**Musselshell Watershed Coalition**

**Musselshell Monitoring Project 2015**

**Sampling and Analysis Plan**



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# Introduction

### Project Area Overview

The Musselshell River is part of a unique combination of mountain and stream watershed systems located in Central Montana. Originating in the Crazy, Castle, and Little Belt Mountains, the Musselshell flows over 300 miles from its source near Martinsdale, MT to its confluence with the Missouri at Fort Peck Reservoir. Late spring rainfall and snowmelt from the valley's bordering mountain ranges are responsible for the majority of the Musselshell's in-stream flows throughout the year. The 9,500 square mile drainage in the Musselshell encompasses a varied landscape including ponderosa pine woodlands, sagebrush dominated plateaus, short grass prairie, and a thin ribbon of riparian corridor characterized by cottonwood galleries and thickets of willow.

The valley's economy is centered on agriculture with dry-land farming and ranching operations representing the majority of agricultural production. Mineral extraction has also long been present in the valley, namely coal mining in the Bull Mountains south of Roundup, MT. Since the late 19th century, many significant alterations have been made to the Musselshell River floodplain. Most significantly, the now defunct “Milwaukee Road” railway running adjacent to the Musselshell for a large extent of its reach shortened the river's original channel length and prohibited it from accessing its floodplain. Historically, the Mussellshell was commonly dewatered during late summer months due to irrigation withdrawals. In 2011, the Mussellshell River encountered unprecedented flooding (the largest measured flood since recording began in 1946) which saw flows over 15,000 cf/s at Roundup and 25,100 cf/s at Mosby (Boyd et al. 2012). The biggest flood prior to 2011 saw flows around 9,600 cf/s at Roundup. The impact from the flooding drastically changed the geomorphologic conditions and caused extensive damage to infrastructure and property in the river corridor (Boyd et al. 2012).

The Musselshell has been listed on the 303d list of impaired waterbodies by the Montana Department of Environmental Quality (MDEQ) as impaired for alterations to stream-side or littoral vegetation, low flow alterations, nitrogen, phosphorus, substrate alterations and sediment (MDEQ, 2014). The river is not listed as impaired for salinity, but increasing salinity in the lower reaches of the river near and below Melstone is of concern to local irrigators.

### Project Goals and Objectives

The goal of this monitoring project is to simultaneously collect credible, useful data while also providing a method for education and outreach about water resources. Salinity, sedimentation/erosion, and weeds have been raised as topics of concern and will be monitored alongside salinity. Salinity is addressed by using specific conductance meters, while erosion/sedimentation and weeds are addressed through photo point monitoring. Monitoring efforts seek to meet the following basic objectives:

1. To collect salinity data that can help inform sustainable irrigation practices. Examples include adjusting the quantity or timing of irrigation sessions, or conducting shoreline or ecological restoration in areas identified as problematic.
2. To collect photo documentation of bank condition changes through time. The emphasis will be placed on sedimentation/erosion and weeds, and could help MWC identify areas in need of shoreline or ecological restoration.
3. To engage local water users in data collection to increase awareness about water quality.
4. To produce locally collected data that can be used in public education efforts to foster stewardship and increase communication about water resources.

# 2 Sampling Process

### Study Design

Sampling will be conducted on the Musselshell River and several of its tributaries from the confluence of its north and south forks to its confluence with Flatwillow Creek upstream from Fort Peck Reservoir. The tributaries, Careless Creek and Flatwillow Creek, will also be monitored along with a section of the Delphia-Melstone Canal. There will be 12 sites monitored in total. Additional field parameters will be measured at the sites visited by the volunteer coordinator (historically a BSWC member) who will have access to a meter with dissolved oxygen and pH in addition to temperature and specific conductance. Most sample sites are laid out above and below major points of diversion and confluences, others are laid out above and below human developments. The Musselshell River differs significantly from its upper to lower reaches, transitioning from a mountain to a prairie stream system, so the sites are laid out to capture those differences. Proximity of sites to USGS gaging stations was also taken into account, such as the Mosby and Musselshell bridge stations.

Before the start of the sampling season, meters will be calibrated with fresh calibration solution (to be obtained by MWC), then tested together with at least 15 solutions with salinity ranging from 500-5000uS/cm (Each of the 15 test solutions should confirm that the probes stay within 5% margin of error). Volunteers will receive training from the volunteer coordinator. Sample collection will occur twice per month within a 3-day window and will bracket the irrigation season to the degree possible. The volunteer will let the coordinator know if they will not be able to take a sample within the 3-day window. Ideally, sampling will occur during the first and third weeks of the month starting in mid-April and ending mid-October. If possible, higher frequency sample collection, especially during or after storm events, will be encouraged. Volunteers will conduct data collection with meters and cameras provided by the MWC. The volunteer coordinator will maintain contact with these volunteers throughout the season to ensure timely collection of measurements and photo data.

