

Northeast
Utilities System

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February 12, 1997

SES-97-GN-026

D10812

Mr. James Grier
Supervising Sanitary Engineer
Water Management Bureau
Department of Environmental Protection
79 Elm Street
Hartford, CT 06106-5127

Dear Mr. Grier:

Millstone Station
NPDES Permit No. 0003263
Supplemental Information for Molybdenum

Reference: Letter D10765 from S. Scace to J. Grier dated February 5, 1997

Northeast Nuclear Energy Company (NNECO) recently submitted supplemental information in support of its request to use of LCS - 1000 as a corrosion inhibitor in the Millstone Unit 1 Closed Cooling Water Systems (Reference). Subsequent to that submittal, you requested additional reference material regarding background concentrations of molybdenum in seawater. This information is included as Attachment 1.

In addition, Mr. Paul Jacobson of NNECO informed you by phone on February 10, 1997 that he had become aware that the manufacturer had sent the wrong formulation of LCS - 1000 used in bioassay tests performed at the NU Environmental Laboratory (NUEL) between December 31, 1996 and January 4, 1997. The formulation proposed for use and the formulation tested are identical except that sodium carbonate was included at a concentration of 0.283% in samples for which the bioassay testing was performed. Sodium carbonate has been eliminated in the formulation which we will actually use in the cooling water system.

Bioassay testing is currently being performed on the correct formulation (ie. without sodium carbonate) and this information will be forwarded to you upon completion. As requested, a letter from Calgon Corporation explaining their error and the slight differences in the two formulations is included as Attachment 2.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

250139


S. Scace

Director - Nuclear Engineering Programs

cc: M. Harder
NRC

9702260346 970212
PDR ADOCK 05000245
P PDR

COOL 1/1

Attachment 1.

Background Concentrations of Molybdenum in Sea Water

Reference:

**Millstone Nuclear Power Station Unit 3
Environmental Report - Operational License Stage
Section 2.4 Hydrology**

2.4 HYDROLOGY

2.4.1 Surface Water

The public water supplies within a 32-km (20-mile) radius of the site are identified on Figure 2.4-1. The characteristics of these public water supplies are listed in Table 2.4-1. The information contained on Figure 2.4-1 and Table 2.4-1 was furnished by the Bureau of Sanitary Engineering of the Connecticut State Health Department. The nearest surface public water supply is the New London Water Company's Lake Ronomac, 9.2 km (6 miles) north-northwest of the site.

No surface drainage from the site could affect this reservoir because of the distance involved, the surface conditions, the expected groundwater gradient from the reservoir area to the site, and the generally impervious nature of the overburden on and near the site. The bedrock surface is exposed at the south end of the site, but covered with a dense glacial till at the north end. Because both are quite impervious, precipitation does not permeate into it readily, and much of the precipitation runs off the surface directly into Niantic Bay or Jordan Cove. Some surface water collects in depressions in the northern part of the site.

There are no major rivers or streams in the vicinity of Millstone Point, nor are there any water courses on the site. A number of small brooks flow into the Niantic River and then to Niantic Bay, west of the site. Any flooding of these brooks would not directly affect the site or significantly raise the water levels in Niantic Bay, Jordan Cove, or Long Island Sound in the vicinity of the site. All site drainage, including the roofs of safety related buildings, will be designed on the basis of the probable maximum precipitation to assure against the local flooding of station facilities.

2.4.2 Groundwater

The Millstone site has several shallow wells on it, the nearest being about 1.2 km (3/4 mile) from the station area (Figure 2.4-2). None of these provides water for domestic purposes, but one is used to water a nearby baseball field and to supply a drinking fountain at the field. Ridges of granite between the station and these wells create a drainage divide which would keep any water or chemicals accidentally released from the station from reaching these wells.

Groundwater observations at the site have been documented in previous reports (EBASCO 1966; Bechtel Corp. 1969). Observations of the water levels in the granite quarry at the site show that the water level in the quarry, before the existing discharge channel opened to the ocean, typically lay approximately 5.2 meters (17 feet) below the level of the adjacent Long Island Sound. It is significant that this quarry was worked for over 100 years (1830 to 1960) at distances of as little as 61 meters (200 feet) from the waters of Long Island Sound without experiencing notable inflows of water.

These observations confirm previous findings documented during the Millstone 2 construction phase that the permeabilities of the bedrock and the overlying ablation till and the dense basal till are extremely low. Little or no groundwater flow has been observed in the crystalline bedrock, and virtually all of the groundwater movement is restricted to the soil overburden. Measurements taken during previous investigations in August 1969 showed average influx rates into 0.61 meter x 3.7 meters (2 feet by 12 feet) by 3-meter (10-foot) deep test pits of about 30.3 liters (8 gallons) per hour.

Observations at the site prior to construction of Millstone 3 were made in several borings between 1971 and 1973. Piezometric surface readings of these boreholes appear to be subject to considerable seasonal fluctuations and vary with locations. A stabilized groundwater level contour map, based on the seasonal high water levels measured in January 1972, and extrapolation of data to post-construction site conditions, were plotted. This map (Figure 2.4-3) is representative of higher than average water level reading as determined during the site study and from visual observations during construction. Figure 2.4-3 also indicates a groundwater piezometric surface with a 3-percent gradient generally sloping from northeast to southeast.

Localized perched groundwater conditions probably exist because of the irregular distribution of ablation till materials of varying gradation and porosity. It is also likely that shallow, ponded water exists in localized bedrock troughs. The prevalence of bedrock outcrops to the north and northwest of the site indicates that bedrock acts as a groundwater divide, isolating the soils of the tip of Millstone Point from soils further inland. Thus, groundwater recharge would primarily be due to absorption of local precipitation, with probable migration to the waters of the immediate adjacent Long Island Sound.

Water pressure tests were also performed in three boreholes and during installation of rock anchors in the turbine and service building. These tests indicated that the rock within the site area is generally massive with slight to moderate interconnected jointing. Low pressures observed from these tests, as tabulated in Table 2.5.4-16 of the Millstone 3 FSAR, further verified the low permeability of the rock mass.

2.4.3 Oceanography

2.4.3.1 Tides

Normal tides at Millstone Point are semidiurnal with a mean range of 0.82 meter (2.7 feet) and a spring range of 1 meter (3.2 feet). The mean period of the tide is 12 hours-25 minutes. Tides in excess of the mean high water occur on an average as follows: in excess of 0.9 meter (3 feet), about once a year; in excess of 0.6 meter (2 feet), about 5 times a year; and in excess of 0.3 meter (1 foot), about 98 times a year.

