

APPENDIX A

REGIONAL CASE STUDY: THE UPPER MISSOURI RIVER BASIN SOIL MOISTURE AND PLAINS SNOW MONITORING NETWORK

A.1 Background

After the historic 2011 flood, and in response to one of the six recommendations from the Independent Review Team, the U.S. Army Corps of Engineers (USACE) and various Missouri River Basin agencies developed a framework in 2013 for the establishment of an Upper Missouri River Basin Soil Moisture and Plains Snow Monitoring Network (UMB Monitoring Network). The USACE is collaborating with Federal and state partners to update the 2013 recommendations. The USACE uses plains snowpack and soil moisture data in its runoff forecasting for operations, and along with other Federal agencies, has found limitations with the plains snow and soil moisture data that is currently being collected.

A.2 Federal Support

The Water Resources Reform and Development Act of 2014³⁰ included a requirement that the Secretary of the Army, in coordination with other specified agencies, carry out snowpack and soil moisture monitoring in the Upper Missouri Basin. The Water Infrastructure Improvements for the Nation Act of 2016³¹ Section 1179(b) designated the USACE as the lead agency for that effort.

A.3 Value to the USACE and the Upper Missouri River Basin

The data obtained from the network will be available for all federal, state, and local agencies to use in their betterment of existing products and/or the development of new products (e.g., NWS river forecasts and flood outlooks, U.S. Drought Monitor, NOAA Climate Prediction Center outlooks, U.S. Bureau of Reclamation (USBR) and USDA-NRCS water supply forecasts, and various Federal and state fire hazard reports). Specifically for the USACE, the data will be used by the NWS-National Operational Hydrologic

Remote Sensing Center (NOHRSC) office to better their plains snow map. The map is direct input into the river and runoff models used by the NWS and the USACE, respectively. Those river and runoff models also use soil moisture data to model the impacts of melted plains snow and rainfall to estimate the inflows into the USACE's reservoir projects.

A.4 Network Goals

The plains area of the Upper Missouri River Basin (above Sioux City, Iowa) in the United States totals 270,000 square miles, as shown in Figure A.1 (*next page*). Ongoing discussions with soil moisture experts (e.g., state mesonet operators, NRCS and NRCS-National Soils Lab) and plains snow and river forecasting experts (NWS-NOHRSC and NWS-Missouri Basin River Forecast Center (MBRFC)) has revealed that a soil moisture and plains snow monitoring site should be installed in every watershed (*see Figure A.1*) at a density of 1 in every 500 sites, meaning a goal of 540 monitoring sites total.

A monitoring site includes the following sensors: soil moisture and temperature at five depths, snow depth, wind speed and direction, solar radiation, relative humidity, precipitation, and air temperature. In addition, during the December–March period, onsite weekly snow depth and snow water equivalent measurements should be taken at each site and conveyed to the USACE, NWS-NOHRSC, and NWS-MBRFC offices for integration into their models.

There are approximately 180 existing soil moisture sites in the Upper Missouri River Basin. These sites do not include plains snow monitoring equipment. Of these 180 sites, 156 are owned and operated by five state mesonet offices (Montana, Wyoming, North Dakota, South Dakota, and Nebraska), the other 24 are owned and operated by the USBR (AgriMet). The USACE is actively working with the

