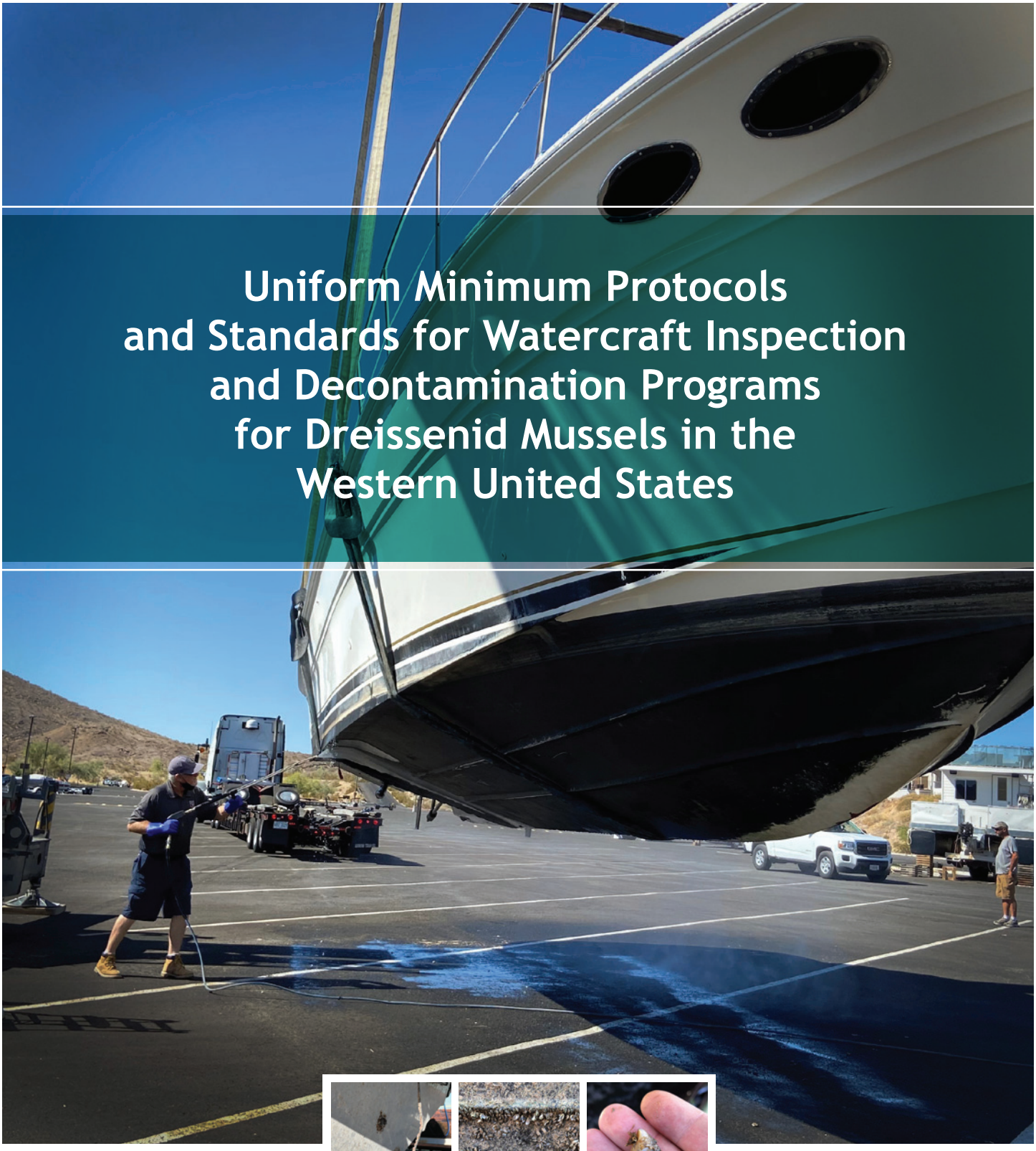
Uniform Minimum Protocols and Standards for Watercraft Inspection and Decontamination Programs for Dreissenid Mussels in the Western United States



Leah C Elwell and Stephen Phillips, editors

The Western Regional Panel on Aquatic Nuisance Species (WRP) Watercraft Inspection and Decontamination Think Tank Committee currently exists to improve the WIT process and has provided feedback in the revision process. Review and discussion by this committee was part of the process to develop this document.

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DISCLAIMER: The following protocols and standards are provided here to protect natural resources from the damage caused by aquatic invasive species.

Cover photo courtesy of Nevada Department of Wildlife. All inset cover photos courtesy of Quagga D LLC.

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PREFACE

The purpose of *Uniform Minimum Protocols and Standards for Inspection and Decontamination Programs for Dreissenid Mussels in the Western United States* (UMPS IV) is to 1) provide the best possible recommendations for watercraft inspection and decontamination (WID) programs and 2) to provide the best standards, practical science, and technology currently available for WID program consistency. Since the original publication in 2009, UMPS has provided the current scientific information and minimum standards as a guideline for new or ongoing WID programs. The document has undergone three (2012, 2016, 2021) revisions to align with new information and improvements. These revisions are also a reflection of the evolution of invasive species programming across our management landscape.

UMPS IV is meant to guide those creating a new program and capture ongoing refinement from existing programs. Further, UMPS IV, the *Watercraft Inspection and Decontamination Manual* (Brown 2021) and the *Watercraft Inspection and Decontamination Trainer's Manual* (Brown 2021) work together to provide the necessary components to implement a WID program and help support consistent quality WID programming.

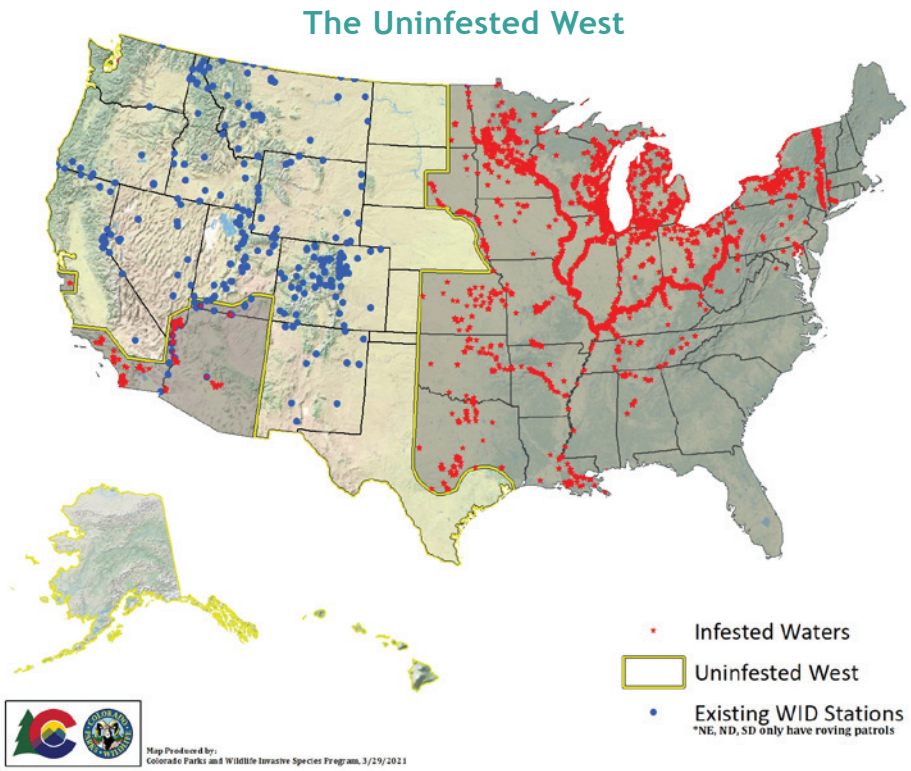
The protocols and standards recommended in this document are primarily directed at preventing the inadvertent transfer of dreissenid mussels on watercraft, seaplanes, and water-based equipment from geographic areas where they are currently present to unaffected waters. Further, the protocols and standards are effective for reducing the risk of overland transport of other aquatic invasive species (AIS) such as aquatic plants, fish, disease pathogens, and plankton species.

INTRODUCTION

The discovery of adult quagga mussels in the western United States at Lake Mead, Nevada in January 2007, and their subsequent detection downstream is recognized as a turning point in western aquatic invasive species management. This discovery prompted many water and resource management agencies and organizations in the western United States to initiate watercraft inspection and decontamination (WID) programs to prevent the further expansion of dreissenid mussels. The infestation of western waters such as Lake Mead, and Lake Powell, as well as the infestations in the Great Lakes region, continue to drive inspection and decontamination program strategies and prioritization. Inspection programs are a valuable tool used by state, federal and other jurisdictions to address watercraft and other high-profile vectors in minimizing the spread of aquatic invasive species (AIS).

Inspection programs have been critical in slowing the spread of dreissenid mussels to other waterbodies. Between 2016-2020, 401 dreissenid-fouled watercraft were intercepted by inspection staff in Pacific Northwest state programs (Pacific States Marine Fisheries Commission WID database) and staff in Colorado intercepted 285 in the same time period (R. Walters personal communication). Watercraft inspection and decontamination programs have become a successful, and necessary element in preventing the spread of invasive dreissenid mussels and other AIS. Over the last decade, partly in response to increased understanding of the risks posed by dreissenid mussels, there has been a dramatic evolution in AIS management in western states. Moreover, the broader understanding of invasive species impacts by legislators, recreationists, and all levels of agency management has made invasive species an acknowledged priority. Another important trend is the increasing participation in recreational boating that has been observed. Established watercraft inspection and decontamination programs inspect more boats every year and many programs are under considerable strain. WID programming has created a strong, reliable safety net for natural resources and has protected these recreation opportunities for everyone.

FIGURE 1:
A map of the uninfested West illustrates the contrast between dreissenid mussel occurrences and current inspection station locations.



The use of WID programs has become a major strategy to prevent the spread and introduction of dreissenid mussels throughout the western states. By implementing consistent and effective protocols, managers have realized success in identifying watercraft and other equipment that pose a risk. Implementing regionally consistent watercraft inspection programs across the West is a challenge. With a large number of programs already in place and a wide range of agency and organization capacity to implement these programs, consistency across jurisdictional boundaries is difficult to achieve.

> **Inter-jurisdictional coordination and cooperation has been, and will continue to be, the key to preventing the range expansion of dreissenid mussels in the western United States.**

A watercraft inspection program is typically the prevention component of a larger invasive species program which often includes outreach and education, monitoring, control, and rapid response. Whether novel or established, successful watercraft inspection programs consist of common elements and are guided by scientific information. UMPS IV provides the source of coordination and consistency to guide inspection programs across the West and beyond.

The recommended protocols and standards in this document reflect the current scientific research on dreissenid mortality. For over a decade, scientific studies to determine mortality of dreissenid mussels under a variety of circumstances have shown that hot water and drying are highly effective methods. In general, the use of 140°F water for external features, such as the hull, engine, and trailer, and 120°F for internal components are recommended for effective

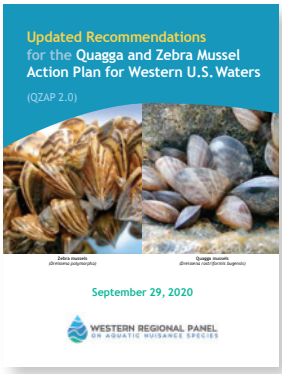
watercraft decontamination. High pressure water is used to remove mussels from encrusted surfaces, but low pressure is used for most decontamination processes. The millions of watercraft inspections and decontaminations conducted throughout the West have informed current protocols and standards as well. Researchers continue to explore methods to improve decontamination processes. Watercraft manufacturers are also engaged in improving boat construction, design, and materials to improve the inspection and decontamination process and minimize AIS spread.

The focus of resource agency WID programs has largely been on trailered watercraft; however natural resource managers recognize that other types of equipment and vehicles should also be subject to inspection or decontamination. To address the broad range of equipment types and vehicles, inspections and decontaminations may require variations or additional details to address specific vectors. The subsequent sections of this document are separated into major types to allow for ease of use, and include motorized watercraft, non-motorized watercraft, commercially hauled watercraft, seaplanes, and water-based equipment associated with wildland firefighting.

The application of consistent strategies across a wide geographic area improves boater relations and public support, internal dialog, and improved confidence in the quality of the inspection itself. The goal of this document is to provide the best possible recommendations for WID programs that benefit boaters and managers, and provide increased protection for our water resources.

THE DEVELOPMENT AND METHODS OF UNIFORM PROTOCOLS AND STANDARDS

In 2010, U.S. Fish and Wildlife Service (USFWS) funding became available to implement portions of *Quagga Zebra Mussel Action Plan for Western US Waters* (QZAP, WRP 2010). The goals of QZAP, developed by the Western Regional Panel on ANS (WRP) and adopted by the Aquatic Nuisance Species Task Force (ANSTF), were to summarize current strategies to address the invasion of quagga and zebra mussels in the West, and to identify and prioritize the specific actions that are needed to comprehensively prevent the further spread, respond to new infestations, and manage existing infestations. To address the growing quagga mussel problem, QZAP listed *"Continue the development of effective watercraft inspection and decontamination protocols and standards"* as one of its "Highest Priority Actions" needed. As a result, UMPS was developed and continues to fulfill this identified high priority. A re-envisioning of QZAP was recently conducted and resulted in *Updated Recommendations for Quagga and Zebra Mussel Action Plan for Western US Waters* (QZAP 2.0, WRP 2020) document which reiterates "the need for consistent and effective WID protocols" as a primary strategy in its implementation.



UMPS IV is a living document and will continue to evolve as new information becomes available. The basic principles and program elements originally outlined in UMPS I and carried forward in subsequent revisions of UMPS II and UMPS III (Zook and Phillips 2009 & 2012, Elwell and Phillips 2016), remain in this most recent revision. As in previous revisions, a process to reconcile and adopt UMPS IV protocols and standards was utilized to incorporate the best available science and information. In 2018, the *Review of Chemicals Associated with Watercraft Decontamination to Address Aquatic Invasive Species - a Special Supplement to UMPS* was also created to better inform the process for hot water use and to discourage the use of chemicals in the recreational watercraft decontamination process.

The use of best available science, in the form of both unpublished data as well as peer-reviewed publications **(Table 2)**, has been the strategy to guide the inspection and decontamination protocols and standards of UMPS. In addition, practical hands-on experience by staff conducting WID activities and the teaching of nearly 110 Pacific States Marine Fisheries Commission (PSMFC) Watercraft Inspection Training (WIT) classes have influenced the methods recommended in this manual.

QZAP (2010) and QZAP 2.0 (2020) have both emphasized the critical importance of supporting and maintaining effective standards for WID. QZAP 2.0 summarizes current strategies to address the invasion of quagga and zebra mussels in the West and, identifies and prioritizes the specific actions needed to comprehensively prevent the further spread of these mussels, respond to new infestations, and manage existing infestations. UMPS IV directly fulfill the priority strategies.

The protocols and standards recommended here are the products of:

- An extensive literature search, review and surveys conducted in the 2009/2012 versions of UMPS and additional information collected in developing the current version of this document.
- The experience and feedback gained from PSMFC watercraft inspection and decontamination trainings since 2008.
- Information gathered through discussions and consensus building on WID from many western program managers.

THE LANDSCAPE OF WATERCRAFT INSPECTION AND DECONTAMINATION PROGRAMS

IMPLEMENTATION

UMPS has informed policies, protocols, and standards used to establish and implement western WID programs. Additionally, a majority of WID program staff and managers have attended the watercraft inspection and decontamination training conducted by PSMFC. The larger community of managers continue to share and expand on the current knowledge of inspection and decontamination programs. The national inspection and decontamination training program administered by PSMFC has helped guide professionals in creating programs, training staff and broaden the knowledge of resource professionals. The combination of watercraft inspection trained professionals and the application of protocols and standards found in UMPS have resulted in a coordinated effort that effectively addresses the watercraft vector. Consequently, watercraft inspection programs throughout western states utilize similar components.

There are currently a range of programmatic inspections that can be encountered by boaters including, but not limited to, self-inspection, screening for high-risk watercraft, inspection and decontamination, drying time, and quarantine. This document provides the necessary details to understand the general implementation of these types of programs. By following the guidelines provided here, an effective watercraft inspection and decontamination program can be implemented that readily identifies and addresses high-risk watercraft to protect water resources.

