THIN-LAYER PLACEMENT PROJECT SHEET

Randle Reef

September 2020

Location: Randle Reef, Canada

Type: Sediment Remediation

Area: 7.5 ha

City: Hamilton Harbour, Ontario

County: N/A

Main Agencies: Norwegian Climate and Pollution Agency, and Norwegian Institute for Water Research and Marine Contaminants

Country: Canada

Hamilton Barbour bay in Ontario, Canada. Image adapted from Santiago et al., 2012.

Background

Hamilton Harbour (Ontario, Canada) is a closed basin with the exception of a ship canal (820 m long, 107 m wide, and 9.5 m deep) connecting with the western boarder of Lake Ontario. It has a maximum depth of 23 m, a mean depth of 13 m, and a surface area of 21.5 km^2. Randle Reef, located in Hamilton Harbour, is considered as one of the largest polycyclic aromatic hydrocarbon (PAH) contaminated sediment sites in the Great Lakes (He et al., 2014; Graham et al. 2012). Contamination in this area is attributed to multiple sources over a period of more than 150 years including coal gasification, petroleum refining, steel making, municipal waste, and sewage effluent (Graham et al. 2012). Randle Reef is a 60 hectare portion of the Hamilton Harbour bed, heavily contaminated with polycyclic aromatic hydrocarbons and heavy metals. Thus, a containment approach was proposed using dredged contaminated sediment to a constructed engineered containment facility (ECF) to manage residual contamination from nearby dredging. In combination with the ECF thin layer capping was proposed as a means of stabilizing marginally contaminated sediments that may not meet criteria for the containment facility.

Santiago et al. (2012) developed a containment plan to address a number of priority zones of sediments contaminated with high levels of PAHs in the Randle Reef area, with the potential to address other sediments from other locations in the Harbour. The objective of the proposed effort is to reduce the exposure of organisms in the Harbour to the most persistent toxic substances in the sediments, and ultimately to reduce the risk of exposure of aquatic and terrestrial biota, including humans, to these same substances.

Project Description

The proposed remediation of Randle Reef involves the construction of a capped engineered containment facility (ECF) of about 7.5 ha in size, consisting of an attached peninsula. The containment facility would cover in-situ approximately 130,000 m^3 of sediments contaminated with PAHs, and contain about 500,000 m^3 of dredged PAH contaminated sediments from surrounding areas. The site footprint covers largely the area of highest contamination in the priority zone area. A target of approximately 1/3 of the ECF was stated to potentially create

ecological diversity that may enhance local terrestrial and avian habitat if naturalized to include native vegetation. It is anticipated that the ECF will also provide approximately 5 ha of the primary site for a marine terminal and operations, while accommodating ongoing port operations. Specifically, the scope of the project includes:

1) A containment facility consisting of an adjacent peninsula with an area of approximately 7.5 ha,
2) Dredging of areas of contaminated sediments outside the perimeter of the containment facility, and between the proposed double walled perimeter for the transport and placement of these sediments in the containment facility,
3) Naturalization of the north and west sides of the ECF to provide a naturalized feature without focusing on enhancing a specific habitat type, and
4) Development of 5 ha of the peninsula for marine terminal uses.

Santiago et al. (2012) stated that dredging is not anticipated to remove 100% of the contaminant mass, and therefore, the contaminated sediment remaining in the sediment bed will be subjected to post-dredging monitoring to determine if the dredge criteria are met and if additional measures will be warranted. Following dredging, backfilling with a sand cover is recommended in two lifts of approximately 8 cm (3 inch) layers for those areas where verification sampling shows PAH concentrations greater than 100 mg/kg, and where an additional dredge pass will not be done. The first lift of the cap will undergo some mixing with the underlying sediment, while the second should provide predominantly a sand cap layer with PAH < 100 mg/kg. Methods for placing the sand to reduce sediment re-suspension and contaminated sediment entrainment in the cap layer will be specified by the contractor and could include mechanical placement with a bucket, washing sand off a barge, “sand box” vibratory screens, or submerged diffuser placement. The proposed plan for the ECF capping system consists of a foundation layer, an underliner drainage system, a hydraulic barrier layer, an overliner drainage system, paved surface (in the marine terminal area), vegetative cover, suitable aggregate cover, and stormwater management systems. The hydraulic barrier is expected to be used in the system to reduce infiltration into the underlying sediments, and reduce upwelling of either pore water or groundwater into the cap materials. Santiago et al. (2012) notes that the final thickness of the cap will be approximately 3 m.

Findings

The remediation of the Randle Reef site is expected to have a positive effect on aquatic habitat and biota by improving the quality of the habitat in Hamilton Harbour in the long-term due to decreased contaminant flux from disturbance of contaminated sediments. However, in the short-term, potential exists for an increase in contamination when the site is disturbed during construction and dredging. Environmental dredging to confine the contaminated sediments from Randle Reef within the ECF is part of the project design and is also the fish habitat mitigation/compensation that will be a component of the DFO Fisheries Act Authorization for the Harbour infilling from the ECF construction.

To date, remediation of contaminated sediment at Randle Reef is currently underway and is expected to be completed by 2022 (Graham, 2017). Beginning in 2018, less contaminated sediments from Randle Reef have been dredged and pumped into the steel container through an underwater pipeline. Santiago noted that the dredging for this project in expected to be completed in 2020, and as of December 2019, 50% of the dredging work had been completed (Bunch, 2020). The third and final phase is anticipated to take place in 2021, when all sediments will be dewatered and compressed, with the water being treated for contaminants, tested and released back into Lake Ontario. The ECF will then be impermeably capped to completely isolate the contaminants inside from the environment (Bunch, 2020).

References

Bunch, K. 2020. Great Lakes Connection. International Joint Commission. https://ijc.org/en/hamilton-harbour-randle-reef-restoration-entering-final-phase.

Graham, M., Hartman, E., He, C. 2012. Exploring the Dynamics of Thin Layer Cap Stability in a Freshwater Industrial Harbour. Exploring the Dynamics of Thin Layer Cap Stability in a Freshwater Industrial Harbour

Graham, M., Hartman, E., Joyner, R., Kim, K., Santiago, R. 2017. Environmental monitoring to guide and assess the effectiveness of Randle Reef sediment remediation on the recovery of Hamilton Harbour. Aquatic Ecosystem Health & Management. 20 (2017):308-318.

He, C., Scott, E. Graham, M., Binns A. 2014. Measurement and numerical modeling studies of the highest bottom sheer stress in the Randle Reef area. Canadian Journal of Civil Engineering. 41:828-838.

Santiago, R., Hartman, E., Joyner, R., An, S., Graham, M., Vieira, C., Hewitt, R., Fitzgerald, B. 2012. The Randle Reef Sediment Remediation Project Comprehensive Study.

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Main Agencies:

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Environment Canada
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