

ASSESSMENT OF ENVIRONMENTAL CONDITIONS IN SYDNEY HARBOUR, NOVA SCOTIA: GENERAL INTRODUCTION

P.A. YEATS

*Ecosystem Research Division, Science Branch
Department of Fisheries and Oceans, Maritimes Region
Bedford Institute of Oceanography
P.O. Box 1006
Dartmouth, Nova Scotia B2Y 4A2*

The Sydney steel works and its associated coking plants discharged large quantities of chemical pollutants into the local environment for 100 years from the beginning of steel and coke production in 1901 until the final shut-down of the steel plant in 2001. The coking operation, which was responsible for a large fraction of the atmospheric discharge of polyaromatic hydrocarbons (PAHs) and other chemicals, was phased out somewhat earlier between 1981 and 1988. Contaminant inputs to the atmosphere from steel mill and coke oven smokestacks decreased from the early 1980s until 2001 as first the coke ovens and then the steel plant ceased production. The same cannot be said about contaminants discharged to the aquatic environment. Aqueous discharges from the site were funneled through Coke Oven Brook to the Sydney Tar Ponds, an area at the head of the estuarine portion of Muggah Creek that was dammed off to form a contaminant holding facility (see Fig 1). Large quantities of sediments contaminated with hydrocarbons as well as polychlorinated biphenyls (PCBs) and heavy metals accumulated in the Tar Ponds as well as in Muggah Creek. Because the Tar Ponds are not isolated from natural freshwater runoff, runoff water (and contaminants) continues to flow through the Tar Ponds into Muggah Creek and Sydney Harbour. In addition to these inputs directly related to the steel plant, the South Arm of Sydney Harbour receives municipal and industrial discharges of a city of approximately 24,000 people (2001 census). One of the main sewers discharges into Muggah Creek.

A large engineering project is underway in the city of Sydney to remediate chemical contamination in the area of Coke Oven brook, the Tar Ponds and Muggah Creek. In this project large quantities of contaminated sediments will be removed, others immobilized and capped, and the freshwater flow and existing sewage discharges into Muggah Creek channeled to the Harbour through a new uncontaminated channel bed. The project is described on the Sydney Tar Ponds Agency website (<http://tarpondscleanup.ca>). The project, identified on this website as 'the most prominent remediation project in Canada', has undergone extensive and sometimes controversial environmental review and includes monitoring of environmental conditions in Sydney Harbour.

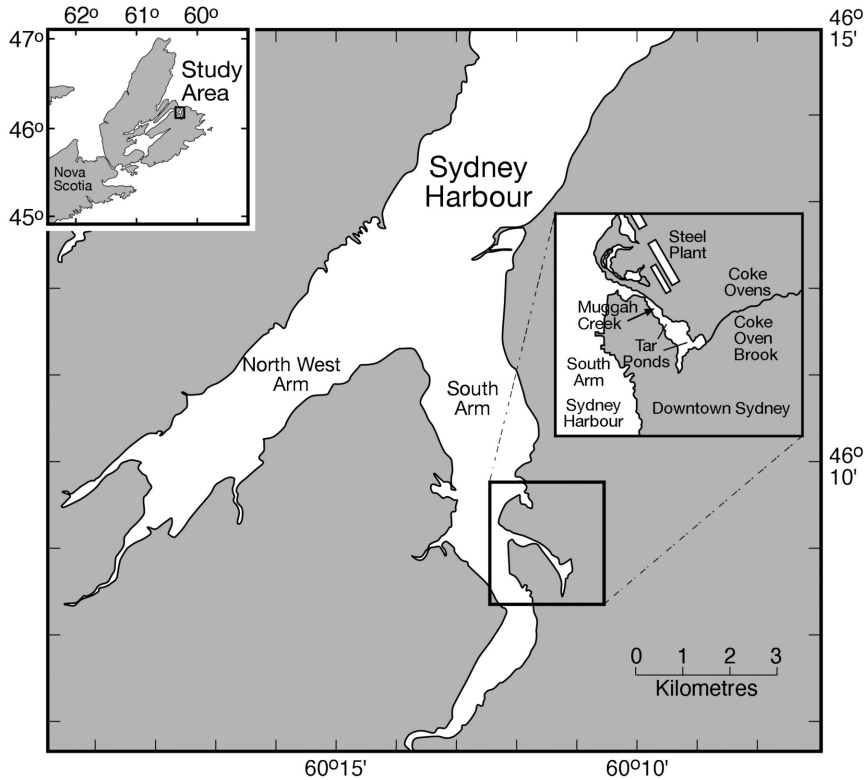


Fig 1 Relative locations of Sydney, Sydney Harbour, Muggah Creek, Coke Oven Brook, the Sydney Steel Plant, the Coke Ovens and the Tar Ponds.