2.4.3.2 Tides and Flooding Due to Storms

Since Millstone Point is a peninsula which projects into Long Island Sound, it is subjected to tidal flooding from severe storms. The highest such flooding has resulted from the passage of hurricanes. New England Corps. of Engineers (1965), Harris (1963), and Redfield and Miller (1957) indicate that twelve severe hurricanes have crossed coastal southern New England since 1635 and that four of these storms occurred in the past 44 years. These most recent storms include the hurricanes on September 21, 1938; September 14, 1944; August 31, 1954; and September 12, 1960. The center of the September 1938 storm crossed the Connecticut coast about 24 km (15 miles) east of New Haven and about 32 km (20 miles) west of Millstone Point. The center of the 1944 hurricane passed inland between Charlestown and Point Judith, Rhode Island, about 56 km (35 miles) east of Millstone Point. The center of the August 1954 storm crossed the Connecticut Coast in the vicinity of Millstone Point. The center of the September 1960 storm also crossed the coast in the vicinity of Millstone Point. The maximum flood tide levels recorded in the vicinity of Millstone Point during these storms are indicated below:

Hurricane	Maximum Flood Tide Levels Mean Sea Level (msl)
September 21, 1938	3.0 meters (9.7 feet)
September 14, 1944	1.9 meters (6.2 feet)
August 31, 1954	2.7 meters (8.9 feet)
September 12, 1960	1.8 meters (6.0 feet)

The design storm surge level at the site was computed using the probable maximum hurricane (PMH) as reported by the U.S. National Oceanic and Atmospheric Administration (NOAA) in their unpublished report HUR 7-97. HUR 7-97 describes the PMH as "...a hypothetical hurricane having that combination of characteristics which will make it the most severe that can probably occur in the particular region involved." The characteristics of the PMH used in computing the maximum surge levels were:

1. Central pressure index = 69.24 cm (27.26 inches)
2. Radius of maximum wind = 88.9 km (48 nautical miles)
3. Forward speed = 27.8 km/hr (15 knots)
4. Maximum gradient wind = 198.4 km/hr (124 miles per hour)
5. Peripheral pressure = 77.62 cm (30.56 inches)

The locus of maximum winds of the PMH was brought inshore along a track which passes just to the east of the eastern end of Long Island. This calculated maximum surge height is elevation +6 meters (+19.70 feet) msl. The total surge includes 0.73 meter (2.40 feet) of astronomical tide, 0.30 meter (1 foot) of forerunner or initial rise, 0.72 meter (2.36 feet) of rise due to barometric pressure drop, and 4.25 meters (13.93 feet) of wind setup.

Wave action during the PMH was also considered. Millstone Point is sheltered from the direct onslaught of open ocean waves by Long

Island. Moreover, the station is located on the western side of the Point and a considerable distance inland from the southernmost tip. Thus, the topography of the point itself protects the station area from breaking waves during the period of peak tidal flooding when the winds are from the southeast quadrant. By the time the winds back around to the southwest quadrant, the direction of maximum station exposure, the surge level will be below elevation 2.5 meters (8.2 feet) msl, and the winds will have subsided considerably.

The design basis flood (maximum combination of storm surge and wave runup) established for Millstone 3 is elevation +7.25 meters (+23.8 feet) msl. With the exception of the circulating and service water pump house, all safety related structures and equipment are protected from flooding by the Millstone 3 site grade of elevation +7.32 meters (+24 feet) msl. Each of the two pairs of service water pumps and pump motors is located at elevation 4.42 meters (+14.5 feet) msl inside individual watertight cubicles of the seismically designed pump house. The walls of these cubicles are watertight up to elevation 7.77 meters (+25.5 feet) msl, protecting the pump motors and associated electrical equipment from wave action and PMH surge.

2.4.3.3 Tidal Current

To understand the hydrographic and hydrothermal characteristics of the water bodies in the vicinity of the site, Northeast Utilities Service Company (NUSCo.) has retained several different investigators to perform hydrographic surveys since 1965. The hydrographic survey conducted in late summer of 1965 established baseline data in the vicinity of the site, including tidal current velocities and volume flow measurements (Docket No. 50-245 Unit 1 Environmental Report, Appendix B, Section III-B). The survey station locations are shown on Figure 2.4-4.

The tidal current velocities and volume flow survey (results shown on Figure 2.4-5) employed one continuous monitoring current meter located at the index station and a portable current meter, which was operated at each station successively, approximately once per hour for one tidal cycle. Readings were made with the portable meter at depths of 1.5 meters (5 feet), half way to bottom and 1.5 meters (5 feet) off bottom.

There was an apparent negative gradient of current velocity from the surface toward the bottom. In terms of maximum ebb velocity, at Station One the mid-depth velocity was 74 percent of the surface velocity, and the bottom velocity was 61 percent of surface velocity. Comparable figures for Station Two were 66 and 60 percent, respectively. At Station Three it was 85 and 62 percent, respectively. At Station Four it was 85 and 65 percent, respectively. This velocity gradient would produce considerable vertical mixing in the water flow and would be a factor in the thorough distribution of the water column.

MNPS-3 EROLS

The results from the continuous recording meter located at the index station conformed in general with those from the portable meter. In addition, they indicated an asymmetry between the flood and ebb tides, with the flood tide achieving a peak velocity of 0.53 meters/sec (1.75 ft/sec) and the ebb tide reaching a peak velocity of 0.45 meters/sec (1.48 ft/sec).

Bottom profiles (Figures 2.4-6) were run from Station One through Station Two to the shoreline, and from Station Four through Station Three to the shoreline, with a continuous recording fathometer. The bottom profiles were divided into an appropriate number of trapezoids whose areas were calculated and summed to arrive at total cross sectional area. Using a mean velocity of 0.26 meters/sec (0.857 ft/sec) for the tidal cycle beginning one hour before low slack water on September 2, 1965, it was calculated that a mean tidal flow of 3,576 cubic meters/sec (126,287 cfs) in Twotree Island Channel and 2,243 cubic meters/sec (79,186 cfs) across the section running from Bell 4 northeast towards the shore will occur. The flow across the Twotree Island Channel is in close agreement with a preliminary estimate of 3,398 cubic meters/sec (120,000 cfs) based on available USC&GS data (Docket No. 50-245 Unit 1 Environmental Report Appendix B, Section III-A).

The hydrographic survey conducted in February 1974 (Figure 2.4-7) was for the purpose of collecting tidal and current data. These data were then used to calibrate a two-dimensional hydrodynamic model which was used to simulate flow patterns at the Millstone site (NUSCo. 1975).

Figure 2.4-8 shows the modeling area. A grid size of 305 meters by 305 meters (1,000 feet by 1,000 feet) was selected. The solid line defines the closed boundary which was chosen to closely approximate the shoreline geometry from Black Point to Seaside Point. The dashed line defines the open boundary which extends through the open water of Long Island Sound.

Description of the model, input parameters, and model verification can be found in NUSCo.'s Summary Report (1975). The model results are shown on Figures 2.4-9 through 2.4-12. Each figure represents a synoptic picture of the tidal current speed and direction at all cells within the model. Times have been selected that represent the tidal current stages of strength of flood, high slack water, strength of ebb, and low slack water. The reference point for time is the lower right cell.

The strength of flood on Figure 2.4-9 shows a general westward circulation with maximum velocities of 0.61 meters/sec (2 fps) in the Twotree Island Channel. The high slack stage occurs approximately 0.52 hour after high tide. Figure 2.4-10 illustrates the low velocities and mixed directions characterizing this period of tide reversal. The tidal current stage of the Niantic River estuary lags in time and still shows a moderate flooding current.

The strength of ebb develops about 4.05 hours after high tide. The flow from west to east appears on Figure 2.4-11. Finally, on Figure 2.4-12, low slack water occurs and a general mixed flow pattern precedes a reversal of direction. The tidal current stage of the Niantic River still lags the outer bay and shows an ebbing flow.

