clear | Light Debris | Mod. Debris | Heavy Debris Light algae/veg | Mod. algae/veg | Heavy algae/veg Shore Ice | Anchor Ice | Ice covered | No Flow Scour control change | Fill control change | Submerged	Yes No	Yes No	Yes No

DATALOGGER INFORMATION

TIME (military, CST)	STAGE (SFSTG)	TURBIDITY	CUMULATIVE RAIN (Rain)	24hr RAINFALL (RAIN24)	
	ft	NTU	in	in	
BATTERY VOLTAGE	**WATER TEMPERATURE**	**CUMULATIVE FLOW (TFLOW)**	**RESET TFLOW?**	**RESET ISCO_cnt?**	**ISCO_cnt value**
volts	degF	ft³	Yes | No	Yes | No	#

Adjustment/Notes:

STAGE ACCURACY

DIFFERENCE (Stage) = [Measured Stage – Datalogger Stage]	IS DIFFERENCE > +/- 0.02 FT	CURRENT OFF SET (STGADJ)	NEW OFF SET (STGADJ)	CORRECTED STAGE (SFSTG)
ft	Yes (new offset) No	ft	ft	ft

ISCO 6712 AUTOSAMPLER NOTES

EFI

Current Bottle#	Bottle 1: START Date/Time	Bottle 2: START Date/Time	Bottle 3: START Date/Time	Bottle 4: START Date/Time	EFI QAQC Sample
Pulse#	END Date/Time	END Date/Time	END Date/Time	END Date/Time	DUPLICATE | REPLICATE EQUIPMENT BLANK | NONE
					EFI QAQC Sample ID

EFI Notes:

ETI

Pulse#	START Date/Time	ETI Problems Notes/Errors:	ETI QAQC Sample
	END Date/Time		DUPLICATE | EQUIPMENT BLANK NONE
			ETI QAQC Sample ID

WEATHER CONDITIONS

Temperature, % cloud cover, wind speed, recent weather conditions (Rain event? Dry?)

CURRENT AGRONOMY CONDITIONS

Crop and field conditions, crop height

CHANNEL OBSERVATIONS

Water appearance (clear, sediment, debris, etc), flow conditions.

MAINTENANCE or MISC NOTES

RAIN GAUGE:	TURBIDITY PROBE CLEAR:	SOLAR PANEL:	DESICCANT:
Clear | Plugged | Level	Yes | No	Clean | Cleaned | Needs to be cleaned	New | Good | Bad | Needs to be changed

WATERSHED OUTLET

B.4 Autosampler Information Form (page 2 of all field sheets):

BOTTLE: 1 | 2 | 3 | 4

SAMPLE ID:

PULSE	DATE	TIME	COMMENTS
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

BOTTLE: 1 | 2 | 3 | 4

SAMPLE ID:

PULSE	DATE	TIME	COMMENTS
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

BOTTLE: 1 | 2 | 3 | 4

SAMPLE ID:

PULSE	DATE	TIME	COMMENTS
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

BOTTLE: 1 | 2 | 3 | 4

SAMPLE ID:

PULSE	DATE	TIME	COMMENTS
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
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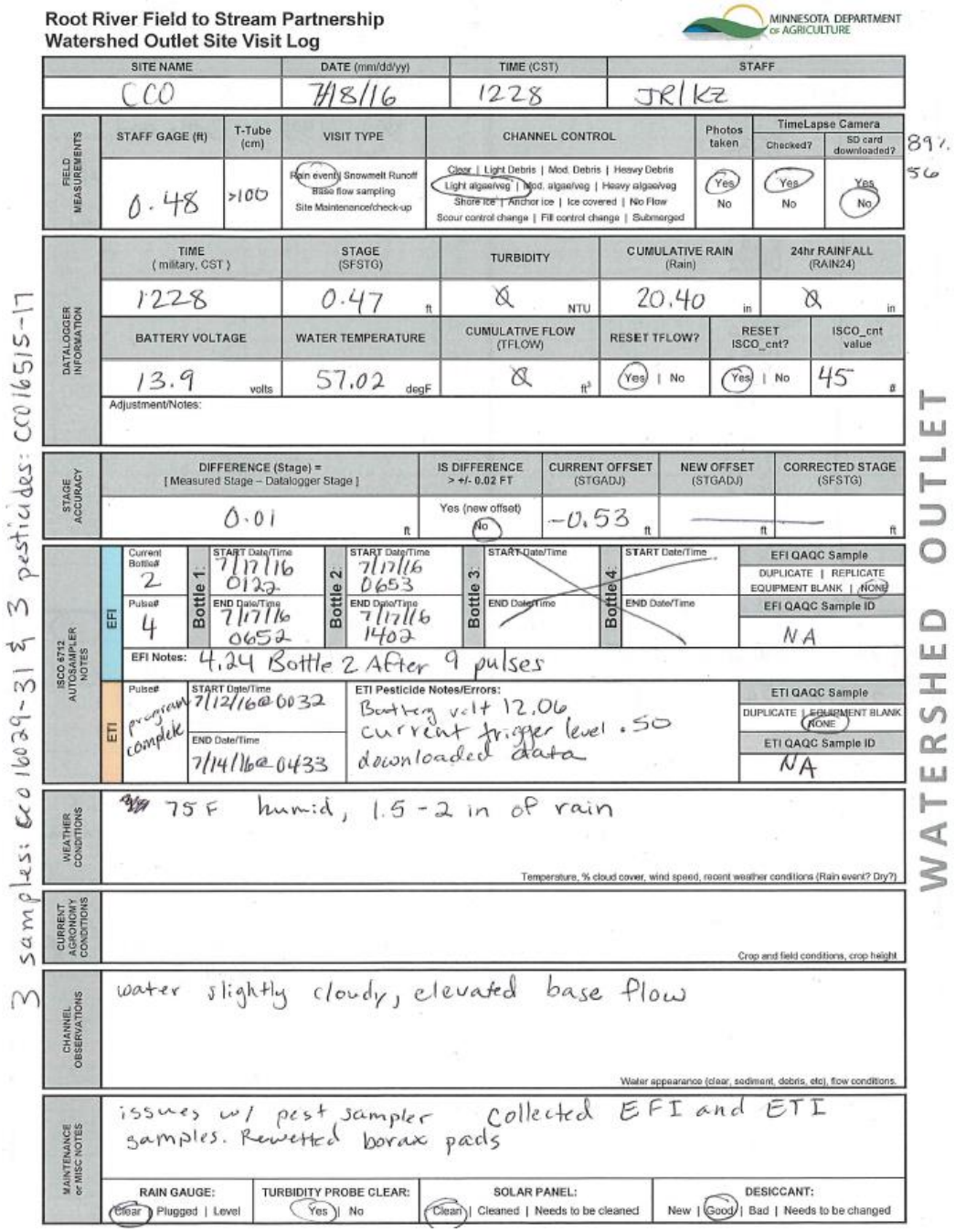
23			
24			

B.5 Site inspection forms (filled out example, 2 pages):



Root River Field to Stream Partnership
Watershed Outlet Site Visit Log

MINNESOTA DEPARTMENT OF AGRICULTURE

SITE NAME	DATE (mm/dd/yy)	TIME (CST)	STAFF
CCO	7/18/16	1228	JR/KZ

FIELD MEASUREMENTS

STAFF GAGE (ft)	T-Tube (cm)	VISIT TYPE	CHANNEL CONTROL	Photos taken	TimeLapse Camera: Checked?	TimeLapse Camera: SD card downloaded?
0.48	>100	(Rain event) | Snowmelt Runoff | Base flow sampling | Site Maintenance/check-up	Clear | Light Debris | Mod. Debris | Heavy Debris; Light algae/veg | Mod. algae/veg | Heavy algae/veg; Shore Ice | Anchor Ice | Ice covered | No Flow; Scour control change | Fill control change | Submerged	(Yes) / No	Yes / No	Yes / (No)

89% 56

DATALOGGER INFORMATION

TIME (military, CST)	STAGE (SFSTG)	TURBIDITY	CUMULATIVE RAIN (Rain)	24hr RAINFALL (RAIN24)
1228	0.47 ft	X NTU	20.40 in	X in