COORDINATION

The members and partners of the WRP have recognized the need for coordination and consistency in the application of programs used to prevent the overland transport of dreissenid mussels and other AIS on watercraft. To address this need, there are multiple structures that bond this coordination including the

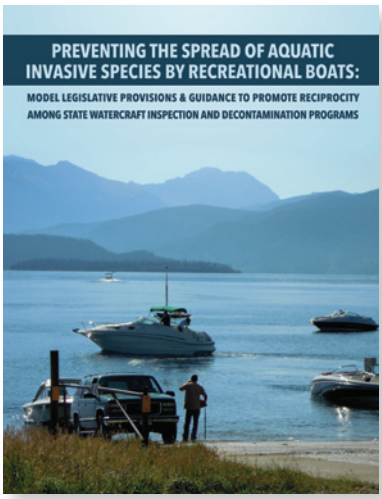
WRP WID Think Tank Committee, the Western Invasive Species Coordination Effort, 100th Meridian Columbia River Basin and Missouri River Basin AIS Teams, and the American Boat and Yacht Council's AIS Project Technical Committee. Ongoing information exchange, cooperation, communication and coordination among agencies and organizations engaged in WID programs in the western United States is necessary. Adopting uniform minimum protocols and standards for these programs is one step toward achieving that goal and increasing the overall effectiveness of these programs. When the many resource management jurisdictions across the West undertake prevention efforts that include mutual support, consistency, and cooperation, the West is safer from the damaging impacts of aquatic invasive species. Changes to regulations at the federal, state, local, and tribal level may be necessary to implement a comprehensive multi-jurisdictional program in the West.

CONSISTENCY

Many WID programs in the western United States and Canada have adopted and implemented the protocols and standards recommended in UMPS (Zook and Phillips 2009 & 2012; Elwell and Stephens 2016). UMPS has proven to be a valuable resource for individual jurisdictions to create and enhance their respective training protocols which has increased continuity across programs. As a result, there are many similarities between WID programs currently being implemented. However, variations in programs still exist due to local conditions, budgetary restrictions, risk tolerance, and differing regulations.

Achieving a greater level of consistency in protocols and standards employed by WID programs benefits water and resource managers and the boating public in several important ways, including:

- Increased effectiveness by ensuring that all programs utilize the best practical science and technology currently available to protect aquatic resources.
- Establishing a high level of quality and confidence in the effectiveness of programs and trust in the programs implemented by others.
- Reducing the amount of staff time and funding required of all programs by avoiding unnecessary duplication of effort while increasing effectiveness and public acceptance.
- Providing optimal customer service by making it easier for the boating public to understand, anticipate and comply with watercraft inspection and prevention programs.



Not every agency or organization currently has the resources or authority to implement all the protocols and standards identified here. In cases where capacity is lacking, steps may be taken to obtain the regulatory authority and resources necessary to implement a robust program. Through a process of consensus building among western resource managers, legal professionals, and law enforcement leaders via the National Sea Grant Law Center and the WRP Building Consensus in the West Committee, several key documents that outline model legislative provisions and regulations were developed. *Preventing the Spread of Aquatic Invasive Species by Recreational Boats: Model Legislative Provisions and Guidance to Promote Reciprocity among States Conducting Watercraft Inspection and Decontamination Programs* (Otts and Nanjappa 2014) and *Model Regulation for State Watercraft Inspection and Decontamination Programs* (Otts and Nanjappa 2016) can serve as helpful tools in creating or modifying watercraft inspection and decontamination authorities, and create a regulatory standard for WID programs.

Additional key elements have been instrumental in improving WID programs, including the adoption of management agencies to utilize common language and definitions, and a common waterbody classification system based on monitoring results. This has not only improved working relationships among agencies, but it also seems to have fostered a better understanding by

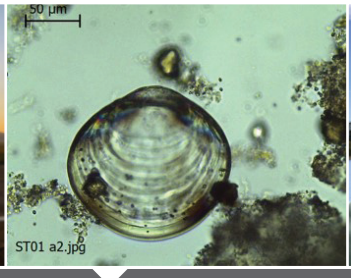
affected boaters. A driver for consistency between WID programs is the implementation of waterbody monitoring that can guide programmatic responses. The current waterbody classification system provides terminology and scientific criteria for managers to utilize **(Table 1)**. This classification system has been widely used and accepted across western management agencies to communicate, rationalize, and support actions. The common definitions and classification system can be found in the *Building Consensus in the West Workgroup: Final Activity Report 2011-2019* (WRP 2019).

TABLE 1:

Waterbody status can be classified by the presence/absence of aquatic invasive species based on monitoring results. These definitions provide terminology and characterize waterbodies for management purposes using a common language. Developed by the Western Regional Panel on ANS Building Consensus in the West Working Group (2011-2019). The possible management responses are intended to guide responses based on classification.

Waterbody Classification Term	Definition / Criteria	Possible Management Response
Status Unknown	Waters that have not been monitored.	Initiate early detection monitoring efforts.
Undetected/Negative	Sampling/testing is on-going, and nothing has been detected, or nothing has been detected within the time frames for de-listing.	Continue early detection monitoring efforts. Conduct prevention and containment inspection and decontamination procedures.
Inconclusive	Waterbody has not met the minimum criteria for detection (i.e., two independent results from the same sample using scientifically accepted techniques).	Increase monitoring efforts; consider diver-assisted surveys. Conduct prevention and containment inspection and decontamination procedures.
Suspect	Waterbody that has met the minimum criteria for detection.	Increase monitoring efforts; consider diver-assisted surveys. Conduct prevention and containment inspection and decontamination procedures.
Positive	Multiple (two or more) subsequent sampling events that meet the minimum criteria for detection.	Continue monitoring efforts. Conduct mandatory inspection and decontamination for all exiting watercraft using containment procedures.
Infested	A waterbody that has an established (recruiting or reproducing) population of AIS.	Continue monitoring efforts. Conduct mandatory inspection and decontamination for all exiting watercraft using containment procedures.

Photos courtesy of (left to right): Colorado Parks and Wildlife, Idaho Department of Agriculture, Idaho Department of Agriculture, Idaho Department of Agriculture



ECONOMIC RATIONALE

Establishing and implementing a comprehensive dreissenid mussel prevention program comes at a considerable cost. State, federal, tribal, and local agencies and organizations in the western United States spend tens of thousands to millions per jurisdiction annually on WID programs. These prevention programs may also include investments for risk assessment, education and outreach, early detection monitoring, and response planning. WID is the largest expense within these programs.

Since the discovery of dreissenid mussels in the Great Lakes in 1988, their economic impact has resulted in billions of dollars spent on control measures for power producers, municipal water suppliers, agricultural producers, and other water users. The economic impact of quagga mussels since the 2007 Lake Mead discovery has also been significant. The US Bureau of Reclamation at its Lower Colorado projects (Hoover, Parker and Davis Dams) spends approximately $1 million annually on quagga mussel control (Boyd 2016). The Metropolitan Water District of Southern California spent over $40 million between 2008 and 2014 for quagga mussel prevention related operations, maintenance and capital costs in the Colorado River Aqueduct and associated facilities (De Leon Metropolitan Water District of Southern California, personal communication).

As dreissenid populations expand in the West, this will result in mitigation costs that far exceed the estimated costs required to implement the prevention efforts outlined in QZAP 2.0. Several assessments have been conducted to better understand the economic impacts of introduction. A recent study estimated costs in failing to prevent invasion of dreissenids within the Pacific Northwest could be $500 million annually. (Pacific Northwest Economic Region and Pacific States Marine Fisheries Commission 2015).

Assessments by the Independent Economic Analysis Board (IEAB) (2010 & 2013) concluded that even if dreissenid mussels were to eventually become established in western waters, there is great value in delaying establishment. The annual cost saving for each year of delay would be substantial. Any delay would allow important scientific advances to occur which may help prevent an introduction, contain an introduction

Photo courtesy of: Colorado Parks and Wildlife

A recent study estimated costs in failing to prevent invasion of dreissenids within the Pacific Northwest could be $500 million annually.

or eradicate a newly established population. In contrast, dreissenid mitigation costs would far exceed the cost of implementing a comprehensive prevention program as envisioned by QZAP. As an example, the State of Idaho estimated that if dreissenid mussels were introduced, then $94 million in annual indirect and direct costs to Idaho infrastructure, facilities, agriculture, and recreation could be possible (Idaho Department of Agriculture 2012).

Finally, while WID programs are an important public outreach and education tool, all agencies and organizations are encouraged to use comprehensive outreach strategies to engage sectors of the public in preventing the spread of AIS and the role they can play in those prevention efforts. A WID program by itself is not sufficient to gain public involvement, support and cooperation. Public outreach and education should be the foundation of all state, federal, tribal, and local AIS prevention programs.

WATERCRAFT INSPECTION AND DECONTAMINATION TRAINING

In 2004, PSMFC developed the Watercraft Inspection Training Program (WIT) as a 90-minute training to enlist the voluntary help of boating law enforcement officers across the United States to educate boaters and inspect high risk watercraft during normal boater safety duties. Since 2012, PSMFC has amplified the training program with lead instructor "Quagga D" Davis to become the leading effort to provide multiple levels of training and enhance professionalism of the services associated with WIT implementation. All levels of training provide the necessary tools for watercraft inspection program staff to provide consistent information.

Level I (WIT I) Inspector Training is recommended for anyone who will be directly involved in watercraft inspections, including state, federal, tribal, and local resource management agencies and organizations. Level I offers an immediate opportunity for agencies, organizations, and industry members to train their staff on the dreissenid mussel issue and includes prevention strategies and watercraft inspection procedures.

Level II (WIT II) Inspection and Decontamination Training is designed for people who will be conducting both inspection and decontamination for their agency, tribe, or organization. The training focuses on risk assessment knowledge by staging inspection scenarios and demonstrating how to reduce the biological risk of standing water and fouled watercraft with decontamination. To date, over 50 Level II classes have been conducted training over 679 agency attendees representing over one hundred agencies from nearly every western US state and Canadian province. Trainings have also been attended by commercial boat haulers, boat mechanics, marina operators, boat sellers, and others with a professional interest in boat inspection. The advanced training of Level II should be taken by at least one agency or organization representative, engaged in or planning to become engaged in watercraft inspection.

Level III Trainer Training was created to train Level II individuals to train others to conduct inspections and decontaminations and is recommended for people who are AIS coordinators, and WID site supervisors representing local, state, federal, or tribal governments, marinas, and concessionaries. Level III is based on the *Watercraft Inspection and Decontamination Trainer's Manual* (Brown 2021). The Level III Training provides the knowledge, tools, and resources necessary to become a supervisor or an in-house trainer for Level I and Level II for their respective agency or organization.

Photo courtesy of: Quagga D LLC

Advanced Decontamination Training was created in 2014 to provide professionals with intensive instruction on specific decontamination equipment, techniques, and watercraft components requiring complex decontamination. This training is intended for individuals who have extensive experience in WID procedures and is meant to enhance technical knowledge on decontamination. To date, 70 people have participated in the regional training.

The intent of UMPS has been to provide the current scientific information and minimum standards as a guideline for new or ongoing WID programs. The *Watercraft Inspection and Decontamination Manual* (Brown 2021) incorporates the scientific information and minimum standards to provide step-by-step procedures for inspection and decontamination to reduce the risk of introduction of AIS. The *Watercraft Inspection and Decontamination Trainer's Manual* (Brown 2021) provides consistent guidance to AIS trainers who are responsible for the certification of individuals to perform watercraft inspection and decontamination. UMPS, the manual, and the trainer's manual together provide the necessary components to implement a WID program.

THE SCIENCE OF DECONTAMINATION

RESEARCH ON DECONTAMINATION EFFICACY

The published scientific research and grey literature related to decontamination has focused on the efficacy of methods to achieve mortality of dreissenid mussels or other invasive species. Various water temperatures and duration of exposure have been examined for lethality and effectiveness on multiple invasive species. The following research highlights the duration and temperature lethality for quagga mussels, and has influenced the current decontamination procedures **(Table 2)**. Further, the research provided here informs the UMPS recommendation to utilize lethal temperatures of water as the preferred decontamination method, as well as appropriate drying time **(Table 3)**. There continues to be a need for scientific exploration in the use of hot water for a variety of situations and equipment.

SPECIFICATIONS FOR DECONTAMINATION UNITS

The equipment that is currently utilized to perform decontamination can provide specified hot water temperatures and are either portable units, housed units, or recycled content units. Regardless of the decontamination unit type there are minimum specifications that ensure that a proper decontamination can be performed. That information is provided in the *WRP Decontamination Unit Minimum Standards* (WRP 2019) and the *WRP Trailered Decontamination Unit Specifications* (WRP 2019) documents **(Appendices A and B)**.

The following are specifications for units used to perform decontaminations:

- Operating temperature recommendations are no greater than **120°F internal or 140°F engines/external** at the point of contact to achieve effective decontamination.
  Note: Operating temperatures must be constantly checked to ensure proper performance at the above specifications.
- Minimum 5 gallons per minute
- 3000-3500 pounds per square inch, if performing a decontamination of hull and trailer
- Proper attachment tools, including 40-degree angle nozzles

ALTERNATIVE TECHNOLOGIES AND METHODS

There is no shortage of alternative technologies and methods that have been explored to kill dreissenid mussels. Both physical and chemical methods have been examined. Physical methods refer to methods that limit adherence to boat components or life forms entering a boat. The use of physical alternatives has been limited primarily due to practicality. The incorporation of designs and materials on new watercraft may be possible. However, with over 17 million watercraft already in the recreational landscape (National Marine

TABLE 2:

The Comeau et al. 2011 study examined quagga mussel mortality when exposed to various hot water temperatures for different time intervals. Adult quagga mussel mortality (%) observed under different temperature treatments at day 10*. Treatments of four control groups and eight exposure duration groups at each temperature were tested. Adapted from Comeau et al. 2011.

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Temp (°F)	Time 1 s (%)	2 s (%)	5 s (%)	10 s (%)	20 s (%)	40 s (%)	80 s (%)	160 s (%)
68	4	4	6	0	0	2	2	0
104	2	2	8	12	94	100	100	100
122	10	22	36	82	100	100	100	100
129	54	72	98	100	100	100	100	100
140	72	92	100	100	100	100	100	100
158	88	98	100	100	100	100	100	100
176	86	98	100	100	100	100	100	100

**Note the above table reflects research on the mortality of quagga mussels. This scientific information has informed the current protocols and standards found here and reflect the maximum time and temperature that will achieve mortality of quagga and zebra mussels. Zebra mussels have thicker shells and consequently require more exposure time.*

Manufacturers Association), addressing this fleet of watercraft with after-market changes would require different strategies and pose significant challenges. Chemical methods refer to the use of specific chemical products during decontamination process. The application of chemicals or other alternatives are not recommended for use in WID programs. Chemicals do kill mussels, but their use poses additional risks to the boats, boat owners and the environment. Additional background on various chemical mortality in association with dreissenid mussels (e.g., chlorine bleach and propylene glycol-based antifreeze) are addressed by Elwell and Phillips (2018).

There are some circumstances where chemical or physical alternatives may have appropriate applications, (e.g., wildland firefighting equipment decontamination, agency field gear decontamination, aquaculture transfers, etc.), but their use among watercraft owners is discouraged. The key difference between the WID programs and other situations that use chemicals (e.g., aquaculture transfer) is the resident time available for treatment. For example, fish stocking programs effectively use chemicals to treat stocking trucks for dreissenids and other AIS. However, these types of agency procedures have unlimited time available for treatment, can carefully monitor chemical concentration, and have policies for usage and disposal. Alternatively, WID stations experience time, logistics and other restraints. Within WID programs, chemicals also have liability, watercraft warranty, disposal, permitting, and correct use as per label aspects that must be considered.

TABLE 3:
A digest of published and unpublished studies that help inform the inspection and decontamination process.