The general flow patterns are similar to those observed in past field surveys. They also indicate two phenomena recently noted in the summer of 1973 survey data. First, there are no completely slack water conditions between the flood and ebb tides, a characteristic of rotary tide currents. Second, the time of lowest velocity does not always coincide with the high and low tide, as is observed in other bays along open coastlines, but a lag of from 1/2 to 1 hour usually occurs.

2.4.3.4 Water Quality

A 1-year, intensive water quality monitoring program was conducted during 1974 by The Research Corporation of New England, Inc. (TRC). These data supplement a large information base established during the routine biological monitoring conducted by Clapp Laboratories since 1968. The objectives were to establish the baseline chemical composition of Long Island Sound waters and bottom sediments adjacent to Millstone Point and to detect any changes in these chemical constituents resulting from the discharge of the Millstone Station. The locations of the water quality and benthic sampling stations are presented on Figure 2.4-13. Monthly water samples were collected at all stations on both ebb and flood tides. At sampling stations within the influence of the Millstone 1 thermal plume, samples were collected at 0.3 meter (1 foot) below the surface, mid-depth, and 0.3 meter (1 foot) above the bottom:

The sampling itinerary was coordinated so that stations within the influence of the thermal plume on flood tide (Stations 4 and 8) were sampled at the strength of flood tide. Station 3, within the influence of the thermal plume on both ebb and flood slack, was sampled at ebb and flood slack.

Average concentrations of parameters analyzed on a monthly and quarterly schedule are presented in Tables 2.4-2 and 2.4-3, respectively. Those parameters sampled quarterly were expected to show little or no seasonal fluctuation.

2.4.3.4.1 Major Seawater Constituents

The seawater constituents discussed in this section are present in ocean water in concentrations greater than approximately 140 mg/l (Martin 1970). The concentrations of these constituents are relatively constant for all ocean water. The total alkalinity and calcium concentration remained relatively constant throughout 1974. The alkalinity in Long Island Sound, approximately 230 mg/l as calcium carbonate or 5×10^{-3} M, is higher than values reported for the open ocean of 2.5×10^{-3} M (Martin 1970) or 139.7 mg/l (Sverdrup et al 1942).

The calcium concentrations of approximately 245 mg/l recorded in Long Island Sound during 1974 are lower than reported values of 400 mg/l (Sverdrup et al 1942) and 413 mg/l (Martin 1970).

The concentrations of potassium in eastern Long Island Sound ranged between 500 and 650 mg/l during the 1974 sampling program. This is higher than the values of 390 mg/l (Harvey 1955) and 380 mg/l (Sverdrup et al 1942) reported for the open ocean.

Magnesium concentrations of 1,270 mg/l (Sverdrup et al 1942), 1,294 mg/l (Martin 1970), and 1,330 mg/l (Harvey 1955) have been reported for ocean water. Seasonal fluctuations of magnesium were reported during this program. Lowest ranges were recorded during the spring runoff in March (775 to 825 mg/l). The range of June concentrations between sampling stations was 960 to 1,805 mg/l; this wide fluctuation resulted from the analytical laboratory techniques and followed no apparent pattern. September values ranged from 1,050 to 1,170 mg/l.

2.4.3.4.2 Nutrients

Nitrogen

Riley (1959) reports that nitrogen is the limiting nutrient for phytoplankton growth in Long Island Sound. He found that ammonia is a more important nitrogen source than nitrate during most of the season of active phytoplankton growth. Winter maximum concentrations of 3.0 $\mu\text{g-atoms PO}_4\text{-P/l}$ (0.09 mg/l) and 16.0 $\mu\text{g-atoms NO}_3\text{-N/l}$ (0.22 mg/l) were reported. A major phytoplankton bloom occurs in winter, culminating in March, with a second bloom in May and June in the eastern end of Long Island Sound. Harris (1959) reports ammonia concentration of 5 $\mu\text{g-atoms NH}_3\text{-N/l}$ (0.07 mg/l) after nitrate depletion in March. The winter bloom exhausts inorganic nutrients in the eastern end of the Sound slowly between December and March. The eastern end of the Sound had a small but noticeable nitrate increase in April.

Nutrient determinations made over an annual cycle in the Niantic River Shoals by Marshall (1967) show a seasonal range of phosphate from less than 0.2 to 1.5 $\mu\text{M/l}$ (0.018 to 0.142 mg/l) and a seasonal range of nitrate from 0.2 to 5.5 $\mu\text{M/l}$ (0.012 to 0.247 mg/l). Marshall (1967) reported an early spring bloom in the estuary and a summer maximum in Niantic Bay.

The data reported during the 1974 sampling program suggest that nitrate concentrations have either reached the midwinter maximum or are in the depletion stage of the midwinter phytoplankton bloom on the sampling date in January (Table 2.4-2). The magnitude of nitrate concentrations at that time (approximately 0.7 mg/l = 11.4 $\mu\text{g-atoms NO}_3\text{-N/l}$) is less than the average recorded mid-winter maximum of 15-20 $\mu\text{g-atoms N/l}$ (Riley 1959), but within a 1954 maximum of approximately 9 $\mu\text{g-atoms NO}_3\text{-N/l}$ (Harris 1959). Nitrate is not depleted rapidly but decreases gradually over at least 4 weeks to

levels below 0.1 mg/l (1.6 μ -atoms NO₃-N/l) in late March to mid-April.

Nitrate concentration remains in a depleted condition until May when concentrations at all stations increase markedly. These phenomena, caused by increased freshwater input from the Connecticut River, have been reported to occur in April (Riley 1959).

Nitrate is rapidly depleted (<4 weeks) to very low levels from mid-May to mid-June, suggesting a spring phytoplankton bloom in nearshore areas in eastern Long Island Sound. This bloom in the eastern Sound has been reported by Riley (1959). The low nitrate concentrations recorded during June continued through the November sampling period. No gradual fall increase in nitrate was detected. However, concentrations did begin to increase from the November to December period.

Ammonia nitrogen concentrations are low during the winter bloom period, in the range of 0 to 0.04 mg/l (0 to 2.3 μ g atoms/l). In May, almost all stations recorded less than 0.01 mg/l (0.6 μ g atoms/l). Ammonia concentrations increased during June when nitrate concentration is depleted. Lowest salinities were recorded in May; hence, the ammonia maximum does not appear to be the result of freshwater drainage. Jordan Cove and the Niantic River on the ebb tide contained twice the concentration of ammonia recorded at any other stations during this June period.

The June increase is probably due to zooplankton excretion of ammonia and bacterial decomposition of phytoplankton on the ocean bottom. Concentrations remained elevated through July. Ammonia concentrations decreased to nondetectable limits in August at all stations except the Niantic River mouth, where ammonia concentrations are high (0.18 to 0.3 mg/l) on both tidal cycles. Summer bloom may account for this ammonia depletion in August. The high concentration of ammonia in the Niantic River suggests that active bacterial decomposition processes may be occurring in the Niantic estuary during these periods.

Ammonia concentrations from September through December fluctuate randomly. Many station concentrations are below the limits where nutrients are considered exhausted, yet other stations achieve concentrations as high as those recorded during the June to July maximum. Sampling stations in the vicinity of the generating station appear to be slightly ammonia-rich during these September to December months. Some depletion of the NH₃ occurs during this period, but not to the low levels recorded in February, May, and August.

