DRAFT

Musselshell Watershed Coalition

Salinity Monitoring Program

Standard Operating Procedures (SOPs)

Revised September 30th 2014

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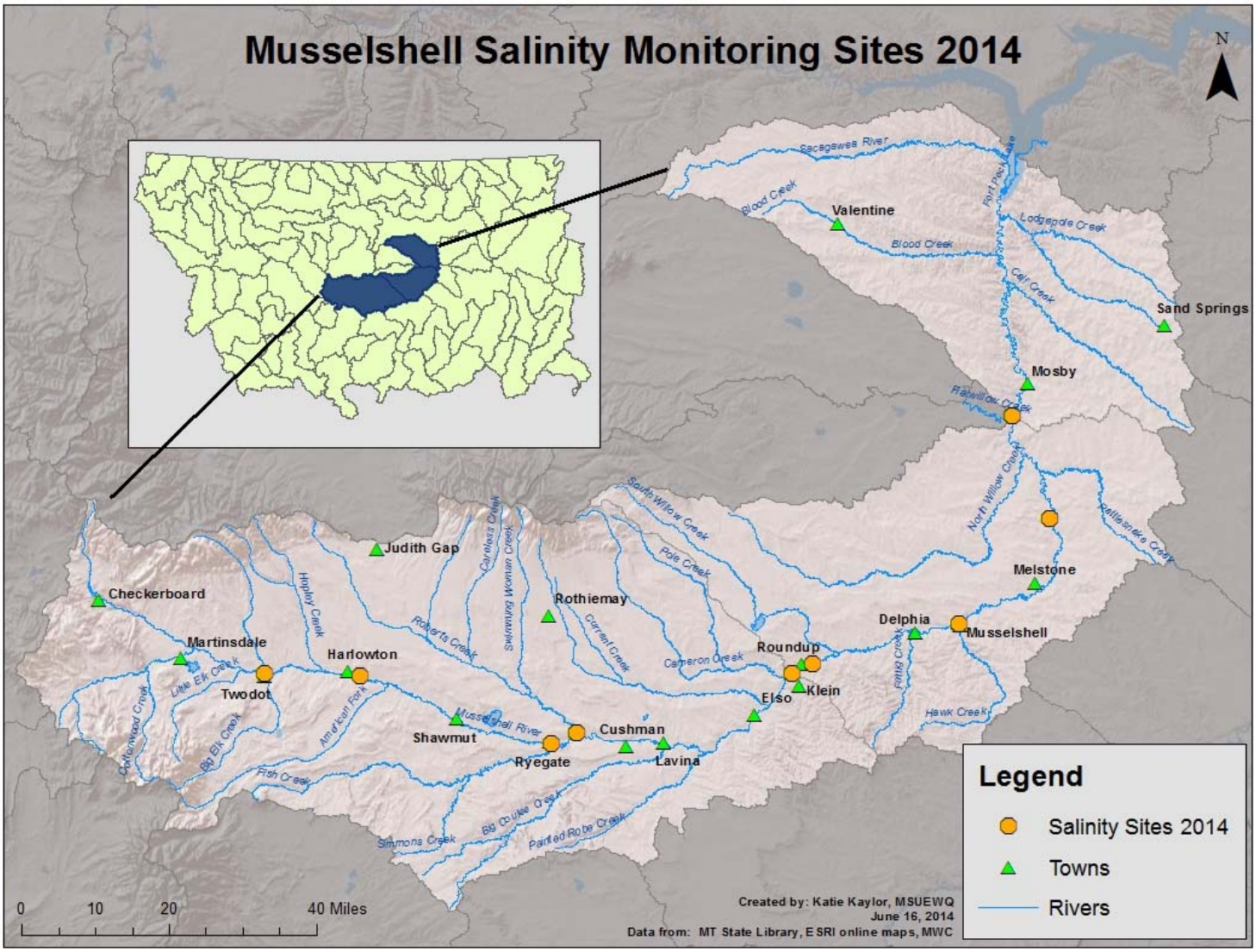
Contents

Introduction

This document outlines data collection methods for salinity and photo point monitoring for the Musselshell Watershed Coalition's Water Quality Volunteer Monitoring Program. Original efforts began in 2009 on Careless Creek, where trained members of the community collected a suite of water quality data. In 2013, the volunteer program was revamped and only required volunteers to collect salinity and photo point data along the Musselshell River. This was coordinated by Big Sky Watershed Corp members David Stout in 2013 and Luke Stappler in 2014. Technical assistance was provided by MSU Extension Water Quality.

Sample Sites and Sample Frequency

Twelve sampling stations have been selected throughout the reach of the Musselshell from Martinsdale to north of Melstone. Data collection will start in April and end in September 2014. Data will be collected twice a month (every two weeks) or more often as possible.



