Trends of Metals (Pb,Zn,Cd,Cr,Mn,Fe,Hg and Ni) Concentration in the New Jersey Air Environment.

By

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Thesis submited to the faculty of the Graduate School of the New Jersey Institute of Technology in partial fulfillment of the requirements for the degree of Master of Science 1990

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ABSTRACT

Title of Thesis: Trends of Metal (Co, Cd, Fe, Hg, Pb, Ni, Zn, Cu, Cr and Mn) Concentrations in Airborne Particulate in the New Jersey, Air Environment.

Shobha R. Boddu: Master of Science, 1990

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The atmospheric concentrations and relative trends of ten trace elements (Co, Cd, Fe, Hg, Pb, Ni, Zn, Cu, Cr and Mn) were studied at Elizabeth and Carteret, New Jersey from July 1987 to September 1989. The specific sites are Industrial and Residential Interface areas. The analytical procedure involved collection of the airborne particulates on a quartz microfiber filter using a high volume sampler. The samples were digested and then analyzed using the atomic absorption spectrometer. Elizabeth usually showed lower values for the metals than Carteret. Average concentrations (ng/m^3) for the respective metals over the entire project are:

Metal:	Co	Cd	Fe	Hg	Pb
Elizabeth:	9.56	1.78	495.45	0.48	29.66
Carteret:	12.78	3.32	788.64	0.58	49.18

Metal:	Ni	Zn	Cu	Cr	Mn
Elizabeth:	18.78	103.56	44.60	18.96	16.40
Carteret:	33.21	106.81	89.20	27.46	24.28

It was determined that there were significant variations (more than 25%) in average levels of the metals Cadmium, Iron, Lead, Nickel, Copper, Chromium and Manganese, between the Elizabeth and the Carteret sites. In addition there are variations of over 50% in levels of quarterly averages for Iron, Copper, Nickel at the Carteret site and Copper, Nickel and Iron at the Elizabeth site.

The results were compared with those of a previous NJIT study from 1981 and 1982 at Elizabeth and Newark, New Jersey where the levels of Lead, Iron, Cadmium, Manganese, Copper, and Nickel were quantitated. For. Pb the following illustrates the very significant decrease observed.

Comparison Site	% Pb decrease
Elizabeth 88/89 - Elizabeth 81/82	91.3
Elizabeth 88/89 - Newark 81/82	92.0
Carteret 88/89 - Elizabeth 81/82	85.5
Carteret 88/89 - Newark 81/82	86.8

These decreases in Lead concentrations are assigned to decreased use of lead in Vehicular fuels. Zinc and Cadmium also showed similar trends to that of Lead with a decrease of 15.55 in 88/89 for Elizabeth when compared with Elizabeth 81/82 and 61.3% decrease when compared with the Newark site. Manganese, Copper and Nickel showed increases in concentration for this 1988/89 study by 50.5%, 68.1% and 65.4% respectively relative to the Elizabeth 1881/82 site.

Statistical Analysis on metal concentration as a function at the 3-hour average wind direction reported by the US Meteorological Service has also been performed to determine trends in metal concentration vs wind direction.

OBJECTIVE

The objective of this study is to determine concentration and trends of trace metals in airborne particulates at Industrial/Commercial-Residential Interface Areas of Elizabeth and Carteret N.J. The present results were compared with those of previous studies to discern long term trends of these metals concentrations in New Jersey airborne particulates. Analyses have been conducted on these data sets for examinations of seasonal variations and averages . This thesis focuses on Ten metals target (Pb, Zn, Cd, Co, Cu, Mn, Ni, Hg, Fe, and Cr). Statistical Analysis on the metal concentrations as a function of the 3-hour average wind directions reported by the US Meteorological Service has also been performed to determine trends in metal concentration vs wind direction.

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CHAPTER 1

INTRODUCTION

1.1 Background

During the last two decades, there has been an increasing interest in air pollution studies. An extensive amount of work has been carried out to assess the environmental pollution by heavy metals. Studies have been made of trace elements in atmospheric aerosols at rural sites and urban areas. The concentrations of trace elements on airborne particulates serve as indicators of the sources of atmospheric materials and are used in receptor modeling to study the histories of air masses.[1] Compounds of the metals are, of course, very widespread in the environment, mainly as minerals. Many of the minerals are located in the soils; but also lakes, rivers, oceans and the air. They occur both as a result of natural processes and of man made activities. The atmosphere is recognized as an important contributor to the geochemical cycling of many trace elements.[2]

The determination of toxic element concentrations in airborne particulates will establish background and individual event levels for these species in regions throughout the state of New Jersey. The primary sources of inorganic atmospheric aerosols are wind-blown continental dust, sea spray, biological activity and anthropogenic emissions.[3] The first three activities represent natural sources of metals to the atmosphere, while the anthropogenic emission is the highest source for Cr, Co, Ni and Pb.[4] However the Lead concentrations have decreased by a factor of 50-100 in the last 10 years because of elimination of Pb from vehicular fuel. The significance of atmospheric trace elements can be based on the human activity which altered their biogeochemical cycles.[5] The behavior of trace elements in the atmosphere depend on their chemical nature and size distributions and these two characteristics are mostly dependent on the originating sources and ambient atmospheric conditions. Atmospheric trace elements are known to be present around non-ferrous metal smelters, electric power plants, incinerators and near major roads and streets.[6] Less information is available on the perturbations of the biogeochemical cycles and concentration of trace elements on a regional or global scale. According to the literature (e.g. Rahn, 1976; Wiersma and Davidson, 1986) the concentrations of trace elements in remote areas are even more scarce and usually far too low to cause any adverse effects.[7] In urban areas, Zinc and other chalcophile elements are usually associated with coal fired plants or sulfide ore smelters while Nickel is an indicator of oil combustion. [8] Although, receptor models have been applied mostly to urban scales, Husain and Samson [9] (1979) showed that trace elements including toxic ones such as Cadmium, Lead, Cobalt could be transported by air masses from the pollution source over long distance to rural regions [10]. It is well established that many high-temperature combustion and smelting operations emit particles containing toxic elements such as Nickel, Zinc, Cadmium and Lead. Many of these elements are enriched in ambient urban aerosols by as much as 100 to 1000 fold over their natural crustal abundance.[11]

Lead has been a common contaminant in the urban environment. In a monumental survey of lead in the atmosphere of three urban communities conducted by the U.S. Department of Health Education and Welfare, it was reported that downtown areas of cities had higher concentrations of lead than the outlying area of the cities sampled.[12]

Pb analyses done in 1988 [13] showed lower concentrations near houses, offices, and schools close to passing traffic in the urban areas when compared to the studies done previously (Harrison and Johnson, 1985 Rodriguez-Flores and Rodriguez-Castellon, 1982).[14] Pb is now decreasing significantly due to decreased use of leaded gasolines. Inhaled lead is an important contribution to the total human lead exposure, even though the amount of lead orally ingested is considered to be higher than that inhaled. The reason for the concern regarding inhaled lead is that the physiological absorption of lead from inspired particulate is much more efficient than that from ingested material.[15]

In the developed countries, the effect of lead on human population has been an important research subject for more than a decade. Medical research thrusts in these countries have been in the area of both clinical and subclinical effects of lead on humans [16]. Under normal conditions, more than 90% of the lead retained in the body is in the skeleton [17]. Lead poisoning results from very high levels of lead in the human body, particularly in the soft tissue and it most often affects the blood, kidneys and nervous system. Without a clearcut answer to the questions concerning the consequences of such inadvertent exposure, the public is resigned to a state of understandable anguish. Although, other heavy metals such as Zinc, Nickel, Cadmium and Chromium are widely dispersed throughout the environment and in the biosphere, their concentrations in harmful forms are rarely high enough as to give rise to the same concerns.

CHAPTER 2

PREVIOUSLY PUBLISHED RESEARCH

2.1 Source Apportionment Analysis

The behavior of trace metals in the atmosphere depends on their chemical nature and size distribution. These two characteristics are to some extent dependent on their sources and the ambient atmospheric conditions [18]. In 1985 (Wolff and Korsog) [19] conducted a study on total suspended particulate during the months of June, July and August in Detroit, Michigan because of the belief that the higest TSP values are generally observed during these months. Their studies centered on determination of major chemical constituents in inhalable particulate matter, contributions of the fine particulate species to the TSP and in trying to identify major sources of the particulate matter. The week of 15-21 July 1981 was selected for elemental analysis for the reason that the week contained one of the most severe pollution episodes during the study period in terms of low visibility and high ozone in the city of Detroit, Michigan. Moreover, just before and immediately after this 4-day episode, two clear periods in terms of visibility were observed. The area was heavily loaded with diversity of industries such as coal and oil fired boilers, foundries, incinerators, coke ovens, cement plants, iron and steel plants, motor vehicles manufacturing, processed chemical plants and oil refineries. These made source apportionment of the particulates, very difficult.

Wolff and Korsog in 1981 found out that fine particulate mass was loaded moderately with Nickel (Ni) and was most likely representative of fuel oil combustion and also showed high loading for Zn which suggests that this is from an incineration component. They estimated that Zn comprised about 2% of fine particulate mass from incinerators. The components in the coarse particle mass were heavily loaded with Pb which might represent motor vehicle emission. The estimated vehicular contribution to fine particles was 7.3%.

Metals like Pb, Fe, Mn, Zn, and Cu have been measured in low concentrations at remote sites, with higher levels recorded near industrial complexes. This is an indication of a strong anthropogenic influence on trace metals in the atmosphere. Preliminary measurements of trace metals in cloud and fog water have also been reported recently (Munger Et Al 1983; Jacob Et Al., 1985) [20]

2.2 Urban and Rural Relationship

Harrison and Williams [21] studied the concentrations of airborne metals such as Pb and Zn present in rural and urban sites in order to examine relationships statistically between metals at each site. It was seen that the mean Pb levels were more than an order of magnitude higher at the urban site than at the rural site. Also, there was an increased level of Zn at the urban site. This confirmed the major vehicular source of Pb and lesser source of Zn at the urban site.[22] It was found that Zn was present in tire tread samples at a slightly higher concentration; So higher levels of Lead and Zinc observed in high traffic density area, support the hypothesis that automobiles are a likely source of Pb and Zn. Although the atmospheric concentration of these were higher in a city area compared with the suburbs, they apparently exhibit no other significant trends. The significant high levels for urban to rural regions could result from facile transport of airborne Zn arising from an urban area. An explanation for these correlations may lie in the differences between the meteorological conditions associated with more polluted air mass.

Harrison and Williams (1982) [23] also studied seasonal trends on airborne Lead and Zinc at the rural and urban sites. Their results showed a high variability for all the metals at both sites. It showed that the mean levels of Pb and Zn were higher during the "winter" months (October-March) than during the "Summer" (April-September). At the rural area this effect was more marked for Zn than for Pb. They identified two sets of factors which may have produced these seasonal fluctuations. Firstly, they said that the atmospheric emission rates of the metals may be greater in winter, due to increased burning of fossil fuels. They also noted, however, that this should be relatively unimportant for airborne Pb, where the predominant motor-vehicle source should be virtually constant throughout the year. Secondly, they suggested seasonal meteorological variation may have been important; temperature inversion layers within the atmosphere are more persistent in winter than in summer. This, they said should restrict vertical mixing of the atmosphere during the winter and thereby produce higher concentrations of airborne metals near ground level.

Another study (Mclnnes 1978) [24] indicated that an increase of airborne concentration during winter is especially characteristic of "industrial" pollutant metals such as Cadmium, Lead, Cobalt, Copper, Manganese, Iron, Nickel, and Zinc.

2.4 Potential Health Effect at Published Levels

Health scientists have paid more attention to assessment of health risks from exposures to outdoor: time variations in concentrations of pollutants and number of persons affected. Digestive and respiratory tracts have been identified as major routes by which lead enters the body. Stephen Hall [25] (1972) found out that under normal conditions, more than 90% of the lead retained in the body is in the skeleton. With the passage of time absorbed lead becomes progressively more deeply buried in the bone matrix. This develops a potentially dangerous pool of exchangeable lead which can persist for months or even years. The effect of an excessive amount of lead in the blood is anemia and in severe case it may lead to kidney failure. The Lead effect on the central nervous system results in convulsions or swelling of the brain. Repeated bouts of lead poisoning can also cause permanent brain damage.

Chronic lead poisoning results from a slow build up of lead over a period of years or as after effects by slow build up of acute poisoning. This lead poisoning, which is often without symptoms, is difficult to diagnose and may only be recognized after irreversible damage has been done. Acute lead poisoning has easily recognizable symptoms, and if treated in time, permanent damage can be avoided.

The minimum blood concentration of lead below which it is most unlikely that poisoning will occur is 80 μg of lead per 100ml of blood for adults. In children the threshold is much lower. Nickel and Zinc are of similar toxicity to Lead, but with the exception of isolated instances have been increasingly unrecognized.

Metals like Mercury Lead Cadmium and Lithium have shown to pose a risk to the developing embryo. Mercury is the metal for which the greatest documentation of teratology has been recorded. Extensive studies in Sweden by Nordstrom have reported adverse reproductive effects in women living close to or working in a smelter discharging arsenic and lead. An increased spontaneous abortion rate occured in women living close to the smelter. Lead was implicated in the abnormal development of sperm resulting in impaired morphology, motility and an increased incidence of chromosomal aberrations.[25]

CHAPTER 3

EXPERIMENTAL METHOD

Airborne particulates were collected at Elizabeth and Carteret by NJIT for New Jersey Department of Environmental Protection. Airborne particulate samples are collected by using high volume samplers for 24 hours (midnight to midnight) in Industry/Commercial- Residential Interface Areas at the respective sites.

The sample filter is 8 by 10 inches in size and is composed of quartz microfibre filter Whatman # QM-A (Typical air flow of high volume pump is 40-45 cfm (1.13 to 1.27 m^3/min), particle size cut off 0.3 micron and particles above 35 μM diameter do not enter the covered sampler.

3.1 SAMPLING:

3.1.1) Principle of the Method

Atmospheric suspended particulate matter is collected on a filter with a high volume air sampler. Particulate matter is collected by drawing air at a flow rate of approximately 1.2 - 1.7 m^3/min through the filter on which the airborne particulate is collected. This method provides a sample for the analysis of Trace metals and other pollutants in/on the airborne particulate.

a) Air is drawn into a covered housing and through a filter by means of a high-flow blower-motor assembly at a flow rate that allows suspended particles having diameters of less then 0.3m to pass to the filter surface.

b) The mass concentration of suspended particulate in the ambient air($\mu g/M^3$) is computed by measuring the mass of collected particulate and the volume of air sampled.

c) This method is applicable to measurement of the mass concentration of suspended particulate in ambient air. This method does not control the flow of air during samping and for this reason is applicable mostly to trend measurements. The size of the sample collected is usually adequate for other analyses in addition e.g.

i) Total organic Materials
ii) Nitrates
iii) Sulfates
iv) Chlorides
v) Ammonium
vi) Fluoride

3.2 SAMPLER

Airborne particulate at Elizabeth and Carteret was collected by a High-Volume Sampler. Each Sampler consisted of a General Metal Works (GMW) 2000 or similar Hi-Vol Assembly.

The samplers consist of three units: (a) the face plate and gasket, (b) the filter adapter assembly, (c) the motor unit and the housing which limits particlates to size less than 35µm. The sampler must be capable of passing environmental air through an appproximate 400cm^2 area of a clean 20.3 x 25.4 m (8" x10") glass-filter at a rate of at least 1.13 M^3/min (40 ft^3/min). The motor must be capable of continuous operation for 24 hrs periods with input voltages ranging from 110-120 volts, 50-60 cycles alternating current and must have third-wire safety ground.

It is important that the sampler be properly installed on a suitable shelter. The shelter is subjected to extremes of environmental conditions such as high and low temperatures, humidity and all types of air pollutants. For these reasons the materials of the shelter must be chosen carefully. The sampler at Elizabeth and Carteret were protected by heavy guage aluminum which was umbrella-type. This system helps in elimination of non-uniformities in sample collection with wind direction. The sampler was mounted with the inlet 7 feet above the ground in the shelter so that the filter is parallel with the ground surface. The sampler at Carteret was fixed on the roof of the police station, which was 21 feet above the ground level.

3.3 Sample Collection

To collect airborne particulates we used Whatman filter paper (20cm x25cm) at a flow rate of about 1.1 M^3/min. The filters are dried for three days in a dessicator and weighed to the nearest milligram, tare weight and filter identification number was recorded before the filter was used to collect airborne particulates. We were very careful not to bend or fold the filter before the collection of the sample. The shelter hood of the sampler is opened and the wing nuts were slackened to remove the face plate assembly from the filter holder. The numbered and pre-weighed glass-fiber filter was mounted in the filter housing in position (rough side up) and the face plate was replaced without disturbing the filter and fastened securely, as undertightening would allow air leakage. It was turned on from midnight 12:00 to midnight 12:00 by an automated timer. After the completion of the run, filters were unloaded into a polythene envelope for storage. Slight changes in volume flow of air from the begining to the end of sample collection were at times observed. The mean flow was calculated by averaging the initial and final flow.

$$\text{Air volume} = \frac{Qs + Qe}{2}\, t,$$

Where Qs is the flow rate at the start of collection (m^3/min), Qe the flow rate at the end of collection (m^3/min), and t = the collection time(mim).

The filter paper was folded parallel to the shorter sides (approximately 20 cm in length) with the particulate collecting surface enclosed. The filter was then dried in a dessicator for 4 days and weighed. The weight is then recorded.

A total of 72 particulate samples were collected at Elizabeth and 124 at Carteret through from 1987 to September 1989 .

3.4 Analytical Procedures

The analysis of the airborne particulate sample was performed by dissolving and (digesting) the particulates from the filter paper in an acid solution as discussed below, quantitatively transferring the solution into a volumetric flask, and diluting it to exactly 50 ml volume. The analysis was then performed by atomic absorption spectroscopy within 24 hours.

3.4.1 Extraction

Prior to analysis of the airborne particulate filters for the metals (Pb, Cd, Cu, Zn, Fe, Mn, Cr, Hg, Co, Ni.) a group of the filter samples, 6 - 20 were digested (metals extracted into solution) by heating the particulates on the filter paper submersed in an acid solution.

The extraction process involved, cutting up the glass fiber filter to 2 x 2 cm squares and adding 20 ml of acid solution to the squares in a 250 ml Erlenmeyer flask. The acid solution is a mixture of 50% Nitric acid, 10% Hydrochloric acid and 40% high purity water and 3ml of 30% Hydrogen Peroxide was added separately. The solution/filter was boiled for 30 minutes in acid solution and decanted into a volumetric flask (50 ml). This process was repeated. Then the solution was diluted to 50 ml volume.

A blank filter of identical material was taken through the entire procedure. This allowed background metal impurities which could originate from the filter, acids and glassware to be subtracted from the metal concentration analysis. Blank values of the filter itself, paper and the reagent used were always small.

Commercial standards for each metal were purchased (Baxter Scientific Inc. Edison N.J.) either in 1000ppm concentration or in high purity solid form. Accurately weighed solids were dissoved in acid solution to a known concentration. The standards were diluted with distilled water using calibrated pipets and volumetric flasks. Typical standard levels were between 0.1 and 10 mg/ml. A least squares fit at the absorbance vs. concentration data was calculated using the standards data and the point(0.0). The slope from this least squares calculation was then used to determine the concentration(μg/ml) from the sample absorbance readings.

3.5 Atomic Absorption Analysis

3.5.1 Introduction

Since determination of metallic elements in a sample matrix is a complex process, a sensitive and selective method of analysis was desirable. The steadily growing list of atomic absorption analytical apllications now covers some 65 elements. The major breakthrough in the development of the use of measurement of atomic absorbance as an analytical technique came in the 1950's when Sir Alan Walsh realized that it was possible to use a line source which emitted very narrow lines at the same wave length in place of a continuum source.

3.5.2 Operating Principles

As the instrument is turned on and the necessary lamp currents, wavelength, slit widths and PMT voltages are set to the required levels, a light source (hollow cathode lamp) emits the spectrum of the metal selected for analysis. A specific line of the target metal spectrum is capable of being absorbed by atoms of the same metal if they are present in the sample. The liquid sample is converted to a fine aerosol by a nebulizer and the aerosol is then reduced to the constituent atoms in a flame. The flame lies in the light path between the lamp and the line detector (monochromator and photomultiplier tube). If any of the metal is present in the sample, absorption of the characteristic line will provide an accurate measure of the concentration of the metal. The analytical precision is typically around 1% relative.

3.5.3 Principle of the method

a) In atomic absorption, the element of interest in the sample is not present in an excited state. Rather, it is in an elemental form dissociated from its chemical bonds and placed into an unexcited, un-ionized "ground" state. This dissociation is most commonly achieved by burning the sample in a flame. The element is then capable of absorbing radiation at discrete lines of narrow bandwidth.

b) A hollow cathode lamp usually provides the narrow emission lines which are to be absorbed by the same element. The lamp contains a cathode made of the same element being determined and is filled with an inert atmosphere at low pressure. Such a lamp emits the spectrum of the desired target element.

The atomic absorption spectrophotometer was tuned each day before the analysis was carried out. The tuning process involves burner alignment, optimization of lamp alignment and wavelength. A Varian atomic absorption spectrophotometer, model 12 was used.

A calibration absorbance curve for each metal was prepared from standard metal solutions each time analysis was carried out. When samples were run, the standards were checked at the beginning and end of each metal analysis. In an analysis of a group of samples for a metal, all the spectrophotometric conditions, wavelength, alignment, lamp current, zero reading were first optimized. The standards were then run and a graph of absorbance versus concentration plotted to verify the linear relationship. The zero reading was checked for instrumental drift. Figure 1 shows a typical absorption curve for the lead standard. The spectrophotometric conditions for each metal and lamp are listed in Table 3.1 . The line source commonly used is a hollow-cathode lamp and the flame is air-acetylene.

Calibration Curve for the Lead

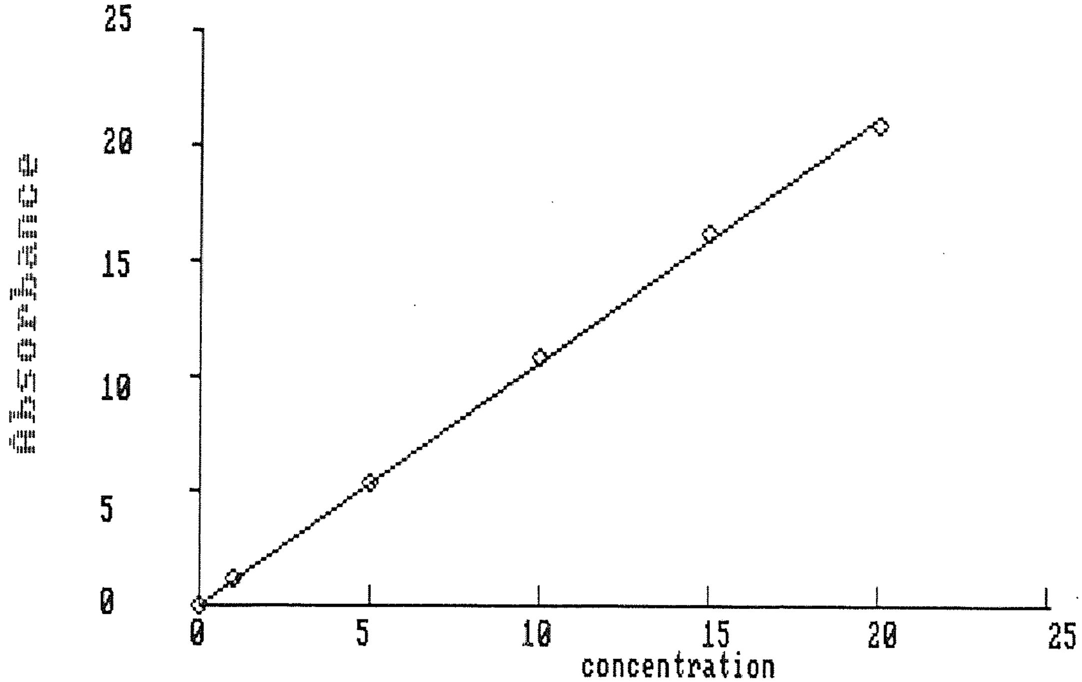


Fig. 1

Table 3.1

Spectrophotometric Conditions for Each Metal

Element	Wavelength(nm)	Spectral Band Pass(nm)	Lamp Current (ma)
1)Lead	217.0	1	4
2)Nickel	232.0	1	5
3)Copper	324.8	2	4
4)Cobalt	240.7	1	6
5)Iron	248.3	2	6
6)Zinc	213.9	1	5
7)Chromium	357.9	2	6
8)Mercury*	253.7	1	3
9)Manganese	279.5	2	5
10)Cadmium	228.8	1	3

* Cold Vapor Method

3.5.4 Mercury Analysis

Mercury was analysed using the cold vapor technique in the atomic absorption instrument. A solution was made by taking a 20 ml portion of the digested solution and 2ml of concentrated nitric acid in a capped plastic vial. The nitric acid was added in order to stabilize the Mercury as the HgO. 10 ml of this solution was placed in a 50 ml aerator tube just before the analysis. 1ml of 10%(saturated) stannous chloride solution (Reducing solution to convert HgO into Hg vapor) was then added to the liquid in the aerator tube and standard cold vapor analysis performed.

Analysis of National Bureau of Standards Urban particulate:

A National Bureau of Standards(NBS) urban particulate standard, No.1648, was purchased and analysed in these laboratories for quality assurance determinations. The standard was analyzed for lead, cadmium, nickel, Manganese, Copper, Cobalt, Iron, Zinc and Chromium.

3.6 Error Analysis

The standard solutions used for the calibration curve were of 1000 ppm and purchased from Baxter Inc., Edison,N.J. The standards were rates + or - 0.2% accurate by US National Bureau of Standards. The standards were diluted using pipets, burets and volumetric flasks which have standard error limits of less than 15%. Reading small differences in the buret contributed an error of about 3%. On this basis, the accuracy of the standard solution was placed within 2-3% of the nominal value. The standard solutions deteriorated due to adsorption effect (walls of container) thereby introducing error. The effect was eliminated by preparing new solutions at least once every 4 weeks.

The accuracy of the atomic absorption analysis on the digested sample solutions was estimated to be about + or - 10 absorbance units for the metals analyzed. The determination of the limit was based on the atomic absorbance reading itself and the standard curve by which the absorbance reading was converted to the metal concentration. The readings of absorbance were obtained directly from the Varian Model 12 spectrometer units on a scale of 1 to 1000. The absorbance reading is directly proportional to the metal concentration, so high concentrations exhibited low error while low concentration showed higher error.

The process of sample digestion used was a standard method approved and accepted by the U.S Environmental Protection Agency (25). An approximate error limit of 10% was assigned to this step by assumption that it contributed half the total error + or - 20% accepted by U.S EPA.

The samples were collected with quartz fiber filters. These filters were rated to have a collection efficiency of 99.9% for 0.3 micron particles and greater than 99.9% for larger particles as reported by the manufacturer, Whatman Inc. The summary of the errors is illustrated in Table 3.2.

Table 3.2
Summary of Error Analysis

Terms	Accuracy (%)	Error Level (%)
Standards	97.00	+ 3.00
AA Analysis	95.00	+ 10.00
Digestion	90.00	+ 10.00
Collection Efficiency	99.00	+ 1.00

$$\text{Random Error } \% = (3^2 + 10^2 + 10^2 + 1^2)^{1/2} = 14.46\ \%.$$

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Quarterly Averages

The quarterly average concentrations for metals at each site, year and season are illustrated in Figures 4.1 to Fig 4.20 while the data are listed in Table 4.1 to Table 4.5.

Elizabeth : Sampling started in April 1988 in Elizabeth. The site in Elizabeth was in Mattano Park on the East End and midpoint between north and south boundaries of the park. Mattano park is located off the corner at 3rd Ave in the region of Elizabeth west of the N.J Turnpike. The site was approximately 1 mile North at the Turnpike Exit # 13 Elizabeth and about 1/2 mile west at the Turnpike. The predominantly western winds would place the Elizabeth site upwind of the N.J Turnpike vehicle traffic emissions. The park was, however, on the same level and about 1.5 miles East at N.J Routes 1 & 9 through Elizabeth. Residential areas were adjacent to the park on the North, South and West. Open areas, light Industrial and then the N.J Turnpike were East of the park.

The site which is represented by a square on the map, figure 4.1 is the site Elizabeth. This site is located in Union county in New Jersey.

The higest concentrations found were for Iron and the lowest were Mercury.

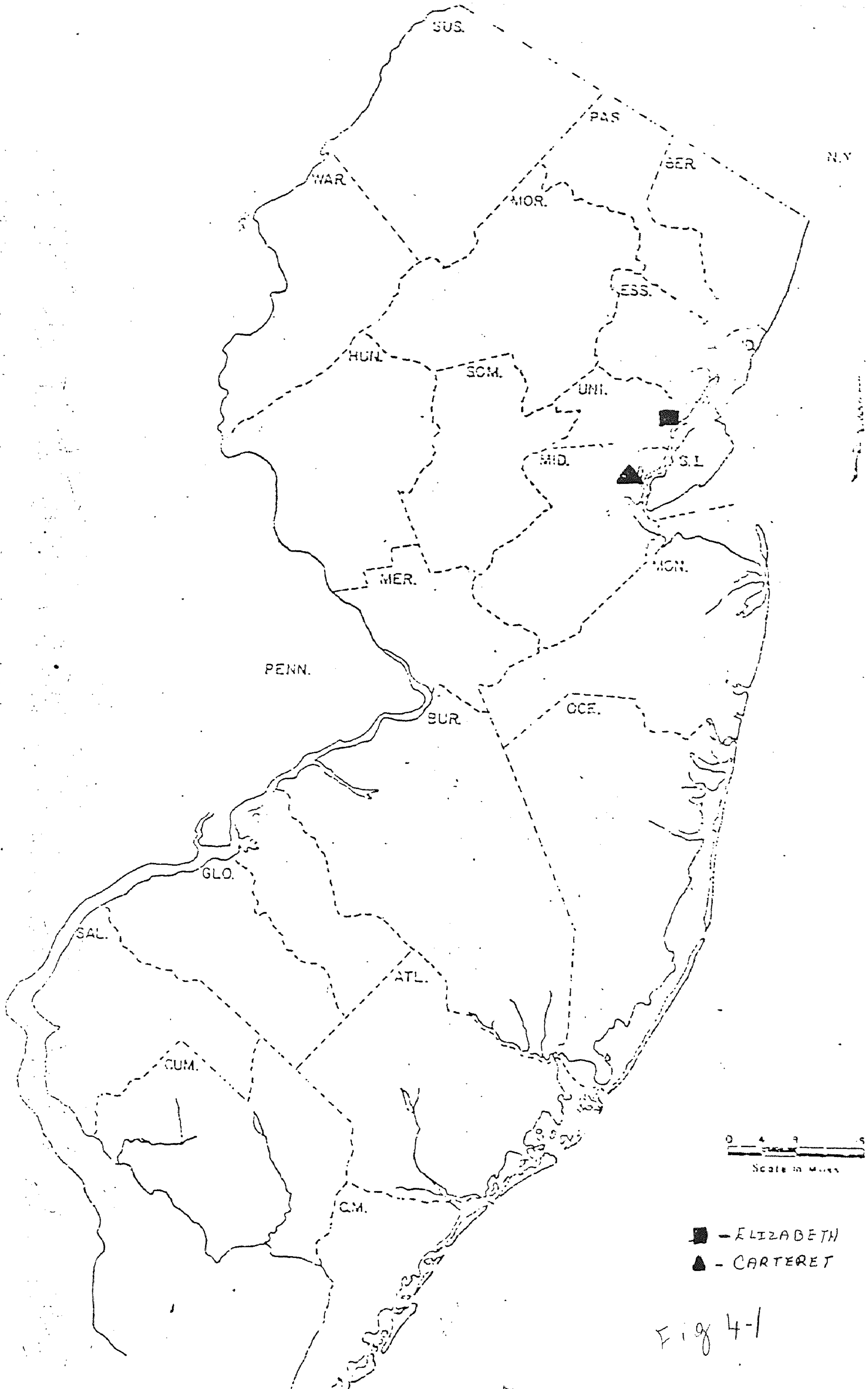

SUS.
PAS
N.Y
BER
WAR.
MOR.
ESS.
HUN.
SOM.
UNI.
MID.
S.I.
MON.
MER.
PENN.
BUR.
OCE.
GLO.
SAL.
ATL.
CUM.
C.M.
Scale in Miles
- ELIZABETH
- CARTERET

Fig 4-1


NEW JERSEY
Miles
0 10 20
The New York Times
NEW YORK
PENNSYLVANIA
DELAWARE
MARYLAND
SUSSEX
PASSAIC
BERGEN
WARREN
MORRIS
ESSEX
HUDSON
UNION
HUNTERDON
SOMERSET
MIDDLESEX
MERCER
MONMOUTH
OCEAN
BURLINGTON
CAMDEN
GLOUCESTER
SALEM
ATLANTIC
CUMBERLAND
CAPE MAY
Sussex
Hamburg
Franklin
Newton
Sparta
West Milford
Mahwah
Wanaque
Oak Ridge
Wyckoff
Ridgewood
Milton
Butler
Paterson
Hackensack
Blairstown
Hopatcong
Boonton
Clifton
Passaic
Delaware Water Gap
Dover
Montclair
Bloomfield
Union City
West New York
Hackettstown
Morristown
Hoboken
E. Orange
Newark
Jersey City
Belvidere
Long Valley
Madison
Elizabeth
New York City
Bernardsville
Washington
Califon
Rahway
High Bridge
Watchung
Woodbridge
Phillipsburg
Clinton
Somerville
Metuchen
Raritan
Manville
Perth Amboy
Flemington
Sayreville
Middletown
Frenchtown
New Brunswick
Rumson
Red Bank
Long Branch
Blawenburg
Lambertville
Princeton
Plainsboro
Cranbury
Freehold
Asbury Park
Hightstown
Trenton
Manasquan
Lakewood
Pt. Pleasant
New Egypt
Lakehurst
Toms River
Burlington
Willingboro
Mount Holly
Philadelphia
Moorestown
Camden
Medford Lakes
Lindenwold
Woodbury
Bridgeport
Waterford Works
Braddock
Swedesboro
Glassboro
Hammonton
Tuckertown
Woodstown
Malaga
Elmer
Buena
Salem
Alloway
Mays Landing
Norma
Vineland
Canton
Pleasantville
Atlantic City
Bridgeton
Millville
Greenwich
Cedarville
Tuckahoe
Ocean City
Port Norris
Woodbine
Cape May Court House
Wildwood
Cape May
Delaware River
Delaware Bay
Atlantic Ocean
PENNSYLVANIA TURNPIKE
NEW JERSEY TURNPIKE
GARDEN STATE PARKWAY
ATLANTIC CITY EXPWY
287
80
78
195

84 Fig-4.2

Year 1988

Metal	Results Summary (Quarterly Averages)
Iron (Fe):	Showed average concentration of 661.0 ng/m^3 during April-June quarter, decreased in Oct-December 1988 quarter to average concentration of 308.4 ng/m^3.
Lead (Pb):	High concentrations of 38.1 ng/m^3 for Jan-Mar quarter decreased in April-June and July-September to 21.6 ng/m^3 and 31.3 ng/m^3 respectively.
Cobalt (Co):	Showed relatively constant values of 7.1 ng/m^3 July-September quarter and 7.1 ng/m^3 for Oct-December quarter with a slight variation upward of 3.2 ng/m^3 to 11.3 ng/m^3 for April-June quarter.
Zinc (Zn):	High concentration in the quarter of Oct-Dec 117.9 ng/m^3 and in the quarter of July- September 83.0 ng/m^3 and low in the quarter of April-June 78.4 ng/m^3.
Nickel (Ni):	High in April-June quarter 13.6 ng/m^3 and low in Oct-Dec quarter 8.3 ng/m^3
Chromium (Cr):	Showed very high concentration in the quarter April-June of 33.9 ng/m^3 when campared to Oct-Dec quarter of 3.9 ng/m^3.

Manganese (Mn): April-June quarter showed high concentration 23.1 ng/m^3 and low in Oct-Dec quarter of 14.9 ng/m^3.

Cadmium (Cd): High concentration in the quarter of April-June 1.6 ng/m^3 and decreased by half to 0.8ng/m^3 in the quarter of Oct-Dec.

All the metals were analyzed for the 1st 3 quarters of 1989 and the sampling campaign ended after September 1989.

Year 1989

Metal Results (Quarterly Averages)

Iron (Fe): This metal showed higher concentrations then all the other metals. It showed a high concentration of 591.7 ng/m^3 in the quarter of July-Sep 1989. Jan -Mar quarter the concentration of 401.5 ng/m^3 was the lowest.

Lead (Pb): High concentration of 38.6 ng/m^3 in the quarter April-June. And then similar same concentrations in Jan-Mar and July-Sept quarters 22.6 ng/m^3 and 25.8 ng/m^3 respectively.

Cobalt (Co): Showed 13.8 ng/m^3 and 12.8 ng/m^3 in the quarters July-Sept and April-June. Low in the quarter Jan-Mar 5.3 ng/m^3.

Zinc (Zn): High concentration of 139.9 ng/m^3 in the quarter of July-Sept but decreased to 114.1ng/m^3 in April -June quarter and 88.1 ng/m^3 in Jan-Mar quarter.

Nickel (Ni): High concentration in the quarter April-June of 30.9 ng/m^3 and low in quarter Jan-Mar 13.5 ng/m^3.

Chromium (Cr): Showed large variations in its concentratiom and its highest concentration and lowest concentration varied by 25 ng/m^3 from 9.7 ng/m^3 in July-Sept to 35.9 in April-June quarter.

Manganese (Mn):This showed cocstant levels through out the 3 quarters. July-Sep 14.1 ng/m^3, 14.3 in April-June quarter and 15.6 ng/m^3 in Jan-Mar quarter.

Cadmium (Cd): High in the quarter July-Sep 3.2 ng/m^3 and low in the quarter Jan-Mar 1.5 ng/m^3.

Copper (Cu): high in the quarter July-Sep 52.2 ng/m^3 and low in the quarter 25.0 ng/m^3.

Carteret : The quarterly average concentration of most metals in the Carteret site are significantly higher than the values of the Elizabeth site.

This site is on the roof of a police station which is located on Roosevelt street 1 block North of Washington Street. This is 2 miles east of the Turnpike. On the North there is a firehouse and Industry, on the south side are auto body shops and some houses and open space on the east side and water (the Arthur Kill). And to the west a residential area. The location is represented by the triangle in the Fig 4.1

All the metals were analysed for 3 quarters in 1988.

Year 1988

Metal	Results (Quarterly Averages).
Iron (Fe):	High concentration of 752.6 ng/m^3 in Jan-Mar quarter and low of 426.0 ng/m^3 in Oct-Dec quarter.
Lead (Pb):	Showed large variations. 118.7 ng/m^3 in Jan-Mar quarter and 30.8 ng/m^3 in April-June quarter.
Nickel (Ni):	Jan-Mar quarter 76.3 ng/m^3 and low of 9.3 ng/m^3 in Oct-Dec quarter, 67.0 ng/m^3 variation.
Chromium (Cr):	High concentration of 42.7 ng/m^3 in April-June and 3.1 ng/m^3 in Jul-Sept quarter.
Mercury (Hg):	High in Jan-Mar 5.0 ng/m^3 and low in April-June 0.6 ng/m^3.
Zinc (Zn):	Showed almost equal concentrations through out the 3 quarters. Jan - Mar 89.8 ng/m^3 , 90.3 ng/m^3 and 93.0 gn/m^3 in Oct-Dec.
Mangnese (Mn):	High in April-June 32.2 ng/m^3 and low in Oct-Dec 18.9 ng/m^3.

Cobalt (Co): Showed almost equal concentrations in all quarters Jan-Mar 11.0 ng/m^3 and April-June 10.0 ng/m^3 and low in July-Sep 7.1 ng/m^3.

Copper (Cu): High in July-Sep quarter 105.4 ng/m^3 and low in Jan-Mar quarter 78.4 ng/m^3.

In 1989 the concentrations of all metals show lower concentrations then in 1988. Carteret showed higher concentrations then Elizabeth.

Year 1989

Metal	Result (Quarterly Averages)

Iron (Fe): High concentration in the quarter of July-Sept 761.4 ng/m^3 and low in Jan-Mar quarter 508.1 ng/m^3.

Mercury (Hg): Same concentrations throughout the 3 quarter 0.4 ng/m^3.

Zinc (Zn): High concentrations in July-Sept quarter 173.3 ng/m^3 and low concentrations April-June 93.2 ng/m^3.

Chromium (Cr): Showed large variation of 48.5 ng/m^3 from April-June 51.8 ng/m^3 to Jan-Mar 13.3 ng/m^3.

Manganese(Mn): Showed almost equal concentrations April-June 25.7 ng/m^3 and 21.6 ng/m^3 in July-Sept quarter.

Cobalt (Co): Showed high concentration of 16.3 ng/m^3 in July-Sept quarter and low in Jan-mar 5.7 ng/m^3.

Nickel (Ni): High of 31.7 ng/m^3 in July-Sep quarter and low of 13.9 ng/m^3 in Jan-Mar quarter.

Table 4.1

Elizabeth Site Year 1988

3 month Average Concentration ng/M^3

Metals	April-June	July-Sep	Oct-Dec
1)Cobalt	11.3	7.1	7.1
2)Cadmium	1.6	NA	0.8
3)Iron	661.0	495.6	308.4
4)Mercury	0.9	NA	0.7
5)Lead	21.6	31.3	38.1
6)Manganese	23.1	NA	14.9
7)Copper	76.4	NA	26.6
8)Chromium	33.9	NA	3.9
9)Nickel	13.6	NA	8.3
10)Zinc	78.4	83.0	117.9

NA- Not analysed

Table 4.2

Elizabeth Site Year 1989

3 month Average Concentrations (ng/M^3)

Metals	Jan-Mar	April-Jun	July-Sep
1)Cobalt	5.3	12.8	13.8
2)Cadmium	1.5	1.8	3.2
3)Iron	401.5	514.5	591.7
4)Mercury	0.3	0.5	0.4
5)Lead	22.6	38.6	25.8
6)Manganese	15.6	14.3	14.1
7)Copper	42.8	25.0	52.2
8)Chromium	11.4	35.9	9.7
9)Nickel	13.5	30.9	27.6
10)Zinc	88.1	114.1	139.9

Table 4.3

Carteret Site Year 1987

3 Month Average Concentration (ng/M^3)

Metals	Jul-Sep	Oct-Dec
1) Cobalt	17.6	18.4
2) Cadmium	3.3	1.6
3) Iron	404.2	519.7
4) Mercury	NA	NA
5) Lead	65.3	69.0
6) Manganese	42.0	29.5
7) Copper	75.9	47.0
8) Chromium	29.8	22.7
9) Nickel	19.8	30.6
10) Zinc	222.8	182.0

Table 4.4

Carteret site Year 1988

3 month Average Concentration (ng/M^3)

Metals	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
1) Cobalt	11.0	10.0	7.1	NA
2) Cadmium	1.8	4.5	2.7	NA
3) Iron	752.6	805.4	NA	426.0
4) Mercury	5.0	0.6	NA	0.8
5) Lead	118.7	30.8	NA	38.1
6) Manganese	27.0	32.2	NA	18.9
7) Copper	78.4	113.5	105.4	NA
8) Chromium	37.9	42.7	3.1	NA
9) Nickel	76.3	29.3	NA	9.3
10) Zinc	89.8	90.3	NA	93.0

NA- Not analysed

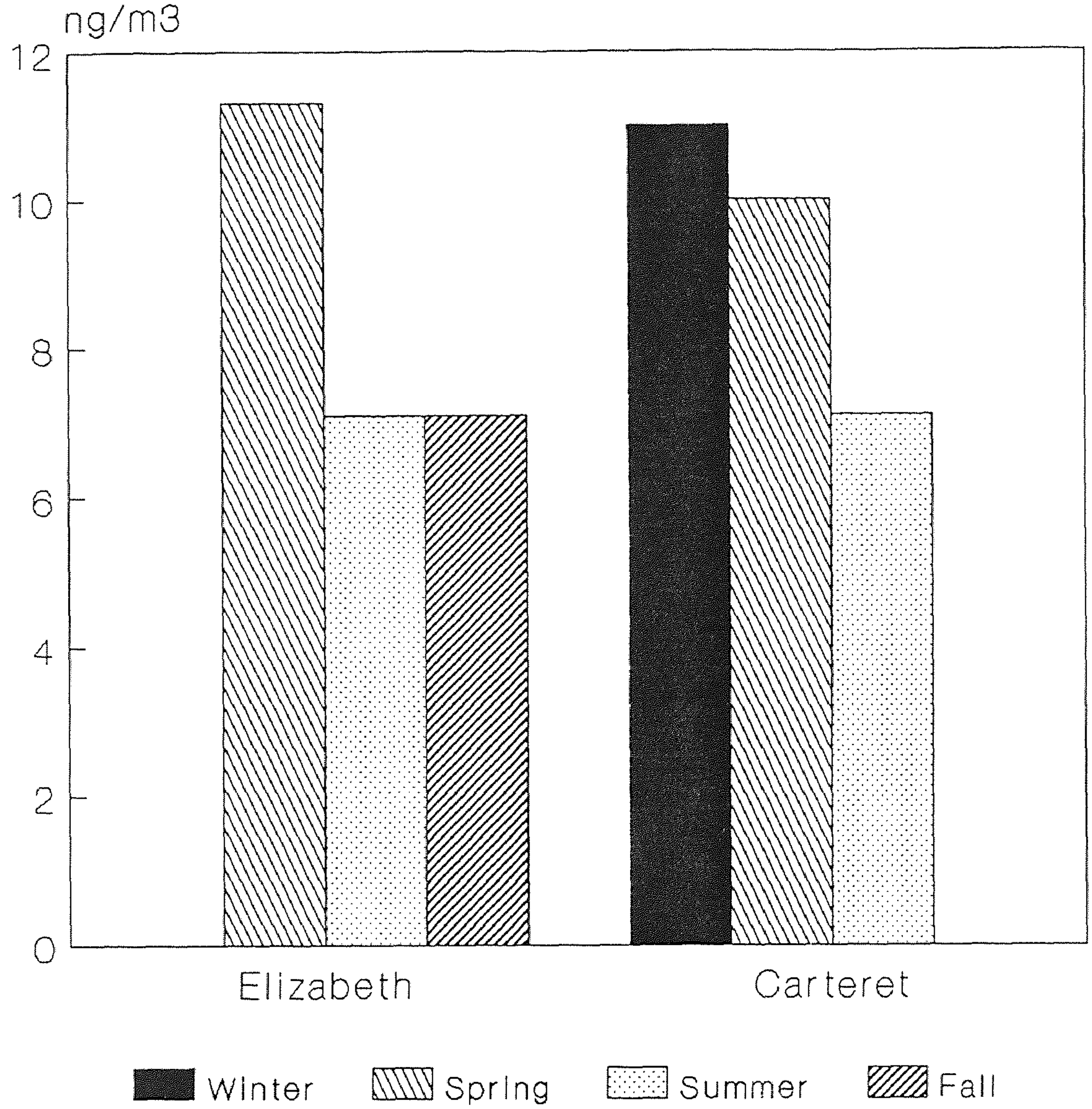
Table 4.5

Carteret Site Year 1989

3 month Average Concentration (ng/M^3)

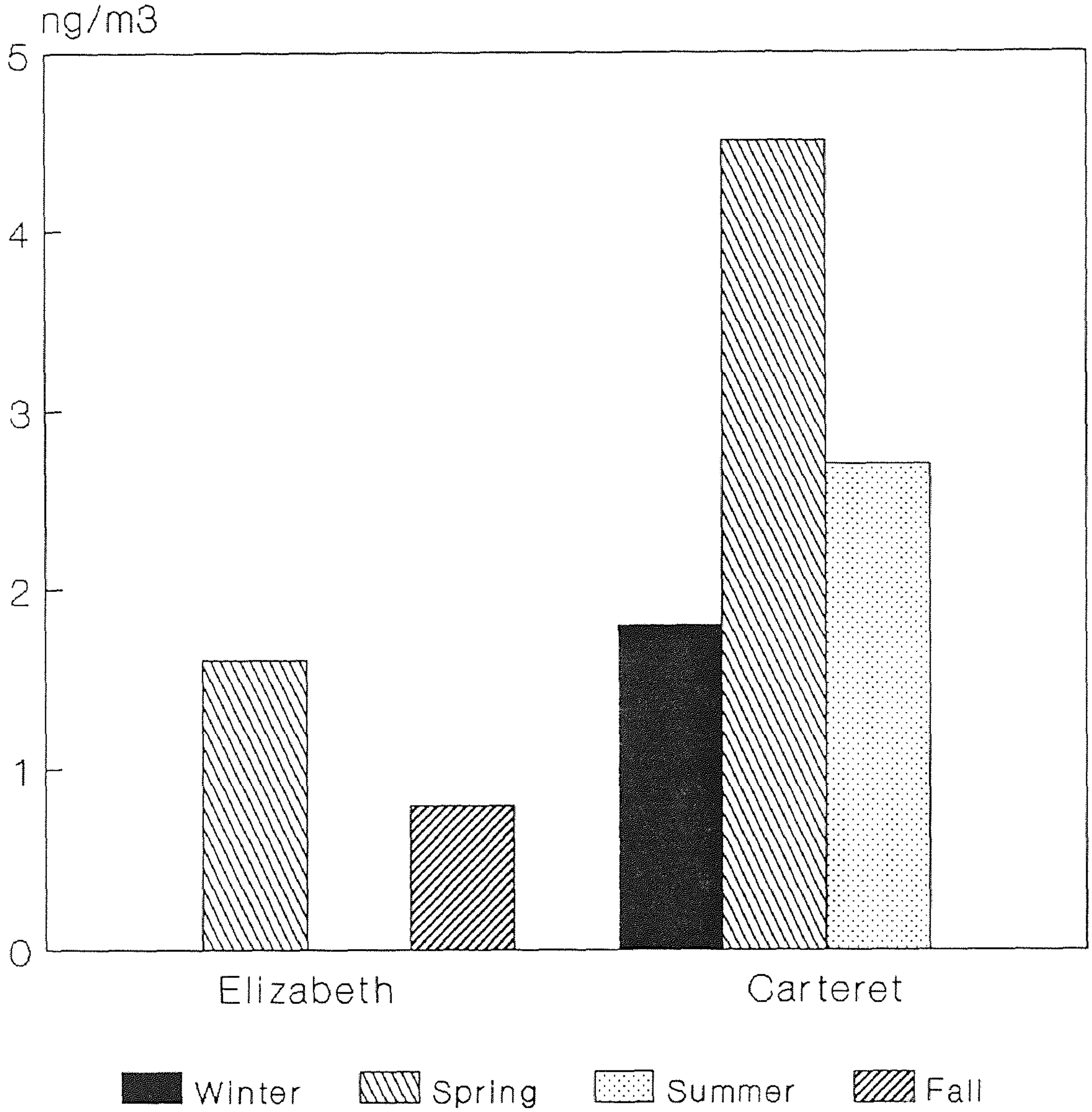
Metals	Jan-Mar	Apr-June	Jul-Sep
1) Cobalt	5.7	13.3	16.8
2) Cadmium	1.8	1.9	3.9
3) Iron	508.1	689.7	761.4
4) Mercury	0.4	0.4	0.4
5) Lead	26.4	43.1	38.0
6) Manganese	20.3	25.7	21.6
7) Copper	83.7	69.1	85.1
8) Chromium	13.3	51.8	16.0
9) Nickel	13.9	38.8	31.7
10) Zinc	101.5	93.2	173.1