Date	Authors	Title of Publication	Results	Summary	Study Area
1995	Riccairdi A, R Serrouya and FG Whoriskey	Aerial exposure tolerance of zebra and quagga mussels *(Bivalvia: Dreissenidae)*: implications for overland dispersal. *Canadian Journal of Fisheries and Aquatic Sciences*.	This study found that survivorship of mussels in air significantly increased with increasing relative humidity, decreasing temperature, and increasing adult mussel size.	Out of water, large mussels may survive 5 days in typical temperate summer conditions (20°C, 50% relative humidity); and 10-15 days in cool conditions (10°C, 95% relative humidity).	Quagga Zebra Mussel (QZM) Aerial Tolerance
1995	Ussery TA and RF McMahon	Comparative Study of the Desiccation Resistance of Zebra Mussels *(Dreissena polymorpha)* and Quagga Mussels *(Dreissena bugensis)*. Center for Biological Macrofouling Research, University of Texas at Arlington.	A direct result of this research was the development of a conversion table to determine the drying time required to kill all on-board mussels when exposed to air. The "Drying Time Calculator" determines how long watercraft and equipment must be out of the water (dried) in order to completely desiccate and render harmless all attached dreissenid mussels. The calculator can be found at https://www.westernais.org/watercraft	Drying time to effectively kill mussels will vary based on geographic location, season, and air temperature.	Quagga Zebra Mussel (QZM) Desiccation Resistance
2009	Morse JT.	Assessing the effects of application time and temperature on the efficacy of hot-water sprays to mitigate fouling by *Dreissena polymorpha* (zebra mussels Pallas), *Biofouling*.	This was the first published study to look at the efficacy of hot water sprays to mitigate dreissenid fouling. Morse found that zebra mussels required a 10 second spray time with 140°F water to achieve 100% mortality. Morse noted that "it is of interest that quagga mussels *(D. rostriformis bugensis)* are reported to have thinner shells and less tightly sealing shell valves than zebra mussels which may make them more susceptible to hot water sprays. However, this supposition requires experimental confirmation."	100% mortality of zebra mussel adults can be achieved with 10 second spray time of 140°F water.	Zebra Mussel Adult Mortality with Hot Water

continued on next page

Date	Authors	Title of Publication	Results	Summary	Study Area
2011	Comeau SR et al.	Susceptibility of quagga mussels *(Dreissena rostriformis bugensis)* to hot-water sprays as a mean of watercraft decontamination. *Biofouling*.	This study examined the efficacy of hot water sprays to decontaminate boats fouled with quagga mussels. Comeau et al. recommended a spray temperature of 140˚F for 5 seconds to mitigate fouling by quagga mussels.	100% mortality of quagga mussel adults can be achieved with 5 second spray time at 140˚F. See Table 2.	Quagga Mussel Adult Mortality with Hot Water
2011	Craft CD and CA Myrick	Evaluation of quagga mussel veliger thermal tolerance. Colorado State University Report #53-0555.	An examination of quagga mussel thermal tolerance was examined. Veligers were exposed to conditions similar to those on a watercraft traveling between waterbodies, including darkness, limited oxygen and small volumes of water.	100% mortality of quagga mussel veligers in water temperatures above 95˚F, and indicate that veligers can live in standing water for up to 24 days at 50˚F, 8.5 days at 59˚F or 4.5 days at 86˚F.	Quagga Mussel Veliger Mortality
2011	Bayer J et al.	Acute Upper Thermal Limits of Three Aquatic Invasive Invertebrates: Hot Water Treatment to Prevent Upstream Transport of Invasive Species. *Environmental Management*.	Bayer et al. found that for *D. polymorpha, D. r. bugensis and Bythotrephes* 100% mortality was achieved with exposure to 110˚F hot water for 5 minutes.	100% mortality of adult dreissenid mussels can be achieved with 5 minutes exposure of 110˚F water.	Quagga Mussel Adult Mortality with Hot Water
2012	Jerde CL et al.	Eurasian watermilfoil fitness loss and invasion potential following desiccation during simulated overland transport. *Aquatic Invasions*.	This study examined survival rates following desiccation. Jerde et al. found that plant fragments that experienced desiccation for more than 24 hours had little risk of surviving.	Milfoil fragments showed decreased survival probability as the plant becomes desiccated under average summer conditions.	Aquatic Plant Mortality from Desiccation
2013	Choi WJ et al.	Estimating survival rates of quagga mussel *(Dreissena rostriformis bugensis)* veliger larvae under summer and autumn temperature regimes in residual water of trailered watercraft at Lake Mead, USA. *Management of Biological Invasions*.	This study examined veliger survival following exposure to seasonal air temperatures. Choi et al. found that veligers could survive up to 5 days of summer temperature conditions and up to 27 days of autumn temperature conditions at Lake Mead.	Veligers experience 100% mortality after 5 days under summer conditions and 27 days under autumn conditions.	Quagga Mussel Veliger Mortality from Air Exposure
2014	Snider JP et al.	Assessment of quagga mussel *(Dreissena bugensis)* veliger survival under thermal, temporal and emersion conditions simulating overland transport. *California Fish and Game*.	This study examined veliger survival under simulated conditions found on recreational watercraft and equipment and using small amounts of water.	There is a risk of transporting live immersed quagga veligers in small droplets of water for at least 7 days at temperatures of 77˚F (25˚C) or lower.	Quagga Mussel Survival under Emersion Conditions
2015	Anderson LG et al.	Invaders in hot water: a simple decontamination method to prevent the accidental spread of aquatic invasive non-native species. *Biological Invasions*.	This study examined the efficacy of killing a range of invasive species with hot water as well as drying. 113˚F water for 15 minutes caused 99% mortality among species tested (e.g., zebra mussels, parrot's feather and signal crayfish).	99% mortality across 7 AIS was achieved with 113˚C within 1 hour of submerged treatment.	Zebra Mussel (and other AIS species) Mortality from Hot Water
2015	Comeau S et al.	Boat decontamination with hot water spray: Field validation. *Biology and Management of Invasive Quagga and Zebra Mussels in the Western United States*.	This study examined the water temperature and exposure time needed for mortality of quagga mussels and further examined specific boat areas for the time needed to reach lethal levels.	At least 2 minute and 12 second rinse water of the entire gimbal unit is needed to achieve 100% mortality, and constant temperature measurements of the water flushing ballast areas to ensure adequate temperatures for mortality.	Quagga Mussel Mortality from Hot Water on Specific Areas of Boat

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Date	Authors	Title of Publication	Results	Summary	Study Area
2016	Campbell T et al.	Volume and contents of residual water in recreational watercraft ballast systems. Management of Biological Invasions.	Watercraft ballast tanks were examined for the presence of residual water and organisms after being drained and pumped.	Residual water remains in ballast tanks after pumping. Live organisms, including veligers, were found one-week after drainage.	Ballast Tank Residual Water Assessment
2016	Davis E et al.	Livewell flushing to remove zebra mussel *(Driessena polymorpha)* velgers. *Management of Biological Invasions*.	This study examined the ability of a garden hose to flush the contents of a watercraft livewell to remove veligers for multiple lapsed times to determine if this could be used as a prevention technique.	More than 90% veligers were removed after 150 seconds of flushing.	Zebra Mussel Veliger Removal with Water and Live Wells
2018	Doll A	Occurrence and survival of zebra mussel *(Dreissena polymorpha)* veliger larvae in residual water transported by recreational watercraft. *University of Minnesota Thesis*.	This study observed the presence of veligers within residual water from watercraft compartments exiting dreissenid infested waters. Also examined the survivability of veligers in watercraft live wells and ballast tanks under various laboratory induced temperatures.	Residual water samples typically contained fewer than 5 veligers. Veligers contained in live wells experienced 95% mortality after 5 hours of exposure, whereas ballast tank veligers experienced 95% mortality within 48 hours.	Zebra Mussel Veligers Survival and Ballast Tank Residual Water Assessment
2018	Shannon C et al.	The practical application of hot water to reduce the introduction and spread of aquatic invasive alien species. *Management of Biological Invasions*.	This study examined immersion in hot water for lethal impacts to dressenids, and multiple aquatic plant species. In addition, the study examined a combination of duration and temperatures for effectiveness.	100% mortality for D. *polymorpha* was achieved for temperature/duration combinations. Plant mortality was variable and required more time.	Zebra Mussel Adult (and other AIS) Mortality from Hot Water Immersion
2019	Pucherelli S	Invasive mussel survival in recreational boat ballast pumps. *US Bureau of Reclamation Report*.	The study observed the survival of veligers and adults after passage through two types of watercraft ballast pumps and subsequent time in ballast tanks.	More than 90% of veligers survived passage, and between 46% to 85% of adults survived depending on the pump type. Tanks contained live veligers after two hours.	Veliger and Adult Mussel Survival and Ballast Pumps
2020	Collas FPL et al.	Effect of airflow on overland transport potential of invasive quagga mussel *(Dreissena bugensis)*. *Management of Biological Invasions*.	The study assessed the influence of air movement on the survival and behavioral changes of quagga mussels.	Adult mussels survived air speeds of 50 km/h for at least 18 hours. Valve gaping behavior changed when exposed to air speeds of 10 km/h.	Quagga Mussel Survival and Air Exposure at Velocity
2021	Bradbeer SJ et al.	The effectiveness of hot water pressurized spray in field conditions to slow the spread of invasive alien species. *Management of Biological Invasions*.	Multiple invasive species, including dreissenid mussels and multiple plant species, were examined for mortality after exposure to various temperatures of water at different time periods.	Duration and distance of water to AIS affected the mortality of invasive animal species. Plant species may need additional disposal as hot water did not achieve complete mortality.	Various AIS Mortality and Hot Water achieve complete mortality.

PROGRAMMATIC GUIDELINES FOR WATERCRAFT INSPECTION AND DECONTAMINATION

There are many states, provinces, and tribes that have implemented watercraft inspection and decontamination programs. However, funding, authority, and policies all play a role in determining the establishment of a watercraft inspection and decontamination program and how extensive that program will be. It is the responsibility of the managing agency to determine the level of acceptable risk and which type of watercraft inspection program most closely reflects the mission, values and capacity of their agency or organization. Numerous resources exist to help design a suitable WID program **(Table 4)**. Carefully crafted outreach (e.g., clean, drain and dry) that engages boaters in preventing the spread of invasive species is a critical component of all AIS programs.

The two most common positions for WID station locations are at geographic borders (or roadsides) and at waterbodies (lakes or reservoirs) **(Figure 2)**. Border (roadside) inspection stations are typically used to prevent AIS from entering a defined geographic area. These programs use a series of inspection stations placed at entries to an area and all watercraft passing the station are required to stop for an inspection. Stations at waterbodies place a WID station at the access point to a waterbody and can function in a prevention or containment scenario. An inspection program used for prevention would primarily conduct watercraft inspection prior to launch to prevent potentially high-risk boats from entering the water. A program used for containment would primarily conduct inspections on watercraft exiting a waterbody known to have established dreissenids or other AIS. In some cases, WID stations at waterbodies perform inspections on both entering and exiting watercraft.

FIGURE 2: Watercraft Inspection and Decontamination Models

Watercraft inspection and decontamination program types across the western states and provinces; including roadside, waterbody, or a combination.

Photos courtesy of (left to right): Tahoe Regional Planning Agency, Idaho Department of Agriculture

Another important dynamic for WID program development is voluntary versus mandatory aspects. Depending on the legal authorities of the managing agency there may be considerable variation in programs. Voluntary and mandatory requirements can range from the ability to stop a conveyance to quarantine of watercraft.

Risk assessments and recreation use information on waterbodies are helpful methods to direct and prioritize resources to waters with the highest risk for and impact from mussel introduction and establishment. The examination of several features of a waterbody should help determine if that waterbody is at a particular risk for dreissenid establishment (e.g., Whittier et al. 2008, Wells et al. 2010, Prescott and Claudi 2012). The following factors may be considered in a waterbody risk assessment:

- Water quality parameters that support the survival, growth and reproduction of dreissenid mussels (e.g., calcium, pH, salinity, conductivity, food supply, water temperature)
- Boating pressure including the number, origin, and types of watercraft using the waterbody
- Geographic proximity to dreissenid positive or suspect waters
- If the waterbody is a headwater, municipal water, power supply system, or agricultural use
- If the waterbody supports species listed under the Endangered Species Act
- Other waterbody parameters and uses such as access, recreational uses, etc.

Other considerations when implementing a WID program may include annual duration of program, daily duration of program (night station operation) and augmenting staff with canine capabilities. Annual duration of a WID program is often determined by weather, regional transportation patterns, agency regulated recreation season, recreation participation volume, and seasonal conditions. Daily duration of program is often determined by recreation and transportation patterns, and in some cases, staff safety concerns (i.e., nighttime inspections along roadsides). Funding and staff capacity will also influence the ultimate program season and hours of operation.

The use of canine inspectors is a valuable tool that can help publicize a WID program and assist human inspectors in difficult conditions such as long operation hours and night conditions. The use of canine inspectors is a relatively new addition to the inspection program process but has proven to be a valuable tool to enhance operations within an inspection or detection program. Scent-trained canine inspectors can identify both adult and veliger forms of dreissenids (Deshon et al. 2016). Canines can provide added staff to an inspection station, quality assurance / quality control, and overall visibility to the inspection process with the recreating public (Sawchuck and Hurt 2019). The commitment required to incorporate canine inspectors as part of a WID program is significant and will require a long-term vision for success.

Photos courtesy of (left to right): Mussel Dogs LLC, Invasive Species Action Network, Tahoe Regional Planning Agency

TABLE 4: Foundational Elements of Watercraft Inspection and Decontamination Programs

The foundational elements for implementing a watercraft inspection and decontamination program are represented by a broad collection of resources. Most of these documents and training information listed here can be found at westernais.org. Additional information on some elements can be found within this document are noted*.

Details and Types of WID Programs Depending on Needs and Jurisdictional Authorities*

- Voluntary / Self-inspection
- Partial / Screening inspection
- Inspection and decontamination
- Station Located Off-Water
- Station Located at Waterbody
- Station Located at Office or Business
- Guidelines for Inspection Station Design

Training for New and Experienced Individuals*

PSMFC In-person and web-based training workshops

- Level I Inspector Training
- Level II Inspection and Decontamination Training
- Level III Trainer Training
- Advanced Decontamination Training

Laws and Regulations for Authorities

- Model Legislative Provision
- Model Regulations
- Legislative Gap Analysis
- Model MOU
- Federal Policy Options Document
- Western Association of Fish and Wildlife Agencies Resolution on Plants and Watercraft Plugs
- WAFWA Resolution on Clean Drain Dry universal usage
- WAFWA Resolution on discouragement of chemicals in decontamination
- Toolkit for Local Governments

Program Features for Incorporation

- Boat seals and receipts for communication on watercraft status*
- Decontamination Unit Specifications*
- Quality Assurance /Quality Control for staff and program evaluation
- Regional Watercraft Inspection and Decontamination Data Sharing System
- Night station implementation analysis
- Local Boater/Rental Programs for waterbody specific use
- Passport inspection form

WID Experts to Inform and Educate on WID Implementation

- Western Invasive Species Coordinating Effort
- Pacific States Marine Fisheries Commission
- Western Regional Panel on ANS
- ABYC Technical Committee

Training Resources

- WID Manual
- WID Trainer's Manual
- Advanced Decontamination Manual
- Short videos demonstrating specific procedures
- COVID Guidelines for Inspection and Decontamination Stations

Funding Mechanisms

- State legislative appropriations
- Watercraft owner decal purchases
- Watercraft owner service purchase
- ANSTF approved State AIS Management Plan funding
- Federal QZAP grant funds
- Federal WRDA funds
- Various federal funding (BOR, BLM, USDA Forest Service)
- Local county/municipality/water district funds

Monitoring and Risk Assessment

- WRP Field Monitoring Standards
- WRP Laboratory Standards for Dreissenid Veligers
- Prioritizing Quagga and Zebra Mussel Monitoring (Wells et al. 2011)
- Vernacular on waterbody classification*
- WISCE position paper on eDNA results and monitoring

RECOMMENDED UNIFORM MINIMUM PROTOCOLS AND STANDARDS FOR WATERCRAFT INSPECTION AND DECONTAMINATION PROGRAMS

The term uniform minimum protocols and standards implies that all states, agencies, and organizations should strive to adopt this information as an integral component of WID programming. These protocols and standards reflect the best current available science, technology, and understanding. However, the field of watercraft inspection and decontamination is rapidly evolving, and new information may affect these protocols and standards in the future. Recent situations on highly infested waterbodies, such as Lake Powell, have shown managers that dreissenid mussels may be capable of previously undocumented biological characteristics or physiology that can challenge currently accepted procedures. For example, floating mussels can attach to watercraft during day use, rather than only on long-term moored watercraft, and infest hard to reach interior locations, such as the sea strainer. These situations only serve as a reminder that WID programming is ever evolving, and requires consistency and flexibility to be successful. For in-depth coverage of step-by-step procedures for inspection and decontamination, refer to *Watercraft Inspection and Decontamination Manual* (Brown 2021) and *Advanced Decontamination Manual* (Boos 2021).