BATTERY VOLTAGE	WATER TEMPERATURE	CUMULATIVE FLOW (TFLOW)	RESET TFLOW?	RESET ISCO_cnt?	ISCO_cnt value
13.9 volts	57.02 degF	X ft³	(Yes) | No	(Yes) | No	45 #

Adjustment/Notes:

STAGE ACCURACY

DIFFERENCE (Stage) = [Measured Stage – Datalogger Stage]	IS DIFFERENCE > +/- 0.02 FT	CURRENT OFFSET (STGADJ)	NEW OFFSET (STGADJ)	CORRECTED STAGE (SFSTG)
0.01 ft	Yes (new offset) / (No)	-0.53 ft	— ft	— ft

ISCO 6712 AUTOSAMPLER NOTES

EFI

Current Bottle#	Bottle 1: START Date/Time	Bottle 2: START Date/Time	Bottle 3: START Date/Time	Bottle 4: START Date/Time	EFI QAQC Sample
2	7/17/16 0122	7/17/16 0653			DUPLICATE | REPLICATE EQUIPMENT BLANK | (NONE)
Pulse# 4	END Date/Time 7/17/16 0652	END Date/Time 7/17/16 1402	END Date/Time	END Date/Time	EFI QAQC Sample ID: NA

EFI Notes: 4.24 Bottle 2 After 9 pulses

ETI

Pulse#	START Date/Time	ETI Pesticide Notes/Errors:	ETI QAQC Sample
program complete	7/12/16@0032	Battery volt 12.06 current trigger level .50 downloaded data	DUPLICATE | EQUIPMENT BLANK (NONE)
	END Date/Time 7/14/16@0433		ETI QAQC Sample ID: NA

WEATHER CONDITIONS

75 F humid, 1.5 - 2 in of rain

Temperature, % cloud cover, wind speed, recent weather conditions (Rain event? Dry?)

CURRENT AGRONOMY CONDITIONS

Crop and field conditions, crop height

CHANNEL OBSERVATIONS

water slightly cloudy, elevated base flow

Water appearance (clear, sediment, debris, etc), flow conditions.

MAINTENANCE or MISC NOTES

issues w/ pest sampler collected EFI and ETI samples. Rewetted borax pads

RAIN GAUGE: (Clear) Plugged | Level	TURBIDITY PROBE CLEAR: (Yes) | No	SOLAR PANEL: (Clean) | Cleaned | Needs to be cleaned	DESICCANT: New | (Good) | Bad | Needs to be changed

3 samples: CCO 16039-31 & 3 pesticides: CCO16515-17

WATERSHED OUTLET

BOTTLE: (1) | 2 | 3 | 4 -- EFI | ETI

SAMPLE ID: CC016029 & CC016515

PULSE	DATE	TIME	COMMENTS
1	7/17/16	0122	Bottle start
2		0142	
3		0202	
4		0222	
5		0242	
6		0302	
7		0322	
8		0342	
9		0402	
10		0422	
11		0432	
12		0442	
13		0452	
14		0502	
15		0522	
16		0532	
17		0542	
18		0552	
19		0602	
20		0612	
21		0622	
22		0632	
23		0642	
24		0652	Bottle end

BOTTLE: 1 | (2) | 3 | 4 -- EFI | ETI

SAMPLE ID: CC016030

PULSE	DATE	TIME	COMMENTS
1	7/17/16	0653	Bottle start
2		1002	
3		1402	Bottle end
4			
5	7/18/16	1224	Manual Pause
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

BOTTLE: 1 | 2 | 3 | 4 -- EFI | ETI

SAMPLE ID: CC016031 & CC016516

PULSE	DATE	TIME	COMMENTS
1	7/18/16	1240	Grab from stream
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
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22			
23			
24			

BOTTLE: (1) | 2 | 3 | 4 -- EFI (ETI)

SAMPLE ID: CC016517

PULSE	DATE	TIME	COMMENTS
1	7-12-16	0032	Bottle start
215	7-12-16	1432	n m l
318	7-12-16	1732	n l d
420	7-12-16	1932	n m l
633	7-13-16	0832	n m l
8	7-13-16	2353	Power failed
7	7-13-16	2353	Power restored
8	7-14-16	0003	Power failed
9	7-14-16	0003	Power restored
10(4)	7-14-16	0032	Power failed
11			multiple power failures
12	7-14-16	0953	program stopped low battery
13			Bottle End
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

B.6 Elevation Survey Log

Elevation Survey Log, Page 1

Root River Field to Stream Partnership
Elevation Survey Log

MINNESOTA DEPARTMENT OF AGRICULTURE

SITE NAME	DATE (mm/dd/yy)	START TIME (CST)	END TIME (CST)	STAFF
FIELD CONDITIONS	(TILLAGE, GRASS HEIGHT, CROPS PLANTED, ETC.)			

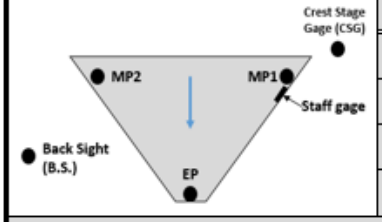
BENCHMARK / BACKSIGHT INFORMATION

DESCRIPTION OF BENCHMARK				
		SURVEY EQUIPMENT	LASER LEVEL	VRS
ASSIGNED DATUM (AD)	100	BACKSIGHT / BENCHMARK (B.S.1) PRIOR TO SURVEY		
HEIGHT OF INSTRUMENT (H.I.)		BACKSIGHT / BENCHMARK (B.S.2) AFTER SURVEY		

Flume Elevation Survey

EQUIPMENT USED:

FLUME ELEVATION SURVEY POINTS



MEASUREMENT POINT	1ST Survey Grade rod (GR)	2nd Survey Grade rod (GR)
MP1		
MP2		
EP		
CSG		
Are MP1, MP2 and EP different elevations?	Yes (adjust flume, conduct second survey) No	Yes (adjust flume, conduct another survey) No
Are B.S.1 and B.S.2 different elevations?	Yes (conduct second survey) No	Yes (conduct another survey) No
PICTURES TAKEN	Description and number of pictures taken	
NOTES	Any field observations, errors/anomalies during survey, etc.	

ELEVATION SURVEY

SEDIMENT SURVEY

SURVEY EQUIPMENT USED (include ATV, survey wheel, etc. if applicable)		OFFSET USED FOR SURVEY EQUIPMENT (when using an ATV / survey wheel, etc.)	
STARTING SURVEY POINT		END SURVEY POINT	
ERRORS DURING SURVEY	Note any errors (e.g., loss of signal at XX point), etc.		
NOTES / PICTURES TAKEN	Any field observations, pictures taken, etc.		

Elevation Survey Log, Page 2

WINGWALL SURVEY

EQUIPMENT USED	
DESCRIPTION OF STARTING POINT	(North end of wingwall, nearest to xxxx etc)

SURVEY POINT	GRADE ROD	SURVEY POINT	GRADE ROD	SURVEY POINT	GRADE ROD	SURVEY POINT	GRADE ROD	SURVEY POINT	GRADE ROD	SURVEY POINT	GRADE ROD	SURVEY POINT	GRADE ROD
1		26		51		76		101		126		151	
2		27		52		77		102		127		152	
3		28		53		78		103		128		153	
4		29		54		79		104		129		154	
5		30		55		80		105		130		155	
6		31		56		81		106		131		156	
7		32		57		82		107		132		157	
8		33		58		83		108		133		158	
9		34		59		84		109		134		159	
10		35		60		85		110		135		160	
11		36		61		86		111		136		161	
12		37		62		87		112		137		162	
13		38		63		88		113		138		163	
14		39		64		89		114		139		164	
15		40		65		90		115		140		165	
16		41		66		91		116		141		166	
17		42		67		92		117		142		167	
18		43		68		93		118		143		168	
19		44		69		94		119		144		169	
20		45		70		95		120		145		170	
21		46		71		96		121		146		171	
22		47		72		97		122		147		172	
23		48		73		98		123		148		173	
24		49		74		99		124		149		174	
25		50		75		100		125		150		175	

SURVEY DRAWING

Provide a drawing of the site including the direction of survey using cardinal directions and notable points during survey.