A team of scientists from the Department of Fisheries and Oceans, Environment Canada, the National Research Council, and Dalhousie and Trent Universities recently completed an extensive assessment of environmental conditions in Sydney Harbour, environmental effects of contaminants and potential for remediation of contaminants in the Harbour (Lee 2002). The focus was the chemical contamination of the Harbour with hydrocarbons, PCBs and heavy metals much of which would have originated from the Sydney Steel Plant. The project was funded by the Toxic Substances Research Initiative (TSRI), of Health Canada, which provided among other things, research funding for understanding the impacts of toxic chemicals discharged to the environment on ecosystem and human health. The timing of the field work for this project (1999-2002) was ideal from the perspective of providing an up-to-date assessment of environmental processes and conditions in the Harbour immediately before the commencement of planning for the Tar Ponds clean-up project in 2004.

The TSRI project was a multidisciplinary investigation of physical water circulation, contaminant distributions in water and surficial sediments, time

series inventories of contaminants in sediments, and biological effects of contaminants in the sediments including changes in community structure and function. It also included components that investigated microbiological processes controlling the biodegradation of contaminants in sediments and developed predictive mass balance models for the transport of contaminants through the Harbour. Two graduate student theses have been based on this work (Ethier 2002, Querbach 2002), and a number of technical reports have been published (Ernst et al. 1999, Holstead & Mackay 2000, Petrie et al. 2001, Stewart et al. 2001, Stewart et al. 2002). Papers on the results of this research are now appearing in the literature (Fortin et al. 2003, Tay et al. 2003) including three papers being published in this issue of the Proceedings of the Nova Scotian Institute of Science. The first of these by Loring et al., describes geochemical and environmental processes controlling the distribution of heavy metals in surficial sediments; the second by Yeats and Dalziel, the geochemistry of heavy metals in the water column; and the third by King, the contamination of sediments and lobster by PAHs and associated human health risks from consumption of lobster tomalley. In the next issue of the Proceedings, we hope to publish several more articles relevant to the continuing interest in the clean-up of Sydney Harbour, including ones on water circulation and mixing and modeling of water quality.

REFERENCES

- Ernst B, Pitcher D, Matthews S, Julien G** (1999) Concentrations and distribution of polycyclic aromatic hydrocarbons (PAHs), PCBs and metals in sediments, mussels (*Mytilus edulis* and *Modiolus modiolus*) and lobsters (*Homarus americanus*) from Sydney Harbour, Nova Scotia. Environment Canada (Atlantic Region), Surveillance Report EPS-5-AR-99-7
- Ethier ALM** (2002) A review and mass balance model of the sources and fate of polycyclic aromatic hydrocarbons in Sydney Harbour, Nova Scotia. MSc thesis, Environmental Engineering, Trent University, Peterborough, ON
- Fortin N, Beaumier D, Lee K, Greer CW** (2003) Soil washing improves the recovery of total community DNA from polluted and high organic content sediments. *J Microbiol Methods* 56:181-191
- Holstead AL, Mackay D** (2000) Development of a multi-QWASI model to simulate fate of PAHs in Sydney Harbour, Nova Scotia (operations manual for distribution to potential users). Report to Department Fisheries and Oceans, Maritimes Region, Dartmouth, NS
- Lee K** (2002) Environmental effects and remediation of contaminants in Sydney Harbour, Nova Scotia. Final report to Health Canada for Toxic Substances Research Initiative (TSRI) Project #93
- Petrie B, Bugden G, Tedford T, Geshelin Y, Hannah C** (2001) Review of the physical oceanography of Sydney Harbour. *Can Tech Rep Hydrog Ocean Sci* 215
- Querbach K** (2002) Impacts of coal-generated polycyclic aromatic hydrocarbons on benthic macrofaunal community structure in Sydney Harbour, Nova Scotia. MSc thesis, Department of Oceanography, Dalhousie University, Halifax, NS

- Stewart ARJ, Milligan TG, Law BA, Loring DH** (2001) Disaggregated inorganic grain size and trace metal analyses of surficial sediments in Sydney Harbour, NS. Can Data Rep Fish Aquat Sci 1072
- Stewart PL, Kendrick PA, Robinson TL, Lee K** (2002) Softbottom benthic communities in Sydney Harbour, Nova Scotia. 1: 1999 Survey – Distribution, relation to contamination and comparison to previous studies. Can Tech Rep Fish Aquat Sci 2424
- Stewart PL, Kendrick PA, Levy HA, Robinson TL, Lee K** (2002) Softbottom benthic communities in Sydney Harbour, Nova Scotia. 2: 2000 Survey – Distribution and relation to sediments and contamination. Can Tech Rep Fish Aquat Sci 2425
- Tay KL, The SJ, Doe K, Lee K, Jackman P** (2003) Histopathologic and histochemical biomarker responses in Baltic clams, *Macoma balthica*, to contaminated Sydney Harbour sediment, Nova Scotia, Canada. Environ Health Perspect 111:273-280