The authority to stop, inspect, decontaminate, impound, quarantine, and exclude watercraft or equipment varies between jurisdictions. Further there may be legal reporting requirements when encountering a mussel-fouled watercraft. It is critical to understand your legal authority and exercise it according to the law regarding search and seizure. It is recommended that you confer with your agency law enforcement and legal staff prior to the development of a new WID program or significantly changing elements of an existing WID program.

The following information outlines specific methods currently utilized by various jurisdictions.

SELF-INSPECTION

The purpose of self-inspection is to engage watercraft operators in a process to minimize dreissenid or AIS introduction and to provide guidance to watercraft operators on how to be responsible.

FIGURE 3:
Sample of self-inspection form utilized by Utah Division of Wildlife Resources.

Watercraft decontamination

Before boating

Before launching your boat, it *must* be mussel-free. It's the law! Mandatory boat inspections are routine at Lake Powell, some state points of entry, roadside stops and other waters. This form serves as an inspection or decontamination receipt. A full year certificate can be obtained at ***wildlife.utah.gov/QuaggaCourse.***

Scan the QR code to obtain your certificate!

Clean, Drain and Dry decontamination

Check each box as you **Clean, Drain and Dry**

☐ **Clean** all plants, fish, mussels and mud off your boat.

☐ **Drain** all water, even from your ballast tanks, bilge, livewells and motor. (Lower your motor or outdrive to drain it.)

Dry your boat and equipment for at least:
- ☐ 7 days in summer (June through Aug.)
- ☐ 18 days in spring or fall (March through May, Sept. through Nov.)
- ☐ 30 days in winter (Dec. through Feb.)

NOTE: All boats with inboard or I/O engines, ballast tanks, and other raw water systems are always subject to a 30 day dry-time during all seasons (because of unverifiable water).

Professional decontamination

Professional decontamination is another option. Certified specialists use scalding (140° F) water to wash your trailer and boat inside and out plus flush your ballast tanks, bilge, livewells and motor.

Locate professional decontamination units:
- Northern Utah, 801.648.6315
- Northeastern Utah, 435.790.5357
- Southern Utah, 435.590.9465
- Central Utah, 435.503.4066
- Southeastern Utah, 435.299.9562
- Or visit STDoftheSea.com

Visit STDoftheSea.com for more information.
Invasive mussel hotline: 1 800 662-3337

Complete, sign and place this side up on the dashboard of the tow vehicle before launching.

Was boat used in any of the following mussel-affected areas within the past 30 days?

- **Utah:** Lake Powell
- **California, Nevada, New Mexico or Arizona**
- **Waters east of Montana, Wyoming, Colorado and New Mexico**
- **Mexico or Canada:** (Canadian provinces of Quebec, Ontario or Manitoba)
- **Other:** Waters published on the DWR website at *wildlife.utah.gov/rules.*

If you answered NO to the question above, sign below, then place this form, with the signature side up, on the dashboard of your launch vehicle before launching.

If you answered YES to the question above, you *must* decontaminate your boat using one of the methods below:

☐ **Clean, Drain and Dry decontamination** (See the front side of this form for instructions.)

☐ **Professional decontamination**
(See the front side of this form for help in locating decontamination units.)

Under penalty of law, I declare that I have either not used my boat in any water listed above or I that have decontaminated my boat and trailer as outlined on the front side of this form.

Boater signature **Date**

Valid only when signed. Providing false information is unlawful. (Admin rule R657-60).

Elements of a Self-Inspection Program

- Self-inspection is typically implemented at a waterbody and can require voluntary or mandatory participation from the watercraft operator.
- This program provides an inspection form **(Figure 3)** that is made available at an entry station, kiosk or online with instructions for the watercraft/equipment operator to complete questions and inspect all areas of watercraft, trailer, and equipment.
- This program provides education to watercraft operators on AIS and inspection processes and creates a social contract between the watercraft operator and the AIS program staff.

Protocols:

1. Provide a self-inspection form at the point of entry, kiosk, dedicated check-in area, or online with clear directions on how the boater can inspect their watercraft following the checklist.
2. Require (with required authority) or request (without required authority) that the form be completed, signed, and posted in clear view on the dash of watercraft/equipment transport vehicle prior to launching.
3. Failure to comply may have disciplinary actions based on local authority.

Standards:

Before launching, watercraft operator should confirm that the following conditions have been met by signing and displaying a completed self-inspection form.

1. Watercraft, trailer, and equipment have not been in any water known or suspected of having quagga/zebra mussels or other AIS in the past 30 days.
   a. Consider adding a checklist of those waterbodies of most concern in your area so boaters can indicate if they have been in any of those specific waters.
2. Watercraft, trailer, and equipment have been visually inspected by the operator at the site prior to launching.
3. Watercraft, trailer, and equipment are clean, drain and dry.

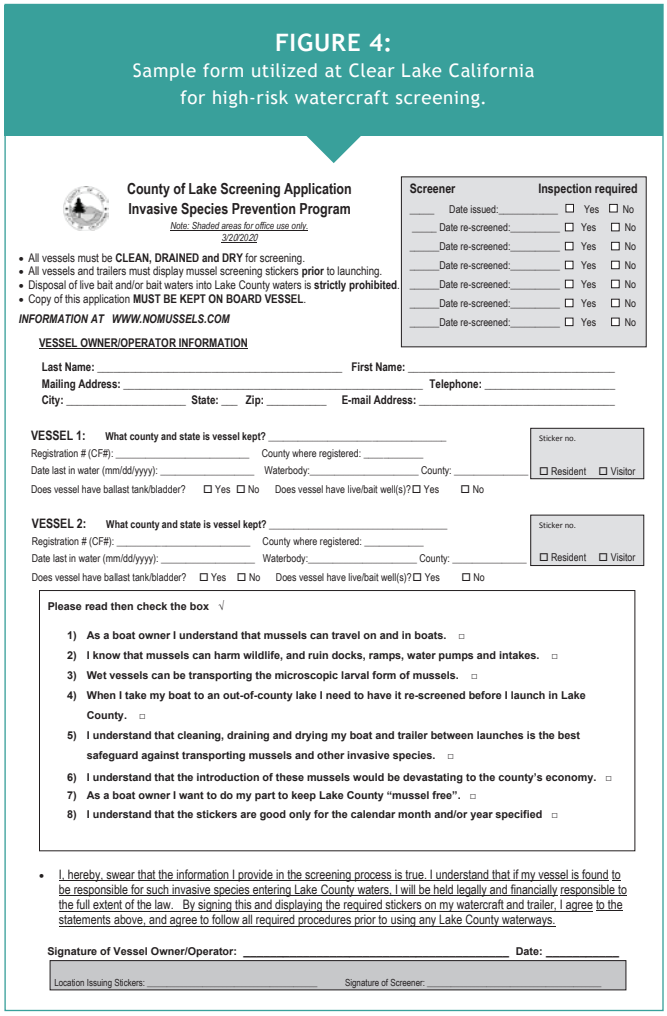
SCREENING FOR HIGH-RISK WATERCRAFT

The purpose of this program is to assess watercraft for risk prior to launch at a waterbody. Information and verification are provided by the watercraft operator, and the assessment is conducted by screening staff or volunteers.

Elements of Screening for High-Risk Watercraft

- The program utilizes a screening interview to collect information from the watercraft operator through a standard set of questions prior to launching or entry. These questions determine the level of risk posed by that watercraft based on its recent use history **(Figure 4)**.
- Authority by local jurisdiction allows for watercraft operator compliance.
- This program provides education to watercraft operators on AIS and watercraft inspection processes.

FIGURE 4:
Sample form utilized at Clear Lake California for high-risk watercraft screening.



County of Lake Screening Application
Invasive Species Prevention Program
Note: Shaded areas for office use only.
3/20/2020

Screener	Inspection required
____ Date issued:_____	☐ Yes ☐ No
____ Date re-screened:_____	☐ Yes ☐ No
____ Date re-screened:_____	☐ Yes ☐ No
____ Date re-screened:_____	☐ Yes ☐ No
____ Date re-screened:_____	☐ Yes ☐ No
____ Date re-screened:_____	☐ Yes ☐ No
____ Date re-screened:_____	☐ Yes ☐ No

- All vessels must be **CLEAN, DRAINED and DRY** for screening.
- All vessels and trailers must display mussel screening stickers **prior** to launching.
- Disposal of live bait and/or bait waters into Lake County waters is **strictly prohibited**.
- Copy of this application **MUST BE KEPT ON BOARD VESSEL**.

INFORMATION AT WWW.NOMUSSELS.COM

VESSEL OWNER/OPERATOR INFORMATION

Last Name: _____ **First Name:** _____
Mailing Address: _____ **Telephone:** _____
City: _____ **State:** ___ **Zip:** _____ **E-mail Address:** _____

VESSEL 1: **What county and state is vessel kept?** _____
Registration # (CF#): _____ County where registered: _____
Date last in water (mm/dd/yyyy): _____ Waterbody:_____ County: _____
Does vessel have ballast tank/bladder? ☐ Yes ☐ No Does vessel have live/bait well(s)? ☐ Yes ☐ No
Sticker no. ☐ Resident ☐ Visitor

VESSEL 2: **What county and state is vessel kept?** _____
Registration # (CF#): _____ County where registered: _____
Date last in water (mm/dd/yyyy): _____ Waterbody:_____ County: _____
Does vessel have ballast tank/bladder? ☐ Yes ☐ No Does vessel have live/bait well(s)? ☐ Yes ☐ No
Sticker no. ☐ Resident ☐ Visitor

Please read then check the box √

1) **As a boat owner I understand that mussels can travel on and in boats.** ☐
2) **I know that mussels can harm wildlife, and ruin docks, ramps, water pumps and intakes.** ☐
3) **Wet vessels can be transporting the microscopic larval form of mussels.** ☐
4) **When I take my boat to an out-of-county lake I need to have it re-screened before I launch in Lake County.** ☐
5) **I understand that cleaning, draining and drying my boat and trailer between launches is the best safeguard against transporting mussels and other invasive species.** ☐
6) **I understand that the introduction of these mussels would be devastating to the county's economy.** ☐
7) **As a boat owner I want to do my part to keep Lake County "mussel free".** ☐
8) **I understand that the stickers are good only for the calendar month and/or year specified** ☐

- I, hereby, swear that the information I provide in the screening process is true. I understand that if my vessel is found to be responsible for such invasive species entering Lake County waters, I will be held legally and financially responsible to the full extent of the law. By signing this and displaying the required stickers on my watercraft and trailer, I agree to the statements above, and agree to follow all required procedures prior to using any Lake County waterways.

Signature of Vessel Owner/Operator: _____ **Date:** _____

Location Issuing Stickers: _____ Signature of Screener: _____

Protocols:

1. Develop and use a standard screening interview form that includes the following questions:
    - The home state or postal code where the watercraft or equipment is registered
    - The specific waterbody where the watercraft or equipment was last used (and if possible, a complete 30-day use history)
    - The date of the last use
    - If the watercraft/equipment is clean, drain, and dry (be aware that some compartments and propulsion systems cannot be fully drained, and may require additional actions such as decontamination)
2. Verify the responses by checking the license plate or registration (boat ID) number and do a brief visual inspection for mussels, mud, plants, or water.
3. Clarify any inconsistencies between the responses given and the physical evidence before clearing the watercraft or equipment for launch or continued travel.
4. Utilize the screening interview as an educational opportunity.

Standards:

1. Watercraft that has been used in any dreissenid mussel infested, positive, or suspect waterbody in the past 30 days or are not clean, drained and dry should be subject to a thorough inspection by a trained staff before being allowed to launch, or excluded if inspection or decontamination is not possible.
2. If there is reasonable suspicion of deception on the part of the owner/operator/transporter during the screening interview, the vessel should be subject to a thorough inspection before being permitted to launch.

WATERCRAFT, TRAILER, AND EQUIPMENT INSPECTION AND DECONTAMINATION

The authority to stop, inspect, decontaminate, and/or quarantine watercraft or equipment varies between jurisdictions. Make sure you understand your authority and exercise it according to the law regarding search and seizure. This level of program requires a process to evaluate the boat for risk using both a screening interview, a physical and visual inspection, and may include if appropriate decontamination, quarantine, impound, or exclusion. Watercraft or equipment last used in infested, positive, or suspect dreissenid mussel areas within the past 30 days that have not been decontaminated or been out of the water for the required time based on the 100th Meridian Initiative Dry Time Estimator **(Table 6)** should be:

1. Decontaminated and/or
2. Placed in quarantine for the required time frame per the Dry Time Estimator; or
3. Excluded

Further, watercraft that are not clean, drained and dry should be decontaminated and/or excluded.

Photo courtesy of: Invasive Species Action Network

CLEAN:
Remove attached vegetation, debris, or surface deposits

DRAIN:
Remove visible water in any live well, bait well, bilge area, floor, cooler, or residual water in a ballast tank or engine compartment

DRY:
No standing water. No detectable water on exterior or interior surfaces.

Watercraft, Trailer, and Equipment Inspection

Conducting an effective inspection requires some knowledge of dreissenid mussel identification, life history and biology; knowledge of the working parts of a wide range of watercraft types and equipment (*See Special Considerations below*); and the cooperation of the watercraft/equipment operator.

The purpose of inspection is to verbally and physically assess and evaluate the level of risk a watercraft poses for AIS spread and introduction.

Elements of Inspection

- Legal authority to stop watercraft for mandatory inspection.
- Programs that utilize inspections can be conducted at a roadside location, waterbody, office, business location, or with roving crews.
- The process of inspection can be used as an AIS educational opportunity with watercraft operators and watercraft haulers.

The WID Manual (2021) to inspect watercraft provides the WRP approved step-by-step procedures to properly perform an inspection including:

- Incoming Entrance and Off-Water Inspection Procedure
- Outgoing Exit Inspection – Prevention Waters Procedure
- Outgoing Exit Inspection – Containment Waters Procedure

The protocols and standards here guide programs for consistency across the West.

Protocols:

1. Use and follow an inspection checklist or the Regional Watercraft Inspection and Decontamination Data Sharing Application **(Figure 5)** to characterize the watercraft and watercraft risk level. The inspection checklist should include, at a minimum, the following information:
   - The home state or postal code where the watercraft or equipment is registered
   - The vessel ID number
   - Last 30-day history of use
   - The date of the last use
   - If the watercraft/equipment has been cleaned, drained and dried
   - A checklist of areas to be inspected, including ballast tanks
2. Use a systematic and repeatable plan when conducting inspections to ensure consistent and complete coverage of every area of the watercraft; utilize H(ull)E(ngine)A(nchor)D(rain) as a guide for conducting the physical inspection.
3. A checklist of areas to be inspected should include the following:

   (H) Hull and Exterior Surfaces (at and below the waterline): Hull, transducer, speed indicator, through-hull fittings, trim tabs, water intakes, zincs, centerboard box and keel (sailboats), pontoons (pontoon boats), and foot-wells (personal watercraft)

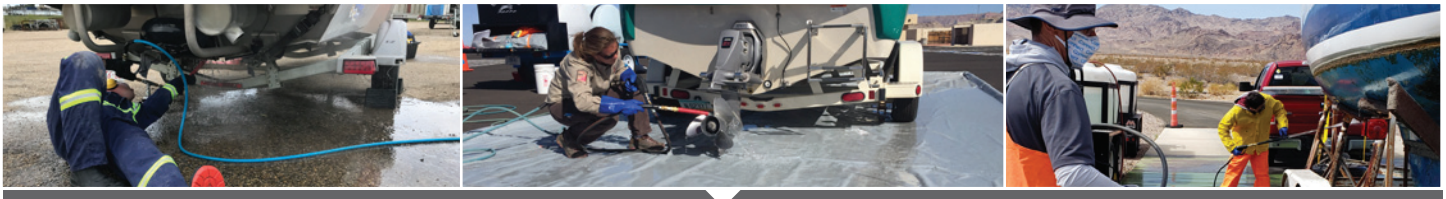
   (T) Trailer: Rollers and bunks, light brackets, cross-members, hollow frame members, license plate bracket, springs, and fenders

   (E) Engine or Propulsion System: Lower unit, cavitation plate, cooling system intake, prop and prop shaft, bolt heads, gimbal area, engine housing, jet intake, paddles and oars

   (A) Anchor and other Equipment: Anchor, anchor and mooring lines, Personal Flotation Devices, swim platform, wetsuits and dive gear, inflatables, down-riggers and planing boards, water skis, wake boards and ropes, ice chests, fishing gear, bait buckets and stringers, and bumpers

   (D) Drain all Interior Areas: Bait and live wells, storage areas, splash wells, under floorboards, bilge areas, water lines, ballast tanks, sea chest, and drain plug

Photos courtesy of (left to right): Alberta Environment and Parks, Invasive Species Action Network, Nevada Department of Wildlife



4. If a high-risk watercraft has standing water, or is suspected or found to be fouled, the watercraft will need to be decontaminated, quarantined, and/or exclusion.
5. If dreissenid mussels are found anywhere on the watercraft or equipment, the inspection should continue to document all occurrence of AIS on the entire watercraft, trailer, and equipment. Then the watercraft will need to be decontaminated and/or quarantined before being allowed to launch or leave.
6. Use the inspection process as an opportunity to educate the boat operator on the importance of practicing of clean, drain, and dry. Demonstrate the proper way to conduct a watercraft inspection.

