

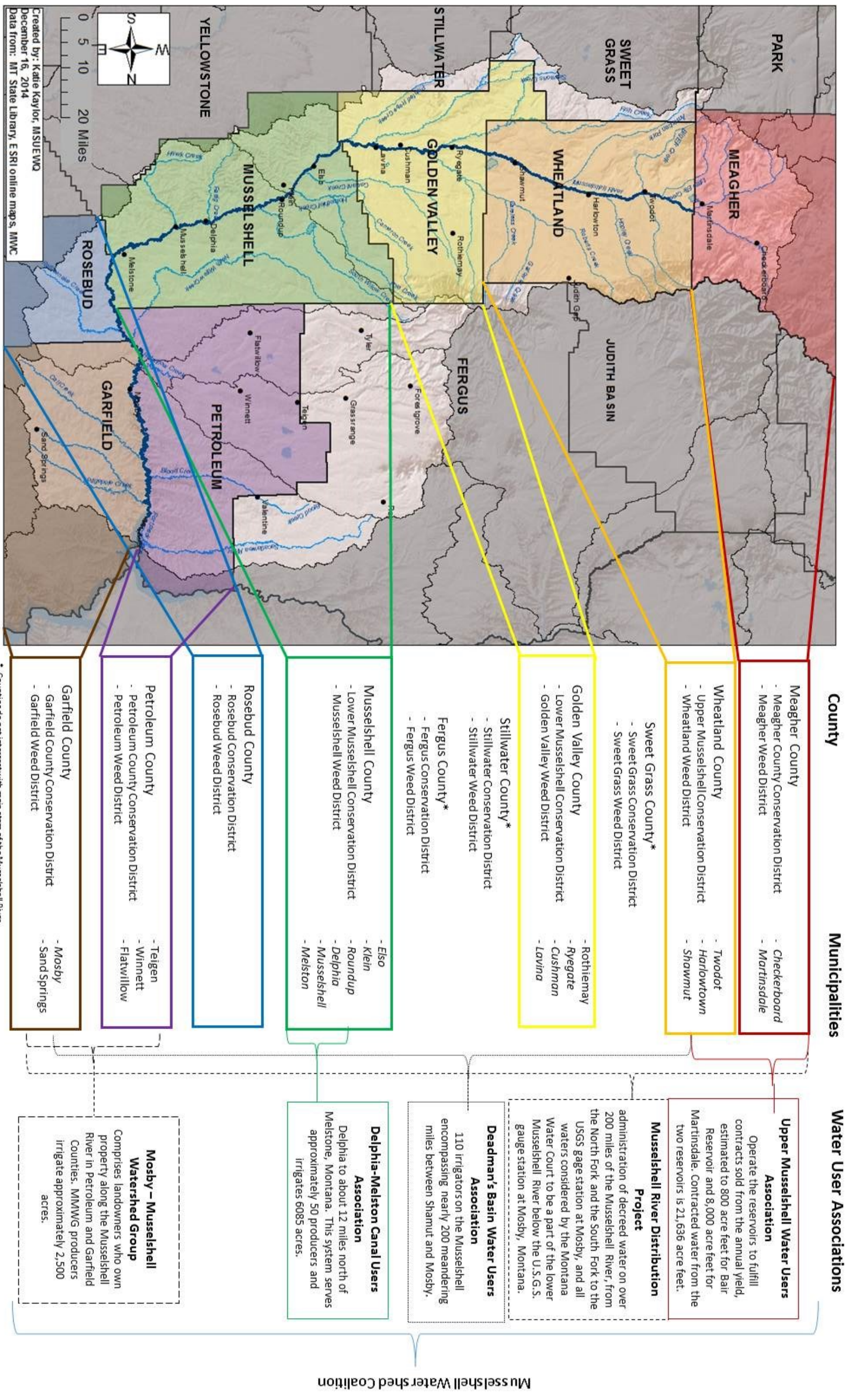
MUSSELSHELL WATERSHED LONG RANGE INVASIVE MUSSEL PREVENTION PLAN



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Musselshell Project Partners Diagram



Executive Summary

Quagga and zebra mussels are among the most devastating aquatic species to invade North American fresh waters.

The **Musselshell Watershed Long Range Prevention Plan** utilizes the five major categories from the Montana Invasive Species Council Framework: Coordination; Prevention; Detection; Rapid Response; Control and applies specific tasks to these categories for the Musselshell Watershed.

This plan will: establish clear priorities in coordination and information sharing; outline prevention, management, and eradication efforts; suggest education efforts to increase awareness of the problem and its solutions. The plan defines actions intended to fill gaps in the state's defenses against invasive species.

Partners in the development of the Long Range Prevention Plan for the Musselshell Watershed include federal and state agencies, local government, water and irrigation districts, watershed groups, private landowners and other invasive species stakeholders.

Coordination

Coordination among partners will achieve a unified and effective message to residents and visitors to the watershed. To become a cohesive and coordinated front, we must engage in and support regional efforts to manage invasive species at the local level.

Prevention

Effective management and prevention of AIS requires knowledge of introduction pathways, ecological processes, and impacts of invasion. For this reason, it is important to identify major traffic transport routes, high risk waterbodies, and locations for potential inspection station and hotwash stations within the Musselshell Watershed.

Detection

Effective monitoring techniques provide opportunities to detect the presence of zebra and quagga mussels in advance of population establishment, when eradication becomes cost-intensive and nearly impossible. Information must be quickly shared in order to initiate effective prevention and containment.

Rapid Response

Coordination at the federal, state, local, and private level plays a key role in rapid response and can greatly increase the effectiveness of containment and control. It will be important to follow the chain of command with clear and open channels of communication with MT FWP to assist with assembling monitoring teams and in disseminating information to pertinent groups.

Control

Controlling infestations in water distribution systems for municipal, agricultural and industrial supply enables continued operation of facilities and may contribute to reducing populations, which can also reduce the likelihood of a quagga or zebra mussel infestation spreading to new areas. Methods of control (biological, chemical, physical) and feasibility of these techniques need to be explored.

Our primary focus, and the purpose of this plan, is to foster strategic, unified, and coordinated approaches to minimize the detrimental effects of invasive species.

Introduction

Invasive species hinder ecological goods and services; they may be the primary cause of biodiversity loss and they significantly reduce nature-based recreation. AIS can erode the functionality of natural systems and impede irrigation, flood control, and other critical services.

Zebra and Quagga mussels were first identified in the U.S. (great lakes) in 1988 and have spread thousands of miles infesting U.S. waterways, altering ecosystems and generating in excess of \$160 million/year (2007) in economic damages to water intake systems, water front property, bridges, and infrastructure. Central and Eastern Montana is vulnerable and susceptible to Zebra and Quagga Mussel establishment and spread. An invasive mussel infestation would significantly erode the valuable goods and services that rely on water such as; surface water for irrigation, oil and gas, mining, recreation, fishery activity, and other services.

Once established, dreissenid mussels can clog water intake and delivery pipes, foul dam intake gates and pipes, and adhere to boats, pilings, and most hard and some soft substrates. The arrival of mussels poses ecological ramifications including negatively impacting aquatic biodiversity and water quality and reducing food sources for native mussels, fish larvae, and zooplankton. Mussels will impact public water delivery systems, fire protection, and irrigation systems and require costly removal maintenance.

In response to this threat, the Musselshell Watershed Coalition developed this plan to reflect the rising threat of invasive quagga and zebra mussels in Central and Eastern Montana. The goal of this document is to identify gaps in current strategies to address the invasion of zebra and quagga mussels in the Musselshell Watershed, and to identify and prioritize the specific actions that are needed to comprehensively prevent the further spread of quagga and zebra mussels, respond to new infestations, and how to manage possible infestations. The concerted effort to address quagga and zebra mussels fits into the larger battle against aquatic invasive species that threaten our waters.

Effective and decisive actions and support are needed from water management entities at all levels, including state and federal agencies, water and irrigation districts, concessionaires, and private landowners to prevent the introduction or spread of, or respond to an infestation of quagga or zebra mussels. State actions and coordination must complement and support watershed group and stakeholder efforts. Water management jurisdictions and authorities in the West are varied and complex, emphasizing the need for comprehensive and effective coordinated action. Because of Montana's status as a headwater state, the interconnectedness of its waterways, and the fragility of Montana's freshwater ecosystems, and a high level of dependence on surface water - vigilance will be needed to prevent invasive mussels from colonizing.

Given the popularity of waters in MT for out-of-state boaters, and the current distribution of zebra and quagga Mussels in the US, it is assumed that invasive mussel transmission into the state would occur via out-of-state boaters from states with invasive mussel infestation. Efforts have been aimed primarily at

Quagga and Zebra Mussel Biology

These invasive mussels are small, freshwater bivalves that **attach** to hard and soft substrates, including plants, rocks, man-made materials and structures including docks, dams, canals, aqueduct walls, watercraft hulls, etc.

A mature female Dreissenid mussel can produce over one million eggs per year. In the warmer waters of the Southwestern U.S., there is the potential for year-round spawning. Eggs develop into microscopic larvae called **veligers**, which float in the water column.

Juvenile and adult mussels secrete byssal threads (small, thin fibers) to attach themselves to substrates and can survive on substrates removed from one body of water and transferred to another.

Dreissenid mussels often cluster in huge colonies from the surface of the water to more than 400 feet in depth. As veligers grow, they settle out of the water and attach to a substrate where they may then crawl or float in search of a more suitable location.