A nitrite-nitrogen maximum of 7 μ g/l in October has been previously reported (Harris 1959). This period is the only one during the year when nitrification (the complete oxidation of ammonia to nitrite, then nitrate) occurs in the Sound. Concentrations around Millstone Point in September are in the 7 μ g/l range; however, peak concentrations of 40 to 80 μ g/l were recorded in October. A

relatively high September ammonia concentration of 0.1 mg/l may account for the higher October nitrite concentrations.

Little fluctuation in the concentrations of organic nitrogen is apparent. Typical concentrations throughout the year are in the range of 0.2 to 0.3 mg/l (14 to 21 μg atoms N/l) during prewinter bloom and winter bloom periods and 0.3 to 0.4 mg/l (21 to 28 μg atoms N/l) from May to September. Since the majority of these samples were taken at surface or mid-depth, this data can be compared to the previous data of Harris (1959) who reported a total of 9 μg atoms N/l in the winter, 16 μg atoms/l after the early spring bloom, and 6 μg atoms/l in May.

Phosphorus

Hardy (1971) reports that minimum phosphate values in Long Island Sound were recorded in the eastern end, where values of 0.4 M/l were detected in April. Generally, phosphate is higher in Long Island Sound at the surface due to high-phosphorus-containing sewage effluents being discharged by the Connecticut River and the Thames River. However, no vertical distribution of phosphate was apparent in eastern Long Island Sound. In August, Hardy (1970) detected 0.6 μM $\text{PO}_4\text{-P/l}$. Phosphate in surface drainage to Long Island Sound was generally less than or equal to phosphate levels in the Sound. Maximum phosphate concentrations occurred soon after summer stratification breakdown in the fall. An EPA cruise (1971) reported 0.03 mg/l $\text{PO}_4\text{-P/l}$ at The Race in September 1969, and a range of 0.03 to 0.06 mg/l total $\text{PO}_4\text{-P}$ in July 1970, between Goshen Point and Giants Neck. Niantic Bay contained 0.03 mg/l; Jordan Cove contained 0.04 mg/l.

Both total and orthophosphate concentrations are low in January, building up to the winter maximum in late February. The maximum phosphate concentration of 0.2 mg/l (2 μg -atoms P/l) is higher than the maximum reported by Riley (1959) during pre-phytoplankton bloom conditions. Previous studies (Riley 1959) report that phosphate decreased gradually to a minimum value in April. During 1974, phosphate decreased within 4 weeks to nondetectable levels in March at all stations. Phosphate concentrations built up to 0.1 mg/l at all stations by June. The May to June nitrate depletion has no effect on the phosphate concentration. Phosphate depletion in July occurs at some stations, but levels of 0.1 mg/l are generally maintained throughout the remainder of the sampling year.

Organic Carbon, Oil and Grease, BOD

An EPA cruise (1971) recorded 2 mg/l of Total Organic Carbon (TOC) and 0.6 mg/l of Biochemical Oxygen Demand (BOD) in September - October 1969 at the Race. In July 1970, they recorded TOC values in the range of 1 to 3 mg/l from Goshen Point to Giant's Neck. No BOD was detectable. BOD concentrations recorded during this study are in the range of 0 to 2 mg/l with concentrations in excess of 3.0 mg/l occurring during June and November. The amount of biodegradable organic material in the water appears to be constant and not a

function of the soluble organic carbon or oil and grease concentrations. Soluble organic carbon values generally range from 0 to 10 mg/l; however, values of 20 to 30 mg/l were common at isolated stations and values as high as 50 to 100 mg/l were reported. No fluctuation in BOD with increased organic carbon concentrations is apparent, indicating that the major portion of the organic material in samples having high concentrations of organic carbon is non-biodegradable. Oil and grease concentrations in the water column show a markedly higher concentration during the months of January to April (3 to 30 mg/l) than during the months of July-October (0.86 to 12.02 mg/l). This summer increase may be due to an increase in biological activity which follows increased water temperatures. This increased biological activity may hasten the breakdown of oil and grease. It is interesting to note that no stratification of oil and grease is apparent in the water column. Oil and grease is probably adsorbed on the surfaces of suspended particles. The low concentrations of oil and grease continue into November, when biological activity should decrease due to decreased temperature. No correlation is apparent between oil and grease and TOC concentrations, due to the apparent absorption of oil and grease onto suspended particles. Organic carbon associated with suspended particles was not measured.

2.4.3.4.3 Trace Metals

An ongoing monitoring program was established by NUSCo. to determine potential impacts of the Millstone Nuclear Power Station on trace metal concentrations in Long Island Sound. The parameters selected for study include: copper, zinc, iron, chromium, and lead. The results of this program through the 1980 (NUSCo. 1981) sampling period are presented in this section. Samples were collected from four locations in the vicinity of the station: Millstone 1 intake; Quarry cut (station discharge); Giants Neck; and Twotree Island. Mean trace metal concentrations at these locations from 1973-1980 are presented in Table 2.4-5. Monthly average trace metal concentrations measured during the 1974 baseline study are presented in Table 2.4-4.

Copper

Mean total copper concentrations at the four sampling locations generally decreased from 1973 through 1980, with the lowest mean concentrations at all stations recorded during the 1980 period. Mean concentrations ranged from 1.7 ppb (Twotree Island, 1980) to 18 ppb (Quarry Cut, 1973). The average concentration of total copper for all stations from 1973-1980 was 6.1 ppb, with averages ranging from 2.2 ppb in 1980 to 11 ppb in 1973 (all stations averaged).

In the 1974 baseline study, soluble copper determinations were conducted from July through December. The detected concentrations never exceeded 5 ppb. Concentrations detected at the station discharge (Quarry Cut) exceeded those recorded at other stations only in November on ebb tide. The concentration of soluble copper at the discharge at that time was 3 ppb.

Zinc

The mean concentrations of total zinc ranged from 2.4 ppb (Quarry Cut, 1980) to 22 ppb (Twotree Island, 1973). The lowest mean concentrations for all stations were recorded in 1980. The average concentration of total zinc for the 1973-1980 period was 10.2 ppb. The annual average concentrations ranged from 3.0 ppb in 1980 to 16.1 ppb in 1976.

The monthly average total zinc concentration on ebb and flood tide during the 1974 baseline study is presented in Table 2.4-4. Total zinc concentrations have seasonal fluctuations, with average concentrations ranging from 3 to 12 ppb between January and April. During the May runoff period, average concentrations reached 35 to 45 ppb. After a decline to 6 to 7 ppb in June, total zinc concentrations increased to 25 to 26 ppb in July. Concentrations decreased to 4 to 5 ppb in August and then gradually increased from August to December to 15 to 21 ppb.

Iron

Mean annual concentrations of total iron fluctuated randomly between 1973 and 1980, with annual mean concentrations ranging from 59 ppb (Quarry Cut, 1975) to 856 ppb (Giants Neck, 1977). Annual average concentrations (all stations) ranged from 67 ppb in 1975 to 327 ppb in 1977. The average concentration of total iron for the entire 1973-1980 period was 156 ppb.

During the 1974 baseline study, the range of average total iron concentrations between January and May was 100 to 200 ppb, and between June and December the range decreased to less than 100 ppb. An exception to the low range of concentrations recorded from June through December was recorded in September when many stations recorded between 100 and 200 ppb total iron, and concentrations greater than 200 ppb were recorded at five locations.