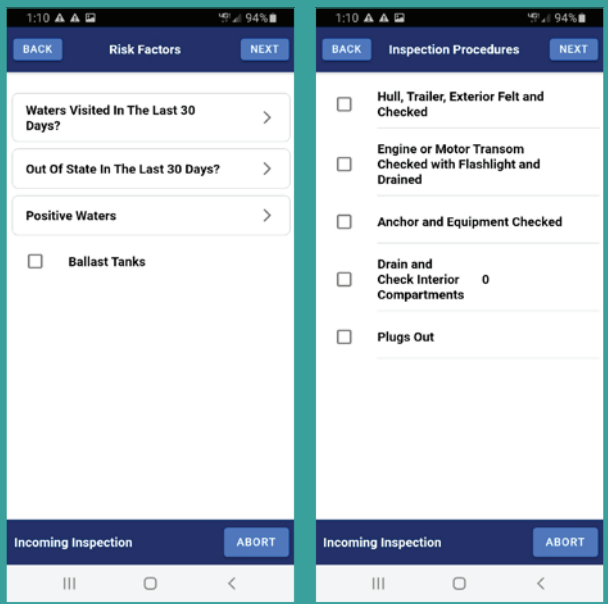
Standards:

1. If attached mussels or standing water (verifiable or unverifiable) are found on a high-risk vessel, it should not be allowed to launch without first being decontaminated or subject to the appropriate quarantine or both.
2. If verifiable standing water is found on exposed areas of a low risk and clean watercraft, the watercraft should be thoroughly wiped dry first and allowed to launch.
3. If no mussels or standing water are found following a thorough inspection of the watercraft that is considered high risk because it has been in known mussel waters within the last 30 days, but has been out of the water long enough to be considered safe by applying the Dry Time Estimator, it should be allowed to launch, except for watercraft that have unverifiable water in ballast tanks, engines, or other difficult to access and completely drained raw water storage areas.
4. Normal drying time standards do not apply when areas that cannot be visually inspected and completely drained are present. These areas need to be decontaminated to kill any mussels or veligers. Due to high numbers of complex watercraft that hold unverifiable water leaving infested waters, some AIS programs have offered a 30-day dry time as an alternative to a hot water decontamination.
5. Any watercraft or piece of equipment with attached vegetation (including algae growth) should not be allowed to launch without complete removal, or plant decontamination if necessary, and re-inspection.
6. Any watercraft with enough dirt, calcium, or bio-fouling build-up should be required to be cleaned and re-inspected before being allowed to launch.

Watercraft, Trailer, and Equipment Decontamination

Following inspection, if a watercraft is confirmed or suspected to have mussels on board, three options are available: 1) decontamination, 2) quarantine to allow sufficient drying or 3) exclusion. The purpose of decontamination is to remove and kill dreissenid mussels, and other AIS, from watercraft, trailers, and equipment to prevent further spread or introduction. Killing mussels prevents establishment of new populations resulting from watercraft/equipment transfer, but removing dead mussels is also important. It may be possible that dead mussels could influence monitoring results by affecting environmental DNA (eDNA) or polymerase chain reaction (PCR) samples from waterbody monitoring efforts (i.e., resulting in a false positive). Furthermore, determining the viability of attached mussels in the field within the context of a watercraft inspection or decontamination can be problematic. Therefore, mussels on watercraft or equipment that appear dead do not necessarily indicate that those mussels are in fact dead.

FIGURE 5:
Screenshots capturing inspection components within the Regional Watercraft Inspection and Decontamination Data Sharing Application.



Decontamination uses hot water at specific temperatures for specific times to successfully kill AIS. The exclusive use of hot water **(140˚F or 120˚F at the point of contact)** and pressure washing or flushing equipment with various attachments to kill and remove any possible mussels and kill all veligers from every area of the watercraft, engine, trailer, and equipment is recommended **(Table 5)**.

Elements of a Decontamination Program

- Legal authority to decontaminate a boat.
- Programs that conduct decontamination can be applied in prevention capacity (decontamination of watercraft prior to launch) and containment capacity (decontamination of watercraft exiting a suspect, positive, or infested waterbody) or both.
- The process of decontamination can be used as an AIS educational opportunity with watercraft operators and haulers.

The WID Manual (2021) provides the step-by-step procedure to properly perform a decontamination. The Advanced Decontamination Manual (2021) provides the step-by-step procedures to decontaminate very complex watercraft and components in specific decontamination situations. The protocols and standards here guide programs for consistency across the West.

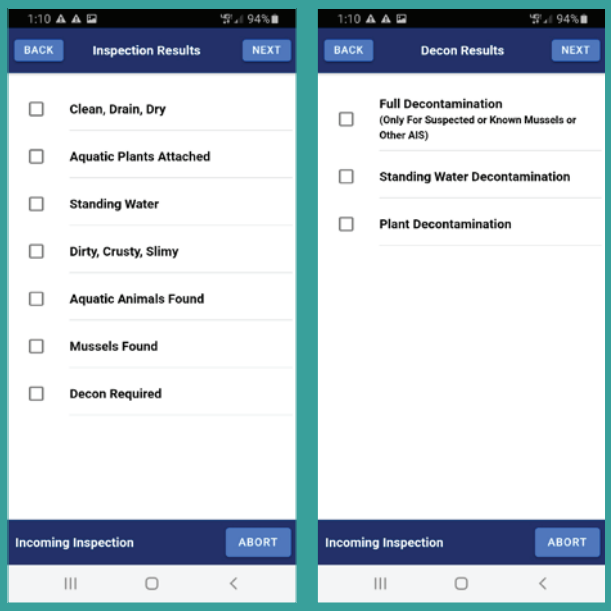
Protocols:

1. Use a location to conduct the decontamination that is away from the waterbody and where the run-off and solids from the decontamination process can be contained and will not re-enter any waterbody. Compliance with all state and federal discharge regulations is advised. Wastewater and solids as a result of the decontamination process should be totally contained and directed to an appropriate waste treatment or disposal facility.
2. Consider requesting a liability waiver signature from the watercraft operator as a condition of the decontamination. Most operators typically agree to sign a liability waiver when the option is quarantine or exclusion. Agencies should consult with their legal staff on liability issues.
3. Once the decontamination process and alternatives have been explained and before beginning a decontamination procedure, permission by the watercraft operator should be granted.
4. Use the Regional Watercraft Inspection and Decontamination Data Sharing System or Application to document actions taken **(Figure 6)**.

Standards:

1. Use a plastic scraper, brushes, and gloves to remove attached mussels before applying hot water spray to significantly reduce the time required to complete the watercraft decontamination.
    a. Encrusted watercraft will need decontamination and dry time.
    b. Slipped and moored watercraft will have the highest risk due to the length of time in the water and complex systems which will need flushing (i.e., generators, and air conditioning units).

FIGURE 6:
Screenshots capturing inspection components within the Regional Watercraft Inspection and Decontamination Data Sharing Application.



NOTE: DECONTAMINATION SAFETY ADVISORY
Extreme caution should always be used when working in and around watercraft and equipment, specifically when working with high pressure hot water, and vehicles.

2. Monitor water temperature at the nozzle and at the point of contact to be sure that equipment is operating as required before initiating decontamination. Water loses approximately 10-15˚F degrees per foot of distance from a power nozzle, so account for this heat loss. Always use a thermometer or temperature logger to verify and maintain proper water temperatures at the point of contact.

3. Use 140˚F water at the point of contact to kill mussels and veligers on the exterior (hull, engine, and trailer) and 120˚F on the interior (compartments) **(Table 5)**.

WARNING:
Watercraft/engine damage can occur if decontamination procedures are not carefully followed.

TABLE 5:
A summary of scientific research indicating the lethal water temperature at point of contact and duration for decontamination. Information is grouped by the location of the boat that is targeted and the life form of dreissenid mussel targeted (e.g., adult mussel or veliger). The water temperatures should be no greater than those listed. The duration is the minimum time necessary to achieve mortality. Please refer to The WID Manual (Brown 2021) for complete step-by -step procedures.

	Boat Part/Location	Water Temp.	Duration*	Type of application	Target Life Stage
Exterior	Hull	140˚F	10 seconds[A]	High pressure spray	Adult
	Trailer	140˚F	10 seconds[B]	Low pressure spray	Adult
	PFDs, anchor, paddle	140˚F	10 seconds[A]	Low pressure spray	Adult or Veliger
Propulsion System	Gimbal	140˚F	132 seconds[B]	Low pressure spray	Adult
	Engine	140˚F[1]	130 seconds[B]	Flush	Veliger
Interior	Ballast tanks	120˚F[1]	130 seconds[B]	Low risk - Flush	Veliger
				High risk- Fill and flush	
	Live well/Bait well	120˚F	130 seconds[B]	Low pressure spray or flush	Veliger
	Bilge	120˚F	130 seconds[B]	Flush or low pressure spray	Veliger

1 These temperatures denote the exit temperature of water exiting the boat (interior compartment temperature), not exiting wand or flush attachment.
A Morse 2009
B Comeau et al. 2015
High pressure = 3000 psi.
Low pressure = pressure from the decontamination unit with no nozzle, essentially a garden hose flow.
Flush = adding water to a compartment of a boat and forcing the water out.

NOTE: DECONTAMINATION TEMPERATURE AND DURATION
Scientific studies have determined lethal temperature and exposure time for a variety of AIS **(Table 2)**. There may be temperatures and times capable of effectively killing that are lower than those recommended here for some AIS. However, the recommended temperatures and times increase the success of killing AIS during the decontamination process for the most resilient species or when species mortality is unknown. For any decrease in lethal temperature, protocols must be amended with an increase in exposure time.

NOTE: DECONTAMINATION UNIT SPECIFICATIONS
A decontamination unit that can spray a minimum of 5 gallons/minute with 3000 psi nozzle pressure are the recommended specifications. The 5 gallon/minute provides an adequate rate for cooling most watercraft engines. 3000 psi strikes a balance in effectively removing encrusted mussels and minimizing human hazards when performing a full decontamination. Larger engines may require more gallons/minute to ensure a safe and effective flush. Detailed specifications can be found in **Appendices A and B**.

NOTE: REMOVING ATTACHED MUSSELS
When attached mussels can dry for several days their byssal threads begin to decompose. Removing mussels by scraping or power washing after a period of drying requires considerably less effort and can be accomplished with lower nozzle velocities than those required for live mussels (3,000 psi).

DRYING TIME

Drying is a simple technique to desiccate dreissenids or other invasive species to decrease their viability. Numerous studies in both laboratory and applied situations have examined the viability of specific invasive species following different climatic exposures, including temperature, and humidity (e.g., Collas et al. 2020, Urssery and McMahon 1995). The amount of time required to achieve complete desiccation of dreissenids will vary depending on temperature, relative humidity, and size of the mussels, and can range from 1-30 days (McMahon University of Texas at Arlington, personal communication). The 100th Meridian Initiative's Dry Time Estimator **(Table 6)** determines the length of drying time needed to assure that a watercraft or equipment is safe to launch (except when ballast tanks or other inaccessible raw water storage systems are involved). Drying times provided by the estimator may be less effective in some geographic locations with widely varying temperature or humidity compared to more uniform weather locations. Therefore, current conditions should be considered when utilizing the estimator.

The two primary situations where drying is utilized are 1) following watercraft decontamination of an infested conveyance, and 2) when decontamination is not possible. In a decontamination process, the manual application of hot water is not always 100% effective in removing all mussels from hidden areas found on some types of watercraft and/or equipment. Further, the survivability of attached mussels in some hidden areas of watercraft is difficult to determine visually.

Therefore, it is recommended all watercraft and equipment with attached mussels be subject to a drying period sufficient to achieve complete desiccation after inspection, mechanical removal, and hot water decontamination. Further, drying time will not apply in the same way to watercraft with ballast tanks or other water storage areas that are not easily accessed for inspection or cannot be completely drained. Research suggests that veligers can survive 27 days in residual water of compartments (Choi et al. 2013). If these areas maintain water, then the actual time required to achieve 100% mortality either through desiccation or anoxia will most likely exceed the drying time standards recommended. Variation in ballast tanks drainage capabilities will influence the length of time required to dry. For this reason, hot water flush of ballast tanks is critical for effective decontamination.

Another application of drying time is simply to require that all high-risk watercraft serve a predetermined drying/waiting period prior to launch, or after exiting an infested, positive or suspect water (duration determined by risk level and current temperature and humidity conditions). Under this scenario, all high-risk watercraft are prohibited from launching in a new water until the required drying time has passed, as determined by the inspection.

Quarantine and Impound

The implementation of drying time may take various forms, including quarantine and impound. The Dry Time Estimator is the recommended tool for determining the appropriate quarantine or impound

TABLE 6: DRY TIME ESTIMATOR

The 100th Meridian Initiative's Dry Time Estimator is a tool to estimate the amount of time needed to properly dry a watercraft. The estimation is based on daily temperature, humidity, and size of mussels present on watercraft.

Maximum Daily Temperature (°F)	Minimum Days Out of Water
<30	28 days (4 weeks)
30-40	28 days (4 weeks)
40-60	21 days (3 weeks)
60-80	14 days (2 weeks)
80-100	7 days (1 week)
>100	3 days

time. If watercraft or equipment suspected of carrying quagga or zebra mussels cannot be decontaminated for any reason, then the watercraft must be held out of water for an appropriate period of time necessary to desiccate and kill all mussels and veligers on-board. This is often referred to as quarantine. Quarantine can be voluntary or mandatory in that a boater may have to leave their watercraft in dry storage on site or may be required to keep it out of water at their home.

Physical quarantine of a watercraft or piece of equipment requires providing a safe and secure holding area where it can be parked for the time required to desiccate all mussels. Some agencies/organizations have used this option to take possession of suspect watercraft to ensure watercraft remains out of the water long enough to be considered safe. Establishing and maintaining a dedicated quarantine facility can be expensive and comes with some potential liability issues. When a quarantine facility is not available, then drying time can be achieved by sealing (secured connection between watercraft and trailer) the watercraft or piece of equipment to the trailer or other means of transport. The operator is advised or required not to launch until the date indicated on the seal and/or an accompanying receipt. The legal act of seizing the watercraft is considered impound and must be performed by law enforcement personnel. Both quarantine and impound have significant implications for liability and logistics. Program managers should fully explore legal and logistic options before conducting quarantine or impound operations.

The major concern with drying alone is that it does not remove attached mussels. If mussels remain on the vessel, they will eventually drop off. If that occurs at a boat ramp or beach, the presence of mussel shells can raise concern of a new infestation (either by someone finding a shell or via eDNA monitoring of the waterbody), triggering alarm, and resulting in expensive and unnecessary action. In many states the possession of dead AIS is prohibited in addition to live AIS. For those reasons, it is recommended that all visible mussels be removed from dried watercraft that has been quarantined before allowed to launch.

Protocols:

1. Drying time is highly recommended for all watercraft following full decontamination on watercraft with adult mussels attached, and watercraft that have significant mussels attached due to long-term mooring. It is also recommended in lieu of, or in addition to, decontamination for watercraft that have operated on or in any suspect, positive or infested waterbody in the last 30 days.
2. All visible mussels should be removed from watercraft or equipment following quarantine or drying time before being allowed to launch.
3. After drying time is completed, the watercraft should be re-inspected.

NOTE: "HIDDEN" MUSSELS

It may not be possible to remove all attached mussels from every area of the watercraft/equipment. A day or two following decontamination, it is not unusual for mussels to appear as byssal threads begin to decompose. If properly treated, these mussels are dead and in the process of decay. In addition, there are some areas of a watercraft or pieces of equipment that cannot be easily accessed to remove dead mussels. Brushes may be used in conjunction with flushing in some of these areas to increase the effectiveness of mussel removal.

