

Emerging Best Management Practices in Stormwater: **Mitigating Zinc in Boatyards**



Introduction

Stormwater is the leading contributor to water quality pollution in Washington State.¹ For this reason, the Washington Department of Ecology requires businesses and municipalities to control stormwater pollutants, such as heavy metals and organics. Strict limits on zinc require a number of Washington organizations to use source control or treatment measures to reduce zinc in runoff. According to Lisa Rozmyn, the Washington Stormwater Center's Business Resource Manager, "Zinc is difficult to control because it's everywhere in industrial sites and equipment."

With support from the Russell Family Foundation, the Pacific Northwest Pollution Prevention Resource Center (PPRC) is helping businesses navigate a tangle of emerging zinc-reduction technologies and techniques to achieve acceptable stormwater quality. As an unbiased non-profit resource, PPRC seeks to promote stormwater practices that are economically and environmentally beneficial.

This report focuses on mitigating zinc in boatyard stormwater. It is one in a series that explores emerging techniques and practices to manage zinc in stormwater. Other report topics include: *Biochar as Filtration Media*; *Street & Surface Sweeping to Reduce Stormwater Pollution*; and *Addressing Galvanized Roofing*.



Boatyards and Zinc

There are well over 60 public boatyard general permits issued by Washington State, and 55 of these reside in the greater Puget Sound area. A 2006 report characterizing stormwater runoff at three Washington boatyards found zinc as a dominant metal in the runoff, measuring between 345 to 2,600 micrograms/liter ($\mu\text{g/l}$).² Considering that the boatyard state zinc exceedance level is now at 90 $\mu\text{g/L}$, boatyards may be challenged to maintain zinc levels below this permit level.

Zinc comes from numerous sources. Some are unique to boatyards and marinas, while others are common to most industrial sites. Sources of zinc at boatyards include:

- Bottom paint/removal residues. Zinc and copper are common antifouling agents used in bottom paint.
- Galvanized surfaces including roofs, siding, fencing, downspouts, storage racks, boat trailers, timber fasteners, manhole covers, and metal parts pulled out of boats sitting on the grounds exposed to precipitation.
- Sacrificial zinc anodes used on boat hulls.
- Welding of galvanized metals.
- Petroleum-based vehicle and hydraulic fluids, including engine oil residues in bilge water.
- Timbers treated with zinc borate.
- Tire wear.
- Additional sources may come from airborne diesel emissions deposited on the ground, use of moss control chemicals and de-icers containing zinc, and aerial deposition from neighboring sites or vehicle traffic.

Boatyards operate differently based on how they are managed, and whether the yard offers services to clients or rents space to tenants who conduct their own work or moor vessels at the site. The Best Management Practices (BMPs) in this document can apply to site management and operations as well to tenants or moorage guests.

Best Management Practices for Zinc Sources Found in Boatyards

Source control BMPs and filtration are some of the readily implementable ways to reduce zinc reaching stormwater. Source control is preferred because it works toward reducing use or release of zinc before it reaches stormwater, through behavioral and operational changes, which are often cheaper and easier to implement than treatment or structural BMPs.



Figure 2: Boatyards have many sources of zinc - from hull paints to galvanized roofs to tires.

If zinc is an issue at the site, the first step is to identify probable sources. If necessary, sample specific flows from potential sources, such as downspouts from galvanized roofs or fences.

Once the contributing sources are determined, implement policies and BMPs to address these, starting with the higher zinc contributors.

From a site management perspective, any BMPs adopted for the site must be documented as formal policy, communicated to tenants and staff, implemented, and enforced. Provide the requirements or stormwater policy in clear and concise terms, and in multiple languages if needed, to tenants and moorage guests. By requiring that clients sign an agreement to comply with site requirements, boatyards have more leverage to ensure that management practices are followed.

The following recommended BMPs are for boatyards with zinc issues. They are applicable for property managers and site operations, and are also transferrable to tenants using the property. Several of the BMPs can also help reduce copper levels. Table 1 (below) helps to link BMPs to specific zinc sources. Filtration recommendations are also discussed below.