2014 Sampling Site Information

Site #	Site Name	Site ID	Latitude	Longitude	Site Description	Why?
1	Musselshell at Two Dot Bridge	MWC_MSSL_TwoDot	46.430172	-110.072134	Musselshell at northwest side of bridge	Represents water quality flowing out of Martinsdale reservoir.
2	Musselshell East of Harlowton	MWC_MSSL_EHarlow	46.425111	-109.799982	Musselshell off bridge to the southwest	Represents water quality downstream of Harlowton, MT.
3	Musselshell Above Careless Confluence	MWC_MSSL_Abv_Careless	46.293983	-109.257867	Musselshell River south of Ryegate near city water building	Representative of Musselshell before the Careless Creek confluence
4	Musselshell Below Careless Confluence	MWC_MSSL_Blw_Careless	46.315209	-109.184957	Musselshell River downstream from Careless Creek, just off of the parking area south of the hwy on the north side of the river	Musselshell where Deadman's water is back in the stream. Careless Creek, Deadman's and Barbara Canal
5	Careless Creek at Musselshell	MWC_Careless_Abv_Mssl	46.315299	-109.185269	Careless Creek at hwy just above confluence of Musselshell	Deadman's basin water reaching Musselshell mixed with more saline Careless Creek water. Data gathered from this site can be used to demonstrate the effect discharge from Careless Creek has on water quality below its confluence with the Musselshell with regards to sediment and salinity.
6	Musselshell at Hwy 87 near Roundup	MWC_MSSL_Hwy87	46.427732	-108.570852	Musselshell at hwy 87 bridge north west of bridge	Upstream of Roundup, data will represent water quality before the stream reaches the city
7	Musselshell at County Rd #4	MWC_MSSL_CoRd4	46.446475	-108.512595	Musselshell at County Road number 4 bridge east of Roundup on the northeast corner of bridge	Downstream from Roundup Lagoons
8	Musselshell at Bridge at Musselshell	MWC_MSSL_Musselshell	46.519962	-108.091637	Musselshell at bridge north of Musselshell off bridge to the south east	Quality of water going into south and north of canal of Delphia/Melstone Canals
9	Musselshell Above Melstone South Canal	MWC_MSSl_Abv_Canal	46.724689	-107.827183	Musselshell Above Delphia/Melstone South Canal	This data will be representative of the quality of water in the Musselshell before its confluence with the canal and will be essential

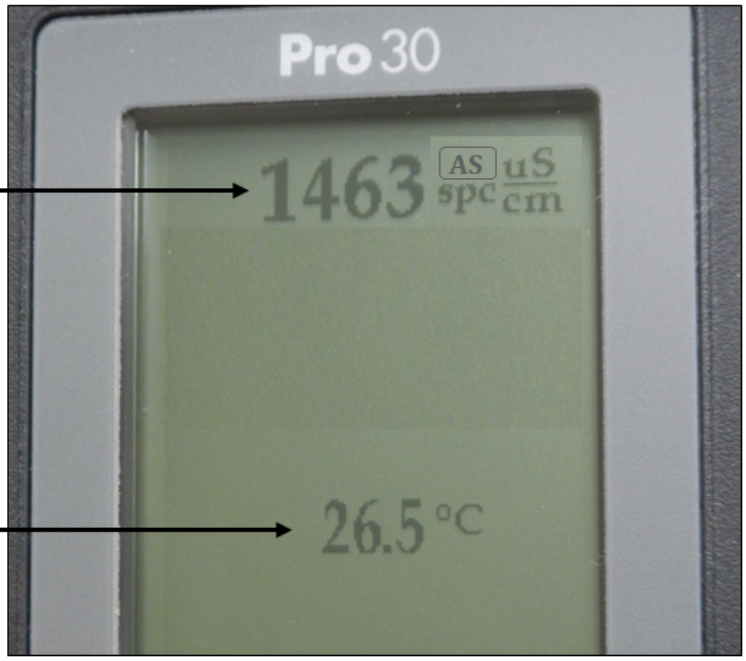
						for establishing a relationship between pre-confluence discharge and downstream water quality.
10	Melstone South Canal at End	MWC_MSSL_Blw_Canal	46.724932	-107.826953	Delphia/Melstone South Canal at end above confluence with Musselshell	Represents quality of water exiting canal at its confluence. This data will be representative of the quality of water in the canal before its confluence with the river and will be essential for establishing a relationship between pre-confluence discharge and downstream water quality
11	Musselshell Above Flatwillow	MWC_MSSL_Abv_Flatwillow	46.927707	-107.930428	Musselshell above Flatwillow Creek	River above Flatwillow Creek. Potentially lots of alkaline inflow between here and Delphia. Data gathered here will be representative of the quality of water in the Musselshell before its confluence with the creek and will be essential for establishing a relationship between pre-confluence discharge and downstream water quality.
12	Musselshell Below Flatwillow	MWC_MSSL_Blw_Flatwillow	46.916666	- 107.926016	Musselshell below Flatwillow Creek	Represents water quality post Flatwillow and irrigation returns

