

Sampling Protocols and Results Appendix.

Royal Marina Application

**USACE Public Notice #97-13010- Y2
Royal Marina Application**

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Submitted to:

- New York State Department of Environmental Conservation
- U.S. Army Corps of Engineers, New York District
- New York State Department of State

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Sediment Samples- Protocols & Collection

Sediment samples were collected by Gaia Institute personnel, from Royal Marina on 23 February 1998, following standard sediment sampling protocols.

The field sampling personnel exercised standard sampling protocols to minimize potential contaminant introduction into, or cross-contamination of, the sediment samples. All sampling equipment was decontaminated before and between each sample. Sediment samples were collected manually using a 20-inch sediment sampler with Lucite liners. The sediment sampler was driven 0 feet - 3 feet into the sediment. Samples were collected from three (3) points on the north side of Royal Marina, and three (3) points on the south side of the marina. The three points from the north side were homogenized in a decontaminated stainless steel bowl and labeled as N-1. The three points from the south side of the marina were homogenized in a decontaminated stainless steel bowl and labeled as S-1. These samples were placed in sampling containers provided by the analytical laboratory, preserved on ice in a cooler, and promptly delivered to the laboratory for analysis on 23 Feb 1998. The volatile organic samples were filled to capacity so that no headspace was present.

The sediment samples were analyzed for Herbicides, Pesticides, PCB's, Priority Pollutant Metals, Total Solids (%), Polyaromatic Hydrocarbons (PAH's), Volatile Organics (VOA's), and Semi-Volatile Organics (Semi-VOA's). All samples were analyzed using Standard EPA Detection Methods or U.S. Army Corps of Engineers (USACOE) Dredge Materials Methods. A copy of the laboratory analytical results is included in the Appendix of this document.

Sediment Concentrations - Priority Pollutant Metals

Of all the Priority Pollutant Metals, ten (10) metals had detectable levels in the sediments. The detected metals included Arsenic, Beryllium, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, and Zinc. The concentrations for each analyte detected in South Sediment Sample Location 1 (S-1), and North Sediment Sample Location 2 (N-1), are listed in the table below. The metal concentrations are in mg/kg or parts per million (ppm).

Detected Metals Concentrations in Royal Marine Sediments**Arsenic****Beryllium****Cadmium****Chromium**

Copper

Lead

Mercury

Nickel

Selenium

Zinc

Table of Average Metal Concentrations in Royal Marine Sediments Compared to Environmental Criteria

Analyte	Average Sediment [mg/kg]	Background Soils Range Eastern U.S.	Background Soils Mean Eastern U.S.	Sediment Criteria NYDEC	EPA Region 3 Screening
Arsenic	2.21	.1 – 73	5	5	8.20
Beryllium	0.45	1 – 7	0.55	-	-
Cadmium	1.58	0.01 – 0.7	0.6	0.8	1.20
Chromium	36.30	1 – 1000	33	26	260
Copper	71.15	1 – 700	12	19	34
Lead	47.85	10 – 300	14	27	46.7
Mercury	0.86	0.01 – 3.4	0.81	0.11	0.15
Nickel	15.30	5 – 700	11	22	20.9
Selenium	3.73	0.1 – 3.9	0.30	-	-
Zinc	193	20 - 2000	220	85	150

Sediment Data Interpretation - Metals

The Table above compares the Average Metal Concentrations in Royal Marine Sediments to the following environmental criteria:

- Range of Background Soils in the Eastern U.S., and Mean Concentration of Background Soils in the Eastern U.S. from Elemental Concentrations in Soils and Other Surficial Materials of the Conterminous United States, USGS, 1984;
- Sediment Criteria from the Bureau of Environmental Protection, Division of Fish and Wildlife, New York State Department of Environmental Conservation, December 1989;
- U.S. EPA Region 3 Biological-Technical Assessment Group (BTAG) Sediment Screening Criteria for Ecological Assessments, 1995; and
- Guidelines for the Pollutational Classification of Great Lakes Harbor Sediments. U.S. EPA Region 5, April 1977.

The chemical concentrations provided in these documents are conservative guidelines for the evaluation of sampling data at sites that are being considered for environmental assessments. These concentrations are screening guidelines and are not enforceable cleanup criteria. The guidelines stress that these data serve as a starting point to establish whether or not a more rigorous assessment is warranted, and should be used in cases where insufficient data have been gathered.

From the comparisons of the Royal Marina sediment metal concentrations to various environmental criteria, the following can be stated:

The two sample locations, S-1 and N-2, had relatively similar chemical concentrations. The calculated average of the two sample locations is a likely representative of the average metal concentrations in the Royal Marina sediments; except for Cadmium, where the difference between S-1 and N-1 concentrations is more than doubled.