Data will be managed through a combination of paper records to be filled out onsite, online database to be updated immediately after site visit, and offline database to be updated at least twice per field season. Hard copies of data sheets will be collected throughout the monitoring season and scanned at the end of the monitoring season, to be stored by MWC. All meters will be recollected and recalibrated at the end of each sampling season. Online data will be taken down; corrections will be made for calibration drift, and reposted. Hard copies of data will be stored by MWC for a minimum of five years.

### Sampling Locations

| **Site #** | **Site Name** | **Site ID** | **Lat** | **Long** | **Site Description** | **Sampler 2015** | **Notes** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | Musselshell at Two Dot Bridge | MWC\_MSSL\_TwoDot | 46.430172 | -110.072134 | Musselshell at NW side of bridge | Leon Hammond | 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 | Leon Hammond | Represents water quality downstream of Harlowton, MT. |
| 3 | Musselshell Above Careless Confluence | MWC\_MSSL\_AbvCareless | 46.293983 | -109.25867 | Musselshell River south of Ryegate near city water building | Pam Mickelson | Representative of Musselshell before the Careless Creek confluence |
| 4 | Musselshell Below Careless Confluence | MWC\_MSSL\_BlwCareless | 46.3151 | -109.183957 | Musselshell River downstream from Careless Creek, just off of the parking area south of the HWY on the north side of the river | Pam Mickelson | Musselshell where Deadman's water is back in the stream. Careless Creek, Deadman's and Barbara Canal |
| 5 | Careless Creek at Musselshell Confluence | MWC\_Careless\_AbvMssl | 46.315299 | -109.185769 | Careless Creek at hwy just above confluence of Musselshell | Pam Mickelson | Deadman’s basin water reaching Musselshell mixed with more saline Careless Creek water. |
| 6 | Musselshell at Hwy 87 Bridge near Roundup | MWC\_MSSL\_RoundupHwy87 | 46.427732 | -108.570852 | Musselshell at hwy 87 bridge north west of bridge | Donna Pedrazzi | Upstream of Roundup |
| 7 | Musselshell at County Road 4 Bridge | MWC\_MSSL\_CoRd4 | 46.446475 | -108.512595 | Musselshell at County Road number 4 bridge east of Roundup on the northeast corner of bridge | Donna Pedrazzi | 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 | Lynn Rettig | Quality of water going into south and north of canal of Delphia/Melstone Canals |
| 9 | Musselshell Above Melstone South Canal Return | MWC\_MSSl\_AbvMelCanal | 46.720 | -107.8225183 | Musselshell Above Delphia/Melstone South Canal | Lynn Rettig | Quality above confluence |
| 10 | Musselshell Below Melstone South Canal Return | MWC\_MSSL\_BlwMelCanal | 46.725532 | -107.8275953 | Musselshell below confluence with Lower end of Delphia/Melstone South Canal | Lynn Rettig | Represents quality of River water after mixing with Canal water |
| 11 | Musselshell Above Flatwillow Creek | MWC\_MSSL\_AbvFlatwillow | 46.921969 | -107.927144 | Musselshell above Flatwillow Creek | Tammie Starkjohann | River above Flatwillow Creek. Potentially lots of alkaline inflow between here and Delphia |
| 12 | Musselshell Below Flatwillow Creek | MWC\_MSSL\_BlwFlatwillow | 46.931214 | 107.927372 | Musselshell below Flatwillow Creek | Tammie Starkjohann | Represents water quality post Flatwillow and irrigation returns |

Macintosh HD :Users:Work:Documents:2015 Musselshell Sites.pdf

### Sampling Methods

Sampling will be conducted for in-stream temperature and electrical conductivity with YSI Pro 30’s (for volunteers) and YSI Pro Plus multi-meters (for monitoring coordinator) and photo points. Each of these methods will be conducted in accordance with SOPs outlined in the Appendices. A data sheet will be filled out at each site during each monitoring period. Site locations will be corroborated using the site list and photos in Appendix A and/or a GPS. The GPS coordinate system datum will be NAD 1983 State Plane Montana, in decimal degrees to at least the fourth decimal. Photographs will be taken using a digital camera.

Data collection will be supplemented by use of discharge from USGS gaging stations within the reach.