NOTES / PICTURES

APPENDIX C. CHANGING VARIABLES IN THE DATALOGGER

C1. EDGE-OF-FIELD SITES CHEAT SHEET

To make a STAGE ADJUSTMENT (EOF):

1. Calculate the offset needed
    - Example:
        - Measured stage: 0.56 feet
        - Datalogger stage (Head_APG): 0.63 feet
        - Difference (offset): 0.56-0.63 = **-0.07** feet
2. **Processes**
3. **APGcorr** (or **OTTcorr**)
4. **Set**
5. Enter the new offset value
    - If there is already an offset in place (other than 0.00), the new 'difference' will need to be added or subtracted from the existing offset
6. Select the green check mark to accept
7. Click the green check mark when asked to set as a Default Power Up value 
8. Under Current Conditions, verify that the Head_APG or Head_OTT are now reading correctly

To change the volume threshold trigger (EOF):

CumVolume: this value is the water volume threshold at which the sampler will trigger. As an example, if the threshold was set to 300 ft^3, the CumVolume would accumulate up to 300 ft^3 and then trigger a pulse of water to be collected into the bottle. Once done, the number will reset and count up to 300 ft^3 again from zero. Once the threshold is hit again, the sampler will trigger another pulse, etc. This continues until the bottles are full, or stage falls below the activation stage.

1. **Processes**
2. **F_trig**
3. **Set**
4. Enter new value
5. Click green check mark to accept
6. Click the green check mark when asked to set as a Default Power Up value 

Resetting CUMULATIVE VOLUME (CumVolume)(EOF):

1. **Processes**
2. **CumVolume**
3. **Set**
4. Use touchscreen to set value to 10 cubic feet below the volume threshold (F_trig)

Zeroing CUMULATIVE RAIN (CumRain)(EOF):

1. **Sensors**
2. **CumRain**
3. **Reset/Zero**

To change the ACTIVATION STAGE (EOF):

The activation stage is the water level at which flow will begin to calculate. For RRFSP and Discovery Farms, we are using an activation stage of 0.05 feet. **This should not be altered unless directed by the appropriate MDA staff.**

1. **Processes**
2. **Fstg_min**
3. **Set**
4. Enter new value
5. Select green check mark to accept
6. Click the green check mark when asked to set as a Default Power Up value 

To reset Fisco_cnt (pulse numbers)(EOF):

The **Fisco_cnt** is the process which counts up the number of pulses that have been collected (24 pulses per bottle). It is helpful to reset this number back to zero after each runoff event.

1. **Processes**
2. **Fisco_cnt**
3. **Zero**

To change between Head_OTT and Head_APG (EOF and SR3):

As a default, the datalogger should be set to the OTT bubbler (EOF) or CS450 pressure transducer (SR3) because it is a more reliable and accurate instrument. If the OTT bubbler or CS450 pressure transducer were to experience issues, the user has the ability to switch the datalogger over to the APG ultrasonic. CumVolume will then be calculated based off of stage data from the APG versus the OTT/CS450.

1. **Processes**
2. **Fflow_sel** (EOF) or **Flow_sel** (SR3)
3. **Set**
4. Enter **0** for OTT/CS450 or **1** for the APG
5. Select green check mark to accept
6. Click the green check mark when asked to set as a Default Power Up value 

C2. OUTLET SITE CHEAT SHEET

To make a STAGE ADJUSTMENT (outlet):

1. Calculate the offset needed
    - Example:
        - Measured stage: 0.56 feet
        - Datalogger stage (SFSTG): 0.63 feet
        - Difference (offset): 0.56-0.63 = **-0.07** feet
2. **Processes**
3. **STGADJ**
4. **Set**
5. Enter the new offset value
    - If there is already an offset in place (other than 0.00), the new 'difference' will need to be added or subtracted from the existing offset
6. Select the green check mark to accept
7. Click the green check mark when asked to set as a Default Power Up value 
8. Under Current Conditions, verify that the SFSTG is now reading correctly

To change the volume threshold trigger (outlet):

TFlow: this value is the water volume threshold at which the sampler will trigger. As an example, if the threshold was set to 3,000 ft^3, the TFlow would accumulate up to 3,000 ft^3 and then trigger a pulse of water to be collected into the bottle. Once done, the number will reset and count up to 3,000 ft^3 again from zero. Once the threshold is hit again, the sampler will trigger another pulse, etc. This continues until the bottles are full, or stage falls below the activation stage.

1. **Processes**
2. **F_trig**
3. **Set**
4. Enter the new volume threshold value
5. Select the green check mark to accept
6. Click the green check mark when asked to set as a Default Power Up value 

Zeroing CUMULATIVE VOLUME (TFLOW)(outlet):

1. **Processes**
2. **TFLOW**
3. **Zero**

Zeroing the cumulative RAIN (Rain)(outlet):

1. **Sensors**
2. **Rain**
3. **Zero**

To change the ACTIVATION STAGE (outlet):

The activation stage is the water level at which flow will begin to calculate. For RRFSP and Discovery Farms, we are using an activation stage of 0.05 feet. **This should not be altered unless directed by the appropriate MDA staff.**

1. **Processes**
2. **Stg_min**
3. **Set**
4. Enter new activation stage value
5. Select the green check mark to accept
6. Click the green check mark when asked to set as a Default Power Up value 

To reset ISCO_cnt (pulse numbers) (outlet):

The **ISCO_cnt** is the process which counts up the number of pulses that have been collected (24 pulses per bottle). It is helpful to reset this number back to zero after each runoff event.

1. **Processes**
2. **ISCO_cnt**
3. **Zero**

APPENDIX D. SRT PROCEDURES

D.1 CHANGING THE DATALOGGER STAGE / STAGE ADJUSTMENT

1. Use water level meter to measure from top of Agri-drain (at black arrow) to top of water on the inlet side (Agri-Drain tapedown measurement on field sheet) or the outlet site.
2. Subtract value from step 1 from 4.220 ft. If there is no flow over the board, record "0" (subsurface tile measured stage).

Description for equation variable	**Computation**
Depth to boards (ft) =	4.220
Subtract Depth to water level (ft) =	-
Subsurface tile measured stage (ft) =	

3. On the keypad, press "Enter" five times to display current values. Record values on site visit log.
4. Complete the "STAGE ACCURACY" section of the site visit log
   a. Complete the following table:

Description for equation variable	**Computation**
Subsurface tile measured stage (ft) (see table above) =	
Subtract Datalogger Stage ("SRT_IStg") (ft) =	-
DIFFERENCE (TILE) stage (ft) =	

   b. If the difference is greater than +/– 0.02 ft, complete the following
      i. Press "Esc" on the keypad to get back to the initial Campbell Scientific screen or press "Enter" to turn the keypad on.
      ii. Press "Enter" once. Use arrows to move to "Configure, Settings". Press "Enter". Use arrows to move to "Public Table". Press "Enter". Use arrows to move to "Tapedown_in" (inlet) or "Tapedown_out" (outlet) and press "Enter".
      iii. Enter the current stage value and press "Enter". This will navigate back to the "Public Table" screen. This will automatically calculate the offset and apply it to the stage measurement. Please "Esc" and select "Yes" to save changes.
      iv. Record values on site visit log for each step.
      v. VERIFY that the offset changes were saved and that the new Datalogger Stage ("SRT_IStg") matches the field measured stage.

D.2 RESETTING CUMULATIVE FLOW

After an event, cumulative (total) flow should be reset in anticipation of the next event.