- Arsenic concentrations did not exceed any of the criteria.
- Beryllium concentrations did not exceed the Range or Mean of Eastern U.S. Soils. No other environmental criteria were available for comparison.
- The average Cadmium concentration exceeded the Eastern U.S. Soil Range and all Criteria.
- The average Chromium concentration fell within the range of expected Eastern U.S. Soil Concentrations and below the EPA Region 3 Criteria, but slightly exceeded the Mean Soil Concentration and NYDEC levels.
- The average Copper, Lead and Mercury concentrations fell within the range of expected Eastern U.S. Soil Concentrations, but exceeded the Mean Soil Concentration value and both the NYDEC and Region 3 Criteria.
- The average Nickel concentration fell within the range of expected Eastern U.S. Soil Concentrations and below the NYDEC and EPA Region 3 Criteria, but slightly exceeded the Mean Soil Concentration.
- The average Selenium concentration did not exceed the Range of Eastern U.S. Soils, but did exceed the Mean Soil Concentration. No other environmental criteria were available for comparison.

•The average Zinc concentration did not exceed the Range or Mean of Eastern U.S. Soils. It did exceed both the NYDEC and Region 3 Criteria.

A comparison of the detected metal concentrations at Royal Marina, to Region 5 Guidelines for the Pollutional Classification of Harbor Sediments, indicate that none of the sediments would be considered Heavily Polluted, and only a couple of metals barely fall into the Moderately Polluted level (Cu and Hg). All other detected metal concentrations found at Royal Marina would fall into Non-Polluted Category.

Sediment Concentrations - Herbicides, Pesticides, PCB's

Neither of the sediment samples had detectable levels of Herbicides, Pesticides nor PCB's.

Sediment Concentrations - Volatile and Semi-Volatile Organics

Some VOAs and Semi-VOAs were detected in the sediment samples. The following lists of chemicals had detectable levels in the sediment samples, and are reported as ug/kg or ppb:

Table of Volatile and Semi-Volatile Organic Concentrations in Royal Marina Sediments

Analyte
Acenaphthylene
Anthracene
1,2,4-Trimethylbenzene
m,p-xylene

	Benzo(a) anthracene
	Benzo(a) pyrene
	Benzo(a)fluoranthene
	Benzo(g,h,i,)perylene
	Benzo(k)fluoranthene
	bis(2-Ethylhexyl)phthalate
	Chrysene
	Di-n-butylphthalate
	Fluoranthene
	Indeno(1,2,3-cd) pyrene

Phenanthrene

Pyrene

ND=Not Detectable

All values in ug/kg or ppb, unless otherwise noted

Table of VOA and Semi-VOA Average Concentrations vs. Environmental Criteria

Analyte

Acenaphthylene
Anthracene
1,2,4-Trimethylbenzene
m,p-xylene
Benzo(a) anthracene
Benzo(a) pyrene
Benzo(a)fluoranthene
Benzo(g,h,i,)perylene
Benzo(k)fluoranthene
bis(2-Ethylhexyl) phthalate
Chrysene
Di-n-butylphthalate

Fluoranthene
Indeno (1,2,3-c,d) pyrene
Phenanthrene
Pyrene

ND=Not Detectable

All values in ug/kg or ppb, unless otherwise noted

Data Interpretation - VOAs and Semi-VOAs

The average sediment concentrations were compared to the following sediment quality criteria:

- U.S. EPA Region 3 Biological-Technical Assessment Group (BTAG) Sediment Screening Criteria for Ecological Assessments. Philadelphia, PA: USEPA. 1995; and

- Interim Sediment Criteria Values for Nonpolar Hydrophobic Organic Contaminants. SCD 17. Washington, DC: USEPA. 1988.

As previously mentioned, the chemical concentrations provided in these documents are conservative guidelines for the evaluation of sampling data at sites that are being considered for environmental assessments. These concentrations are screening guidelines and are not enforceable cleanup criteria. The guidelines stress that these data serve as a starting point to establish whether or not a more rigorous assessment is warranted, and should be used in cases where insufficient data have been gathered.

The table above provides the Average VOAs and Semi-VOAs concentrations in the Royal Marina sediments and the available environmental data for comparison. From this comparison, the following chemicals revealed concentrations that exceeded at least one of the environmental screening criteria: acenaphthylene, benzo(a)anthracene, and chrysene.