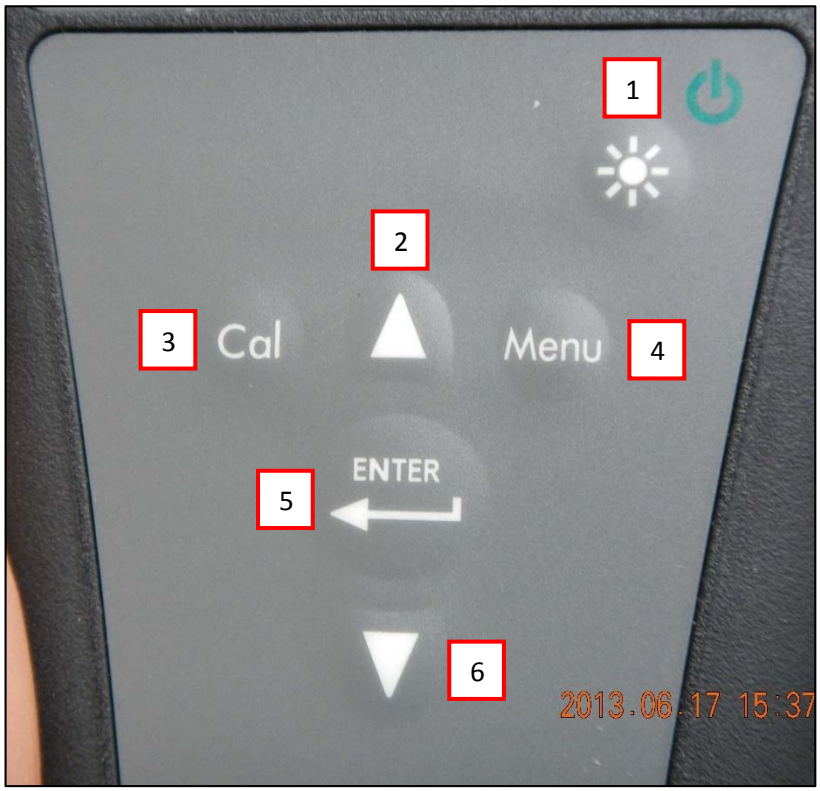
Measuring Salinity with the YSI Pro30

Unlike other water quality parameters, the conductivity sensor of the YSI Pro30 meter will provide readings that equilibrate quickly. The sensor must be fully submerged in a well circulated section of the steam with no air bubbles trapped in the space between the sensor's anode and cathode. In addition to regular calibration, the sensor should be cleaned occasionally to maintain accuracy and increase the responsiveness.

The following steps should be followed when taking a conductivity measurement with the YSI Pro30:

1. Plug connecting cable into the YSI handheld meter
2. Turn on the device by selecting the white power button
3. In a well circulated section of stream, fully submerge the meter into the water
    a. Be sure you are downstream of the sensor to avoid influencing the measurements
    b. Initially agitate the sensor to release any air bubbles, and then leave it undisturbed to facilitate equilibration
4. An auto-stabilize function is function on each field meter to minimize drift during equilibration. After the sensor has been equilibrating for at least **5** minutes, look to see if the conductivity measurement is accompanied by the 'AS' symbol (indicating the measurement has stabilized). If so, record the following on the next available row on the data sheet:
    a. Date
    b. Time
    c. Specific Conductivity Reading
    d. Temperature Reading
    e. Date of Last Calibration
5. Once the instrument has equilibrated and the data sheet has been properly filled out, remove the device from the stream.
6. Shut down and properly store the device.
7. Check the data sheet for completion.





1. **Power and Backlight:** press once to turn on instrument. Press a second time to turn backlight on. Press a third time to turn backlight off. Press and hold for three seconds to turn off instrument

2. **Up Arrow:** use to navigate through menus, to navigate through box options along the bottom of the Run screen and to increase numeric inputs

3. **Calibrate:** Press and hold for three seconds to calibrate. Opens calibrate menus from the run screen

4. **Menu:** use to enter the system setup menus from the Run screen

5. **Enter:** press to confirm entries and selection

6. **Down Arrow:** use to navigate through menus, to navigate through box options along the bottom of the Run screen and to decrease numeric inputs

Photo Point Monitoring

Equipment Needed

Required:

- Camera and backup camera
- Folder with copies of previous photos
- Topographic and/or road map
- Aerial photos if available
- Compass
- Timepiece
- Extra batteries for camera (if applicable)
- Photo-log data sheets
- GPS unit

Optional:

- Staff gauge (for scale on landscape shots)
- Ruler (for scale on close up views of streams and vegetation)
- Steel fence posts for dedicating fixed photo points in the absence of available fixed landmarks

Considerations When Taking Photographs

For the entire duration of the stream photograph documentation project, always take photo-points from established sites at the same location with identical vertical angles, and definitive feature(s). Multiple photo-points may be taken at a selected monitoring site. Upon arrival a monitoring site, refer to the *Appendix C – Site Photos and Driving Directions* for instructions on what specific photo-points are to be taken at each site. Supplementary photographs can be taken at the photographer's specific discretion.