Adult mussels are hardy and can survive out of water for up to five days in warm, dry weather and up to 30 days in cool, moist weather.

recreational pathways, and include boater education and outreach, watercraft inspection training, coordination of early-detection monitoring, assessment of watercraft use, and evaluation of inter-state routes of trailered watercraft movement. In the Musselshell Watershed the environmental conditions (high calcium concentrations) coupled with high popularity of fishing and recreational boating in reservoirs create a high probability of severe infestation – it all depends on the level of arrival prevention (inspection stations, signage, and local stewardship), monitoring (high priority waterbodies), and response planning implemented in a coordinated fashion. Montana FWP has laid the groundwork by hosting inspection stations, placing signs at fishing access sites across the state, and performing outreach. Our efforts in the Musselshell should fill in gaps by expanding outreach and coordination with local and regional stakeholders (private and public), identifying partners and locations for additional inspections stations, and providing education in the schools.

Ecological Impacts

In terms of ecological and economic impacts, quagga and zebra mussels are two of the most devastating aquatic species to invade North American fresh waters. The arrival of these species to Western waters brings the potential to extend devastating impacts into an area already severely challenged with water-related issues. The spread of quagga and/or zebra mussels threatens the natural environment, water delivery systems, hydroelectric facilities, agriculture, and recreational boating and fishing.

The ecological ramifications of these mussels include impacting aquatic biodiversity; reducing food sources for native mussels, fish larvae, and zooplankton; and changing water quality. Many other aquatic organisms rely on plankton for survival. The presence of quagga or zebra mussels in an environment can disrupt the food chain and out-compete other species. Therefore, food consumed by the mussels is detrimental to other species, and can result in the displacement of native, often threatened or endangered species, and recreationally important sportfish. Given their ability to filter large volumes of water, and in combination with extremely high densities, these mussels can significantly reduce the amount of nutrients and particles in the water,

resulting in increased water clarity. This increased clarity allows for greater light penetration, resulting in increased algae and vegetation growth. Quagga and zebra mussels also selectively feed on green-algae and may increase the proportion of foul-smelling bluegreen algae in water systems, which also impacts your recreation experience on a hot day. Additionally, recovery efforts for several salmonid species, and other threatened and endangered fish would be significantly hindered by the establishment of zebra and quagga mussels, so your favorite fishing hole may be compromised.

Dreissenid mussels can also reduce dissolved oxygen through respiration and increase dissolved calcium carbonate concentrations through shell building—which can cause a water body to become more alkaline. The increase in alkalinity levels could affect irrigation, especially in an area where salinity levels are already elevated such as the Musselshell Watershed.

Economic Impacts

Dreissenid mussels can cause substantial economic damage by infesting municipal, industrial, and agricultural water systems and attaching themselves to the hard substrates of pipes, dams, and diversion pathways. This restricts the flow of water through the systems impacting component service life, system performance, and maintenance activities.

Quagga and zebra mussels can clog water intake and delivery pipes, foul dam intake gates and pipes, and as a result impact water delivery systems. An infestation requires reoccurring, costly mechanical removal of mussels, and the decay of dead mussels can corrode steel and cast-iron pipelines resulting in increased maintenance costs.

Quagga and zebra mussels also negatively impact recreation and commercial fishing, and thus local economies. Attached mussels can increase drag on the bottom of watercraft, reducing speed, wasting fuel, and requiring scraping and repainting of the watercraft’s hull. Mussels attached in and around the steering components can jam the equipment and can block the cooling system in engines causing them to overheat. Degraded habitats also reduce sportfishing opportunities, which affect recreation opportunities and tourism.

The State of Montana is currently working on an economic impact assessment of an invasive mussel infestation within Montana. The completion of this report is anticipated to be the end of 2018. Some estimates of economic impacts of zebra and quagga mussels are included here to show the value of preventing the introduction of mussels and other aquatic invasive species.

Location	Infrastructure Type	Costs
Great Lakes	Power Industry	\$715 mil/year
Great Lakes	Water Intake	\$1 mil/year

Columbia River Basin	Hydroelectric Facilities – install chlorination systems	\$2 mil/facility
Columbia River Basin	Hydroelectric Facilities – maintenance costs	\$100,000/year
Columbia River Basin	Water Supply Facilities – costs vary due to size – annual maintenance	\$13,000 - \$400,000/year
	Water Supply Facilities – capital costs	\$12,000 - \$1.4 million
Idaho	All water-related infrastructure (except irrigation)	\$94,474,000
Bureau of Reclamation	Agency-wide infrastructure (actual costs since 2008)	\$12.6 million
North America	Power Plants and municipal drinking water systems	\$4.5 million/year
Colorado River	Control and management on lower river	\$300,000/year

Musselshell Watershed

The Musselshell River Watershed in Central/Eastern Montana provides water for irrigation, municipal and industry supplies, livestock, recreation, and fish and wildlife, and occasionally for mining and well drilling, mineral exploration and other uses. There are engaged groups of stakeholders in the watershed that are interested in the issues surrounding the Musselshell River and its tributaries. The Musselshell Watershed is a diverse watershed ranging from mountain streams in the upper parts of the watershed, to prairie and river-breaks type streams lower in the watershed.

The [Musselshell Watershed Coalition \(MWC\)](#) formed in 2009 as a unique partnership of individuals and organizations with a shared vision of supporting the whole Musselshell River management through whole river collaboration. The MWC is a voluntary partnership of the Upper Musselshell Water Users Association, Deadman’s Basin Water Users Association, Delphia Melstone Canal Water Users Association, Mosby Musselshell Watershed Group, Upper Musselshell Conservation District, Lower Musselshell Conservation District, Petroleum County Conservation District, Garfield County Conservation District and landowners. State and Federal agencies, including the Montana Department of Natural Resources and Conservation, Montana Department of Environmental Quality, Montana Fish, Wildlife, and Parks, and the Natural Resources and Conservation Service participate as partners. The management of water is closely linked with an improving local economy and MWC is widely respected for its inclusive and pro-active leadership.

In 2014, the MWC hired one part-time coordinator. The group averages 700 volunteer hours contributed per year. In early 2015, a board of directors was formed. Also in early 2015, the MWC received the 2015 Montana Wetland and Watershed Stewardship Group Award for, “the group’s persistence, dedication, and creativity put forth in its work within the Musselshell Watershed.”

Mission and Goals

The mission of the Musselshell Watershed Coalition is to benefit water users and the Musselshell River through basin-wide cooperative management of the Musselshell River.

The Musselshell Watershed Coalition operates under three overarching goals:

1. Support whole river management through whole river collaboration

- Coordinate and communicate with MWC partners, agencies, and others along the Musselshell through regular meetings, newsletters, and other means of communication.
- Enhance beneficial use of water, conserve the resource, and strive to improve river health.

2. Water Quantity

- Meet decreed and contract water rights obligations by sustaining sufficient water in the Musselshell through cooperative flow management and a well-maintained irrigation infrastructure system

3. Water Quality

- Work with State agencies to meet State Water Standards using a voluntary local approach.

Because of this dynamic system and the remoteness of much of Central and Eastern Montana, it is important to continue to strengthen regional coordination within watershed groups, agencies, private landowners, and other stakeholders to protect our waters and prevent the introduction and establishment of invasive mussels.

Irrigation is important in the basin, primarily for the production of alfalfa, grasses, small grains, and some corn silage. Irrigation constitutes the largest use of water. Most irrigated acres are along the Musselshell River bottoms, with some along major tributaries like Careless and Flatwillow Creek. Total irrigated acreage is ~60,000 on the Musselshell mainstem and ~50,000 irrigated acres on tributaries of which the Upper Musselshell Basin (from the headwaters to Deadman's Basin) has about 32,392. The lower Musselshell River Basin (from Deadman's to Ft. Peck) has 25,424 irrigated acres (excluding Flatwillow Creek). Bair and Martinsdale Reservoirs have 7010 ac-ft and 23110 ac-ft of active storage, respectively. These two reservoirs are operated by the Upper Musselshell Water Users Association and supply water for irrigation. The largest reservoir, Deadman's Basin, has an active storage capacity of 72,220 ac-ft. It is operated by the Deadman's Basin Water Users Association and supplies water for contract holders from the basin. Crooked Creek is a Marina and campground with boat access to Ft. Peck Reservoir. These three reservoirs and marina are popular fishing destinations (especially for boaters), and should be top priority waterbodies in the Musselshell Watershed for AIS prevention. Other waterbodies to monitor are the Musselshell River at Selkirk FAS, Harlowton FAS, Yellow Water Reservoir, War and Wild Horse Lakes, Bear Lake, Payola Reservoir, Petrolia Lake, Vogel Reservoir, Lake Mason, and Horsethief Creek.

Mining and industry and municipal water supplies are other important uses within the basin. The town of Ryegate, Roundup, and Melstone draw water from the river to serve 2200 people.

Recreation use averages about 93,000 visitor days per year at three reservoirs, mainly fishing.

Current Efforts

- Education at Musselshell Watershed schools.
 - Winnett, Grass Range, Lavina, Ryegate, Roundup, Melstone, Harlowton
- Displays showing invasive mussels encrusted on pipes distributed.
 - Distributed to conservation districts and area schools
- Education to target groups.
 - Water user associations, conservation districts, city and county government officials
- Development of information sheet specific to irrigators about invasive mussels.
 - Distributed to landowners along the Musselshell River
- Development of information card conveying impacts specific to the Musselshell River if an infestation were to happen.
 - Distributed with reusable shopping bags carrying the Clean.Drain.Dry and MWC logos to local businesses within the watershed
- Coordination of land managers to get Clean.Drain.Dry signs placed at strategic locations within the watershed.
- Participant in the Central and Eastern Montana Invasive Species Team (CEMIST).
 - Providing information/staffing for booth displays
 - Developing summary report (March 2017) to FWP following the detection of invasive mussels in 2016
- Participation at area events that allow information booths.
 - Central Montana Fair

Coordination

We must respond to invasive species as a shared responsibility and a common priority across the Musselshell Watershed. Coordination among partners will achieve a unified and effective message to residents and visitors to the watershed. To become a cohesive and coordinated front, we must engage in and support regional efforts to manage invasive species at the local level. The following tasks should be implemented to become transparent and aware of what each stakeholder and partner is doing in the region concerning AIS. We will partner with the MT FWP and DNRC in coordination efforts and on outreach material.