1. On the keypad, press "Enter" five times to display current values.
2. Use arrows to highlight "SRT_CFLO" and press "Enter".
   a. Enter "0" and press "Enter"

3. Press “Esc” to return to main menu.
4. Record values on site visit log for each step.

D.3 CHANGING ACTIVATION STAGE OR EFI VOLUME THRESHOLD

1. If directed by MDA, follow these instructions to change activation stage or EFI volume threshold.
    a. Press “Esc” on the keypad to get back to the initial Campbell Scientific screen or press “Enter” to turn the keypad on.
    b. Press “Enter” once. Use arrows to move to “Configure, Settings”. Press “Enter”. Use arrows to move to “Constant Table”. Press “Enter”. Use arrows to move to select the constant that is to be changed and press “Enter”.
        i. Activation Stage = “SRTActST”
        ii. EFI cumulative volume threshold= “SRT_EFI”
    c. Enter the new value where the curser is flashing and hit “Enter”.
    d. This will navigate back to the “Constant Table” screen. Please “Esc” and select “Yes” to save changes.
    e. Record values on site visit log for each step.

APPENDIX E. SR3 PESTICIDE PILOT MONITORING SITE GUIDANCE

In 2012, additional equipment was added to SR3 to add equal-timed incremented (ETI) based composite sampling. At SR3, this required an additional shelter, datalogger, pressure transducer, and sampler. This sheet is designed to be an overview of site operation.

E1. SHELTER LOG

A shelter log will be located at the site. A written entry should be completed every time the shelter is opened, even if no changes are made. This is intended to be an efficient way to track information important to the operation of the site. All other information should be included on the site visit log that includes the primary shelter.

E2. CR850 PROGRAM SUMMARY AND OPERATION

The CR850 datalogger is the brain of the site. The CR850 collects soil moisture and water level data, and controls when the ISCO sampler is triggered. There are many processes that occur, however, this section will present only relevant items for the successful operation of the site. The current program is included below for reference.

The CR850 has a display that will be used to operate the site. All needed information is stored in the "Public" table. Steps to access the "Public" Table, and the relevant fields are discussed. To access the "Public" Table:

1. Press "Enter" to wake the logger. A CSI symbol and the current date/time will be visible.
2. Press "Enter" to get to Options.
3. Press "Enter" to select "Data" (Data is top field, and should be highlighted).
4. Press "Enter" to select "Real Time Tables" (Real Time Tables is top field, and should be highlighted).
5. Press "Enter" to select "Public" (Public is top field, and should be highlighted).

All of the information needed to complete a field visit, and to control the ISCO Avalanche is available in the "Public" Table. Relevant fields are discussed below. Some variables in "Public" can be changed during site visits, and are indicated in the "SWCD Changeable" column. The far right column provides guidance on what values to enter.

Table E1. SR3 ETI CR850 program variables and associated operational instructions.

Field	Explanation	Shelter Log?	SWCD Changeable?	Value to Enter
TimeStamp	Current date and time on datalogger	Yes	No	--
Batt_Volt	Battery Voltage	Yes	No	--
Staff_Gage_Obs	User inputted staff gage reading, same until new value is entered	--	Yes	Staff Gage Reading
Act_Stage	Activation Stage (Stage when ETI sampler turns on)	--	Yes	Stage to activate samplers
ETI_Interval	Minutes between ETI pulses (Set to 59, fires every 60)	--	Rarely	59 unless MDA specifies
ETI_Pulses	Number of ETI pulses to be sent before turning off (almost always will be 96)	--	Rarely	96 unless MDA specifies
Stage	Stage from pressure transducer	Yes	No	--
Stage_avg	15 minute rolling stage, this controls ETI sampler	--	No	--
StageTimerActive	Controls ETI sampler "True" = sampler running "False" = ready for event	--	Yes (unlikely, see notes below)	ETI Sampler: "True" = On "False" = Off
ISCO_Pulse_Counter	Number of pulses sent to the ETI sampler (this will reset "True" to "False" when this values exceeds ETI_Pulses); auto resets	--	Yes (unlikely, see notes below)	Type "0" to restart a 4-day ETI (See below)
ISCODelayTime	Timer since last ETI pulse was sent; when this value exceeds ETI_Interval, ETI sampler will be sent pulse	--	Yes (unlikely, see notes below)	Type "0" only if ISCO_Pulse_Counter is set to "0"
Several Additional Values	There are several more fields below that are used in the program, but can be ignored by field staff		No	--

To edit a variable in "Public"

1. Follow steps above to access "Public" table.
2. Use arrow keys to scroll down to the desired field.
3. Press "Enter" to enter "Edit Field" screen.
4. Type in new desired value. Current value is shown for reference.
5. Press "Enter" to accept changes.
6. New value will be accepted and will show as the updated value in the "Public" table.

Several fields can be changed in the public field. After changes are made, wait a few minutes to allow the datalogger to run the program (every minute) and to make sure changes occur.

Special Instructions are included for the operation of the equal-time based sample collection period. These fields include StageTimerActive, ISCO_Pulse_Counter, and ISCODelayTime on the datalogger and the ISCO sampler itself.

In ideal situations, the equal-time based program will begin when the stage in the ditch (Stage_avg) exceeds (>=) the activation stage (Act_Stage). This will trigger the equal-time based program on the datalogger (StageTimerActive) by changing the "False" to "True". Once "True", the datalogger will send a pulse to the ISCO sampler and record the pulse (ISCO_Pulse_Counter) with change of "0" to "1" (and so on). Once the pulse is sent, a timer (ISCODelayTime) is started and records the minutes since the last pulse were sent. When the timer (ISCODelayTime) exceeds (>) the equal time based sample interval (ETI_Interval), another pulse will be sent to the autosampler, the ISCO_Pulse_Counter will increase by one, and the timer (ISCODelayTime) will restart. This will continue until the pulse counter (ISCO_Pulse_Counter) exceeds (>) the number of desired ETI pulses (ETI_Pulses). At this point, if the stage in the ditch (Stage_avg) is less than (<) the activation stage (Act_Stage), the equal-time based program (StageTimerActive) will be turned off signaled by "False". The ISCO sampler can be interrogated to obtain sample times and error codes, and then the ISCO program can be restarted.

E2.1 STOPPING AND/OR RESTARTING ETI

A complete, four-day equal time based sample is highly preferred; however, there may be instances when a sample will be collected during the four-day sample period. Such instances may include resetting the sampler at the end of the week to ensure weekend sample coverage, forecasted rains from the end of the four-day window to the next planned site visit, non-project staff commitments, etc. Several scenarios are presented below.

Ending the equal time based sample before it finishes, and <u>resetting immediately to start</u> collection of a four-day equal time based sample.

1. On the ISCO sampler, review and record sample collection times and errors, select Stop Program to end current sample, and then select Run Program (Should read sample 1 of 96 after 1 pulse)
2. On the CR850 datalogger, navigate to "Public" table and ensure the following:
    a. Stage_avg is higher (>) Act_stage.
        i. If Stage_avg is below (<) Act_stage, lower Act_Stage 0.1 foot below current Stage_avg
    b. Reset ISCO_Pulse_Counter to "0".
    c. Reset ISCODelayTime to "0"
    d. Highlight StageTimerActive and change it to "False". The equal time based sample program will start on the next datalogger execution (every minute)

3. Stay at site until ISCO sampler collects a sample when StageTimerActive changes from "FALSE" to "TRUE".

Ending the equal time based sample before it finishes, <u>without immediately resetting</u> an additional equal time based sample. This will prepare the system for the next run-off event.

1. On the ISCO sampler, review and record sample collection times and errors, select Stop Program to end current sample, and then select Run Program (Should read sample 1 of 96 after 1 pulse)
2. On CR850 datalogger, navigate to "Public" table and ensure the following:
    a. Stage_avg is lower (<) Act_stage.
        i. If Stage_avg is above (>) Act_stage, increase the Act_Stage to 0.1 foot above the current Stage_avg
    b. Reset ISCO_Pulse_Counter to "0".
    c. Reset ISCODelayTime to "0"
    d. Highlight StageTimerActive and change it to "False". This should stay FALSE until the next event.
3. Stay at site to ensure that the ISCO sampler does not collect a sample for a few minutes.

The stream is still elevated above Act_Stage, but you don't want an additional four-day sample to start. This step can be completed during the on-going four-day equal time composite collection period.