Source Control BMPs - General Site

- For galvanized surfaces showing high zinc runoff content, consider the following as applicable:
 - » Coat galvanized surfaces. Ensure the coating material is zinc-free, and is applied in a method that prohibits future leaching or zinc migration.
 - » Replace galvanized materials with non-zinc alternatives.
 - » Cover galvanized materials and piles of metal.
- Prohibit discharge to ground or water, of any material that would produce a sheen.
- Sweep paved areas using a professional sweeping vendor that maintains their equipment and practices thorough and conscientious sweeping. A regenerative air sweeper is the most effective for removing metal pollutants and fines that collect on pavement.
- Implement a pavement inspection protocol based on activity at the site to identify the following: vehicle fluid leaks; sandblasting debris; paved areas with significant deterioration and cracks where dissolved pollutants and fine sediment can accumulate. Schedule necessary clean up and repairs.
- Provide clearly-labeled solid waste containers, specifying what types of wastes go in which containers.
- Regularly inspect and maintain catch basins, cleaning and replacing filters or media as needed. At a minimum, twice yearly is recommended.
- Institute a no-idling policy on site, and restrict generator use only as needed.
- Always use secondary containment for chemicals and wastes, and under fixed machinery that use oil or gas.
- Use manual moss removal methods and/or safer, non-zinc moss or fungicide products.
- Use sound snow and ice management methods and non-zinc de-icers. De-icers are often misused, and over-applied. Minimize de-icer use by removing snow before it melts, and by using anti-icing strategies such as pre-applying anti-icing chemicals to break bonds before the snow falls.

Source Control BMPs – Boat Work, Moorage and Storage

- Plan for spill prevention & preparedness, including training of tenants and staff.
 - » Require tenants or staff notify boatyard manager of spills immediately, and initiate cleanup right away.
 - » Provide spill kits to all tenants, and/or place in strategic locations throughout the site. Spill kits should contain instructions, absorbents such as rags, absorbent mats or pads, rice hull ash, vermiculite, or sand, to pick up greasy or oily spills.
 - » Always use drip pans under any vessel or vehicle fluids transfer.
 - » Install secondary containment under fixed machinery that uses oil or gas.
 - » When absorbents are saturated, sweep or vacuum to pick up the saturated absorbents and remove as much of the material from the ground as possible.
 - » For smaller boats, up to about 200 horsepower, use a non-spill pump system with a dipstick oil suction device to draw crankcase oils out through the dipstick tube.
 - » Slip a plastic bag over the used oil filter prior to removal to capture any drips.
 - » Post signage to remind staff and tenants of best practices.
- Evaluate alternatives to zinc products used on boats, especially zinc anodes and zinc-based antifoulant coatings.
 - » Aluminum anodes are one alternative to zinc.
 - » As boat hulls are stripped and repainted, non-biocide coatings may be an option, as they do not contain zinc or copper. Instead, they contain silicon compounds and/or fluoropolymers whose smooth surface makes it difficult for marine organisms to attach. The US EPA has recently sponsored research on some of these coatings for efficacy, performance and cost-effectiveness. The results were positive.³
 - » Another option is to ban use of materials containing zinc, or in the case of bottom paint, new applications of coatings containing zinc. This is likely to face implementation hurdles for tenant-based boatyards, but a copper ban in hull paints has been successful at a Connecticut marina. (See Examples below).
- Minimize any work over or in waterways, including boat cleaning with divers.
- Always use vacuum sanders for paint removal and other woodwork. At a minimum, use sanders that meet the Washington permit spec stating: “The sander must be electric or air powered and capable of 98% dust extraction with a static lift of 60 inches/minute and airflow of 116 cfs/minute.”
- Tarp under/over/around hull and boat repair operations, such as welding, sanding, grinding, scraping, painting, wood planning, or any other activity which may release zinc to ground.
- If welding of galvanized metal is a common practice, consider purchasing a portable or central weld fume extraction system that uptakes weld smoke and fumes, and filters the particles.
- Properly collect and treat bilge water and other non-stormwater discharges. Require boats moving to dry storage to fully pump all bilge before storage. Also, consider providing an onsite collection vessel for tenants, or individual containers, and require they do not release to waterways or to the ground or storm drains. See Examples section below for a suggestion on how to provide service to tenants that encourages them to practice proper disposal of bilge. Dry storage often tilts the bow forward, then when the bilge is pumped out it spills more easily. Require tenants or staff to collect all liquid and particulate residuals daily and dispose of in specified dumpsters.
- Provide clearly labeled containers for different waste streams.
- Do not leave any metals or tires on site without cover.
- Repair any vehicle, vessel, or equipment leaks immediately.
- Conduct daily walkthrough inspections of site operations and tenant operations to ensure site stormwater policies are being followed.