The Musselshell River Distribution Project and the Musselshell Watershed Coalition use these gaging stations extensively. Sites were chosen in part because of their proximity to these established gaging stations.

###### YSI Pro30 System Specifications

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Sensor Type** | **Range** | **Accuracy** | **Resolution** |
| Conductivity (mS, μS) | Four-electrode cell | 0 to 200 mS/cm (auto range) | 1- or 4-m cable, ±1.0% of the reading or 1.0 μS/cm, whichever is greater  10-, 20-, or 30-m cable, ±2.0% of the reading or 1.0 μS/cm, whichever is greater | 0.0001 to 0.1 mS/cm (range dependent) |
| Temperature | Thermistor | -5 to +55°C (23 to 131°F) | ±0.2°C | 0.1°C |

###### YSI Pro Plus System Specifications

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Sensor Type** | **Range** | **Accuracy** | **Resolution** | **Units** | **Calibration** |
| Conductivity | Four electrode cell | 0 to 200 mS/cm (auto range) | ±0.5% of reading or 0.001 mS/cm, whichever is greater (1-, 4-m cable) ±1% of reading or 0.001 mS/cm, whichever    is greater (20-m cable) | 0 to 0.500 mS/cm = 0.001  0.501 to 50.00 mS/cm = 0.01  50.01 to 200 mS/cm = 0.1  (range dependent) | µS, mS | 1 point |
| Temperature |  | -10 to 100.00°C | ±0.2% FS ±1 digit | 0.1°C | °C, °F, K |  |

### Photo Monitoring Setup

Landscape photographs can offer a qualitative and, in some situations, quantitative evaluation of the current and trending conditions in a watershed or on a waterbody when cross referenced with more concrete information such as bankfull dimensions. The details contained within photographs provide insight into a number of ecological parameters and environmental conditions that can be logistically challenging to measure, thus making photo monitoring cost effective. The parameters and conditions that can be documented with photographs range from stream bank erosion and riparian vegetation regeneration to assessing restoration effectiveness and consequences of natural disasters. If repeated for sufficient period of time, these photos can be used to evaluate resource conditions over time and help inform management decisions. Modern camera technology is inexpensive, widely available, and simple to operate. In addition to being valuable pieces of scientific data, photographs can also be used in reports and presentations as a powerful tool to explain what is going on in the field.

### Types of Photographs

* **Photo-points**

Photo-points are photographs that are taken at a specific location to address a specific objective. These photographs will always be taken from the same position and oriented in the same direction with the same vertical angle. The goal is to recreate the same scene within the picture to track changes through time. Camera operators must take extra precaution when taking photo-points to ensure they are in the correct location and are pointing the camera in the correct direction, as well as recording the necessary information about the photograph (metadata).

* **Supplementary Photos**

Supplementary photos can be taken of features or evidence of activity within the stream and riparian area that are either unusual or of interest. These photos do not need to be taken in any particular position, but should be documented with the same information (metadata) used with the photo-points. In the extreme case of an extraordinary finding, such as Bigfoot, GPS coordinates should be recorded in the photo description section of the datasheet. Examples of supplementary photos include:

|  |  |
| --- | --- |
| * Evidence of flood damage | * Irrigation structure damage |
| * Invasive plants | * Turbidity events |
| * Unidentifiable plants or animals | * Trash dumps |
| * Extreme erosion | * Happy volunteers |

### 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

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# 3 Project Team Responsibilities

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Person** | **Role** | **Contact Info** | **Responsibilities** | |
| Matt Schmidt BSWC 2015 | Volunteer Coordinator | [mwatershedc@gmail.com](mailto:mwatershedc@gmail.com) | | Ensure field sheets are complete and accurate. Publish and compile salinity and photo-point data. Manage GIS database. Author preliminary and final reports on monitoring program. |
| Erin Wall and Adam Sigler | Technical Assistance | [ExtensionWater@montana.edu](mailto:ExtensionWater@montana.edu) [asigler@montana.edu](mailto:asigler@montana.edu) | | Assistance with SAP/SOP modifications when necessary. |
| Leon Hammond | Volunteers | rhammond@itsTriangle.com | | Take salinity measurements and photos points at: MWC\_MSSL\_TwoDot, MWC\_MSSL\_EHarlow |
| Pam Mickelson | Volunteer | pj.trails@yahoo.com | | Take salinity measurements and photo points at: MWC\_MSSL\_AbvCareless, MWC\_MSSL\_BlwCareless, MWC\_Careless\_AbvMssl |
| Tammie Starkjohann | Volunteer | tlstarkjohann@hotmail.com | | MWC\_MSSL\_BlwFlatwillow, MWC\_MSSL\_AbvFlatwillow |
| Lynn Rettig | Volunteer | <rettig@midrivers.com> | | Take salinity measurements and photo points at: MWC\_MSSL\_Musselshell, MWC\_MSSl\_AbvCanal, MWC\_MSSL\_BlwCanal |
| Donna Pedrazzi | Volunteer | Donna.Pedrazzi@mt.nacdnet.net | | Take salinity and photo points at:  MWC\_MSSL\_RoundupHwy87  MWC\_MSSL\_CoRd4 |