Standards:

1. To determine the appropriate drying time, refer to the Dry Time Estimator.
2. Watercraft with ballast or other internal water storage tanks that cannot be completely drained should be treated differently regarding drying time. If hot water decontamination is not possible, then a drying time should be required to kill veligers.

Photo courtesy of: Invasive Species Action Network

WATERCRAFT/EQUIPMENT EXCLUSION

A high-risk watercraft that is not decontaminated and/or quarantined should be excluded and not allowed to launch. Exclusion can be the result of vessel operator refusal to submit to an inspection, lack of available equipment or trained applicators, traffic, or facilities. Exclusion will vary based on state regulation or local authority. The use of exclusion should not be a long-term substitute for development of a more user-friendly and proactive inspection program that recognizes the value of recreational boating to the economy and the legitimate interests and enjoyment of the boating public. The case for using exclusion as a prevention strategy has diminished as agencies and organizations have been able to develop public policy, establish regulations, budget for equipment and manpower, train staff, and purchase equipment needed for more proactive and considerate approaches.

Protocols:

1. Watercraft and equipment that have not been or cannot be inspected, decontaminated or meet the drying time standard are excluded from launching.
2. The information obtained from the screening interview used to determine risk level should be shared with the watercraft owner/operator and made available on a real-time basis at all access points to prevent excluded watercraft/equipment from attempting to launch from any other point of access on the same waterbody.

Standards:

1. Watercraft or equipment that were last used in infested, positive or suspect dreissenid mussel areas within the past 30 days and have not been decontaminated and/or been out of the water for the required time (determined by the Drying Time Estimator) should be:
    a. decontaminated if appropriate facilities are available or
    b. placed in quarantine for the required time frame or
    c. excluded
2. Watercraft that are not clean (attached vegetation, debris or surface deposits that can mask the presence of small mussels), drained (having visible water in any live well, bait well, bilge area, engine compartment, floor or cooler) and dry (not been out of the water long enough for attached mussels to desiccate) should be decontaminated and/or quarantined or excluded.

WATERCRAFT SEALING AND COMMUNICATION

Many entities that conduct watercraft inspection and decontamination currently utilize some physical method to signify and communicate actions associated with the watercraft or equipment **(Appendix D)**. Seals or bands that mark the watercraft serve as a communication between jurisdictions, and can reduce workload, processing time and focus limited resources on higher risk watercraft. Further, watercraft that has been sealed can potentially streamline the watercraft operator experience at their next inspection station or waterbody launch.

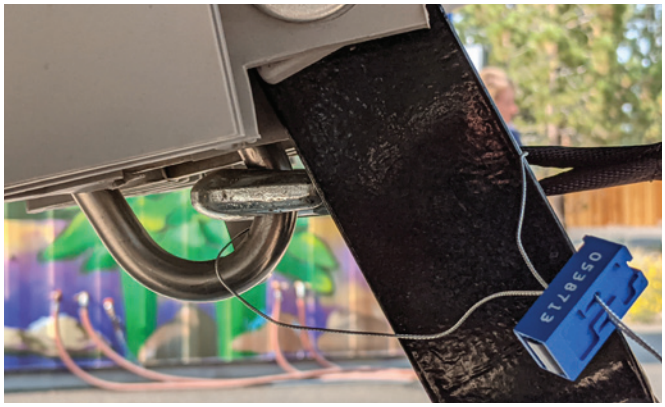


Photo courtesy of: Tahoe Regional Planning Agency

Many agencies and organizations apply seals that connect the watercraft/equipment to the trailer so that it cannot be used between inspections without detection. This provides proof of compliance for the boater and indicates the watercraft has not launched since the seal was applied. There can be different scenarios in which a seal is utilized. It often signifies some level of inspection or decontamination that has been done to the watercraft, but seals can serve a variety of communication purposes. In many cases, a written, printed or electronic receipt is also issued with the watercraft seal. The information that is generated when a seal is applied should be archived for further internal use.

Sealed watercraft can help with coordination between jurisdictions, where it may be possible for management actions to be expedited (at the discretion of the implementing agency/organization) at the next launch or inspection site only if the seal remains intact. Such a system may reduce staff and equipment time required at inspection facilities region-wide, thereby increasing resource protection, saving money, and increasing positive boater relations.

Some entities currently offer a sticker or paper communication without a seal, often addressing watercraft for specific geographic locations or specific waterbodies. These communications can convey the date and location of previous inspections, and often include additional AIS educational information. However, since there is no way to determine where that watercraft or equipment has been between inspections, this method is limited to specific situations.

Protocols:

1. When applying a seal in association with a watercraft decontamination, the sealing entity should follow the Uniform Minimum Protocols and Standards at a minimum.
2. All agencies and organizations that utilize seals should use a system that attaches the watercraft to the trailer which cannot be tampered with or removed without detection.
3. The seal is no longer valid, and status of the watercraft cannot be confirmed, if the seal has been tampered with, severed or removed.
4. Specific information can either be incorporated into the seal or provided on an accompanying receipt or paperwork. While a variety of different seal styles and materials may be used, all seals should have the following features:
    - The name of the agency/organization applying the tag and the location where it is being applied.
    - The sealing date should be indicated on the tag or on the accompanying receipt.

Standards:

1. Watercraft or equipment that have been inspected, decontaminated or quarantined by trained personnel in accordance with the *WID Manual* (Brown 2021) or appropriate equivalent should receive a watercraft seal.
2. Watercraft or equipment leaving infested waterbodies may also be sealed to signify that watercraft may not have been inspected or decontaminated for communication purposes.
3. Seals should only be applied by a trained inspector.
4. Watercraft and equipment that have been inspected and sealed by an agency or organization utilizing the Uniform Minimum Protocols and Standards may receive expedited processing at the discretion of the receiving agency/organization in other jurisdictions.

SPECIAL INSPECTION CONSIDERATIONS—UNIQUE BOAT DESIGN & FUNCTION

The *WID Manual and the Advanced Decontamination Manual* are resources that examine all boat types and the special considerations that come with these boat types. Comprehensive training in boat specifics is a critical component for WID staff to understand boats. Several specific boats are highlighted here to provide examples of different aspects of boats that should be considered.

Pontoon boats: The flotation portion of the pontoon boat is designed to contain air and no water should enter this portion of the boat. The boats are equipped with manufacturer placed “drain plug” and they are not engineered to be removed on a frequent basis. The only reason for possible water inside the tube is a structural failure, loose or improperly sealed drain plug, or a puncture. Annual inspection of the tubes and drain plugs by boat manufacturer or mechanic is recommended.

Fire boats: Specialized rescue and response boats have additional water storage capacity for the function of boats to respond to fire situations. Water storage areas may require decontamination between uses and waterbodies.

Wake boats: Wake boats are recreational boats that have additional design features to create a large wake. The additional design feature typically includes increased ballast areas. The ballast areas may require decontamination between uses and waterbodies.

Jet-propulsion engines (including personal watercraft and jet skis): During decontamination procedures, the water must be turned on after the watercraft is already running. Different flushing attachments are needed, as well as important additional decontamination steps, such as cleaning out two plastic cylinders called “clean outs” which retain water in addition to the jet engine.

ADDITIONAL PROGRAMMATIC CONSIDERATIONS

Non-motorized Watercraft

Non-motorized watercraft are capable of transporting dreissenids and other AIS. Different jurisdictions may have authority to stop all watercraft – motorized, non-motorized and any other conveyance that may be capable of carrying water or spreading AIS. Non-motorized watercraft could include the following: drift boat, kayak, canoe, raft, stand-up paddle board, sailboard, windsurfer board, foldable boat, rowboat, fishing boat, and other conveyance used for recreation on the water.

Non-motorized watercraft are subject to the same inspection and decontamination protocols and standards outlined here, including decontamination with 140˚F water (Nicholas Zurfluh Idaho Department of Agriculture personal communication). However, low-quality construction materials (e.g., thin inflatable vinyl) may require different considerations to minimize negative impacts to the product integrity.

Commercial Watercraft and Water-based Equipment Haulers

Large watercraft and equipment transported by commercial haulers represent a risk in the overland transport of dreissenid mussels and other AIS. Watercraft and equipment that require a commercial hauler tend to be larger, more structurally and functionally complex and more likely to have been in the water for an extended time. Those factors elevate the level of risk for having attached mussels, mussel veligers or other invasive species on-board when watercraft are moved between waterbodies.

All commercially hauled watercraft and water-based equipment are subject to inspection and decontamination protocols and standards provided here including decontamination with 140˚F water. It is recommended that haulers contact the specific state agency based on the state the watercraft is destined and adhere to all associated laws. A summary of state laws can be accessed online at www.westernais.org.

In recent years, increased effort to better understand this vector has been initiated by various states. Including efforts to identify watercraft brokers and auctions, where watercraft sales results in commercial hauling and making specific outreach contacts to these entities. Several states directly contact commercial hauling companies alerting them of the AIS issue and watercraft inspection requirements. A sample letter to commercial haulers from Idaho Department of Agriculture is provided for reference **(Appendix E)**. Finally, the Utah Division of Wildlife Resources offers a Commercial Haulers AIS Awareness Program featuring online information and a proficiency test.

Seaplanes

Water resource managers throughout North America have long been concerned about seaplane activity as a pathway for the spread of aquatic vegetation, dreissenid mussels and other AIS. According to the National Seaplane Pilots Association (SPA) there are an estimated 23,000 seaplane rated pilots in the United States. The Federal Aviation Administration (FAA) does not distinguish between airplanes with floats, wheels or skis, so the exact number of seaplanes operating in the United States is not known. The SPA estimates that there are between 5,000 and 8,000 seaplanes currently in use in the United States. Individual jurisdictions with consistent seaplane use have developed processes to engage seaplane operators in prevention and sometimes mandatory inspection.

There have been recent regional efforts to promote prevention strategies among seaplane operators. For example, several Pacific Northwest states participate in a multi-partner Memorandum of Understanding with

Photo courtesy of: Nevada Department of Wildlife

the National Seaplane Association that attempts to address possible spread of AIS by seaplanes. To assist managers in seaplane management, the WRP Seaplane Committee developed specific inspection and decontamination procedures in 2019. Implementation of any procedures will be at the discretion and authority of the managing jurisdiction.

The WRP Inspection and Decontamination Procedures for Amphibious Seaplanes (2020) provides the step-by-step procedures to properly perform an inspection and decontamination on amphibious seaplanes. The protocols and standards here guide programs for consistency across the West. The use of chemicals to decontaminate seaplanes is not recommended or endorsed.

Protocols:

1. All seaplane pilots should view the seaplane inspection and cleaning video at westernais.org.

Standards:

1. Before entering the watercraft:
    a. Inspect and remove all aquatic vegetation, attached mussels, or other debris from exterior surfaces of floats, wires, cables, transoms, spreader bars and rudders.
    b. To the extent practical, remove all water from floats, wheel wells and any other compartments or areas of the aircraft that can contain water. Decontaminate with 140˚F water.
2. Before takeoff:
    a. Taxi clear of any aquatic vegetation.
    b. Re-inspect for any visual sign of aquatic vegetation.
    c. Raise and lower rudders several times or otherwise remove any aquatic vegetation.
    d. Make sure all floats remain dry internally during takeoff.
3. After takeoff:
    a. Raise and lower rudders several times to free any remaining aquatic vegetation while over the departing waterbody or over dry land.
    b. If aquatic vegetation persists and are still visible on floats, cables or rudders, return to the same waterbody and manually remove them.
4. Storage and mooring:
    a. Remove aircraft from the water whenever practical to better facilitate self-inspection, drainage, cleaning and drying.
    b. Maintain floats and hulls to make sure they remain watertight; including sealing seams, replacing gaskets on inspection covers and repairing any cracks.

Fire Fighting Equipment

Wildland fire fighting has been recognized as an area for AIS prevention to be incorporated into operations. The National Wildfire Coordinating Group has developed guidelines for agencies, tribes or private contracting entities to prevent the spread of AIS with firefighting equipment and vehicles. Equipment and vehicles that may be capable of spreading AIS include water delivery tank trucks, foot valves, pumpkins, scooper planes, and any equipment capable of transporting water.

Photo courtesy of: USDA Forest Service

The *Guide to Preventing Aquatic Invasive Species Transport by Wildland Fire Operations* (2017) provides the step-by-steps procedures to properly perform inspection and decontaminate equipment and vehicles. The protocols and standards here guide programs for consistency across the West.

Protocols:

1. All firefighting staff that operate water delivery or water transport equipment should review the Guide to Preventing Aquatic Invasive Species Transport by Wildland Fire Operations.

Standards:

1. Water delivery or water transport equipment arriving on site should be clean, drain, and dry.
2. During firefighting operations, the equipment or vehicle drawing from water sources for fire control should focus on one waterbody.
3. Document decontamination that is performed on all vehicles or equipment.

Incorporation of HACCP into AIS Programs

The analysis of all agency operations for the possibility of AIS spread or introduction is a primary element to creating agency-wide adoption of prevention attitudes. There are many agency activities that are not specific to AIS operations but may be capable of spreading AIS. These might include, but are not limited to activities such as, fish transfer in aquaculture practices, monitoring for wildlife or vegetation, and maintenance of aquatic park operations. Hazard Analysis Critical Control Point (HACCP) is a common strategy used to examine activities for specific mechanisms that may spread AIS, to develop specific tools and implement actions to mitigate the potential for introduction or spread. This widely used strategy brings all agency operations into an AIS prevention mindset. The use of HACCP is appropriate for all levels of government, agencies, sovereign nations, private businesses, and academic institutions.

To learn more about incorporating HACCP into your programming, training and detailed information can be gained here:
https://nctc.fws.gov/courses/HACCP/haccp.html

CONCLUSION

The resounding success in the prevention of dreissenid and AIS spread is evident in the limited species occurrence across the West. The simple but effective method to utilize hot water decontamination has protected many waters from AIS infestation. However, future advancements in WID delivery strategies, and new watercraft design techniques can all enhance the boating experience and further protect aquatic resources. Additional studies that further refine and strengthen our confidence in the duration and temperatures of hot water are recommended. Recent explorations into new ways to deliver lethal hot water temperatures quickly and efficiently, such as the hot water decontamination dip tank, could greatly improve decontamination program efficiency where the number watercraft requiring decontamination is significant. Methods that can effectively kill dreissenids while decreasing staff time and physical strain are needed to help streamline processes and improve morale. Further, other program features that can incorporate technology in additional ways to automate data collection or waterbody watercraft check-in are on the horizon and may advance the invasive species management landscape. UMPS will continue to serve as the primary resource to assist professionals in creating the most scientifically sound and consistent methods for WID programming in this ever-evolving landscape to manage aquatic invasive species.

Photos courtesy of (left to right): Tahoe Regional Planning Agency, Quagga D LLC, Invasive Species Action Network

GLOSSARY

Aquatic Invasive Species (AIS): As per Executive Order 13112 "an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health." Note: Often referred to as Aquatic Nuisance Species (ANS).

Clean: A watercraft, trailer or equipment that does not show visible AIS or attached vegetation, dirt, debris, surface deposits, or non-verifiable water. This includes mussel shells or residue on the watercraft, trailer, outdrive or equipment that could mask the presence of attached mussels or other AIS.

Containment: To stop or attempt to stop AIS from spreading to other waterbodies.

Conveyance: Something that carries people or things from one place to another (e.g., watercraft, trailer, vehicle, etc.).

Decontamination: A treatment with the intent to kill, destroy, and remove AIS to the extent technically and measurably possible.

- Full decontamination – applied to watercraft with suspected mussels, attached mussels, and other suspected AIS. Flush engine with hot water as defined in WID Manual, internal compartments and equipment that may have come in contact with water. Hot water rinse of the hull and use of high pressure to remove attached mussels or other AIS. Physical removal of adult mussels or suspect mussels/AIS.
- Standing water decontamination – Hot water flush or rinse/spray as defined in WID Manual of compartments with standing water and/or exterior.
- Plant decontamination (and other suspected AIS) – Apply hot water as defined in WID Manual to kill plants that can't be physically removed by hand during inspection.

Documentation: A process whereby watercraft/equipment are determined to present minimal risk based on inspection, decontamination or quarantine/drying time and receive some visible form of documentation of that fact (e.g., trailer tag, seal, band, paper receipt, etc.). It is important to note that is not possible to certify watercraft as "free of mussels", only that the most currently available and effective protocols and standards have been applied to kill all mussels and to the greatest extent possible remove all visible mussels.