Chromium

Mean annual concentrations of total chromium reported during the 1973-1980 study period never exceeded 2 ppb for all stations monitored. Clapp Laboratories (NUSCo, 1973) reported no total chromium concentrations in eastern Long Island Sound which were greater than 5 ppb on six sampling dates between February 1973 and February 1974. Soluble chromium concentrations reported by Clapp Laboratories never exceeded 1 ppb. During the 1974 baseline study, soluble chromium concentrations were measured from July through December and never exceeded 1 ppb at all stations in all samples.

Lead

Mean annual concentrations of total lead ranged from less than 1 ppb (Millstone Intake, 1980) to 8.4 ppb (Twotree Island, 1976) during the 1973-1980 period. The lowest mean concentrations for all stations

were reported in 1980. Average annual concentrations ranged from less than 1.2 ppb in 1980 to 5.3 ppb in 1976.

Clapp Laboratories (NUSCo. 1973) reported total lead concentrations in excess of 5 ppb in 5 of 24 samples collected between February 1973 and February 1974. The maximum total lead concentration detected was 15 ppb, of which 14 ppb were insoluble lead. During the 1974 baseline study, soluble lead concentrations were less than 2 ppb at all stations between June and December.

Aluminum

The concentration of total aluminum recorded during 1974 ranged from less than 0.2 mg/l to 3.7 mg/l. Maximum average aluminum concentrations occur during July when concentrations on ebb and flood tide are 3.7 and 2.3 mg/l, respectively. Minimum aluminum concentrations of less than 0.2 mg/l were reported in October, which is the high salinity period when there is minimum dilution of high salinity water entering eastern Long Island Sound through The Race from Block Island Sound. Runoff may be a major source of aluminum input into eastern Long Island Sound.

Manganese

The total manganese concentrations measured during the 1974 study have seasonal fluctuations. The maximum average concentrations (37 to 45 $\mu\text{g/l}$) are recorded during the spring runoff period of March and April. Since the manganese concentrations include metal associated with suspended matter, the spring runoff period probably contributes manganese to eastern Long Island Sound. Manganese concentrations generally decrease from June to December with December concentrations below 5 $\mu\text{g/l}$.

Nickel

The concentrations represent total nickel. Monthly average total nickel concentrations on ebb and flood tide are presented in Table 2.4-4. The range of average concentrations of nickel was between 75 and 170 $\mu\text{g/l}$ between January and July, except for a March maximum of approximately 240 $\mu\text{g/l}$. The March yearly maximum occurs when runoff conditions may contribute particulate nickel to the water column. A decrease in the magnitude of nickel concentration occurred in August when concentrations averaged approximately 21 $\mu\text{g/l}$. A September increase to approximately 45 $\mu\text{g/l}$ is followed by a decrease to less than 5 $\mu\text{g/l}$ in December.

Arsenic

A range of arsenic concentrations in sea water of 9 to 22 $\mu\text{g/l}$ has been reported by Rakestraw and Lutz (1933). Other seawater values reported include 2 $\mu\text{g/l}$ in the ocean (Preston 1972), 1.12 to 1.71 $\mu\text{g/l}$ in Japan (Chemical Abstracts 1977), and 5.6 $\mu\text{g/l}$ in the Atlantic Ocean (Chemical Abstracts 1977).

No arsenic was detected during the 1974 sampling program. However, the detection limit of the analytical methods used to measure arsenic was above the concentrations reported by previous investigators.

Molybdenum

The detection limit of the analytical methods used to measure molybdenum during the 1974 baseline study was 15 $\mu\text{g/l}$. The range of molybdenum concentrations recorded is from 150 to 600 $\mu\text{g/l}$ in March and 38 to 56 $\mu\text{g/l}$ in September. Recorded June concentrations are as high as 1 mg/l . No molybdenum was detected in December. A major portion of the molybdenum present in the water column appears to be associated with suspended matter. In June, higher concentrations of molybdenum were detected at the station discharge than at other locations in the area.

Titanium

Concentrations of 0.0 to 17.88 $\mu\text{g/l}$ of titanium in the northeast Atlantic Ocean in sea water suspended matter (Blazhis 1971), and 1 $\mu\text{g/l}$ in the open ocean (Preston et al 1972) have been reported. The detection limit for titanium during the 1974 sampling program was 150 $\mu\text{g/l}$ which is above the concentrations reported by previous authors. No titanium was detected in the water column except in December, when four stations recorded a range of 150 to 320 $\mu\text{g/l}$. Titanium was not detected at the discharge of Millstone Power Station.

Cadmium

Dehlinger et al (1973) reports cadmium concentrations in eastern Long Island Sound of 0.1 $\mu\text{g/l}$. He reports that these concentrations agree with those obtained for nearshore waters by other investigators and that large concentrations of cadmium are not associated with the acid leachable material or strong chelating substances. In eastern Long Island Sound, spring of 1972, he reported a range of cadmium concentrations of 0.16 to 2.7 $\mu\text{g/l}$.

During the 1974 study, soluble cadmium determinations were conducted in September and December, and detectable concentrations ($>1 \mu\text{g/l}$) were reported in only 9 of 44 samples. The station discharge never contained more than 1 $\mu\text{g/l}$.

Beryllium

Beryllium concentrations of 0.36 and 0.03 $\mu\text{g/l}$ in the Sea of Japan (Chemical Abstracts 1951a) and 0.005 $\mu\text{g/l}$ in the open ocean (Preston et al 1972) have been reported. No beryllium was detected during the 1974 sampling program. The detection limit of the analytical method used was 50 $\mu\text{g/l}$.

Mercury

Concentrations of 0.013 to 0.018 $\mu\text{g/l}$ of mercury in the northeast Atlantic Ocean (Chemical Abstracts 1951b) and 0.4 to 2 $\mu\text{g/l}$ in the Atlantic Ocean (Chemical Abstracts 1959) have been reported. Dehlinger et al (1973) reports 0.045 to 0.078 $\mu\text{g/l}$ in eastern Long Island Sound in October of 1972. No mercury was detected during the 1974 sampling program. The detection limit for the mercury analysis was 2 $\mu\text{g/l}$.

Tin

Smith (1971) reports 2.25 $\mu\text{g/l}$ tin in the open ocean. Difficulties in tin analysis resulted in unreliable March determinations during the 1974 study. From June to December, tin was detected in only one sample. The detection limit for tin was 200 $\mu\text{g/l}$.

Phenol

Alekserva (1972) reports 0.02 to 0.08 mg/l in the open ocean. Phenol was detectable at only four sampling stations throughout 1974. Concentrations do not exceed 9 $\mu\text{g/l}$. No phenol was detected at the station discharge during the 1974 study period.

2.4.3.4.4. Physical Parameters and Dissolved Gases

Salinity

Clapp Laboratories (NUSCo. 1973) has collected salinity data around Millstone Point. Seasonal maxima occur from September to November, peaking at greater than 31 ppt. Seasonal minima usually occur between March and May, generally at 27 to 28 ppt. Jordan Cove salinities are consistently lower than levels recorded in the rest of the Millstone Point area in the May-July period. Values in the range of 25 to 26 ppt were recorded at these times. Average salinities in the area were in the range of 28 to 30 ppt.

