



**Project Background**

Mackworth-Enviro designed and installed a temporary re-suspension barrier system (TRB) as part of a federal harbor dry dock remediation project in Victoria, BC. The project required installing several filter barrier curtains with barge gate access to surround the jetty perimeter and dredging areas to contain re-suspended contaminated sediments (Figure 1). Contaminants of concern included metals, PCBs, TBT, and PAHs.

The system was engineered to seal to the re-driven perimeter sheet pile wall, which served as the lower portion of the TRB system to mitigate recontamination from construction activities (Berlin et al., 2017a). The TRB system also had to withstand the wide tidal range in Esquimalt Harbor and allow for water exchange (Figure 2).

The silt curtains for this project were constructed of flexible, reinforced, thermoplastic material and suspended from a 30.5-centimeter flotation hood (Figure 3). The bottom of the curtain was constructed with an impermeable layer U-skirt, which overlapped on both sides of the top of the sheet pile wall that was anchored with a 14-millimetre chain ballast (Berlin et al., 2017a).

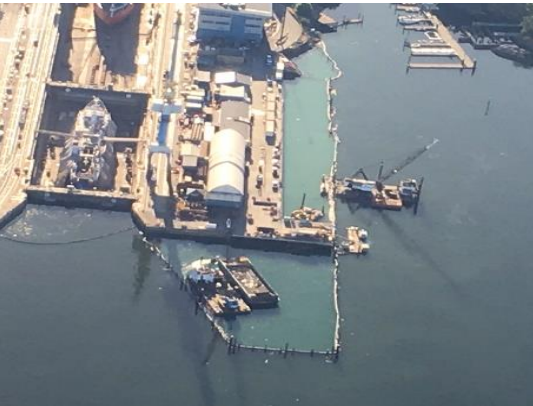


Figure 1. Aerial view of the TRB system

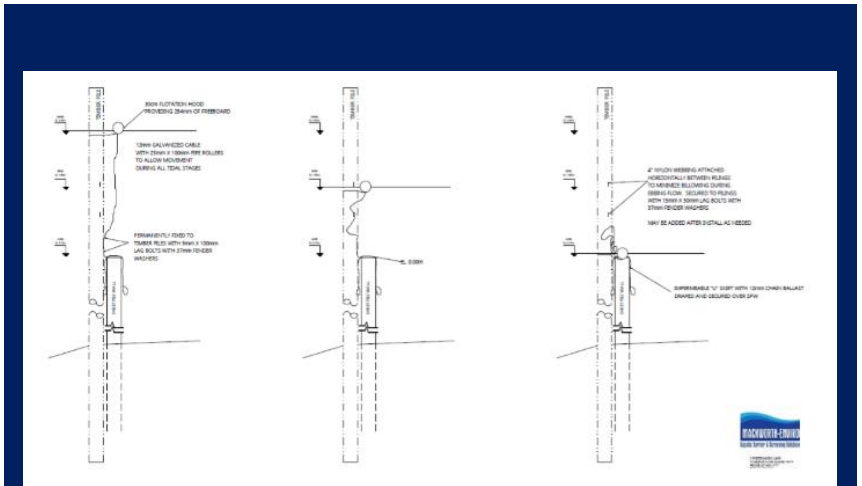


Figure 2. TRB system profile through tidal range

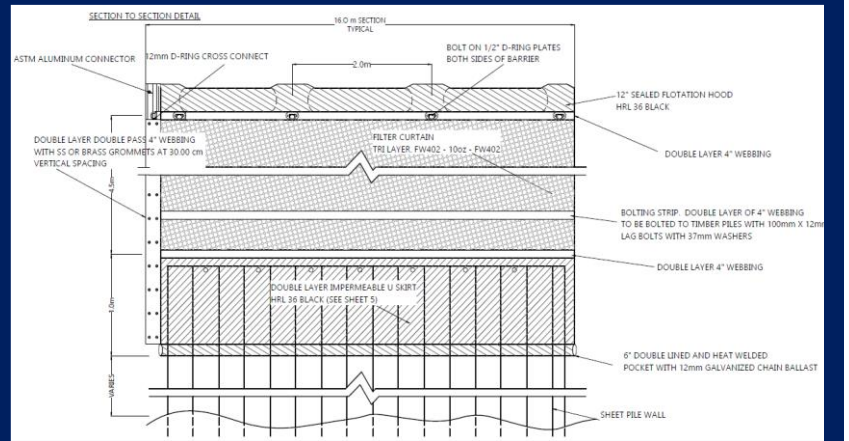


Figure 3. Design of TRB system

**Performance**

Water Quality Performance Criteria was established to protect aquatic life and limit recontamination of remediated areas. Water Quality Performance Criteria was assessed at several monitoring stations 25 meters outside the curtain established as early warning levels and 100 meters outside of the curtain for compliance levels. Over 21,000 in situ water quality measurements were taken and 583 water samples sent for laboratory analyses between November 2015 and December 2016. Of the in-situ measurements taken from the early warning monitoring stations (25 m), 93 samples were exceeded for turbidity, equating to a 0.4% frequency (Berlin et al., 2017). The maximum recorded turbidity measurement was 23.7 NTU. Thirteen of the laboratory measurements were exceeded for total suspended solids (TSS), with the maximum recorded measurement at 16 mg/L (Table 1). No exceedances occurred at the compliance level monitoring stations. The most frequent and highest level of exceedances were reported at water quality monitoring stations EW 32 and EW 42 (Figure 4) outside of zone 2 (Berlin et al., 2017). Water quality monitoring crews observed occasional short-term turbid water plumes outside of the TRB containment area. These occurrences happened more frequently than water quality exceedances for turbidity or TSS and did not reach beyond 25 meters (Berlin et al., 2017).