Drain: To the extent practical, all water drained from any live-well, bait-well, storage compartment, bilge area, engine compartment, deck, ballast tank, water storage and delivery system, cooler or other water storage area on the watercraft, trailer, engine, or equipment.

Dreissenid mussel: Dreissenids are the common term associated with the family Dreissenidae which are small freshwater mussels who attach themselves to hard surfaces using byssal threads. Two invasive dreissenid species of interest in North America are the quagga *(Dreissena rostriformis bugensis)* and the zebra mussel *(Dreissena polymorpha)*.

Dry: No standing water; opposite of wet; interior/exterior; boater is exposing the watercraft to increase drying. A watercraft is completely dry if there is no detectable water on the exterior or interior surfaces of the watercraft, and no dampness can be felt on the interior of the watercraft; and water-related equipment is completely dry if there is no detectable water on the equipment and no dampness can be felt on the equipment.

Drying time: The amount of time out of the water required to assure that all AIS are killed through desiccation. This time requirement varies widely depending on temperature and humidity conditions. Drying time is not a substitution for decontamination.

Emersion: The process or state of emerging from or being out of water after being submerged.

Environmental DNA (eDNA): DNA collected not directly from the tissue of an organism, as is normally done, but filtered from an environmental sample such as stream, lake or reservoir water.

Exclusion: Not allowing high risk watercraft or equipment to be launched when it has not been or cannot be decontaminated or meet the quarantine/drying time standard. In extreme cases, exclusion can be applied to all watercraft at a waterbody.

Fouled watercraft: A watercraft known to be contaminated for infestation of AIS. Notification of any fouled conveyance will occur among destinations or travel states.

High-risk watercraft/Equipment: High risk watercraft or equipment can include one or more of the following; i. watercraft or a piece of equipment that has operated on or in any suspect, positive or infested waterbody known or suspected of having AIS in the last 30 days; ii. watercraft or equipment that is not clean, drained and dry and to the extent practical; iii. watercraft that is complex (e.g., with a closed hull, inaccessible containers or compartments, ballast, inboard/outboard motor, inboard motor, etc.); or iv. watercraft that is undocumented, and does not have a seal or receipt; or v. the hauler is non-compliant, non-cooperative, and deceptive.

Inspection: A process to determine whether a watercraft or equipment presents an AIS risk by physically examining watercraft/equipment/conveyance per protocols supplied in this document.

Inspector: An individual that is certified to perform watercraft inspection for AIS.

Inspector and Decontaminator: An individual that is certified to perform watercraft inspection and decontamination for AIS.

Impound: A law enforcement action to seize a watercraft and hold it to ensure the drying time is met or decontamination procedures are performed.

Low-risk watercraft/Equipment: Low risk watercraft or equipment can include one or more of the following: i. watercraft coming from undetected or negative waterbody; ii. watercraft coming from a state with no known positive or infested waterbodies; iii. Watercraft with a valid seal and receipt from an undetected or negative water; iv. watercraft that has been cleaned, drained and dried; v. watercraft that is simple (e.g., with an open hull, no compartments or easily accessible containers, a single outboard motor, etc.).

Prevention: To stop, or attempt to stop, the introduction of AIS.

Quarantine: The voluntary or mandatory act of securing a watercraft out of water for a required period of time.

Reciprocity: The acceptance of watercraft/equipment inspection and/or decontamination by multiple jurisdictions when equivalent protocols and standards are employed by similarly trained professionals.

Screening Interview/Risk Assessment: Asking the watercraft operator a series of questions prior to launching or entry into a waterbody that are designed to determine the level of risk based on the history of use.

Seal: A tamper-proof device that locks the watercraft to the trailer. A seal is affixed to a conveyance indicates that the boat has not been launched since it was inspected, decontaminated, and/or quarantined. Seals are often accompanied by a valid seal receipt.

Self-Inspection (voluntary or mandatory): An inspection conducted by a conveyance owner, operator, or transporter. A process in which an individual clean, drains, and dries their own conveyance. Note: Self-inspection is not decontamination.

Trainer: An individual who is certified to train others in watercraft inspection and decontamination for AIS.

Unverifiable Water: Water that is found within compartments of boats that cannot be visually or physically inspected, such as in ballast tanks, bilge areas, or engines.

Veliger: The free-floating larval form of a dreissenid mussel.

Verifiable Water: Water that is found within boat compartments that you can feel or visually inspect, such as in wells or bilges.

Waterbody Risk Assessment: The determination of waterbody risk is the prerogative of the responsible managing entity. Some of the factors that may be used to determine risk potential include: water quality parameters that support the survival, growth and reproduction of dreissenid mussels; the amount and type of boater use; proximity to dreissenid positive or suspect waters; waterbody is a headwater, water or power supply system or supports listed species. Assessments may include references to high-risk waterbody, secondary risk waterbody and low risk waterbody.

Watercraft Inspection and Decontamination (WID): Any program which seeks to prevent the spread of dreissenid mussels and other AIS on watercraft and/or equipment by requiring that they be inspected to verify the watercraft is clean, drain, dry or decontaminated, prior to launching or upon exiting. WID is performed at authorized stations on roadsides, at waterbodies, agency offices and business locations.

Western States: A geographic reference that includes all the 19 states west of the 100thMeridian, including those bisected by the 100th Meridian.

Photo courtesy of: Invasive Species Action Network

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APPENDIX A:
DECONTAMINATION UNIT MINIMUM SPECIFICATIONS

DECONTAMINATION UNIT MINIMUM STANDARDS

WRP Decontamination Think Tank Committee Final April 2, 2019

Checklist for Determining Viability of On-Demand Tankless Water Heater Decontamination System

Electrical Connection					
Does The Location Have Access to an electrical connection?		Yes		No (Electrical Connection Required)	
Fuel Source					
Does the Location Have Access to Fuel Source?		Yes		No (Fuel Source Required)	
Type of Fuel Available At Location?		Propane		Natural Gas	
Water Source					
Does the Location Have Access To Water Supply?		Yes		No (Will Require Section 7 of RFP)	
Water Flow Rate From Proposed Water Supply? (GPM)				GPM	
Recycling & Filtration System					
Is a Recycling & Filtration System Required?		Yes		No (Will Require Section 8 of RFP)	
Enclosure (Building)					
Does The Location Have Suitable Enclosure To House Units?		Yes		No (Will Require Section 9 of RFP)	

RED- FOR THEM TO FILL OUT

OBJECTIVES:

[XXX] seeks proposals from qualified manufacturers/distributors to supply a decontamination unit, or similar technology, including any associated equipment and maintenance necessary to decontaminate watercraft.

The primary needs of the program include acquiring the necessary equipment to conduct decontaminations of watercraft with the following criteria:

- Decontamination of watercraft is achieved using hot water, up to 150°F;
- Water is heated to 120-150°F and pumped to conduct the decontaminations
- Operable for up to 16 hours per day;
- Sturdy construction that is weather resistant, efficient and easily maintained.
- Ability to safely operate by staff without special certifications.
- Components of the unit shall be durable, while considering ease of maintenance, replacement, and efficiency.
- Refer to Uniform Minimum Protocols and Standards for Watercraft Inspection and Decontamination Programs for Dreissenid Mussels in the Western United States III as a regional guidance document for decontamination procedures and recommended equipment.

DESIRED SPECIFICATIONS, REQUIREMENTS AND OBJECTIVES:

The successful proposal includes equipment with the following specifications and requirements (more than one type/model of equipment may be submitted for consideration):

1. **General system-** The system operates for extended periods daily and long-term use under varying weather conditions.
   Specifications:

   - Select non-corroding materials that meet or exceed ASME standards for application and satisfy the specific requirements in each section within.
   - Provide a minimum of two hoses (one low pressure/high volume and one high pressure) capable of operating at full capacity for up to 16 hours a day. (Number of hoses and length of day is scalable)
   - Design the unit to expel exhaust from equipment.

   Considerations:
   - Decibel levels below the OSHA Standard exposure threshold for 10-hour work days.
   - Design the system to facilitate easy understanding of the design, movement within, repairs, maintenance and safety.
   - Design the system to allow for the opportunity to uniquely customize, update, and improve the system as technology changes.
   - Design the system to allow scheduled maintenance to occur during business hours; allowing portions to be deactivated and maintained without shutting down the entire system.
   - The power requirements depend on the design of the system.
   - Certify all applicable safety standards as necessary by Nationally Recognized Testing Laboratories (NRTL), such as UL or ETL certifications. (Note: certification may cost money)
   - Securely fasten all equipment, plumbing fixtures, piping and electrical switches, receptacles, junction boxes and conduit installed within the enclosure; in such a way to prevent personnel injury or interference with operation or maintenance.
   - Identify fuel sources when choosing equipment.

2. **Heating Systems-** For this RFP, heating systems are referred to as "heaters." Include the correct number of heaters in the design to operate the number of hoses of the decontamination unit so that a single heater failure will not disable the entire unit.
   - Heaters shall employ appropriate measures for safe use and prevent burning if touched.
   - Heaters shall activate in conjunction with trigger operation through a flow-switch and not a pressure switch.

   Low-Pressure/High-Volume Heaters-
   Specifications:
   - [Specify how many hoses you need to operate.]
   - Utilize On-demand (tankless) water heaters.

- Maintain a constant operator-defined temperature at the trigger between 120°F and 150°F while variable flow rates are used, regardless of the source water temperature.
- Temperature variance while in use shall be no more than +/- 5°F.
- Design to easily set to desired temperatures utilizing digital thermostat controls.
- Temperature change increments at a maximum of 5 degrees.
- Design to operate at full capacity for long periods. Pump components (e.g. unloaders, flow switches, fuel solenoids, etc.) shall be engineered to handle, short, frequent bursts of the trigger.
- Condensate or by-product shall be neutralized prior to discharge.

Considerations:

- If you have the need to simultaneously run high & low pressure, additional heaters may be necessary. Simultaneous operation will also require increased incoming flow rate.
- Would like to see temperature adjusting in increments in 1 degree increments

3. **Pumps and Capacity-**

Specifications:

- High-pressure heater pump capacity of 5GPM at the trigger (without pressure fitting) and a pressure rating of 3000psi using a 40° pressure tip.
- The high pressure pump shall be rated for incoming water temperatures up to 160°F.
- Specify how pump is powered. Electric or Gas.

Considerations:

- High-volume pump pressure range of 60-100 psi after adjustments for altitude.
- Pumps supplying water to the low-pressure/high-volume heater systems shall be sized appropriately so that a minimum of 5GPM is seen at each of the low-pressure/high-volume triggers under full load.
- Heater coil plumbing sufficiently sized to not restrict water flow.
- Meet capacity by avoiding bottlenecks, considering the coil diameter and length, hose run, quick connects, and trigger when providing projected output.
- If utilizing a live water connection a low pressure pump is not necessary.

4. **System Output-** [identify number of hoses needed]

Specifications:

- Set up all hoses with identical 3/8” or 1/2” stainless steel quick connect fittings at the terminals.
- Hose Reinforced, non-marking and temperature rated to at least 200°F.
- Include 200 psi or greater, low-pressure/high volume hoses and 5000 psi high pressure hose.
- 50-foot hose lengths.
- The pumps for on-demand systems shall turn off when the trigger is released and turn on when the trigger is activated if present
- Pump for high pressure unit shall include bypass pump protection such as an unloader to reduce load on pump, hose and trigger.

- Each hose requires a properly sized trigger assembly ergonomically designed and capable of long-term use.
- High-volume trigger assemblies shall have an on/off control and consider heat transfer, ease of use, longevity, & safety.

Considerations:

- Properly size hoses for volume and pressure requirements, according to the specifications listed above in "Pumps and Capacity."
- Auto-retractable reels.
- Construct a rack to mount the hose reels if it facilitates efficiency.
- On/off switch and a temperature control for high pressure unit on or near the hose reel rack.
- Temperature and flow control for on-demand units on or near the hose reel rack.
- Have a lock-open (e.g. quarter turn ball valve) function to allow water to flow while flushing engines. (If at all)
- Use meter to indicate time or gallon usage to aid in determining appropriate maintenance intervals.

5. **Winterization of Equipment**-

Specifications:

- Design the system to facilitate winterization of components (drain plugs, blow-out and addition of antifreeze).

Considerations:

- Include a stand-alone space heater. Include variable thermostat and direct the exhaust outside the unit. The heater is used to prevent freezing, as the decontamination unit may be used periodically throughout the winter.
- Design the system to have long periods (several months) of down time in which no power will be provided.
- Self Protection from freezing.

6. **Water supply**- Design the system to supply necessary flows described in "Pumps and Capacity."

Considerations:

- Employing agency should consider the following tests of their water supply prior to installation:
  - Hardness
  - Pressure & Flow Rate
  - Source water temperature to determine heat rise necessary
- Employing agency may also consider pre-filtering water prior to introducing water in to the system

7. **Water source tank**-

Specifications:

- The source tank(s) shall be upright and have a cone bottom. It shall have a top opening of no less than 16” in diameter.
- Use an air gap or Reduced Pressure Backflow Assembly (RPBA) to prevent contamination of the water supply.

Considerations:

- Allow space between the tank and ceiling to allow cleaning with a pressure washer.
- Develop a system to sanitize and/or filter the source tank to limit algal or bacterial growth. Non-chemical injected sanitation systems such as UV light, filtration, and ozone are preferred options.
- A selector switch or exterior port to supply outside water source to the high-pressure system directly, allowing use of the pressure washer while the system is empty.
- Allow the source tank to be filled by a transfer pump through an exterior mounted camlock fitting.
- Design to require infrequent water exchanges. Allow the complete draining through an exterior mounted camlock fitting using a trash pump to siphon water out.
- Include an alarm system, indicating high and low water levels to prevent flooding or damage to equipment.

8. **Recycling and Filtration System**- The objective of this process is to reclaim, filter and resupply the water used for decontaminations. The first part is vacuuming/pumping water from the containment mat(s), then settling/filtering and lastly pumping to the source tank. Include plumbing to receive water from the containment area before treating and returning to the source tank. The system shall be developed to address the following factors:

Vacuum/Pump for Containment Mats-

Specifications:

- One vacuum or pump per containment mat, including suction hoses.
- Supply a pump to transport water from the containment mats to the recycling system.
- The vacuum/pump shall be appropriately powered to remove and transport water at a rate equal to the output.

Considerations:

- Preferable to have the vacuum/pump turn on/off automatically with the presence of water.
- If pumps are used to reclaim water from the containment area, include an additional vacuum with 30-foot 1.5” suction hose to remove water from watercraft.

Filtration System-

Specifications:

- Provide filtration of 20 microns or better to the source tank.
- The rate of reclamation and filtration shall be greater than the GPM output rate of the combined hoses. Normal degradation and/or blinding of the filters shall not impede this rate.
- Incorporate automatic backwash operation.

- Provide an annual operation cost, if consumables are used within the process.
- Include replacement schedule and costs for filtration components (e.g. replacement filters).

Considerations:

- Conduct an effluent chemical analysis to determine appropriate filtration requirements.
- Filter out sediment, road debris, sand, emulsified hydrocarbons (gas, oil, diesel), antifreeze, etc.
- Address organic growth, either before, or within the source tank.
- Chemical filtration or flocculation is discouraged due to expense and logistics of storage and disposal.
- If chemicals are part of the design, ensure the chemical will not damage personal gear (e.g. life jackets), the watercraft, or the internal components of the engine. Employees will have extended and repeated exposure to chemical laden water. A small amount of the treated water could remain in the watercraft systems and be introduced into the lake. Include the Material Safety Data Sheet for any chemical proposed.

9. Enclosure to house equipment-

Specifications:

- Weather-proof, secure (prevent tampering when staff are not present), self-contained and sturdy to facilitate transportation if necessary.
- Door/s should accommodate human entry as well as facilitate movement of equipment.
- All wire rated for a minimum of 25 amps.
- Include Ground Fault Interrupter (GFI), Arc Fault Interrupter (AFI) or combination safety outlets and circuit breakers as appropriate.
- Include overhead lighting.
- Compliant with local/regional building codes including ground snow loads.