Once at a monitoring site, the following steps should be performed:

1. Confirm you are at the correct location with either existing marker (on the landscape such as steel fence post) or with GPS.
2. Locate the definitive feature for the given photo-point and correctly align the feature within the camera's view using a compass
3. Take a photograph
4. With digital cameras, confirm photograph is as close to a complete duplication as possible to the original photograph
5. Record the appropriate metadata on the datasheet

Photograph Metadata

For long term monitoring, it is critical to document factors about the photograph that are not contained within the picture. Some metadata should be recorded when sending photographs to the monitoring coordinator.

The following information should be recorded with all photo-points and supplementary photographs:

- Photo file name (.jpeg) – to be recorded when saving photos to flash drive
- Date and time when photograph was taken
- Name of photographer
- Location (site and stream)
- Description of photograph
- Examples
    - Careless Creek, looking upstream at site CC-CNF
    - North Meadow Creek, looking at north bank at site NM-MLL

Data Management

Data sheets for each site should be scanned and submitted to Luke Stappler after each monitoring period (every two weeks) and photographs from the photo points should be emailed to Luke Stappler at the same time. The data will be stored on the Program Coordinator's computer and posted on the Lower Musselshell Conservation District's website after the second monitoring period each month. These posts will include the raw data as well as graphs to show how the salinity levels have changed.

- Physical Address:
  Lower Musselshell Conservation District
  109 Railroad Avenue East
  Roundup, MT 59072

- Phone Number:
  (406) 323-2103 ext. 101

- Email:
  Luke.Stappler@mt.usda.gov

An excel worksheet will house all calibration and salinity data collection data. The excel worksheet will also include metadata. The Excel worksheet will contain at the minimum:

Calibration information:

- Volunteer name
- How many times was the meter calibrated?
- Longest time span between calibrations?
- Range in drift?

Data Collection:

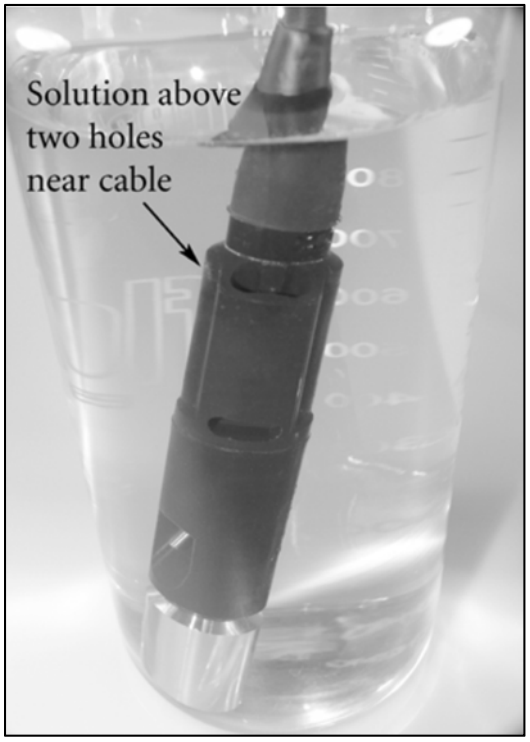
- Site Name, date, time
- Salinity reading
- Temperature
- Date of last calibration
- Sampler name
- Photos collected? If so, how many photos? .jpeg numbers

Appendix A – YSI Pro30 Calibration Instructions

Adapted from YSI Pro30 User Manual

The following instructions should be used for calibrating the YSI Pro30 in lieu of YSI's provided instructions. Subtle amendments have been made to the calibration process, which are not outlined in YSI's guidance manual. Temperature calibration is not required for the YSI Pro30.

Calibration of field meters should be performed **once every two weeks.** Follow the steps below to calibrate conductivity on the YSI Pro30:



1. Clean the probe with tap water and, if necessary, a wire brush.
2. Rinse the probe with used calibration solution to avoid contamination of conductivity standard.
3. Fill a clean container (glass beaker, graduated cylinder) with fresh conductivity calibration solution and place the sensor into the solution. The solution must cover the holes of the conductivity sensor that are closest to the cable (figures at right). Ensure the entire conductivity sensor is submerged in the solution or the instrument will read approximately half the expected value. Gently move the probe up and down to remove any air bubbles from the conductivity sensor.
4. Turn the instrument on and allow the conductivity and temperature readings to stabilize. Record the conductivity measurement (prior to calibration) in the calibration log.
5. Press and hold the Cal key for 3 seconds. Highlight Specific Conductivity and press enter.
6. Highlight uS/cm and press enter. Next, use the up or down arrow key to adjust the value on the display to match the value of the conductivity calibration solution. This value will always be 1413. The Pro30 will remember the entered calibration value and display it the next time a conductivity calibration is performed.
7. Press enter to complete the calibration. Or, press Cal to cancel the calibration and return to the Run screen. 'Calibration Successful' will display for a few seconds to indicate a successful calibration and then the instrument will return to the Run screen. If the calibration is unsuccessful, an error message will display on the screen. Press the Cal key to exit the calibration error message and return to the Run screen.
8. Empty the used calibration solution into the rinse vessel so the solution can be recycled.