1. On CR850 datalogger, navigate to "Public" table and ensure the following:
    a. Stage_avg is lower (<) Act_stage.
        i. If Stage_avg is above (>) Act_stage, increase the Act_Stage to 0.1 foot above the current Stage_avg

Whenever collecting a four day equal time composite sample, always double check the StageActiveTimer. If it is "TRUE", the sampler will collect water immediately. If it is "FALSE", the datalogger will not send a pulse to the ISCO sampler to collect water until Stage_avg exceeds (>) Act_stage. Whenever the ISCO sampler is reset, ensure ISCO_Pulse_Counter and ISCODelayTime are both "0".

E3. DATALOGGER WIRING

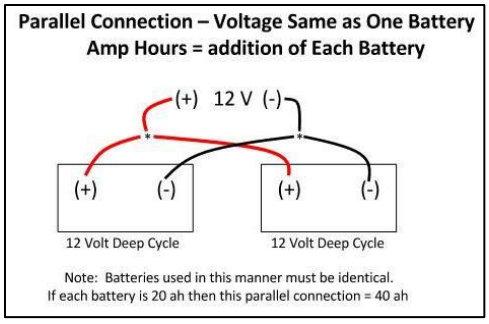
A CR850 datalogger is used. All instruments, and associated wiring, are included in the table below.

Instrument/Cable	Wire Color	Datalogger Port
CS450 Pressure Transducer	White	Control Port 1 (CP1)
	Red	12V
	Black	Ground
CS650 Soil Moisture Probe	Green	Control Port 3 (CP3)
	Red	12V
	Black/Orange	Ground
Sampler Control Cable	Yellow	Control Port 2 (CP2)
	Red	SW12
	Purple/Clear	Ground

E4. BATTERY / SOLAR CONFIGURATION

A large solar panel is located on the north side of the shelter. This panel is wired into the PS100 in the white CSI box in the shelter. The wires from the solar panel are wired into the two charge ports on the PS100. The PS100 regulates charging of the deep cycle batteries, and also has a small internal battery. The PS100 is connected to batteries in the rectangular, white ports (labeled Battery). These Battery ports connect to the small internal battery, and another runs to one of the deep cycle batteries.

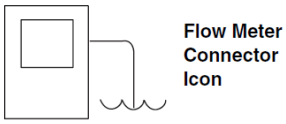
The deep cycle batteries are connected in parallel, meaning that a jumper wire should be connected to both positive terminals, and both negative terminals. One of the batteries will also have the battery the wires from the PS100 connected.



E5. ISCO AVALANCHE

E5.1. ISCO AVALANCHE CONNECTIVITY

The ISCO avalanche should be connected to the datalogger via the sampler control cable in the Flow Meter port.



The avalanche should be connected directly to one of the deep cycle batteries.

E5.2 PROGRAMMING / CONFIGURATION

The ISCO Avalanche is operated as an equal-time composite sampler, however, the CR850 datalogger controls when the sampler pulses (every hour). The ISCO is programmed as a "Flow" based sampler to allow the datalogger to send the pulse to initiate each sampling event. The following steps will highlight how to configure and program the sampler.

- Extended Programming
- 30 minute data interval
- 1 bottle, 9.45 liters, 30 ft suction line, auto suction head, 1 rinse, 0 retries
- One part program
- Pacing: FLOW, 1 pulse
    - Flow pacing, 1 pulse, No sample at start
    - Run continuously? No.
- 96 samples, 70 mL
- Enable: none-programmed
- Enable: once enabled, stay enabled, sample at enable
- Enable: 0 pauses and resumes
- No delay to start
- Run this program now? Yes (screen should read "sample 1 after 1 pulse")

E6. SAMPLE NUMBERING AND BOTTLE CLEANING

Pesticide samples will include grab samples, equal flow based, and equal time based samples. Pesticide samples should be labeled sequentially with a "500" series label. For example, SR315501, SR315502, etc.

All ISCO bottles should be cleaned thoroughly following SOP guidelines.

E7. SR3 CR850 PROGRAM

Name: SR3_ETI_Pest_Pilot_v7.CR8

```
'CR800
'Declare Constants
ConstTable
Const ISCO_TIMER = 1
EndConstTable

'Declare Variables and Units
Dim FRun
Dim Old
Dim Changed
Public Batt_Volt 'Datalogger battery voltage
Public Staff_Gage_Obs
Public Act_stage 'ACTIVATION STAGE FOR ETI SAMPLER must be set every time program is
compiled
Public ETI_Interval 'MINUTES BETWEEN SAMPLES, For 60 minutes collection interval, enter "59"
must be set every time program is compiled
Public ETI_Pulses '# OF SAMPLES PER COMPOSITE (96) must be set every time program is compiled
Public Stage
Public Stage_avg 'Rolling average of staff gage, this is used to trigger sampler
Public StageTimerActive As Boolean 'Sampler timer (IGNORE)
Public ISCO_Pulse_Counter 'Number of ETI sample pulses sent
Public ISCODelayTime 'ETI Timer Function (IGNORE)
Public Cr800Temp_C 'Datalogger panel temperature
Public CS450_Stg 'Raw level from the pressure transducer (do not use this to set stage level)
Public CS450(2) 'Pressure transducer line (IGNORE)
Public CS650(3)'Pressure transducer line (IGNORE)
Public Offset_SG

Alias CS450(1)=CS450_PS
Alias CS450(2)=CS450_WTemp

Alias CS650(1)=VolWatCon
Alias CS650(2)=ElecCondu
Alias CS650(3)=SoiltTemp

Units Batt_Volt=Volts
Units Cr800Temp_C=Deg C
Units CS450_Stg=feet
Units Stage_avg=feet
Units VolWatCon=m^3/m^3
Units ElecCondu=ds/m
Units SoiltTemp=C
Units Stage=ft
Units CS450_WTemp = Deg C
```

```
Units Act_stage = ft

Dim LogerTime(10)
	'1 - Year, 2 - Month, 3 - Day of Month, 4 - Hour, 5 - Minute
	'6 - Second, 7 - Microsecond, 8 - Day Of Week (Sunday = 1), 9 - Day of Yea

'Define Data Tables
DataTable(SR3_ETI_FLOW10,True,-1)
	DataInterval(0,10,Min,10)
	TableFile ("USB:"+Status.SerialNumber+"_SR3_ETI_FLOW10",8,-1,0,0,Min,0,0)
	Average (1,Cr800Temp_C,FP2,False)
	Average(1,Stage,IEEE4,False)
	Average(1,Stage_avg,IEEE4,False)
	Average (3,CS650(),FP2,False)
	Minimum(1,Batt_Volt,FP2,False,False)
	Average(1,CS450_Stg,IEEE4,False)
	Average(1,Offset_SG,IEEE4,False)
	Average(1,CS450_WTemp,IEEE4,False)
	Average(1,Act_stage,IEEE4,False)
	EndTable

DataTable (ETI_SampleOut, 1, -1)
	DataInterval (0, 0, Sec, 0)
	TableFile ("USB:"+Status.SerialNumber+"_ETI_SampleOut",8,-1,0,0,Min,0,0)
	Sample (1, ISCO_Pulse_Counter, FP2)
EndTable

PreserveVariables

'Main Program
BeginProg
	Scan(60,Sec,1,0)
	  SW12 (1 )
	  'Default Datalogger Battery Voltage measurement Batt_Volt:
		Battery(Batt_Volt)
		'Wiring Panel Temperature measurement PTemp_C
		PanelTemp(Cr800Temp_C,_60Hz)
		'CS650 Soil Moisture Probe Generic SDI-12 Sensor measurements VolWatCon,
ElecCondu, SoiltTemp,
		SDI12Recorder(CS650(),3,"0","M!",1,0)
		'CS450 Pressure Transducer Generic SDI-12 Sensor measurements
		SDI12Recorder (CS450,1,0,"M!",1.0,0)
		'Convert PS to Stage (ft)
		CS450_Stg=(CS450_PS)*2.30666


	'Offset calculation 'Offset_SG'
		If FRun=0 Then
			Staff_Gage_Obs=0
			FRun=1
		EndIf
```

```
        Changed=Staff_Gage_Obs-Old
        If Changed=0 Then
                Stage=CS450_Stg+Offset_SG
        Else
                Offset_SG=Staff_Gage_Obs-CS450_Stg
                Stage=CS450_Stg+Offset_SG
                Old=Staff_Gage_Obs
        EndIf

        'Calculate 15 minute average stage to activate samplers
        AvgRun (Stage_avg,1,Stage,10)

'ETI Sampling Routine
If NOT StageTimerActive Then
If (Stage_avg >= Act_stage) Then
'pulse the port
 WriteIO (&B10,&B10) 'same as PortSet(2,1), but for conditional control
Delay(1,1,Sec)
WriteIO (&B10,&B00) 'same as PortSet(2,0), but for conditional control
'Increment Isco pulse counter
ISCO_Pulse_Counter = 1
CallTable ETI_SampleOut
'reset the Timer
Timer(ISCO_TIMER,Min,2)
'Start the Timer
'Activate Stage Timer
StageTimerActive = True
EndIf

 Else ' Once the Stage Timer is activated
'Read Timer
ISCODelayTime = Timer(ISCO_TIMER,Min,4)
'After 1 hour,
If ISCODelayTime >= ETI_Interval Then
'pulse the port
WriteIO (&B10,&B10) 'same as PortSet(2,1), but for conditional control
Delay(1,1,Sec)
WriteIO (&B10,&B00) 'same as PortSet(2,0), but for conditional control
'Increment Isco pulse counter
ISCO_Pulse_Counter = ISCO_Pulse_Counter+ 1
CallTable ETI_SampleOut
'reset the Timer
 Timer(ISCO_TIMER,Min,2)
EndIf
EndIf

'AFter desired number of samples collected, stop pulsing
 If (ISCO_Pulse_Counter >= ETI_Pulses) Then
'Clear the StageTimerActive (stops hourly pulsing continuing)
StageTimerActive = False
'Stop and clear the timer
```

```
   Timer(ISCO_TIMER,Min,3)
   ISCO_Pulse_Counter = 0
   ISCODelayTime = 0
   EndIf

   CallTable(SR3_ETI_FLOW10)

         NextScan
EndProg
```