Quarterly Averages 88
Cobalt



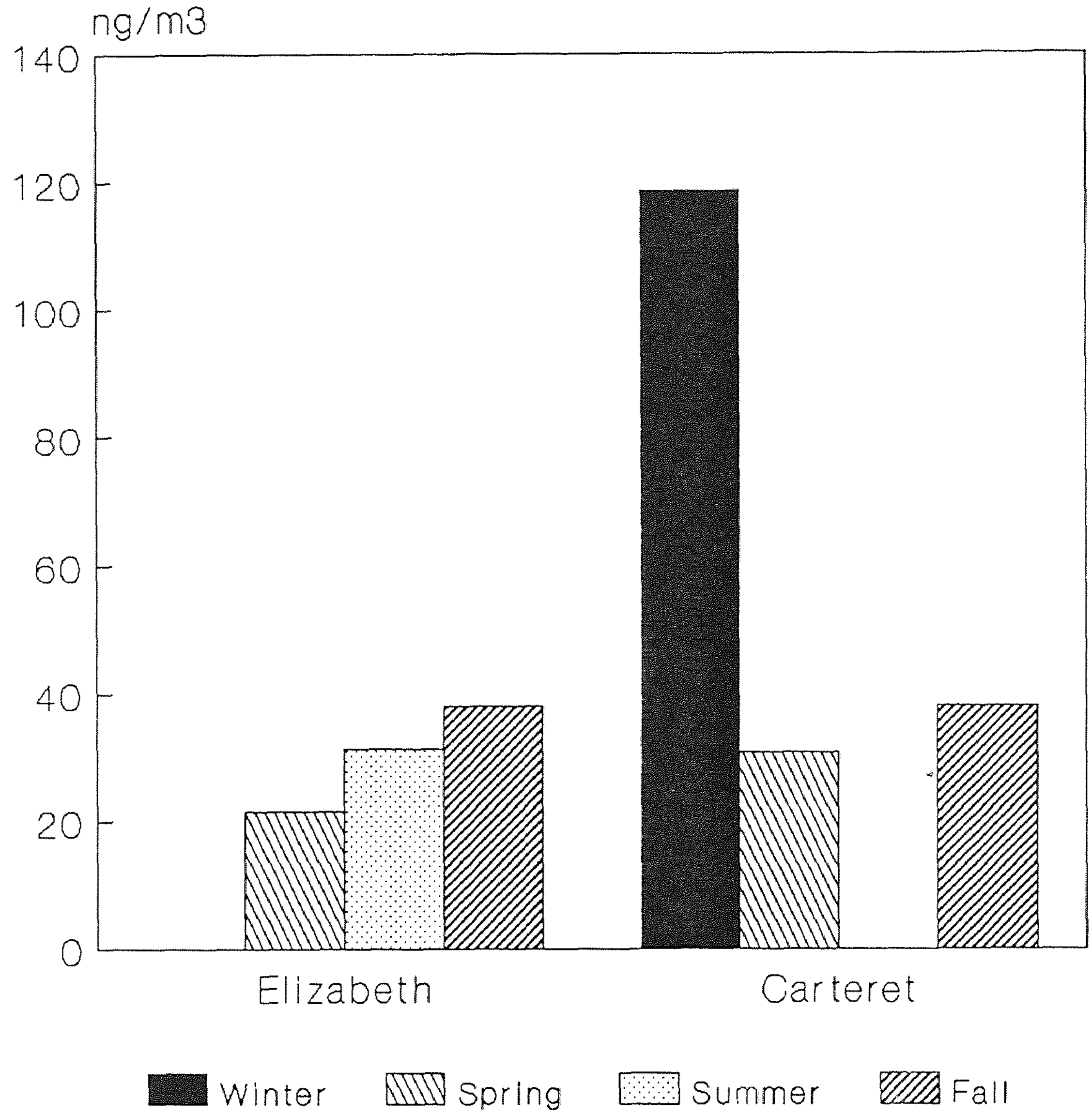
Winter Jan-Mar Fall Oct-Dec
Spring Apr-Jun
Summer Jul-Sep

Quarterly Averages 88
Cadmium



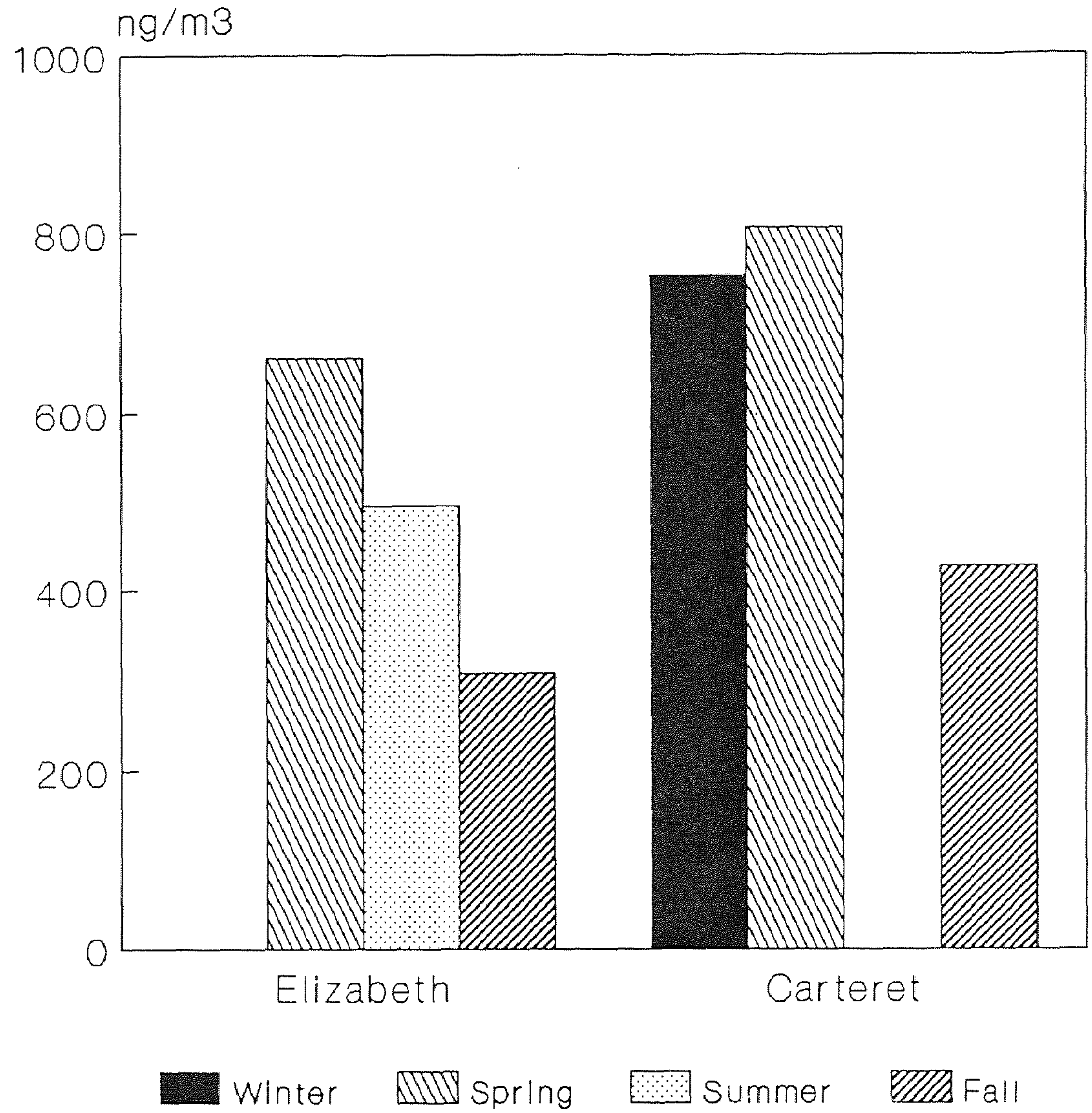
Winter Jan-Mar   Fall Oct-Dec
Spring Apr-Jun
Summer Jul-Sep

Quarterly Averages 88
Lead



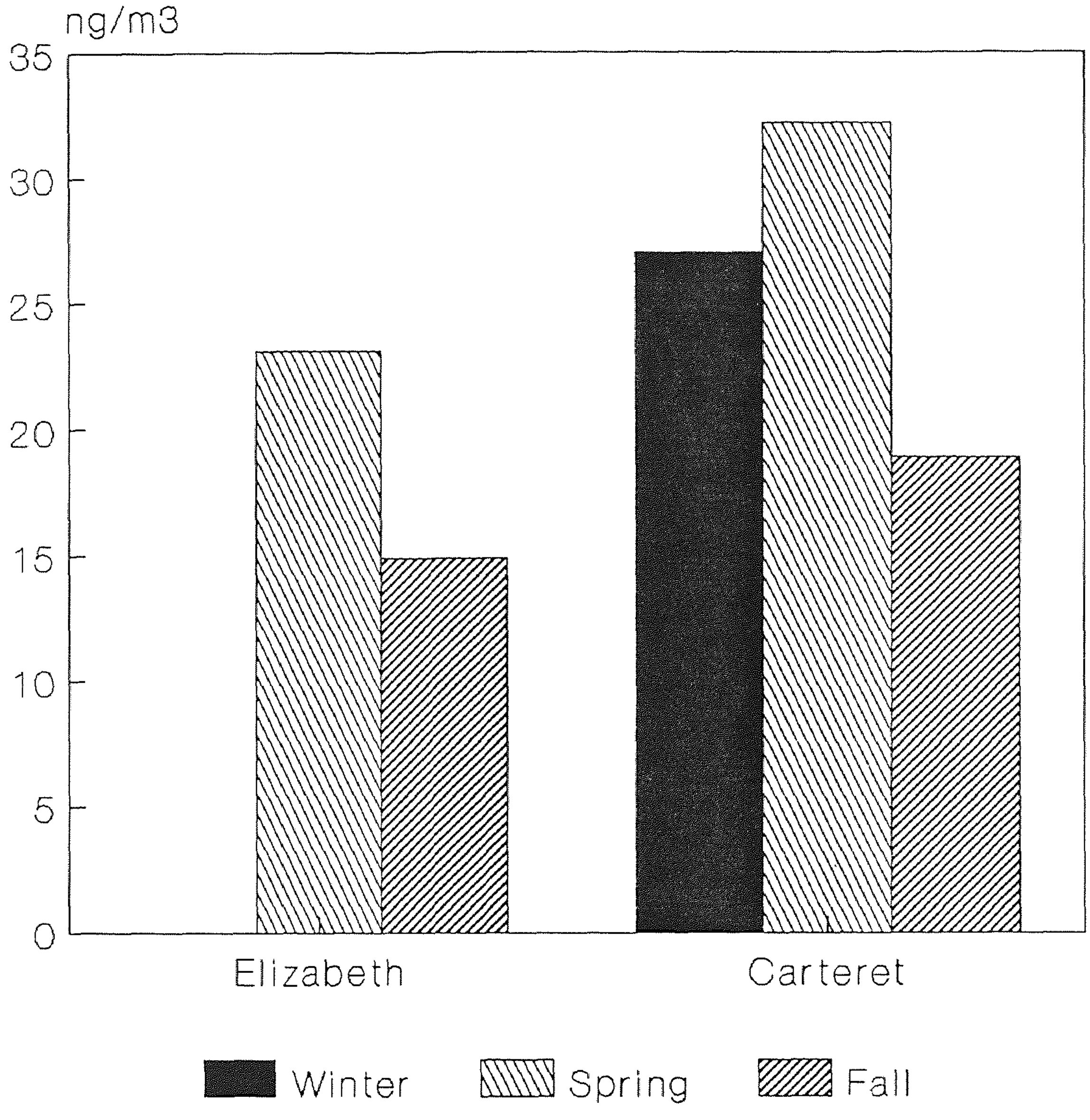
Winter Jan-Mar   Fall Oct-Dec
Spring Apr-Jun
Summer Jul-Sep

Quarterly Averages 88
Iron

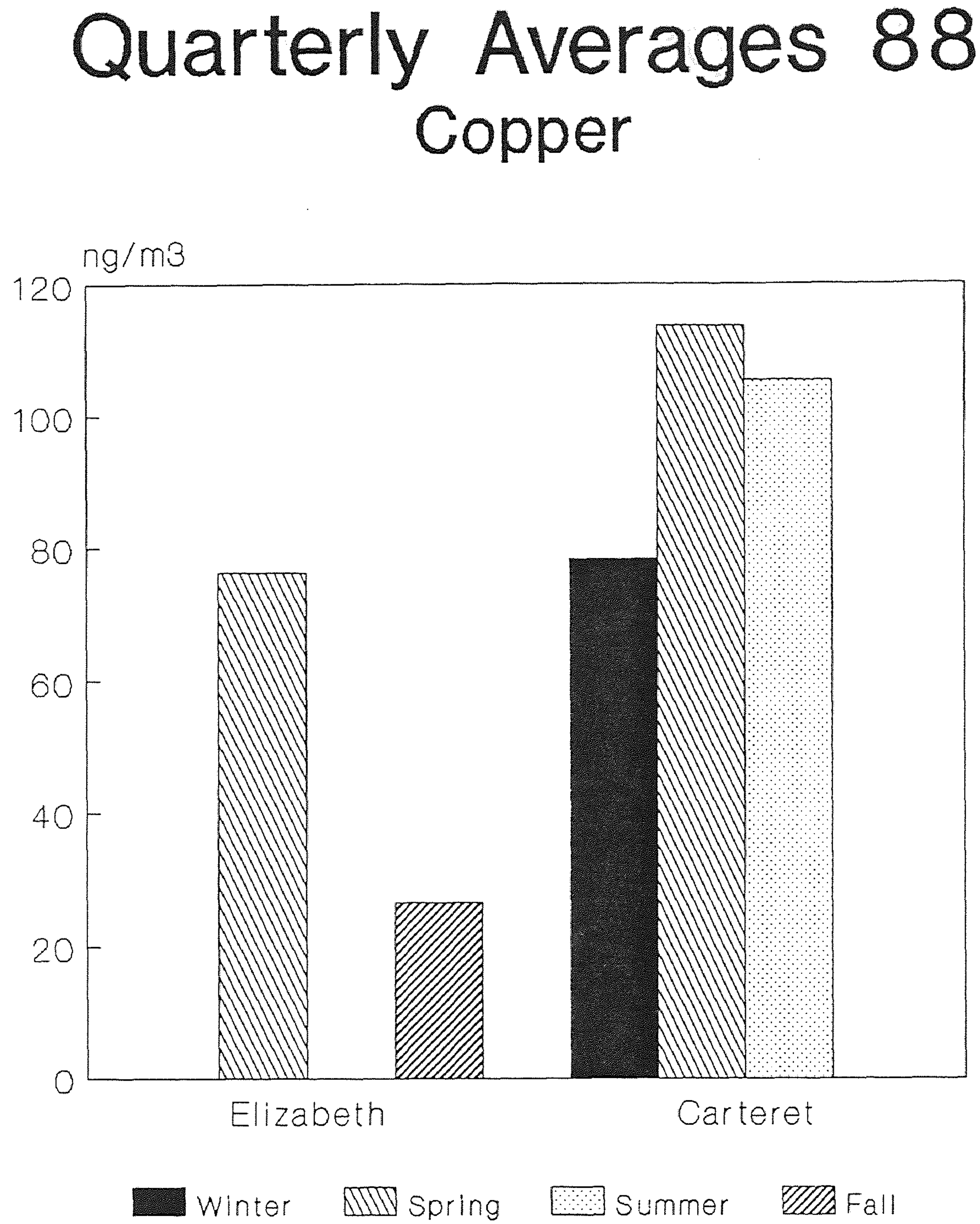


Winter Jan-Mar   Fall Oct-Dec
Spring Apr-Jun
Summer Jul-Sep

Quarterly Averages 88
Manganese

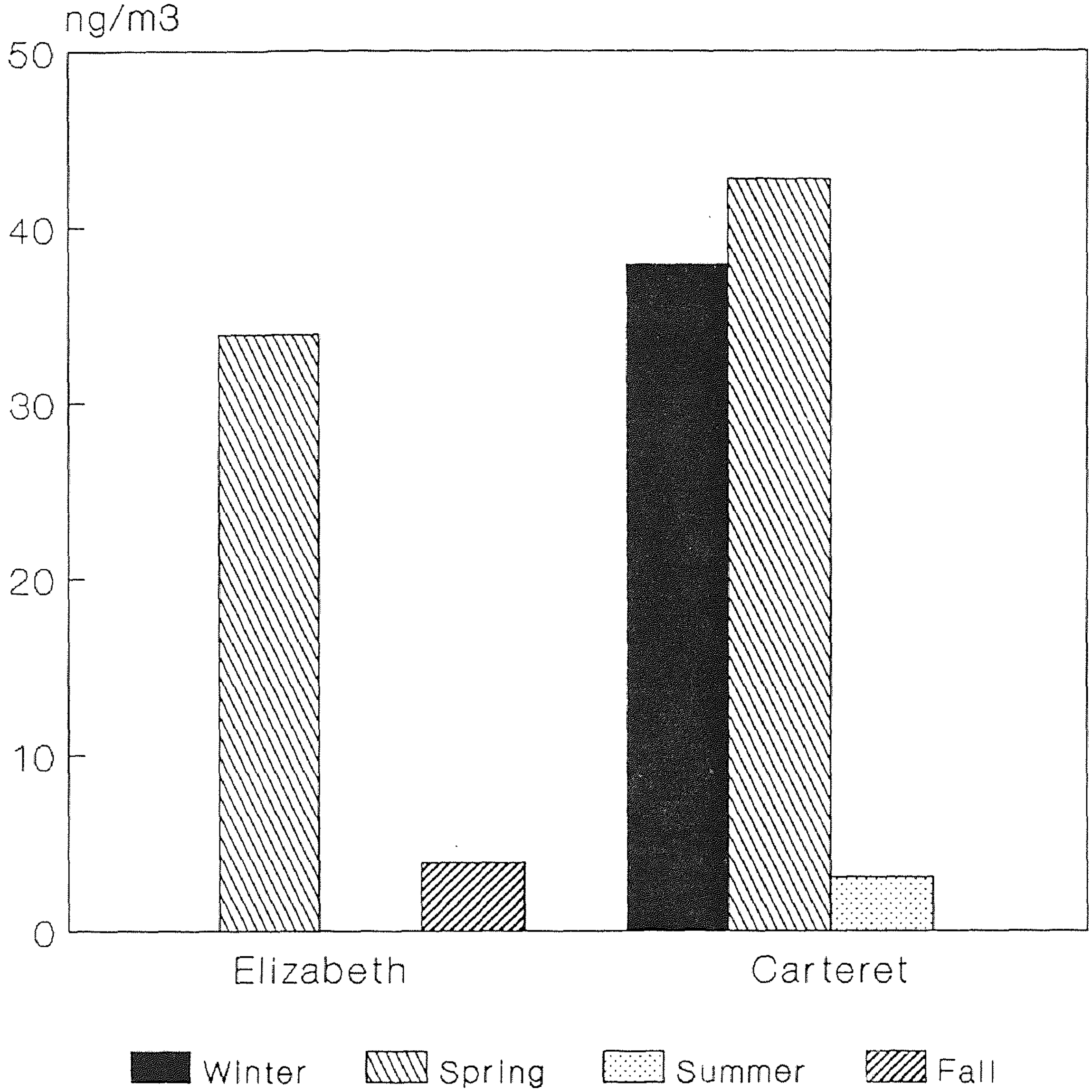


Winter Jan-Mar Fall Oct-Dec
Spring Apr-Jun
Summer Jul-Sep



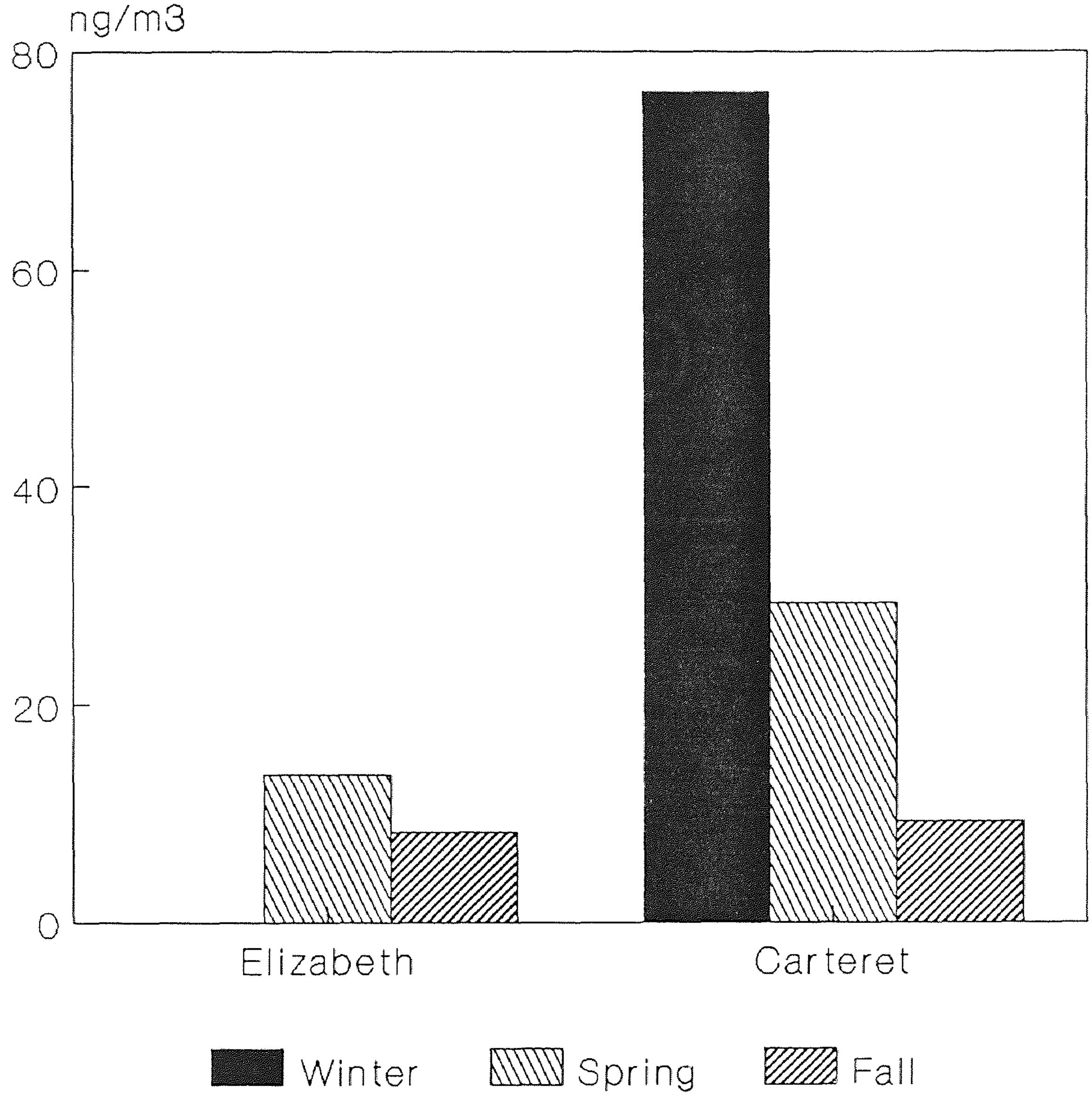
Winter Jan-Mar   Fall Oct-Dec
Spring Apr-Jun
Summer Jul-Sep

Quarterly Averages 88
Chromium



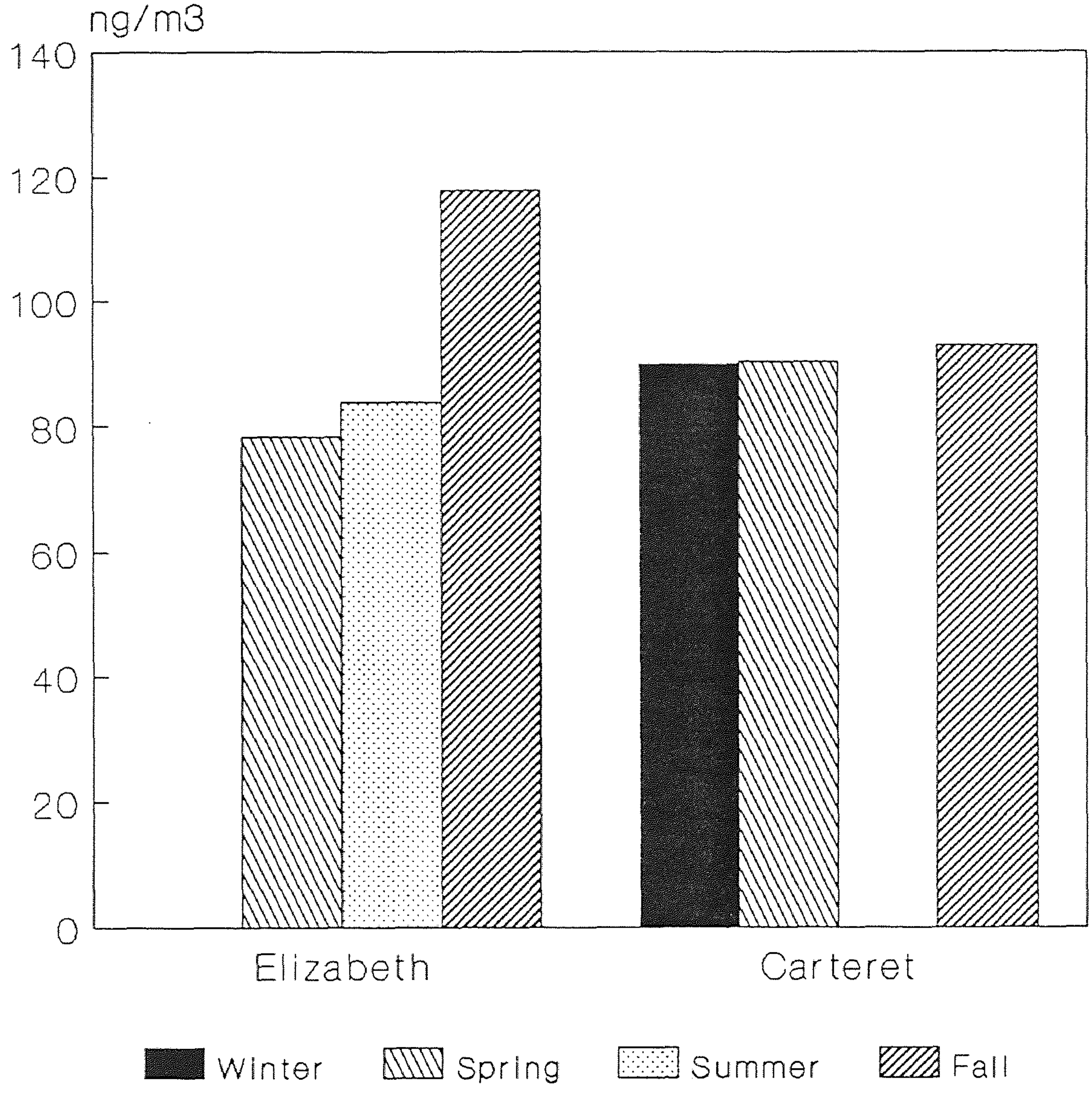
Winter Jan-Mar Fall Oct-Dec
Spring Apr-Jun
Summer Jul-Sep

Quarterly Averages 88
Nickel



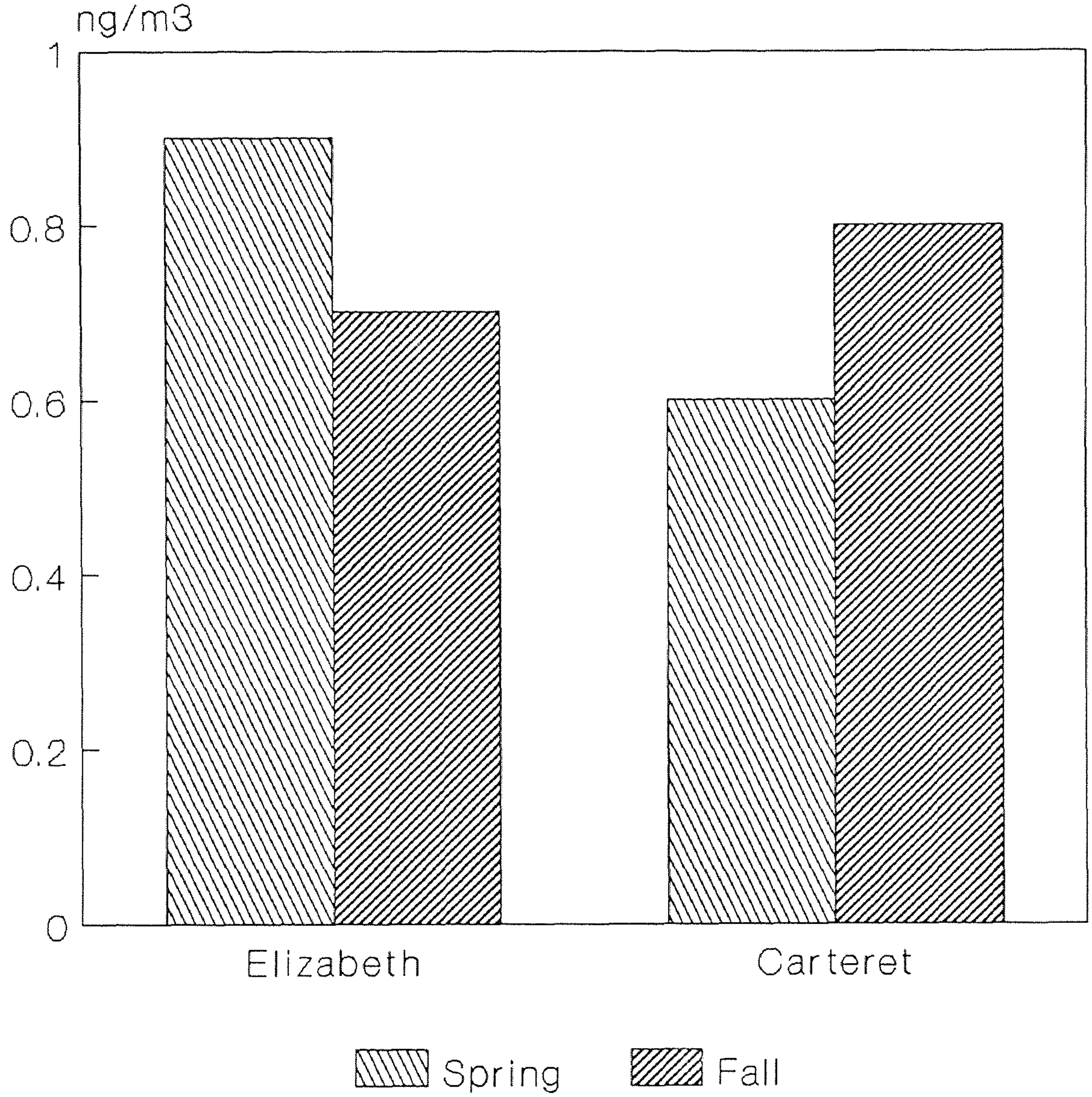
Winter Jan-Mar Fall Oct-Dec
Spring Apr-Jun
Summer Jul-Sep

Quarterly Averages 88
Zinc



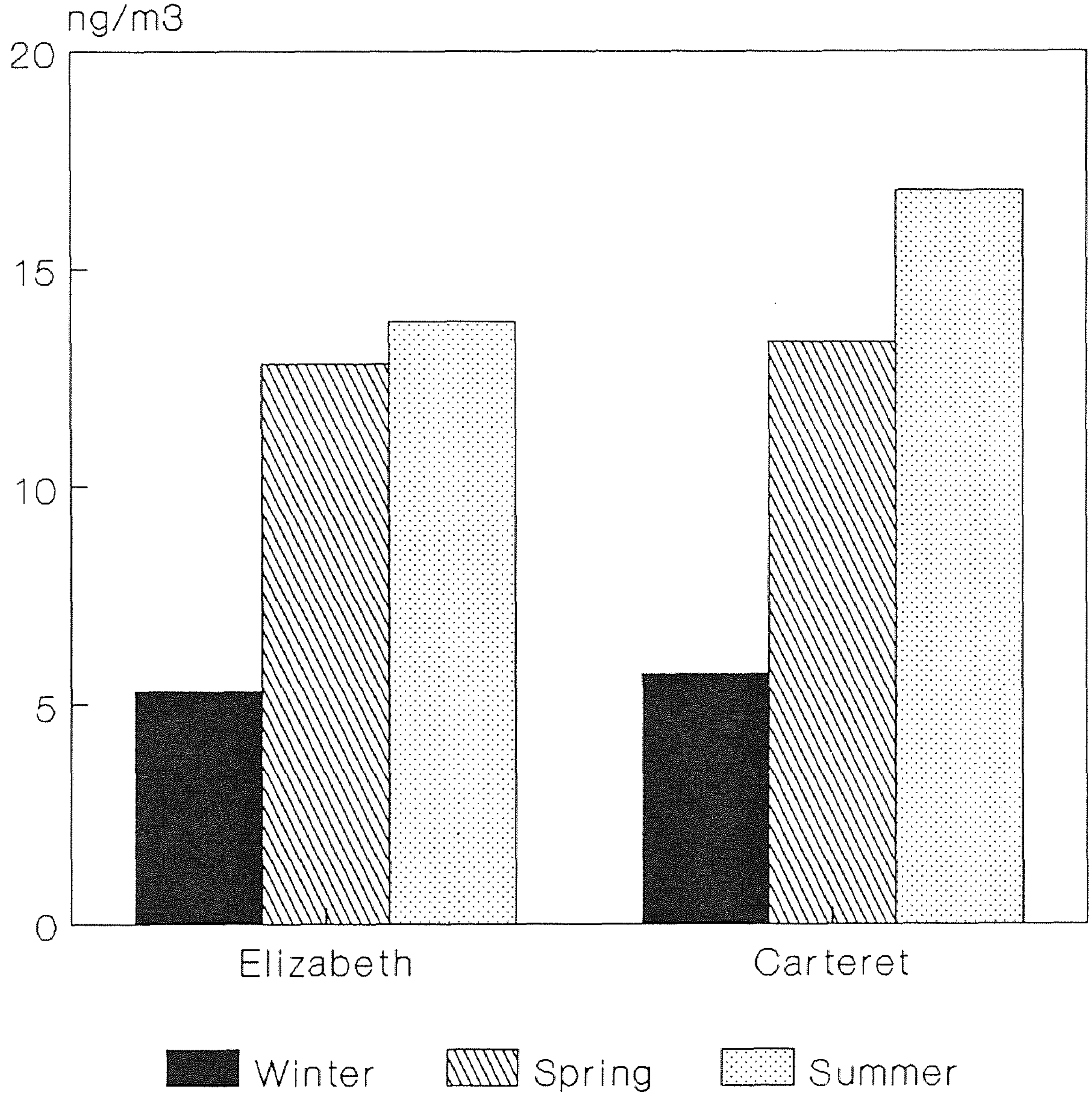
Winter Jan-Mar   Fall Oct-Dec
Spring Apr-Jun
Summer Jul-Sep

Quarterly Averages 88
Mercury



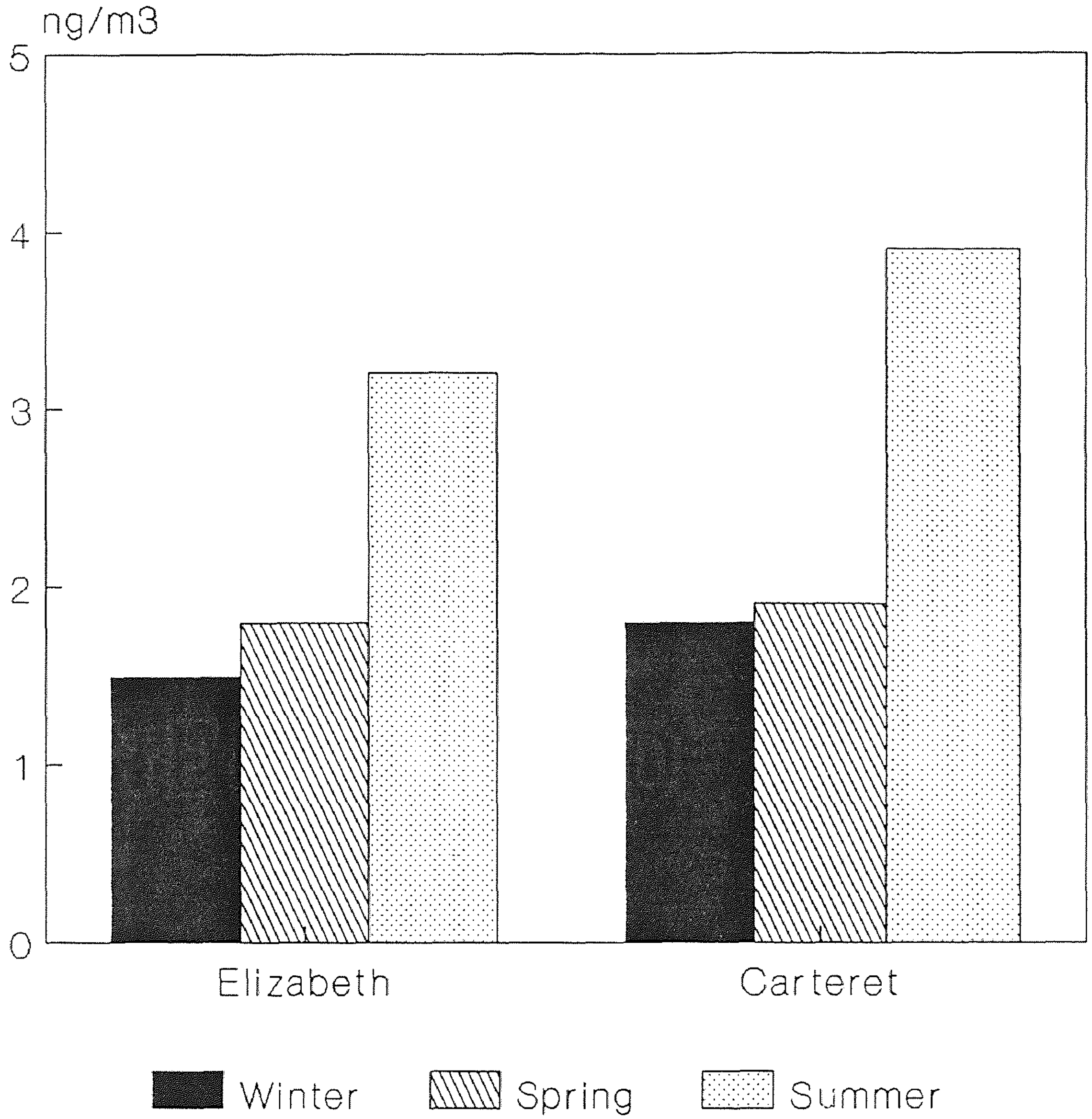
Winter Jan-Mar   Fall Oct-Dec
Spring Apr-Jun
Summer Jul-Sep

Quarterly Averages 89
Cobalt



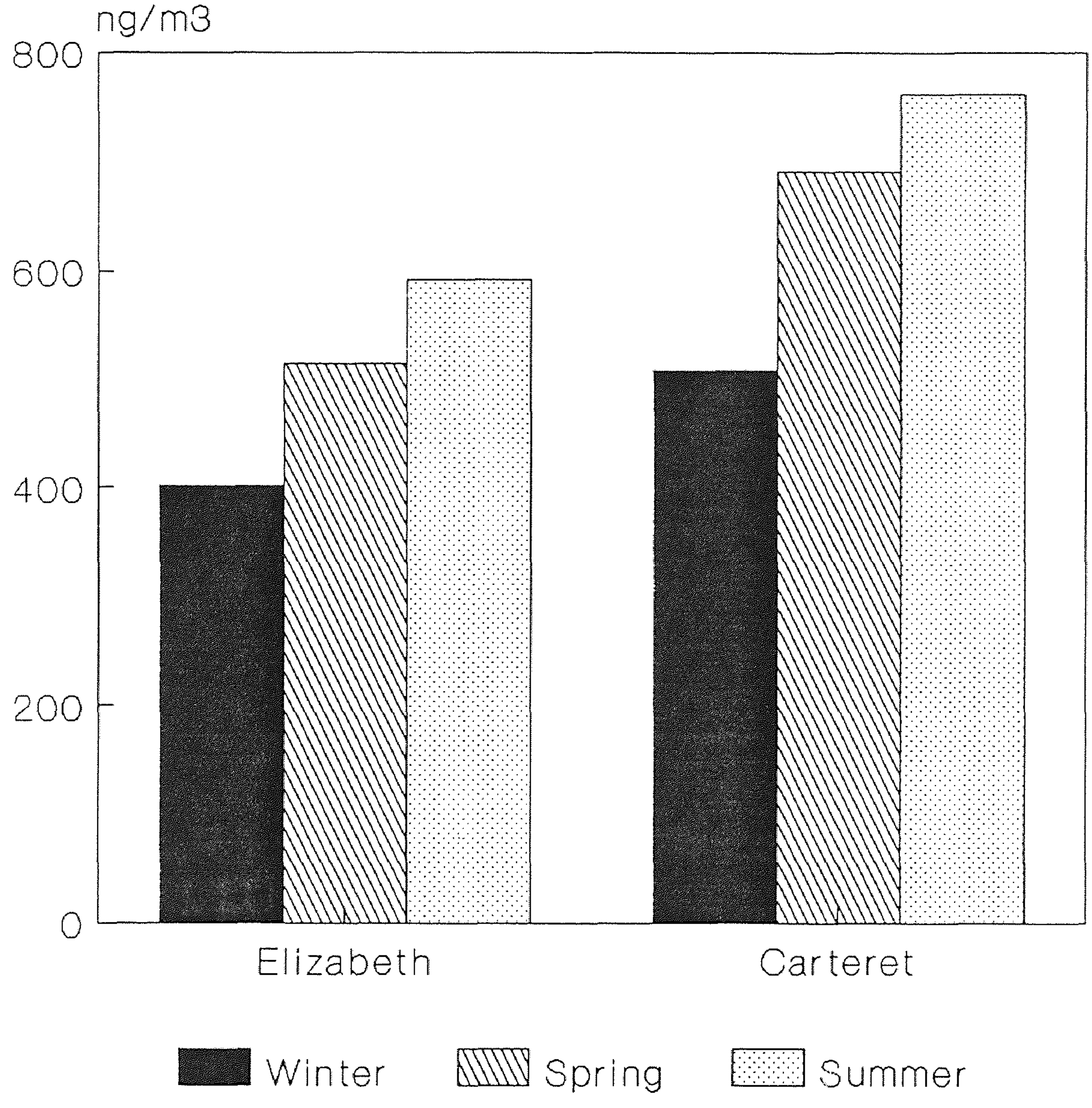
Winter Jan-Mar
Spring Apr-Jun
Summer Jul-Sep

Quarterly Averages 1989
Cadmium



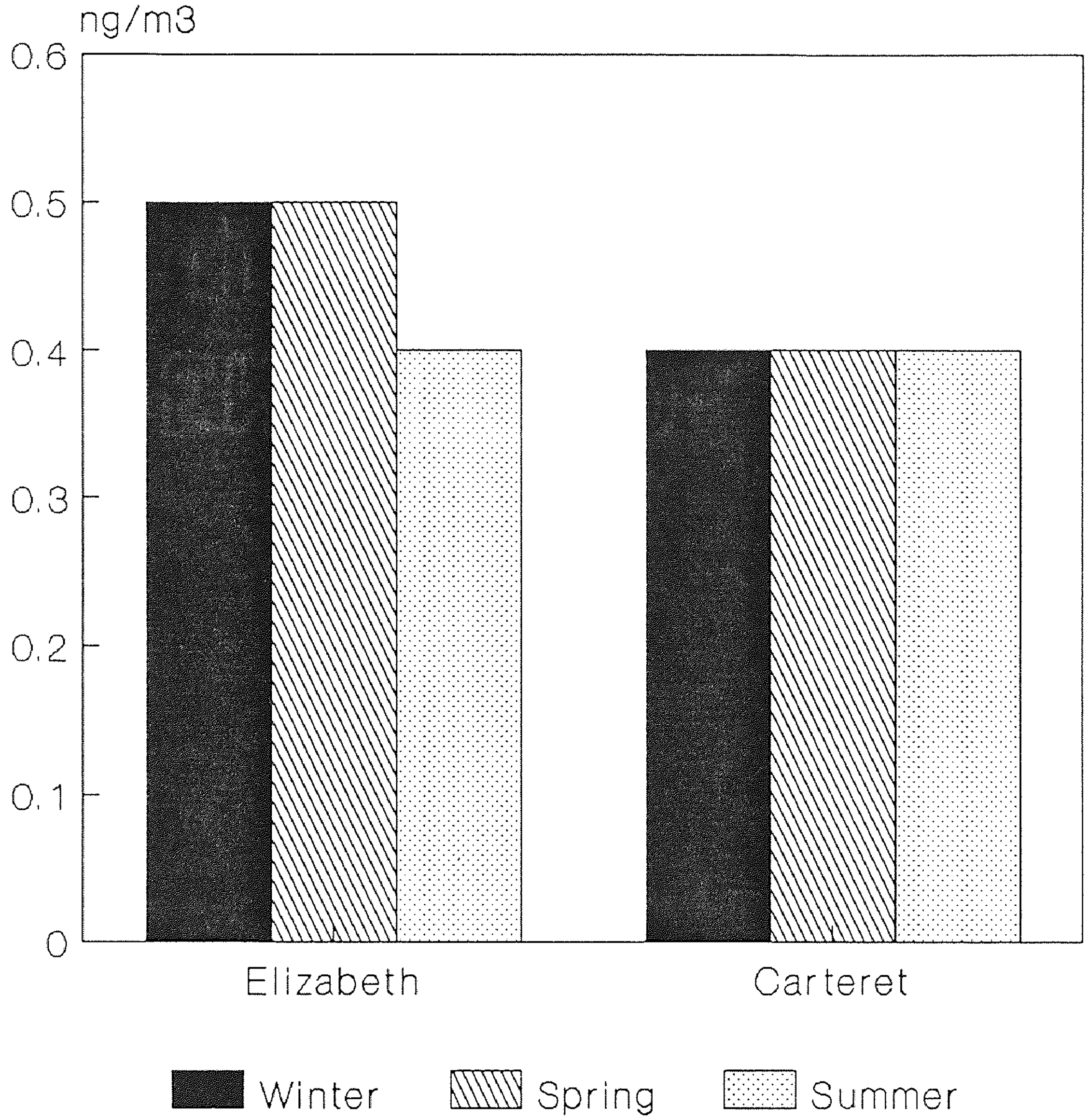
Winter Jan-Mar
Spring Apr-Jun
Summer Jul-Sep

Quarterly Averages 89
Iron



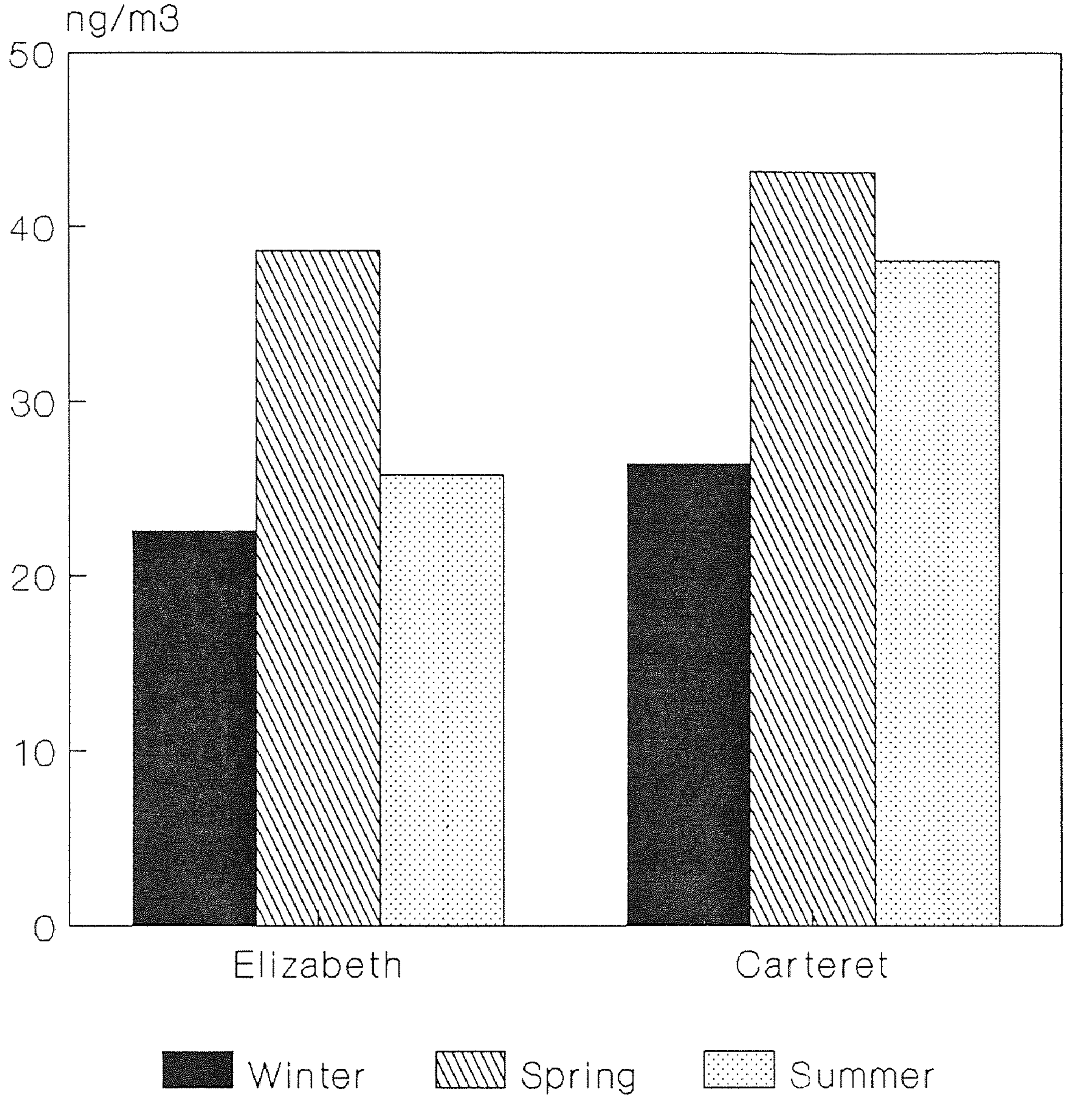
Winter Jan-Mar
Spring Apr-Jun
Summer Jul-Sep

Quarterly Averages 89
Mercury



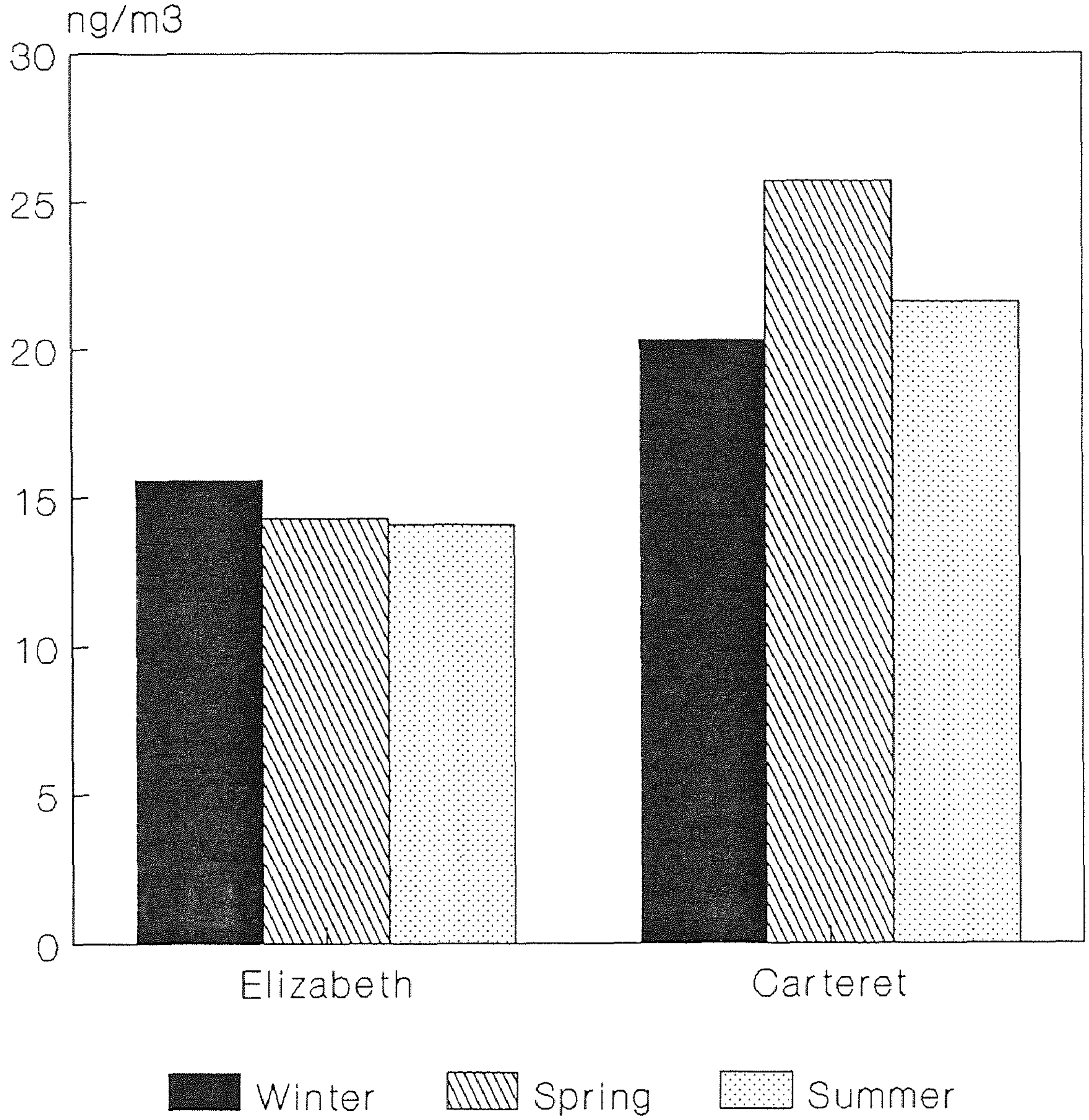
Winter Jan-Mar
Spring Apr-Jun
Summer Jul-Sep