YSI Pro 30 and Pro Plus: Information, Usage, and Maintenance

The collection of water quality data will be conducted using the YSI Pro30 and the YSI Pro Plus. Both instruments are handheld meters encased in impact resistant and waterproof cases. Each meter features a rugged cable connector that is linked to one or more probes. When submerged in water, the probe(s) will measure the water quality parameter it is able to detect.

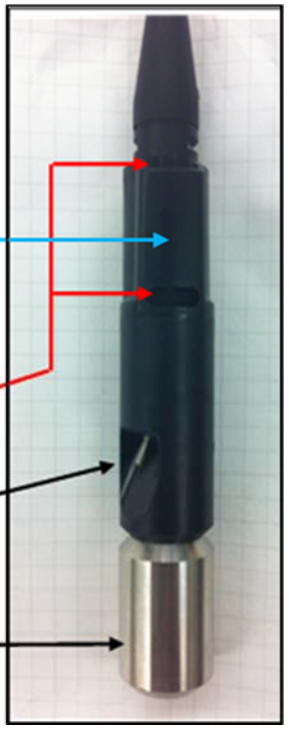
YSI Pro30

The YSI Pro30 measures electrical conductivity and temperature. The meter's computer uses these values to calculate specific conductivity, salinity, and total dissolved solids. It's important to be able to make the distinction between what is being measured and what is being calculated. The calculated values require the use of user-selectable coefficients, constants, and reference temperatures. For the purposes of this project, the default coefficients and constants will be used. Submitting grab samples to a lab can be done to determine the relationship between electrical conductivity and the calculated parameters, and thus, the ideal coefficients and constants for the Musselshell. Default values and conversion equations are as follows:

1. Specific conductance (SPC) default reference temperature = 25˚C
2. Specific conductance default temperature coefficient = 1.91%
   - Specific conductance (25˚C) = $\frac{\text{Electrical Conductivity}}{1 + 0.0191 * (T - 25)}$
3. Total dissolved solid default constant = 0.65
   - TDS (mg/L) = SPC (µS/cm) * 0.65


Looking down at the probe's anode and cathode

The YSI Pro Plus is more versatile with a 4-port probe, which measures temperature, electrical conductivity, dissolved oxygen, pH, oxidation reduction potential, ammonium, chloride, and nitrate. Volunteers will use the YSI Pro30's and the project coordinator will use the Pro Plus when a larger suite of water quality parameters are needed. Information on using the Pro Plus is not included in this document.



YSI Pro30 Care Instructions

- Calibration
  The YSI Pro30 should be calibrated prior to each use in the field to ensure the most accurate readings. Instructions for calibration can be found in Appendix A.

- Temperature Sensor Maintenance
  The sensor must be inspected before use to ensure that is it free of debris and build up. A toothbrush can be used to clean the sensor if necessary.

- Conductivity Sensor Maintenance
  The access ports that allow stream water access to the conductivity electrodes need to be inspected and cleaned regularly. Over time, deposits can form on the electrodes and affect the readings on the meter. This build up will be uncommon when conducting measurement in snowmelt fed mountain streams, but expected in prairie streams with elevated levels of salt and other dissolved solids. A small pipe cleaning brush can be used to clean the meters electrodes. In the event that deposits need to be removed, mild detergent should be used. Rinse thoroughly with clean water, then check the response and accuracy of the probe with calibration solution.

- Short and Long Term Storage
  - For both short and long term storage, the conductivity sensor should be stored **clean and dry.** Do not allow the probe to sit for long periods with deposits built up on the electrodes.
  - For short term storage and during transportation, the meter should be kept in a closed protective case (pelican case).
  - Remove batteries from the instruments when storing for long periods of time (>30 days)
  - Long term storage temperature: -5 to 70 ˚C (23 to 158 ˚F)
  - During long term storage, the meter's dry case should be kept open to eliminate humidity.

Appendix B – Data Sheets

Appendix B contains data sheets to be used in the field, and in preparation for field work. Data sheets can be found on the following pages.