Lowest salinities (26 to 28 ppt) recorded by TRC during the 1974 baseline study were recorded in the March-May spring runoff period on both tidal conditions. Jordan Cove and Niantic River salinities are lower than at other stations around Millstone Point during the March-May period, because these water bodies are sources of freshwater input to Niantic Bay.

Salinities gradually increased after May, peaking at 31 to 32 ppt in late September, and decreasing thereafter to a concentration in December similar to that recorded the previous January. The average salinity was in the range of 28 to 30 ppt.

Salinities reported in 1980 as part of the ongoing monitoring program ranged from 24.9 ppt (Giants Neck) in May to 33.0 ppt (Twotree Island) in September. The lowest salinities for all four sampling locations were recorded in May (27.6 ppt average of all stations).

The highest salinities at each station were recorded in September (32.7 ppt average of all stations).

Dissolved Oxygen

Monthly fluctuation of oxygen saturation was recorded during the 1974 study on both high and low tidal stages. Maximum saturation was recorded at ambient stations outside of the influence of the thermal discharge during January (approximately 120-percent saturation), June through July (110 percent saturation), and November (105 to 110 percent saturation). Minimum saturation was recorded during October (75 to 84 percent saturation). The lowest concentrations recorded were between 5.7 and 6.0 mg/l on flood tide at the quarry cut and in the Niantic River.

pH

Portions of the pH data collected during the early months of 1974 were not considered valid due to malfunction of the pH monitoring instrumentation. Accordingly, only scanty pH data are available from the January to May period. Complete data were collected between June and December.

The pH range recorded during the majority of the 1974 sampling year was between 7.5 and 7.7. Values greater than a pH of 8 were reported during March, October through November, and July on the flood tide. The pH range of 7.5 to 7.7 is low compared to values of 8.1 to 8.3, reported for the open ocean at the surface (Sverdrup 1942). The range 7.5 to 7.7, however, has been reported by previous researches in the Millstone area (NUSCo. 1973) during most of the year. The generally lower pH range may be due to the dilution effect of the freshwater input to eastern Long Island Sound.

Values of pH reported in 1980 as part of the ongoing monitoring program ranged from 7.2 (Quarry Cut, July) to 8.0 at Twotree Island, Millstone 1 Intake, and the Quarry Cut in May. A pH value of 8.0 was also recorded at the Giants Neck sampling station in December.

Suspended Solids

Suspended solids concentrations reported during the 1974 baseline study are similar throughout the year. Twenty to 35 mg/l is the typical concentration range for suspended solids for most stations. Station 3 (see Figure 2.4-4) consistently records higher suspended solids concentrations than other stations throughout the year, especially at 0.3 meter (1 foot) above the bottom. At other stations where samples were taken at different depths, little stratification of suspended solids concentration was noted. Station 4, however, displayed consistently lower suspended solids concentrations.

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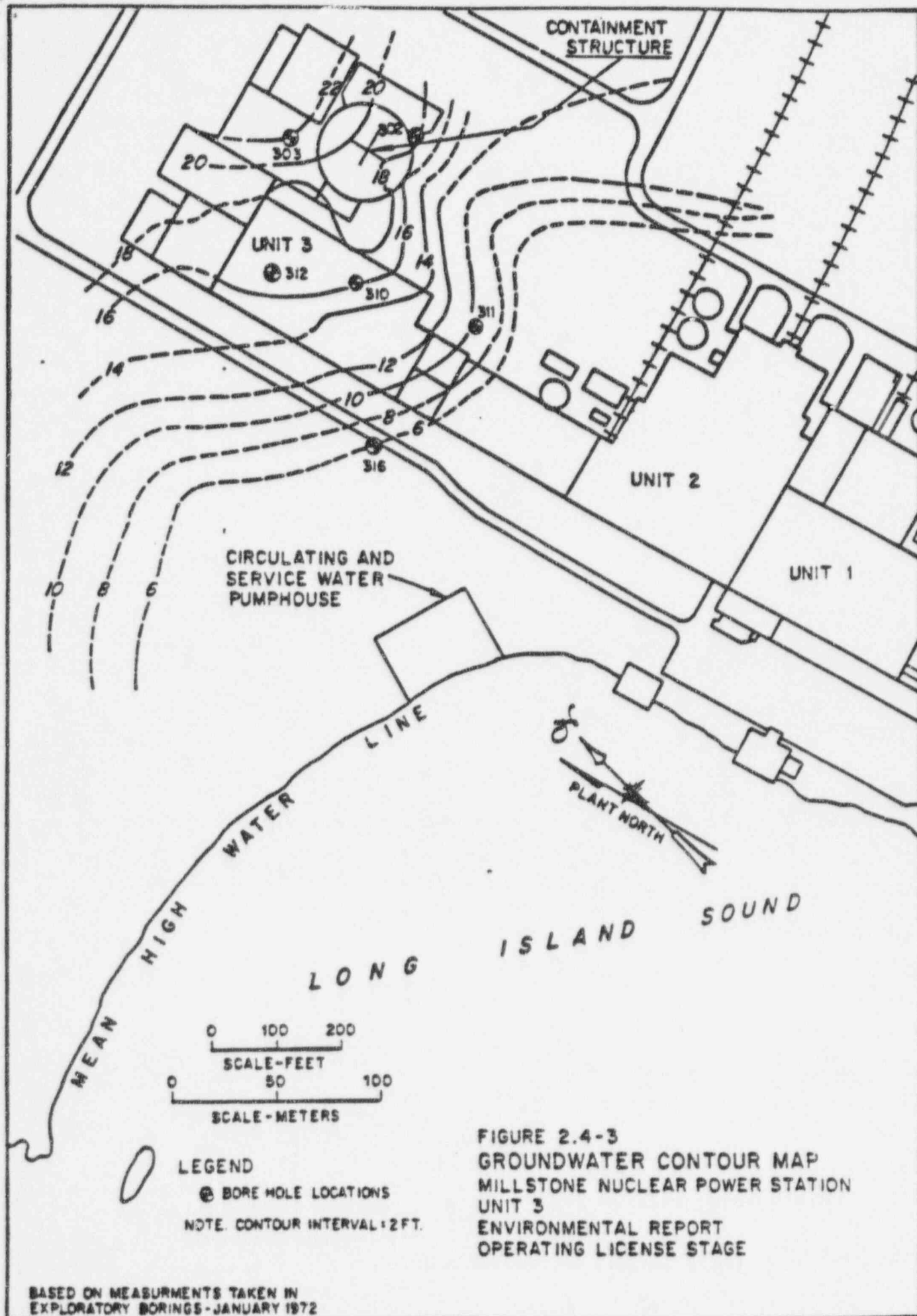
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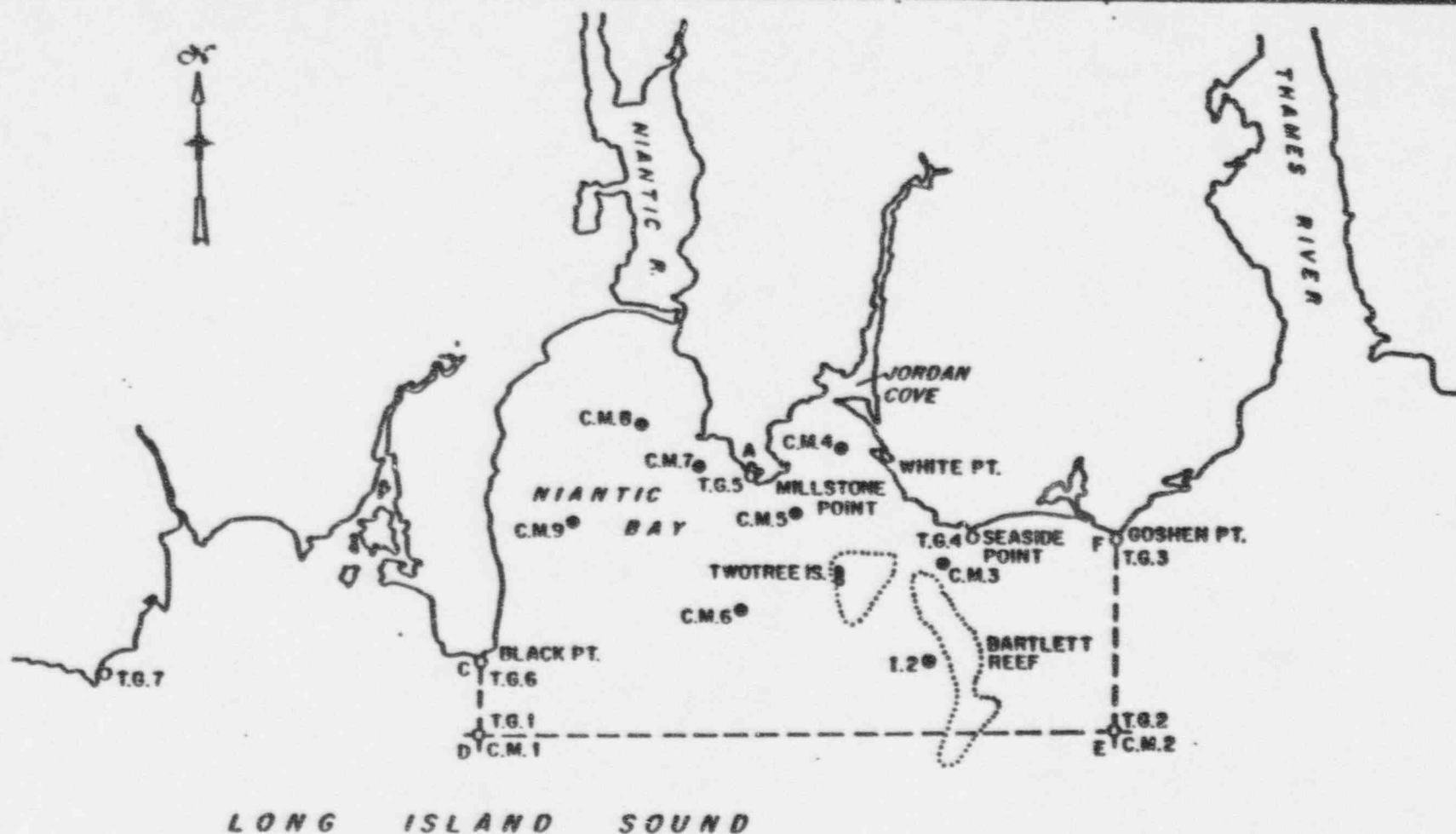
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LEGEND