Quarterly Averages 1989
Lead



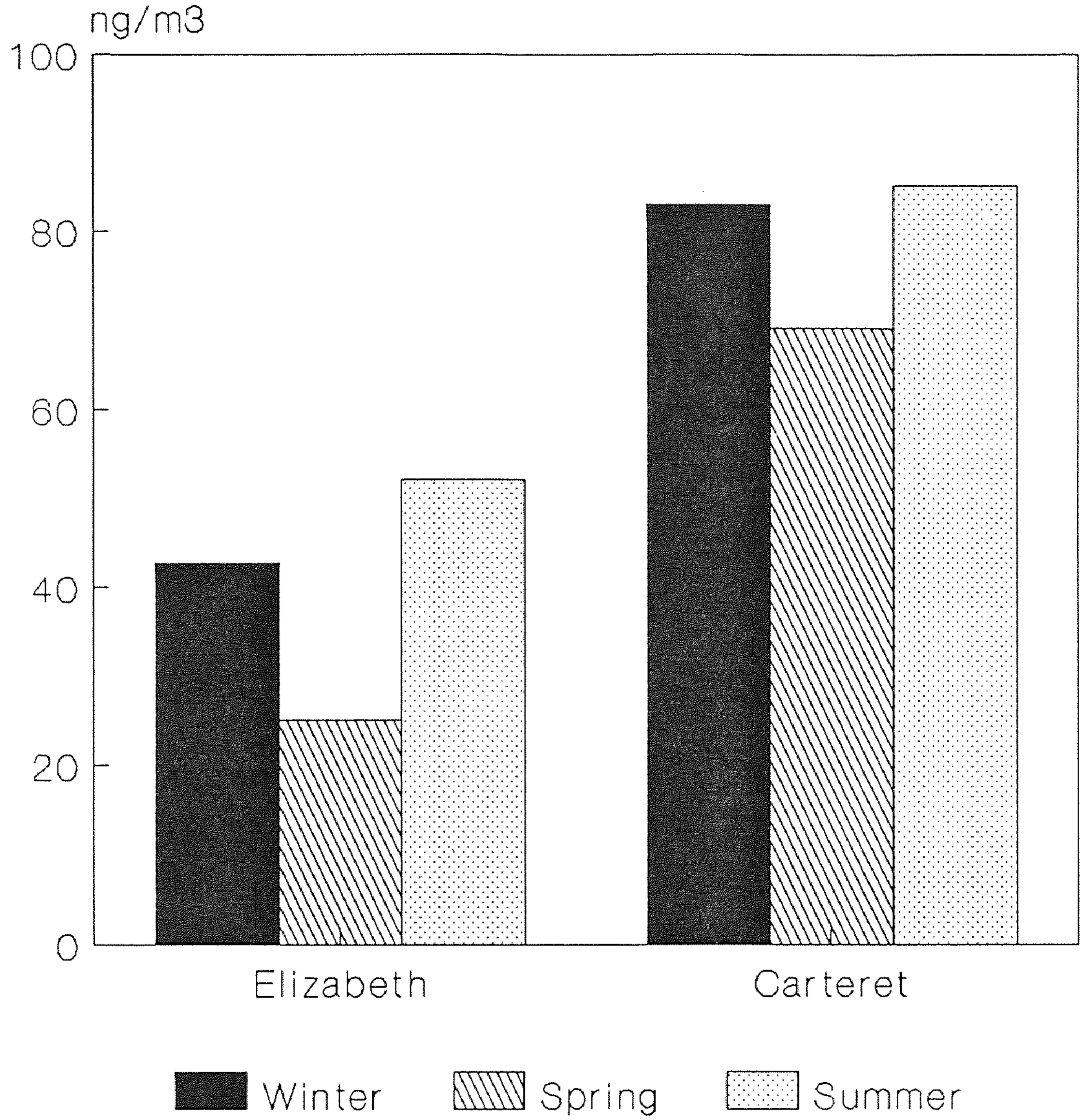
Winter Jan-Mar
Spring Apr-Jun
Summer Jul-Sep

Quarterly Averages 1989
Manganese



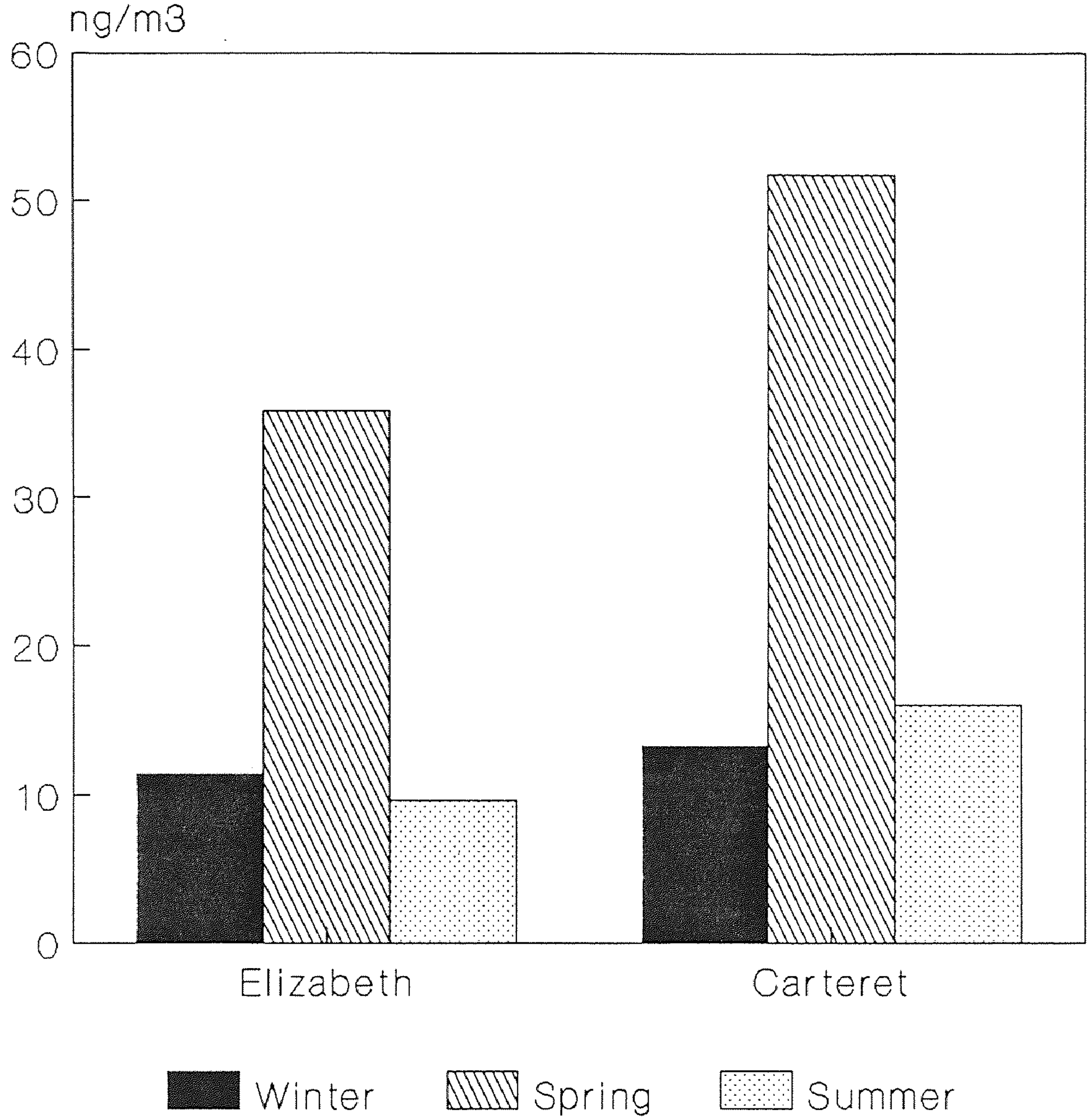
Winter Jan-Mar
Spring Apr-Jun
Summer Jul-Sep

Quarterly Averages 89
Copper



Winter Jan-Mar
Spring Apr-Jun
Summer Jul-Sep

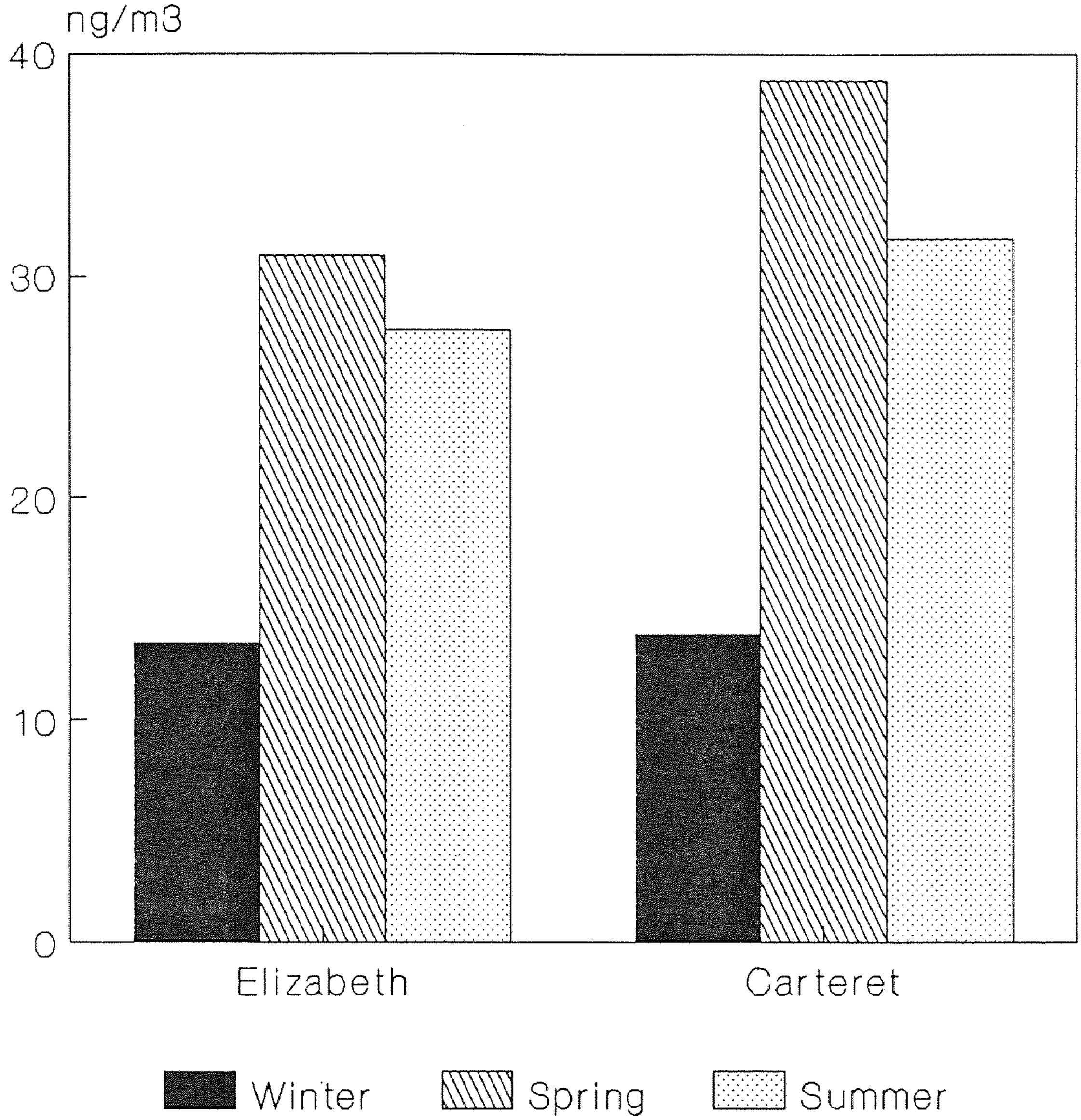
Quarterly Averages 89
Chromium



Winter Jan-Mar
Spring Apr-Jun
Summer Jul-Sep

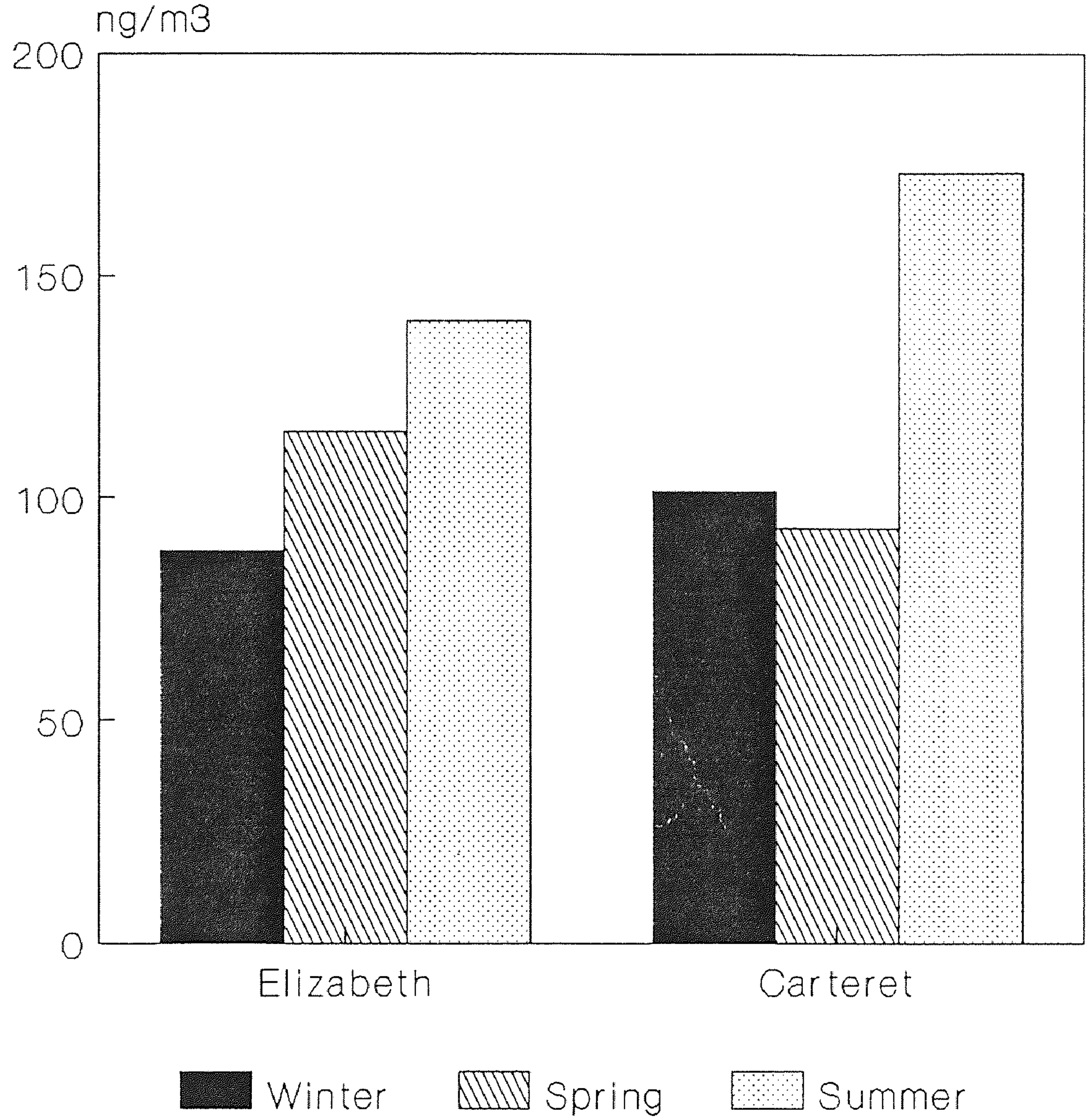
4.20

Quarterly Averages 89
Nickel



Winter Jan-Mar
Spring Apr-Jun
Summer Jul-Sep

Quarterly Averages 89
Zinc



Winter Jan-Mar
Spring Apr-Jun
Summer Jul-Sep

4.2 Overall Averages:

Table 4.6 illustrates the overall averaged concentrations of each metal for the two sampling sites presented in nanograms per cubic meter (ng/m^3). The data are based on a sampling duration of 24 hours for the 19 month sampling campaign in Elizabeth and for 27 months in Carteret.

The overall average concentration of Lead detected at each site is well below the EPA (quarterly average air quality standard of 1.5 ng/M^3 or 1500 ng/M^3. The Carteret site had the average of 53.67 ng/M^3 for 8 quarters and Elizabeth showed 29.6 ng/M^3 for 6 quarters. Elizabeth usually showed lower values of the target metal concentrations when compared to Carteret.

Iron showed 608.38 ng/M^3 for the Carteret site over 8 quarters and Elizabeth showed 495.45 ng/M^3 for 6 quarters. Here Elizabeth showed only slightly lower levels when compared with Carteret for 6 quarters.

Nickel at the Carteret site again showed higher concentrations 31.3 ng/M^3 for 5 quarters when compared with Elizabeth site 18.78 ng/M^3 for 5 quarters. Mercury showed high concentration for the Carteret site in 1 st quarter but this maybe an error which possibly occured during the first time of analysis. We did not consider this sample concentration in our data of the overall results.

The overall concentrations for each metal for the sites are illustrated graphically in figure 4. It is easily seen from the graphs that Carteret has the higher concentration for all metals except Zinc, where the data are nearly identical.

Cadmium concentrations at each site were relatively similar and constant values. Manganese showed constant values for both the sites when compared over the 5 quarters.

Lead showed a higher average concentration at Carteret 53.67 ng/m^3 than at Elizabeth, 29.6 ng/m^3. We suspect that the metal concentrations were higher at Carteret than at Elizabeth, because there is a higher particulate loading at Carteret. We are checking the data to verify this postulate.

Table 4.6

Overall Averages Concentrations (ng/M^3)

Metals	Elizabeth (1988-89)	Carteret (1987-89)
1) Cobalt	9.56	12.48′
2) Cadmium	1.78*	2.68′
3) Iron	495.95	608.38′
4) Mercury	0.56*	1.26"
5) Lead	29.6	53.67′
6) Manganese	16.4*	27.15′
7) Copper	44.6*	82.26′
8) Chromium	19.96*	27.16′
9) Nickel	18.78*	31.21′
10) Zinc	103.56	103.71′

Elizabeth - April 1988 to Sep 1989 (6 quarters)

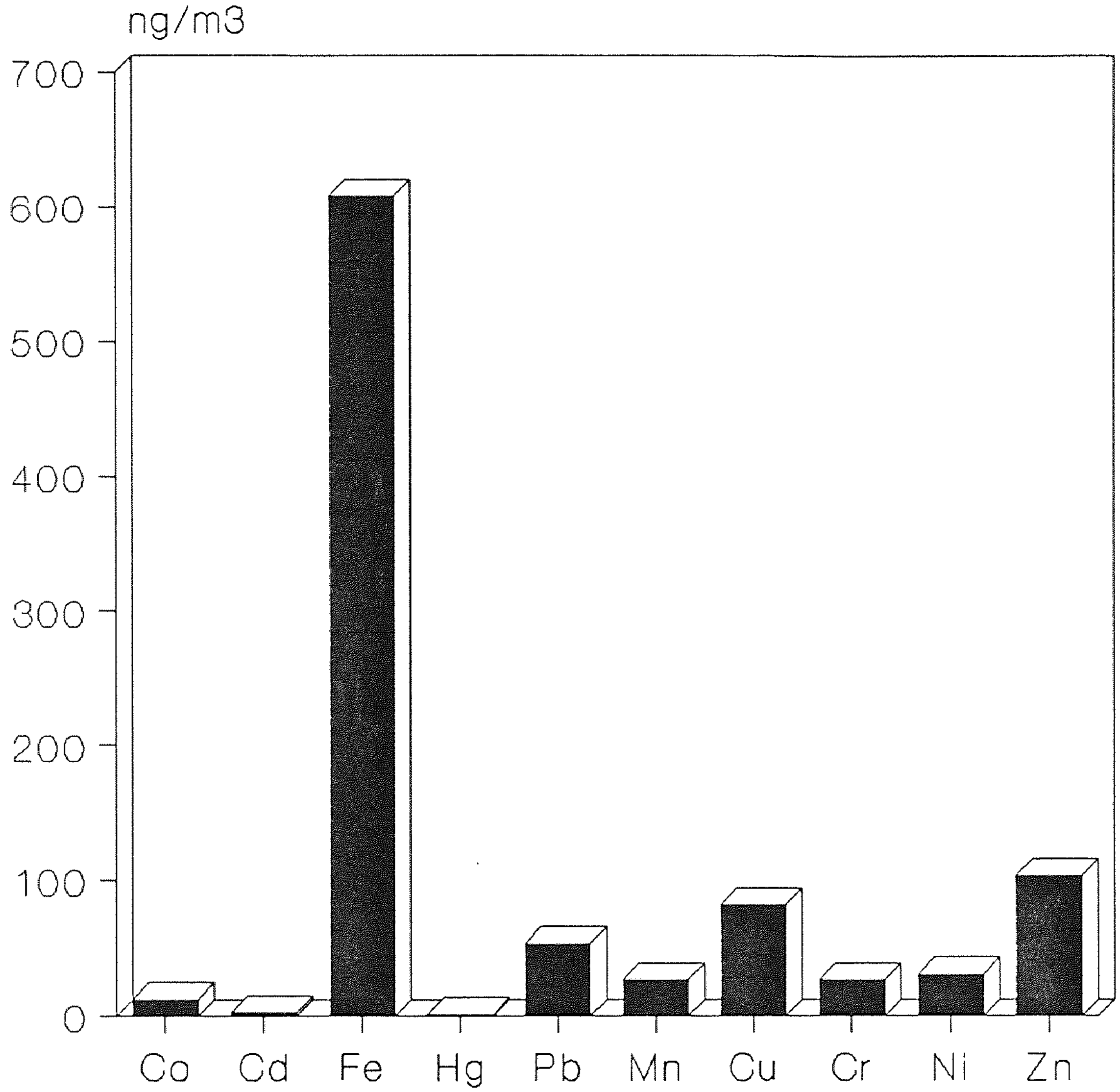
Carteret - July 1987 to Sep 1989 (9 quarters)

* Analysed for 5 quarters

′ Analysed for 8 quarters

" Analysed for 6 quarters

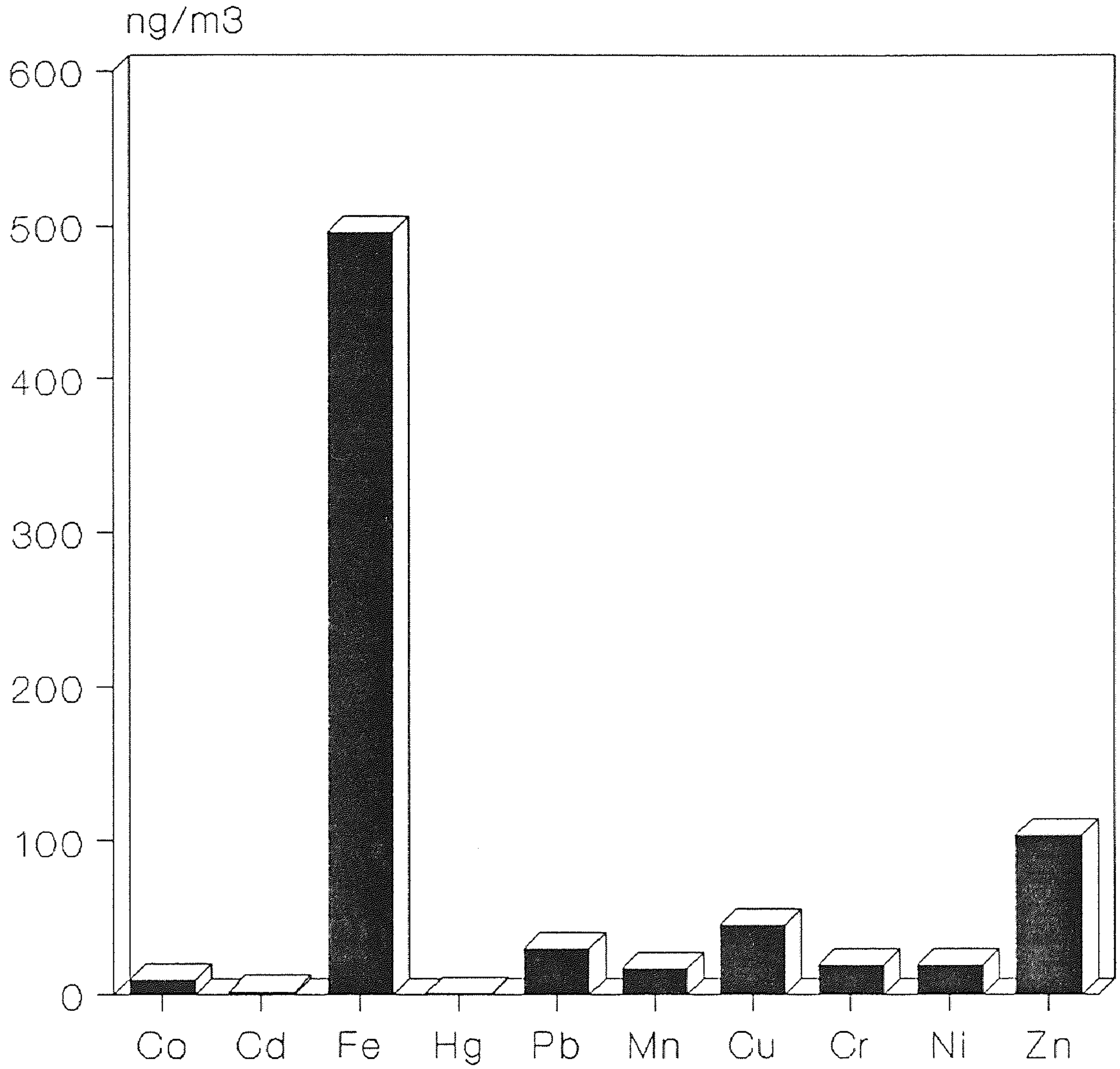
Overall Average
Concentrations



Carteret 1987-1989

FIG - 4.22

Overall Average
Concentrations



Elizabeth 1988-1989

FIG-4.23

4.3 Air Pollutant Wind Vectors or Air Pollutant Wind Roses

Atmospheric pollution modeling has become an integral part of environmental protection. [27] The model selected for application should be able to simulate diffusion for a range of meterological conditions, especially those associated with elevated pollution levels. Identifying the important meterological regimes, and therefore the appropriate atmospheric pollution model, can be determined from an air pollution climatology.

Wind direction is a troublesome variable when trying to validate or evalute atmospheric pollution models for point sources. An error as small as 5 degrees can alter concentration by 50%. Errors are likely to occur for several reasons: horizontal variation of the wind, vertical variation of the wind and temporal changes of the wind. [27]

Climatology deals with the description of meteorologic factors that are important in the occurrence of a large or undesirable concentration of atmospheric pollutants. Air Pollution climatologies deal basically with variables such as wind speed, wind direction, mixing height and stability class.

The United States Weather Bureau collects data routinely on the wind direction and intensity. The project or analysis outlined here is an excercise to determine whether pollutants are originating from any specific direction. The data collected by the weather bureau breaks the day into 8 three hour time periods; it therefore breaks any 24 hour period into 8 three hour periods, and gives direction of the wind (origin) in degrees from 0 to 360 degrees clockwise rotation from the North. The required information for this study of air pollutant concentration data and the wind information was collected from the Local Climatological Data Site, Newark, N.J.

The analysis results in a set of vectors, with length proportional to pollutant species originating from each wind direction. For convenience and practicality the 360 degrees of a circle are grouped into 8 wind sectors. The sectors North, Northeast, East, Southeast, South, Southwest, West and Northwest are abbreviated N, NE, E, SE, S, SW, W, NW respectively.

Each sector incorporates 45 degrees + or - 22.50 from its center line. For example North, encompasses 337.5 to 22.5 degrees, with a center of 0 while Northeast encompasses 22.5 to 67.5, with a center of 45 etc.

Table 4.9.1 illustrates a sample data set with the date sampled, concentration of the metal for the specified day, and the number of times wind came from different directions.

Table 4.9.2 illustrates the total number of times the wind originated from a given sector during the specified sampling period as a Wind Sum (WS). The windsum table can be represented as WS (J,N), where J is the number of days sampled, and N is number of wind directions, N = 8.

We use the array (WS) to weight the pollutant concentrations and tell us something about the direction of origin. This is done by multiplying each WS term by the concentration for the corresponding day (J), which results then in a Concentration Wind vector (CW).

The relative wind vectors can now be obtained by dividing Sum WS (N) by the concentration vector Sum CW (N) to get a pollutant Vector , WV(N).

$$WV(N) = \frac{\text{Sum } WS(N)}{\text{Sum } CW(N)}$$

This Pollutant Vector WV(N) is shown in Table 4.9.2. From this table we can interpret that the maximum concentration of the particular metal (Lead) is from the direction North which is illustrated in the Fig 4.9.2

The above mentioned tables are listed in the appendix for the 10 metals, through each season in 1988 for the sites Elizabeth and Carteret. The wind vectors for all the metals are illustrated in the following figures 4.9.2 for the different seasons.

Carteret 1988: The wind vectors data for each metal for one year are shown in Table 4.7

TABLE- **4.7**

Carteret 1988

Wind Vectors

Metal	N	NE	E	SE	S	SW	W	NW
Pb	89.76;	41.06;	48.38;	57.56;	46.00;	44.96;	32.90;	82.60
Fe	689.56;	580.73;	606.36;	622.53;	653.80;	525.00;	500.90;	779.60
Zn	93.10;	77.66;	85.53;	100.60;	100.60;	103.20;	79.13;	89.83
Mn	26.70;	17.23;	18.66;	23.10;	22.53;	16.36;	21.13;	35.56
Cr	28.13;	27.06;	34.40;	30.36;	26.80;	28.53;	33.23;	34.10
Cd	2.93;	2.73;	2.80;	3.83;	2.56;	2.06;	2.06;	3.46
Ni	35.96;	60.56;	70.96;	65.60;	50.53;	37.20;	24.10;	28.83
Cu	149.50;	135.63;	85.23;	103.50;	124.30;	110.16;	82.3;	124.56
Hg	3.45;	3.85;	5.56;	3.40;	2.20;	2.05;	1.90;	2.55
Co	14.03;	8.56;	8.00;	9.70;	8.23;	8.33;	6.20;	11.86

The following illustrates the high level and low level pollutant for each metal in each directions.

Carteret 1988

Metal	N	NE	E	SE	S	SW	W	NW
Pb	H	L					L	H
Fe	H	L				L	L	H
Zn		L		H	H	H	L	
Mn	H	L				L		H
Cr		L	H				H	H
Ni			H	H			H	H
Cu	H	H		L			L	
Hg			H				L	
Co	H						L	H

H = high level pollutant vector

L = Low level pollutant vector

Pb - trend of higher values in North and Northwest directions.

Cd - Relatively uniform levels in all directions, high South west and North west.

Hg - Similar values in all directions, high values East and low is West.

Elizabeth 1988: Yearly Windvectors for Elizabeth are presented in Table 4.8.

Table 4.8

Elizabeth 1988

Wind Vectors

Metal	N	NE	E	SE	S	SW	W	NW
Pb	38.60;	39.25;	27.70;	35.65;	36.55;	31.50;	27.40;	40.75
Fe	407.30;	392.20;	358.95;	446.20;	550.55;	421.70;	382.15;	448.85
Zn	109.75;	168.95;	97.35;	133.75;	132.60;	97.20;	94.85;	97.60
Mn	35.20;	41.70;	42.20;	42.70;	46.20;	37.10;	37.90;	34.20
Ni	11.70;	10.00;	13.10;	10.60;	9.30;	7.60;	6.80;	6.50
Cu	33.90;	24.50;	21.40;	22.70;	35.80;	53.00;	47.00;	33.30
Co	7.70;	4.30;	2.80;	6.00;	8.30;	8.20;	6.15;	11.10
Hg	0.70;	0.60;	0.70;	0.70;	0.70;	0.70;	0.80;	0.70
Cr	4.40;	7.70;	3.50;	3.60;	6.20;	6.50;	7.10;	5.20
Cd	1.55;	2.40;	0.45;	1.75;	2.25;	1.20;	2.00;	1.80

The following shows the high and low levels for each metal and direction.

Elizabeth 1988

Metal	N	NE	E	SE	S	SW	W	NW
Pb		H	L				L	H
Fe			L		H		L	H
Zn		H		H			L	
Mn						L		H
Cr	L	H					W	
Cd		H	L		H			
Ni	H		H					L
Cu			L			H	H	
Hg		L					H	
Co			L			H		H

H = high level pollutant vectors.

L = low levels pollutant vectors.

Co-definite trend of high for SW and W low from NE and SE

Fe-relatively uniform level in all directions high from South.

Hg- relatively uniform levels in all directions.

Pb-High in North and South directions and low in East and West directions.

Mn-Higher levels for Northeast and South.

Cr-Trends of higher values for South and West with single vector to Northwest also.

Ni-Definite trend high volume North through Southeast.

Zn- High values from North through South.

Table - 4.9.1

SITE - Carteret Year - 1988

Metal - Lead

Period: Jan 1988 - Dec 1988

Sam. No.	Date	Pb Conc. ng/m3	N	NE	E	SE	S	SW	W	NW
			Wind			Direction *				
1	1/04/88	23.5	3	0	0	0	0	1	4	0
2	1/10/88	981.7	4	0	0	0	0	0	0	4
3	1/16/88	51.2	0	0	0	0	6	2	0	0
4	1/22/88	67.5	3	0	0	0	0	0	2	2
5	1/28/88	85.8	0	0	0	0	0	3	3	1
6	2/03/88	89.2	2	2	3	1	0	0	0	0
7	2/09/88	62.0	3	1	0	1	3	0	0	0
8	2/15/88	53.9	0	1	0	0	6	0	0	0
9	2/21/88	8.3	0	0	0	0	0	0	5	3
10	2/27/88	122.9	1	1	1	4	1	0	0	0
11	3/03/88	60.0	4	4	0	0	0	0	0	0
12	3/10/88	99.3	3	0	0	0	0	0	0	5
13	3/16/88	21.2	0	0	0	0	0	0	1	7
14	3/22/88	47.0	4	0	0	0	0	0	1	3
15	3/28/88	6.4	1	0	0	0	0	0	3	3
16	4/03/88	9.2	0	1	5	2	0	0	0	0
17	4/09/88	13.4	3	0	0	0	0	0	0	5
18	4/15/88	20.2	1	0	2	3	2	0	0	0
19	4/21/88	50.9	1	0	0	0	2	1	0	4
20	4/27/88	41.1	0	0	1	3	3	1	0	0
21	5/03/88	13.6	0	3	1	0	0	2	1	0
22	5/09/88	40.9	0	0	0	6	1	0	0	0
23	6/14/88	33.2	0	0	0	0	0	4	4	0
24	6/20/88	20.8	0	0	0	0	2	6	0	0
25	6/28/88	60.1	3	0	0	0	2	3	0	0
26	7/02/88		1	0	0	0	0	0	0	7
27	7/08/88		0	0	1	4	0	2	1	0
28	7/14/88		0	0	0	1	2	5	0	0
29	8/01/88		0	0	0	3	4	0	0	0
30	8/07/88		0	0	0	0	1	0	5	2
31	8/13/88		0	0	0	0	0	6	2	0
32	8/19/88		4	0	0	0	2	1	0	0
33	8/25/88		1	0	0	3	4	0	0	0
34	8/31/88		3	1	0	0	0	1	1	2
35	9/06/88		0	0	0	0	0	0	3	5
36	9/12/88		1	0	0	0	2	2	1	1
37	9/18/88		0	0	0	0	0	7	1	0

Table - 4.9.1 (contd)

Sam. No.	Date	Conc ng/M3	N	NE	E	SE	S	SW	W	NW
38	9/24/88		5	0	0	0	0	1	1	1
39	9/30/88		0	0	0	0	1	7	0	0
40	10/06/88	46.6	0	0	0	0	0	1	2	5
41	10/12/88	35.6	0	0	0	0	0	2	6	0
42	10/18/88	48.1	1	0	0	1	4	2	0	0
43	10/24/88	37.8	0	0	0	0	4	1	2	1
44	10/30/88	41.2	3	0	0	0	0	0	1	4
45	11/05/88	27.6	1	0	3	3	1	0	0	0
46	11/11/88	40.3	1	0	0	0	0	2	1	4
47	11/17/88	36.8	0	0	0	0	3	0	4	1
48	11/23/88	42.1	1	1	0	0	1	2	2	0
49	11/29/88	33.2	0	0	0	0	0	2	5	1
50	12/05/88	33.5	0	0	0	0	0	4	4	0
51	12/11/88	34.5	2	0	0	0	0	1	0	5
52	12/17/88	40.9	5	0	1	0	0	0	0	2
53	12/23/88	35.5	1	2	1	2	0	1	1	0
54	12/29/88	38.5	0	0	0	0	0	1	4	3

* # of 3 hour periods per 24 hour period that the wind originated from indicated direction.

Data from National Weather Service Data Station Newark Airport.

AL: b CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Carteret

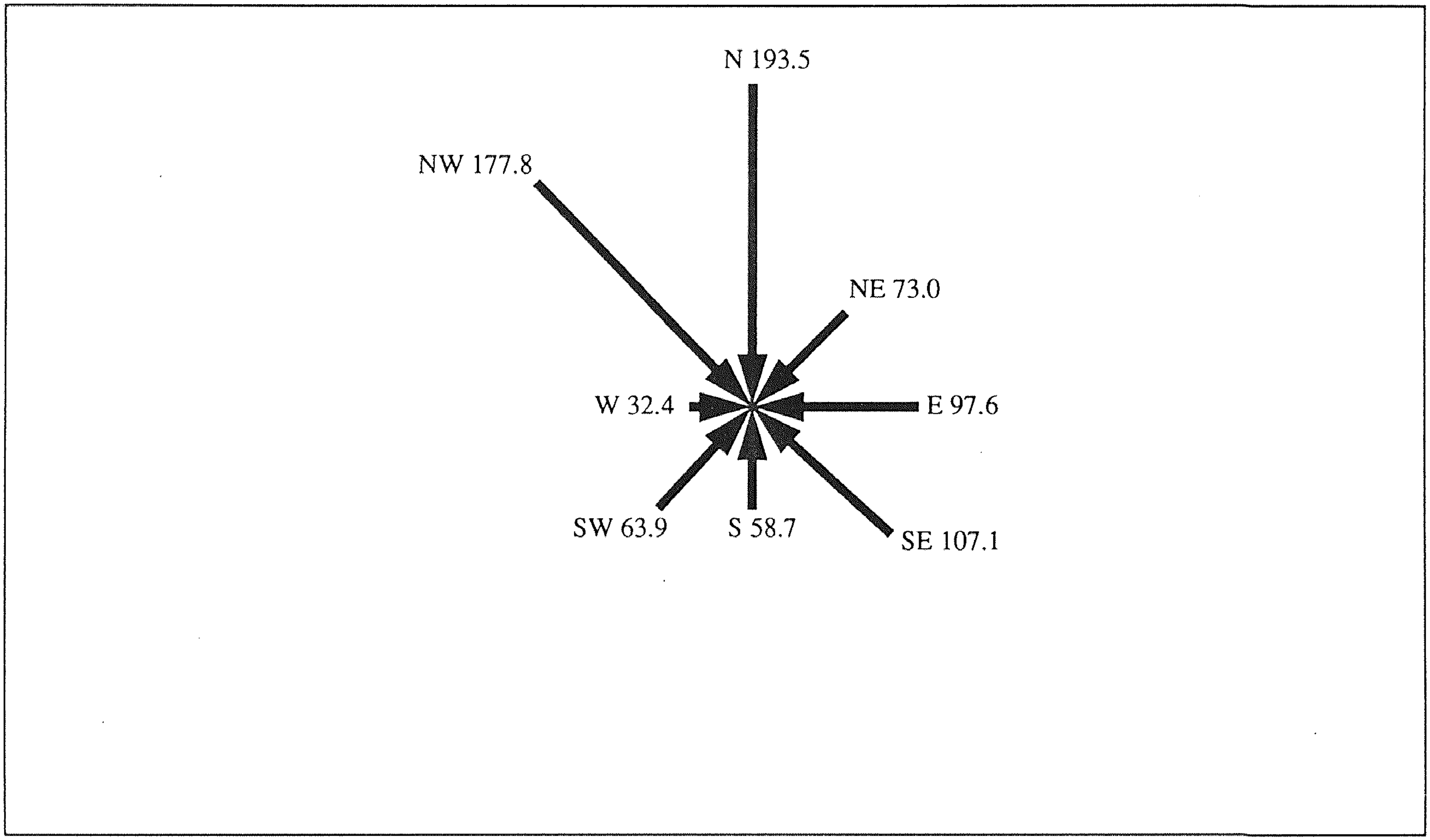
SAMPLE	N	NE	E	SE	S	SW	W	NW
1	70.5	0.0	0.0	0.0	0.0	23.5	94.0	0.0
2	3926.8	0.0	0.0	0.0	0.0	0.0	0.0	3926.8
3	0.0	0.0	0.0	0.0	307.2	102.4	0.0	0.0
4	202.5	0.0	0.0	0.0	0.0	0.0	135.0	135.0
5	0.0	0.0	0.0	0.0	0.0	257.4	257.4	85.8
6	178.4	178.4	267.6	89.2	0.0	0.0	0.0	0.0
7	186.0	62.0	0.0	62.0	186.0	0.0	0.0	0.0
8	0.0	53.9	0.0	0.0	323.4	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	41.5	24.9
10	122.9	122.9	122.9	491.6	122.9	0.0	0.0	0.0
11	240.0	240.0	0.0	0.0	0.0	0.0	0.0	0.0
12	297.9	0.0	0.0	0.0	0.0	0.0	0.0	496.5
13	0.0	0.0	0.0	0.0	0.0	0.0	21.2	148.4
14	188.0	0.0	0.0	0.0	0.0	0.0	47.0	141.0
15	6.4	0.0	0.0	0.0	0.0	0.0	19.2	19.2
C VECTORS	%5419.4	657.2	390.5	642.8	939.5	383.3	615.3	%4977.6
D VECTORS	193.5	73.0	97.6	107.1	58.7	63.9	32.4	177.8

cessing complete...Press...<<ENTER>>...<f2>>.....to repeat.
This is your completed concentration vector and wind vector table.

4.9.2

Metal: Lead

Winter (January - March) 1988



Site: Carteret **Units - ng/m3**

Metal: Lead

Year - 1988

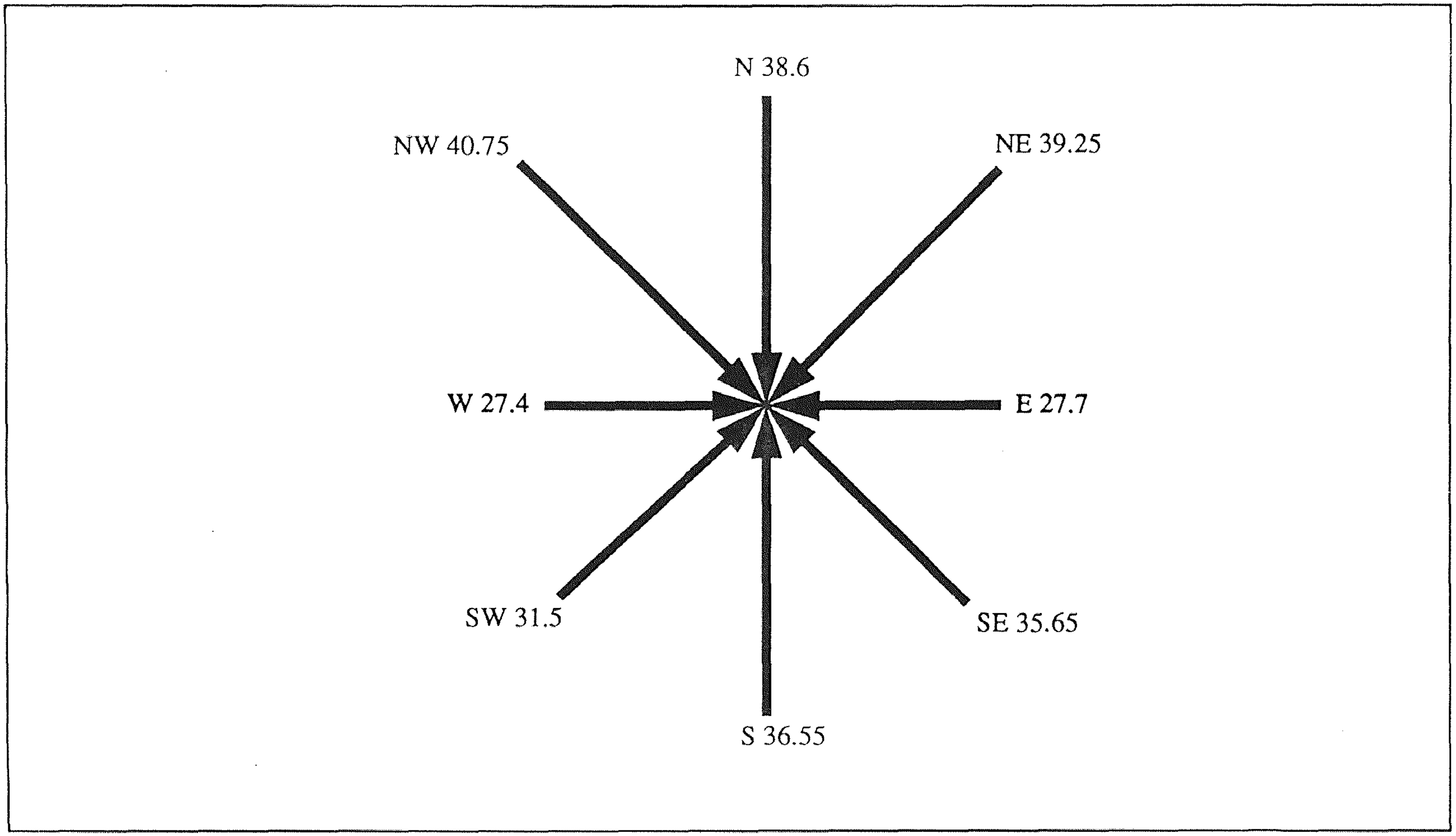


Figure 4.24.