Musselshell Watershed Site Visit Form

Team Members:	
Site Name:	**Site ID:**
Site Description:	

#	Date	Time	spc (µS/cm)	Temperature (˚C)	Date of Last Calibration
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

Comments:

EC Calibration Log Sheets

Date: ________________ Time: ________________

Name: ____

Location (where instrument is being calibrated): ____

Cal. Solution Standard		Reading Before Calibration		Set To		Reading After Calibration		Expiration Date of Calibration Solution	Temperature of Calibration Solution	
	µS/cm^c		µS/cm^c		µS/cm^c		µS/cm^c			°C

Date: ________________ Time: ________________

Name: ____

Location (where instrument is being calibrated): ____

Cal. Solution Standard		Reading Before Calibration		Set To		Reading After Calibration		Expiration Date of Calibration Solution	Temperature of Calibration Solution	
	µS/cm^c		µS/cm^c		µS/cm^c		µS/cm^c			°C

Date: ________________ Time: ________________

Name: ____

Location (where instrument is being calibrated): ____

Cal. Solution Standard		Reading Before Calibration		Set To		Reading After Calibration		Expiration Date of Calibration Solution	Temperature of Calibration Solution	
	µS/cm^c		µS/cm^c		µS/cm^c		µS/cm^c			°C

Date: ________________ Time: ________________

Name: ____

Location (where instrument is being calibrated): ____

Cal. Solution Standard		Reading Before Calibration		Set To		Reading After Calibration		Expiration Date of Calibration Solution	Temperature of Calibration Solution	
	µS/cm^c		µS/cm^c		µS/cm^c		µS/cm^c			°C

Equipment List

1. SAP/SOP _____
2. Site Visit Guide _____
3. GPS _____
4. YSI Meter _____
5. Extra Batteries _____
6. Calibration log _____
7. Calibration solutions _____
8. Waders/Boots _____
9. Clipboard _____
10. Data Sheets _____
11. Pen/Pencil _____

Field Activity Checklist

1. Calibrate YSI meter before going to the field _____
2. Deploy YSI Meter _____
3. Begin filling out Data Sheet _____
4. Collect YSI Meter measurements _____
5. YSI Measurements have equilibrated _____
6. Check that all forms are complete _____
7. Check that all gear is accounted for _____

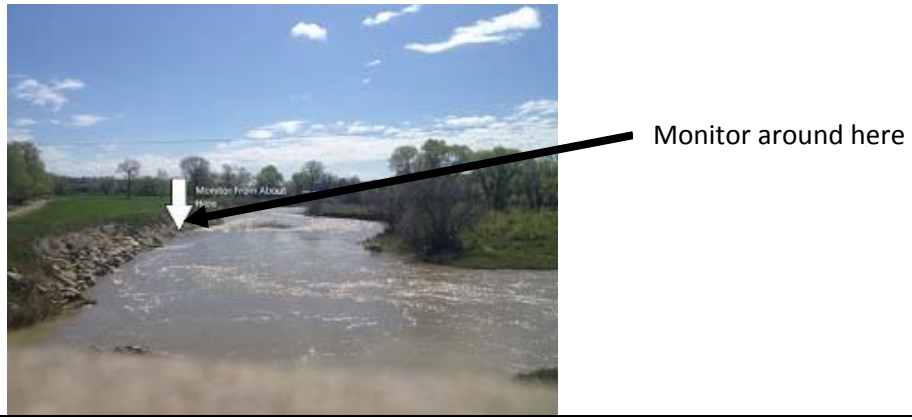
Appendix C – 2013 Site Photos and Driving Directions

Appendix C contains photos of the sample sites and photo points and driving directions

TwoDot Bridge	Monitor: Leon Hammond Upper Musselshell WUA Site ID: MWC_MSSL_TwoDot Lat/Long: 46.43, -110.07 **Driving Directions:** Take Hwy 12 West from Harlowton. Travel about 12 miles and Turn left (South) on Two Dot Hwy (the town of Two Dot turn off). Continue to the bridge, and park at pullout next to bridge. **Access & Monitoring:** River access and sampling site is at the northwest side of the bridge. This reach is frequently de-watered in the late-summer months and flows are highly influenced by discharge from the nearby Martinsdale Reservoir. Monitoring access is just under bridge. **Photo-points:** Photos should be taken from the bridge abutment facing west-southwest with the end of fence and flagging tape in the center of the frame. A marker will be in place for the camera on the abutment. Photo is at a medium downward angle looking upstream on the river with the north bank in view. The photo is bisected by a fence which separates a fishing access easement from a landowner's property. The southern bank of the stream will be slightly in frame. A stretch of the bank is covered in rip-rap on the southern side. **Sample Site:**  **Photo Point:** 

