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 at Terminal 91. The system proved effective in removing zinc, a metal that can leach from galvanized surfaces. 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 water occurs via infiltration through engineered layers of the 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

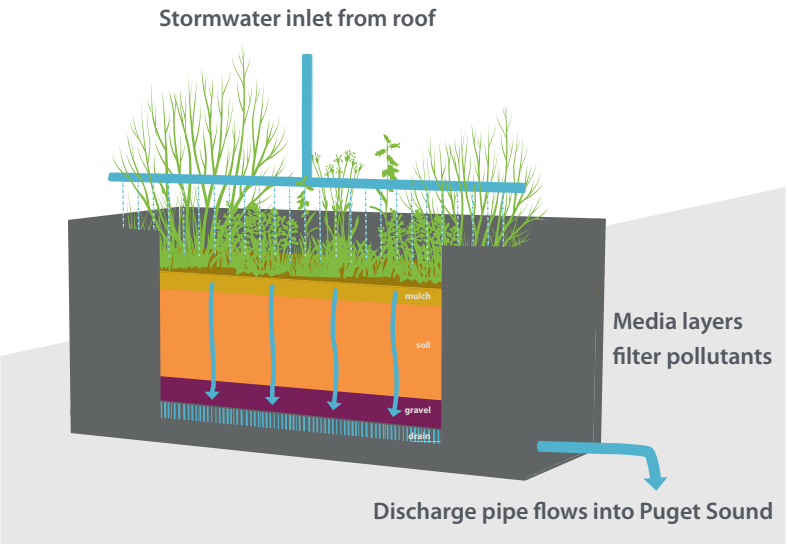

Figure 3. Splash Boxx diagram illustrating stormwater flow

The MIC Splash Boxx receives stormwater through a downspout from the 4,100 sq. ft. building, while the MM yard Splash Boxx pumps stormwater from catch basins in the 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 (see Figure 3). Treated water is released via an outlet pipe and reenters the stormwater system. In the case of an overflow, water is released into a sediment sock before entering the stormwater system. The MIC Splash Boxx annually discharges about 100,000 gallons of treated water into the Salmon Bay. The MM yard Splash Boxx annually treats over 900,000 gallons of stormwater that then 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 observe 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 replacement

The Port tracks increases in contaminant concentrations between the influent and effluent samples to determine when soil media needs replacing. The gravel layer may remain in the system longer due to its function as void space for water capacity and drainage rather than treatment.

Figure 4. Splash Boxx sampling locations indicated with blue circles

EFFECTIVENESS OF SYSTEM

Pollutant removal effectiveness is measured as the difference in pollutant concentrations between samples gathered before (influent) and after (effluent) stormwater flows through the Splash Boxx.

Monitoring results shown in Figures 5 and 6 suggest that stormwater quality significantly improves after flowing through the Splash Boxx systems, with average copper reductions of 60 to 70% and average zinc reductions of 85 to 90%. The orange dotted lines (refer to Figures 5 and 6) 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.

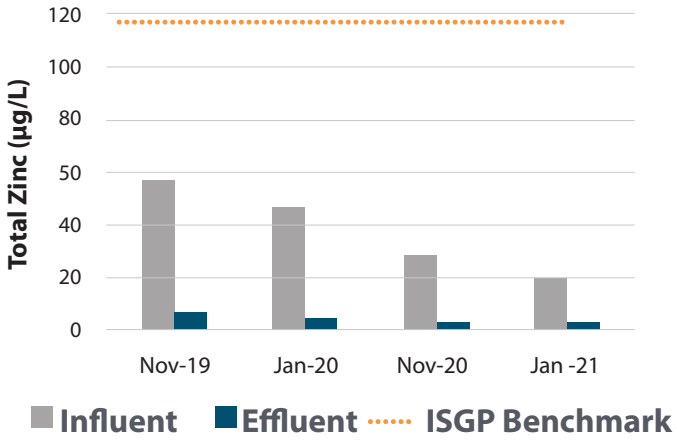

Figure 5. Total zinc runoff before treatment (influent) and after treatment (effluent) at MM and MIC from November 2019 to January 2021.

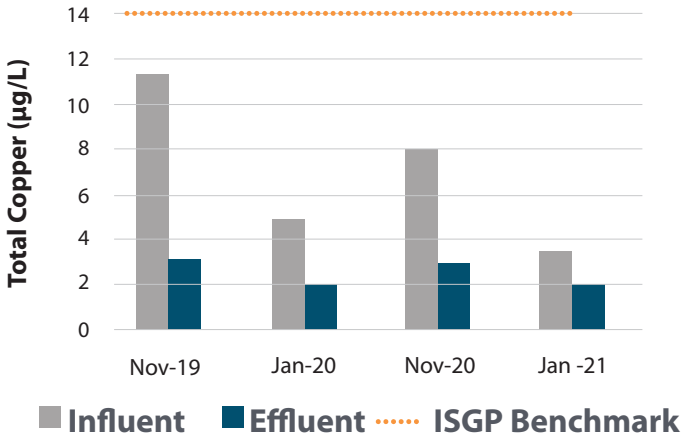

Figure 6. Total copper runoff before treatment (influent) and after treatment (effluent) at MM and MIC from November 2019 to January 2021.