Site: Eli zabeth Units - ng/m3

Metal: Iron
Year - 1988

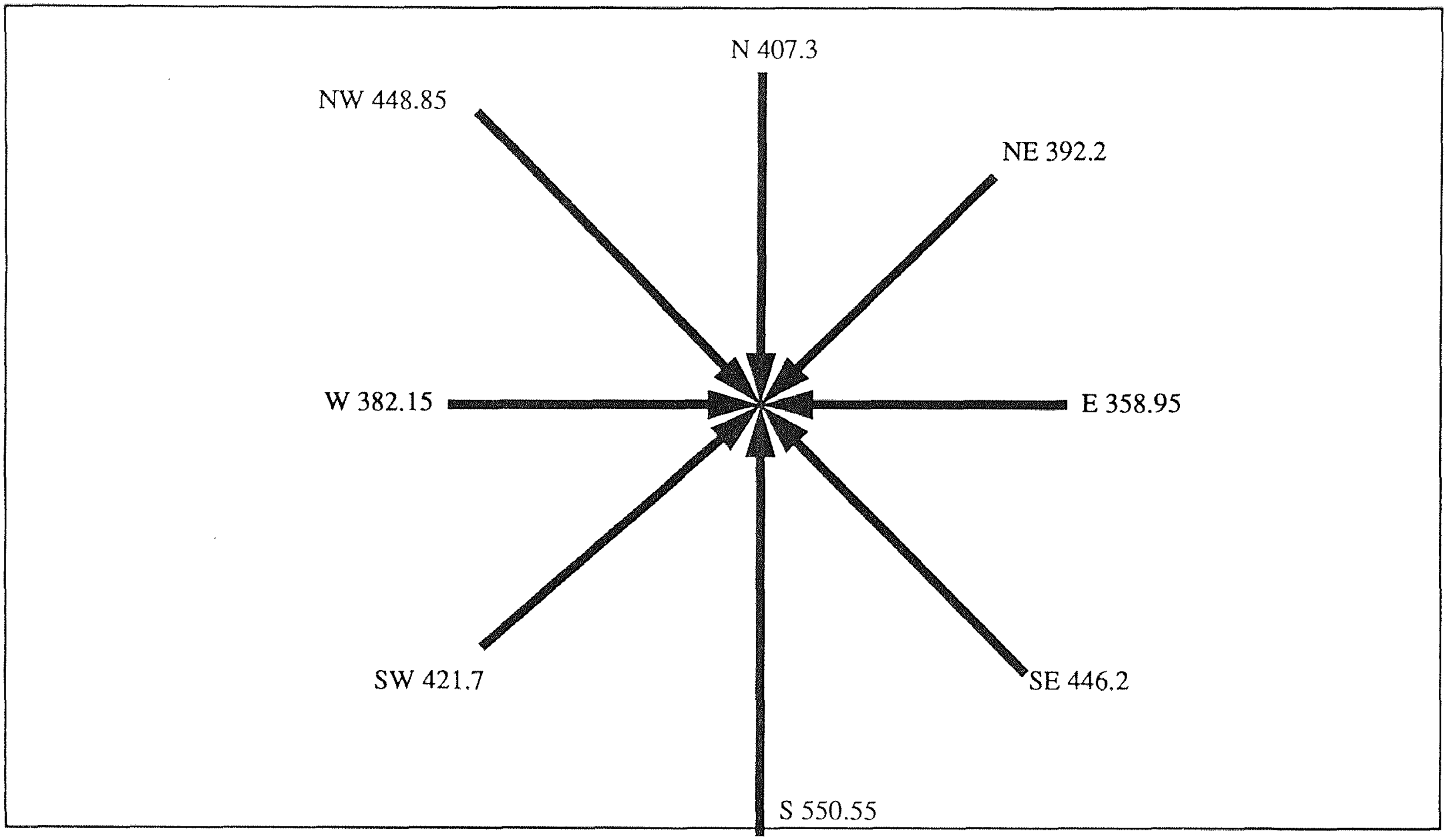


Figure 4.25

Site: Elizabeth Units - ng/m3

Metal: Zinc
Year - 1988

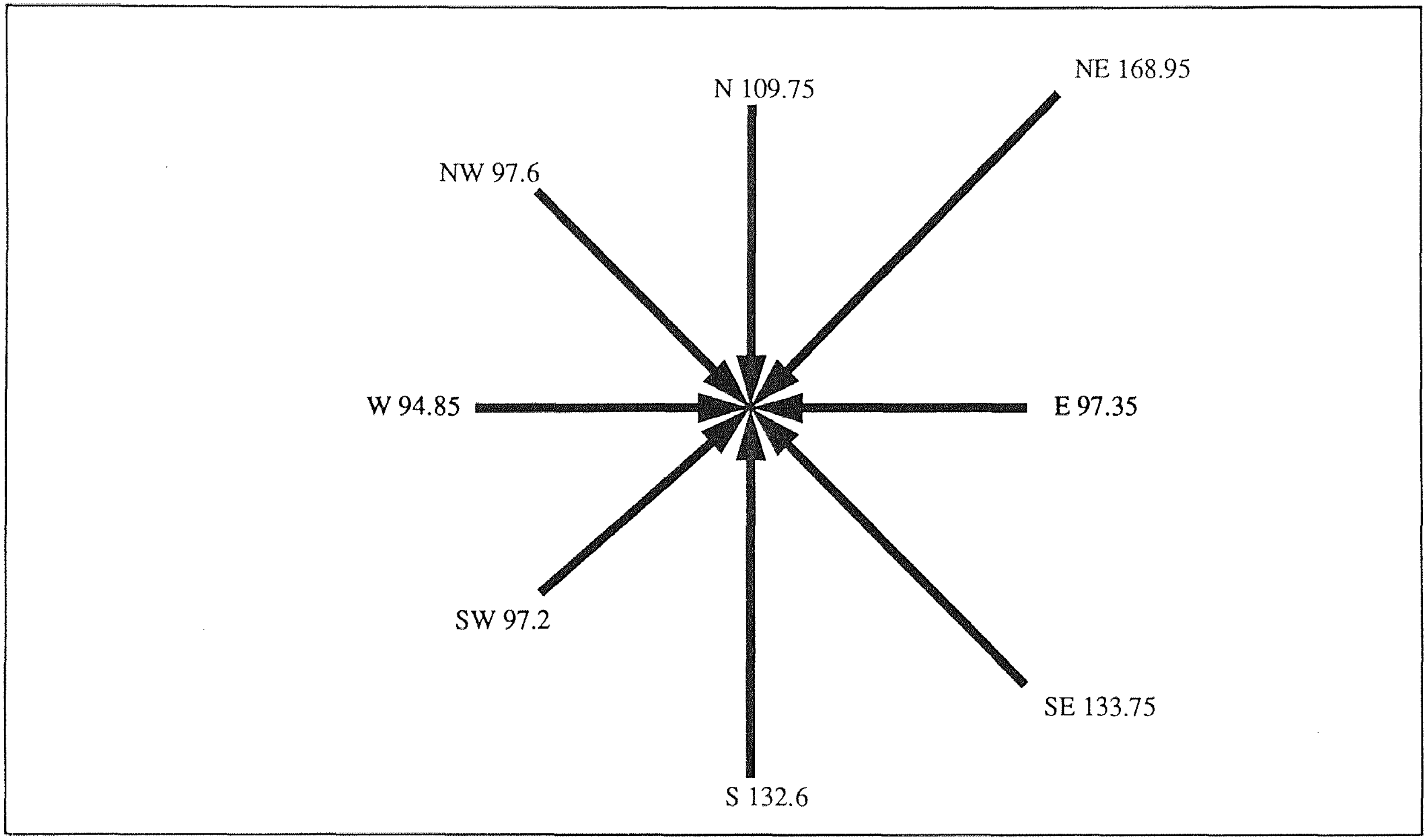


Figure 4.26

Site: Elizabeth Units - ng/m^3

Metal: Cobalt
Year - 1988

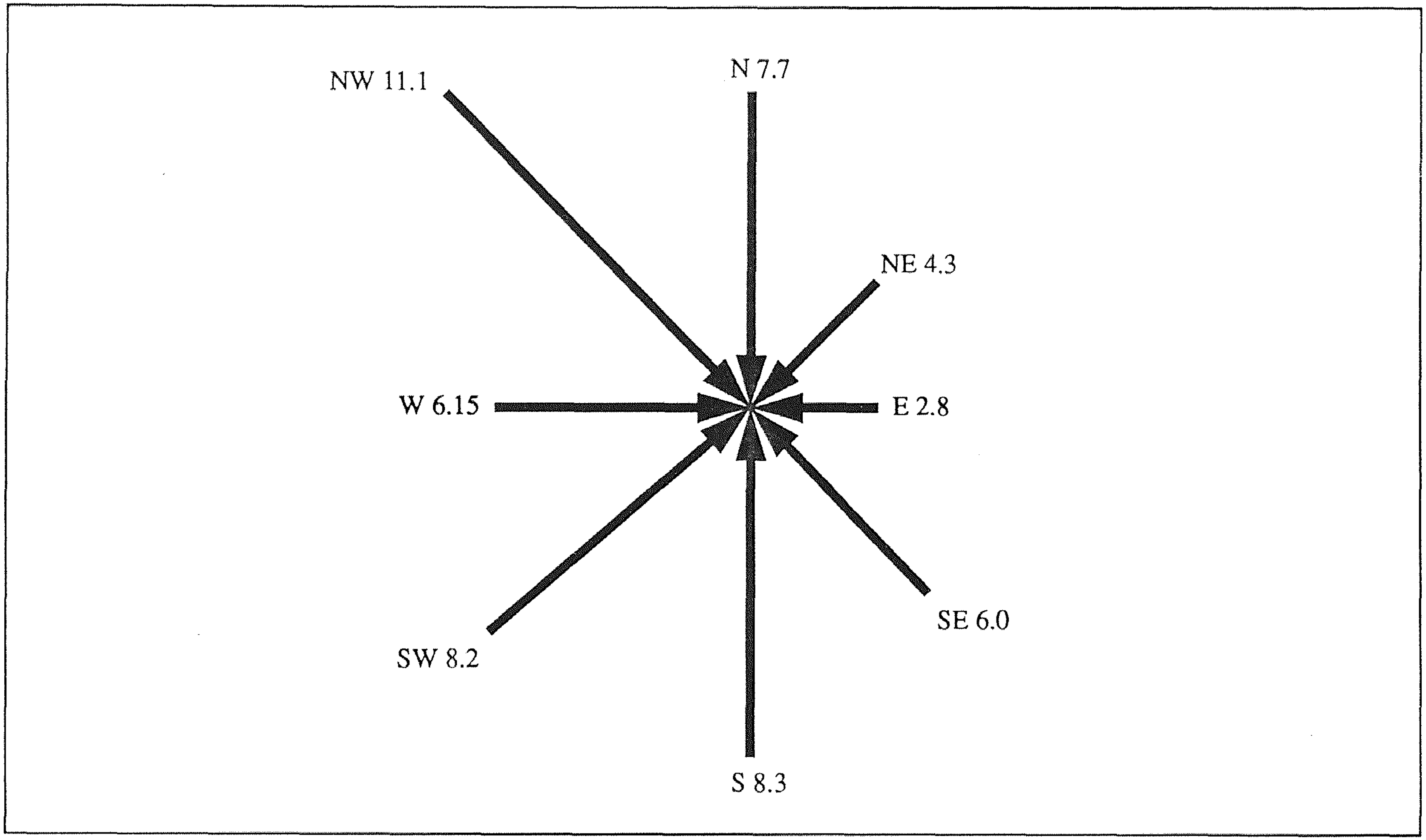


Figure 4.27

Site: Elizabeth Units - ng/m3

Metal: Cadium
Year - 1988

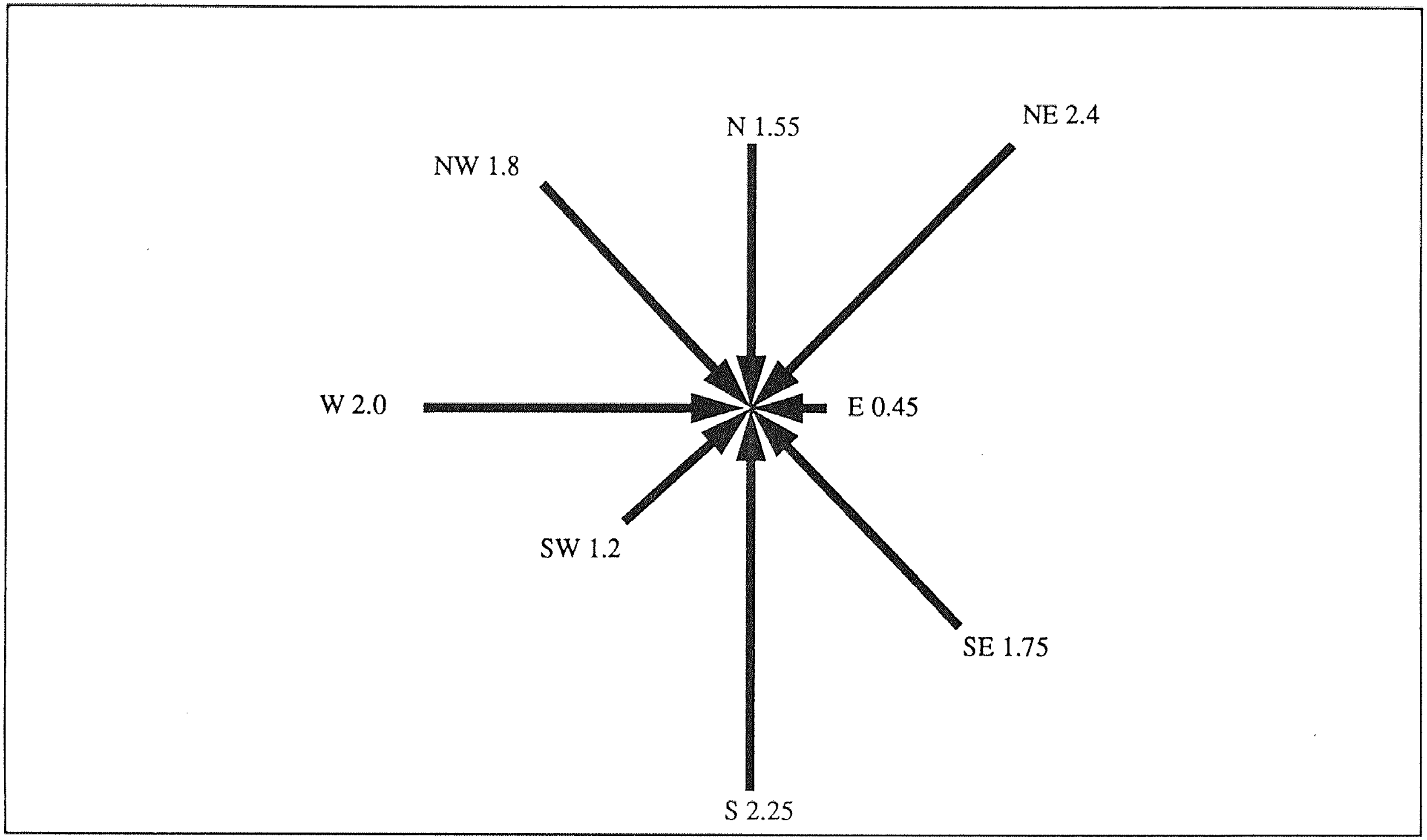


Figure 4.28

Site: Elizabeth   Units - ng/m^3

Metal: Manganese
Year 1988

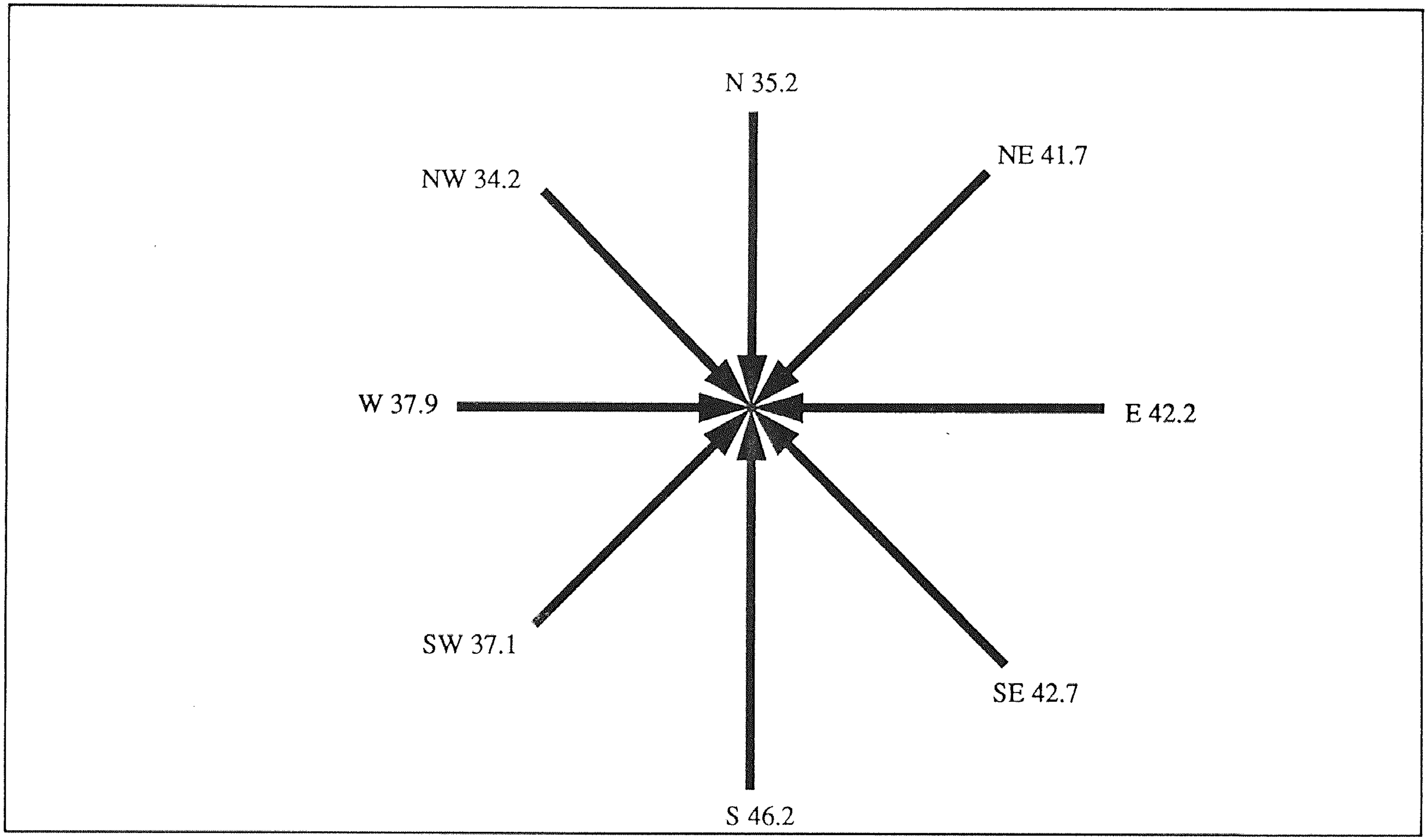


Figure 2.29

Site: Elizabeth Units - ng/m^3

Metal: Nickel

Year - 1988

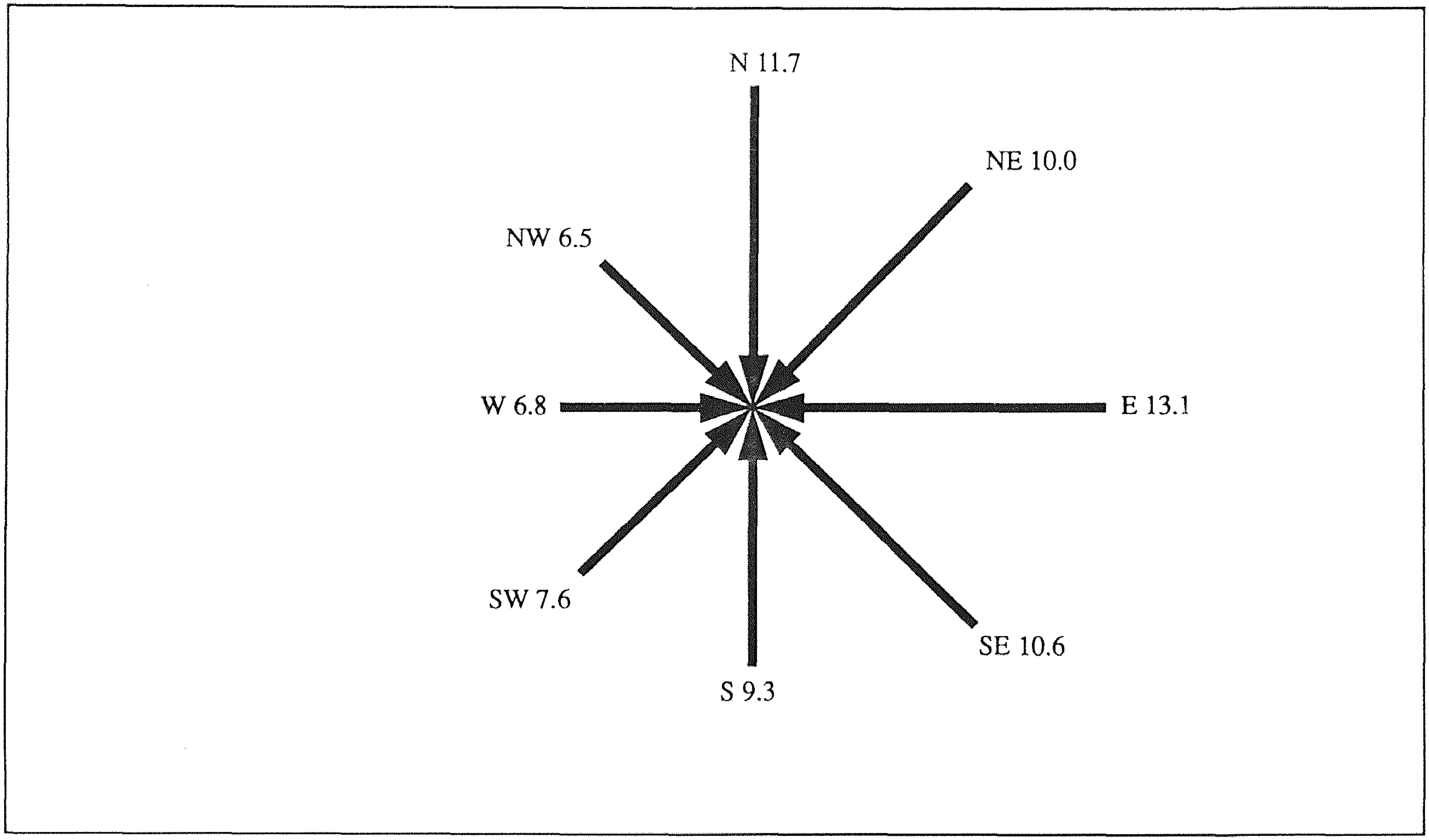


Figure 4.30

Site: Elizabeth Units - ng/m^3

Metal: Copper

Year - 1988

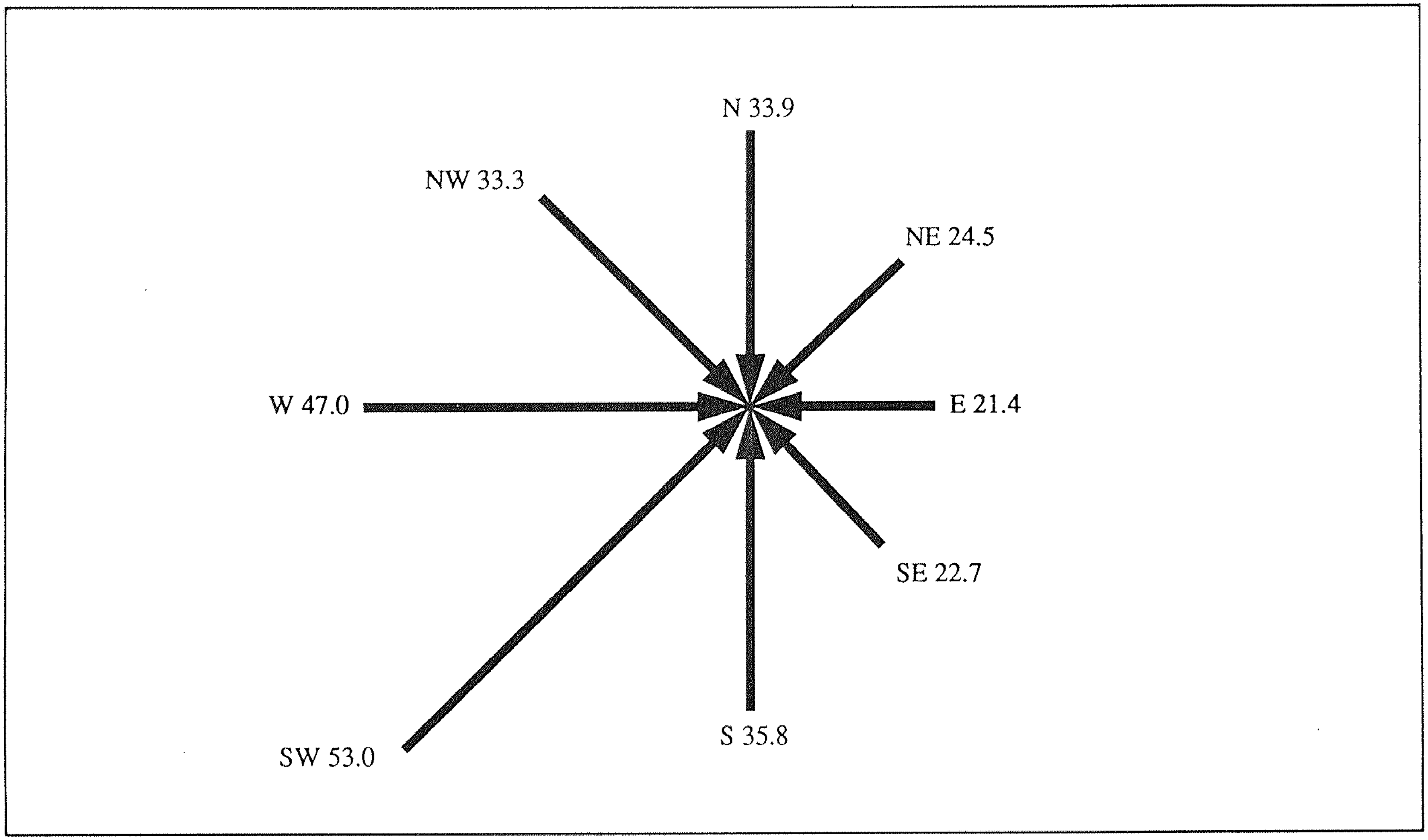


Figure 4.31

Site: Elizabeth Units - ng/m3

Metal: Mercury
Year - 1988

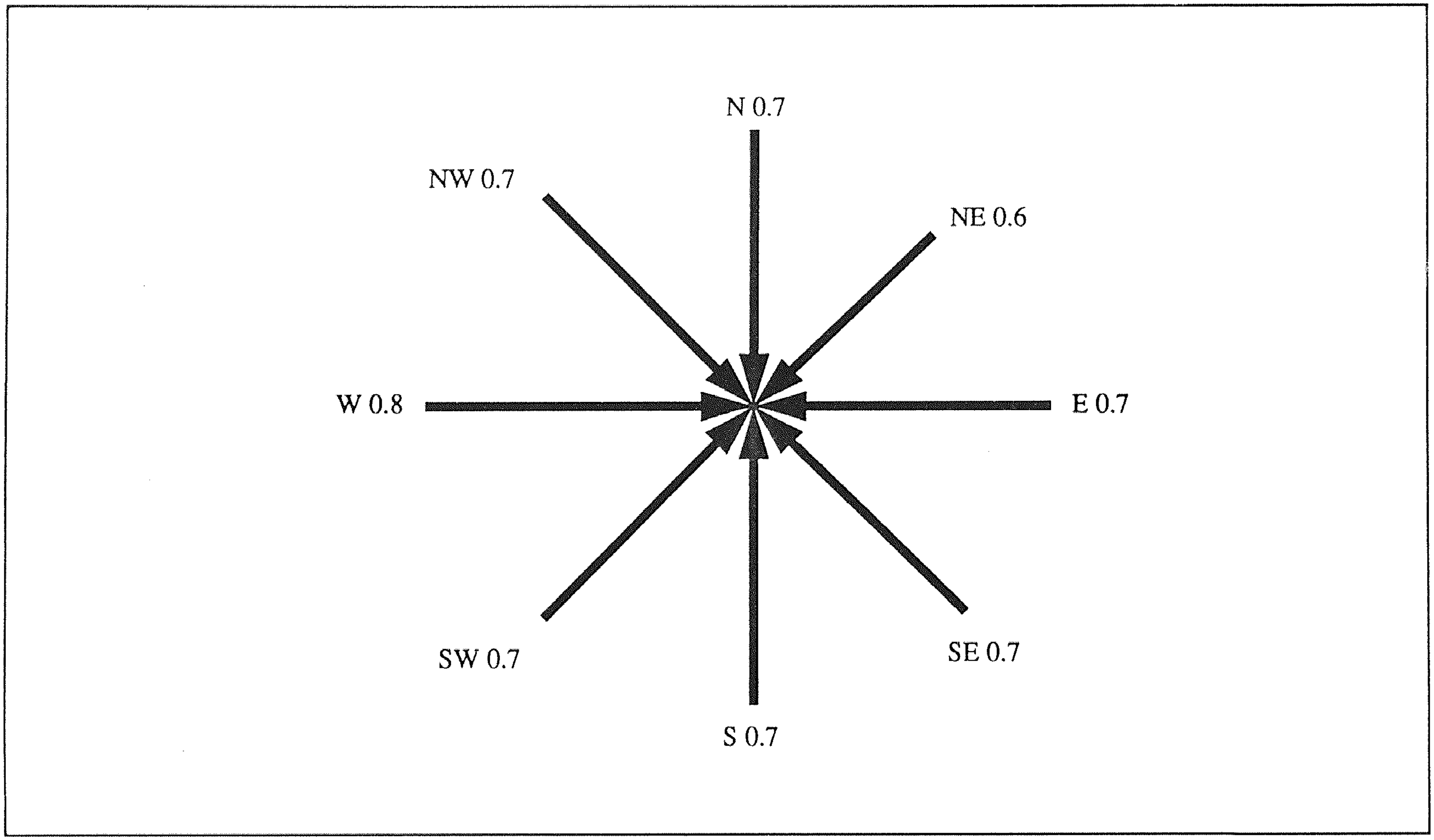


Figure 4.32

Site: Elizabeth Units - ng/m^3

Metal: Mercury
Year - 1988

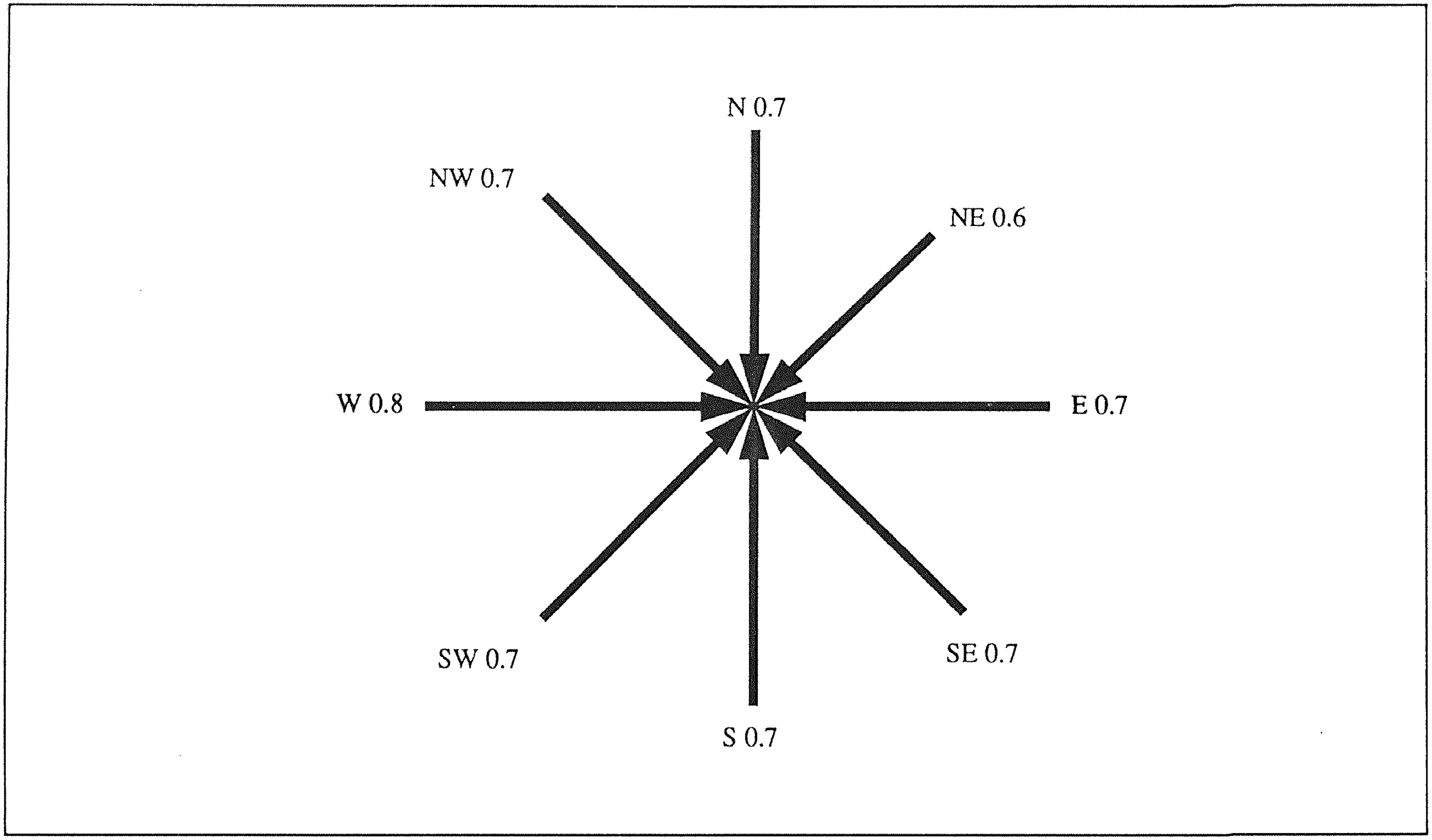


Figure 4.33

Site: Elizabeth   Units - ng/m^3

9c

Metal: Chromium
Year - 1988

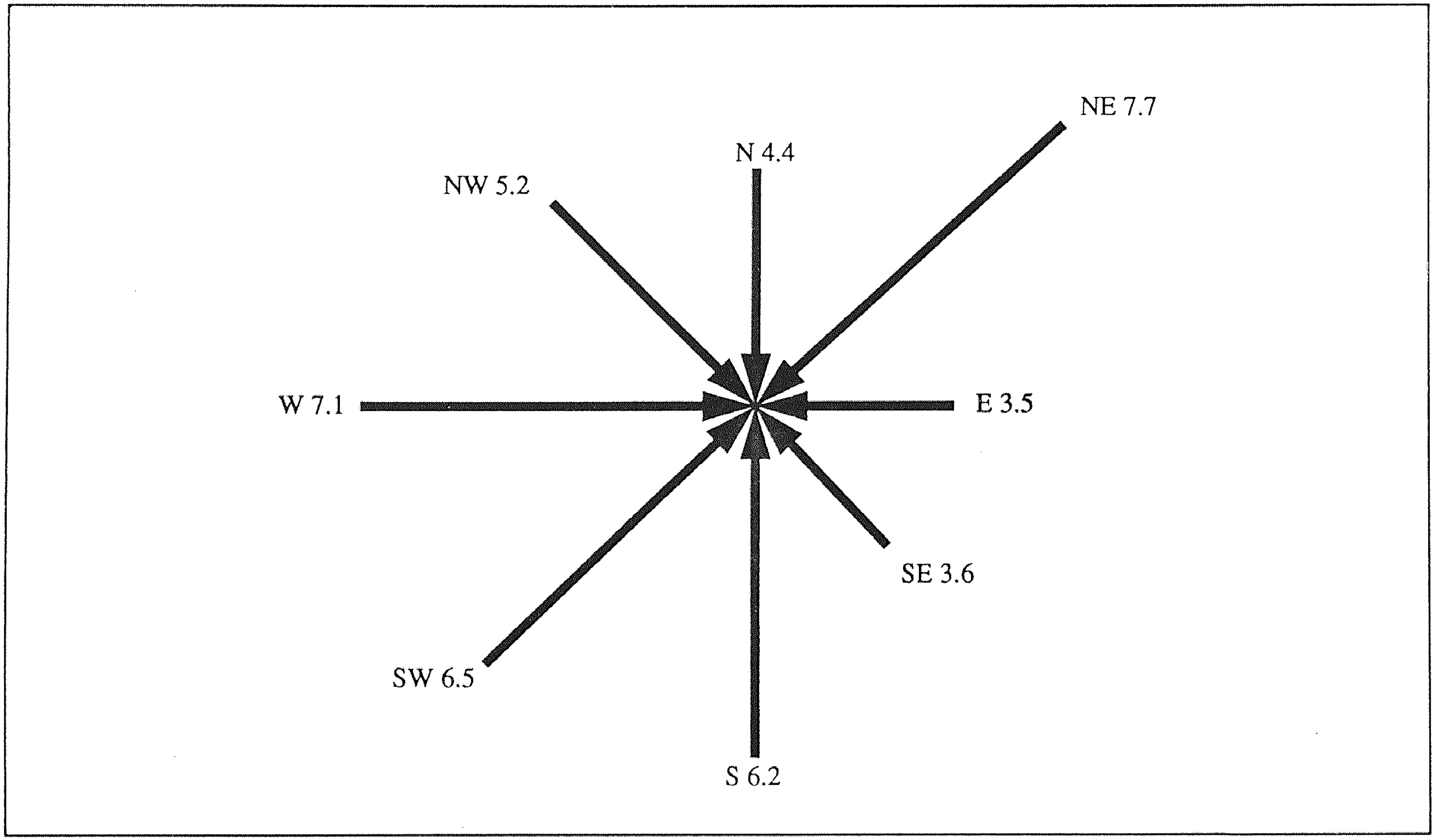


Figure 4.34.