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# 4 Quality Assurance, Data Management and Communication

Data needs to accurately represent the conditions in the watershed in order to be informative. Quality Assurance (QA) is a system used to ensure that data is of sufficient quality to be useful for the intended purpose. This includes having protocols in place, ensuring people are properly trained and following protocols, making sure meters are calibrated, ensuring datasheets are filled out correctly, and entering data into a database for long term storage.

### Instrument Calibration and Maintenance

Volunteer coordinator will calibrate instruments at the beginning and at the end of the sampling season. Any anomalies in calibration will be addressed by correcting the season’s data in linear fashion. Instruments will be cleaned and maintained during winter storage in the Winnett field office.

### Training

The volunteer coordinator will be trained by MSUEWQ on instrument calibration, use of field meters, and data management. The volunteer coordinator will subsequently train the volunteers on use of instruments and data management including updating the online database and collection of photo point data.

### Datasheets and Review

Datasheets for specific conductance and photos are completed in the field and maintained by volunteers. The volunteer coordinator will collect hard copies of datasheets from volunteers each month and will review them for completeness. Issues with datasheet completeness will be addressed with the volunteers.

### Data Entry and Storage

Volunteers will email the program coordinator scanned data sheets and photo-point files after each monitoring event through the monitoring season if convenient. If volunteers do not have access to a scanner, the volunteer coordinator will arrange to pick up data sheets in person. At least one face-to-face meeting between volunteers and coordinator is necessary during the field season. The program coordinator will collect and enter specific conductance data and calibration information once per month during the field season into an Excel worksheet titled “Monitoring Data 2015-YYYY-MM-DD”. During the same time, photo point and site photos will also be saved. Photo files are saved and named with the site ID and date. All data and photos are stored on Google Drive ([www.google.com/drive](http://www.google.com/drive)) under the account [mwatershedc@gmail.com](mailto:mwatershedc@gmail.com) with the password “Friday” The folder pathways for photos and salinity data respectively are My Drive>Citizen-based Salinity Monitoring>Data>[Year i.e. “2015”]>Photopoints and My Drive>Citizen-based Salinity Monitoring>Data>[Year i.e. “2015”]>Salinity Data respectively. All files will be stored in this database.

Specific conductance and temperature data will be plotted as time series in our online database which will be updated in real time (as entries are made) to track the behavior of salinity through time at different locations on the river. At the end of the monitoring season (in October), all data will be entered and plots of specific conductance will be made for a presentation to the MWC group.

The salinity data will also be uploaded to the MWC’s website, http://musselshellwc.wix.com/musselshellwc, to the “Musselshell Salinity Levels” page under the top “Projects” menu. A graph of all the sites through time will be displayed and updated with a table of the raw data. The photo-points will be uploaded regularly to the same page. Make separate Word files for each site for the photo point documents. Make the document by using two columns and then placing the photos in the column opposite the picture from the previous week to easily visually compare the photos and label each photo with the date. (example composite photo point document: http://musselshellwc.wix.com/musselshellwc#!musselshell-salinity-data/c1bhp)   These composite photo point documents are stored on the same Google drive database and in the same file as the photo points, but labeled, “consolidated photo points”.  The documents are named by the site name followed by “photo points 2014” (example: “Consolidated.Photo.Points\_Musselshell.Below.Roundup.09.25.14.docx”).

At the end of each year, the program coordinator will fill out an annual data collection summary. This will include information about how many measurements were taken at each site, instrument calibration anomalies, how many photos were taken, etc.

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### Pre/Post Season Checklists:

**Pre-Season Checklist:**

* Update SAP/SOP/Site-Specific SAP
* Purchase Calibration Solution and New Batteries for Probes.
* Calibrate probes and log calibration information.
* Produce volunteer folders with SAP, Site-Specific SAP, and Datasheet
* Recruit/Train Volunteers
* Distribute Probes/Folders

**Post-Season Checklist:**

* Collect Probes, Datasheets, Photopoints from Volunteers
* File Datasheets, Organize Photopoints, and Store Probes safely
* Produce Post-Season Report

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