East Harlowton	Monitor: Leon Hammond Upper Musselshell WUA Site ID: MWC_MSSL_EHarlow Lat/Long: 46.43, -109.8 **Directions:** Take Hwy 12 East from Harlowton. Turn right (South) on Red Bridge Rd (at sewer lagoons) and continue to the bridge, and park at pullout next to bridge. **Access & Monitoring:** River access is off bridge to the south west. Reach frequently becomes de-watered in the late-summer months. Monitoring is just under bridge. **Photo-points:** Photos should be taken from bridge abutment on the south bank facing northwest with a steel post and green flagging tape on a peninsula on the north bank. The bridge abutment is marked to show where the camera should be. The photo is set at a medium downward angle looking upstream on the river the north bank in view as the river comes through a bend. The south bank will be in view as well along with an abandoned reach and backwater. Banks have health populations of native vegetation at the bend. The area damaged by the flood should be monitored periodically. Supplemental photos detailing the changes to the flood damaged (eroding) bank to the west of the site should be taken as well. **Sample Site:**  **Photo Point:** 

Above Careless Confluence	Monitor: Annie and John Colson Water Users Site ID: MWC_MSSL_Abv_Careless Lat/Long: 46.293983, -109.257867 **Directions:** From Ryegate, head South on 1st St S, follow the curve to the right, and park in front of the water building before the bridge. The monitoring site is immediately upstream from the bridge. **Access & Monitoring:** This sampling site is upstream from the Careless Creek confluence just south of Ryegate. It represents the water quality of the Musselshell River before the discharges from Careless Creek. It is beneath the bridge south of Ryegate near the city water building. **Photo-points:** Photos should be taken from the bridge south of Ryegate by the city water building facing upstream. The placement of the camera is marked on the upstream side of the bridge. The camera should be placed within this marked box and angled slightly downward. **Sample Site:** **Photo Point:**  

Below Careless Confluence	Monitor:,Annie and John Colson Water Users Site ID: MWC_MSSL_Blw_Careless Lat/Long: 46.32, -109.18 **Directions**: From Ryegate, drive approximately five miles east to the bridge just after Sterling Rd. Pull into the dirt drive immediately after the bridge on the right, and park in the small dirt pullout before to the right of the gate. To walk into the monitoring site, cross the barbed wire at the HWY, and walk down the rip rap or on top of the bank to the site. **Access & Monitoring:** Access is downstream (east) from Careless Creek, just off the parking area south of the highway on the north side of the river. This site monitors the water returning to the Musselshell from Deadman's basin. Receives discharge from Careless, Deadman's, and Barber Canal. **Photo-points:** Photos should be taken from the bridge over Careless Creek on US 12. There is a point marked on the bridge railing facing downstream for the camera. The camera should be lined up within the marked box facing downstream at a slightly downward angle. **Sample Site and Photo Point:** 

Careless Creek at Musselshell	Monitor: Annie and John Colson Water Users Site ID: MWC_Careless_Abv_Mssl Lat/Long: 46.32, -109.19 **Directions:** From Ryegate, drive approximately five miles east to the bridge just after Sterling Rd. Pull into the dirt drive immediately after the bridge on the right, and park in the small dirt pullout before to the right of the gate. Cross barbed wire fence from south side of the highway. Walk under the bridge and open fence at loose panel held on by piece of wire. Walk to site from there. **Access & Monitoring:** This site monitors Careless Creek at the highway just above its confluence with the Musselshell. **Photo-points:** Photos should be taken from the bridge over Careless Creek on US 12. There is a point marked on the bridge railing facing upstream for the camera. The camera should be lined up within the marked box facing up Careless Creek at a slightly downward angle. **Sample Site and Photo Point:** 

Hwy 87 Roundup	Monitor: Luke Stappler, Musselshell Watershed Coalition Site ID: MWC_MSSL_Hwy87 Lat/Long: 46.43, -108.57 **Directions:** From Roundup, drive 2 miles South to the HWY 87s bridge, and pull off on the road immediately before the bridge on the right side of road. Turn left on the dirt road that runs parallel to the HWY. Park, walk down, and monitor upstream from the bridge. **Access & Monitoring:** River access is on the north west side of the bridge over Hwy 87. Site is close to private property. This site is upstream of Roundup. Monitoring should be done upstream of the bridge and not under it to avoid inaccurate in-stream temperature readings. **Photo-points:** Photo-point site is on the bridge itself facing upstream. There is a spot marked in paint pen where the camera should be placed. Face the camera upstream with a slight downward tilt. **Sample Site:** **Photo Point**  

County Rd #4	Monitor: Luke Stappler, Musselshell Watershed Coalition Site ID: MWC_MSSL_CoRd4 Lat/Long: 46.45, -108.51 **Directions:** In Roundup, head East on 2nd Ave East until it forks. Take #4 Rd (the left fork) until the bridge over the Musselshell (approximately 2 miles). Park in the pull off on the right before the bridge. Enter through the barbed wire fence on the same side, and walk to the site. Monitor approximate 20 feet upstream from the bridge. **Access & Monitoring:** Access is on the northeast end of the bridge over the Musselshell. Monitoring site is on the north side of the river. Access is made somewhat difficult by cattle fence. Monitoring should be done downstream of the bridge and not under it to avoid inaccurate in-stream temperature readings. **Photo-points:** Photo-point site is on the bridge facing upstream. There is a spot marked in paint pen where the camera should be placed. Face the camera upstream with a slight downward tilt. **Sample Site:** **Photo Point**  