Site: Elizabeth Units - ng/m^3

Metal: Lead
Year - 1988

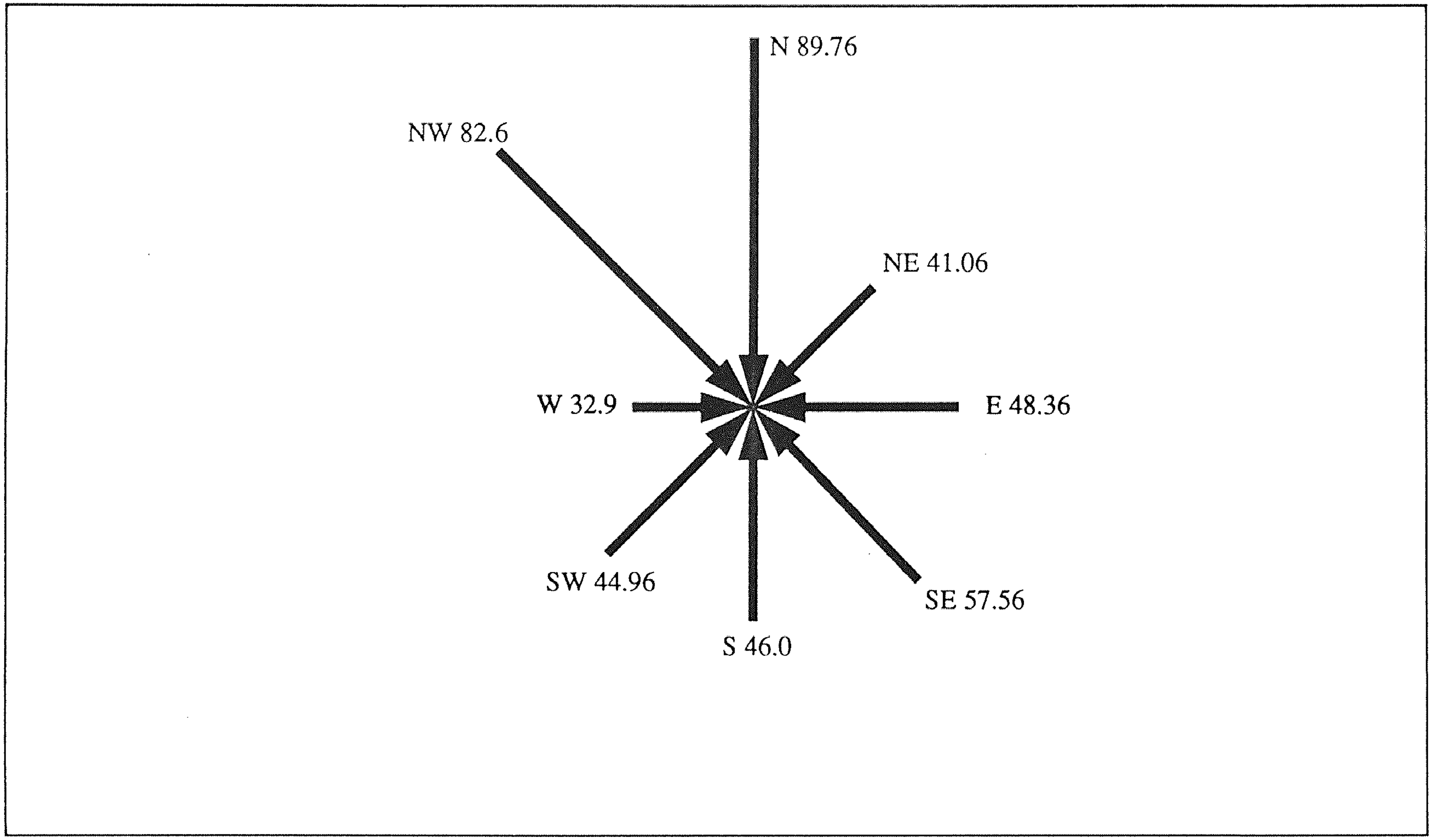


Figure 4.35

Site: Cartaret Units - ng/m^3

Metal: Iron

Year - 1988

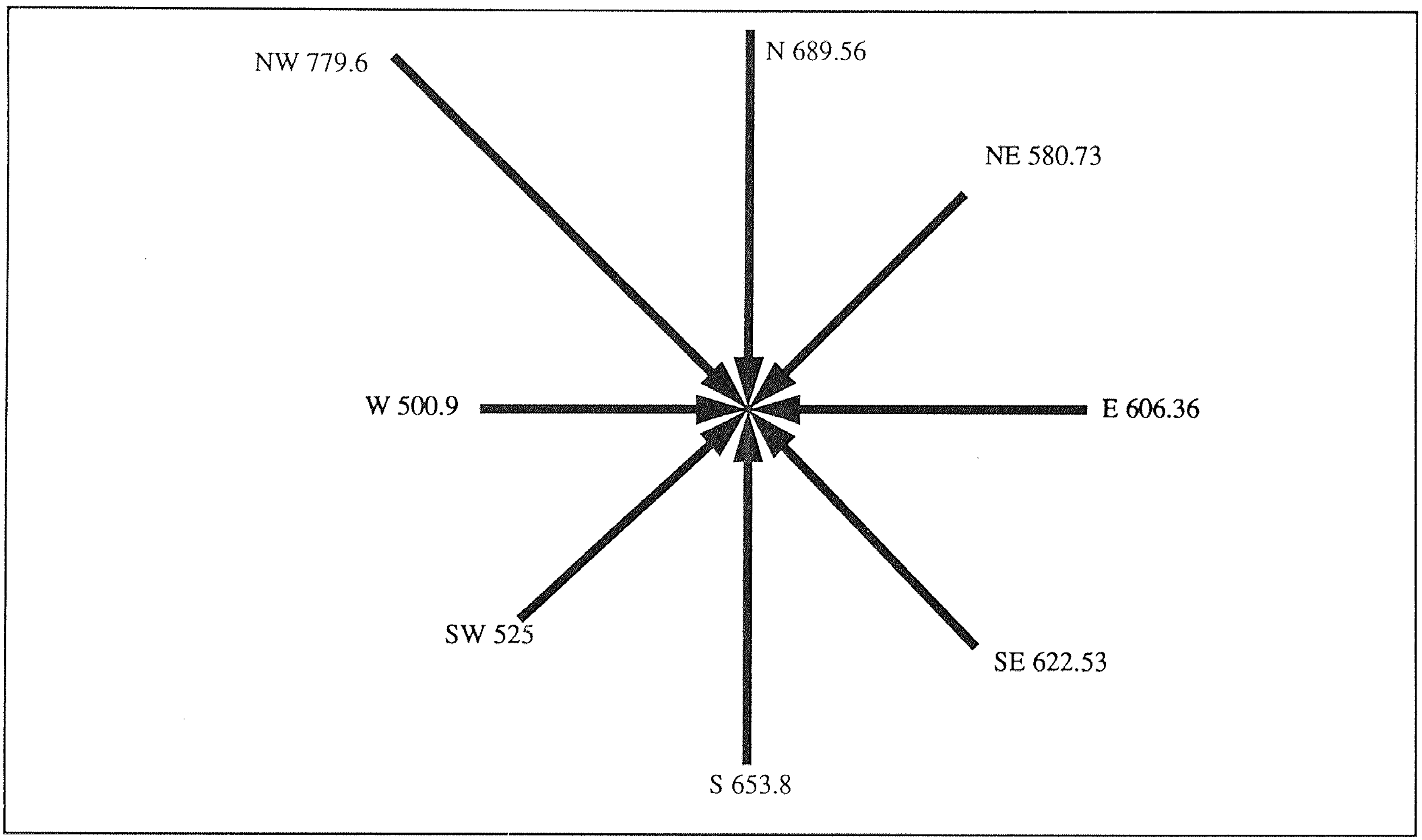


Figure 4.3.6

Site: Cartaret **Units - ng/m3**

Metal: Zinc
Year - 1988

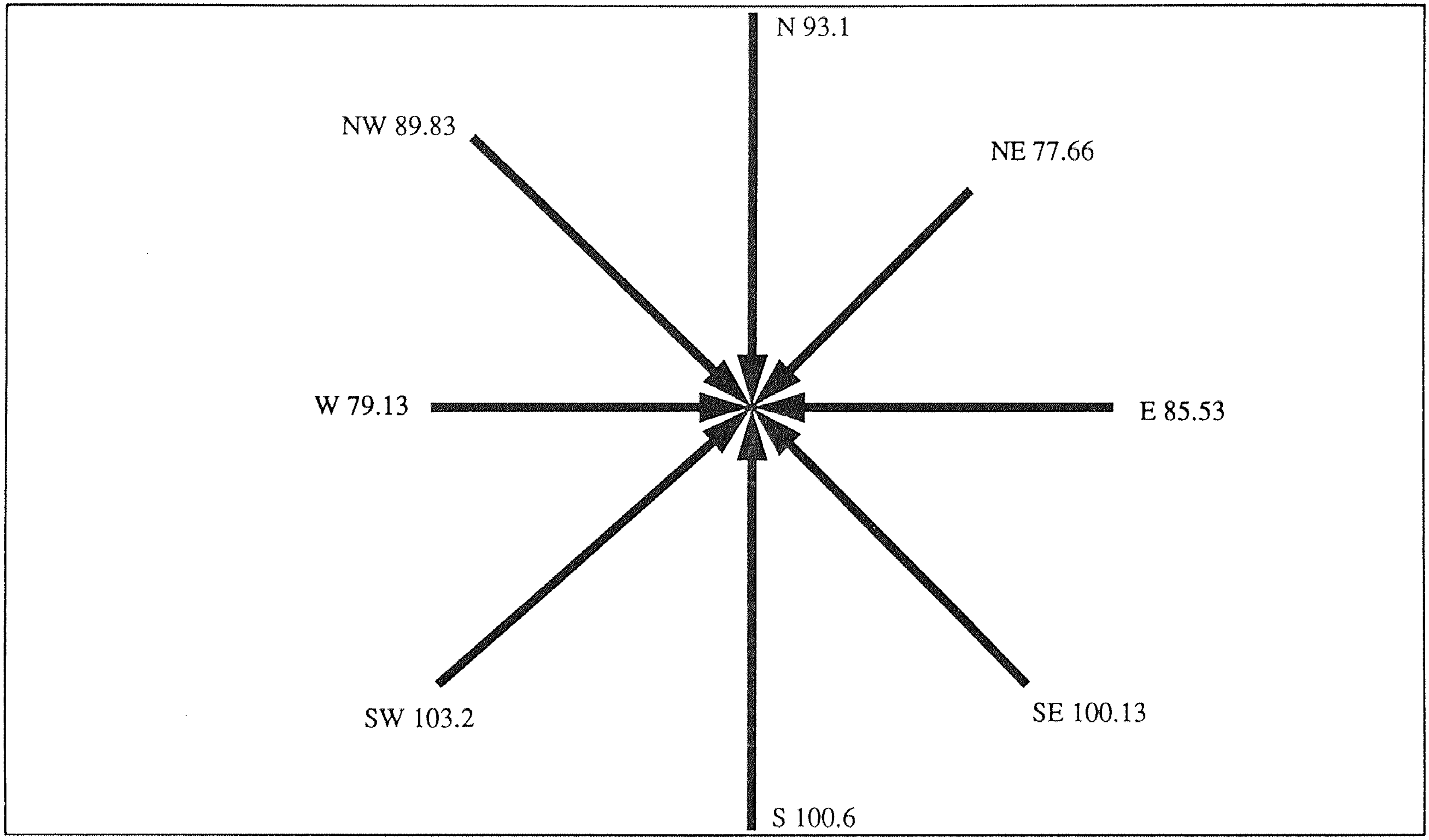


Figure 4.37

Site: Cartaret Units - ng/m^3

Metal: Manganese

Year - 1988

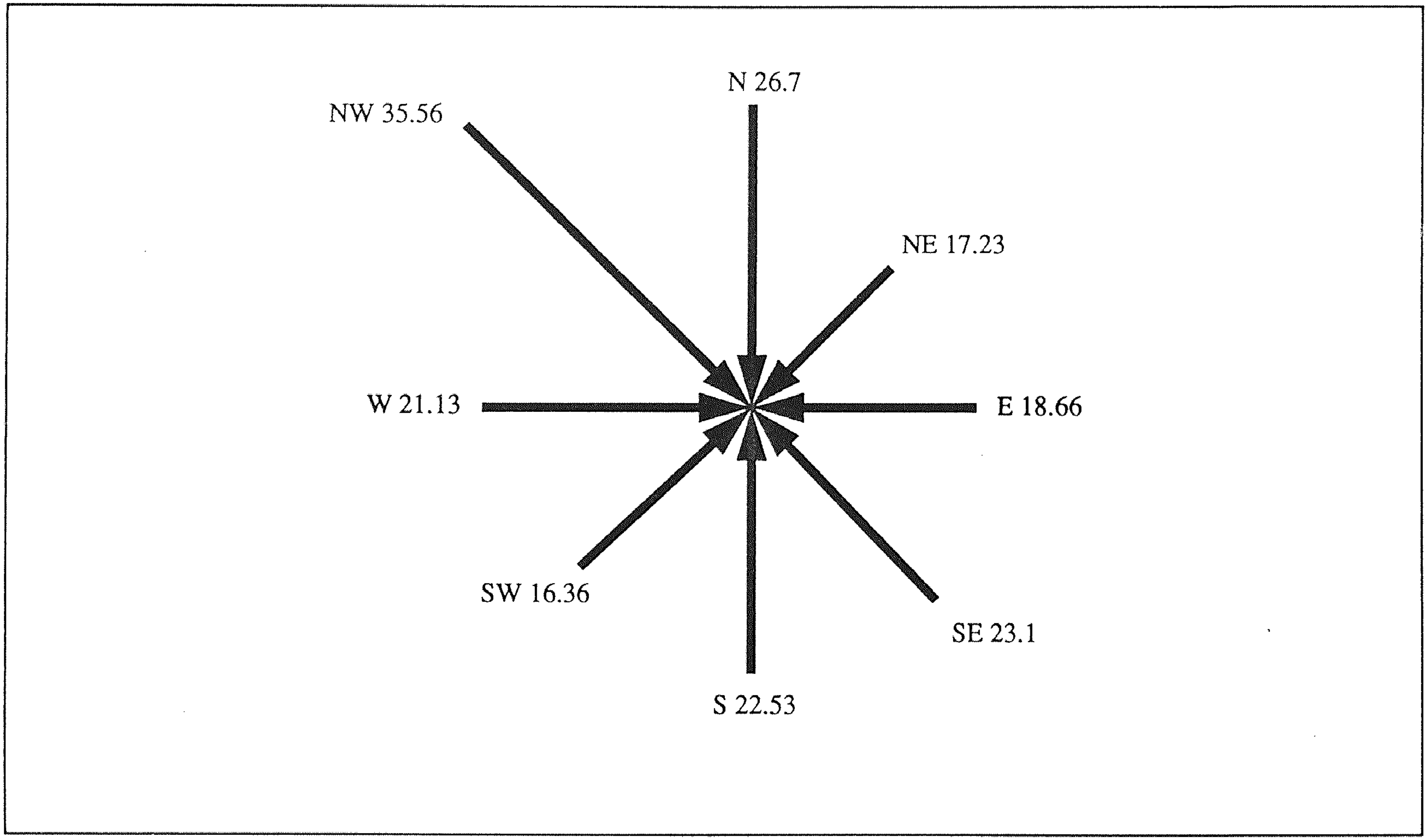


Figure 4.38

Site: Cartaret **Units - ng/m^3**

Metal: Nickel
Year - 1988

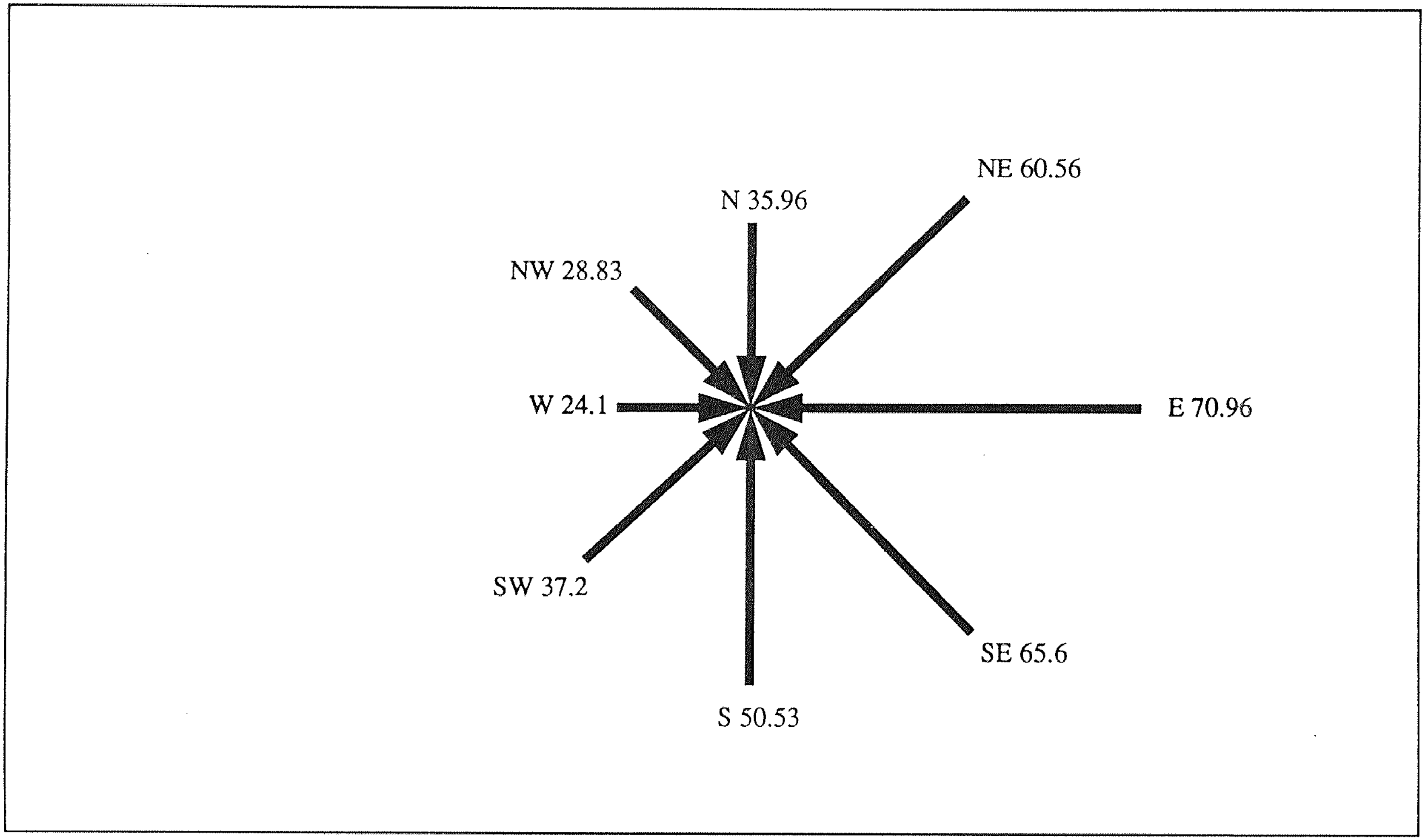


Figure 4.39

Site: Cartaret Units - ng/m^3

Metal: Copper
Year - 1988

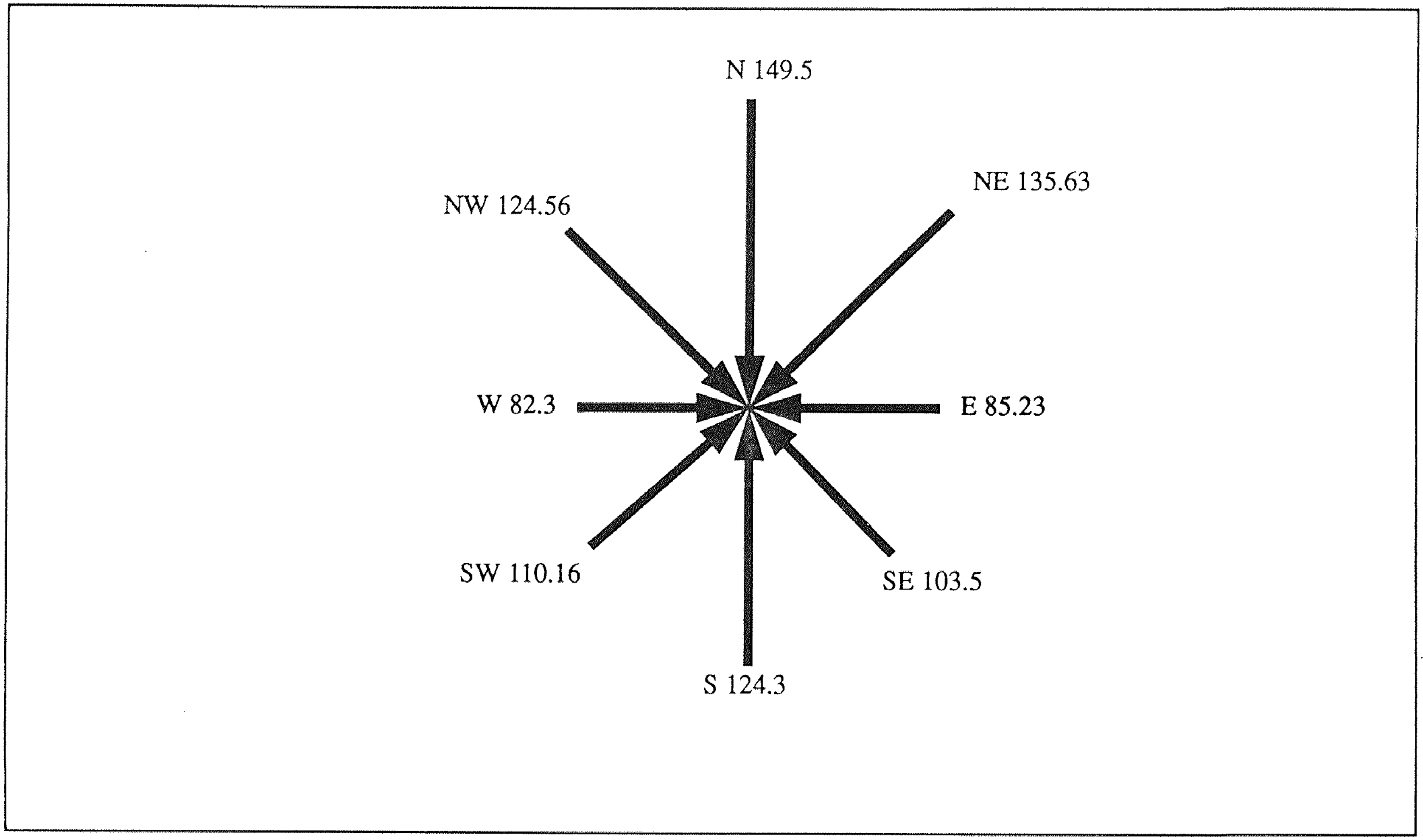


Figure 4.40

Site: Cartaret   Units - ng/m^3

Metal: Cobalt
Year - 1988

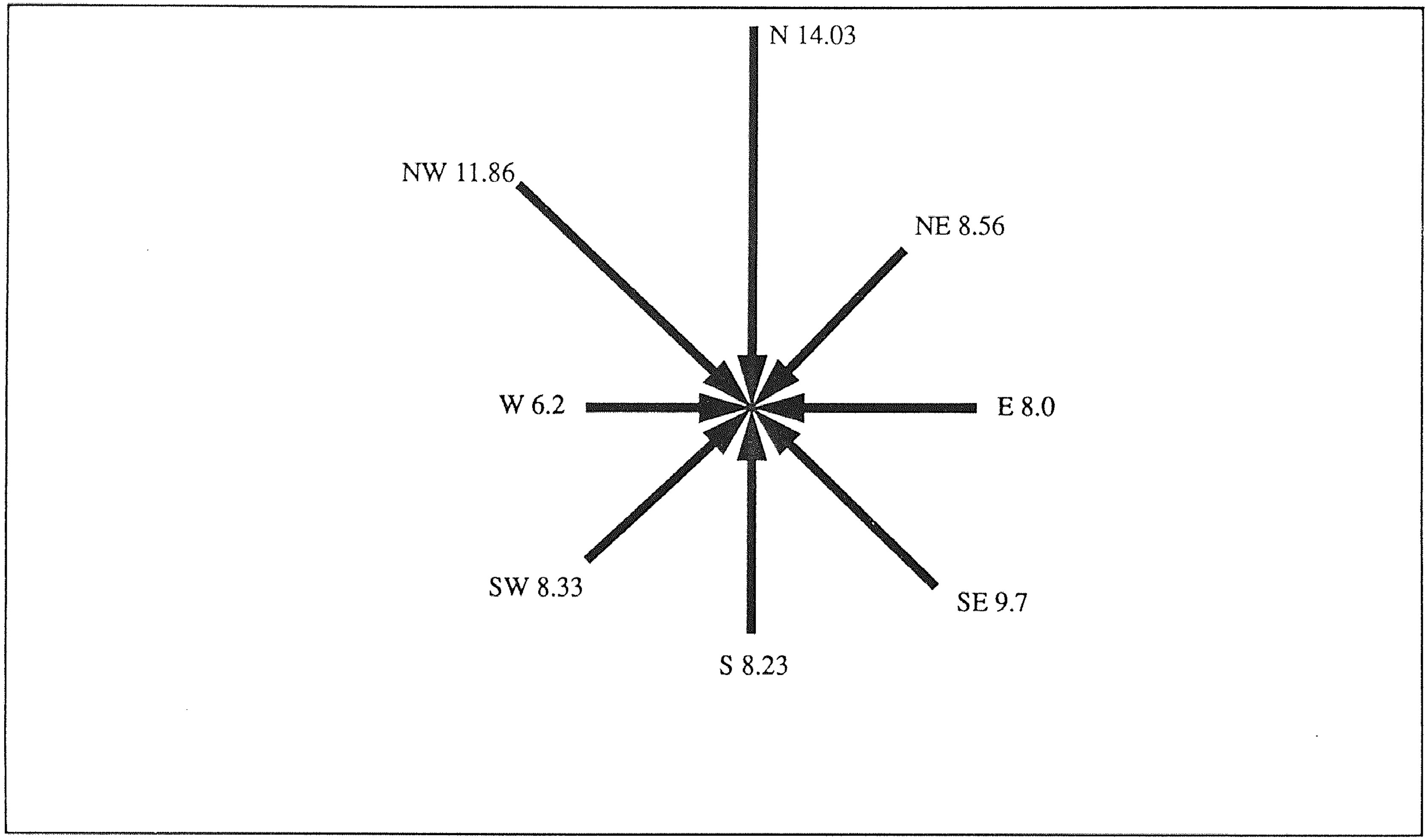


Figure 4.41

Site: Cartaret Units - ng/m3

Metal: Mercury

Year - 1988

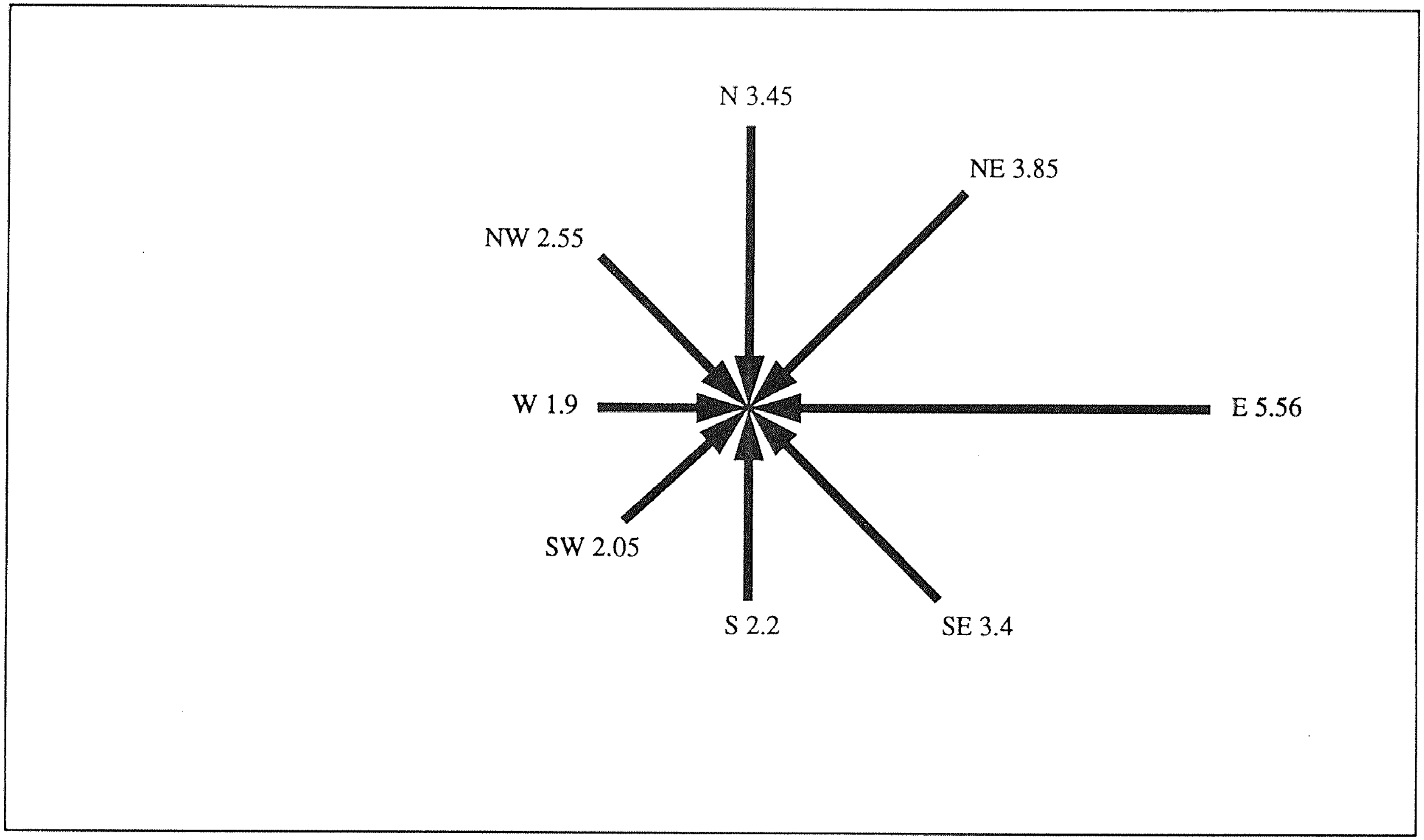


Figure 4.42

Site: Cartaret   Units - ng/m3

Metal: Chromium
Year - 1988

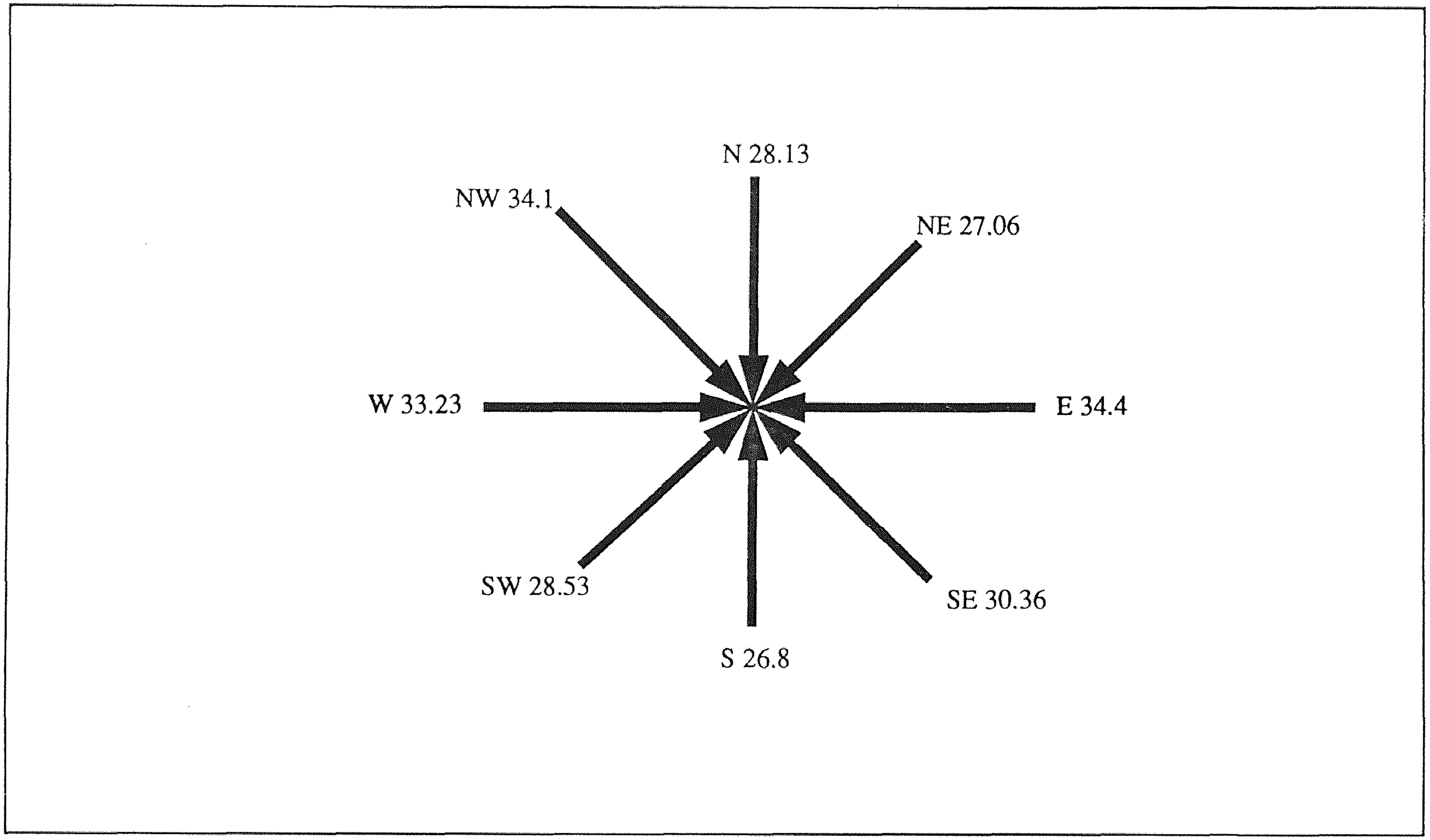


Figure 4.43

Site: Cartaret   Units - ng/m3

Metal: Cadium
Year - 1988

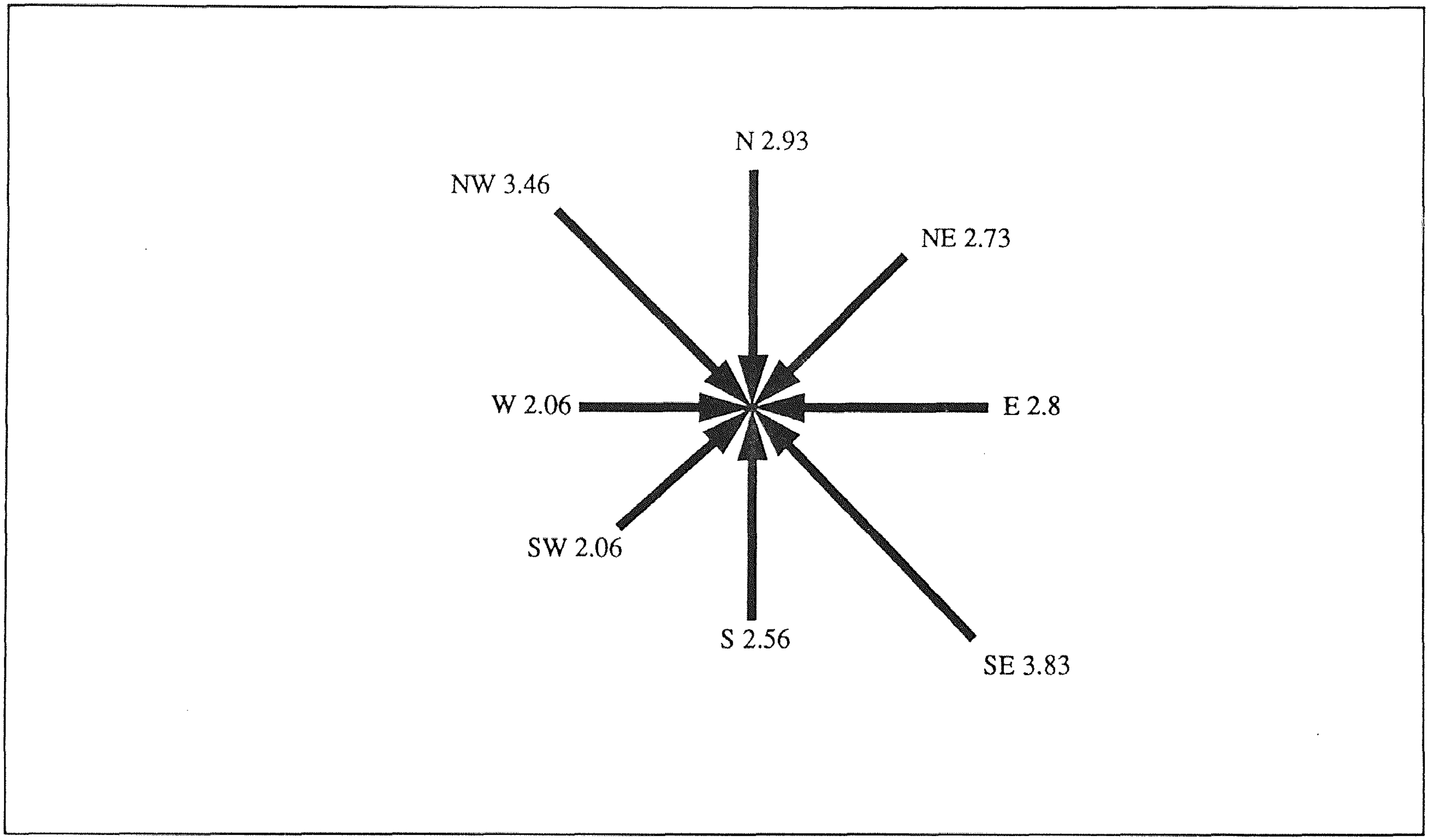


Figure 4.44

Site: Cartaret Units - ng/m^3

4.4 Comparison with Previous Results

The present study of metal concentrations are compared to the study done by NJIT in 1981/82. The results show that there are significant variations in the overall average concentrations of the metals over the 9 year time period. The sites were at Newark and Elizabeth, New Jersey which was sampled in summer of 1981 and Winter of 1982. The Newark site was on a roof top of a building (Boys Club) in the Iron bound district which was an established residential area with industrial facilities within 1-1.5 mile to the Northwest. The city of Elizabeth is to the South. The Elizabeth site is on a rooftop located just North of the central business district in a Business/residential area that is bordered on the East by a commercial area. Refineries are located 1-2 miles to the Southwest and a major traffic route is located 1.5 mile to the East.

The overall average metal concentrations from the Elizabeth site 81/82 and the percentage of increase or decrease, Elizabeth 88/89 and Carteret site 88/89 data are shown in Table 4.10. Table 4.11 shows the overall average concentrations of metals Lead, Nickel, Zinc, cadmium, Manganese, Copper and Iron at the Newark site 81/82, and the Elizabeth 88/89 and Carteret 88/89 percentage increase or decrease.

As can be seen from these tables the concentrations of Lead significantly decreased in 88/89 for Elizabeth and Carteret when compared with Elizabeth 81/82 and Newark

81/82. The concentrations decreased by 92% in Elizabeth 88/89 and 86.8% in Carteret. When compared with Elizabeth 81/82, Pb showed a 91.3% decrease for Elizabeth in 88/89 and an 85.5% decrease for Carteret in 88/89.

Zinc also showed a decrease in its concentrations, 61.3% for Elizabeth 88/89 and 60.07% decrease for Carteret when compared with Newark 81/82. Elizabeth 88/89 and Carteret data 88/89 showed a slight decrease for Zinc by 15.5% and 12.8% respectively when compared with data from Elizabeth 81/82.

Cadmium levels were similar to the 1981/82 data, Carteret 88/89 showed a 25% increase when compared with Elizabeth 81/82 .

Iron showed decreases in concentrations by 39.2% from Elizabeth 88/89 and 3.38% from Carteret 88/89 and Manganese an increase for Carteret 88/89 by 27.9% relative to Elizabeth 81/82.

Copper and Nickel showed increases in concentrations at both the Elizabeth and Carteret sites 88/89 39.5%, 69.7% and 22.7, 56.33% when compared to Newark 81/82.

The major sources of these pollutants [22] in the urban environment are known to be: combustion of fossil fuels for power generation, automotive power, incineration of refuse, industrial processes, coal fired combustion and natural sources. Moreover, individual metal source strength can also vary according to season of the year [22]

Table 4.10

Comparison With Previous Newark Data

Toxic Metals	Newark 81/82	Elizabeth 88/89			Carteret 88/89		
	conc	conc	% Incr	% Decr	conc	% Incr	% Decr
Lead	375	29.66		92	49.18		86.8
Nickel	14.5	18.78	22.7		33.21	56.33	
Zinc	267.5	103.56		61.3	106.81		60.07
Cadmium	4.0	1.78		55.5	3.32		17.00
Manganese	17.5	16.4		6.3	24.28	27.9	
Copper	27.0	44.6	39.5		89.28	69.7	
Iron	815.5	495.45		39.2	788.64		3.38

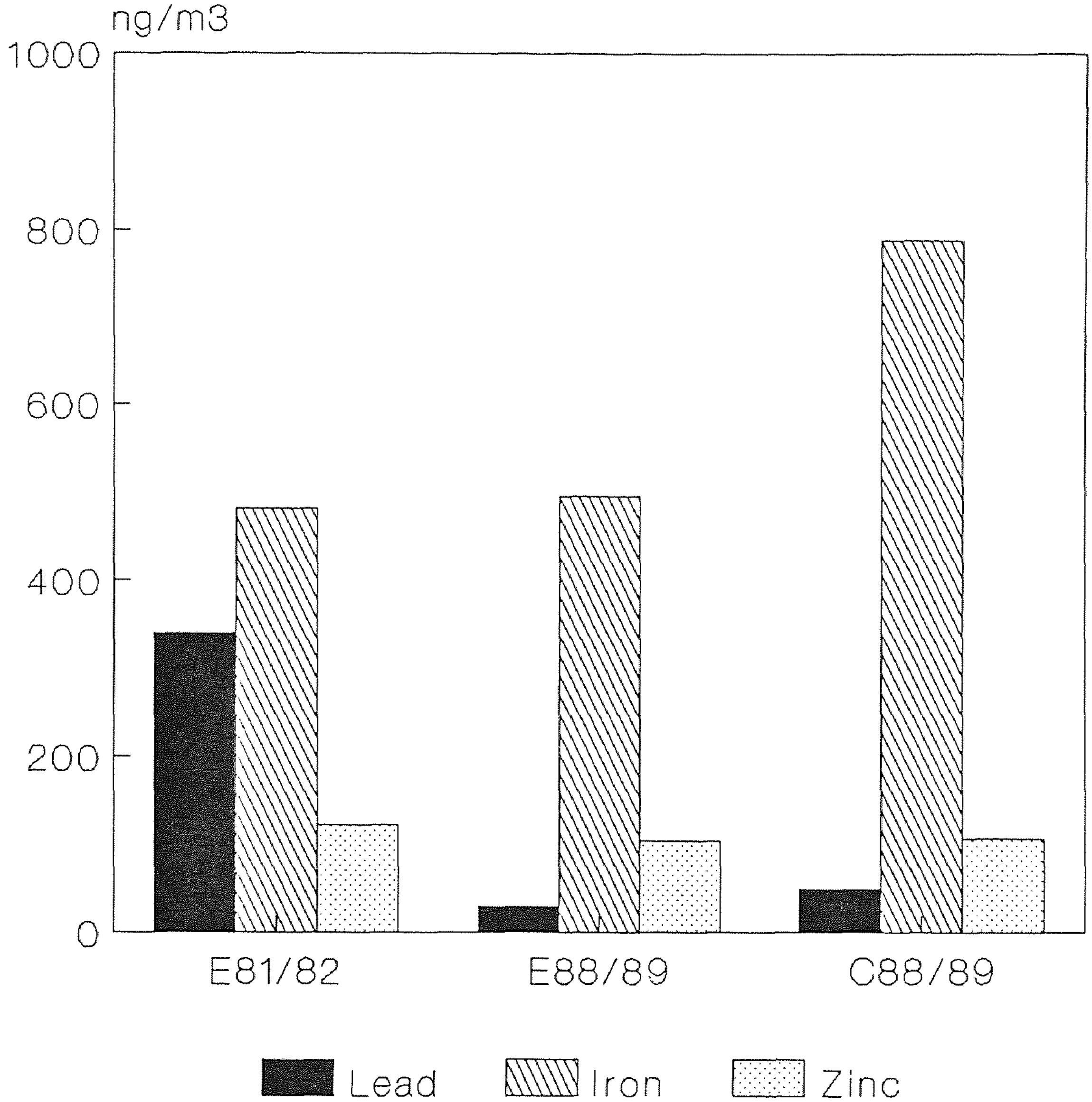
Table 4.11

Comparison with previous Elizabeth Data

Toxic Metals	Elizabeth 81/81	Elizabeth 88/89			Carteret 88/89		
	conc	conc	% Incr	% Decr	conc	% Incr	% Decr
Lead	340.0	29.66		91.3	49.18		85.5
Nickel	11.5	18.78	38.76		33.21	65.4	
Zinc	122.5	103.56		15.5	106.81		12.8
Cadmium	2.5	1.78		28.8	3.32	24.6	
Manganese	12.0	16.40	26.80		24.28	50.5	
Copper	28.5	44.60	36.10		89.20	68.1	
Iron	481.5	18.78	2.80		788.64	38.9	

Units: Nanograms/ cubic meter (ng/m^3)

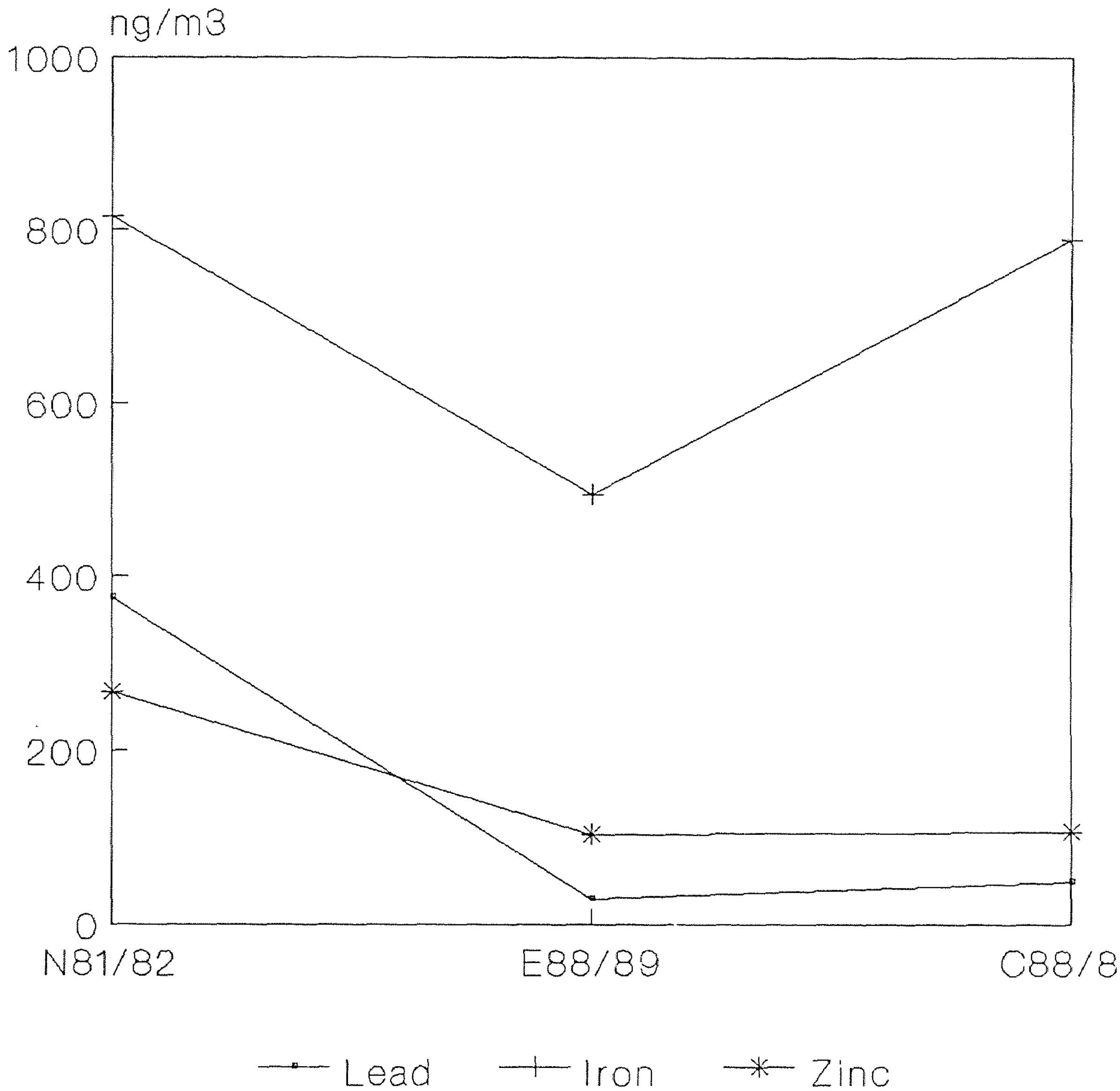
Comparison of Concentrations



E81/82-Elizabeth 81-82
E88/89-Elizabeth 88-89
C88/89-Carteret 88-89

FIG 4.45

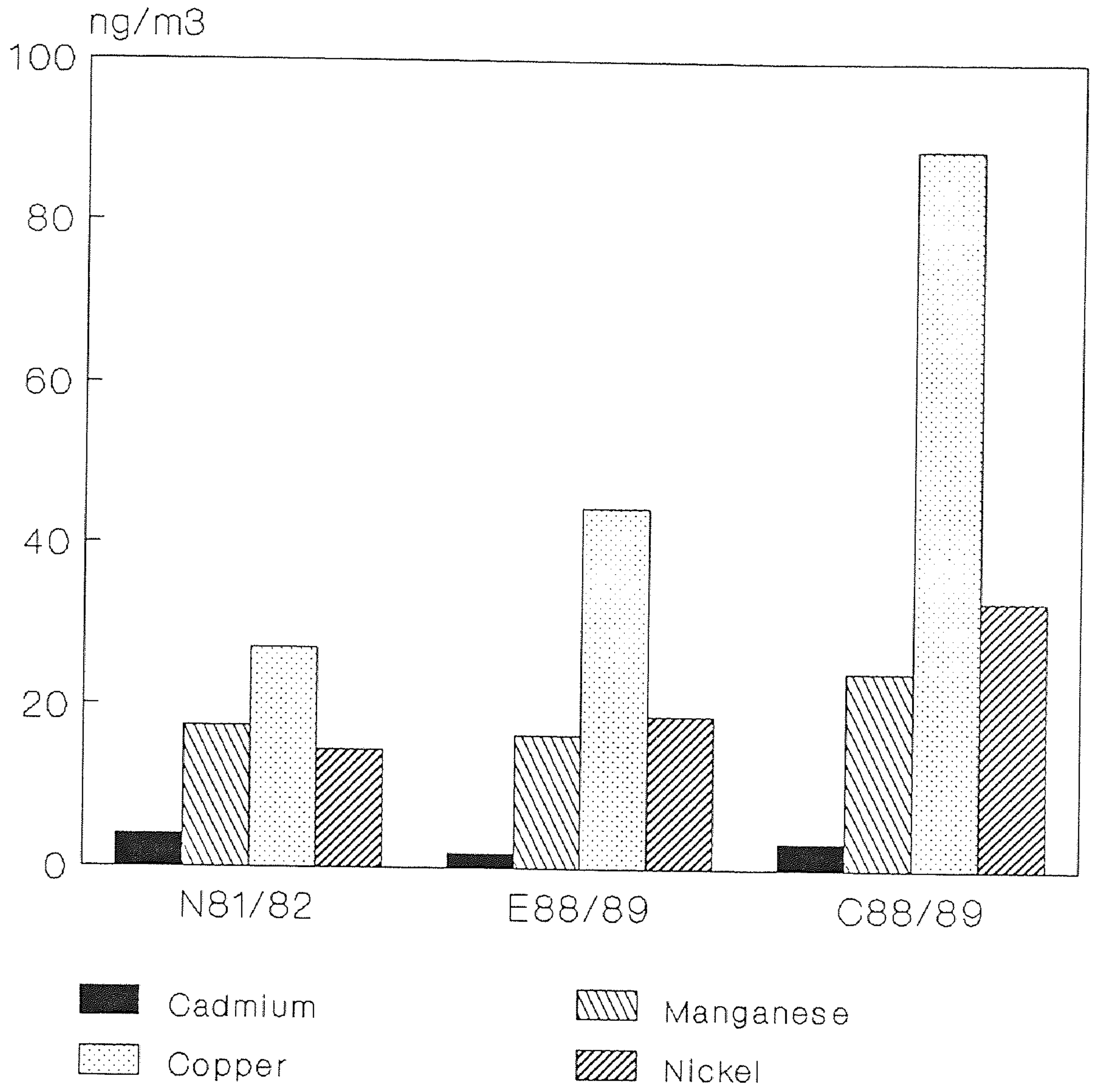
Comparison of Concentrations



N81/82-Newark 81-82
E88/89-Elizabeth 88-89
C88/89-Carteret 88-89

FIG 4.46

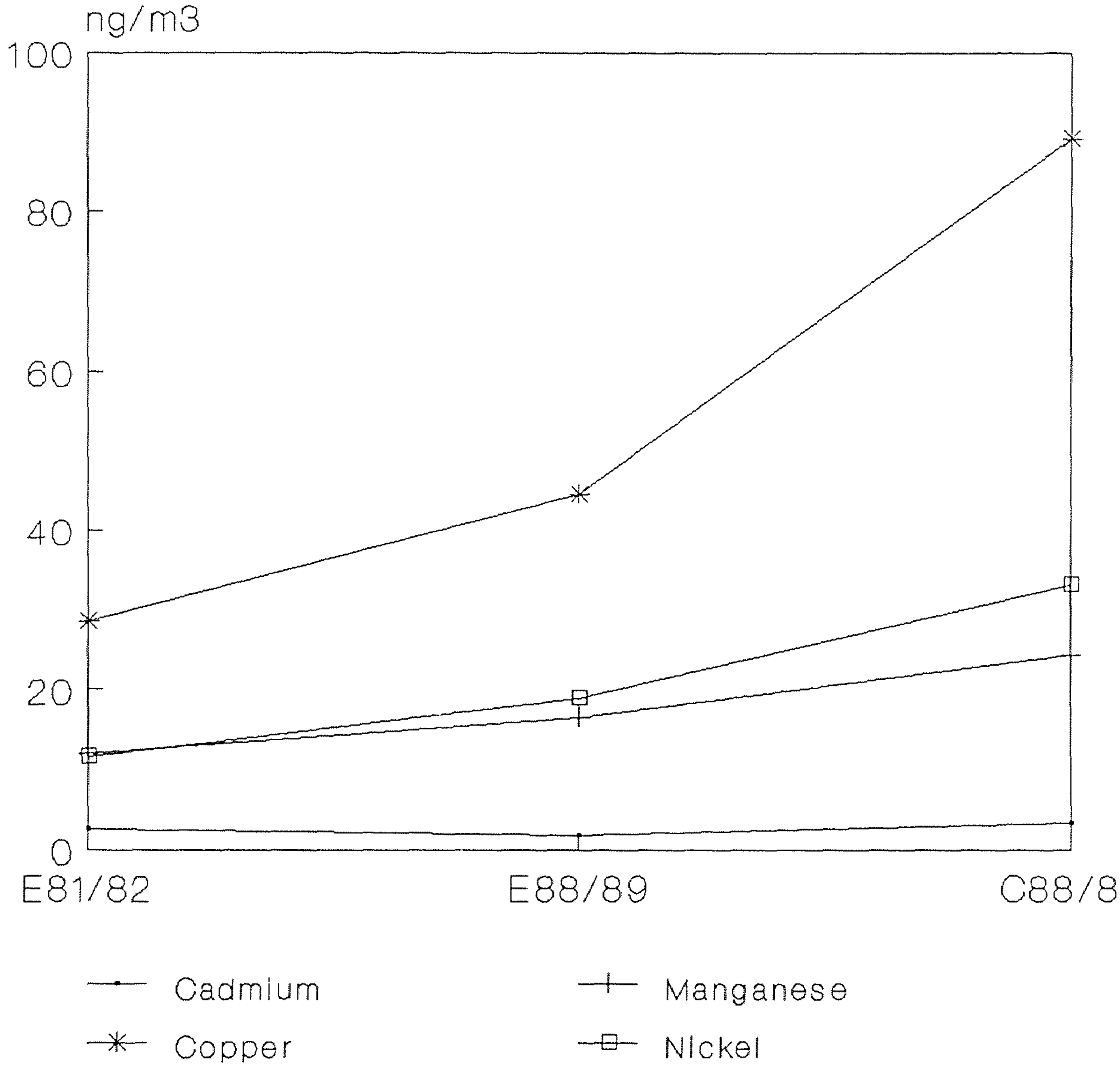
Comparison of Concentrations



N81/82-Newark 81-82
E88/89-Elizabeth 88-89
C88/89-Carteret 88-89

FIG 4.47

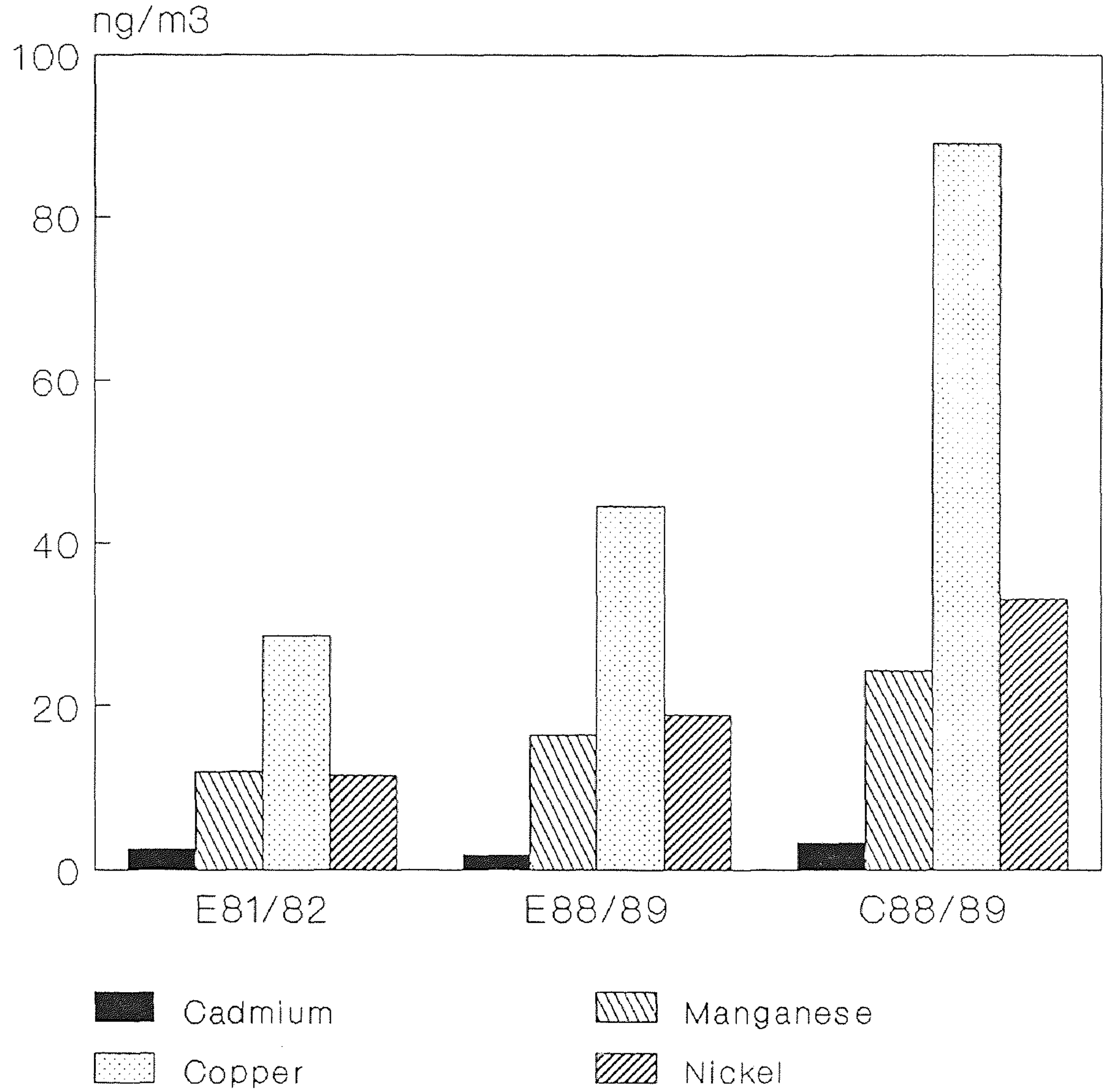
Comparison of Concentrations



E81/82-Elizabeth 81-82
E88/89-Elizabeth 88-89
C88/89-Carteret 88-89

FIG 4.48

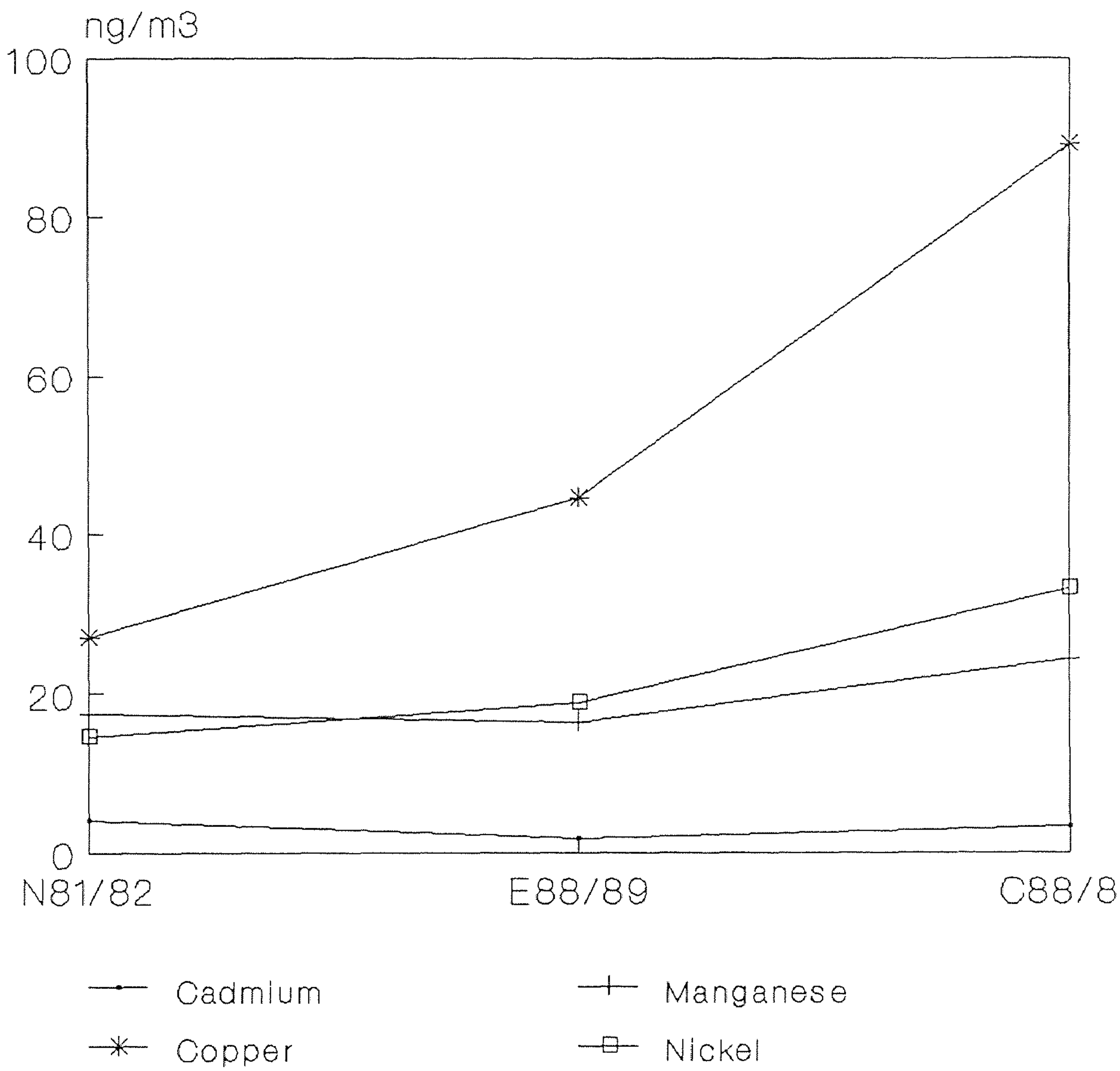
Comparison of Concentrations



E81/82-Elizabeth 81-82
E88/89-Elizabeth 88-89
C88/89-Carteret 88-89

FIG 4.49

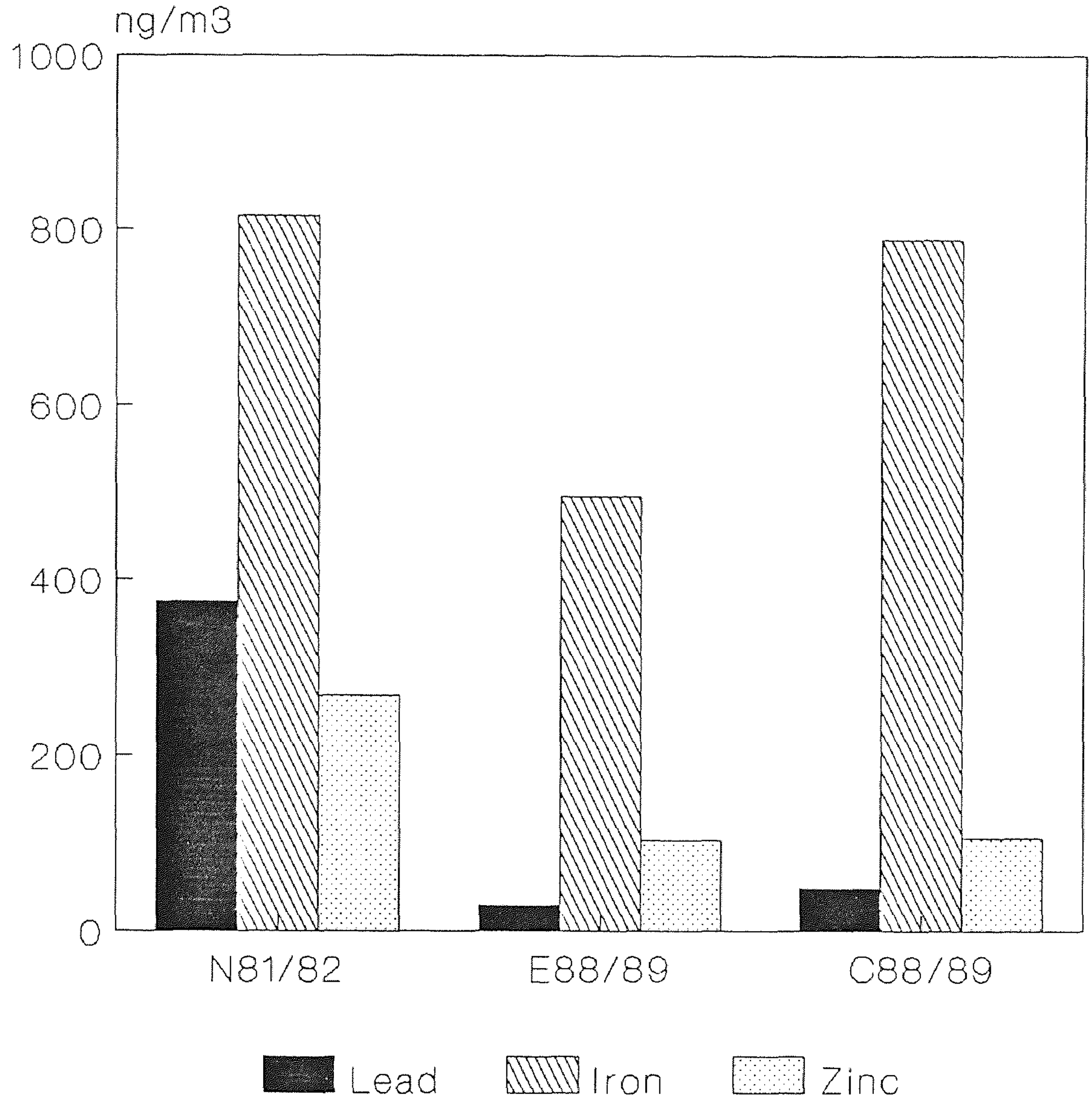
Comparison of
Concentrations



N81/82-Newark 81-82
E88/89-Elizabeth 88-89
C88/89-Carteret 88-89

FIG - 4.50

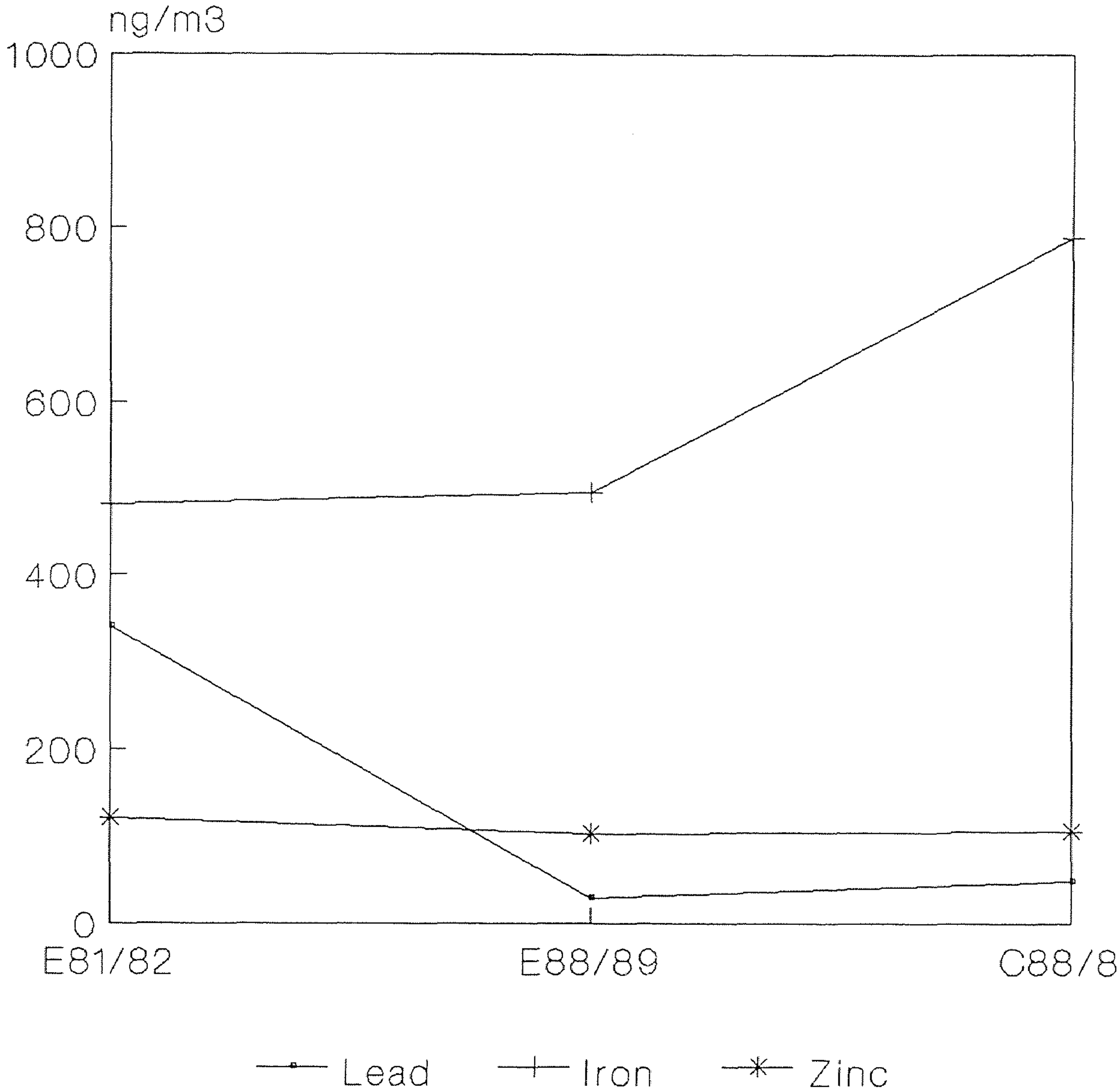
Comparison of Concentrations



N81/82-Newark 81-82
E88/89-Elizabeth 88-89
C88/89-Carteret 88-89

FIG 4-51

Comparison of Concentrations



E81/82-Elizabeth 81-82
E88/89-Elizabeth 88-89
C88/89-Carteret 88-89

FIG 4-52

CONCLUSION

The atmospheric concentrations and relative trends of ten trace elements (Co, Cd, Fe, Hg, Pb, Ni, Zn, Cu, Cr and Mn) were studied at Elizabeth and Carteret, New Jersey from July 1987 to September 1989. The specific sites are Industrial and Residential Interface areas. The analytical procedure involved collection of the airborne particulates on a quartz microfiber filter using a high volume sampler. The samples were digested and then analyzed using the atomic absorption spectrometer. Elizabeth usually showed lower values for the metals than Carteret. Average concentrations (ng/m3) for the respective metals over the entire project are:

Metal:	Co	Cd	Fe	Hg	Pb
Elizabeth:	9.56	1.78	495.45	0.48	29.66
Carteret:	12.78	3.32	788.64	0.58	49.18

Metal:	Ni	Zn	Cu	Cr	Mn
Elizabeth:	18.78	103.56	44.60	18.96	16.40
Carteret:	33.21	106.81	89.20	27.46	24.28

We determine that there are significant variations (more than 25%) in average levels of the metals Cadmium, Iron, Lead, Nickel, Copper, Chromium and Manganese, between the Elizabeth and the Carteret sites. Considering the specific sites individually, we observe variations of over 50% between average levels for different quarter, and year periods :Iron, copper, Nickel at the Carteret site and Iron, Copper and Nickel at the Elizabeth site.