³⁰ <https://www.congress.gov/113/bills/hr3080/BILLS-113hr3080enr.pdf>

³¹ <https://www.congress.gov/114/plaws/publ322/PLAW-114publ322.pdf>

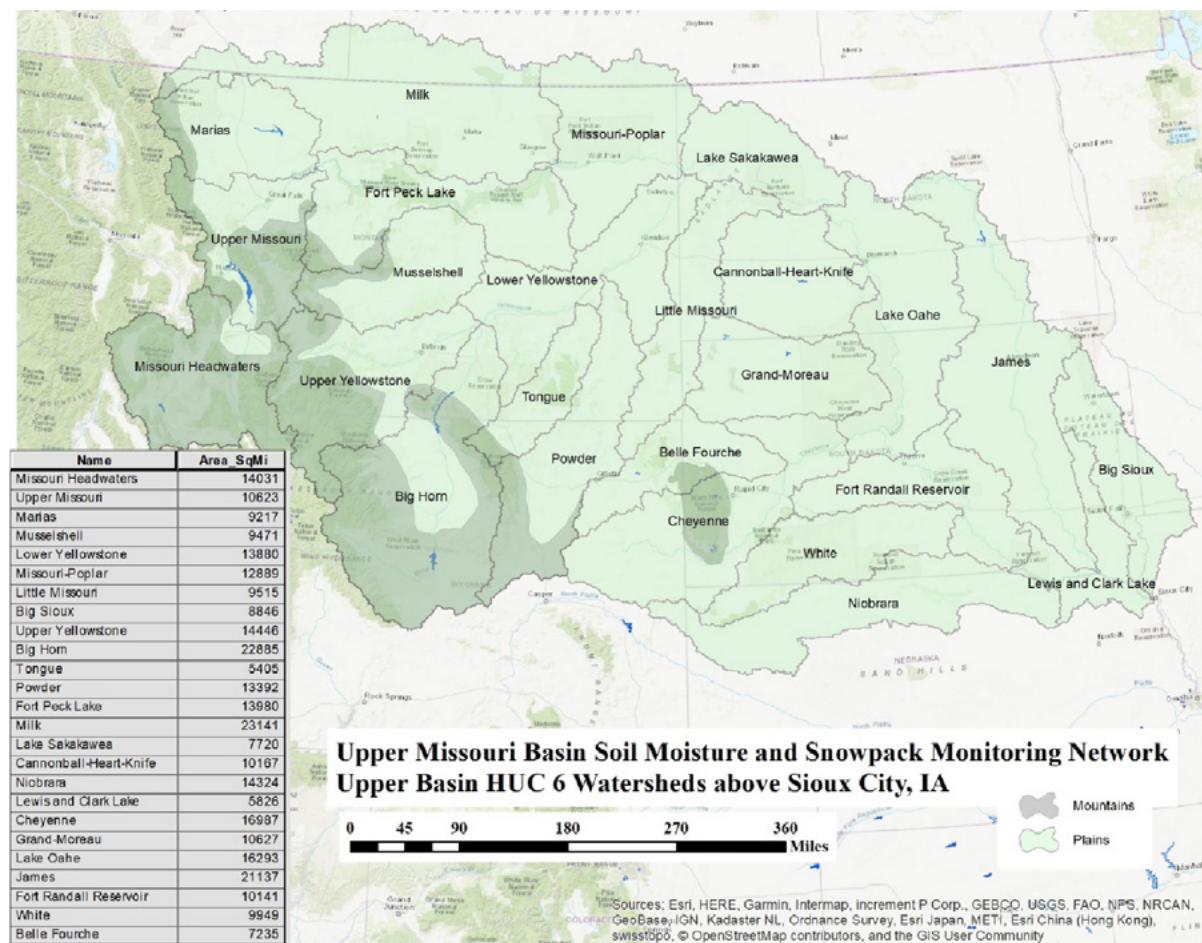


Figure A.1: The geographical extent of the UMB Monitoring Network.

Mesonet offices and the USBR to modify their existing sites to be part of the UMB Monitoring Network. The USACE is also working with the NRCS and NWS-NOHRSC to develop a site selection methodology for new sites for each watershed. To complete the 540-site network, 360 new sites will need to be installed.

A.5 Funding Structure

The USACE is paying for the purchase and installation of all equipment for all sites (existing and new) as well as soil characterization. Specific costs for installing the equipment are still being determined, as well as the determination for what agency will assume ongoing operation and maintenance once the network is installed.

A.6 Completed and Ongoing Work

An instrumentation test bed at South Dakota State University with the South Dakota Mesonet is

complete. The report was furnished to the USACE in August 2019, and established the equipment needs for the network. The USACE and NRCS National Soils Lab have established a methodology to select the new (roughly 360) sites. Work is ongoing to complete the following: 1) complete a Programmatic Environmental Assessment to meet National Environmental Policy Act (NEPA) requirements; 2) establish interagency agreements with the NRCS or NOAA and the state offices operating the Mesonet networks for the installation of new sites and annual maintenance of the entire network; 3) finalize the agreement with the NRCS National Soils Lab regarding the soil characterization effort; 4) establish an agreement for a Mesonet Coordinator, which is a liaison between USACE and the state mesonets to facilitate land use agreements, NEPA, reporting, etc.; and 5) complete an implementation guide that outlines all roles and responsibilities for all offices/agencies involved in the establishment and maintenance of the network.