- CURRENT METER
- TIDE RECORDER
- ✕ CURRENT METER AND TIDE RECORDER

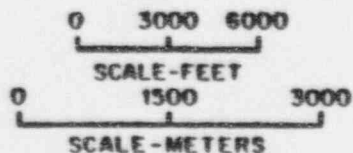


FIGURE 2.4-7
APPROXIMATE LOCATION OF
FIELD SURVEY STATIONS
FEBRUARY 1974
MILLSTONE NUCLEAR POWER STATION
UNIT 3
ENVIRONMENTAL REPORT
OPERATING LICENSE STAGE

MDPS-3 EROLS

TABLE 2.4-3

BASELINE WATER QUALITY DATA - LONG ISLAND SOUND**
QUARTERLY SAMPLING

<u>Parameter*</u>	<u>March</u>	<u>June</u>	<u>September</u>	<u>December</u>
Total alkalinity	230	237	236	257
Chloride	17,182	17,045	17,955	18,352
Potassium	577	588	496	636
Calcium	263	259	234	232
Magnesium	781	1,441	1,120	852
Arsenic	ND	ND	ND	ND
Molybdenum	0.33	<0.3***	0.045	ND
Titanium	ND	ND	ND	<0.19***
Vanadium	0.16	<0.16***	0.016	ND
Cadmium	0.03	0.05	<.013***	ND
Beryllium	ND	ND	ND	ND
Mercury	ND	ND	ND	ND
Total solids	33,203	35,418	33,742	33,510
Volatile solids	5,810	7,732	7,217	5,109
Tin	11.0	ND	<0.3***	ND
Phenol	ND***	ND	<0.003***	ND

NOTES:

* All concentrations are expressed in mg/l.

** Based on data collected during the 1974 water quality monitoring program

*** For those parameters where one or more reported values were below detection limits, concentrations shown are averages of values greater than these limits.