Expand the sense of stewardship

- Identify leaders within the entities listed in the tables below to provide education on invasive mussels within their organization
- Continue engaging private landowners through calculated, consistent messages and outreach. The content of this information should relate to the impact these landowners may face, and contain ways in which these landowners can help with prevention and early detection
- Build stewardship among angler groups such as; Walleyes Unlimited, Trout Unlimited, and Montana Pike Masters to provide information about invasive mussels
- Emphasize - 'Clean. Drain. Dry.' your boat and waders every time, all the time.

Foster cooperation, coordination, and communication

- Support targeted outreach campaigns to educate both the public and private sectors on the impacts of invasive mussels
 - Use common/consistent message and speaking points for groups unfamiliar with invasive mussels to use when discussing AIS
 - Inventory and identify partners' most effective educational tools and dissemination tactics. Coordinate educational programs that are successful in other rural states.
 - Encourage and leverage the participation of those in the private sector, academia, and the public to help with education
- Support the creation of a quarterly newsletter to provide managers and field staff with information on local and regional invasive species issues.
- Increase and enhance communication across all entities to ensure coordinated approaches are supported and tools are accessible to address invasive species issues.

Education and Outreach

Public awareness and education is a large piece of the invasive species puzzle. Widespread public knowledge and simple changes in public behavior will help resource agencies, watershed groups, and their partners to prevent the introduction of invasive mussels, and if established could help with early detection and control. Outreach to target audiences needs to be frequently evaluated to make sure efforts are effective in stimulating action, both for individual projects and to measure success at a regional scale. To do this we must:

- Increase effectiveness by identifying potential educational overlaps between audiences and duplicative educational efforts.
- Assist State Agencies by evaluating and recognizing current methods in the Musselshell Watershed for preventing the introduction and spread of invasive species with private landowners and organizations not directly involved with boating/recreation (i.e. construction....)
 - Work with state agencies to create documents that contains:
 - Practices to encourage the use of invasive species management in habitat restoration projects
 - With partners, conduct analyses of current methods and practices for efficacy and cost-effectiveness. As necessary, strongly encourage the development and incorporation of new methods and practices to prevent the introduction of invasive species.
 - Develop and promote best management practices regarding the use of equipment and proper methods of decontamination when moving between sites
 - Encourage strong working relationships with private landowners and organizations to form a voluntary program that leverages resources through grants as well as volunteer labor and expertise.
 - Send information out via City/County News and Events Websites
- Develop additional distribution plans for invasive mussel info-cards
 - Create plastic invasive mussel informational card (with clean, drain, dry) to be placed at public access sites
 - Plastic cards can be sponsored by REI, Bass Pro, etc – show card at checkout and receive 5% off purchase
- We must continue doing education and outreach in the schools throughout the Musselshell Watershed
 - Work with FWP and ISAN to identify a curriculum for consistency in teaching AIS in schools in the Musselshell Watershed. Different lessons and activities for kids of different ages
 - Also for Conservation District and NRCS kids day events
 - Use education and activities tote provided by FWP for teaching in schools and at events
 - One activity to engage students could be with a rockpack activity – this teaches students about macroinvertebrates, stream health, and could be another level of citizen monitoring
 - Substrate Sampling Program with schools – distribute substrate samplers to schools and have them set-up to monitor at a local waterbody. – Can give updates to BSWC member
- We must identify events and venues in the Musselshell Watershed to provide Education and Outreach, these should be compiled onto a centralized calendar and shared with FWP and DNRC
 - Coordinate with FWP and DNRC to ensure we do not overlap efforts and maximize coverage

- County Fairs and Local Festivals
- Annual events (RIDE)
- Rodeos
- Fishing Tournaments
- Montana Water Resources Association Meetings
- Montana Association of Ditches and Canals Meetings
- Montana Stockgrowers Association Meeting
- Walleye Chapter Annual Meetings
- RV and Boat Shows
- Other Fish and Wildlife Organization Meetings
- Montana Farm Bureau Federation Meetings
- Montana Farmers Union Meetings
- Irrigators
- Local Stockgrower's Association Meetings
- FFA and 4-H
- Montana Section of American Water Works Association
- Great Rockies Sport Show
- Montana Stockgrowers Association Events
- MACO
- MAGGIE
- Produce outreach material for these events - a database of outreach material should be created on the Musselshell Watershed Website with the option of reserving and 'checking-out' the following items for events:
 - Banner, both flat and/or pop-up
 - Tablecloth
 - Tent?
 - Games/activities to attract people to the booth
 - Work with FWP and DNRC for extra swag to give away
 - Develop new swag with MWC and CEMIST logos (work to split funds with CEMIST)
 - Educational Trunk with activities and lessons
- Establish and Host a Biennial Summit
 - Use '2018 Weed Summit' as guideline in organizing process
 - Plan to have one meeting per year to focus on and discuss invasive species, including aquatic invasive species
 - Meetings can have theme and awards to partners who went above and beyond
- Extrapolate the economic risk analysis (including infrastructure and reoccurring costs, both for public entities and private landowners) created by DNRC and FWP for invasive mussels in the Musselshell Watershed, and for the purpose of identifying priority species and focus areas.*
 - This will help in reaching a greater audience if there is a cost associated with the impact of an invasive mussel infestation
 - Research and develop appropriate economic models to inform prioritization actions.
 - Identify management alternatives and identify costs
 - Private damages
 - Public Infrastructure
 - Recreation impact (tourism \$)
 - Mitigation costs

- Total ecosystem services lost

* This effort is being completed by the FWP and DNRC. The MWC should help to distribute the information in this report and if any of the above information is missing, the MWC should fill-in those information gaps.