**Discussion**

Overall, the TRB system was effective in containing contaminated sediments within the delegated containment area. The frequency and magnitude of exceedances was relatively low and mainly limited to the early warning monitoring levels outside zone 2 (Berlin et al., 2017a). A possible factor was the absence of the sheet pile wall in the eastern section due to shallow bedrock. In this section of the TRB, the silt curtain was lying directly on the seafloor and may not have been fully sealed. Further supporting this idea, river otters were observed diving under the curtain around zone 2 and entering the containment area (Berlin et al., 2017a). Crews also observed potential wear and tear damage to the TRB system near zone 2 and 3 on a few occasions. TRB maintenance was conducted and silt curtain holes were patched in a timely manner. Water Quality Performance Criteria applied at the early warning stations reported higher for TSS and turbidity when the TRB gates were open and may have contributed to exceedances based on sampling time (Berlin et al., 2017a).

Table 1. Water quality monitoring exceedances and criterion

Parameter	Exceedances	Maximum	Criterion
21,934 In Situ Measurements			
Turbidity	93 (0.4%)	24 NTUs	2.5 NTUs
583 Laboratory Measurements			
TSS	13 (2%)	16 mg/L	5 mg/L
CU	3 (0.5%)	4.3 µg/L	3 µg/L

Note. From Berlin et al. (2017b) "Controlling Recontamination During Phase 2 Sediment Remediation Dredging at the Esquimalt Graving Dock" [PowerPoint Slides]

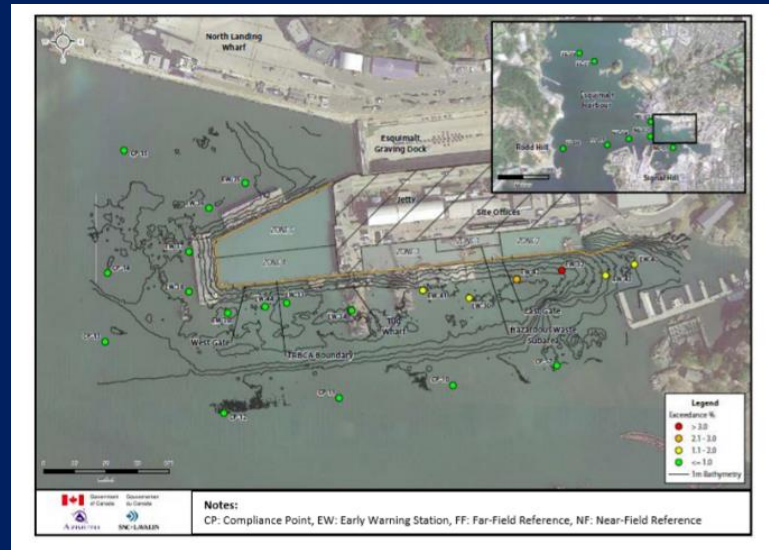


Figure 4. Water quality monitoring stations compliance and exceedances. From *Controlling Recontamination During Phase 2 Sediment Remediation Dredging at the Esquimalt Graving Dock* by Berlin et al., 2017b

**References Cited**

Berlin, D., N. Healey, D. McKeown, C. Major, A. Mylly, D. Osguthorpe, M. Woltman, P.E., T. Wang, P.E., R. Hill, D. Kettlewell. (2017a) "Controlling Recontamination During Phase 2 Remediation at the Esquimalt Graving Dock." Proceedings of the Western Dredging Association (WEDA) Dredging Summit & Expo 2017, Vancouver, British Columbia, Canada, June 26-29, 2017.

Berlin, D., M. Woltman, P.E., T. Wang, N. Healey, R. Hill, D. McKeown, C. Major, A. Mylly, D. Osguthorpe, D. Kettlewell. (2017b) "Controlling Recontamination During Phase 2 Sediment Remediation Dredging at the Esquimalt Graving Dock" [PowerPoint Slides]

**Contact Mackworth-Enviro for more information**

info@mackworth-enviro.com

cguelke@mackworth-enviro.com

www.mackworth-enviro.com