In the cases of acenaphthylene and chrysene, there was only one screening value available. The two chemicals both exceeded the guideline level. However, in both cases the detected values were just over the screening guideline levels. In the case of benzo(a)anthracene, the detected concentration exceeded the Region 3 value, but was lower than the EPA Interim Sediment Criteria Value.

No sediment criteria could be found for the following chemicals: 1,2,4-trimethylbenzene, m,p-xylene, benzo(k)fluoranthene. A more thorough evaluation of toxicological

reference literature would need to be completed to determine if guidelines exist for these chemicals.

Sediment Data Conclusions and Discussion

Of the metals detected in the Royal Marina sediments, Cd, Cu, Pb, and Hg were the chemicals that exceeded the EPA Criteria and the mean value for expected soil concentrations in the Eastern United States. Cadmium concentrations exceeded the range of expected soil concentrations for the Eastern States.

A comparison of the detected metal concentrations at Royal Marina, to Region 5 Guidelines for the Pollutational Classification of Harbor Sediments, indicate that none of the sediments would be considered Heavily Polluted, and only Copper and Mercury (Cu and Hg) barely fall into the Moderately Polluted level. All other detected metal concentrations found at Royal Marina would fall into Non-Polluted Category.

No herbicides, pesticides nor PCBs were detected in the samples.

From a comparison of the average VOA and Semi-VOA concentrations to two (2) EPA guideline levels, the following chemicals revealed concentrations that exceeded at least one of the environmental screening values: acenaphthylene, benzo(a)anthracene, and chrysene. In the cases of acenaphthylene and chrysene, there was only one screening value available. Both averages exceeded the guideline level, however, in both cases the detected values were just over the screening guideline levels. In the case of benzo(a)anthracene, the detected concentration exceeded the Region 3 value, but was lower than the EPA Interim Sediment Criteria Value.

The detection of polyaromatic hydrocarbons (PAHs) in these sediments is potentially linked to coal dust particles, which are ubiquitous throughout the sediments in this region. If the source is coal dust, then it is likely that the PAHs are in particulate, or non-soluble, form. In particulate form, PAHs are less bioavailable to potential human or wildlife receptors.

A cursory comparison of the detected chemical concentrations found at the Royal Marina to previous sediment metal concentrations, detected from four separate sampling periods between 1991- 1995, at Newark Bay, Arthur Kill and East River Bays indicates that these concentrations, at Royal Marina, are well below the measured levels found at the other NY/NJ locations. In many cases the Royal Marina sediment concentrations were an order of magnitude or more lower than the other NY/NJ sites. The Table below provides a comparison of the Royal Marina averages compared to the NY/NJ Harbor Concentration Levels. It should be noted, however, that the contaminant levels within the above noted contained embayments may be substantially higher than rest of the harbor.

Table of Royal Marina Averages Compared to NY/NJ Harbor Levels

Analyte

Acenaphthylene

Benzo(a)anthracene

Lead**Cadmium****Copper****Mercury**

As seen in the Table above, the average concentration for acenaphthylene for the Newark Bay, Arthur Kill and Newtown Creek was 1021 ug/kg whereas, the acenaphthylene concentration detected at Royal Marina was 57.5 ug/kg; and the average concentration for the other sites for benzo(a)anthracene was 3572 ug/kg, while the average benzo(a)anthracene concentration at Royal Marina was 386 ug/kg. In the case of metals, Lead (Pb) concentrations at the other sites were between 50 - 990 mg/kg versus 47.85 at

the subject site. Cadmium (Cd) concentrations were between 8 - 22 mg/kg at the NY/NJ sites and at the subject site the average was 1.58 mg/kg. The levels of Cu and Hg reached as high as 970 mg/kg and 31 mg/kg, respectively. In comparison, the average Cu value was at 71.5 mg/kg and the average Hg concentration was 0.86 at Royal Marina.

As expected the chemical concentrations detected in the Royal Marina indicate that the sediments have most likely been affected by anthropogenic chemical sources. This is more apparent with the Semi-VOAs than with the metals; since most of the metals fell within naturally occurring metal concentrations for soils in the region. The exception being the detected cadmium levels, which exceeded the range of regional cadmium concentrations. In the case of the PAHs, there is some likelihood that these chemicals can be attributed to coal dust that is pervasive throughout the waterways in the region. There is an auspicious lack of Volatile Organic (VOA), Herbicide, Pesticide and Polychlorinated Biphenyl (PCB) concentrations in the sediment samples. Furthermore, none of the detected chemical concentrations from the Royal Marina indicated that the sediments were grossly contaminated by any single chemical or group of chemicals - especially when they are compared to other sediment samples collected from the NY and NJ harbors nearby.