Figure 1: Aquatic Invasive Species Network in Musselshell Watershed

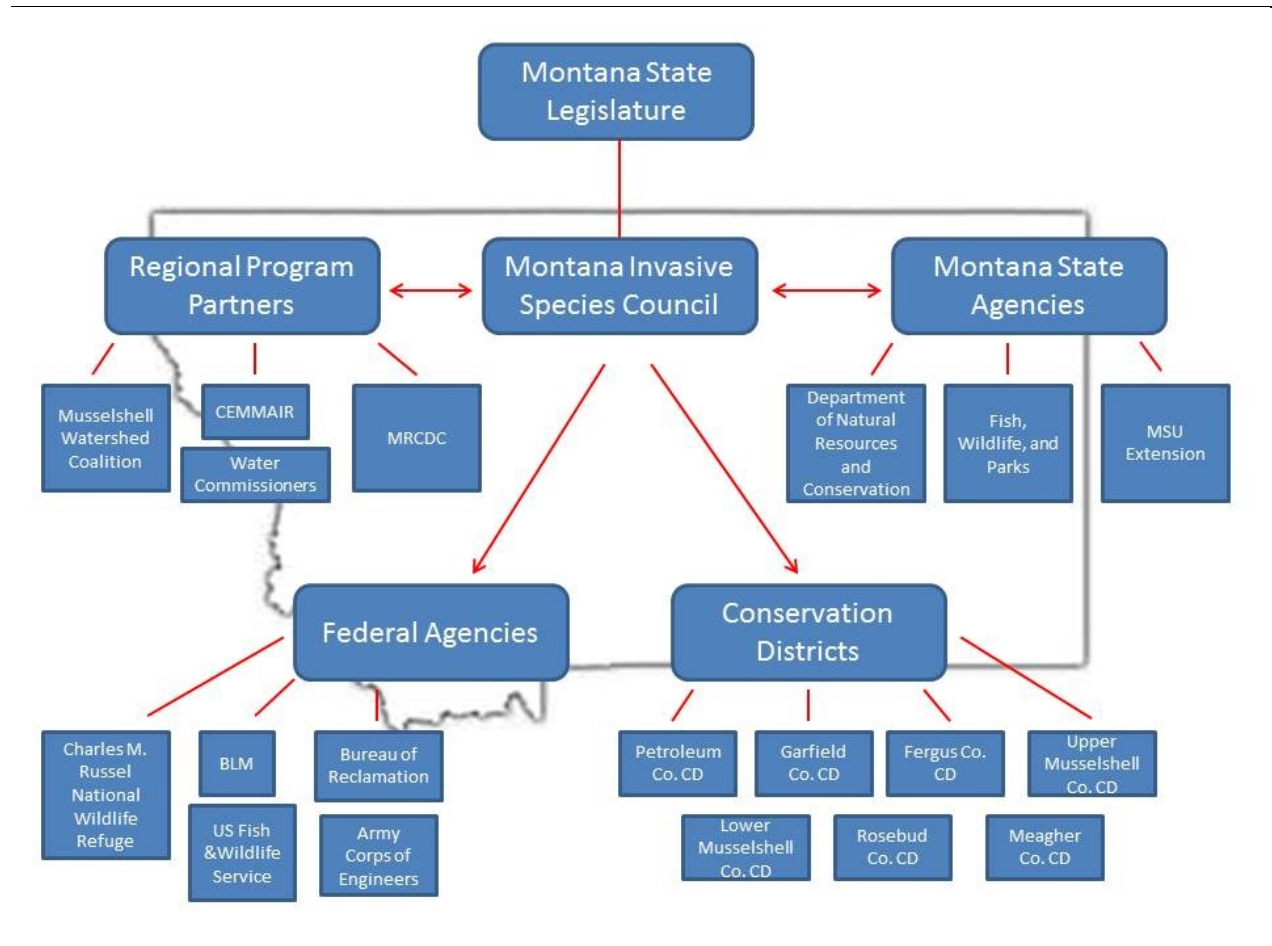
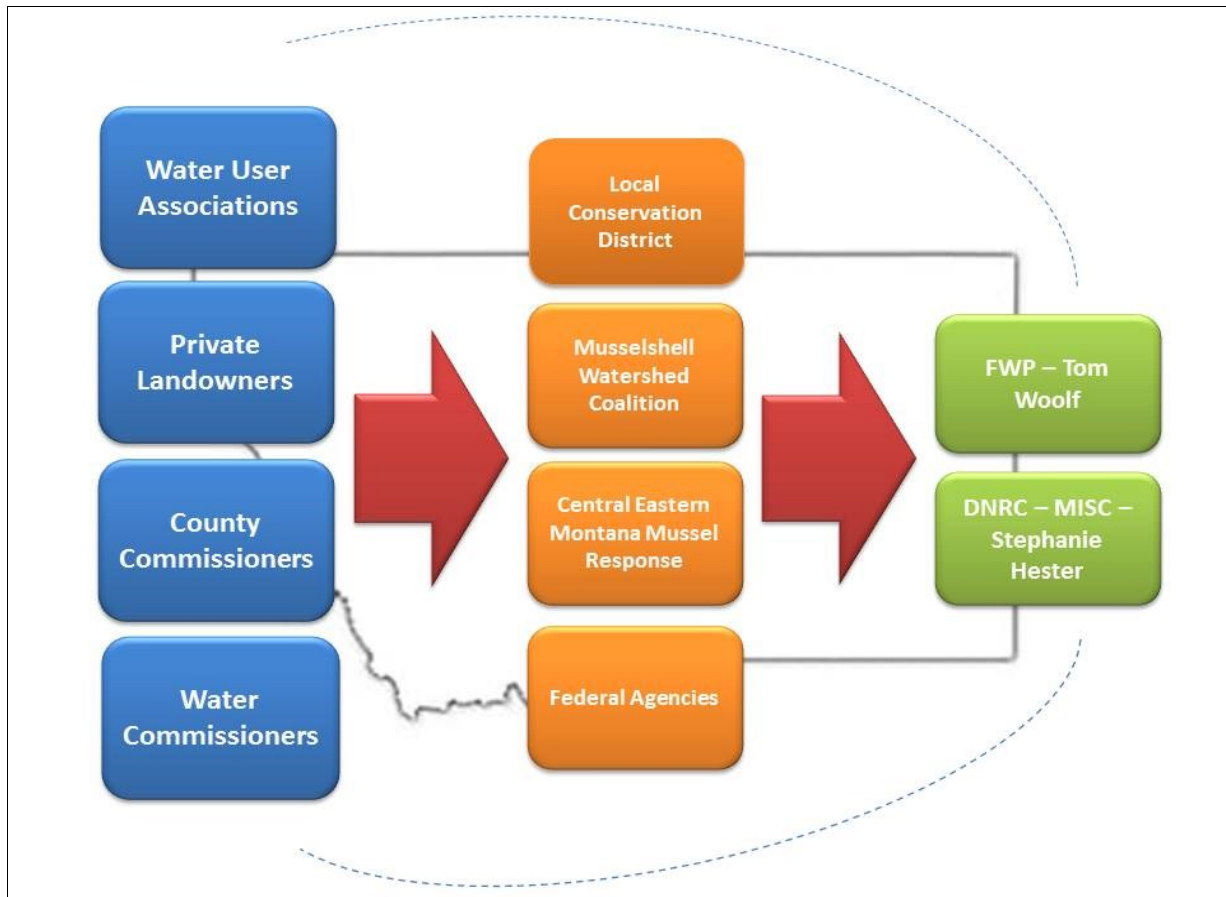


Figure 2: Communication Pathway for AIS Related Issues



Stakeholders

It is important to identify all the stakeholders that manage or use water in some capacity in the Musselshell Watershed that could be impacted from the introduction of invasive mussels. These stakeholder contacts should be compiled into a shared folder to maintain contacts and keep them up to date. A Big Sky Watershed Corps member should conduct an annual update to this list. Below is a list of federal and state agencies, watershed groups, water commissioners, conservation districts, county commissioners, and recreating groups that should be contacted to discuss what they know about invasive mussels and their impacts, what AIS projects they are involved in (if any), and ultimately find new ways to collaborate. These groups should be part of the quarterly newsletter. There should also be a point person to contact in the event invasive mussels are detected.

- Bureau of Land Management – administers federally-owned lands and use of natural resources, including water, on these lands. www.blm.gov
- Bureau of Reclamation – designs, constructs, and operates water projects; conducts river basin water management studies; coordinates water conservation efforts. www.usbr.gov

- U.S. Fish and Wildlife Service – reviews comprehensive water plans and projects for impacts on fish and wildlife habitat and populations; works to recover endangered fish and wildlife species; manages hatcheries; studies fish disease. www.fws.gov
- U.S. Geological Survey – researches the source, quantity, distribution, movement, and availability of surface and groundwater for national water data network and technical reports. www.usgs.gov

Key Stakeholders

In addition to finding a leader within each of these entities below, we must distribute a survey to determine stakeholder needs, concerns, and resources available to address invasive mussel prevention. The survey should consist of their current knowledge of invasive mussels, their willingness to assist with performing outreach and education (distributing information/materials, hosting and inspection station), and identifying priority locations in their geographic area.

Watershed Organizations & CEMIST

Organization	Lead	Contact #	Contact E-mail
Musselshell Watershed Coalition	Laura Nowlin	(406) 429-4832	MusselshellWC@gmail.com
Missouri River Conservation Districts Council	Rachel Frost	(406) 454-0056	MRCDC@macdnet.org
Central Eastern Montana Invasive Species Team	Carie Hess	(406) 429-6646 ext. 104	PetroleumCD@macdnet.org

Water User Groups

Watershed Group	Manager	Contact #	Contact e-mail
Deadman's Basin Water Users Association	Leon Hammond	(406) 220-2093	rhammond@itstriangle.com
Upper Musselshell Water Users Association	Craig Dalgarno	n/a	DalgarnoC87@gmail.com
Delphia-Melstone Canal Users Association	Lynn Rettig	(406) 358-2213	rettig@midrivers.com
Mosby Musselshell Watershed Group	Diane Ahlgren	(406) 429-5621	skipndiane@midrivers.com

Conservation Districts in the Musselshell Watershed

County	Administrator	Phone Number	E-mail Address
Meagher Co. CD	Lacey Rasmussen	(406) 547-3633 X 5	Meaghercocd@mtintouch.net
Upper Musselshell Co. CD	Cheryl Miller	(406) 632-5534	Cheryl.Miller@mt.macdnet.net
Lower Musselshell Co. CD	Donna Pedrazzi	(406) 323-2103 X 101	Donna.Pedrazzi@mt.macdnet.net
Fergus Co. CD	Shonny Nordlund	(406) 538-7401 X 101	n/a
Petroleum Co. CD	Carie Hess	(406) 429-6646 X 104	Petroleumcd@midrivers.com
Rosebud Co. CD	Monica Boyer	(406) 346-7333	Monica.Boyer@mt.usda.gov
Garfield Co. CD	Dusty Olson	(406) 557-2740 X 100	Garfieldcd@macdnet.org

Public Agency Stakeholders

Agency	AIS Contact	Phone #	E-mail Address
FWP - Central	Jorri Dyer	(406) 465-5898	Jorri.Dyer@mt.gov
FWP – East	Sean Flynn	(406) 230-1746	Sean.Flynn@mt.gov
FWP – South Central	Brant Stephens	(406) 444-1267	Brant.Stephens@mt.gov
FWP – State Park	Jesse Conway	(406) 557-2362	Jesse.Conway@mt.gov
CMR NWR	Paul Santavy	(406) 538-8706	cmr@fws.gov
US FWS	Lindy Garner		Lindy_Garner@fws.gov
BLM	Mark Albers	(406) 538-1900	blm_mt_central_do@blm.gov
BLM - Lewistown	Andrew Oestreich	(406) 538-1929	Aoestreich@blm.gov
BLM - Billings	Jennifer Alexander		Jalexander@blm.gov
ACOE	Patricia Gilbert	(406) 526-3411 X 4278	Pratricia.L.Gilbert@usace.army.mil
DNRC – MISC	Stephanie Hester	(406) 444-0547	Shester@mt.gov
DNRC – Water Projects Bureau	John Connors	(406) 444-6646	jhconnors@mt.gov
BoR	Pete Stevenson	(406) 247-7310	Pstevenson@usbr.gov
DEQ	Greg Olsen	(406) 444-0493	GregOlsen@mt.gov
Forest Service	Great Falls Office	(406) 791-7700	
NRCS	Reba Ahlgren	(406) 429-6646	Rebecca.ahlgren@mt.usda.gov

2018 Active Water Commissioners

Name	Role	Location	Water Source	Phone Number	E-mail
Peter Marchi	Chief MRDP	Martinsdale, Musselshell County	Musselshell River	(406) 572-3410 (3307) (406) 220-1947	Petert@mt.intouch.net
Leon Hammond	Water Commissioner	Harlotown, Musselshell County	Musselshell> Deadmans Basin	Cell-(406)2202093 (406)6324462	rhammond@itstriangle.com
Bonnie Stensvad	Water Commissioner	Melstone, Musselshell County	Musselshell River	(406) 358 2235 (406) 320-2454	bstensvad@wildblue.com
John P. Ruane, Jr.	Water Commissioner	Musselshell County	Musselshell River	(979) 793-3447 (406) 281-1758	John.Ruane@live.com
Earl Mainwaring	Water Commissioner	Harlotown, Musselshell County	Musselshell River	(406) 632-4266 (406) 350-0627	Ewaring53@hotmail.com
Kris Schaff	Water Commissioner	Roundup, Musselshell County	Musselshell River	(406) 320-1946	kschaff@mtech.edu
Orren Kiehl	Chief Water Commissioner	Winnett, Petroleum County	Petrolia Irrigation District/Petrolia Reservoir	(406) 429-5841	n/a
Craig Dalgarno	Water Commissioner	Upper Musselshell	Musselshell>Martinsdale Res	(406) 208-2946	Dalgarnoc78@gmail.com
Billeta Mainwaring	Water Commissioner	Harlotown, Musselshell County	Musselshell River	(406) 632-4266 (406) 350-0113	Billeta@itstriangle.com