We compared our results with those of a previous NJIT study from 1981 and 1982 at Elizabeth and Newark, New Jersey where the levels of Lead, Iron, Cadmium, Manganese, Copper, and Nickel were quantitated. The following illustrates the very significant decrease in Pb levels observed over the 9 year time period.

Comparison Site	% Pb decrease
Elizabeth 88/89 - Elizabeth 81/82	91.3
Elizabeth 88/89 - Newark 81/82	92.0
Carteret 88/89 - Elizabeth 81/82	85.5
Carteret 88/89 - Newark 81/82	86.8

This decrease in lead concentration is assigned to decreased use of lead in Vehicular fuels. Zinc and Cadmium also showed similar trends to that of Lead with a decrease of 15.55 in 88/89 year for Elizabeth when compared with Elizabeth 81/82 and 61.3% decrease when compared with the Newark site. Manganese, Copper and Nickel showed increases i concentration for this 1988/89 study by 50.5%, 68.1% and 65.4% respectively relative to the Elizabeth 1881/82 site.

A statistical analysis on the metal concentrations as a function at the 3 hour average Wind directions reported by the US Meterological Service indicates that Pb, Mn, Fe, Cu, and Co show higher levels when wind is from the North and

Northwest. Trends in pollutant vector magnitude for the Elizabeth site varied with individual metals.

APPENDIX DATA

CARTERET SITE

Table - 6.1

SITE - Carteret   Year - 1988

Metal - Lead

Period: Jan 1988 - Dec 1988

Sam. No.	Date	Pb Conc. ng/m3	N	NE	E	SE	S	SW	W	NW
			Wind			Direction *				
1	1/04/88	23.5	3	0	0	0	0	1	4	0
2	1/10/88	981.7	4	0	0	0	0	0	0	4
3	1/16/88	51.2	0	0	0	0	6	2	0	0
4	1/22/88	67.5	3	0	0	0	0	0	2	2
5	1/28/88	85.8	0	0	0	0	0	3	3	1
6	2/03/88	89.2	2	2	3	1	0	0	0	0
7	2/09/88	62.0	3	1	0	1	3	0	0	0
8	2/15/88	53.9	0	1	0	0	6	0	0	0
9	2/21/88	8.3	0	0	0	0	0	0	5	3
10	2/27/88	122.9	1	1	1	4	1	0	0	0
11	3/03/88	60.0	4	4	0	0	0	0	0	0
12	3/10/88	99.3	3	0	0	0	0	0	0	5
13	3/16/88	21.2	0	0	0	0	0	0	1	7
14	3/22/88	47.0	4	0	0	0	0	0	1	3
15	3/28/88	6.4	1	0	0	0	0	0	3	3
16	4/03/88	9.2	0	1	5	2	0	0	0	0
17	4/09/88	13.4	3	0	0	0	0	0	0	5
18	4/15/88	20.2	1	0	2	3	2	0	0	0
19	4/21/88	50.9	1	0	0	0	2	1	0	4
20	4/27/88	41.1	0	0	1	3	3	1	0	0
21	5/03/88	13.6	0	3	1	0	0	2	1	0
22	5/09/88	40.9	0	0	0	6	1	0	0	0
23	6/14/88	33.2	0	0	0	0	0	4	4	0
24	6/20/88	20.8	0	0	0	0	2	6	0	0
25	6/28/88	60.1	3	0	0	0	2	3	0	0
26	7/02/88		1	0	0	0	0	0	0	7
27	7/08/88		0	0	1	4	0	2	1	0
28	7/14/88		0	0	0	1	2	5	0	0
29	8/01/88		0	0	0	3	4	0	0	0
30	8/07/88		0	0	0	0	1	0	5	2
31	8/13/88		0	0	0	0	0	6	2	0
32	8/19/88		4	0	0	0	2	1	0	0
33	8/25/88		1	0	0	3	4	0	0	0
34	8/31/88		3	1	0	0	0	1	1	2
35	9/06/88		0	0	0	0	0	0	3	5
36	9/12/88		1	0	0	0	2	2	1	1
37	9/18/88		0	0	0	0	0	7	1	0

Metal: Lead
Winter (January - March) 1988

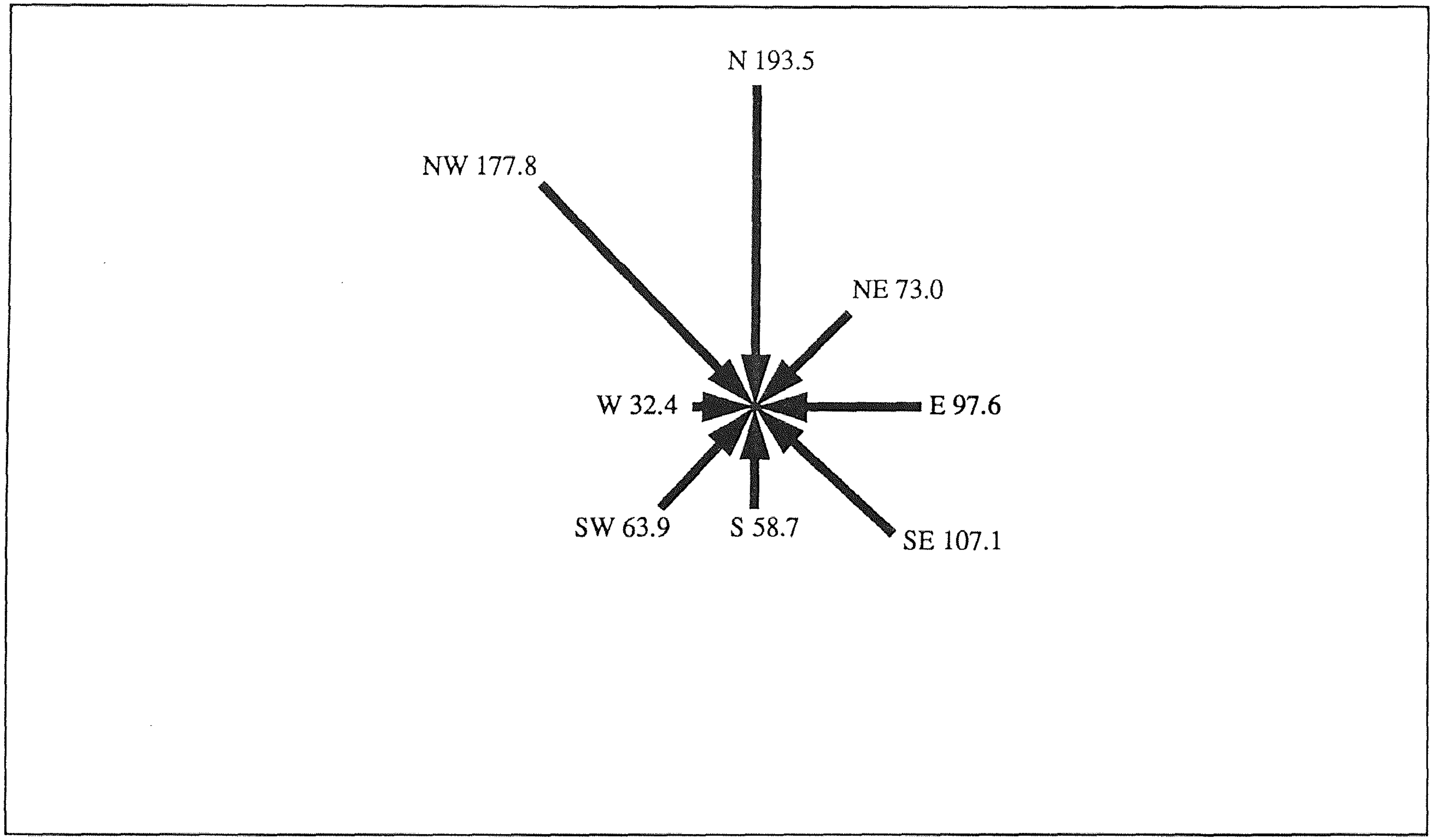


Figure 6.1.1

Site: Carteret **Units - ng/m^3**

Table - 6.1 (contd)

Sam. No.	Date	Conc ng/M3	N	NE	E	SE	S	SW	W	NW
38	9/24/88		5	0	0	0	0	1	1	1
39	9/30/88		0	0	0	0	1	7	0	0
40	10/06/88	46.6	0	0	0	0	0	1	2	5
41	10/12/88	35.6	0	0	0	0	0	2	6	0
42	10/18/88	48.1	1	0	0	1	4	2	0	0
43	10/24/88	37.8	0	0	0	0	4	1	2	1
44	10/30/88	41.2	3	0	0	0	0	0	1	4
45	11/05/88	27.6	1	0	3	3	1	0	0	0
46	11/11/88	40.3	1	0	0	0	0	2	1	4
47	11/17/88	36.8	0	0	0	0	3	0	4	1
48	11/23/88	42.1	1	1	0	0	1	2	2	0
49	11/29/88	33.2	0	0	0	0	0	2	5	1
50	12/05/88	33.5	0	0	0	0	0	4	4	0
51	12/11/88	34.5	2	0	0	0	0	1	0	5
52	12/17/88	40.9	5	0	1	0	0	0	0	2
53	12/23/88	35.5	1	2	1	2	0	1	1	0
54	12/29/88	38.5	0	0	0	0	0	1	4	3

* # of 3 hour periods per 24 hour period that the wind originated from indicated direction.

Data from National Weather Service Data Station Newark Airport.

TAL:pb CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Carteret

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	0.0	9.2	46.0	18.4	0.0	0.0	0.0	0.0
2	40.2	0.0	0.0	0.0	0.0	0.0	0.0	67.0
3	20.2	0.0	40.4	60.6	40.4	0.0	0.0	0.0
4	50.9	0.0	0.0	0.0	101.8	50.9	0.0	203.6
5	0.0	0.0	41.1	123.3	123.3	41.1	0.0	0.0
6	0.0	40.8	13.6	0.0	0.0	27.2	13.6	0.0
7	0.0	0.0	0.0	245.4	40.9	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	132.8	132.8	0.0
9	0.0	0.0	0.0	0.0	41.6	124.8	0.0	0.0
10	180.3	0.0	0.0	0.0	120.2	180.3	0.0	0.0
NC VECTORS	291.6	50.0	141.1	447.7	468.2	557.1	146.4	270.6
ND VECTORS	36.4	12.5	15.7	32.0	39.0	32.8	29.3	30.1

ocessing complete...Press...<<ENTER>>...<f2>>.....to repeat.

This is your completed concentration vector and wind vector table.

Metal: Lead
Spring (April - June) 1988

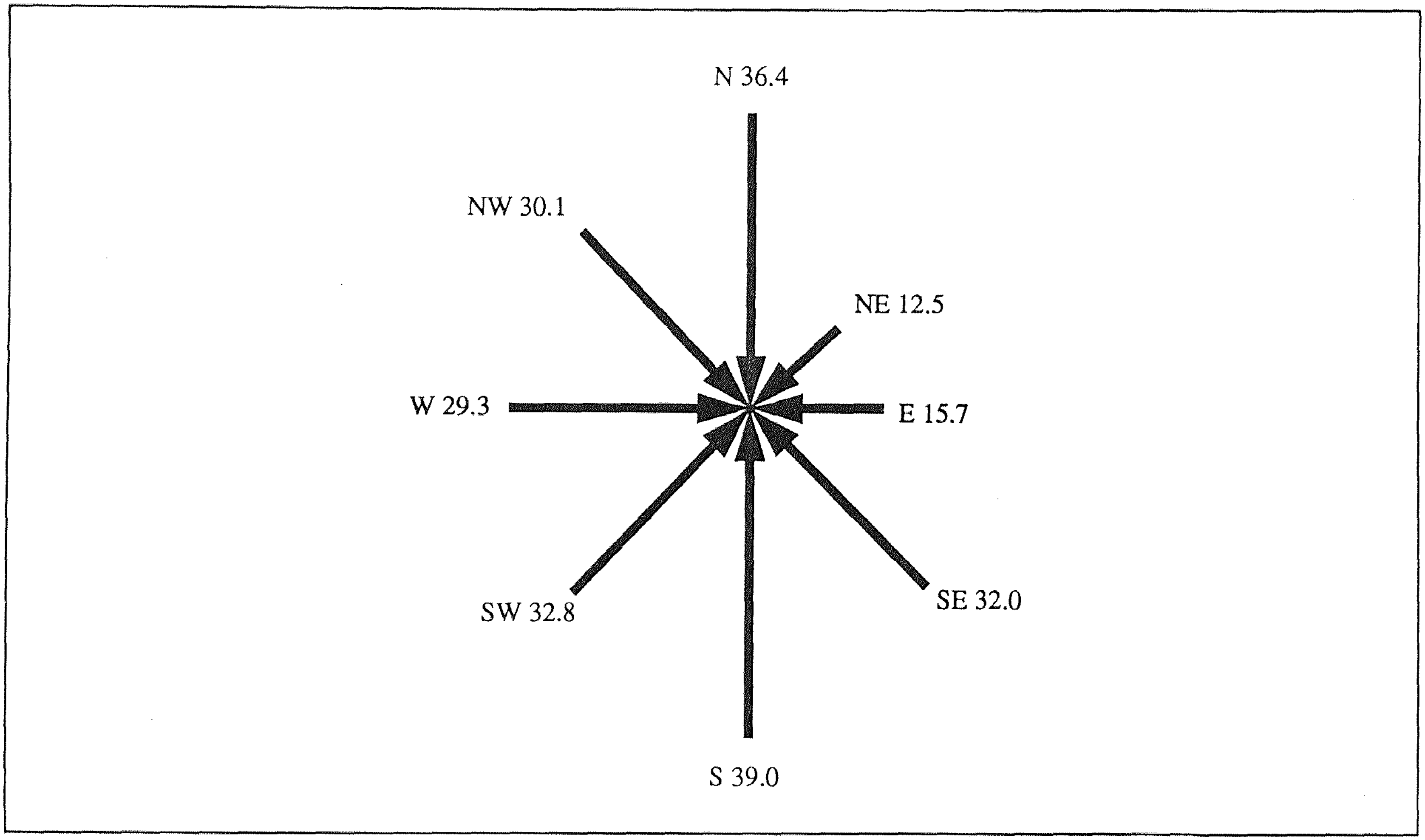


Figure 6.1.2

Site: Carteret Units - ng/m^3

Metal: Lead

Summer (July - September) 1988

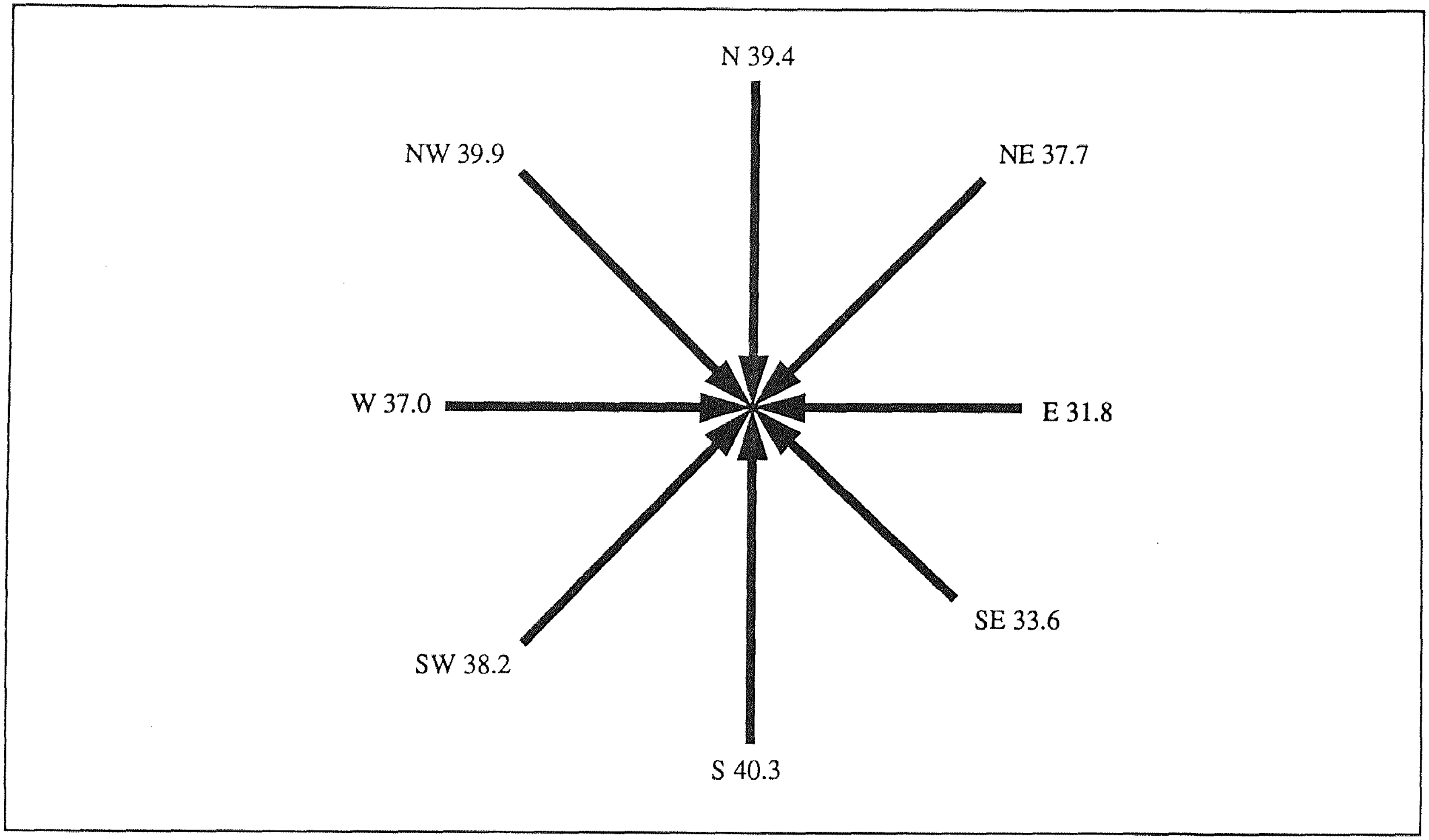


Figure 6.1.3

Site: Carteret Units - ng/m^3

Table - 6.3

SITE - Carteret Year 1988

Metal - Zinc

Period: Jan 1988 - Dec 1988

Sam. No.	Date	Zn Conc. ng/m3	N	NE	E	SE	S	SW	W	NW
			Wind Direction *							
1	1/04/88	77.5	3	0	0	0	0	1	4	0
2	1/10/88	209.1	4	0	0	0	0	0	0	4
3	1/16/88	112.4	0	0	0	0	6	2	0	0
4	1/22/88	82.0	3	0	0	0	0	0	2	2
5	1/28/88	121.0	0	0	0	0	0	3	3	1
6	2/03/88	123.7	2	2	3	1	0	0	0	0
7	2/09/88	67.9	3	1	0	1	3	0	0	0
8	2/15/88	65.5	0	1	0	0	6	0	0	0
9	2/21/88	63.5	0	0	0	0	0	0	5	3
10	2/27/88	116.0	1	1	1	4	1	0	0	0
11	3/03/88	48.0	4	4	0	0	0	0	0	0
12	3/10/88	50.7	3	0	0	0	0	0	0	5
13	3/16/88	67.6	0	0	0	0	0	0	1	7
14	3/22/88	112.0	4	0	0	0	0	0	1	3
15	3/28/88	30.9	1	0	0	0	0	0	3	3
16	4/03/88	38.3	0	1	5	2	0	0	0	0
17	4/09/88	49.2	3	0	0	0	0	0	0	5
18	4/15/88	72.6	1	0	2	3	2	0	0	0
19	4/21/88	164.5	1	0	0	0	2	1	0	4
20	4/27/88	116.1	0	0	1	3	3	1	0	0
21	5/03/88	38.8	0	3	1	0	0	2	1	0
22	5/09/88	134.1	0	0	0	6	1	0	0	0
23	6/14/88	80.3	0	0	0	0	0	4	4	0
24	6/20/88	110.5	0	0	0	0	2	6	0	0
25	6/28/88	98.0	3	0	0	0	2	3	0	0
26	7/02/88		1	0	0	0	0	0	0	7
27	7/08/88		0	0	1	4	0	2	1	0
28	7/14/88		0	0	0	1	2	5	0	0
29	8/01/88		0	0	0	3	4	0	0	0
30	8/07/88		0	0	0	0	1	0	5	2
31	8/13/88		0	0	0	0	0	6	2	0
32	8/19/88		4	0	0	0	2	1	0	0
33	8/25/88		1	0	0	3	4	0	0	0
34	8/31/88		3	1	0	0	0	1	1	2
35	9/06/88		0	0	0	0	0	0	3	5
36	9/12/88		1	0	0	0	2	2	1	1
37	9/18/88		0	0	0	0	0	7	1	0
38	9/24/88		5	0	0	0	0	1	1	1
39	9/30/88		0	0	0	0	1	7	0	0
40	10/06/88	94.4	0	0	0	0	0	1	2	5
41	10/12/88	78.6	0	0	0	0	0	2	6	0

42	10/18/88	145.5	1	0	0	1	4	2	0	0

Table -6.3 (contdd)

Sam No	Date	Zn conc ng/m3	N	NE	E	SE	S	SW	W	NW
			Wind Direction *							
43	10/24/88	65.0	0	0	0	0	4	1	2	1
44	10/30/88	63.0	3	0	0	0	0	0	1	4
45	11/05/88	59.0	1	0	3	3	1	0	0	0
46	11/11/88	79.5	1	0	0	0	0	2	1	4
47	11/17/88	86.6	0	0	0	0	3	0	4	1
48	11/23/88	149.9	1	1	0	0	1	2	2	0
49	11/29/88	82.0	0	0	0	0	0	2	5	1
50	12/05/88	115.7	0	0	0	0	0	4	4	0
51	12/11/88	66.9	2	0	0	0	0	1	0	5
52	12/17/88	122.1	5	0	1	0	0	0	0	2
53	12/23/88	101.8	1	2	1	2	0	1	1	0
54	12/29/88	84.2	0	0	0	0	0	1	4	3

* # of 3 hour periods per 24 hour period that the wind originated from indicated direction.

Data from National Weather Service Data Station Newark Airport.

ETAL:zn CONCENTRATION AND WIND VECTORS TABLE SITE NAME:c

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	232.5	0.0	0.0	0.0	0.0	77.5	310.0	0.0
2	836.4	0.0	0.0	0.0	0.0	0.0	0.0	836.4
3	0.0	0.0	0.0	0.0	674.4	224.8	0.0	0.0
4	246.0	0.0	0.0	0.0	0.0	0.0	164.0	164.0
5	0.0	0.0	0.0	0.0	0.0	363.0	363.0	121.0
6	247.4	247.4	371.1	123.7	0.0	0.0	0.0	0.0
7	203.7	67.9	0.0	67.9	203.7	0.0	0.0	0.0
8	0.0	65.5	0.0	0.0	393.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	317.5	190.5
10	116.0	116.0	116.0	464.0	116.0	0.0	0.0	0.0
11	192.0	192.0	0.0	0.0	0.0	0.0	0.0	0.0
12	152.1	0.0	0.0	0.0	0.0	0.0	0.0	253.5
13	0.0	0.0	0.0	0.0	0.0	0.0	67.6	473.2
14	448.0	0.0	0.0	0.0	0.0	0.0	112.0	336.0
15	30.9	0.0	0.0	0.0	0.0	0.0	92.7	92.7
ONC VECTORS	%2705.0	688.8	487.1	655.6	%1387.1	665.3	%1426.8	%2467.3
IND VECTORS	96.6	76.5	121.8	109.3	86.7	110.9	75.1	88.1

rocessing complete...Press...<<ENTER>>...<f2>>.....to repeat.

k This is your completed concentration vector and wind vector table.

6.3.1

Metal: Zinc
Winter (January - March) 1988

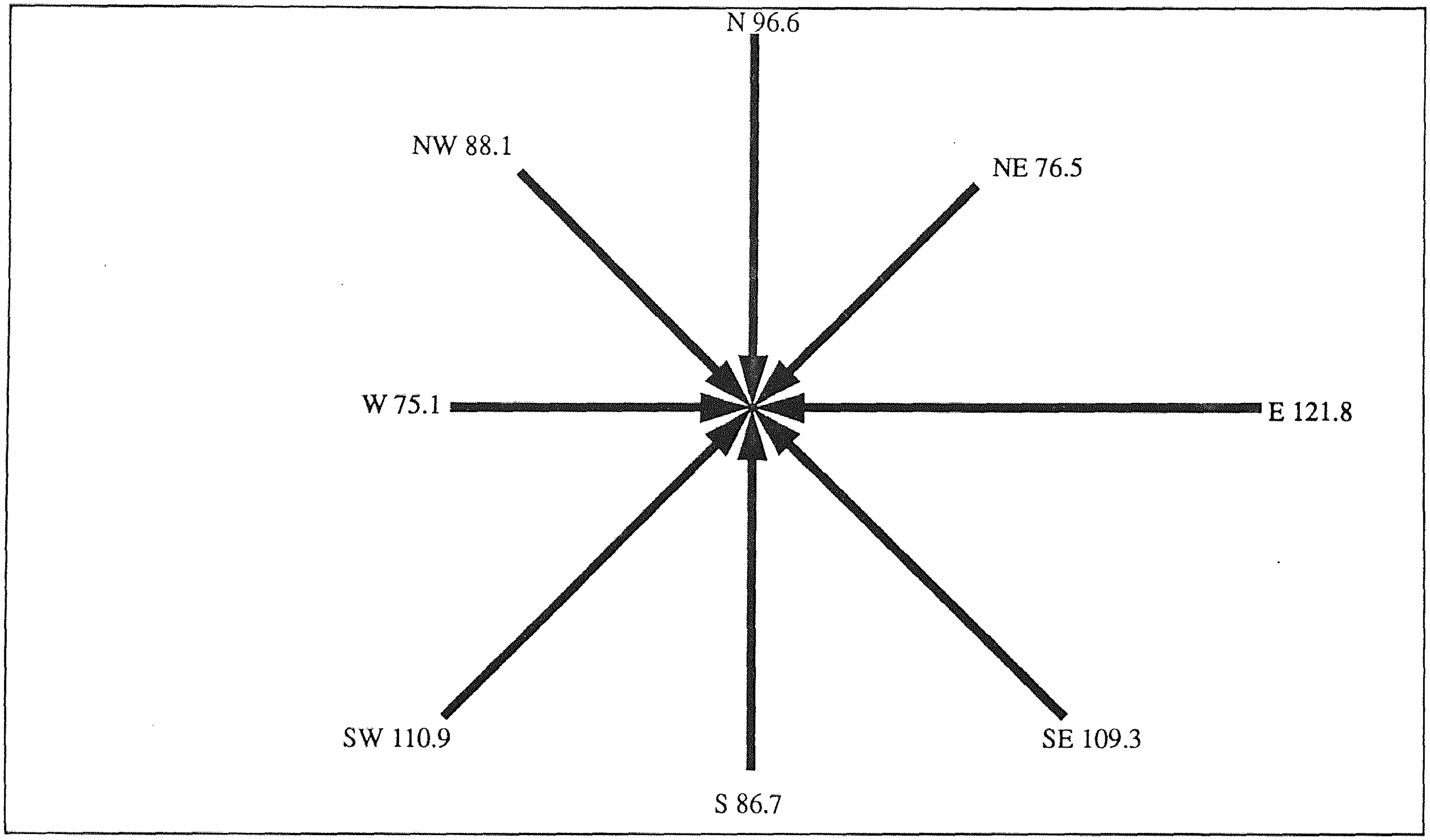


Figure 6.3.1

Site: Carteret   Units - ng/m³

METAL:zn CONCENTRATION AND WIND VECTORS TABLE SITE NAME:c

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	0.0	38.3	191.5	76.6	0.0	0.0	0.0	0.0
2	147.6	0.0	0.0	0.0	0.0	0.0	0.0	246.0
3	72.6	0.0	145.2	217.8	145.2	0.0	0.0	0.0
4	164.5	0.0	0.0	0.0	329.0	164.5	0.0	658.0
5	0.0	0.0	116.1	348.3	348.3	116.1	0.0	0.0
6	0.0	116.4	38.8	0.0	0.0	77.6	38.8	0.0
7	0.0	0.0	0.0	804.6	134.1	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	321.2	321.2	0.0
9	0.0	0.0	0.0	0.0	221.0	663.0	0.0	0.0
10	294.0	0.0	0.0	0.0	196.0	294.0	0.0	0.0
CONC VECTORS	678.7	154.7	491.6	%1447.3	%1373.6	%1636.4	360.0	904.0
WIND VECTORS	84.8	38.7	54.6	103.4	114.5	96.3	72.0	100.4

Processing complete...Press...<<ENTER>>...<f2>>.....to repeat.

Ok This is your completed concentration vector and wind vector table.

6.3.2

Metal: Zinc
Spring (April - June) 1988

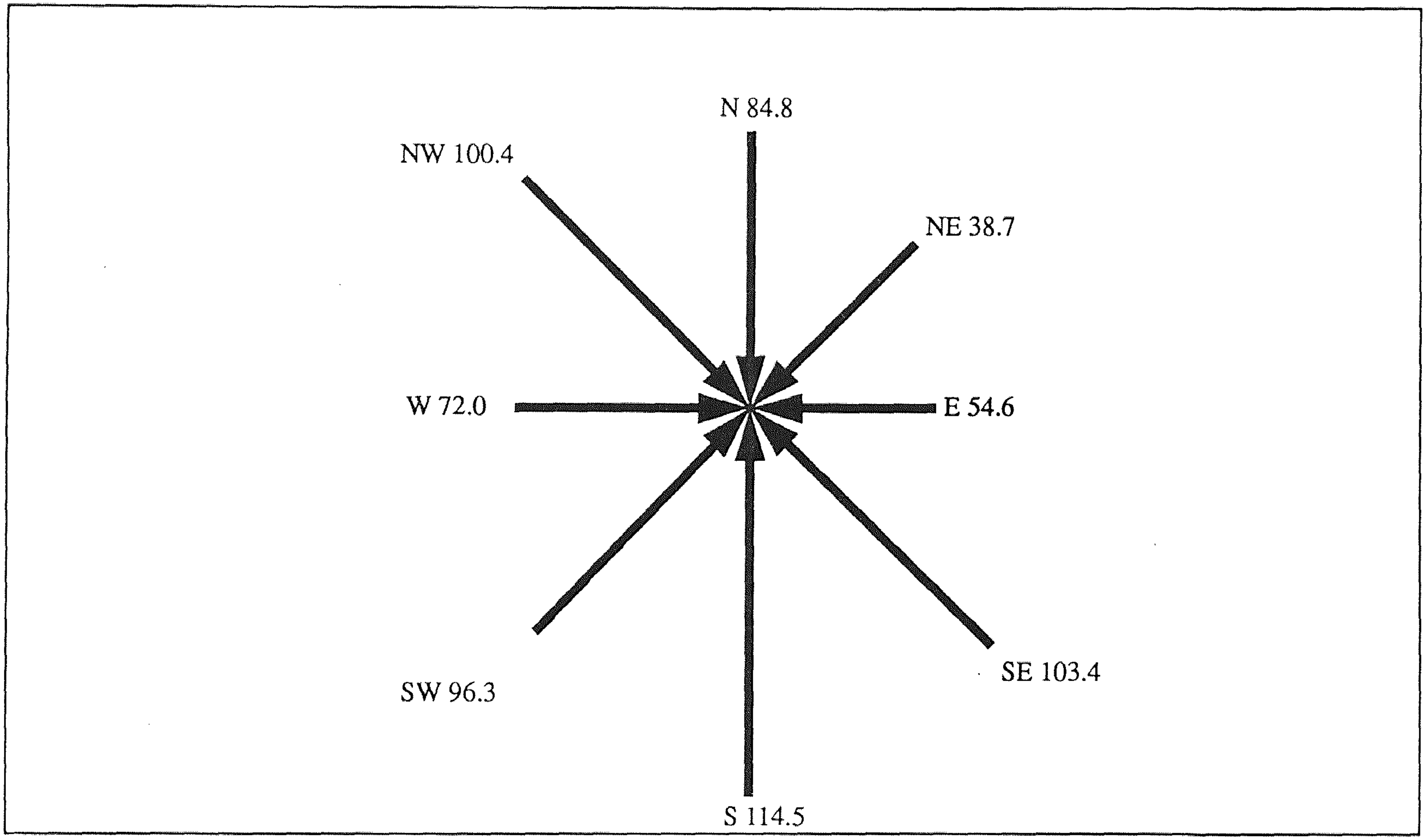


Figure 6.3.2

Site: Carteret Units - ng/m^3

METAL:zn CONCENTRATION AND WIND VECTORS TABLE SITE NAME:c

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	0.0	0.0	0.0	0.0	0.0	94.4	188.8	472.0
2	0.0	0.0	0.0	0.0	0.0	157.2	471.6	0.0
3	145.5	0.0	0.0	145.5	582.0	291.0	0.0	0.0
4	0.0	0.0	0.0	0.0	260.0	65.0	130.0	65.0
5	189.0	0.0	0.0	0.0	0.0	0.0	63.0	252.0
6	59.0	0.0	177.0	177.0	59.0	0.0	0.0	0.0
7	79.5	0.0	0.0	0.0	0.0	159.0	79.5	318.0
8	0.0	0.0	0.0	0.0	259.8	0.0	346.4	86.6
9	149.9	149.9	0.0	0.0	149.9	299.8	299.8	0.0
10	0.0	0.0	0.0	0.0	0.0	164.0	410.0	82.0
11	0.0	0.0	0.0	0.0	0.0	462.8	462.8	0.0
12	133.8	0.0	0.0	0.0	0.0	66.9	0.0	334.5
13	610.5	0.0	122.1	0.0	0.0	0.0	0.0	244.2
14	101.8	203.6	101.8	203.6	0.0	101.8	101.8	0.0
15	0.0	0.0	0.0	0.0	0.0	84.2	336.8	252.6
CONC VECTORS	%1469.0	353.5	400.9	526.1	%1310.7	%1946.1	%2890.5	%2106.9
WIND VECTORS	97.9	117.8	80.2	87.7	100.8	102.4	90.3	81.0

Processing complete...Press...<<ENTER>>...<f2>>.....to repeat.

Ok This is your completed concentration vector and wind vector table.

6.3.3

Metal: Zinc

Fall (October - December) 1988

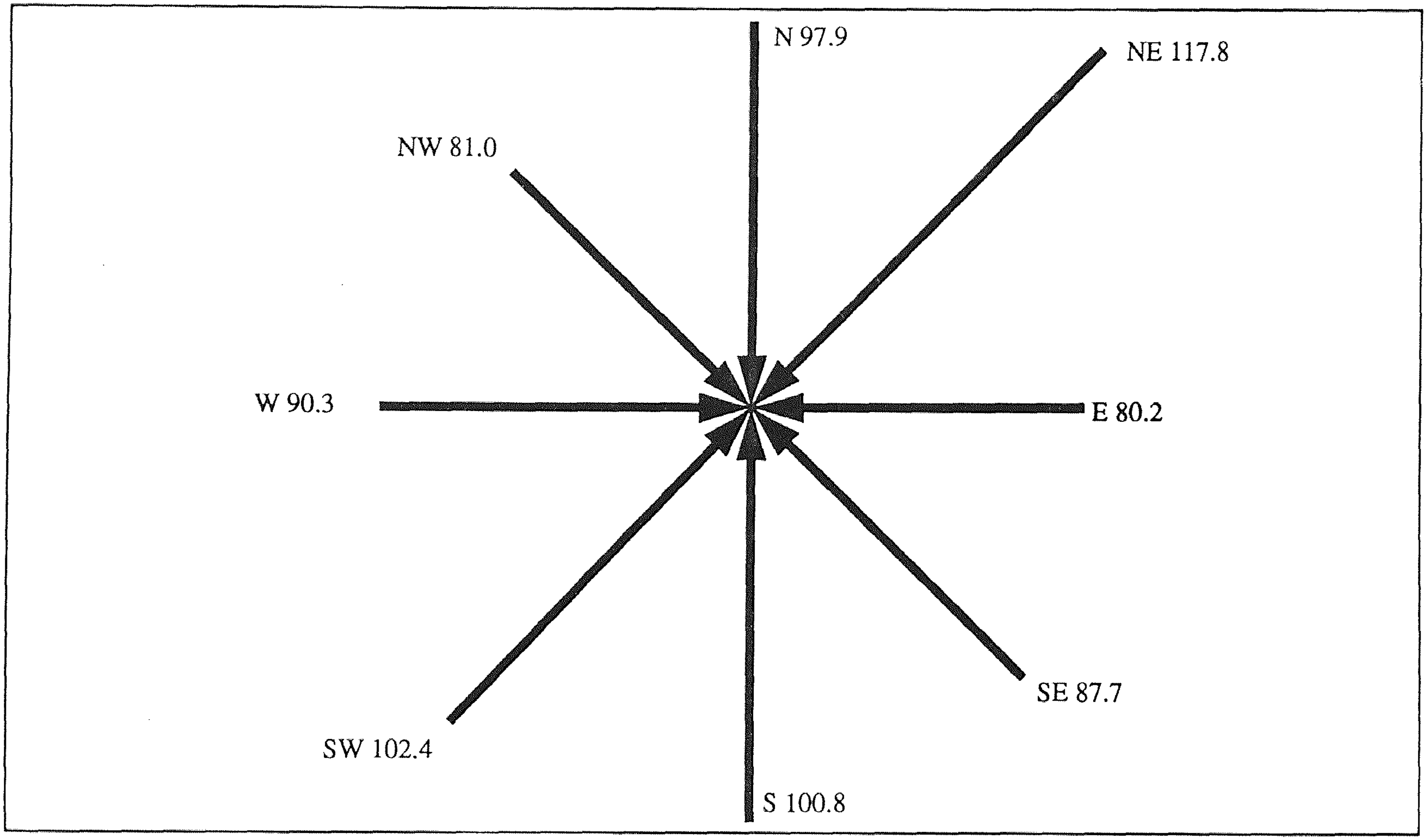


Figure 6.3.3

Site: Carteret   Units - ng/m^3

Table - 6.4

SITE - Carteret Year -1988

Metal - Manganese

Period: Jan 1988 - Dec 1988

Sam. No.	Date	Mn Conc. ng/m3	N	NE	E	SE	S	SW	W	NW
			Wind Direction *							
1	1/04/88	3.0	3	0	0	0	0	1	4	0
2	1/10/88	22.3	4	0	0	0	0	0	0	4
3	1/16/88	12.8	0	0	0	0	6	2	0	0
4	1/22/88	21.0	3	0	0	0	0	0	2	2
5	1/28/88	4.0	0	0	0	0	0	3	3	1
6	2/03/88	16.0	2	2	3	1	0	0	0	0
7	2/09/88	8.1	3	1	0	1	3	0	0	0
8	2/15/88	12.6	0	1	0	0	6	0	0	0
9	2/21/88	12.2	0	0	0	0	0	0	5	3
10	2/27/88	4.0	1	1	1	4	1	0	0	0
11	3/03/88	24.8	4	4	0	0	0	0	0	0
12	3/10/88	24.9	3	0	0	0	0	0	0	5
13	3/16/88	103.9	0	0	0	0	0	0	1	7
14	3/22/88	123.2	4	0	0	0	0	0	1	3
15	3/28/88	12.8	1	0	0	0	0	0	3	3
16	4/03/88	20.7	0	1	5	2	0	0	0	0
17	4/09/88	16.4	3	0	0	0	0	0	0	5
18	4/15/88	48.2	1	0	2	3	2	0	0	0
19	4/21/88	62.0	1	0	0	0	2	1	0	4
20	4/27/88	27.4	0	0	1	3	3	1	0	0
21	5/03/88	14.1	0	3	1	0	0	2	1	0
22	5/09/88	65.0	0	0	0	6	1	0	0	0
23	6/14/88	25.4	0	0	0	0	0	4	4	0
24	6/20/88	17.5	0	0	0	0	2	6	0	0
25	6/28/88	23.7	3	0	0	0	2	3	0	0
26	7/02/88		1	0	0	0	0	0	0	7
27	7/08/88		0	0	1	4	0	2	1	0
28	7/14/88		0	0	0	1	2	5	0	0
29	8/01/88		0	0	0	3	4	0	0	0
30	8/07/88		0	0	0	0	1	0	5	2
31	8/13/88		0	0	0	0	0	6	2	0
32	8/19/88		4	0	0	0	2	1	0	0
33	8/25/88		1	0	0	3	4	0	0	0
34	8/31/88		3	1	0	0	0	1	1	2
35	9/06/88		0	0	0	0	0	0	3	5
36	9/12/88		1	0	0	0	2	2	1	1
37	9/18/88		0	0	0	0	0	7	1	0

Table - 6.4 (contd)

Sam No	Date	conc ng/m3	N	NE	E	SE	S	SW	W	NW
38	9/24/88		5	0	0	0	0	1	1	1
39	9/30/88		0	0	0	0	1	7	0	0
40	10/06/88	21.3	0	0	0	0	0	1	2	5
41	10/12/88	19.3	0	0	0	0	0	2	6	0
42	10/18/88	24.1	1	0	0	1	4	2	0	0
43	10/24/88	17.3	0	0	0	0	4	1	2	1
44	10/30/88	13.7	3	0	0	0	0	0	1	4
45	11/05/88	14.5	1	0	3	3	1	0	0	0
46	11/11/88	10.6	1	0	0	0	0	2	1	4
47	11/17/88	11.5	0	0	0	0	3	0	4	1
48	11/23/88	29.6	1	1	0	0	1	2	2	0
49	11/29/88	18.0	0	0	0	0	0	2	5	1
50	12/05/88	13.1	0	0	0	0	0	4	4	0
51	12/11/88	16.0	2	0	0	0	0	1	0	5
52	12/17/88	24.3	5	0	1	0	0	0	0	2
53	12/23/88	13.1	1	2	1	2	0	1	1	0
54	12/29/88	37.0	0	0	0	0	0	1	4	3

* # of 3 hour periods per 24 hour period that the wind originated from indicated direction.

Data from National Weather Service Data Station Newark Airport.

METAL:mn CONCENTRATION AND WIND VECTORS TABLE SITE NAME:c

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	9.0	0.0	0.0	0.0	0.0	3.0	12.0	0.0
2	89.2	0.0	0.0	0.0	0.0	0.0	0.0	89.2
3	0.0	0.0	0.0	0.0	76.8	25.6	0.0	0.0
4	63.0	0.0	0.0	0.0	0.0	0.0	42.0	42.0
5	0.0	0.0	0.0	0.0	0.0	12.0	12.0	4.0
6	32.0	32.0	48.0	16.0	0.0	0.0	0.0	0.0
7	24.3	8.1	0.0	8.1	24.3	0.0	0.0	0.0
8	0.0	12.6	0.0	0.0	75.6	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	61.0	36.6
10	4.0	4.0	4.0	16.0	4.0	0.0	0.0	0.0
11	99.2	99.2	0.0	0.0	0.0	0.0	0.0	0.0
12	74.7	0.0	0.0	0.0	0.0	0.0	0.0	124.5
13	0.0	0.0	0.0	0.0	0.0	0.0	103.9	727.3
14	492.8	0.0	0.0	0.0	0.0	0.0	123.2	369.6
15	12.8	0.0	0.0	0.0	0.0	0.0	38.4	38.4
CONC VECTORS	901.0	155.9	52.0	40.1	180.7	40.6	392.5	%1431.6
WIND VECTORS	32.2	17.3	13.0	6.7	11.3	6.8	20.7	51.1

Processing complete...Press...<<ENTER>>...<f2>>.....to repeat.

Ok This is your completed concentration vector and wind vector table.

6.4.1

Metal: Manganese
Winter (January - March) 1988

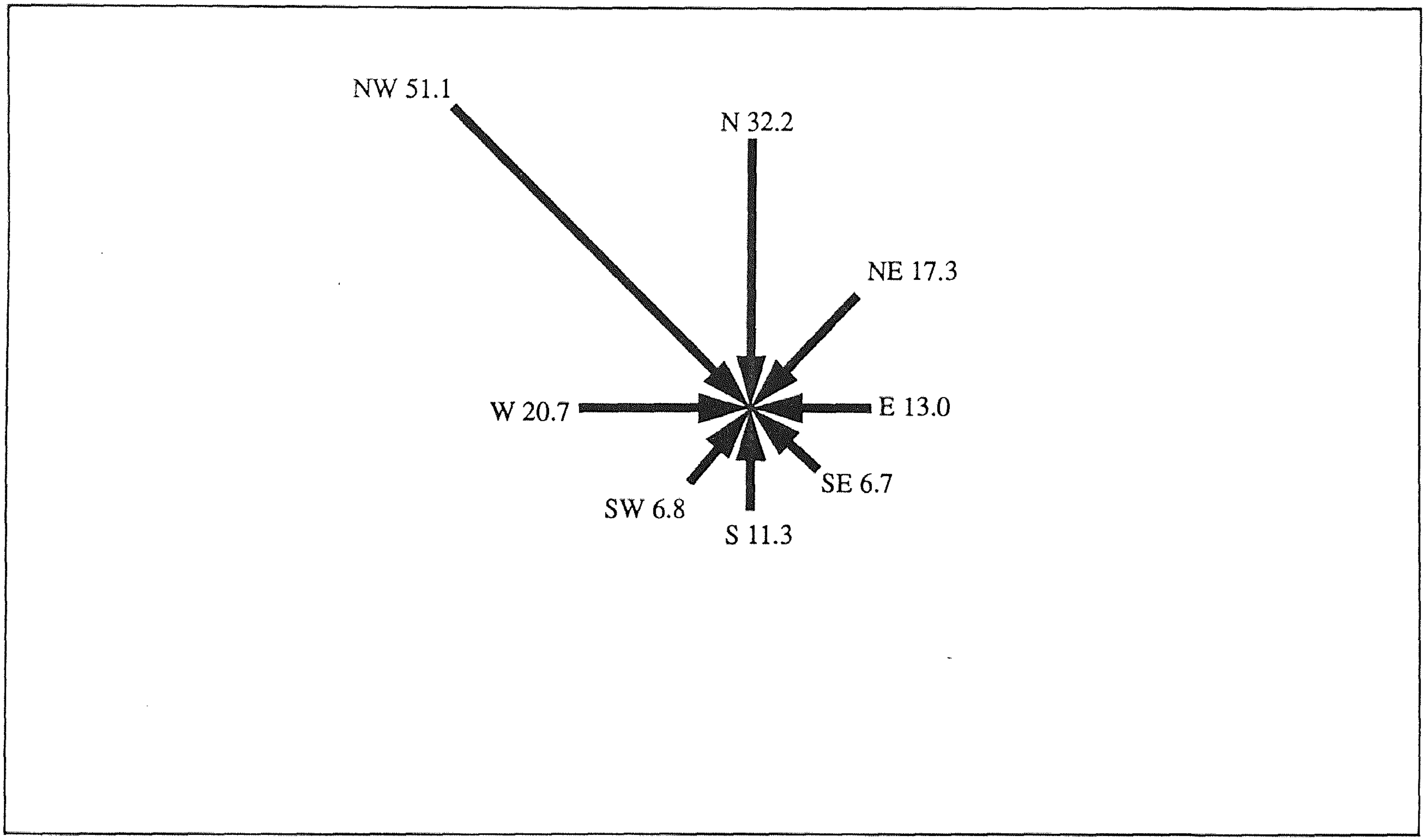


Figure 6.4.1

Site: Carteret   Units - ng/m³

METAL:mn CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Carteret

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	0.0	20.7	103.5	41.4	0.0	0.0	0.0	0.0
2	49.2	0.0	0.0	0.0	0.0	0.0	0.0	82.0
3	48.2	0.0	96.4	144.6	96.4	0.0	0.0	0.0
4	62.0	0.0	0.0	0.0	124.0	62.0	0.0	248.0
5	0.0	0.0	27.4	82.2	82.2	27.4	0.0	0.0
6	0.0	42.3	14.1	0.0	0.0	28.2	14.1	0.0
7	0.0	0.0	0.0	390.0	65.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	101.6	101.6	0.0
9	0.0	0.0	0.0	0.0	35.0	105.0	0.0	0.0
10	71.1	0.0	0.0	0.0	47.4	71.1	0.0	0.0
CONC VECTORS	230.5	63.0	241.4	658.2	450.0	395.3	115.7	330.0
WIND VECTORS	28.8	15.8	26.8	47.0	37.5	23.3	23.1	36.7

Processing complete...Press...<<ENTER>>...<f2>>.....to repeat.
Ok This is your completed concentration vector and wind vector table.