APPENDIX F. BULK DENSITY COMPLIANT CAVITY METHOD

Bulk density compliant cavity method found in this appendix is from the NRCS Soil Survey Field and Laboratory Methods Manual, soil survey Investigation report No. 51, version 2. 2014. Retrieved from: (http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CB8QFjAA&url=http%3A%2F%2Fwww.nrcs.usda.gov%2FInternet%2FFSE_DOCUMENTS%2Fstelprdb1244466.pdf&ei=6PkBVfjEN82VyAT9zIGQCQ&usg=AFQjCNGSLn0mPAAHjN-jMiUUREipELLhsA&bvm=bv.88198703,d.aWw

Additionally a video demonstrating how to complete multiple bulk density sampling methods can be found at: http://youtu.be/E7BSZrJ-TDw#t=m0s0. The compliant cavity method can be found at minute 26:06.

3.3 Bulk Density

3.3.1 Field-State

3.3.1.1 Compliant Cavity

After Grossman and Reinsch (2002) and Soil Survey Staff (2014b)

Application

Compliant cavity method (Grossman and Reinsch, 2002) is useful for fragile, cultivated, near-surface layers. This method has the important advantage that it is not necessary to flatten the ground surface or remove irregularities, i.e., the surficial zone is usually not altered (Grossman and Reinsch, 2002). The procedure described herein is after Grossman and Reinsch (2002) and the Soil Survey Staff (2014b, method 3B3a).

Summary of Method

The cavity volume on the zone surface is lined with thin plastic, and water is added to a datum level. Soil is quantitatively excavated in a cylindrical form to the required depth. The difference between the initial volume and that after excavation is the sample volume. The excavated soil is dried in an oven and then weighed. A correction is made for the weight and volume of rock fragments.

Interferences

Bulk density by compliant cavity can be made on soils with rock fragments but is more complex (Grossman and Reinsch, 2002).

Safety

Be careful when using an oven or microwave. Avoid touching hot surfaces and materials. Follow standard laboratory and field safety precautions.

Equipment

1. Fabricated Plexiglass rings, 9-mm thick, 130-mm inside diameter, and >200-mm outside diameter. Make three 16-mm diameter holes that are 10 mm from the outer edge of ring. Position holes equidistant apart. Use three 25 x 50 mm Plexiglass pieces as guides. Attach two pieces on one side to form an "L." Allow 15-mm gap to permit removal of soil material. On the other side, position the single piece in line with the longer leg of the "L" so that an adjacent parallel line forms a diameter.
2. Make 50-mm thick foam rings from flexible polyurethane with an "Initial Load Displacement" of 15 to 18 kg. Foam rings have the same inside diameter as the Plexiglass rings.
3. Fabricate 240-mm crossbar from 5 x 18 mm metal stock to which legs (25-mm high and 180 x 180 mm in cross section) are welded. Drill hole 100 mm from one end of the crossbar and 7 mm from the edge and through which a No. 6 machine bolt is placed.
4. Mount hook gauge on crossbar. Make hook gauge from No. 6, round-headed, 100-mm long machine bolts and from hexagonal nuts. Obtain the

machine bolts from toggle bolt assemblies. Sharpen the machine bolt to a sharp point. Drill a hole in the center of the crossbar. Insert the machine bolt in the hole. Place nuts above and below the crossbar. The two nuts adjust the hook length below the crossbar and provide rigidity. Hold machine bolt by tightened nuts and heat the bolt. After softening, sharply bend the bolt upward to form U-shape.

5. Use wing nuts and three, 250- to 400-mm long, 10- to 13-mm diameter, threaded rods to mount and position the compliant cavity. Sharpen the rods. Place two regular nuts at the end of threaded rod to increase the area of surface struck.
6. Syringe, 60 mL
7. Plastic film, ½ mil, 380-mm wide or wider; 460-mm wide for larger ring
8. Plastic bags, 110 °C capability, with ties
9. Sharpie pen
10. Graduate cylinders, plastic, 250 to 2000 mL
11. Level, small
12. Kitchen knife, small
13. Scissors, small, to cut fine roots
14. Hacksaw blade to cut large roots
15. Weights for plastic film
16. Clothespins. If windy, use clothespins for corners of plastic film.
17. Hard rubber or plastic mallet
18. Sieve, square-hole, 10 mesh, 2 mm
19. Oven, 110 ±5 °C, or microwave. Refer to Section 3.5.1 of this manual for information on drying soils in a standard laboratory oven or microwave.
20. First-aid kit

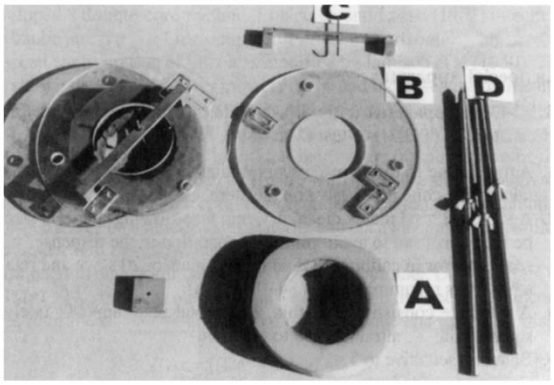


Figure 3.3.1.1.1.—Compliant cavity apparatus: annulus of foam (A), rigid annulus that rests concentrically over the foam annulus (B), bar with hook gauge that mounts across the rigid annulus (C), and threaded rod with wing nuts that goes through holes in rigid annulus (D). Note scale (5 x 5 x 2 cm) in lower left. After Grossman and Reinsch, 2002; printed with permission by Soil Science Society of America.