County Commissioners

County	Commissioners	Phone #	E-mail Address
Wheatland County Commission	Thomas Bennett Richard Moe David Miller	(406) 632-4891	N/A
Fergus County Commission	Ross Butcher Sandy Younbauer Carl Seilstad	N/A	Rbutcher@co.fergus.mt.us Cyoungbauer@co.fergus.mt.us Cseilstad@co.fergus.mt.us
Musselshell County Commission	Robert Goffena Nicole Borner Tom Berry	(406) 323-1104	Rgoffena@co.musselshell.mt.us Nborner@co.musselshell.mt.us Tberry@co.musselshell.mt.us
Petroleum County Commission	Chris King Paul Mckenna Craig Iverson	(406) 429-5821 (406) 429-2121 (406) 429-5571	King@midrivers.com Mckenna@midrivers.com Bcountry@midrivers.com
Meagher County Commission	Ben Hurwitz Herb Townsend Rob Brewer	(406) 547-3500 (406) 547-3453 (406) 547-3549	N/A
Rosebud County Commission	Robert E. Lee Douglas D. Martins Ed Joiner	(406) 346-2251	Rlee@rosebudcountymt.com Dmartins@rosebudcountymt.com Ejoiner@rosebudcountymt.com
Garfield County Commission	Tom Billing Jerry Collins Teddy R. Robertson	(406) 557-2434	N/A

County Extension Agents

County Extension	County Extension Agents	Phone #	E-mail Address
Petroleum Co. Extension	Emily Standley, Denise Seilstad	(406) 535-3919	emily.standley1@montana.edu , denise.seilstad@montana.edu
Fergus Co. Extension	Emily Standley, Denise Seilstad	(406) 535-3919	emily.standley1@montana.edu , denise.seilstad@montana.edu
Garfield Co. Extension	Eric Miller	(406) 557-2770	garextn@midrivers.com
Musselshell-Golden Valley Co. Extension	Mat Walter	(406) 323-2704	m.petersonwalter@montana.edu
Rosebud Co. Extension	Jennifer Anderson	(406) 346-7320	Jennifer.Anderson@montana.edu
Meagher Co. Extension		(406) 547-3612 ext. 109	

Other Stakeholders

Stakeholder	Contact	Phone Number	E-mail Address
Hell Creek Marina	Clint & Deb Thomas	(406) 557-2345	hcm@midrivers.com
Crooked Creek Marina	Abbey Craig	(406) 429-2999	n/a
Walleye Unlimited	Dave Sedlock (website)	(406) 431-8975	aiosdave@hotmail.com
Walleye Unlimited	Bob Gilbert (Executive Director)	(406) 433-7607	elkbug@hotmail.com
Trout Unlimited	David Brooks (Executive Director)	(406) 543-0045	David@montanatu.org
Trout Unlimited	Jessica McCutcheon (Communications)		Jessica@montanatu.org
Fishing Outfitters Association of Montana	Brant Oswald (President)	(406) 684-5564	mailtofoam@gmail.com
Montana Fly Fishing Outfitters	Garrett Munson	(406) 640-4806	heymfo@montanaflyfishingoutfitters.com
Resource Conservation Advisory Council	Judi Knapp	(406) 342-5260	knappjudi@gmail.com
Montana Water Resources Association	Mike Murphy	(406) 235-4555	Mwra_h2o@msn.com
Montana Farm Bureau Federation	Musselshell Co. – Jen Bergin	(406) 587-3153 – Bozeman (406) 947-2103	Jen_bergin@hotmail.com
Montana Farmers Union	Chris Christaens (Special Projects)	(406) 452-6406	cchristaens@montanafarmersunion.com
Montana Stockgrower's Association	Kori Anderson	(406) 449-5105	kori@mtbeef.org
Pet. Co. Stockgrowers Association	Laura Nowlin	(406) 429-4832	musselshellwc@gmail.com
Montana Section of American Water Works Association	Emilie Hoffman (President)	(406) 994-6690	Water@montana.edu
Montana Pike Masters	Clay Buckmiller (President)	(406) 860-7435	n/a
Northern Great Plains Resource Council	Teresa Erickson	(406) 428-1154	Teresa@northernplains.org

Northern Great Plains Resource Council includes the following subgroups:

- Central Montana Resource Council - McCone Ag Protection - Rosebud Protective agency

How are Invasive Mussels Transported?

Veligers float in the water column and can be transported within water distribution systems as well as in watercraft bilges, ballasts, and live wells, and in any other equipment that holds water.

Adult mussels can be easily spread between water bodies by watercraft, especially when protected in the crevices of trim tabs, keels, engines, propellers, and anchors. In addition, they may be moved with equipment, trailers, water tanks, construction equipment, fish for stocking, water-based aircraft, firefighting equipment, bait buckets, anglers, and other recreational water equipment.

Survival out of water can be prolonged by proximity to damp objects, such as coiled rope, or in enclosed areas.



Prevention

Effective management and prevention of AIS requires knowledge of introduction pathways, ecological processes, and impacts of invasion. Once established, it becomes very difficult to eliminate zebra and quagga mussels. Therefore, preventing the spread of zebra and quagga mussel needs to be the goal of our efforts. Prevention will require strong partnerships with DNRC, FWP, and other state and federal agencies.

Since recreational and commercial vessels are the most common modes of transportation, these pathways need to be closely examined.

- Continue speaking to MISC to emphasize importance of implementing more stringent regulations and more severe legal penalties may encourage recreational users to make cleaning their boats a priority (to bring to EQC and Legislature).
- Identify FAS and public access sites, make sure signs are present, visible, and up-to-date to remind boaters to 'Clean. Drain. Dry'. Possibly add phone number to signs for questions or to report a sighting.
 - These campaigns have been successful to raise awareness and change behaviors. The simple message - clean, drain, dry, everywhere, every time – can help contain mussels and many other invasive species. A list of fishing and recreation access sites in the Musselshell Watershed that should be assessed and possibly updated can be found in the table below.
- Educate ditch riders, marina operators, and state park employees about zebra and quagga mussels on how to identify them. This can help with both outreach and early detection.

Target species prevention, for example focusing on species transmission choke points, has been found to be more effective than non-targeted prevention. There are roughly 13 million registered boaters in the US*. Recreational boaters are suspected to be the primary cause of invasive mussel spread for non-connected waters.

As recreational boating is the primary vector for overland transport of mussels and increases the risk of dreissenid introduction, waterbodies should be prioritized to focus efforts and resources. Total day use of a water body, presence of boat

ramps and marinas, water body size and access, and the presence of motorized boating and fishing activities, including angling tournaments that attract boats from other states, are important risk determinants.

Targeted Prevention in the Musselshell

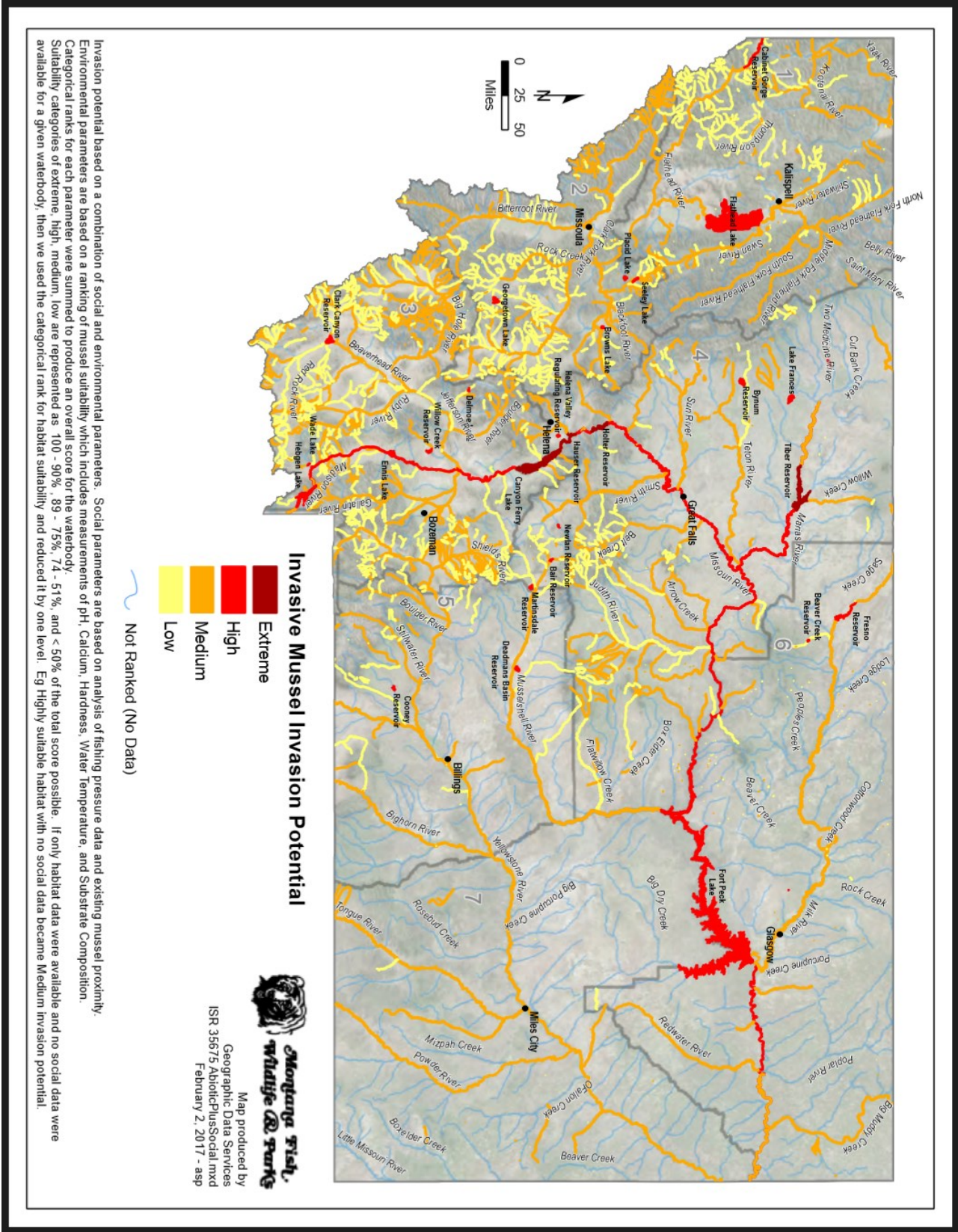
To prevent the spread of invasive mussels to the Musselshell Watershed, our partners have identified the following to limit transmission of invasive mussels:

1. Identify major transportation routes in and out of the basin.
2. Identify major waterbodies
3. Identify major recreation areas
4. Identify target groups that might inadvertently spread invasive mussels
5. Identify means of distributing information

Water Bodies of Concern in the Musselshell Watershed

Up to date invasive mussel signs and education material should be placed at each of the following bodies of water:

Waterbody	Size	AIS Responsibility	Land Ownership	County	Drainage	AIS Surveys	Fishing
Petrolia Reservoir	518 acre	FWP-Jorri Dyer	Private	Petroleum	Flatwillow Creek (MSSL R)	Yes (2018)	1648 Angler Days
Payola Reservoir	74.2 acre	FWP-Jorri Dyer	BLM	Petroleum	Box Elder Creek (MSSL R)	Yes (2018)	198 Angler Days
Little Bear Lake	137.7 acre	FWP-Jorri Dyer	BLM	Petroleum	Box Elder Creek (MSSL R)	No	N/A
War Horse Lake	1444.2 acre	FWP-Jorri Dyer	USFWS	Petroleum	Box Elder Creek (MSSL R)	No	N/A
Wild Horse Lake	1594.2 acres	FWP-Jorri Dyer	USFWS	Petroleum	Box Elder Creek (MSSL R)	No	N/A
Yellow Water Reservoir	441.7 acre	FWP-Jorri Dyer	USFWS/Private	Petroleum/Fergus	Flatwillow Creek	Yes (2017)	N/A
Deadman's Basin	1953.5 acres	FWP-Sean Flynn	State Land Trust/Private/FWP FAS	Golden Valley/Wheatland	Upper Musselshell	Yes (2018)	5353 Angler Days
Martinsdale Reservoir	946.7 acres	FWP-Brant Stephens	State Land trust/Private/FWP FAS	Meagher	Upper Musselshell	Yes (2018)	9828 Angler Days
Bair Reservoir	221 acres	FWP-Jorri Dyer	Private	Meagher	Upper Musselshell	Yes (2018)	2541 Angler Days
Lake Mason	1220.4 acres	FWP-Sean Flynn	USFWS	Musselshell	Middle Musselshell River	No	N/A



Invasion potential based on a combination of social and environmental parameters. Social parameters are based on analysis of fishing pressure data and existing mussel proximity. Environmental parameters are based on a ranking of mussel suitability which includes measurements of pH, Calcium, Hardness, Water Temperature, and Substrate Composition. Categorical ranks for each parameter were summed to produce an overall score for the waterbody. Suitability categories of extreme, high, medium, low are represented as 100 - 90%, 89 - 75%, 74 - 51%, and < 50% of the total score possible. If only habitat data were available and no social data were available for a given waterbody, then we used the categorical rank for habitat suitability and reduced it by one level. Eg. Highly suitable habitat with no social data became Medium invasion potential.

Highest Priority Water Bodies

Deadman's Basin Reservoir is an off-stream reservoir served by a supply canal from the Musselshell River, and is located approximately ten miles east of Harlowton in Wheatland Co. It is owned by DNRC, and has been operated by Deadman's Basin Water Users Association since 1959. Melstone, Ryegate, and Roundup are dependent on the water from the reservoir for their municipal water systems, and 490 families, including ranchers, farmers, and residents of small towns, directly depend on receiving their contracted water shares from the Deadman's Basin Water Project.

Martinsdale Reservoir is an off-stream storage reservoir, in Wheatland and Meagher Counties, located 2.5 miles southeast of Martinsdale. It is owned by DNRC and is operated by Upper Musselshell Water Users Association. The delivery of irrigation water is vitally important to the water user farm/ranch operations. The dam is a popular recreation site, primarily for fishing. A MFWP Fishing Access Site is located on the reservoir's north shore

Bair Reservoir is an off stream storage reservoir in Meagher County. The reservoir is operated by the Upper Musselshell Water Users Association and supplies water for irrigation. Bair is a popular fishing destination with many species of fish including; Brook trout, Brown Trout, Rainbow Trout, Westslope Cutthroat Trout.

Medium Priority Water Bodies

The **Yellow Water Reservoir** is located approximately 8 miles southwest of Winnett, Montana. It lies along the west and southwest shores of the Yellow Water Reservoir which is managed by the Department of Natural Resources and Conservation for irrigation supply to neighboring ranches. The shallow flats on the west end of the lake are quite productive with submergent vegetation and are attractive to waterfowl and shorebirds. The combination of mud flats, shallow water areas, and deep water areas provides habitat for a diversity of water dependent species. Surrounding uplands provide critical nesting and wintering habitats for sage grouse. Pronghorn antelope, mule deer and rattlesnakes are also commonly observed, and there is a large black-tailed prairie dog town located southwest of the reservoir. The reservoir contains rainbow trout which are stocked occasionally by the Montana Fish, Wildlife, and Parks. This reservoir has a boundary fence and a boat launching site for small craft is available.

War Horse National Wildlife Refuge is an unstaffed satellite refuge and is part of the Charles M. Russell Complex. The Refuge consists of three separate land units: Wild Horse, War Horse and Yellow Water. The refuge is open to hunting, fishing, hiking, and wildlife observation. A boat launching site for small craft is available on the Yellow Water Unit but no other recreation facilities are available. In addition to compliance with all applicable state hunting regulations, non-toxic shot must be used to harvest waterfowl and upland game birds.

The **Wild Horse Unit**, located approximately 11 miles northeast of Teigen, Montana, consists of two small and separate land parcels adjacent to the southern shoreline of Wild Horse Lake. The west parcel is 120 acres and the east parcel, located a half mile to the east, is 320 acres. The parcels are separated by private land. A county maintained road crosses both parcels and provides public access. Neither

parcel is boundary fenced. Wild Horse Lake is a natural depression that infrequently contains water, but is very valuable for waterfowl and shorebirds when it does. It is used mainly for migration purposes. Additionally, the sagebrush uplands surrounding the lake are critical for wintering sage grouse and pronghorn antelope which can be found in the area throughout the year. Visitors will also encounter prairie dogs, mule deer, and rattlesnakes.

The **War Horse Unit**, located approximately 7 miles northeast of Teigen, Montana, consists of three separate land parcels adjacent to War Horse Reservoir. One 160-acre parcel is along the north shoreline; the other two parcels (520 and 632 acres) are on the south shoreline. There is also a 40-acre Waterfowl Production Area that connects the two parcels on the south shoreline. None of the parcels are boundary fenced. War Horse Reservoir is a natural depression that contains water only infrequently, but is very productive for waterfowl and shorebirds when it does. The uplands surrounding the reservoir consist of sage brush/grasslands, with an association of ponderosa pines to the south. These pines are part of the acid-shale pine forest unique to central Montana.

We must make it a priority to ensure signage is posted and up to date at the following fishing access sites:

High Priority Fishing Access Sites

Fishing Access Site	Authority	Type	Waterbody
Selkirk FAS	MFWP	Concrete Boat Ramp	Musselshell River
Martinsdale FAS	MFWP	Concrete Boat Ramp	Martinsdale Reservoir
Harlowton FAS	MFWP	Recreation Access - No Boat Facilities	Musselshell River
Deadmans Basin FAS	MFWP	Concrete Boat Ramp	Deadmans Basin Reservoir
Petrolia Lake	Private/BLM	Recreation Access – Boat Ramp	Petrolia Reservoir
Payola Reservoir	BLM	Recreation Access - No Boat Facilities	Payola Reservoir
Yellow Water	CMR NWR - USFWS	No	Yellow Water Reservoir
War Horse Reservoir	CMR NWR – US FWS	No	War Horse Reservoir
Wild horse Reservoir	CMR NWR – US FWS	No	Wild Horse Reservoir
Crooked Creek FAS	CMR-NWR - US FWS	Concrete Ramp	Ft. Peck Reservoir
Horsethief Creek	BLM	Recreation Access Site	Horsethief Creek

Boat Washing Stations

In addition to inspection stations, hot wash stations at public access points and along popular routes should be explored. Together with boater education and awareness campaigns, hot wash stations are expected to be very effective at preventing the arrival of invasive mussels.