Table 1, on the next page, shows the source control BMP efforts that can help address different zinc sources.

Filtration

Source control measures are important first steps in reducing zinc and other pollutants. Depending on the zinc levels after source reduction efforts are undertaken, onsite treatment of stormwater may also be necessary. Some of the options include catch basin filtration, downspout treatment units, centralized site treatment units, and Low Impact Design (LID) structures such as are briefly discussed below.

These systems need to be designed based on levels of zinc (or other contaminants) and expected flows. Monitoring of zinc levels is necessary to determine if and when filtration media must be replaced. Spent filtration media must be disposed in a manner compliant with permit and state regulations if certain contaminants are present above regulated levels.

Catch basin filtration options include inserts such as fabric, absorbents, fine screens, oyster shells, and/or filtration media. Many companies offer custom inserts and systems for catch basins of varying sizes.

Downspout units employ an enclosed system with filtration media, or planter-type boxes with filtration media and metal-absorbing plants, or small LID areas such as landscaping or rain gardens that absorb precipitation from rain events and allow it to filter naturally through root systems and soil.

Centralized filtration treatment systems typically pull in all stormwater generated at the site to one treatment location. Filtration media captures pollutants prior to their release through a main outfall.

LID structures such as bioswales, rain gardens, permeable pavement, and other landscaping that can capture runoff and use root systems and soil to naturally filter out pollutants.

Table 1 –BMPs That Can Reduce Specific Zinc Sources

Reduction /Minimization Opportunities	Bottom paint removal/repair	Galvanized surfaces & stockpiles	Sacrificial zinc anodes	Petroleum-based fluids /bilge	Treated timbers and galvanized fasteners	Tire wear	Deisel emissions	Zinc de-icers and fungicide
Site stormwater requirements /policy	✓							
Tenants and moorage guests sign/agree to policy	✓		✓	✓		✓	✓	✓
Use non-zinc products	✓	✓	✓		✓			✓
No-idling	✓					✓		
Conduct daily walkthrough inspection (EHS Officer)	✓		✓	✓				✓
Sweep paved areas consistently and with best equipment for the conditions	✓		✓	✓		✓	✓	✓
Pavement inspection and repair protocol	✓		✓	✓		✓	✓	✓
Scheduled catch basin cleaning and filter replacement	✓	✓	✓	✓		✓	✓	✓
Replace, coat, or cover galvanized surfaces		✓						
Cover stockpiles of tires, metal, and material or waste storage		✓						
Spill prevention & preparedness, training, spill kits, instructional signage	✓		✓	✓		✓	✓	✓
Secondary containment for storage	✓							
Vacuum sanders that meet state permit specs	✓							
Contain airborne emissions from sanding, grinding, planing, painting, (etc) and welding	✓		✓					
Daily clean-up & disposal of boatwork residuals	✓		✓	✓				
Minimal activities over waterways	✓		✓	✓				
Drip pan under vehicle fluids transfer			✓					
Collect all non-stormwater discharge, including bilge and washwater; treat as necessary	✓		✓					
Report & repair leaks immediately			✓					

Examples / Case Studies

As listed above, there are many BMPs applicable for boatyards needing to reduce zinc in runoff. A few great ideas shared with us by individual boatyards are presented below in more detail.