6.4.2

Metal: Manganese
Spring (April - June) 1988

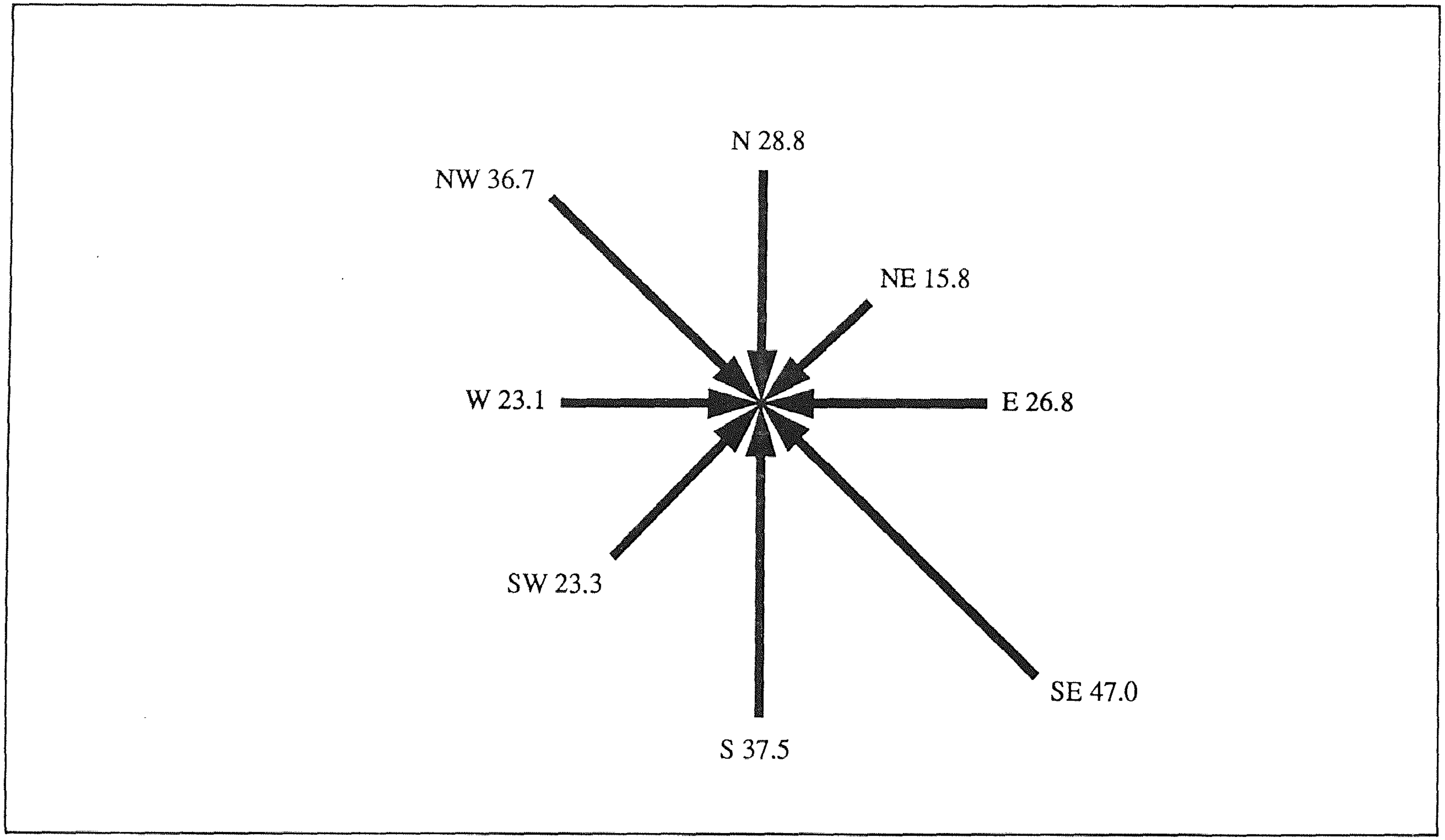


Figure 6.4.2

Site: Carteret Units - ng/m^3

METAL:mn CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Carteret 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	0.0	0.0	0.0	0.0	0.0	21.3	42.6	106.5
2	0.0	0.0	0.0	0.0	0.0	38.6	115.8	0.0
3	24.1	0.0	0.0	24.1	96.4	48.2	0.0	0.0
4	0.0	0.0	0.0	0.0	69.2	17.3	34.6	17.3
5	41.1	0.0	0.0	0.0	0.0	0.0	13.7	54.8
6	14.5	0.0	43.5	43.5	14.5	0.0	0.0	0.0
7	10.6	0.0	0.0	0.0	0.0	21.2	10.6	42.4
8	0.0	0.0	0.0	0.0	34.5	0.0	46.0	11.5
9	29.6	29.6	0.0	0.0	29.6	59.2	59.2	0.0
10	0.0	0.0	0.0	0.0	0.0	36.0	90.0	18.0
11	0.0	0.0	0.0	0.0	0.0	52.4	52.4	0.0
12	32.0	0.0	0.0	0.0	0.0	16.0	0.0	80.0
13	121.5	0.0	24.3	0.0	0.0	0.0	0.0	48.6
14	13.1	26.2	13.1	26.2	0.0	13.1	13.1	0.0
15	0.0	0.0	0.0	0.0	0.0	37.0	148.0	111.0
CONC VECTORS	286.5	55.8	80.9	93.8	244.2	360.3	626.0	490.1
WIND VECTORS	19.1	18.6	16.2	15.6	18.8	19.0	19.6	18.9

Processing complete...Press...<<ENTER>>...<f2>>.....to repeat.

Ok This is your completed concentration vector and wind vector table.

6.4.3

Metal: Manganese
Fall (October - December) 1988

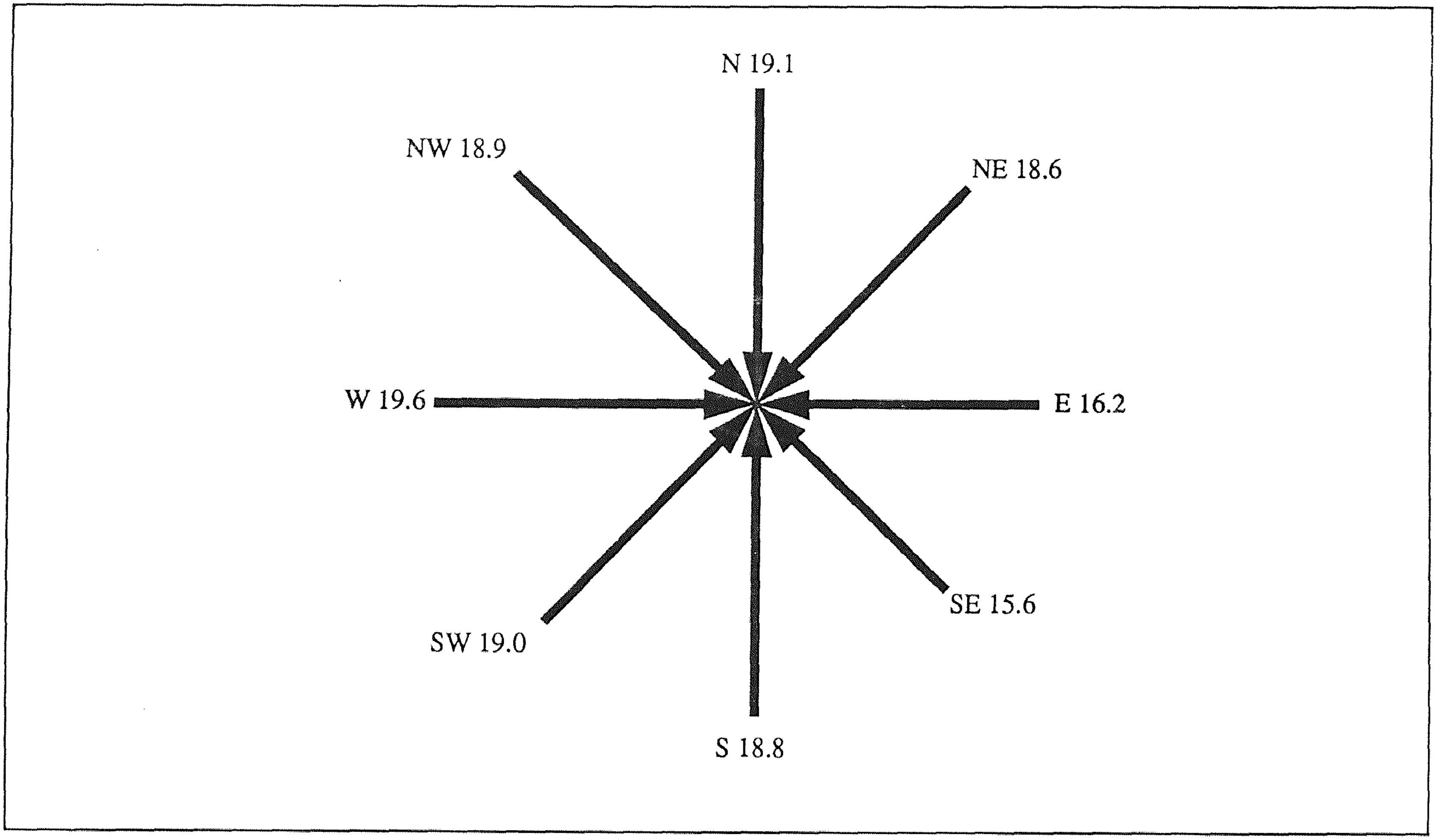


Figure 6.4.3

Site: Carteret **Units - ng/m^3**

Table - 6.5

SITE - Carteret Year 1988

Metal - Chromium

Period: Jan 1988 - Dec 1988

Sam. No.	Date	Cr Conc. ng/m3	N	NE	E	SE	S	SW	W	NW
			Wind Direction *							
1	1/04/88	12.9	3	0	0	0	0	1	4	0
2	1/10/88	19.6	4	0	0	0	0	0	0	4
3	1/16/88	19.1	0	0	0	0	6	2	0	0
4	1/22/88	61.2	3	0	0	0	0	0	2	2
5	1/28/88	46.7	0	0	0	0	0	3	3	1
6	2/03/88	46.6	2	2	3	1	0	0	0	0
7	2/09/88	46.8	3	1	0	1	3	0	0	0
8	2/15/88	48.9	0	1	0	0	6	0	0	0
9	2/21/88	47.3	0	0	0	0	0	0	5	3
10	2/27/88	46.5	1	1	1	4	1	0	0	0
11	3/03/88	0.5	4	4	0	0	0	0	0	0
12	3/10/88	48.3	3	0	0	0	0	0	0	5
13	3/16/88	50.6	0	0	0	0	0	0	1	7
14	3/22/88	29.5	4	0	0	0	0	0	1	3
15	3/28/88	43.5	1	0	0	0	0	0	3	3
16	4/03/88	36.6	0	1	5	2	0	0	0	0
17	4/09/88	38.0	3	0	0	0	0	0	0	5
18	4/15/88	47.9	1	0	2	3	2	0	0	0
19	4/21/88	30.7	1	0	0	0	2	1	0	4
20	4/27/88	30.9	0	0	1	3	3	1	0	0
21	5/03/88	58.1	0	3	1	0	0	2	1	0
22	5/09/88	30.0	0	0	0	6	1	0	0	0
23	6/14/88	54.2	0	0	0	0	0	4	4	0
24	6/20/88	29.5	0	0	0	0	2	6	0	0
25	6/28/88	58.1	3	0	0	0	2	3	0	0
26	7/02/88	59.6	1	0	0	0	0	0	0	7
27	7/08/88	15.7	0	0	1	4	0	2	1	0
28	7/14/88	17.2	0	0	0	1	2	5	0	0
29	8/01/88	4.1	0	0	0	3	4	0	0	0
30	8/07/88	2.3	0	0	0	0	1	0	5	2
31	8/13/88	8.3	0	0	0	0	0	6	2	0
32	8/19/88	2.0	4	0	0	0	2	1	0	0
33	8/25/88	4.2	1	0	0	3	4	0	0	0
34	8/31/88	2.1	3	1	0	0	0	1	1	2
35	9/06/88	2.0	0	0	0	0	0	0	3	5
36	9/12/88	1.7	1	0	0	0	2	2	1	1
37	9/18/88	11.6	0	0	0	0	0	7	1	0

Table -6.5 (contd)

Sam No	Date	Cr conc ng/m3	N	NE	E	SE	S	SW	W	NW
			Wind Direction *							
38	9/24/88	4.0	5	0	0	0	0	1	1	1
39	9/30/88	7.8	0	0	0	0	1	7	0	0
40	10/06/88		0	0	0	0	0	1	2	5
41	10/12/88		0	0	0	0	0	2	6	0
42	10/18/88		1	0	0	1	4	2	0	0
43	10/24/88		0	0	0	0	4	1	2	1
44	10/30/88		3	0	0	0	0	0	1	4
45	11/05/88		1	0	3	3	1	0	0	0
46	11/11/88		1	0	0	0	0	2	1	4
47	11/17/88		0	0	0	0	3	0	4	1
48	11/23/88		1	1	0	0	1	2	2	0
49	11/29/88		0	0	0	0	0	2	5	1
50	12/05/88		0	0	0	0	0	4	4	0
51	12/11/88		2	0	0	0	0	1	0	5
52	12/17/88		5	0	1	0	0	0	0	2
53	12/23/88		1	2	1	2	0	1	1	0
54	12/29/88		0	0	0	0	0	1	4	3

* # of 3 hour periods per 24 hour period that the wind originated from indicated direction.

Data from National Weather Service Data Station Newark Airport.

METAL:cr CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Carteret 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	38.7	0.0	0.0	0.0	0.0	12.9	51.6	0.0
2	78.4	0.0	0.0	0.0	0.0	0.0	0.0	78.4
3	0.0	0.0	0.0	0.0	114.6	38.2	0.0	0.0
4	183.6	0.0	0.0	0.0	0.0	0.0	122.4	122.4
5	0.0	0.0	0.0	0.0	0.0	140.1	140.1	46.7
6	93.2	93.2	139.8	46.6	0.0	0.0	0.0	0.0
7	140.4	46.8	0.0	46.8	140.4	0.0	0.0	0.0
8	0.0	48.9	0.0	0.0	293.4	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	236.5	141.9
10	46.5	46.5	46.5	186.0	46.5	0.0	0.0	0.0
11	2.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0
12	144.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	241.5
14	118.0	0.0	0.0	0.0	0.0	0.0	50.6	354.2
15	43.5	0.0	0.0	0.0	0.0	0.0	29.5	88.5
CONC VECTORS	889.2	237.4	186.3	279.4	594.9	191.2	761.2	%1204.1
WIND VECTORS	31.8	26.4	46.6	46.6	37.2	31.9	40.1	43.0

Processing complete...Press...<<ENTER>>...<f2>>.....to repeat.
Ok This is your completed concentration vector and wind vector table.

Metal: Chromium
Winter (January - March) 1988

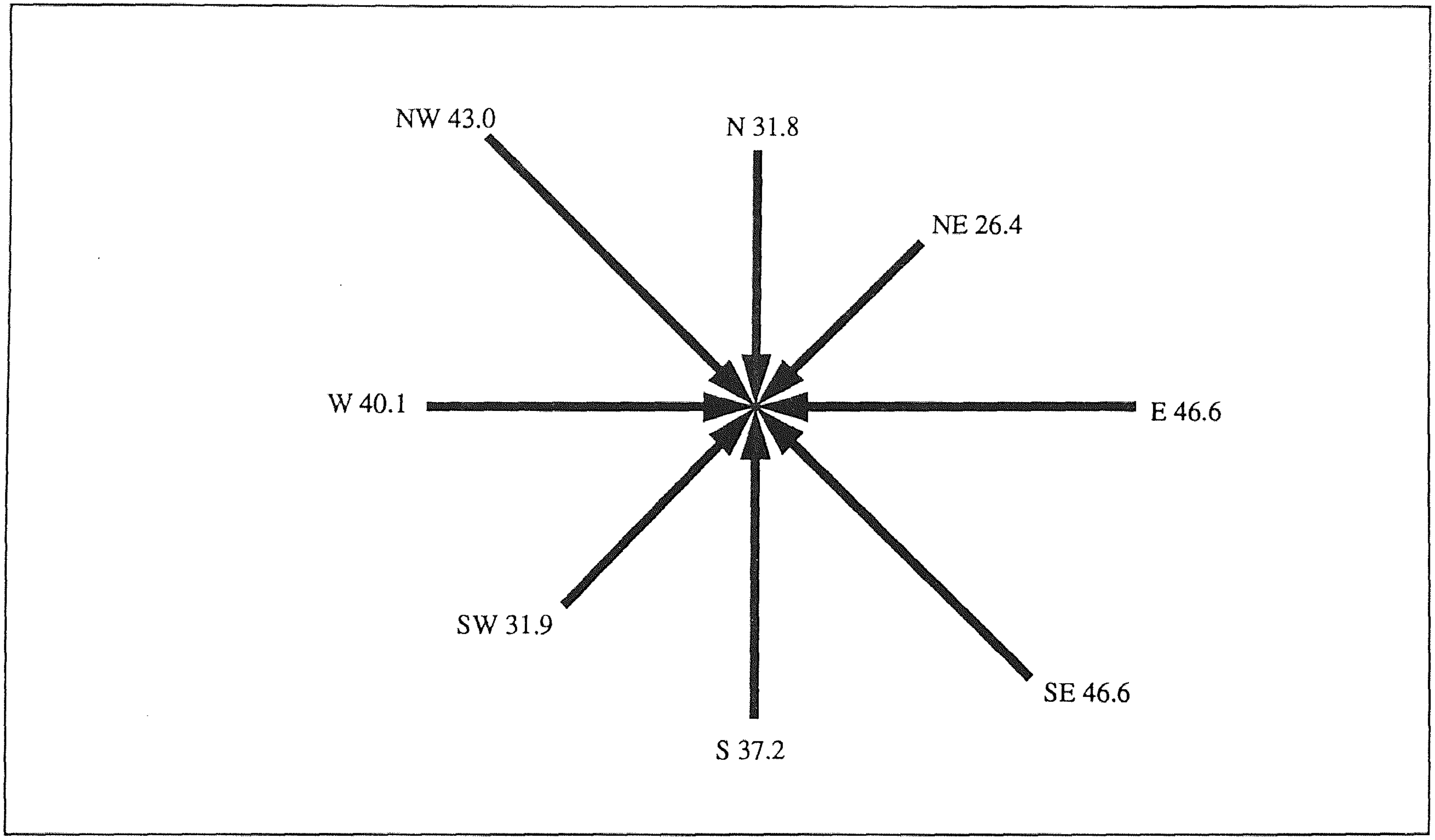


Figure 6.5.1

Site: Carteret   Units - ng/m^3

TAL:cr CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Carteret 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	0.0	36.6	183.0	73.2	0.0	0.0	0.0	0.0
2	114.0	0.0	0.0	0.0	0.0	0.0	0.0	190.0
3	47.9	0.0	95.8	143.7	95.8	0.0	0.0	0.0
4	30.7	0.0	0.0	0.0	61.4	30.7	0.0	122.8
5	0.0	0.0	30.9	92.7	92.7	30.9	0.0	0.0
6	0.0	174.3	58.1	0.0	0.0	116.2	58.1	0.0
7	0.0	0.0	0.0	180.0	30.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	216.8	216.8	0.0
9	0.0	0.0	0.0	0.0	59.0	177.0	0.0	0.0
10	174.3	0.0	0.0	0.0	116.2	174.3	0.0	0.0
ONC VECTORS	366.9	210.9	367.8	489.6	455.1	745.9	274.9	312.8
IND VECTORS	45.9	52.7	40.9	35.0	37.9	43.9	55.0	34.8

rocessing complete...Press...<<ENTER>>...<f2>>.....to repeat.

k This is your completed concentration vector and wind vector table.

6.5.2

Metal: Chromium
Spring (April - June) 1988

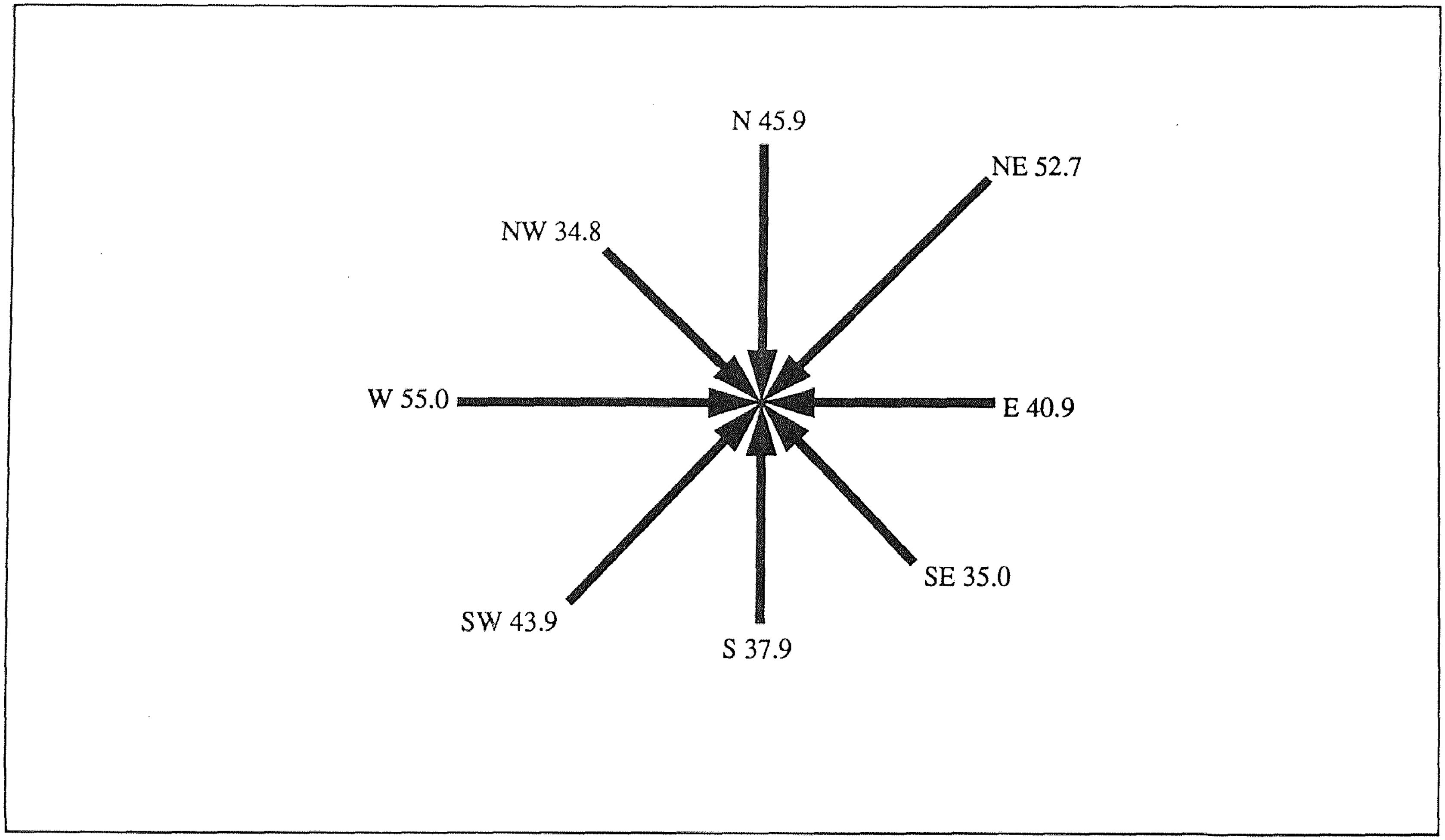


Figure 6.5.2

Site: Carteret Units - ng/m^3

TAL:CL CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Carteret 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	59.6	0.0	0.0	0.0	0.0	0.0	0.0	417.2
2	0.0	0.0	15.7	62.8	0.0	31.4	15.7	0.0
3	0.0	0.0	0.0	17.2	34.4	86.0	0.0	0.0
4	0.0	0.0	0.0	12.3	16.4	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	2.3	0.0	11.5	4.6
6	0.0	0.0	0.0	0.0	0.0	49.8	16.6	0.0
7	8.0	0.0	0.0	0.0	4.0	2.0	0.0	0.0
8	4.2	0.0	0.0	12.6	16.8	0.0	0.0	0.0
9	6.3	2.1	0.0	0.0	0.0	2.1	2.1	4.2
10	0.0	0.0	0.0	0.0	0.0	0.0	6.0	10.0
11	1.7	0.0	0.0	0.0	3.4	3.4	1.7	1.7
12	0.0	0.0	0.0	0.0	0.0	81.2	11.6	0.0
13	20.0	0.0	0.0	0.0	0.0	4.0	4.0	4.0
14	0.0	0.0	0.0	0.0	7.8	54.6	0.0	0.0
NC VECTORS	99.8	2.1	15.7	104.9	85.1	314.5	69.2	441.7
ND VECTORS	6.7	2.1	15.7	9.5	5.3	9.8	4.6	24.5

ocessing complete...Press...<<ENTER>>...<f2>>.....to repeat.

This is your completed concentration vector and wind vector table.

Metal: Chromium
Summer (July - September) 1988

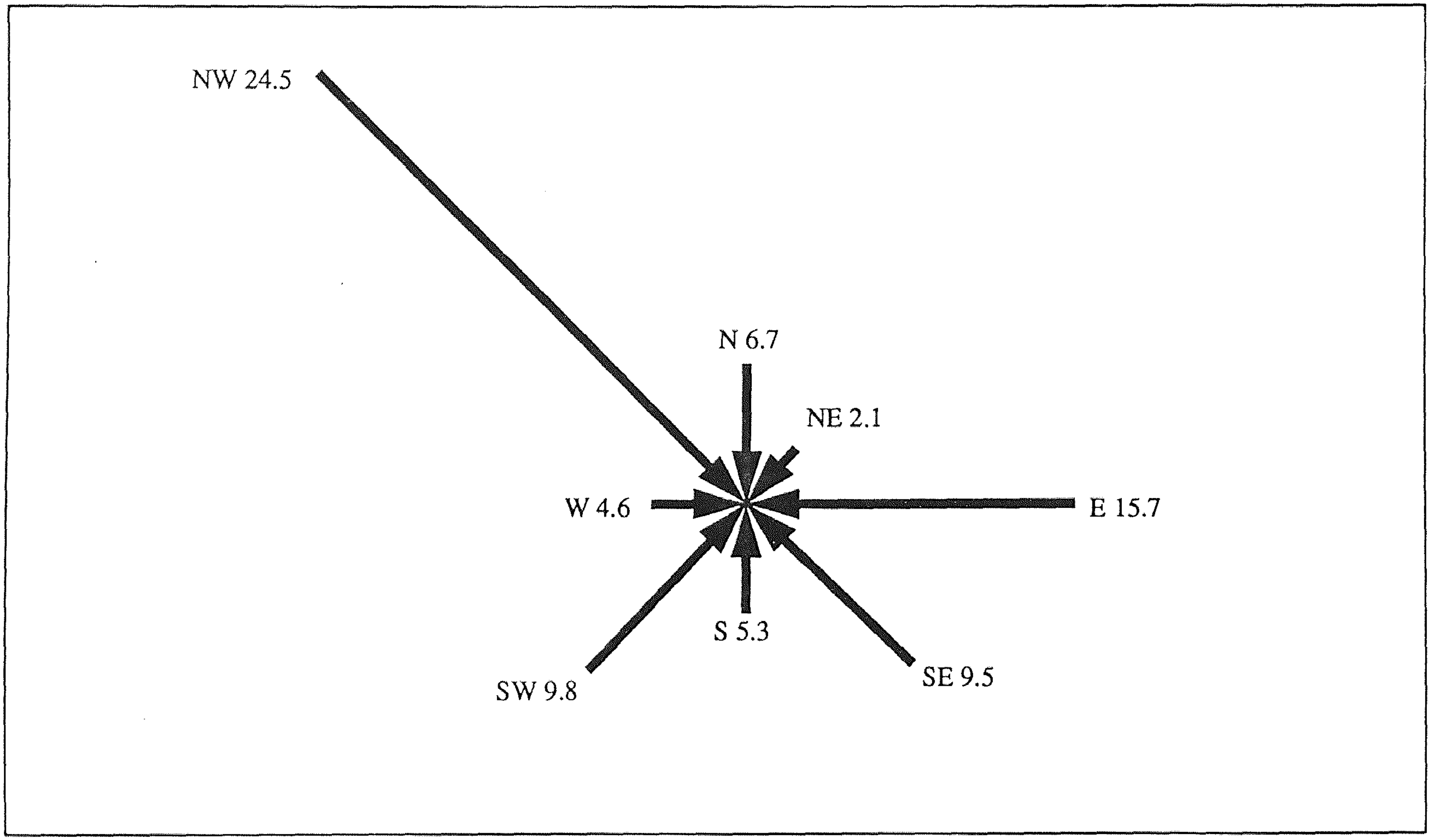


Figure 6.5.3

Site: Carteret   Units - ng/m3

Table - 6.6

SITE - Carteret Year - 1988

Metal - Cadmium

Period: Jan 1988 Dec 1988

Sam. No.	Date	Cd Conc. ng/m3	N	NE	E	SE	S	SW	W	NW
			Wind Direction *							
1	1/04/88	0.5	3	0	0	0	0	1	4	0
2	1/10/88	0.3	4	0	0	0	0	0	0	4
3	1/16/88	0.7	0	0	0	0	6	2	0	0
4	1/22/88	2.0	3	0	0	0	0	0	2	2
5	1/28/88	1.5	0	0	0	0	0	3	3	1
6	2/03/88	1.5	2	2	3	1	0	0	0	0
7	2/09/88	0.7	3	1	0	1	3	0	0	0
8	2/15/88	1.6	0	1	0	0	6	0	0	0
9	2/21/88	1.5	0	0	0	0	0	0	5	3
10	2/27/88	1.5	1	1	1	4	1	0	0	0
11	3/03/88	2.3	4	4	0	0	0	0	0	0
12	3/10/88	1.6	3	0	0	0	0	0	0	5
13	3/16/88	3.7	0	0	0	0	0	0	1	7
14	3/22/88	5.5	4	0	0	0	0	0	1	3
15	3/28/88	2.3	1	0	0	0	0	0	3	3
16	4/03/88	2.0	0	1	5	2	0	0	0	0
17	4/09/88	4.3	3	0	0	0	0	0	0	5
18	4/15/88	1.4	1	0	2	3	2	0	0	0
19	4/21/88	4.8	1	0	0	0	2	1	0	4
20	4/27/88	4.7	0	0	1	3	3	1	0	0
21	5/03/88	2.9	0	3	1	0	0	2	1	0
22	5/09/88	11.7	0	0	0	6	1	0	0	0
23	6/14/88	1.7	0	0	0	0	0	4	4	0
24	6/20/88	1.7	0	0	0	0	2	6	0	0
25	6/28/88	2.0	3	0	0	0	2	3	0	0
26	7/02/88	4.3	1	0	0	0	0	0	0	7
27	7/08/88	4.6	0	0	1	4	0	2	1	0
28	7/14/88	3.0	0	0	0	1	2	5	0	0
29	8/01/88	1.6	0	0	0	3	4	0	0	0
30	8/07/88	1.2	0	0	0	0	1	0	5	2
31	8/13/88	2.4	0	0	0	0	0	6	2	0
32	8/19/88	4.1	4	0	0	0	2	1	0	0
33	8/25/88	4.1	1	0	0	3	4	0	0	0
34	8/31/88	3.7	3	1	0	0	0	1	1	2
35	9/06/88	3.2	0	0	0	0	0	0	3	5
36	9/12/88	2.3	1	0	0	0	2	2	1	1
37	9/18/88	2.2	0	0	0	0	0	7	1	0

Table - 6.6 (contd)

Sam No	Date	conc ng/m3	N	NE	E	SE	S	SW	W	NW
38	9/24/88	3.9	5	0	0	0	0	1	1	1
39	9/30/88	2.6	0	0	0	0	1	7	0	0
40	10/06/88		0	0	0	0	0	1	2	5
41	10/12/88		0	0	0	0	0	2	6	0
42	10/18/88		1	0	0	1	4	2	0	0
43	10/24/88		0	0	0	0	4	1	2	1
44	10/30/88		3	0	0	0	0	0	1	4
45	11/05/88		1	0	3	3	1	0	0	0
46	11/11/88		1	0	0	0	0	2	1	4
47	11/17/88		0	0	0	0	3	0	4	1
48	11/23/88		1	1	0	0	1	2	2	0
49	11/29/88		0	0	0	0	0	2	5	1
50	12/05/88		0	0	0	0	0	4	4	0
51	12/11/88		2	0	0	0	0	1	0	5
52	12/17/88		5	0	1	0	0	0	0	2
53	12/23/88		1	2	1	2	0	1	1	0
54	12/29/88		0	0	0	0	0	1	4	3

* # of 3 hour periods per 24 hour period that the wind originated from indicated direction.

L:cd CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Carteret 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	1.5	0.0	0.0	0.0	0.0	0.5	2.0	0.0
2	1.2	0.0	0.0	0.0	0.0	0.0	0.0	1.2
3	0.0	0.0	0.0	0.0	4.2	1.4	0.0	0.0
4	6.0	0.0	0.0	0.0	0.0	0.0	4.0	4.0
5	0.0	0.0	0.0	0.0	0.0	4.5	4.5	1.5
6	3.0	3.0	4.5	1.5	0.0	0.0	0.0	0.0
7	2.1	0.7	0.0	0.7	2.1	0.0	0.0	0.0
8	0.0	1.6	0.0	0.0	9.6	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	7.5	4.5
10	1.5	1.5	1.5	6.0	1.5	0.0	0.0	0.0
11	9.2	9.2	0.0	0.0	0.0	0.0	0.0	0.0
12	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0
14	22.0	0.0	0.0	0.0	0.0	0.0	3.7	25.9
15	2.3	0.0	0.0	0.0	0.0	0.0	5.5	16.5
							6.9	6.9
E VECTORS	53.6	16.0	6.0	8.2	17.4	6.4	34.1	68.5
D VECTORS	1.9	1.8	1.5	1.4	1.1	1.1	1.8	2.4

essing complete...Press...<<ENTER>>...<f2>>.....to repeat.

This is your completed concentration vector and wind vector table.

6.6.1

Metal: Cadmium
Winter (January - March) 1988

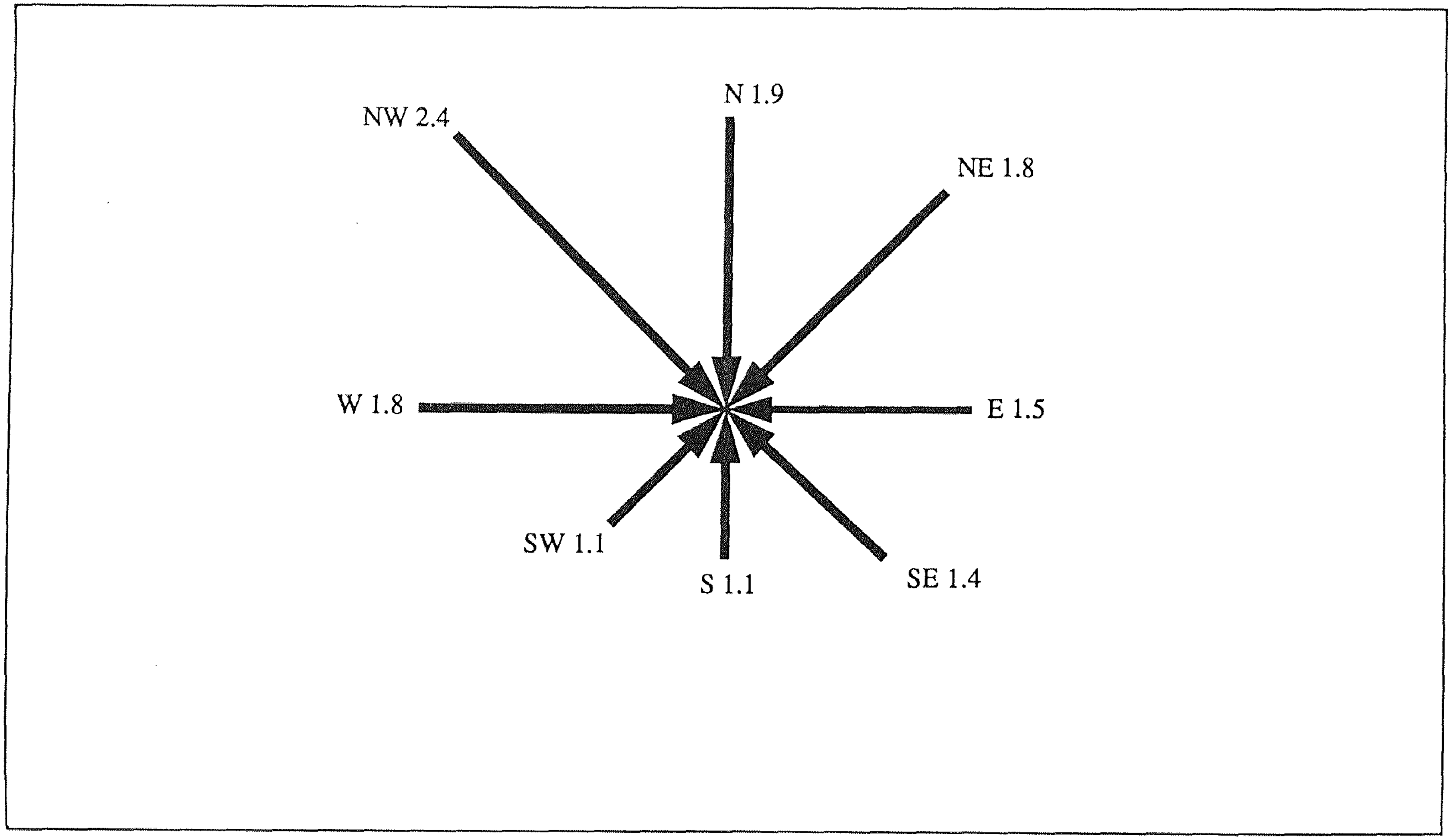


Figure 6.6.1

Site: Carteret Units - ng/m^3

ETAL:cd CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Carteret 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	0.0	2.0	10.0	4.0	0.0	0.0	0.0	0.0
2	12.9	0.0	0.0	0.0	0.0	0.0	0.0	21.5
3	1.4	0.0	2.8	4.2	2.8	0.0	0.0	0.0
4	4.8	0.0	0.0	0.0	9.6	4.8	0.0	19.2
5	0.0	0.0	4.7	14.1	14.1	4.7	0.0	0.0
6	0.0	8.7	2.9	0.0	0.0	5.8	2.9	0.0
7	0.0	0.0	0.0	70.2	11.7	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	6.8	6.8	0.0
9	0.0	0.0	0.0	0.0	3.4	10.2	0.0	0.0
10	6.0	0.0	0.0	0.0	4.0	6.0	0.0	0.0

ONC VECTORS	25.1	10.7	20.4	92.5	45.6	38.3	9.7	40.7
IND VECTORS	3.1	2.7	2.3	6.6	3.8	2.3	1.9	4.5

ocessing complete...Press...<<ENTER>>...<f2>>.....to repeat.

K This is your completed concentration vector and wind vector table.

6.6.2.

Metal: Cadmium
Spring (April - June) 1988

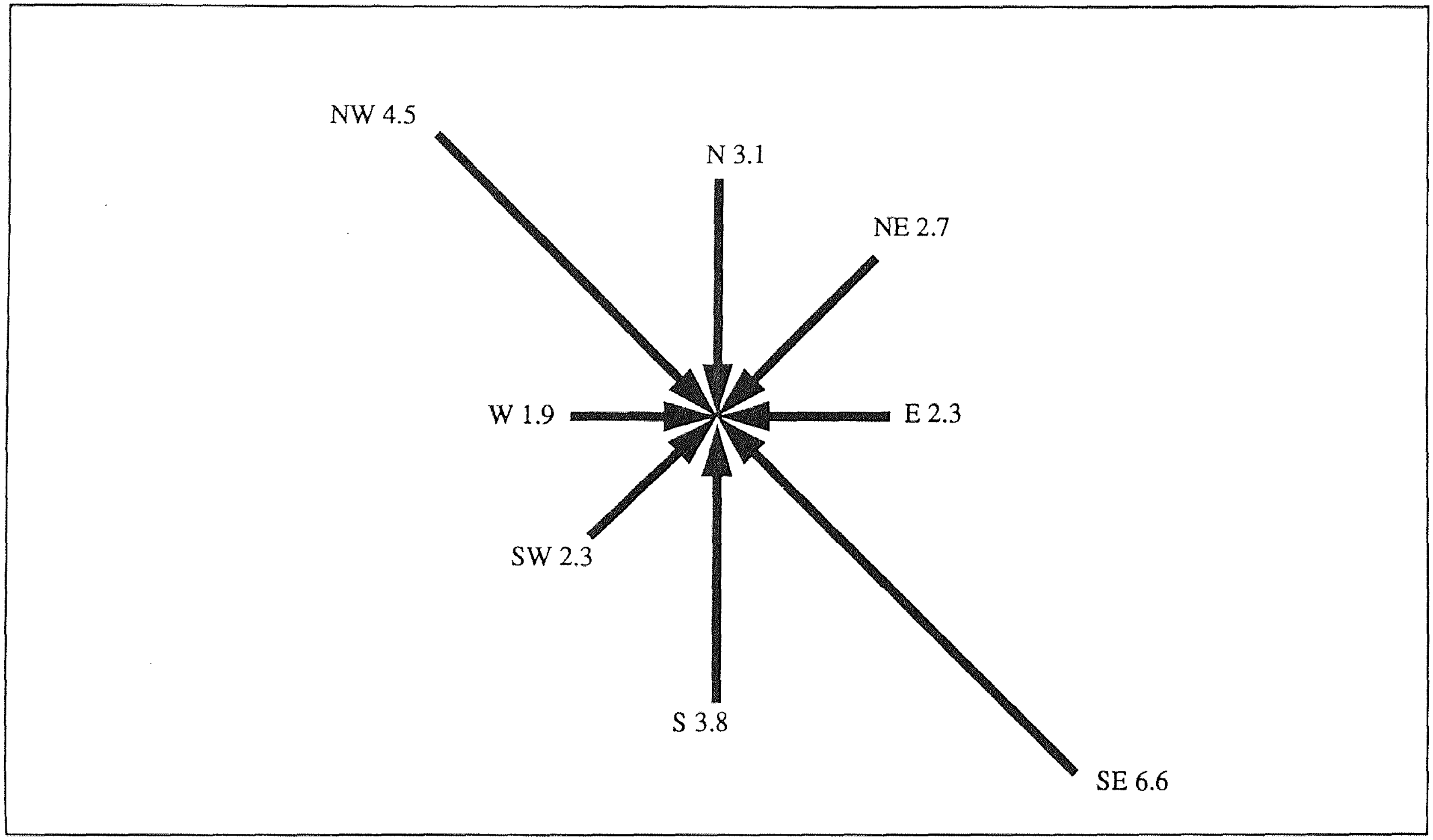


Figure 6.6.2

Site: Carteret Units - ng/m^3

METAL: cd CONCENTRATION AND WIND VECTORS TABLE SITE NAME: Carteret 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	4.3	0.0	0.0	0.0	0.0	0.0	0.0	30.1
2	0.0	0.0	4.6	18.4	0.0	9.2	4.6	0.0
3	0.0	0.0	0.0	3.0	6.0	15.0	0.0	0.0
4	0.0	0.0	0.0	4.8	6.4	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	1.2	0.0	6.0	2.4
6	0.0	0.0	0.0	0.0	0.0	14.4	4.8	0.0
7	16.4	0.0	0.0	0.0	8.2	4.1	0.0	0.0
8	4.1	0.0	0.0	12.3	16.4	0.0	0.0	0.0
9	11.1	3.7	0.0	0.0	0.0	3.7	3.7	7.4
10	0.0	0.0	0.0	0.0	0.0	0.0	9.6	16.0
11	2.3	0.0	0.0	0.0	4.6	4.6	2.3	2.3
12	0.0	0.0	0.0	0.0	0.0	15.4	2.2	0.0
13	19.5	0.0	0.0	0.0	0.0	3.9	3.9	3.9
14	0.0	0.0	0.0	0.0	2.6	18.2	0.0	0.0
CONC VECTORS	57.7	3.7	4.6	38.5	45.4	88.5	37.1	62.1
WIND VECTORS	3.8	3.7	4.6	3.5	2.8	2.8	2.5	3.5

Processing complete...Press...<<ENTER>>...<f2>>.....to repeat.

Ok This is your completed concentration vector and wind vector table.

6.6.3

Metal: Cadmium
Summer (July - September) 1988

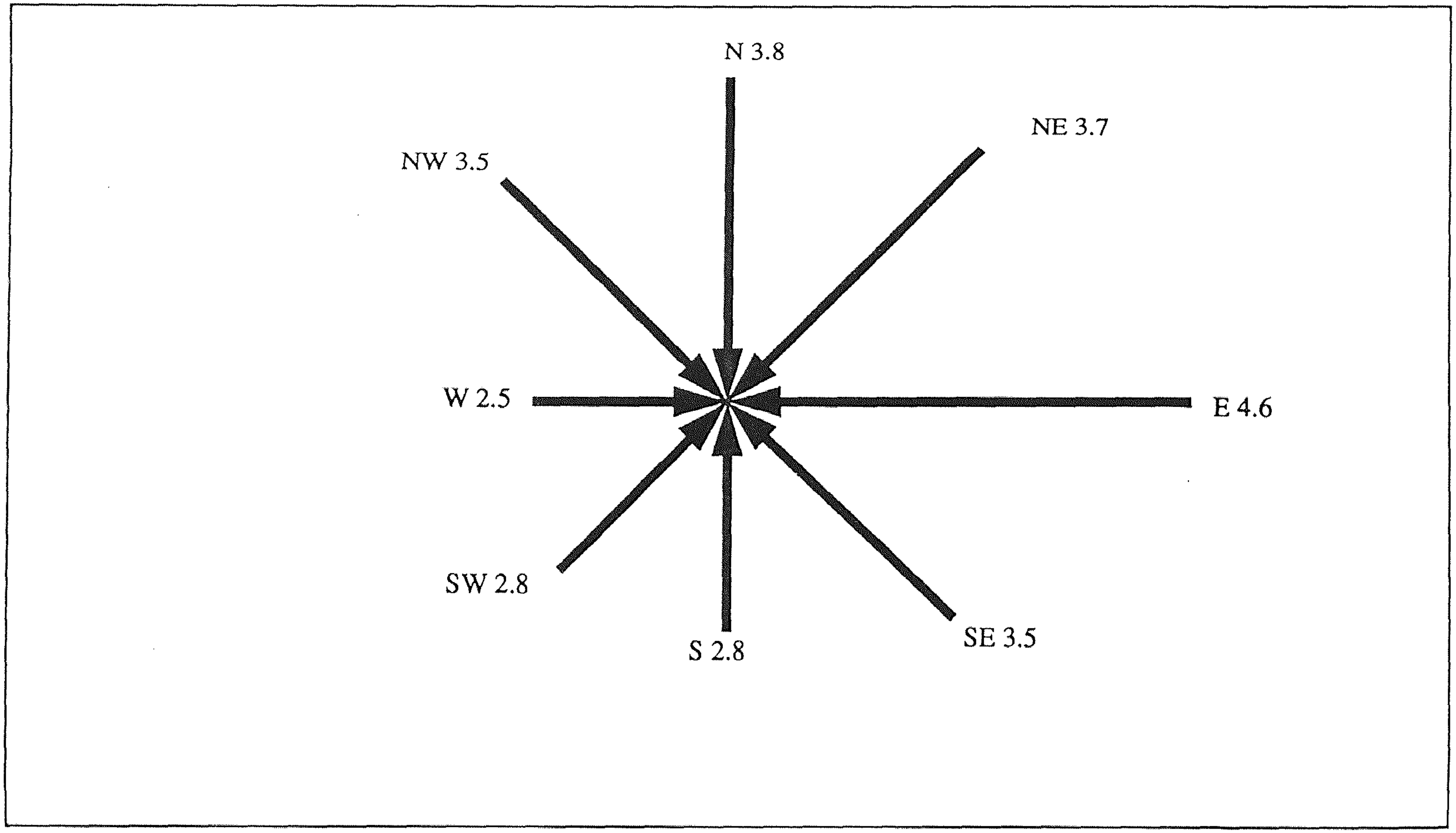


Figure 6.6.3

Site: Carteret Units - ng/m^3

Table - 6.7

SITE - Carteret   Year - 1988

Metal - Nickel

Period: Jan 1988 - Dec 1988

Sam. No.	Date	Ni Conc. ng/m3	N	NE	E	SE	S	SW	W	NW
			Wind Direction *							
1	1/04/88	14.0	3	0	0	0	0	1	4	0
2	1/10/88	7.1	4	0	0	0	0	0	0	4
3	1/16/88	161.6	0	0	0	0	6	2	0	0
4	1/22/88	59.2	3	0	0	0	0	0	2	2
5	1/28/88	45.2	0	0	0	0	0	3	3	1
6	2/03/88	182.5	2	2	3	1	0	0	0	0
7	2/09/88	131.5	3	1	0	1	3	0	0	0
8	2/15/88	47.3	0	1	0	0	6	0	0	0
9	2/21/88	45.7	0	0	0	0	0	0	5	3
10	2/27/88	163.5	1	1	1	4	1	0	0	0
11	3/03/88	93.8	4	4	0	0	0	0	0	0
12	3/10/88	94.5	3	0	0	0	0	0	0	5
13	3/16/88	33.3	0	0	0	0	0	0	1	7
14	3/22/88	33.1	4	0	0	0	0	0	1	3
15	3/28/88	25.7	1	0	0	0	0	0	3	3
16	4/03/88	21.1	0	1	5	2	0	0	0	0
17	4/09/88	31.9	3	0	0	0	0	0	0	5
18	4/15/88	23.8	1	0	2	3	2	0	0	0
19	4/21/88	40.8	1	0	0	0	2	1	0	4
20	4/27/88	33.5	0	0	1	3	3	1	0	0
21	5/03/88	56.6	0	3	1	0	0	2	1	0
22	5/09/88	27.2	0	0	0	6	1	0	0	0
23	6/14/88	21.7	0	0	0	0	0	4	4	0
24	6/20/88	15.1	0	0	0	0	2	6	0	0
25	6/28/88	10.5	3	0	0	0	2	3	0	0
26	7/02/88		1	0	0	0	0	0	0	7
27	7/08/88		0	0	1	4	0	2	1	0
28	7/14/88		0	0	0	1	2	5	0	0
29	8/01/88		0	0	0	3	4	0	0	0
30	8/07/88		0	0	0	0	1	0	5	2
31	8/13/88		0	0	0	0	0	6	2	0
32	8/19/88		4	0	0	0	2	1	0	0
33	8/25/88		1	0	0	3	4	0	0	0
34	8/31/88		3	1	0	0	0	1	1	2
35	9/06/88		0	0	0	0	0	0	3	5
36	9/12/88		1	0	0	0	2	2	1	1
37	9/18/88		0	0	0	0	0	7	1	0

Table - 6.7 (contd)

Sam No	Date	conc ng/m3	N	NE	E	SE	S	SW	W	NW
38	9/24/88		5	0	0	0	0	1	1	1
39	9/30/88		0	0	0	0	1	7	0	0
40	10/06/88	4.2	0	0	0	0	0	1	2	5
41	10/12/88	5.0	0	0	0	0	0	2	6	0
42	10/18/88	20.0	1	0	0	1	4	2	0	0
43	10/24/88	8.7	0	0	0	0	4	1	2	1
44	10/30/88	3.4	3	0	0	0	0	0	1	4
45	11/05/88	1.6	1	0	3	3	1	0	0	0
46	11/11/88	8.8	1	0	0	0	0	2	1	4
47	11/17/88	11.2	0	0	0	0	3	0	4	1
48	11/23/88	14.9	1	1	0	0	1	2	2	0
49	11/29/88	7.6	0	0	0	0	0	2	5	1
50	12/05/88	7.3	0	0	0	0	0	4	4	0
51	12/11/88	5.9	2	0	0	0	0	1	0	5
52	12/17/88	22.5	5	0	1	0	0	0	0	2
53	12/23/88	13.1	1	2	1	2	0	1	1	0
54	12/29/88	5.9	0	0	0	0	0	1	4	3

* # of 3 hour periods per 24 hour period that the wind originated from indicated direction.

Data from National Weather Service Data Station Newrk Airport.

IETAL:n1 CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Carteret 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	42.0	0.0	0.0	0.0	0.0	14.0	56.0	0.0
2	28.4	0.0	0.0	0.0	0.0	0.0	0.0	28.4
3	0.0	0.0	0.0	0.0	969.6	323.2	0.0	0.0
4	177.6	0.0	0.0	0.0	0.0	0.0	118.4	118.4
5	0.0	0.0	0.0	0.0	0.0	135.6	135.6	45.2
6	365.0	365.0	547.5	182.5	0.0	0.0	0.0	0.0
7	394.5	131.5	0.0	131.5	394.5	0.0	0.0	0.0
8	0.0	47.3	0.0	0.0	283.8	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	228.5	137.1
10	163.5	163.5	163.5	654.0	163.5	0.0	0.0	0.0
11	375.2	375.2	0.0	0.0	0.0	0.0	0.0	0.0
12	283.5	0.0	0.0	0.0	0.0	0.0	0.0	472.5
13	0.0	0.0	0.0	0.0	0.0	0.0	33.3	233.1
14	132.4	0.0	0.0	0.0	0.0	0.0	33.1	99.3
15	25.7	0.0	0.0	0.0	0.0	0.0	77.1	77.1
CONC VECTORS	%1987.8	%1082.5	711.0	968.0	%1811.4	472.8	682.0	%1211.1
WIND VECTORS	71.0	120.3	177.8	161.3	113.2	78.8	35.9	43.3

Processing complete...Press...<<ENTER>>...<f2>>.....to repeat.

Ok This is your completed concentration vector and wind vector table.