Boat washing stations help to prevent the spread of invasive mussels. They employ high-pressure very hot water to kill and remove AIS from boat hulls, trailers, and related equipment.

Boat washing portable sprayer systems costs \$3200 for initial purposes. Possible user fee or coin operated for post boat wash, truck wash, or trailer wash to cover maintenance price of station.

Permanent stations typically charge \$10/use. There is a large range in prices for wash station/uses, and quantifying these can provide critical information gaps for future funding. (Jensen 2009)

Boat washing and visual inspection/manual removal is 60-90% effective. The effectiveness of boat wash stations will be greatly influenced by location and participation

Hotwash – washing potentially infested boats and boating equipment with hot water has been found to be effective at killing zebra mussels and removing aquatic macrophytes that may be transporting adult mussels.

- Hotwash stations are already made available to boaters in various other states
- Montana requires anglers traveling from out of state to clean boats before entering Montana and are required to stop at inspection stations
 - Therefore, if an out-of-state boater was unfamiliar with Montana laws, they have the ability to wash their boat as they are traveling to their destination

To implement this idea, we must:

1. Estimate the cost of enforcement and monitoring of hot wash stations requirements for in-state and out-of-state boaters
2. Examine the impact of fees, duration of boat washes, and congestion on level of fishing activity and decision to fish elsewhere
3. Examining the uses of the hot wash
 - a. It could also be used for truck and trailer cleaning after fishing/recreation – the user fee could supplement the cost of installing and maintaining station

As a preventative measure installation of mandatory hot wash stations for out-of-state boaters appear to be a cost-effective means for reducing the threat and potential damages.

Inspection Stations

We must reduce the transport of invasive species into and within Montana by fully engaging existing entities and resources.

It is important to understand species control versus pathway restrictions. Usually, resource managers aim prevention and management efforts at controlling unwanted species rather than closing off particular pathways. Preventing the introduction of any number of species by managing the avenues by which they enter the state is far more desirable. To best implement the idea we must create a defense perimeter around central and eastern Montana. There are 12 Class 1 & 2 and two Class 1 roving inspection stations in Central and Eastern Montana. Only two of these inspections are located in the Musselshell Watershed, and one is a roving station that is mobile and may be in another area. To not allow any gaps in routes to waterbodies, we must identify partners to operate inspection stations in the following priority zones.

We must increase involvement in preventing the spread of invasive species by engaging new audiences, motivating those who can interact with invasive species pathways, and supporting existing stewards.

- Identify inspection stations point of entry into Musselshell watershed and go to CD offices to present this (See map attachment*)
 - Present the benefit of the station to the local economy
- Conservation Districts should include AIS rackcards with 310 permit application
 - Additionally, inform landowners to clean, drain, dry any piece of equipment or material from out of state that will be placed in a waterbody
- Mechanism to ensure fishing derby organizers are promoting and implementing clean, drain, dry at tournaments
 - Possible solution: have a third party partner reach out to organizers to reinforce message
 - Find derby organizers on FWP website, contact, and educate on AIS
 - Provide derby organizers with AIS information and AIS pledge to include with registration – (i.e. by signing this you pledge to Clean. Drain. Dry. your boat prior to entering Montana and to stop at all inspection stations)
 - This could also alleviate congestion at inspection and decontamination stations during tournaments/derbies
- Marina operators
 - Identify leader to sit down and discuss their role in AIS and in what capacity they can assist in inspections. Work with FWP AIS regional staff for these discussions.
 - Ft. Peck - Crooked Creek, Elk Creek, Rock Creek
- State Parks (Hell Creek)
 - Assist FWP staff in providing additional AIS training to State Parks staff in order for them to provide education and outreach, and possibly assisting with inspections.

PARTNER INSPECTION STATIONS

FWP has partnered with the Garfield County Conservation District to operate an inspection station in a location felt significant by both entities.

This model can be replicated in the Musselshell Watershed. Things to know when considering this:

- The cost of the inspection is initially payed out of pocket, but then promptly reimbursed from FWP.
 - Any additional supplies deemed justifiable were also reimbursed by FWP.
 - The hidden costs of payroll such as paid leave, unemployment and workers comp are calculated in and reimbursed.
- The partner will handle employment-from hiring, to employee management.
- The number of employees needed will depend on the number of days the inspection station is open.
- The inspection stations can be open from 3-5 days, with 12-hour shifts. This will need to be discussed further with FWP.
- The location of the inspection station will be handled by or discussed with FWP.

Detection

Early Detection

FWP has developed a rapid response guideline that should be shared in order for it to be followed at the local level. To assist with rapid response, at the local level we can publish a database of principal contacts for communication about newly infested water bodies in the Musselshell Watershed. This should be done for all of Central and Eastern Montana (once leaders in organizations have been identified). Upon completion, this database will be useful for leaders to use for contacting leads in jurisdictional areas if infestations are discovered.

To prevent the introduction and spread, it is imperative that we reach out to private citizens to develop an easily accessible reporting system; government agencies cannot adequately monitor Montana's waters alone and volunteers are the most cost-effective alternative. This can be:

Monitoring

Effective monitoring techniques provide opportunities to detect the presence of zebra and quagga mussels in advance of population establishment, when eradication becomes cost-intensive and nearly impossible.

- Continue working with FWP to assist with the monitoring effort.
- Use website to get updates on boat traffic
- Provide suggestions from partners in respective areas about priority areas and where to monitor

Most monitoring is carried out during the summer months since this is when adult mussel populations are highest and easiest to identify. However, when targeting larval stages of mussels, monitoring should be conducted during and just after spawning seasons. Visual identification of mussels and veliger sampling kits are the most common methods for monitoring mussels and rely heavily on volunteer work. Citizens should be encouraged to closely examine docks and other water borne hardware upon removal, as these structures often attract zebra mussels.

To monitor efficiently we must increase and improve search efforts for invasive species with an emphasis on newly establishing invasive species to contain their populations to a smaller area. Therefore, we must improve monitoring for invasive species populations and control efforts to ensure that management is measured, analyzed, and evaluated for effectiveness implementing the following:

- Work with FWP and conservation districts to provide invasive mussel training to the public
- Identify landowners along the Musselshell River willing to participate in a monitoring program
 - Develop monitoring packs with substrate samplers and informational material
 - Explore veliger sampling kits
- Work with FWP and DNRC to provide water commissioners with AIS training
- Work with FWP and MT Association of Ditches and Canals with AIS training

Early detection is the key to successful rapid response. Early detection often provides the only chance at eradication, especially for aquatic invasive species, which are notoriously difficult to eradicate,

successfully control or manage. The cost to respond to a population that was not detected during early stages of an invasion increases exponentially over time. Early detection of invasive mussels relies upon the discovery of either veligers in the water column or juveniles and adults colonizing hard substrates.

We must think about the following when monitoring:

- Identify which life stages are being targeted
- Water temperature, pH, and calcium concentrations influence spawning and should be taken into account especially when doing veliger sampling.
- Potential invasion corridors determine which life stages should be monitored.
 - If recreational users are suspected to be transferring mussels, adult and juveniles should be searched for.
 - If water from other sources (live well, industrial exhaust pipes, water discharge) is suspected, veliger sampling should be conducted.
- Frequency of monitoring will depend on the targeted life stage.
 - When monitoring for veligers, several sampling efforts should be conducted around spawning.
 - When sampling for adults and juveniles, monitoring can be more rigorous during the summer and scaled back or halted over winter.
- Site selection depends on the amount of public use, proximity to high-risk areas, environmental conditions (temperature, pH, calcium concentration, current, etc.), and potential ecological/economic impacts.
- High risk areas include water inflows from external sources, high traffic boat access points, and areas with dense potential substrate such as docks, ramps, pipe, and floating or sunken debris.
- When monitoring for new populations, veliger sampling or visual identification of mussels are the most common methods.

COSTS TO MONITOR

Cost to coordinate monitoring program:

- \$3,000/year

Water Commissioners:

- 5 Commissioners
- 50 hrs/season
- Training - \$1,000
- \$750/commissioner
- \$4,750 Total

Veliger Monitoring:

- \$150/kit

Substrate Monitoring Kits:

- \$25/kit

Volunteers: \$0

- Salinity Monitors
- Schools
- Landowners
- Water User Associations

Rapid Response

Establish chain of authority and communication – See Figure 2

Participation at the federal, state, local, and private levels is necessary. This coordination plays a key role in rapid response and can greatly increase the effectiveness of containment and control. Assist FWP in whatever capacity is necessary.

- Ensure Musselshell Watershed partners are involved in developing state-level rapid response plan;
 - Develop a common understanding about response guidelines and roles and responsibilities
 - Work with FWP to help develop and update geographic GIS-based response plans for high-priority waterbodies. Compile shapefiles of local geographic waterbodies
 - Prioritize waterbodies by risk (Fishing Access Sites) – See Map of Waterbodies w/access sites
 - Communicate with FWP about response plans for waterbodies within the Musselshell Watershed
 - Provide input on rapid response guidelines
- Assist FWP in communicating with local natural resource managers to effectively use all tools available to improve the outcomes of rapid response actions.
- Build on existing efforts to develop, support, and implement an interagency, early detection and rapid response network that has the capacity to detect new infestations of invasive species, and rapidly contain or eradicate the infestations.
 - Provide education and outreach for information on how to respond if invasive mussels are detected.
 - Increase the speed of notification to key resource agencies when a new invasive species is found
 - Create e-mail distribution lists to send notification of discoveries for partners
 - Develop rapid response processes at the local level for new threats from invasive species
 - Volunteer lists for those willing to provide hands-on detection
 - Process for communicating among volunteers and local partners

Extended Response Long-Term Monitoring

It is the responsibility of MT FWP to manage long-term monitoring of invasive species. This effort will be more efficient and more successful if supported by citizens at the local level within the Musselshell Watershed. Long-term monitoring provides data for adaptive management and long-term evaluation of management and control efforts in coordination with FWP.