In boatyards that allow tenants to work on vessels out of the water, site managers need to ensure that tenants comply with stormwater BMPs. First, tenants should sign an agreement that makes them aware of, and responsible for, all site stormwater policies. Site managers can facilitate compliance by using good signage, daily walk throughs, and constant communications.

The Port of Port Townsend Boat Haven purchased used plastic poly-totes for collection of bilge water, which can contain zinc from the oils in the water. This water must not be discharged to stormwater or to the ground without treatment. Port Townsend delivers the totes, on demand, to tenants and picks them up when full. The port charges the tenant only for disposal of the liquid with the local wastewater vendor. In the first six months of implementing this policy, the port collected about twice as much bilge water as in the prior two years.

In a similar situation with tenants, one boatyard provides **spill kits** and loans a **non-spill pump system** to suction crankcase oils out of marine engines. This system is useful for smaller boats and can be used in the boat shop and at tenant locations for boaters who perform their own oil changes. The boatyard also recommends that DIY oil changers slip a plastic bag over used oil filters prior to their removal to capture any drips before draining them.



Figure 3: The Port of Port Townsend is trying to implement numerous BMPs and treatments to reduce zinc in their runoff.

The Port of Vancouver Washington is using “Do It Yourself” downspout filtration units to filter pollutants with plants, soil, and other easy-to-assemble media. The Port installed one unit for every 600 square feet of galvanized roofing. The units have so far achieved zinc removals of 90% or higher. By using plants that can withstand both dryness and ponding, the units require only periodic maintenance to replace the top mulch layer of filtration media.⁴

Harry’s Marine Repair in Westbrook, CT implemented a copper-containing paint ban for boats mooring or tenanting at the boatyard. Harry’s was able to enact this ban after proving that an alternative product performed well. The marina manager stated: “When I implemented the copper-ban there was some initial grumbling amongst boat owners but now that they have seen how well the paint works after a full season, they are all on board and happy to make Westbrook waters cleaner.”⁵

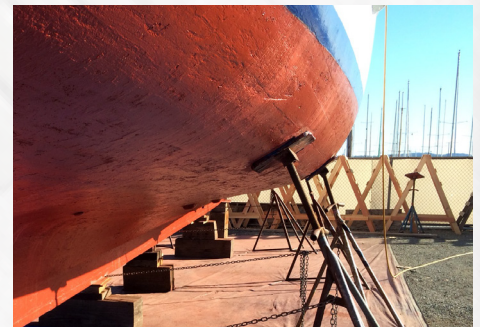


Figure 4: Bottom paints are typical sources of heavy metals, like zinc.

The ban on copper paint, however, did not solve the problem of leaching heavy metals because the recommended replacement coating contains zinc. Ideally, non-biocide paints will be proven effective and the recommended coating would be non-biocidal. While many boatyard managers may not be able to implement a paint ban, communicating the environmental and performance benefits of non-biocide coatings may convince some boat owners to switch to paints with less aquatic toxicity.

Conclusion

Good site management requires up-front, clear, and consistent communication to boatyard tenants and moorage guests about site expectations for minimizing stormwater pollution. Source control BMPs work as effective and cost-effective ways to reduce zinc in stormwater. Filtration is often necessary as well, especially for sites that face high levels of zinc in runoff.

If you are interested in finding out more information or details for a specific BMP, or need referrals or assistance with metal removal in stormwater, please contact PPRC: 206-352-2050.

References

1. Washington Department of Ecology: Stormwater. <http://www.ecy.wa.gov/programs/wq/stormwater> (accessed 2014 April 2).
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6. Cairns, A. Port of Port Townsend Boatyard. Personal communication, January 2014.