Musselshell Bridge	Monitor: Lynn Rettig, Delphia-Melstone Canal Users Site ID: MWC_Mussel_AtMusselshell Lat/Long: 46.52, -108.09 **Directions**: Musselshell Bridge - Take HWY 12 East from Roundup to the Musselshell turnoff. Continue towards Musselshell and cross the Musselshell River on the bridge. On the South side of the river to the left there is a parking spot. Park here. **Access & Monitoring:** Musselshell River at bridge north of Musselshell is accessible from the bridge to the south east. This site monitors the quality of water going into the north and south canals. Monitoring should take place on the south bank of the river and should not take place under the bridge. **Photo-points:** Photo-point site is on the bridge facing upstream. There is a spot marked in paint pen where the camera should be placed. Face the camera upstream with a slight downward tilt. **Sample Site:** **Photo Point:**  

Above Melstone South Canal	Monitor: Lynn Rettig, Delphia-Melstone Canal Users Site ID: MWC_MSSl_Abv_Canal Lat/Long: 46.72, -107.83 **Directions:** Go back out from Musselshell to HWY 12 and head east again. Go past the town of Melstone about a mile and turn North onto the Mosby Road. Maybe about 8 miles you will find a county road that goes east. It is almost to the end of the pavement. If you leave the pavement you have gone too far. After you head east you will find a bridge that crosses the Musselshell River. Park on the East side of the bridge and monitor. **Access & Monitoring:** The monitoring site is on the shore off the left side of this picture, just down from the bridge. Monitor water quality on the Musselshell above Delphia/Melstone South Canal. **Photo-points:** Take from marked spot on bridge over the start of the South canal facing up the Musselshell River. Tilt camera slightly downwards. **Sample Site and Photo Point:** 

Delphia/ Melstone South Canal at End	Monitor: Lynn Rettig, Delphia-Melstone Canal Users Site ID: MWC_MSSL_Blw_Canal Lat/Long: 46.72, -107.83 **Directions:** Continue East from the "above Melstone canal" spot less than 1/4 mile. There will be an old Feedlot on your left. Turn into feed lot and go north through the Feedlot until you come out on the north side. You will cross the South Canal and immediately turn West and it will take you to the river and to where the South Canal dumps back into the river. Park and walk down to the river to monitoring spot. **Access & Monitoring**: Monitor at approximately where the arrow is. It's on the same side of the river as the photo point. Site monitors water quality on the Delphia/Melstone South Canal above its confluence with the Musselshell. **Photo-points:** Place camera on pipe on the river side of the headgate. Tilt the camera slightly downwards while pointing upstream. **Sample Site and Photo Point:** 

Musselshell Above Flatwillow	Monitor: Jolene Shaw, Site ID: MWC_MSSL_Abv_Flatwillow Lat/Long: 46.93, -107.93 **Directions:** From Winnett, head East on HWY 200 for approximately 25 miles until the HWY 500/Melstone Rd intersection right before the town of Mosby. Turn Right (South) on HWY 500 and drive approximately 5 miles until you see a sign for the Woodford ranch. Turn left at the sign, and take the road that curves to the right below the hill where the house is perched. The road will take you past a pen and stables on your left, and it will curve left around these to a gate. Open the gate and drive about 300 feet to the low water crossing. Monitor and take photo points there. **Access & Monitoring:** Monitor right next to where a person would be standing to take this picture. Site is located on the Musselshell above its confluence with Flat Willow Creek. **Photo-points:** Photo-point is taken at the low water crossing downhill from the Woodford residence facing upstream towards the cliffs. **Sample Site and Photo Point:** 

Musselshell Below Flatwillow	Monitor: Jolene Shaw, Site ID: MWC_MSSL_Blw_Flatwillow Lat/Long: 46.92, -107.93 **Directions:** Coming from the Woodford Ranch, head back towards HWY 200. Immediately upon crossing the bridge over Flatwillow, there is a two track and a gate to your right. Go through gate, and turn left. Follow the two track until it dead ends at the river with a long gravely beach down to your left along the river. You can drive down to monitor or you can park and walk. The shore can be muddy. **Access & Monitoring:** Monitor right next to where a person would be standing to take this picture. There is a large tree deposited by the 2011 flood that is a good marker This site is located on the Musselshell river just below the Flatwillow Creek confluence at the low water crossing. **Photo-points:** Photo-point is taken at low water crossing just below the Flatwillow Creek confluence facing upstream. The camera should be held at five feet off the ground with no angle. The hill upstream is centered in the photograph. **Sample Site:**  **Photo Point**