Reagents

1. Water

Procedure

1. Place ring of plastic foam on ground and cover with rigid ring (130-mm inside diameter). Mount the assembly on the soil surface by securely driving threaded rods into the ground through holes in ring and by tightening ring with wing nuts.
2. Line cavity with ½-mL plastic. Fill cavity to tip of hook gauge with a known quantity of water from graduate cylinder.
3. Remove plastic film and water. Measure the volume of water to tip of hook gauge. This volume (Vd) is the measurement of cavity volume prior to excavation (dead space).
4. Excavate soil quantitatively and in a cylindrical form to required depth. Fill excavation cavity to tip of hook gauge with water from graduated cylinder. Measure the volume of water. This volume (Vf) is the measurement of excavated soil and dead space. Difference between the two water volumes (Vf - Vd) is the volume of excavated soil (Ve).
5. Dry excavated soil in oven at 110 °C or in a microwave. Refer to Section 3.5.1 of this manual for information on drying soils in a standard laboratory oven or microwave. If necessary, make a correction for weight and volume of >2-mm material (Vg) in sample and compute bulk density. Weight of macroscopic vegetal material (g cm^{-3}) also may be reported.

Calculations

$Ve = Vf - Vd - Vg$

where:
Ve = Excavation volume of <2-mm fraction (cc)
Vf = Water volume measurement of excavated soil and dead space (cc)
Vd = Water volume measurement of dead space (cc)
Vg = Gravel volume (>2-mm fraction) (cc). Calculate Vg by dividing the weight of >2-mm fraction by particle density of the >2-mm fraction. Default value is 2.65 g cc^{-1}.

$Wf = Wo - Wc$

where:
Wf = Oven-dry weight of <2-mm soil (g)
Wo = Oven-dry weight of excavated soil (g)
Wc = Oven-dry weight of rock fragments (g)

$Db = Wf / Ve$

where:
Db = Bulk density (g cc^{-1})
Wf = Oven-dry weight of <2-mm soil (g)
Ve = Excavation volume of <2-mm material (cc)

Report

Bulk density is reported to the nearest 0.01 g cm^{-3} (g cc^{-1}).

APPENDIX G. EXAMPLE LOG-IN FORMS

G.1 SAMPLE LOG-IN FORM FOR NUTRIENTS AND SEDIMENT – Filled out (example)

Program	Inspector	Delivered By	Delivery Method
Surface Water	James Fett	James Fett	SpeeDee
Notes/Sampling Conditions			Project
			Root River Field to Stream Partnership

	Field Sample ID	Sample Site	Sample Type	Flow Condition	Collection Method	Sample Comments	Date Sampled				Inorganic Analysis						
											Thermal Preservation Method >>> select from dropdown						PRIORITY LEVEL
							Start Date	Start Time	End Date	End Time	Frozen	Frozen	Wet Ice	Wet Ice		Frozen	>>> select from dropdown
											NO_2+NO_3 TKN NH_3	TP DOP	Cl	TSS	NO2+NO3	LLTP DOP	
1	SRT16042	Root River-Lower South Branch-Tile Edge of Field	CF	BF - Baseflow	Automated Sampler - EFI		7/7/2016	16:50	7/18/2016	8:00	☑	☐	☑	☑	☐	☑	P3
2	SRF16028	Root River-Lower South Branch-Edge of Field/SRF	CF	SF - Stormflow	Automated Sampler - EFI		7/17/2016	0:11	7/17/2016	3:40	☑	☑	☑	☑	☐	☐	P3
3	SRF16029	Root River-Lower South Branch-Edge of Field/SRF	CF	SF - Stormflow	Automated Sampler - EFI		7/17/2016	3:41	7/17/2016	3:41	☐	☐	☐	☑	☐	☐	P3
4	SR316039	Root River-Lower South Branch/SR3	CF	SF - Stormflow	Automated Sampler - EFI		7/12/2016	11:45	7/17/2016	11:35	☑	☑	☑	☑	☐	☐	P3
5	SR316040	Root River-Lower South Branch/SR3	CF	SF - Stormflow	Automated Sampler - EFI		7/17/2016	11:55	7/17/2016	21:05	☑	☑	☑	☑	☐	☐	P3
6	SR316041	Root River-Lower South Branch/SR3	CF	SF - Stormflow	Automated Sampler - EFI		7/17/2016	21:35	7/18/2016	12:45	☑	☑	☑	☑	☐	☐	P3
7	SR316042	Root River-Lower South Branch/SR3	CF	SF - Stormflow	Automated Sampler - EFI		7/18/2016	13:25	7/19/2016	8:15	☑	☑	☑	☑	☐	☐	P3
8	SR316043	Root River-Lower South Branch/SR3	G	BF - Baseflow	From Bank, Grab		7/22/2016	8:45	7/22/2016	8:45	☑	☑	☑	☑	☐	☐	P3
9	SRT16043	Root River-Lower South Branch-Tile Edge of Field	CF	SF - Stormflow	Automated Sampler - EFI		7/18/2016	17:05	7/25/2016	10:51	☑	☐	☑	☑	☐	☑	P3
10	SR316044	Root River-Lower South Branch/SR3	CF	SF - Stormflow	Automated Sampler - EFI		7/23/2016	15:15	7/24/2016	15:45	☑	☑	☑	☑	☐	☐	P3
11	SR316045	Root River-Lower South Branch/SR3	CF	SF - Stormflow	Automated Sampler - EFI		7/24/2016	16:45	7/25/2016	14:35	☑	☑	☐	☑	☐	☐	P3
12											☐	☐	☐	☐	☐	☐	P3
13											☐	☐	☐	☐	☐	☐	P3
14											☐	☐	☐	☐	☐	☐	P3
15											☐	☐	☐	☐	☐	☐	P3

G.2 SAMPLE LOG-IN FORM FOR NUTRIENTS AND SEDIMENT – Print out (example)

MINNESOTA DEPARTMENT OF AGRICULTURE
PESTICIDE AND FERTILIZER MANAGEMENT

Root River Field to Stream Partnership
625 Robert Street North
St. Paul, MN 55155-2538

Katie Rassmussen 651-201-6331
Bill VanRyswyk 507-344-3203
Matt Ribikawskis 507-206-2884

Report To: **Katie Rassmussen**	Sampled By: James Fett	Delivered By: James Fett	Delivery Method: SpeeDee	Received Date/Time:	Received By:					PRIORITY LEVEL
Sample Type: **Surface Water**		Lab SDG Number:		Lab Temperature Received (°C):						
Notes/Sample Conditions:		**Chemical Sample Preservation Method:** NONE		Thermal Sample Preservation Method						
				Frozen	Frozen	Wet Ice	Wet Ice	0	Frozen	
SAMPLE LOCATION	**SAMPLE END DATE**	**SAMPLE END TIME**	**FIELD SAMPLE ID**	**NO_2+NO_3 TKN NH_3**	**TP DOP**	**Cl**	**TSS**	**NO2+NO3**	**LLTP DOP**	
Root River-Lower South Branch-Tile Edge of Field/SRT	7/18/2016	8:00	SRT16042	AR-16-		AR-16-	AR-16-		AR-16-	P3
Root River-Lower South Branch-Edge of Field/SRF	7/17/2016	3:40	SRF16028	AR-16-	AR-16-	AR-16-	AR-16-			P3
Root River-Lower South Branch-Edge of Field/SRF	7/17/2016	3:41	SRF16029				AR-16-			P3
Root River-Lower South Branch/SR3	7/17/2016	11:35	SR316039	AR-16-	AR-16-	AR-16-	AR-16-			P3
Root River-Lower South Branch/SR3	7/17/2016	21:05	SR316040	AR-16-	AR-16-	AR-16-	AR-16-			P3
Root River-Lower South Branch/SR3	7/18/2016	12:45	SR316041	AR-16-	AR-16-	AR-16-	AR-16-			P3
Root River-Lower South Branch/SR3	7/19/2016	8:15	SR316042	AR-16-	AR-16-	AR-16-	AR-16-			P3
Root River-Lower South Branch/SR3	7/22/2016	8:45	SR316043	AR-16-	AR-16-	AR-16-	AR-16-			P3
Root River-Lower South Branch-Tile Edge of Field/SRT	7/25/2016	10:51	SRT16043	AR-16-		AR-16-	AR-16-		AR-16-	P3
Root River-Lower South Branch/SR3	7/24/2016	15:45	SR316044	AR-16-	AR-16-	AR-16-	AR-16-			P3
Root River-Lower South Branch/SR3	7/25/2016	14:35	SR316045	AR-16-	AR-16-		AR-16-			P3