Considerations:

- Include an electrical breaker box that is over sized to allow for growth and the addition of several new circuits over time.
- Adequate space to store other operational equipment and tools while not in use (e.g. hand tools, tool box, hoses, vacuum systems, etc.).
- Length is dependent on internal components, ensuring easy maneuvering within, facilitating maintenance and repairs, and site-specific needs.
- Design for transportation on a standard semi-truck trailer, lifted by a fork lift, large cargo handling equipment or sling lifted by a crane. Supply it with “pick points” at all four corners for lifting and hoisting.
- Thermally insulate on all sides, ceiling, floor and doors. Include a projected R-value.
- 20 Amp outlets on two dedicated circuits shall be strategically placed throughout the unit to accommodate use of external equipment (ex: tools, vacuum/pump system for water retrieval from the containment mat).
- Incorporate a utility hub opening where internal plumbing connections are terminated for interface with the site provided connections. These connections include water supply, fuel connection and wastewater feed.
- If a temporary structure, use quick connections for water and power.
- Allow the complete draining through an exterior mounted 2” camlock fitting using a trash pump to siphon water out.

Deliverables:

1. Complete system constructed and ready for transport [insert date]. Include a bid for transport and installation.
2. Training and support to be provided at time of delivery and set up.

Minimum Required Proposal Contents:

The proposal shall address the following items:

1. Definition of the Project: Indicate your understanding of the objective of constructing a decontamination unit and how it will operate given the environmental and operational constraints stated in this RFP.

2. Specifications: Indicate how the system proposed will meet the specifications that are desired as part of this RFP. Ensure each of the items under Desired Specifications, Requirements and Objectives are addressed in an organized manner. [*suggest requesting a certain format to one can compare the RFP with the proposal*]

3. Detailed Schedule and Cost: State the ability of the contractor to meet the required date to build the system. All bidders shall submit a task-based budget which includes a not-to-exceed total project cost. [*Complete the "Budget Table" provided below*]

4. References: Please provide a table listing references with current phone numbers.

5. Contracting Requirements: Consultant must provide copies of the insurance documents required in section [code].

Sample Budget Table

Item	Cost
Container	
Decontamination equipment	
Low pressure system	
High pressure system	
Recycling system	
Water pick-up system	
Installation of equipment	
Freight to vendor	
Freight to site	

The following table includes an approximation of cost based on proposals received by TRPA & CPW, 2018.

(We can provide more accurate numbers once invoiced and break it out into more meaningful categories)

Section	Low Estimate	High Estimate
Heating System - Low Pressure	$8,000.00	$38,000.00
Heating System - High Pressure	$2,700.00	$24,000.00
Recycle System		$50,000.00
Interior Heater		$1,000.00
Water Pickup		$5,000.00
Recycle System		$50,000.00
Enclosure	$1,700.00	$24,000.00
Installation	$0 (Included)	$12,500.00
Freight	$0 (Included)	$8,500.00

APPENDIX B:
TRAILER DECONTAMINATION UNIT MINIMUM SPECIFICATIONS

Description	Trailer Mounted Mobile Decontamination Unit
Decontamination Unit	
PRESSURE: 3000psi	
FLOW CAPACITY: Minimum of 5.0 GPM Consideration: Higher flow rates may be desirable for locations with unlimited water supply and very complex watercraft.	
OUTLET TEMP Adjustable thermostat, able to maintain 120°F & 140°F for long periods w/ maximum of +- 5°F precision discharge water temperature from set temperature regardless of incoming water temperature. Option: Digital or Dual Thermostat Control	
POWER/ENGINE – Appropriate engine HP to produce specified pressure output, 25 amp charging system for burner and electric key start, & alternative pull start. Power generator with AC Plug-In capable of operating 115V Burner. Consideration: May consider inserting DB Level limit to comply with OSHA standards.	
ENGINE FUEL/CAP Unleaded, Minimum of 5 Gallon Tank w/ Fuel Level Gauge	
CONTROLS/SWITCHES Adjustable thermostat, lighted burner control switch, Hour Meter, Battery On/Off Switch, Key switch & Engine choke	
PUMP Three Piston, Lifetime Warranty, unloader, bypass loop for pump protection	
POWER DRIVE Belt Drive Optional: Belt Tensioning System	

PRESSURE CONTROL Pressure regulating unloader. Maximum pressure between 3,000 & 3,500 PSI
WINTERIZATION TANK 5 gallon reserve tank w/ float, standard garden hose fitting, w/3 way inlet valve (in from float tank, in from water tank or other source, out to pump)
PRESSURE HOSE Non-Marking, 50' x 3/8", double-wire (R2) braid hose, 4000psi or greater, 250 degree rated or better w/ swivel connection at trigger gun. Consideration: Hose length can be modified to fit the requirements of your site.
GUN/WAND: Pressure sensitive trigger gun w/ 3/8" stainless quick connect for attachments, 48" dual lance variable pressure w/ 3/8" quick connect nozzles.
NOZZLE Size 6.0 (three at 40°) white in color
BURNER COIL ½" sch. 80 coil, ceramic blanket insulation, emergency shut off, 5 year non-pro rated warranty.
BURNER/POWER Diesel or kerosene fired 115V AC, circuit breaker, auto ignition, inline water separator fuel filter, & Flow switch activated. Safety - If ignitor does not ignite fuel will not be delivered to burner. Consideration: 12V DC oil fired may be considered if cost is prohibitive
BURNER FUEL/CAP Diesel, Kerosene, Minimum of 8 gallons w/ fuel gauge
FRAME CONSTRUCTION Heavy gauge steel, powder coated frame, Stainless panels and coil wrap
HOSE REEL Reel should be of sufficient size to easily store hose and have locking capability w/ stainless hardware. Consideration: 2 Hose Reels, one for high pressure and one for garden hose to fill supply tank
WATER SUPPLY 250+ gallon baffled supply tank w/ garden hose attachment & meet trailer gross vehicle weight.
ATTACHMENTS: Trigger gun, diffuser, 48" dual lance variable pressure wand with (3) quick coupled nozzles, All attachments should be rated to at least 200 degree Fahrenheit. Attachments should be of stainless construction and rated for appropriate pressure. Option: Inline Thermometer w/ quick connects

WARRANTY: Minimum of 1 year and 50 hours parts & labor warranty. All equipment and parts must be new, no refurbished equipments or parts. One year warranty for failure of equipment with normal wear and tear. Warranty must be serviceable within the state of purchase.
Trailer
Lockable Aluminum storage box for equipment can be front, rear or side mounted, minimum size – Insert Desired Size
Minimum 4000# capacity, single or double axle with torsion or leaf spring suspension, fenders with anti-slip coating that can be used as a step and 14" or 15" trailer wheels and radial tires. Frame & Axel Capacity must meet weight specification of water holding capacity previously specified. Must meet DOT Trailer Standards.
Bed size – Insert bed size covered with diamond tread plate steel deck, all metal surfaces must be powder coated. Option: Polyurea Coating
Optional: 12" – 14" rail along outside of deck w/ back end open
DOT approved wiring for Electric brake system to hitch & turn signals
Easily accessible matching spare tire and wheel mounted on bracket
All trailer lighting must be LED's and meet or exceed Federal, DOT requirements.
2 5/16" Ball Coupler
Trailer Breakaway System
Jack stand should be able to withstand weight of unit with water when disconnected from the coupler
Other
Easily accessible mounted fire extinguisher
Non-flammable, weather resistant cover capable of covering entire unit and providing protection from extreme environmental conditions.
Layout diagram for all components
List of Consumable Replacement Parts Must be Provided
Operation and maintenance manuals must be provided including wiring schematics.
Free Safety & Operational Training on Unit at Time of Delivery
Delivery Date

APPENDIX C: MANUFACTURERS OF DECONTAMINATION UNITS AND EQUIPMENT

Members of the Western Regional Panel on ANS have purchased various types of makes and models from these manufacturers. The following list is not all-inclusive and providing information in this document does not constitute an endorsement.

For best parts and service of decontamination units, find a local dealer within a 50-mile radius, (if possible) deliver unit in-person with standard operational training and have a 24/7 hotline for troubleshooting with a 72-hour maintenance response time.

Hotsy Cleaning Systems
6398 N Karcher Way | Aurora, CO 80019 | 800-525-1976
https://www.hotsy.com/en/products/hot-water-pressure-washers/gas-or-diesel-powered.html
Find a local Dealer https://www.hotsy.com/en/find-your-local-hotsy-dealer.html

Hydro Engineering, Inc.
865 W 2600 S | Salt Lake City, Utah 84119 | 1-800-247-8424 | Direct 801-972-1181
https://www.hydroblaster.com
https://www.hydroblaster.com/Specialty/WDS.htm

Hydro Tek Systems, Inc
2353 Almond Avenue | Redlands, CA 92374 | (909) 583-9934
https://www.hydrotek.us/products/hot-water-pressure-washers/
Find a local Dealer https://www.hydrotek.us/dealer-locator/

Landa
6398 N Karcher Way | Aurora, CO 80019 | 877-526-3235
https://www.landa.com/en/products/pressure-washer-trailers.html
Find a local Dealer https://www.landa.com/en/support/customer-support/find-a-dealer.html

Mi-T-M
50 Mi-T-M Dr. | Peosta, IA 52068 | 563-556-7484
https://www.mitm.com/industrial/trailers/
Find a local Dealer https://www.mitm.com/find-a-dealer/

WATERCRAFT ATTACHMENT TOOLS

Attachments should be constructed and fitted to withstand high temperatures.
All fitting connections should be brass with stainless ear crimp hose clamps.

Quagga D LLC
Royal Flush attachment kits | quaggadee@cox.net | 702-236-3814

PWC FLUSH KITS:
Sea-Doo & Kawasaki
Watercraft Superstore
1401 N Myrtle | Clearwater, FL 33755 | 866-957-9277
Flush Kits - http://www.watercraftsuperstore.net/PWC-Flush-Kits.html

Yamaha
https://www.amazon.com/yamaha-flush-adapter/s?k=yamaha+flush+adapter

ENGINE FLUSH ADAPTER KIT:
Perko
16490 NW 13th Ave. | Miami, FL 33169 | 305-621-7525
http://www.perko.com/catalog/underwater_hard-ware/62/flush_pro/
Where to buy – US & Canadian locations https://www.perko.com/where_to_buy/

BANDING SUPPLIES:
Seals.com
American Casting and Manufacturing Corporation
51 Commercial Street | Plainview, New York 11803 | Toll Free 866-534-9043 | Direct 516-349-7010
https://seals.com/

APPENDIX D:
WATERCRAFT SEAL DESCRIPTIONS OF WESTERN STATE AND PROVINCIAL PROGRAMS

Color	State/Province	Entity	Description
Blue	Utah	State of Utah	Boat Passed a Successful Full Decontamination. Receipt Given. *NOTE: Seals are not given for inspection alone.
Blue	California and Nevada	Lake Tahoe	Boat Was Last in Tahoe OR Passed a Successful Inspection and/or Decontamination. No Receipt Given.
Blue	Washington	State of WA	Boat in quarantine. Receipt provided upon request.
Blue	Alberta	Province of Alberta	Boat in quarantine. Receipt provided (Quarantine/Decontamination Order)
Green	Colorado	All Agencies. State-wide cross-jurisdiction seal.	Boat Passed a Successful Inspection and/or Decontamination. Receipt Given.
Green	Nevada	State of Nevada	NV S Fork Washed. Receipt Given.NV Washed. Throughout the state where a decontamination is performed. Receipt Given.
Green	Saskatchewan	Province of Saskatchewan	High risk boat (with written direction to proceed to inspection/decon station) or boat in quarantine.
Green	Manitoba	Province of Manitoba	Successfully Decontaminated (i.e. clean). Receipt provided.
Red	Oregon	State of Oregon	Boat Passed a Successful Full Decontamination at Roadside Station. Boat is required to submit to quarantine after decontamination and red tagged boats have not yet completed the quarantine. Receipt Given.
Red	Nevada	State of Nevada	NV Mead Washed. Decontamination. Receipt Given.
Red	Manitoba	Province of Manitoba	Issued Decontamination Order (i.e. not clean & requires decontamination)
Yellow	Nevada	State of Nevada	NV S Fork Only. In and out only; no decontamination for locals. Receipt Given.
Yellow	Oregon	State of Oregon	Boat Passed a Successful Inspection at Roadside Station. Receipt Given if boat is passing through OR to another state.
Yellow	New Mexico	State of New Mexico	Exit Inspection. Receipt Given.
Yellow	British Columbia	Province of British Columbia	High risk boat (with written direction in a Decontamination order - may include quarantine. Only designated officers can remove the seal).

continued on next page

Color	State/Province	Entity	Description
Brown	Wyoming	State of Wyoming	Boat Passed a Successful Inspection and/or Decontamination. Receipt Given.
Orange	Idaho	State of Idaho	A tamper proof seal is affixed to Watercraft destined out of state or by boat owner request. Neighboring state jurisdiction should review associated inspection report(s) for previous inspection and watercraft history. In- state boats are recorded electronically and the boat owner receives a paper certificate or date stamped passport.
Orange	Utah	State of Utah	Boat has left suspect/positive/infested waterbody and has been inspected and has begun the drying process. Receipt Given.
White	Montana	State of Montana	Boat Passed a Successful Inspection and/or Decontamination. No Receipt Given.
Black	Manitoba	Province of Manitoba	Issued Control Order (required action before seal can be removed - may include quarantine)Issued Control Order (required action before seal can be removed - may include quarantine)
Various colors based on waterbody	Nevada	State of Nevada	Lahontan, Rye Patch and Wildhorse waterbodies each have different color seals. Decontamination performed and Receipt Given.
Various colors based on waterbody and entity	California	Varies	Download the complete document of seal information for California at: *https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=89072&inline*

APPENDIX E:
SAMPLE LETTER TO WATERCRAFT HAULERS

2021 DATE

HAULING COMPANY NAME
ADDRESS LINE 1
ADDRESS LINE 2

Dear Boat Hauler:

The Idaho Invasive Species Law establishes certain prohibited actions, including possession, transport and sale of invasive species in the state (see: https://legislature.idaho.gov/statutesrules/idstat/Title22/T22CH19/). As a boat hauler, be aware that certain invasive species – such as zebra and quagga mussel – may be attached to conveyances that you are transporting into and through the state.

The non-native quagga and zebra mussels were first detected in the Great Lakes in the late 1980s, resulting in hundreds of millions of dollars in damage to water delivery systems and the environment. They were first detected in the western United States in January 2007 and are now in Nevada, California, Arizona, Texas and Utah. Although the mussels are not established in Idaho (insert your state/waters), the waters of the state are extremely vulnerable.

The mussels are primarily transported by watercraft and can survive out of the water for up to 30 days. They attach to surfaces, colonizing on hulls, engines and steering components and can damage boat motors and restrict cooling. Water in engines, bilges, live wells and buckets can also carry mussel larvae (called veligers) to other water bodies.

If you are transporting a watercraft bound for Idaho (insert your state) state waters, call this number to schedule an inspection: 877-336-8676 (insert contact). Be advised that during the boating season, the State of Idaho has mandatory watercraft inspection stations throughout the state. As a boat hauler, please note that you are required to stop at these stations during operating hours. The inspectors will be looking for invasive species – including zebra and quagga mussels - that may be on or in your conveyance. For more information on inspections and proper decontamination of watercraft, visit www.invasivespecies.idaho.gov

The State of Idaho is working to minimize the potential impacts of these species to the state. However, we need your assistance and support to address this threat statewide. Please feel free to contact me if you have any questions about the invasive species program in Idaho (insert your state). I look forward to working with you on this important issue.

Sincerely,

Primary Contact Name
Section Manager- Invasive Species Coordination and Outreach
(208) 332-8686

APPENDIX F:
RESOURCE LIST OF DECONTAMINATION PROCEDURES AND INSTRUCTIONAL VIDEOS

Documents are housed at: https://www.westernais.org/trainer-resources

Watercraft Inspection and Decontamination Manual (2021)

Watercraft Inspection and Decontamination Trainer's Manual (2021)

COVID-19 Guidelines for Watercraft Inspection and Decontamination Stations (2020)

Outgoing Exit Watercraft Inspection – Containment Waters (2020)

Outgoing Exit Watercraft Inspection – Prevention Waters (2020)

Incoming and Off-Water Inspection Protocol (2020)

Standing Water Decontamination of Inboard Engines (2020)

Standing Water Decontamination of Interior Compartments (Not Ballast) (2020)

Standing Water Decontamination of Outboard Motors and Inboard/Outboard Engines (2020)

Instructional Videos are housed at: https://www.westernais.org/trainer-resources

An Overview of Watercraft Inspection and Decontamination Programs (2018)

CPW Boat Inspection (2017)

CPW Full Decontamination (2017)

How to Perform Ballast Tank Decontamination (2018)

How to Perform Inboard Engine Decontamination (2018)

How to Perform Inboard/Outboard Engine Decontamination (2018)

How to Perform Plant Decontamination (2018)