ND - Not detectable

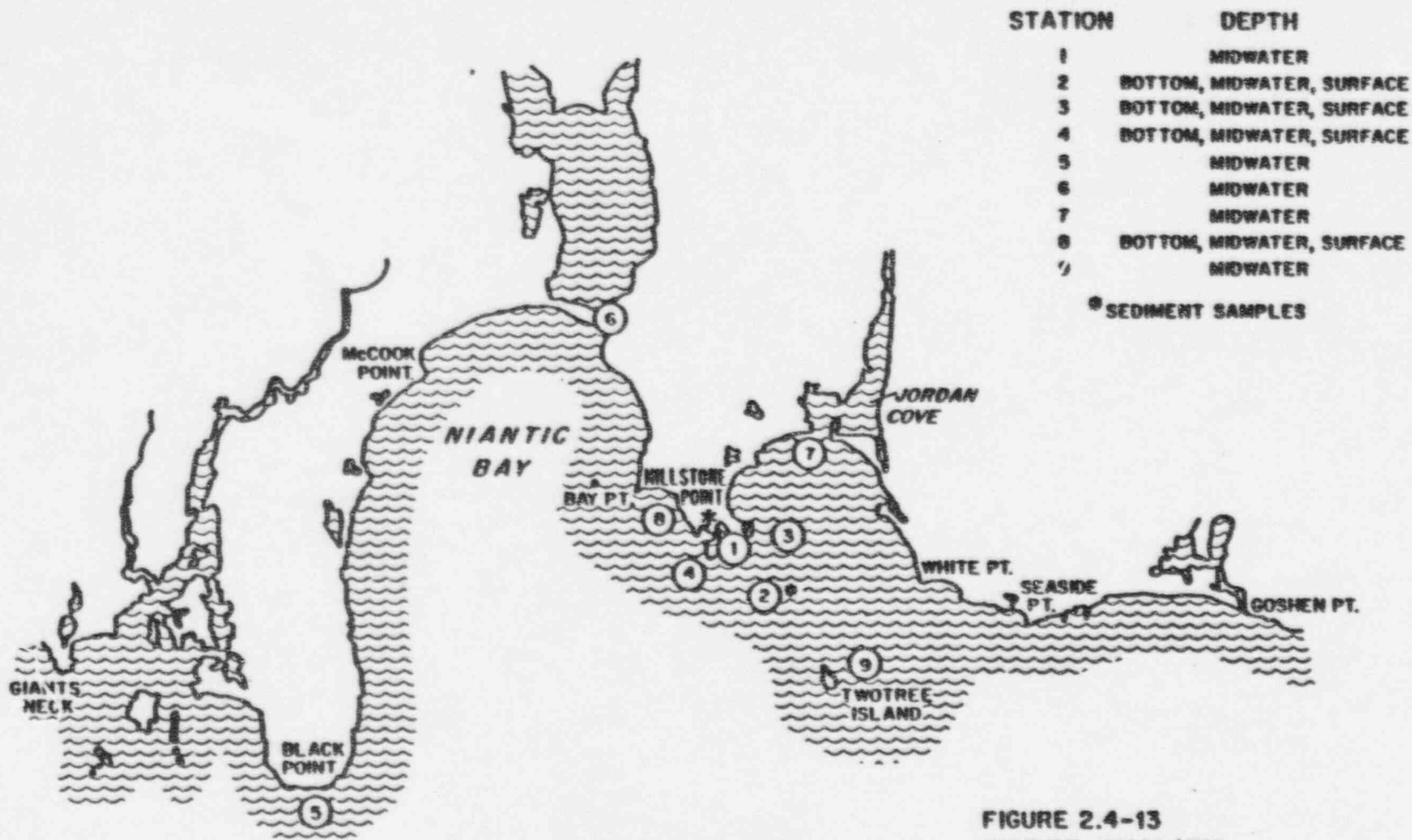


FIGURE 2.4-13
 WATER QUALITY
 SAMPLING LOCATIONS
 MILLSTONE NUCLEAR POWER STATION
 UNIT 3
 ENVIRONMENTAL REPORT—
 OPERATING LICENSE STAGE

MNPS-3 EROLS

TABLE 2.4-4

MONTHLY AVERAGE TOTAL METAL CONCENTRATION*

Month	Tide	(Unfiltered Samples) Parameter (mg/l)				
		Iron	Manganese	Nickel	Zinc	Aluminum
Jan	Ebb	0.16	0.03	0.104	0.009	1.01
	Flood	0.16	0.01	0.069	0.011	1.34
Feb	Ebb	0.08	0.017	0.083	0.003	0.6
	Flood	0.09	0.021	0.075	0.004	0.7
Mar	Ebb	0.14	0.043	0.24	0.012	1.2
	Flood	0.14	0.043	0.25	0.009	1.4
Apr	Ebb	0.13	0.037	0.11	0.011	1.2
	Flood	0.11	0.039	0.13	0.008	0.9
May	Ebb	0.14	0.03	0.16	0.045	0.64
	Flood	0.14	0.02	0.17	0.035	1.00
June	Ebb	0.08	0.026	0.12	0.007	0.28
	Flood	0.08	0.031	0.11	0.006	0.29
July	Ebb	0.09	0.03	0.09	0.026	3.7
	Flood	0.08	0.03	0.09	0.025	2.3
Aug	Ebb	0.05	0.023	0.024	0.004	0.7
	Flood	0.03	0.019	0.019	0.005	0.7
Sept	Ebb	0.14	0.022	0.042	0.005	1.6
	Flood	0.14	0.019	0.049	0.006	0.5
Oct	Ebb	0.05	0.008	0.04	0.011	<0.2
	Flood	0.05	0.012	0.01	0.012	<0.2
Nov	Ebb	0.01	0.006	0.01	0.016	<0.2
	Flood	0.01	0.006	0.02	0.017	0.28
Dec	Ebb	0.04	<0.005	<0.005	0.021	0.3
	Flood	0.03	<0.005	<0.005	0.015	0.3

NOTE:

* Based on data collected on ebb and flood tides during the 1974 water quality monitoring program

MMPS-3 EROLS

TABLE 2.4-5

MEAN ANNUAL METAL CONCENTRATIONS

Selected Site	1980 Mean	1979	1978	1977	1976	1975	1974	1973
Copper (ppb)								
Unit 1 Intake	2.8	2.4	3.6	10.5	10.3	8.7	7	7
Quarry Cut	2.8	3.1	6.0	4.6	5.6	6.7	8	18
Giants Neck	2.1	2.6	4.4	6.4	7.7	5.7	12	7
Twotree	1.7	2.0	3.1	5.3	6.5	6.7	11	12
Zinc (ppb)								
Unit 1 Intake	2.9	6.4	10.8	7.6	13.7	18	9	9
Quarry Cut	2.4	5.0	8.5	6.2	13.0	11	13	9
Giants Neck	3.6	5.0	16.6	11.1	19.8	14	11	13
Twotree	2.9	5.4	7.7	8.6	17.7	14	7	22
Iron (ppb)								
Unit 1 Intake	124	105	67	158	188	76	103	85
Quarry Cut	153	104	100	152	134	59	119	207
Giants Neck	172	165	210	856	145	61	144	357
Twotree	117	98	102	143	156	71	127	201
Chromium (ppb)								
Unit 1 Intake	<1	1.6	<2	<1	<1	1.7	<2	<2
Quarry Cut	<1	1.6	<2	<1	<1	1.7	<2	<2
Giants Neck	<1	1.6	<2	<1	<1	1.7	<2	<2
Twotree	<1	1.6	<2	<1	<1	1.7	<2	<2
Lead (ppb)								
Unit 1 Intake	<1	2.1	3.7	2.8	2.1	2	<2.4	<3
Quarry Cut	<1.3	1.9	4.4	1.9	6.1	2	<3	6
Giants Neck	<1.3	2.0	3.4	1.8	3.5	3	<3.4	3
Twotree	<1.1	1.8	1.8	<2.3	8.4	2	<3.4	<3.4

Attachment 2.

**Calgon Corporation Correspondence
Regarding LCS - 1000 Formulations**



WATER TREATMENT PRODUCTS
PAPER CHEMICALS
SURFACE TREATMENT PRODUCTS
COSMETIC INGREDIENTS
SPECIALTY BLOCKS

February 7, 1997

Mr. Jeff Peters
Chemistry Support
Northeast Nuclear Energy
Post Office Box 128
Waterford, CT 06385-0128

Subject: LCS-1000 Samples

Dear Jeff,

During the summer of 1996 Calgon developed LCS-1000 to be used in your closed cooling water system. The product contained sodium molybdate and sodium tolyltriazole as corrosion inhibitors. The product also contained a blend of sodium carbonate and sodium bicarbonate to buffer the system pH. Several months later after testing at your facility and at Calgon, it was determined that the product pH was slightly too high. At that point the product formulation was modified by eliminating the sodium carbonate from the product (originally at 0.283% concentration in the product).


In December 1996, you requested two liter bottles for toxicity testing. Two samples were made up in our "sample" lab. Unfortunately, the change in formulation had not been forwarded to this lab and the original sample formulation, with the sodium carbonate present, was sent to you. This error was totally our fault.

As you are aware, Calgon is certified to ISO 9002, and we make all attempts to assure our products and processes meet our strict quality standards. All manufacturing specifications for the "new" formulation have been put in place and I see no way this problem could occur in the manufacturing process. The sample lab has now been notified and two new samples will be sent to you right away.

I apologize again for this error. Please feel free to contact me if you need any further information regarding this situation.

Sincerely,

CALGON CORPORATION


Doug Calvey