G.3 SAMPLE LOG-IN FORM FOR PESTICIDES – Filled out (example)

Program	Inspector	Delivered By	Delivery Method
Surface Water	James Fett	James Fett	SpeeDee

Notes/Sampling Conditions

	Inspector Sample ID	LIMS Sample Site	Sample Type	Flow Condition	Collection Method	Sample Comments	Date Sampled				Organic Analysis		
							Start Date	Start Time	End Date	End Time	Thermal Preservation Method >>> select from dropdown: Wet Ice — GC	do not use (placeholder)	PRIORITY LEVEL >>> select from dropdown
1	SR316533	Root River-Lower South Branch/SR3	CF	SF - Stormflow	Automated Sampler - EFI		7/12/2016	11:45	7/17/2016	11:35	☑	☐	P3
2	SR316534	Root River-Lower South Branch/SR3	CF	SF - Stormflow	Automated Sampler - EFI		7/17/2016	11:55	7/17/2016	21:05	☑	☐	P3
3	SR316535	Root River-Lower South Branch/SR3	CF	SF - Stormflow	Automated Sampler - EFI		7/17/2016	21:35	7/18/2016	12:45	☑	☐	P3
4	SR316536	Root River-Lower South Branch/SR3	CF	SF - Stormflow	Automated Sampler - EFI		7/18/2016	13:25	7/19/2016	8:15	☑	☐	P3
5	SR316537	Root River-Lower South Branch/SR3	G	BF - Baseflow	Automated Sampler - EFI		7/22/2016	8:45	7/22/2016	8:45	☑	☐	P3
6	SR316539	Root River-Lower South Branch/SR3	CF	SF - Stormflow	Automated Sampler - EFI		7/24/2016	16:45	7/25/2016	14:35	☑	☐	P3
7											☐	☐	P3
8											☐	☐	P3
9											☐	☐	P3
10											☐	☐	P3

G.4 SAMPLE LOG-IN FORM FOR PESTICIDES – Print out (example)

MINNESOTA DEPARTMENT OF AGRICULTURE
PESTICIDE AND FERTILIZER MANAGEMENT

WATER MONITORING PROGRAM
625 Robert Street North
St. Paul, MN 55155-2538

ROOT RIVER PESTICIDE PROJECT

Katie Rassmussen 651-201-6331
Matt Ribikawskis 507-206-2884
David Tollefson 507-206-2882
Bill VanRyswyk 507-344-3203

Report To:	Sampled By:	Delivered By:	Delivery Method:	Received Date/Time:	Received By:	PRIORITY LEVEL
Katie Rassmussen	James Fett	James Fett	SpeeDee			
Sample Type: **Surface Water**			Lab SDG Number:	**Lab Temperature Received (°C):**		
Notes/Sample Conditions:			**Chemical Sample Preservation Method:** NONE	**Thermal Sample Preservation Method**		
				Wet Ice	0	

SAMPLE LOCATION	SAMPLE END		FIELD SAMPLE ID	GC	<<< not currently used >>>	PRIORITY LEVEL
	DATE	TIME				
Root River-Lower South Branch/SR3	7/17/2016	11:35	SR316533	W-16-		P3
Root River-Lower South Branch/SR3	7/17/2016	21:05	SR316534	W-16-		P3
Root River-Lower South Branch/SR3	7/18/2016	12:45	SR316535	W-16-		P3
Root River-Lower South Branch/SR3	7/19/2016	8:15	SR316536	W-16-		P3
Root River-Lower South Branch/SR3	7/22/2016	8:45	SR316537	W-16-		P3
Root River-Lower South Branch/SR3	7/25/2016	14:35	SR316539	W-16-		P3

APPENDIX H. MDA LABORATORY PESTICIDE LIST

GC-MS/MS

Analyte	Method Reporting Limit (ng/L)
Acetochlor	30.0
Alachlor	30.0
Atrazine	30.0
Benfluralin	25.0
Bifenthrin	20.0
Chlorothalonil	50.0
Chlorpyrifos	40.0
Clomazone	15.0
Cyfluthrin	100
Desethylatrazine	50.0
Diazinon	30.0
Diazinon Oxon	75.0
Dichlobenil	5.0
Dichlorvos	15.0
Dimethenamid	15.0
Disulfoton	60.0
EPTC	10.0
Esfenvalerate	150
Ethalfluralin	50.0
Ethofumesate	50.0
Fonofos	15.0
lambda-Cyhalothrin	75.0
Malathion	50.0
Methoxychlor	50.0
Metolachlor	25.0
Metribuzin	75.0
Oxadiazon	75.0
Parathion-methyl	100
Pendimethalin	75.0
Phorate	25.0
Prometon	100
Propachlor	30.0
Propazine	25.0
Simazine	75.0
Tebupirimfos	30.0
Terbufos	30.0
Tolfenpyrad*	100.0
Triallate	50.0
Trifluralin	50.0
zeta-Cypermethrin	500

APPENDIX I. ISCO AUTOSAMPLER PROGRAMMING

ISCO 6712 One part Programming for Sampler Pulsing (SRT and SR3 EFI only)

Must be in **EXTENDED PROGRAMMING**. From the main menu, type **6712.2** to switch into extended mode.

PROGRAMMING:

1. Enter Program Name and Site Description, if desired. Program name could be DFM, and site description could be GO1 as an example.
2. Units Selected: **ft**
3. **30 minute** data interval
4. Enter bottle information
    - **4** bottles, **3.78** liter bottles
    - **X** ft suction line
    - **Auto section head**
    - **1** rinse, **1** retries (this is only available in extended mode)
5. Pacing: **Flow, Every 1 Pulses, No Sample at Start**
6. Distribution: **24 sample/bottle**
    a. **1** bottle per sample event
    b. Switch bottles on: **Number of samples**
    c. Switch bottles every **24 samples**
    d. Run continuously? **No.**
7. Volume: **125 ml samples**
8. Enable: **once enabled stay enabled, sample at enable**
9. Enable: **0 pause and resumes**
10. **No delay to start**
11. Run program now – **yes**

ISCO 6712 Two Part Programming for Sampler Pulsing (SRF, CFW, CFE and BCE only)

Must be in **EXTENDED PROGRAMMING**. From the main menu, type **6712.2** to switch into extended mode.

PROGRAMMING:

12. Enter Program Name and Site Description, if desired. Program name could be DFM, and site description could be GO1 as an example.
13. Units Selected: **ft**
14. **30 minute** data interval
15. Enter bottle information
    - **4** bottles, **3.78** liter bottles
    - **X** ft suction line
    - **Auto section head**
    - **1** rinse, **1** retries (this is only available in extended mode)
16. Two-Part Program Bottle Assignments
    - **1-1 to 'A'**
    - **2-4 to 'B'**
17. 'A' Pacing: **Flow, Every 1 Pulses, No Sample at Start**
18. 'A' Composite: **3 samples/bottle**
    a. Run continuously: **No**
    b. Take **3** samples
19. 'A' Volume: **1,100 ml samples**
20. 'A' enable: **None programmed**
21. 'A' enable: **Once enabled, stay enabled, sample at enable**
22. 'A' enable: **0 pause & resumes**
23. 'B' pacing: **Flow, Every 1 pulses, no sample at start**
24. 'B' distribution: **24 sample/bottle**
    a. **1** bottle per sample event
    b. Switch bottles on: **Number of samples**
    c. Switch bottles every **24 samples**
    d. Run continuously? **No.**
25. 'B' volume: **125 ml samples**
26. 'B' enable: **when 'A' is done**
27. 'B' enable: **once enabled stay enabled, sample at enable**
28. 'B' enable: **0 pause and resumes**
29. **No delay to start**
30. Run program now – **yes**