Tasks:

1. Continue control strategy developed during Initial Response phase.
 - a. Identify locally-led entities to be involved.
 - b. Identify responsibilities that can be managed at the local level by willing local entities.
2. Develop long-term control objectives.
3. Design a monitoring program to evaluate the status of the zebra/quagga mussel populations - emphasize veliger sampling.
 - a. Monitoring activities should be implemented in coordination with other monitoring or field programs - such as the Musselshell Distribution Project and the Musselshell Salinity Monitoring programs.
4. Disseminate findings through an easily-accessible, consolidated, coordinated real-time database and listserv.
5. Evaluate control strategy against results of monitoring program and revise strategy as needed to meet long-term control objectives.

Preventing the downstream dispersal of invasive mussels and the overland transport to new waters is critical and helps protect economic interests, native fish and wildlife resources, and recreational opportunities.

Control

There have been no detections of invasive mussels in the Musselshell Watershed. Preventing the spread and introduction of quagga and zebra mussels is the ultimate goal. If an infestation were to be found, containing an infestation would become a top priority. Controlling infestations in water distribution systems for municipal, agricultural and industrial supply enables continued operation of facilities and may contribute to reducing populations, which can also reduce the likelihood of a quagga or zebra mussel infestation spreading to new areas.

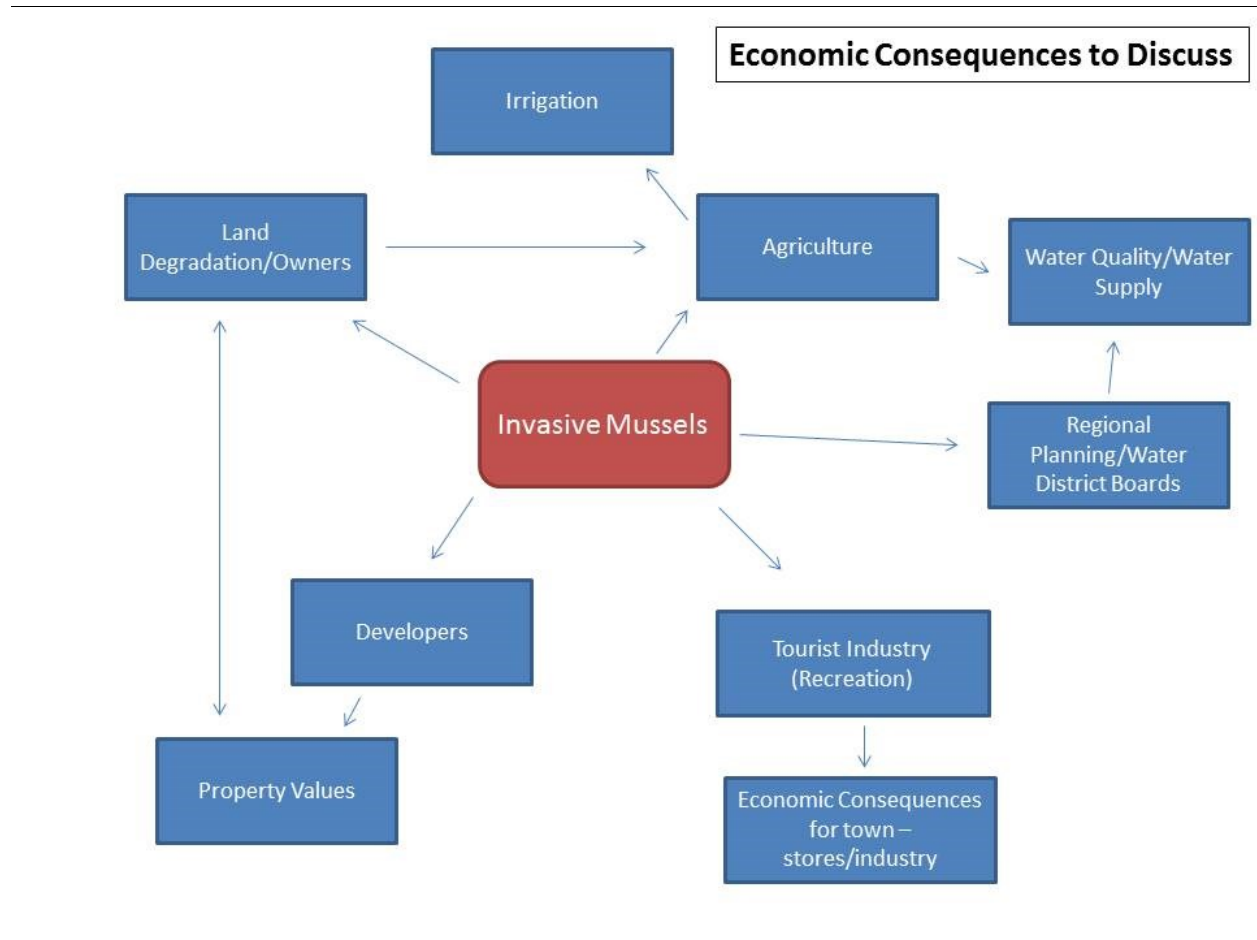
A variety of management techniques are possible, including settlement prevention, desiccation, mechanical removal, oxidizing biocides, thermal, and biological control. Tools for effective, cost-efficient, and ecologically sound quagga and zebra mussel control in the West are limited. Most containment and control technologies were developed for closed-water systems. It is very costly and difficult to prevent the spread through the large water distribution systems that exist. Tools are needed to prevent invasive mussel movement through water delivery systems and for open water systems.

Containment can be difficult as the volume of water to be treated is large, the environmental impacts of the treatment must be acceptable, and the costs must not be prohibitive. Development of options will benefit local governments, state, federal government, private landowners, and private industry to control infestations.

Attachment A: Mussel Establishment

The risk of dreissenid establishment is also influenced by environmental parameters, such as dissolved calcium, pH, water temperature, salinity, dissolved oxygen, and substrate. The natural levels of calcium found in Central and Eastern Montana make all water bodies in high-risk of establishment. Veliger survivorship increases from 3% at 12 mg Ca²⁺/L to 20–25% at 47 mg Ca²⁺/L. 27 North American dreissenid juveniles show initial growth at calcium concentrations between 8.5 and 11 mg Ca²⁺/L, 28, 29 and moderate shell growth between 25 and 26 mg Ca²⁺/L. In general, dreissenid adults inhabit waters with calcium concentrations greater than or equal to 15 mg Ca²⁺/L, and populations become dense at concentrations greater than or equal to 21 mg Ca²⁺/L. 31 Dissolved calcium concentrations and pH are likely the most limiting environmental parameters to dreissenid establishment in the Montana. Water temperature is not expected to limit growth, as dreissenids inhabit a wide range of temperatures in North America. They are found in the Great Lakes at temperatures less than 5°C, and in the lower Mississippi where temperatures reach and exceed 30°C. Waterbodies in the prevention section is a prioritized partial listing of water bodies for dreissenid that proposes the relative risk of introduction and establishment of invasive mussels into the Musselshell Watershed. This list of water bodies should be considered an initial assessment of risk of introduction and establishment; other important parameters, which require detailed site analysis, such as those that determine vulnerability of a hydropower facility or water source to dreissenids, should ultimately inform the level of risk of any water body to a dreissenid introduction. Examples of these parameters include recreation, drinking water, hydropower, irrigation, or other environmental/economic values. Dreissenid mussel surveys of water bodies with the greatest risk of introduction and establishment should employ the standardized protocols (to be created) for the examination of solid surfaces and sediment samples for adult mussel detection, plankton samples for veliger analysis, and shoreline walks to search for mussel shells, particularly in reservoirs that have been drawn down.

Attachment B: Economic Consequence



INVASIVE MUSSELS CAN:

- Clog irrigation equipment
- Increase electro-corrosion of steel, cast-iron pipes, and fittings
- Result in reduced pumping capacity and increased costs



THE MUSSELHELL WATERSHED:

- ~60,000 irrigated acres on the Musselshell mainstem
- ~50,000 irrigated acres on tributaries
- Estimated treatment costs = \$12/acre to irrigation infrastructure
- \$720,000 mainstem + \$600,000 tributaries = **\$1.32 mil**



Appendix C: Central and Eastern Montana Invasive Species Team (CEMIST)

The first step taken was the Central and Eastern Montana Mussel Response Group (Team), which consisted of regional coordinators, partner watershed coordinators, state and federal agencies partners, members at large, and Big Sky Watershed Corps members. The CEMMR has moved beyond the immediate mussel response and is now working to manage and prevent invasive species and has been renamed to the Central and Eastern Montana Invasive Species Team (CEMIST). Each entity within CEMIST has a role and multiple responsibilities to identify gaps in current efforts to prevent the colonization of invasive mussels and to address other invasive species.

- To refine and coordinate our capacity to identify, report, and respond to newly discovered invasive mussel infestations – Collaborate on creating a website for CEMMR to contain the following
 - Develop a web-based information clearinghouse as the interchange for all existing invasive mussel projects in Central and Eastern Montana (more important for Musselshell Watershed)
 - Develop calendar with AIS meetings, training, and Outreach events in Central/Eastern Montana (more important within the Watershed)
 - Inventory of what AIS displays, informational material (rackcards etc.), signs (for boat/fishing access sites), and other materials that can be used at education and outreach events – these items can be signed out on the website
- Find other partners such as CD offices – Priority zones could be the following
 - I-90 from Wyoming
 - East from Sydney US-200 (bc it is between US 201 and US 23)
 - North/Central from Malta US 191 (for those from Canada traveling South)
- Create a public information officer position