

# SPLASH BOXX™ STORMWATER TREATMENT SYSTEM

## BIORETENTION TREATMENT

The Port of Seattle (Port) strives to protect Puget Sound water quality by implementing green stormwater infrastructure whenever possible. When stormwater runs off buildings and paved surfaces it can carry metals, oils and other pollutants into storm drains and waterways. The Splash Boxx™ treatment system is an innovative bioretention method used at two Port properties to treat stormwater runoff prior to discharge. The bioretention soil media target stormwater contaminants specific to each location, including zinc and copper, two metals detrimental to salmon and other aquatic life.

The Splash Boxx systems were first introduced at the Port in 2014 to treat stormwater from a galvanized roof, which can leach zinc, at Terminal 91. The system proved effective in removing zinc. In 2018, the Port moved its two Splash Boxx units to the Horton Street Marine Maintenance (MM) yard (Figure 1) and the Maritime Industrial Center (MIC) (Figure 2) to further explore treatment capabilities and support Salmon-Safe certification goals. Treatment of the stormwater occurs via infiltration through engineered layers of bioretention soil.



Figure 1. Plants and water distribution pipes at the top of the Horton Street maintenance yard Splash Boxx



Figure 2. Splash Boxx at MIC receives roof runoff

## SPLASH BOXX SCHEMATIC

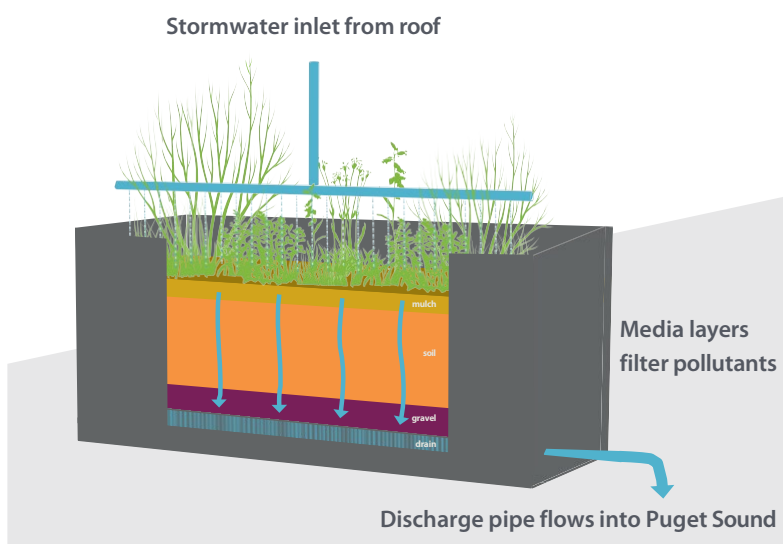


Figure 3. Splash Boxx diagram illustrating stormwater flow

The MIC Splash Boxx receives stormwater from a 4,100 sq. ft. roof downspout, while the MM yard Splash Boxx pumps stormwater from catch basins draining a 39,000 sq. ft. parking lot. With each system, stormwater flows into pipes centered above the containers, allowing for even distribution to plants and soil, and infiltrates the bioretention layers (Figure 3). Treated stormwater is released via an outlet pipe and reenters the drainage system. In the case of an overflow, water is released into a sediment sock before entering the drainage system. The MIC Splash Boxx discharges about 100,000 gallons/year of treated stormwater into Salmon Bay. The MM Splash Boxx treats over 900,000 gallons/year of stormwater that flows into the Duwamish Waterway.

## SPLASH BOXX MONITORING

The Port monitors and maintains the Splash Boxx systems by:

- Collecting samples of the influent (entering) and effluent (outgoing/treated) stormwater from sampling points (Figure 4) to test for metal concentrations, turbidity, and pH
- Inspecting the pipes for damage or blockage
- Weeding and inspecting the soil media and plants four to five times a year to determine need for maintenance or replacement

The Port tracks contaminant concentrations between the influent and effluent samples to determine when soil media needs replacing. If we see increased concentrations, we will initiate replacing the treatment media. To date, that has not been required.



Figure 4. Splash Boxx sampling locations indicated with blue circles

## EFFECTIVENESS OF SYSTEM

Stormwater treatment effectiveness is measured as the difference in pollutant concentrations between samples gathered before (influent) and after (effluent) stormwater flows through the Splash Boxx. Sample collection dates to November 2019 and effectiveness has been consistent throughout the innovative treatment project.

Monitoring results presented in Figures 5 and 6 show that stormwater quality significantly improves after flowing through the Splash Boxx, with average copper reductions of 59 to 69% and average zinc reductions of 87 to 90%. The orange dotted lines represent the current Washington State Industrial Stormwater General Permit (ISGP) benchmark parameters for transportation facilities, which are used as a reference to compare with other industrial activities.

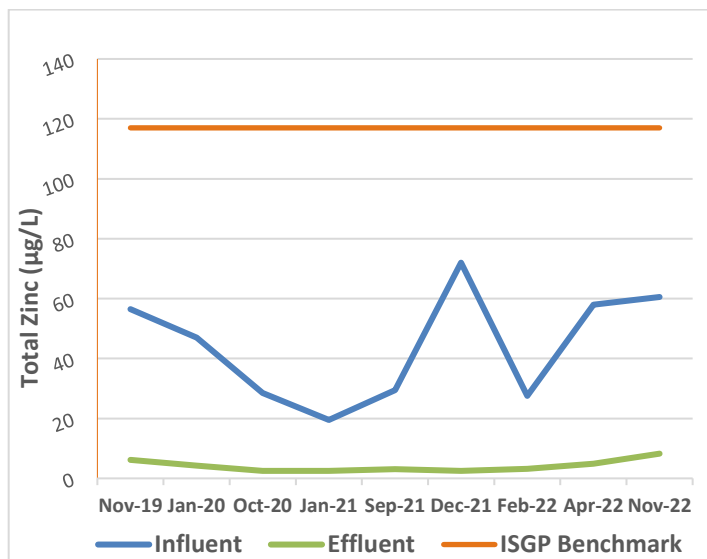


Figure 5. Average zinc concentration before treatment (influent) and after treatment (effluent) at MM and MIC from November 2019 to December 2022

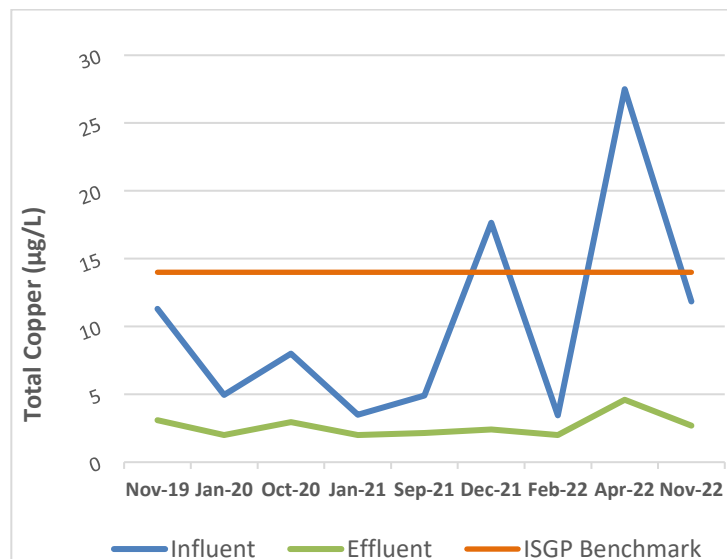


Figure 6. Average copper concentration before treatment (influent) and after treatment (effluent) at MM and MIC from November 2019 to December 2022