6.7.1

Metal: Nickel
Winter (January - March) 1988

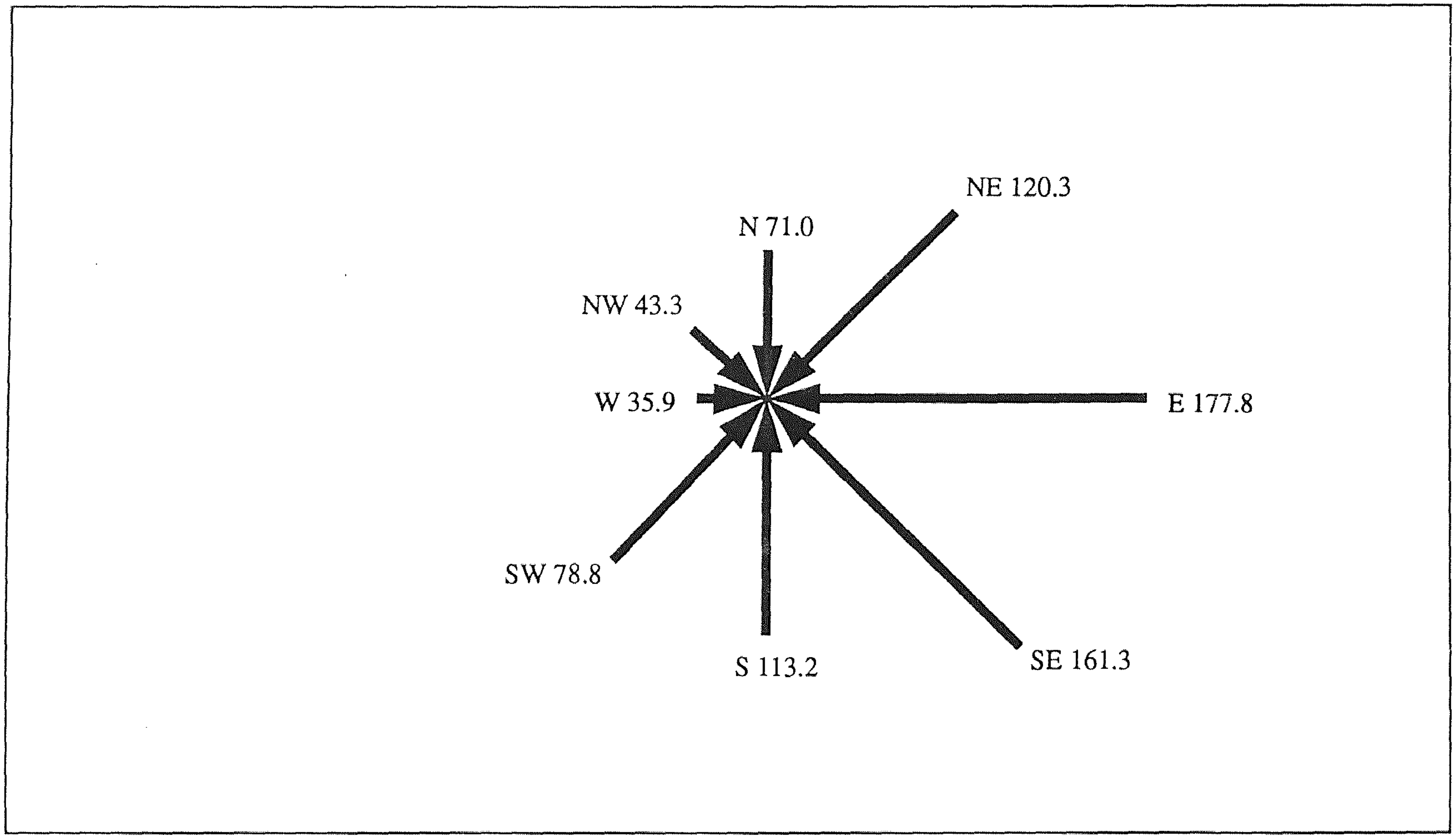


Figure 6.7.1

Site: Carteret Units - ng/m3

METAL:ni CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Carteret 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	0.0	21.1	105.5	42.2	0.0	0.0	0.0	0.0
2	95.7	0.0	0.0	0.0	0.0	0.0	0.0	159.5
3	23.8	0.0	47.6	71.4	47.6	0.0	0.0	0.0
4	40.8	0.0	0.0	0.0	81.6	40.8	0.0	163.2
5	0.0	0.0	33.5	100.5	100.5	33.5	0.0	0.0
6	0.0	169.8	56.6	0.0	0.0	113.2	56.6	0.0
7	0.0	0.0	0.0	163.2	27.2	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	86.8	86.8	0.0
9	0.0	0.0	0.0	0.0	30.2	90.6	0.0	0.0
10	31.5	0.0	0.0	0.0	21.0	31.5	0.0	0.0

CONC VECTORS	191.8	190.9	243.2	377.3	308.1	396.4	143.4	322.7
WIND VECTORS	24.0	47.7	27.0	27.0	25.7	23.3	28.7	35.9

Processing complete...Press...<<ENTER>>...<f2>>.....to repeat.

ok This is your completed concentration vector and wind vector table.

6.7.2

Metal: Nickel
Spring (April - June) 1988

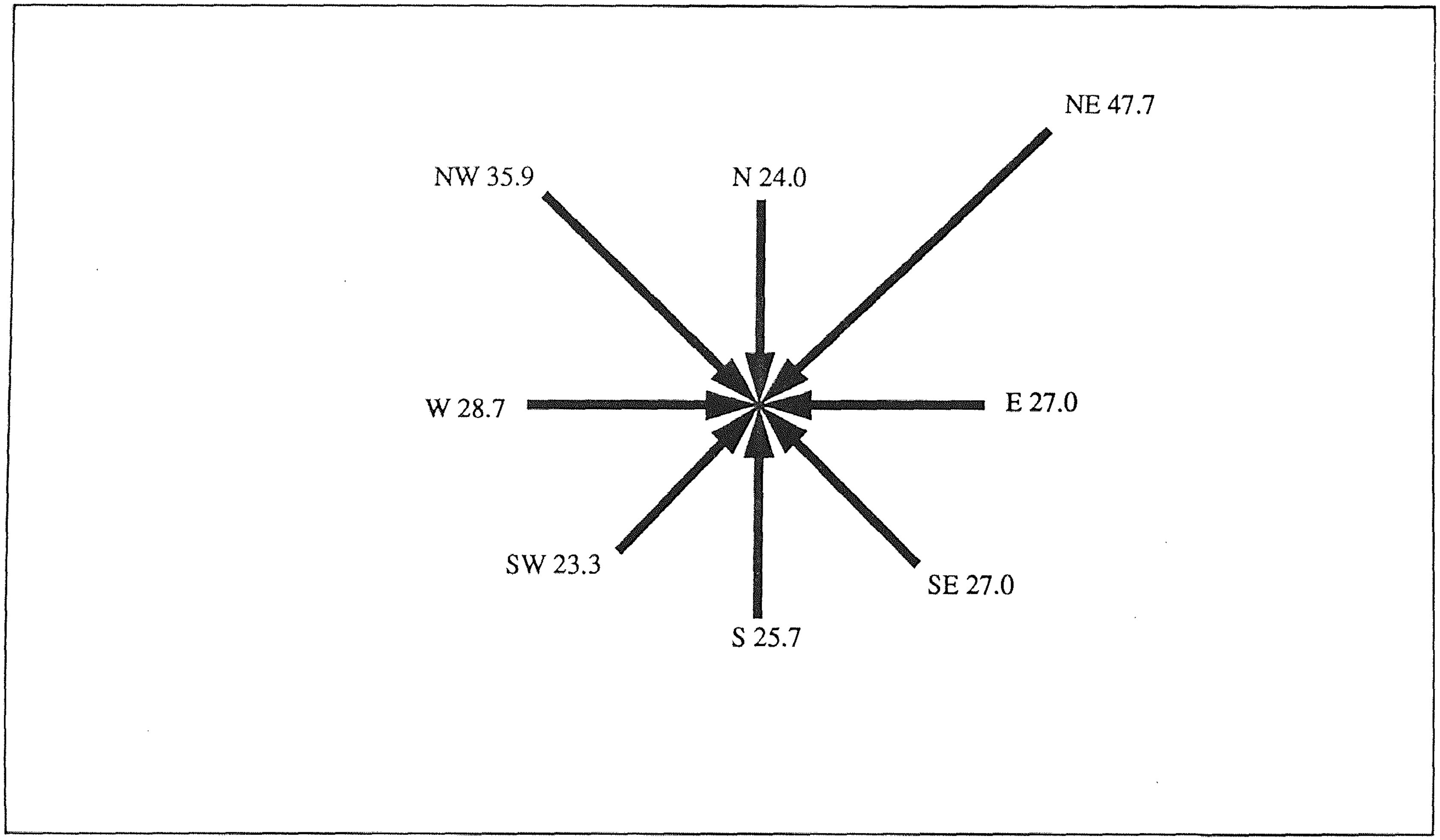


Figure 6.7.2

Site: Carteret Units - ng/m^3

METAL:ni CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Carteret 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	0.0	0.0	0.0	0.0	0.0	4.2	8.4	21.0
2	0.0	0.0	0.0	0.0	0.0	10.0	30.0	0.0
3	20.0	0.0	0.0	20.0	80.0	40.0	0.0	0.0
4	0.0	0.0	0.0	0.0	34.8	8.7	17.4	8.7
5	10.2	0.0	0.0	0.0	0.0	0.0	3.4	13.6
6	1.6	0.0	4.8	4.8	1.6	0.0	0.0	0.0
7	8.8	0.0	0.0	0.0	0.0	17.6	8.8	35.2
8	0.0	0.0	0.0	0.0	33.6	0.0	44.8	11.2
9	14.9	14.9	0.0	0.0	14.9	29.8	29.8	0.0
10	0.0	0.0	0.0	0.0	0.0	15.2	38.0	7.6
11	0.0	0.0	0.0	0.0	0.0	29.2	29.2	0.0
12	11.8	0.0	0.0	0.0	0.0	5.9	0.0	29.5
13	112.5	0.0	22.5	0.0	0.0	0.0	0.0	45.0
14	13.1	26.2	13.1	26.2	0.0	13.1	13.1	0.0
15	0.0	0.0	0.0	0.0	0.0	5.9	23.6	17.7
CONC VECTORS	192.9	41.1	40.4	51.0	164.9	179.6	246.5	189.5
WIND VECTORS	12.9	13.7	8.1	8.5	12.7	9.5	7.7	7.3

Processing complete...Press...<<ENTER>>...<f2>>.....to repeat.

Ok This is your completed concentration vector and wind vector table.

6.7.3

Metal: Nickel
Fall (October - December) 1988

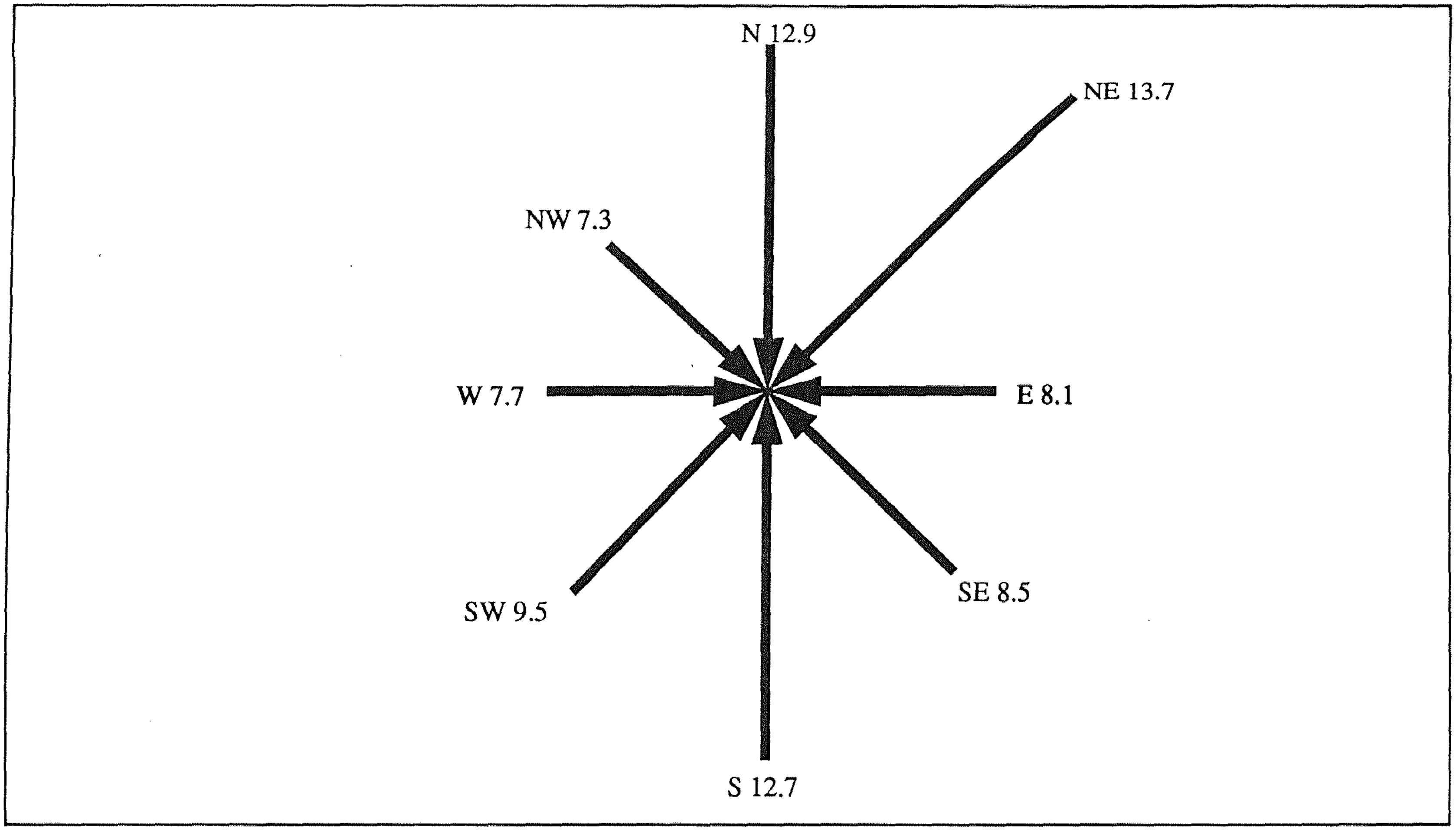


Figure 6.7.3

Site: Carteret Units - ng/m^3

Table - 6.8

SITE - Carteret Year 1988

Metal - Copper

Period: Jan 1988 - Dec 1988

Sam. No.	Date	Cu Conc. ng/m3	N	NE	E	SE	S	SW	W	NW
			Wind direction *							
1	1/04/88	58.3	3	0	0	0	0	1	4	0
2	1/10/88	86.1	4	0	0	0	0	0	0	4
3	1/16/88	61.9	0	0	0	0	6	2	0	0
4	1/22/88	85.1	3	0	0	0	0	0	2	2
5	1/28/88	68.8	0	0	0	0	0	3	3	1
6	2/03/88	114.5	2	2	3	1	0	0	0	0
7	2/09/88	95.9	3	1	0	1	3	0	0	0
8	2/15/88	60.0	0	1	0	0	6	0	0	0
9	2/21/88	73.5	0	0	0	0	0	0	5	3
10	2/27/88	41.8	1	1	1	4	1	0	0	0
11	3/03/88	70.7	4	4	0	0	0	0	0	0
12	3/10/88	67.2	3	0	0	0	0	0	0	5
13	3/16/88	60.5	0	0	0	0	0	0	1	7
14	3/22/88	136.4	4	0	0	0	0	0	1	3
15	3/28/88	94.6	1	0	0	0	0	0	3	3
16	4/03/88	44.9	0	1	5	2	0	0	0	0
17	4/09/88	96.6	3	0	0	0	0	0	0	5
18	4/15/88	118.4	1	0	2	3	2	0	0	0
19	4/21/88	108.3	1	0	0	0	2	1	0	4
20	4/27/88	152.1	0	0	1	3	3	1	0	0
21	5/03/88	85.8	0	3	1	0	0	2	1	0
22	5/09/88	93.7	0	0	0	6	1	0	0	0
23	6/14/88	47.1	0	0	0	0	0	4	4	0
24	6/20/88	137.6	0	0	0	0	2	6	0	0
25	6/28/88	255.3	3	0	0	0	2	3	0	0
26	7/02/88	196.8	1	0	0	0	0	0	0	7
27	7/08/88	81.7	0	0	1	4	0	2	1	0
28	7/14/88	37.6	0	0	0	1	2	5	0	0
29	8/01/88	171.6	0	0	0	3	4	0	0	0
30	8/07/88	71.3	0	0	0	0	1	0	5	2
31	8/13/88	208.7	0	0	0	0	0	6	2	0
32	8/19/88	150.7	4	0	0	0	2	1	0	0
33	8/25/88	231.7	1	0	0	3	4	0	0	0
34	8/31/88	252.5	3	1	0	0	0	1	1	2
35	9/06/88	52.8	0	0	0	0	0	0	3	5
36	9/12/88	149.5	1	0	0	0	2	2	1	1
37	9/18/88	100.9	0	0	0	0	0	7	1	0

Table - 6.8 (contd)

Sam No	Date	Conc ng/m3	N	NE	E	SE	S	SW	W	NW
38	9/24/88	213.5	5	0	0	0	0	1	1	1
39	9/30/88	159.2	0	0	0	0	1	7	0	0
40	10/06/88		0	0	0	0	0	1	2	5
41	10/12/88		0	0	0	0	0	2	6	0
42	10/18/88		1	0	0	1	4	2	0	0
43	10/24/88		0	0	0	0	4	1	2	1
44	10/30/88		3	0	0	0	0	0	1	4
45	11/05/88		1	0	3	3	1	0	0	0
46	11/11/88		1	0	0	0	0	2	1	4
47	11/17/88		0	0	0	0	3	0	4	1
48	11/23/88		1	1	0	0	1	2	2	0
49	11/29/88		0	0	0	0	0	2	5	1
50	12/05/88		0	0	0	0	0	4	4	0
51	12/11/88		2	0	0	0	0	1	0	5
52	12/17/88		5	0	1	0	0	0	0	2
53	12/23/88		1	2	1	2	0	1	1	0
54	12/29/88		0	0	0	0	0	1	4	3

* # of 3 hour periods per 24 hour period that the wind originated from indicated direction.

Data from National Weather Service Data Station Newrk Airport.

METAL:cu CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Carteret 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	174.9	0.0	0.0	0.0	0.0	58.3	233.2	0.0
2	344.4	0.0	0.0	0.0	0.0	0.0	0.0	344.4
3	0.0	0.0	0.0	0.0	371.4	123.8	0.0	0.0
4	255.3	0.0	0.0	0.0	0.0	0.0	170.2	170.2
5	0.0	0.0	0.0	0.0	0.0	206.4	206.4	68.8
6	229.0	229.0	343.5	114.5	0.0	0.0	0.0	0.0
7	287.7	95.9	0.0	95.9	287.7	0.0	0.0	0.0
8	0.0	60.0	0.0	0.0	360.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	367.5	220.5
10	41.8	41.8	41.8	167.2	41.8	0.0	0.0	0.0
11	282.8	282.8	0.0	0.0	0.0	0.0	0.0	0.0
12	201.6	0.0	0.0	0.0	0.0	0.0	0.0	336.0
13	0.0	0.0	0.0	0.0	0.0	0.0	60.5	423.5
14	545.6	0.0	0.0	0.0	0.0	0.0	136.4	409.2
15	94.6	0.0	0.0	0.0	0.0	0.0	283.8	283.8
CONC VECTORS	%2457.7	709.5	385.3	377.6	%1060.9	388.5	%1458.0	%2256.4
WIND VECTORS	87.8	78.8	96.3	62.9	66.3	64.8	76.7	

6.8.1

Metal: Copper
Winter (January - March) 1988

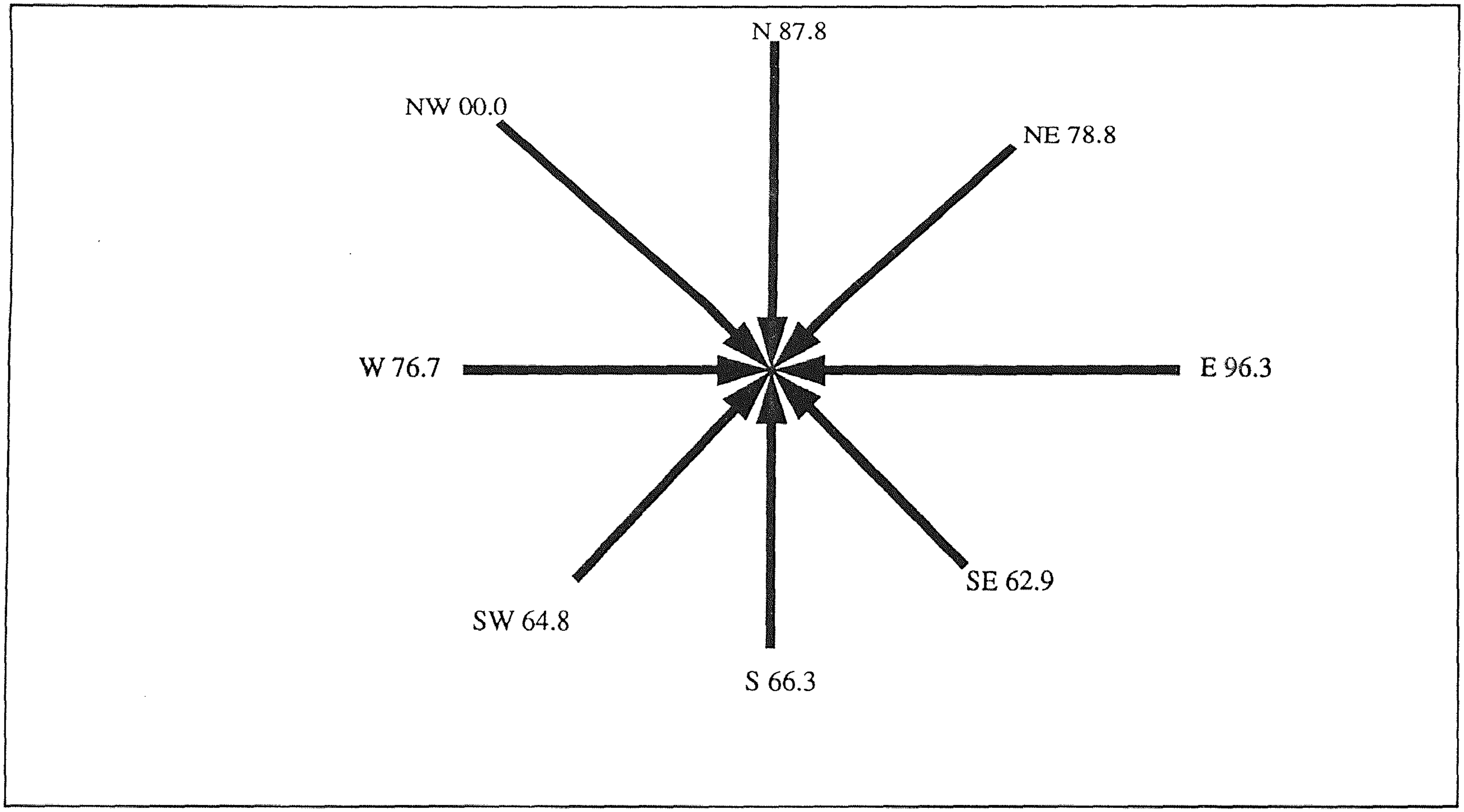


Figure 6.8.1

Site: Carteret Units - ng/m^3

METAL:cu CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Carteret 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	0.0	44.9	224.5	89.8	0.0	0.0	0.0	0.0
2	289.8	0.0	0.0	0.0	0.0	0.0	0.0	483.0
3	118.4	0.0	236.8	355.2	236.8	0.0	0.0	0.0
4	108.3	0.0	0.0	0.0	216.6	108.3	0.0	433.2
5	0.0	0.0	152.1	456.3	456.3	152.1	0.0	0.0
6	0.0	257.4	85.8	0.0	0.0	171.6	85.8	0.0
7	0.0	0.0	0.0	562.2	93.7	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	188.4	188.4	0.0
9	0.0	0.0	0.0	0.0	275.2	825.6	0.0	0.0
10	765.9	0.0	0.0	0.0	510.6	765.9	0.0	0.0
CONC VECTORS	%1282.4	302.3	699.2	%1463.5	%1789.2	%2211.9	274.2	916.2
WIND VECTORS	160.3	75.6	77.7	104.5	149.1	130.1	54.8	101.8

Processing complete...Press...<<ENTER>>...<f2>>.....to repeat.

This is your completed concentration vector and wind vector table.

Metal: Copper
Spring (April - June) 1988

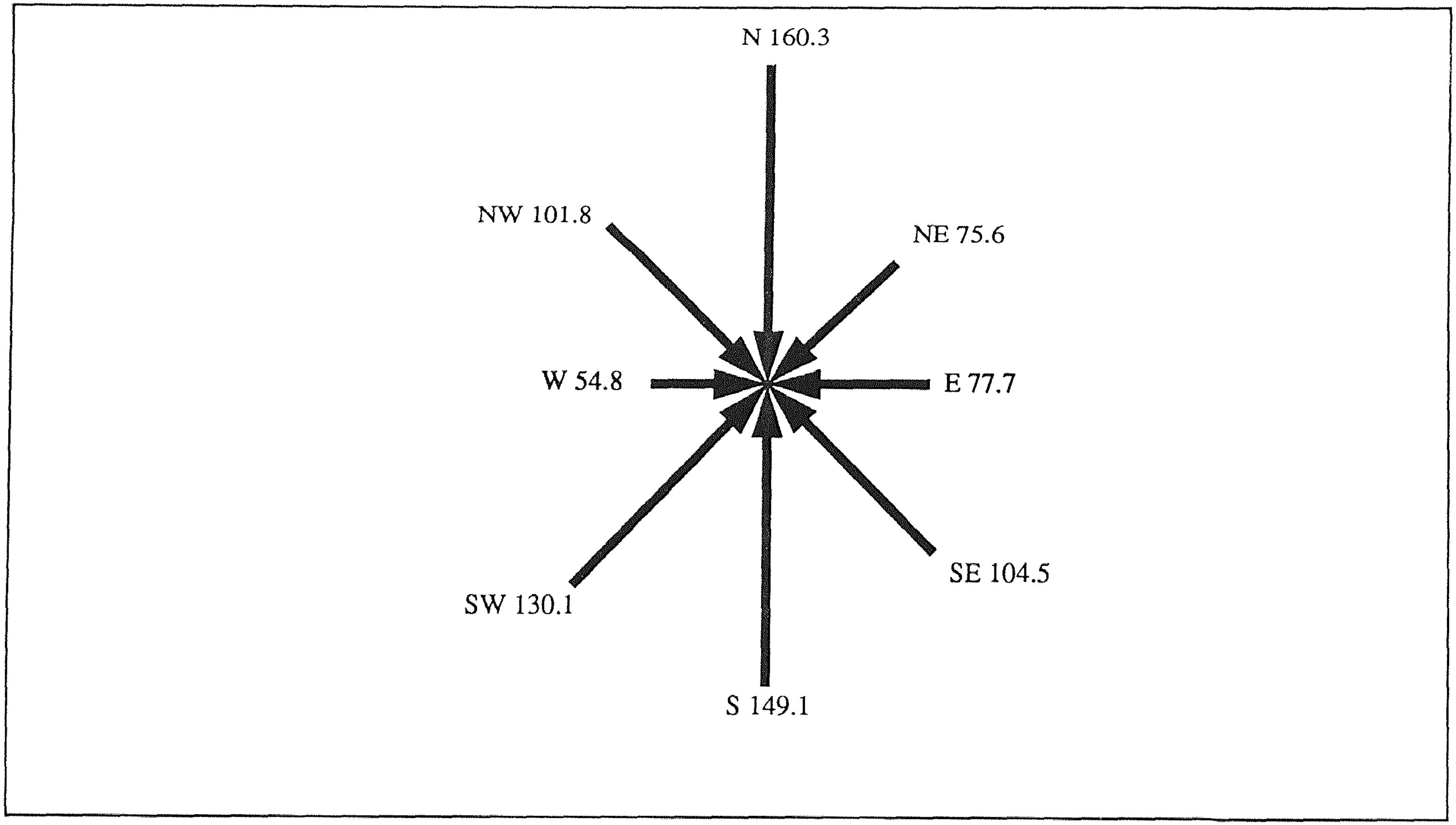


Figure 6.8.2

Site: Carteret Units - ng/m^3

3-6

METAL:cu CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Carteret 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	196.8	0.0	0.0	0.0	0.0	0.0	0.0	1377.6
2	0.0	0.0	81.7	326.8	0.0	163.4	81.7	0.0
3	0.0	0.0	0.0	37.6	75.2	188.0	0.0	0.0
4	0.0	0.0	0.0	514.8	686.4	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	71.3	0.0	356.5	142.6
6	0.0	0.0	0.0	0.0	0.0	1252.2	417.4	0.0
7	602.8	0.0	0.0	0.0	301.4	150.7	0.0	0.0
8	231.7	0.0	0.0	695.1	926.8	0.0	0.0	0.0
9	757.5	252.5	0.0	0.0	0.0	252.5	252.5	505.0
10	0.0	0.0	0.0	0.0	0.0	0.0	158.4	264.0
11	149.5	0.0	0.0	0.0	299.0	299.0	149.5	149.5
12	0.0	0.0	0.0	0.0	0.0	706.3	100.9	0.0
13	1067.5	0.0	0.0	0.0	0.0	213.5	213.5	213.5
14	0.0	0.0	0.0	0.0	159.2	1114.4	0.0	0.0
CONC VECTORS	%3005.8	252.5	81.7	%1574.3	%2519.3	%4340.0	%1730.4	%2652.2
WIND VECTORS	200.4	252.5	81.7	143.1	157.5	135.6	115.4	147.3

Processing complete...Press...<<ENTER>>...<f2>>.....to repeat.

Ok This is your completed concentration vector and wind vector table.

6.8.3

Metal: Copper
Summer (July - September) 1988

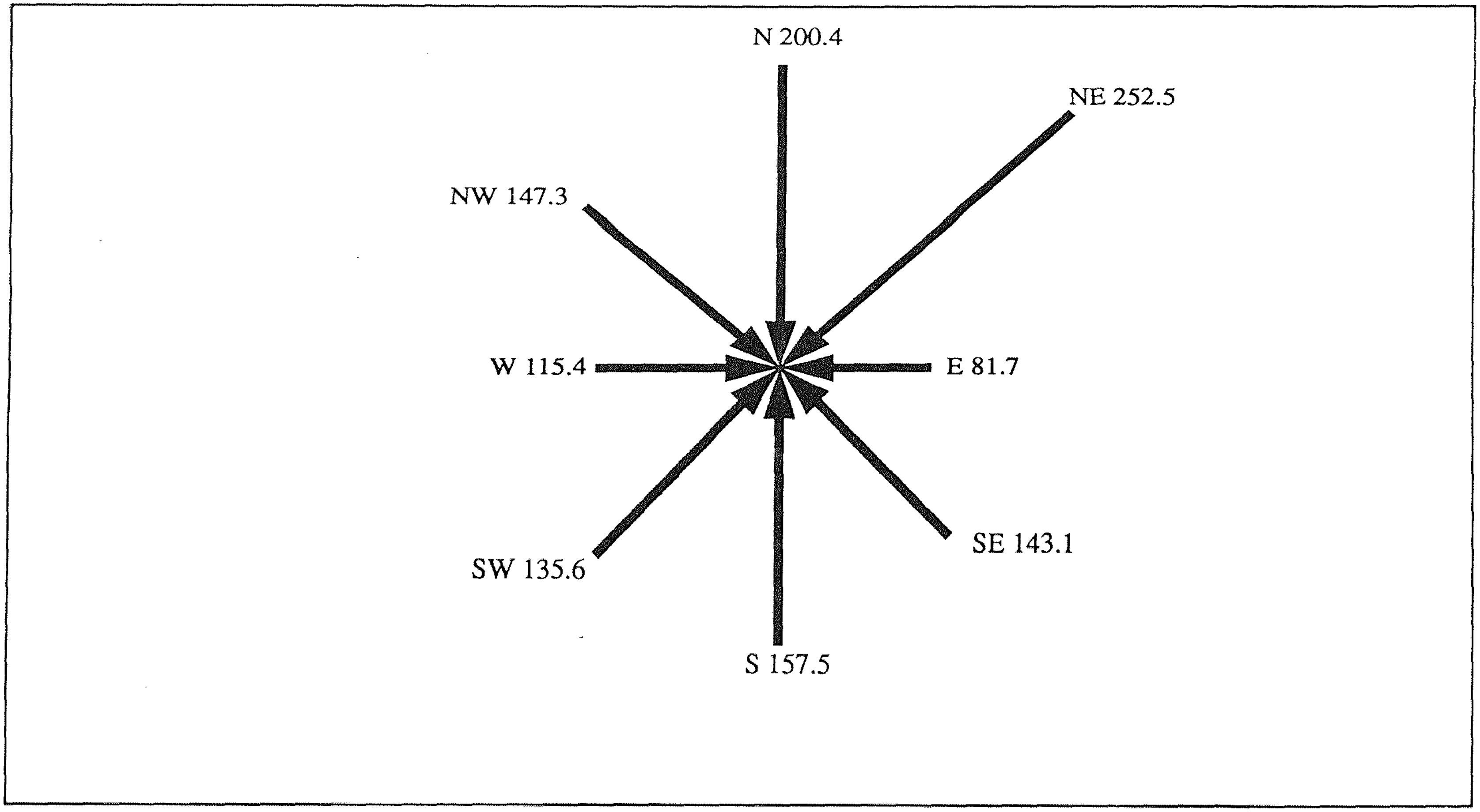


Figure 6.8.3

Site: Carteret Units - ng/m^3

Table - 6.9

SITE - Carteret   Year 1988

Metal - Mercury

Period: Jan 1988 - Dec 1988

Sam. No.	Date	Hg Conc. ng/m3	N	NE	E	SE	S	SW	W	NW
			Wind Direction *							
1	1/04/88	0.7	3	0	0	0	0	1	4	0
2	1/10/88	6.9	4	0	0	0	0	0	0	4
3	1/16/88	6.0	0	0	0	0	6	2	0	0
4	1/22/88	15.8	3	0	0	0	0	0	2	2
5	1/28/88	2.5	0	0	0	0	0	3	3	1
6	2/03/88	12.1	2	2	3	1	0	0	0	0
7	2/09/88	1.0	3	1	0	1	3	0	0	0
8	2/15/88	2.6	0	1	0	0	6	0	0	0
9	2/21/88	3.7	0	0	0	0	0	0	5	3
10	2/27/88	6.2	1	1	1	4	1	0	0	0
11	3/03/88	8.0	4	4	0	0	0	0	0	0
12	3/10/88	7.2	3	0	0	0	0	0	0	5
13	3/16/88	1.5	0	0	0	0	0	0	1	7
14	3/22/88	0.6	4	0	0	0	0	0	1	3
15	3/28/88	0.5	1	0	0	0	0	0	3	3
16	4/03/88	0.5	0	1	5	2	0	0	0	0
17	4/09/88	0.9	3	0	0	0	0	0	0	5
18	4/15/88	0.6	1	0	2	3	2	0	0	0
19	4/21/88	0.4	1	0	0	0	2	1	0	4
20	4/27/88	0.2	0	0	1	3	3	1	0	0
21	5/03/88	0.4	0	3	1	0	0	2	1	0
22	5/09/88	0.7	0	0	0	6	1	0	0	0
23	6/14/88	0.4	0	0	0	0	0	4	4	0
24	6/20/88	0.7	0	0	0	0	2	6	0	0
25	6/28/88	1.3	3	0	0	0	2	3	0	0
26	7/02/88		1	0	0	0	0	0	0	7
27	7/08/88		0	0	1	4	0	2	1	0
28	7/14/88		0	0	0	1	2	5	0	0
29	8/01/88		0	0	0	3	4	0	0	0
30	8/07/88		0	0	0	0	1	0	5	2
31	8/13/88		0	0	0	0	0	6	2	0
32	8/19/88		4	0	0	0	2	1	0	0
33	8/25/88		1	0	0	3	4	0	0	0
34	8/31/88		3	1	0	0	0	1	1	2
35	9/06/88		0	0	0	0	0	0	3	5
36	9/12/88		1	0	0	0	2	2	1	1
37	9/18/88		0	0	0	0	0	7	1	0

Table -6.9 (contd)

Sam No	Date	Hg conc ng/m3	N	NE	E	SE	S	SW	W	NW
38	9/24/88		5	0	0	0	0	1	1	1
39	9/30/88		0	0	0	0	1	7	0	0
40	10/06/88	0.9	0	0	0	0	0	1	2	5
41	10/12/88	0.9	0	0	0	0	0	2	6	0
42	10/18/88	0.6	1	0	0	1	4	2	0	0
43	10/24/88	0.7	0	0	0	0	4	1	2	1
44	10/30/88	0.8	3	0	0	0	0	0	1	4
45	11/05/88	0.6	1	0	3	3	1	0	0	0
46	11/11/88	0.9	1	0	0	0	0	2	1	4
47	11/17/88	0.7	0	0	0	0	3	0	4	1
48	11/23/88	0.8	1	1	0	0	1	2	2	0
49	11/29/88	1.5	0	0	0	0	0	2	5	1
50	12/05/88	0.7	0	0	0	0	0	4	4	0
51	12/11/88	0.6	2	0	0	0	0	1	0	5
52	12/17/88	1.1	5	0	1	0	0	0	0	2
53	12/23/88	0.6	1	2	1	2	0	1	1	0
54	12/29/88	0.5	0	0	0	0	0	1	4	3

* # of 3 hour periods per 24 hour period that the wind originated from indicated direction.

Data from National Weather Service Data Station Newark Airport.

METAL:hg CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Carteret 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	2.1	0.0	0.0	0.0	0.0	0.7	2.8	0.0
2	27.6	0.0	0.0	0.0	0.0	0.0	0.0	27.6
3	0.0	0.0	0.0	0.0	36.0	12.0	0.0	0.0
4	47.4	0.0	0.0	0.0	0.0	0.0	31.6	31.6
5	0.0	0.0	0.0	0.0	0.0	7.5	7.5	2.5
6	24.2	24.2	36.3	12.1	0.0	0.0	0.0	0.0
7	3.0	1.0	0.0	1.0	3.0	0.0	0.0	0.0
8	0.0	2.6	0.0	0.0	15.6	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	18.5	11.1
10	6.2	6.2	6.2	24.8	6.2	0.0	0.0	0.0
11	32.0	32.0	0.0	0.0	0.0	0.0	0.0	0.0
12	21.6	0.0	0.0	0.0	0.0	0.0	0.0	36.0
13	0.0	0.0	0.0	0.0	0.0	0.0	1.5	10.5
14	2.4	0.0	0.0	0.0	0.0	0.0	0.6	1.8
15	0.5	0.0	0.0	0.0	0.0	0.0	1.5	1.5
CONC VECTORS	167.0	66.0	42.5	37.9	60.8	20.2	64.0	122.6
WIND VECTORS	6.0	7.3	10.6	6.3	3.8	3.4	3.4	4.4

Processing complete...Press...<<ENTER>>...<f2>>.....to repeat.

Ok This is your completed concentration vector and wind vector table.

6.9.1

Metal: Mercury
Winter (January - March) 1988

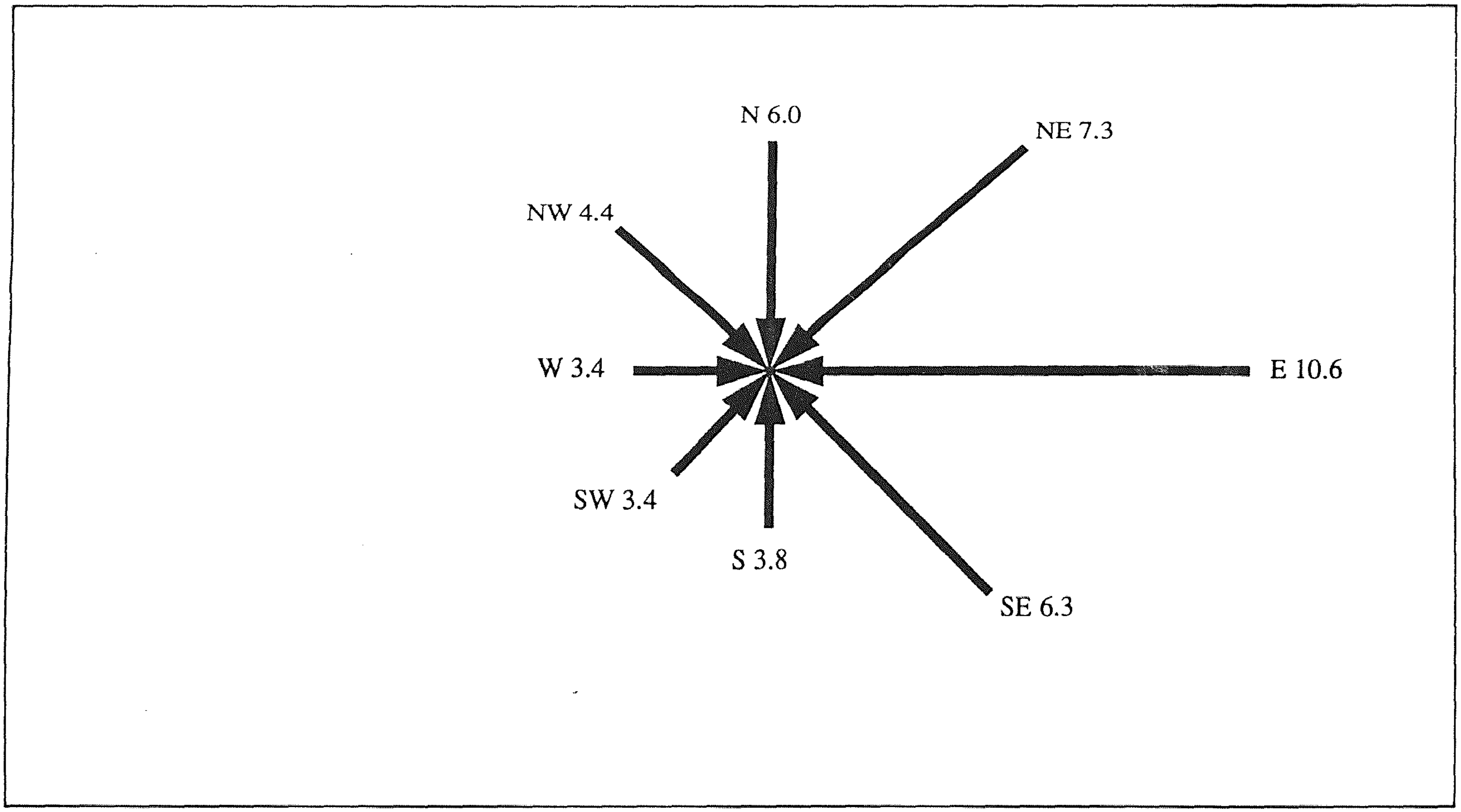


Figure 6.9.1

Site: Carteret Units - ng/m^3

ETAL:hg CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Carteret 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	0.0	0.5	2.5	1.0	0.0	0.0	0.0	0.0
2	2.7	0.0	0.0	0.0	0.0	0.0	0.0	4.5
3	0.6	0.0	1.2	1.8	1.2	0.0	0.0	0.0
4	0.4	0.0	0.0	0.0	0.8	0.4	0.0	1.6
5	0.0	0.0	0.2	0.6	0.6	0.2	0.0	0.0
6	0.0	1.2	0.4	0.0	0.0	0.8	0.4	0.0
7	0.0	0.0	0.0	4.2	0.7	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	1.6	1.6	0.0
9	0.0	0.0	0.0	0.0	1.4	4.2	0.0	0.0
10	3.9	0.0	0.0	0.0	2.6	3.9	0.0	0.0

ONC VECTORS	7.6	1.7	4.3	7.6	7.3	11.1	2.0	6.1
IND VECTORS	0.9	0.4	0.5	0.5	0.6	0.7	0.4	0.7

rocessing complete...Press...<<ENTER>>...<f2>>.....to repeat.

k This is your completed concentration vector and wind vector table.

6.9.2

Metal: Mercury
Spring (April - June) 1988

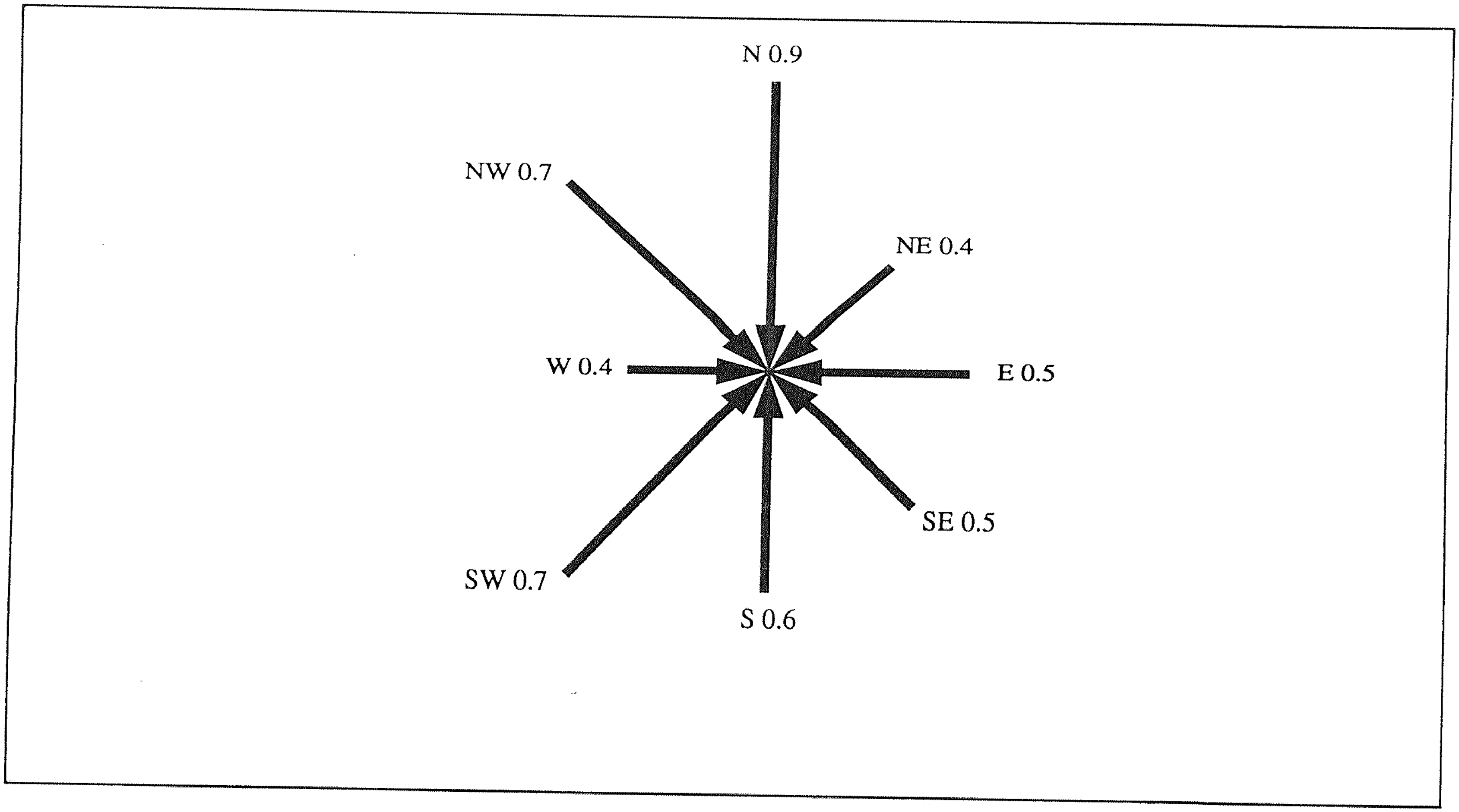


Figure 6.9.2

Site: Carteret Units - ng/m3

Table - 6.10

SITE - Carteret Year 1988

Metal - Cobalt

Period : Jan 1988- Dec 1988

Sam. No.	Date	Co Conc. ng/m3	N	NE	E	SE	S	SW	W	NW
			Wind Directions *							
1	1/04/88	13.3	3	0	0	0	0	1	4	0
2	1/10/88	26.9	4	0	0	0	0	0	0	4
3	1/16/88	4.4	0	0	0	0	6	2	0	0
4	1/22/88	15.8	3	0	0	0	0	0	2	2
5	1/28/88	4.0	0	0	0	0	0	3	3	1
6	2/03/88	12.1	2	2	3	1	0	0	0	0
7	2/09/88	4.1	3	1	0	1	3	0	0	0
8	2/15/88	8.5	0	1	0	0	6	0	0	0
9	2/21/88	8.2	0	0	0	0	0	0	5	3
10	2/27/88	20.1	1	1	1	4	1	0	0	0
11	3/03/88	8.3	4	4	0	0	0	0	0	0
12	3/10/88	12.5	3	0	0	0	0	0	0	5
13	3/16/88	8.7	0	0	0	0	0	0	1	7
14	3/22/88	11.0	4	0	0	0	0	0	1	3
15	3/28/88	7.6	1	0	0	0	0	0	3	3
16	4/03/88	6.4	0	1	5	2	0	0	0	0
17	4/09/88	8.2	3	0	0	0	0	0	0	5
18	4/15/88	6.6	1	0	2	3	2	0	0	0
19	4/21/88	7.4	1	0	0	0	2	1	0	4
20	4/27/88	6.7	0	0	1	3	3	1	0	0
21	5/03/88	3.0	0	3	1	0	0	2	1	0
22	5/09/88	9.3	0	0	0	6	1	0	0	0
23	6/14/88	4.4	0	0	0	0	0	4	4	0
24	6/20/88	7.7	0	0	0	0	2	6	0	0
25	6/28/88	38.6	3	0	0	0	2	3	0	0
26	7/02/88	30.9	1	0	0	0	0	0	0	7
27	7/08/88	4.0	0	0	1	4	0	2	1	0
28	7/14/88	8.7	0	0	0	1	2	5	0	0
29	8/01/88	1.4	0	0	0	3	4	0	0	0
30	8/07/88	1.7	0	0	0	0	1	0	5	2
31	8/13/88	9.2	0	0	0	0	0	6	2	0
32	8/19/88	4.7	4	0	0	0	2	1	0	0
33	8/25/88	9.3	1	0	0	3	4	0	0	0
34	8/31/88	11.8	3	1	0	0	0	1	1	2
35	9/06/88	4.6	0	0	0	0	0	0	3	5
36	9/12/88	2.7	1	0	0	0	2	2	1	1
37	9/18/88	6.5	0	0	0	0	0	7	1	0

Table - 6.10 (contd)

Sam No	Date	conc ng/m3	N	NE	E	SE	S	SW	W	NW
38	9/24/88	8.8	5	0	0	0	0	1	1	1
39	9/30/88	8.7	0	0	0	0	1	7	0	0
40	10/06/88		0	0	0	0	0	1	2	5
41	10/12/88		0	0	0	0	0	2	6	0
42	10/18/88		1	0	0	1	4	2	0	0
43	10/24/88		0	0	0	0	4	1	2	1
44	10/30/88		3	0	0	0	0	0	1	4
45	11/05/88		1	0	3	3	1	0	0	0
46	11/11/88		1	0	0	0	0	2	1	4
47	11/17/88		0	0	0	0	3	0	4	1
48	11/23/88		1	1	0	0	1	2	2	0
49	11/29/88		0	0	0	0	0	2	5	1
50	12/05/88		0	0	0	0	0	4	4	0
51	12/11/88		2	0	0	0	0	1	0	5
52	12/17/88		5	0	1	0	0	0	0	2
53	12/23/88		1	2	1	2	0	1	1	0
54	12/29/88		0	0	0	0	0	1	4	3

* # of 3 hour periods per 24 hour period that the wind originated from indicated direction.

Data from National Weather Service Data Station Newark Airport.

TAL:co CONCENTRATION AND WIND VECTORS TABLE SITE NAME:carteret 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	39.9	0.0	0.0	0.0	0.0	13.3	53.2	0.0
2	107.6	0.0	0.0	0.0	0.0	0.0	0.0	107.6
3	0.0	0.0	0.0	0.0	26.4	8.8	0.0	0.0
4	47.4	0.0	0.0	0.0	0.0	0.0	31.6	31.6
5	0.0	0.0	0.0	0.0	0.0	12.0	12.0	4.0
6	24.2	24.2	36.3	12.1	0.0	0.0	0.0	0.0
7	12.3	4.1	0.0	4.1	12.3	0.0	0.0	0.0
8	0.0	8.5	0.0	0.0	51.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	41.0	24.6
10	20.1	20.1	20.1	80.4	20.1	0.0	0.0	0.0
11	33.2	33.2	0.0	0.0	0.0	0.0	0.0	0.0
12	37.5	0.0	0.0	0.0	0.0	0.0	0.0	62.5
13	0.0	0.0	0.0	0.0	0.0	0.0	8.7	60.9
14	44.0	0.0	0.0	0.0	0.0	0.0	11.0	33.0
15	7.6	0.0	0.0	0.0	0.0	0.0	22.8	22.8
C VECTORS	373.8	90.1	56.4	96.6	109.8	34.1	180.3	347.0
D VECTORS	13.4	10.0	14.1	16.1	6.9	5.7	9.5	12.4

cessing complete...Press...<<ENTER>>...<f2>>.....to repeat.
This is your completed concentration vector and wind vector table.

Metal: Cobalt
Winter (January - March) 1988

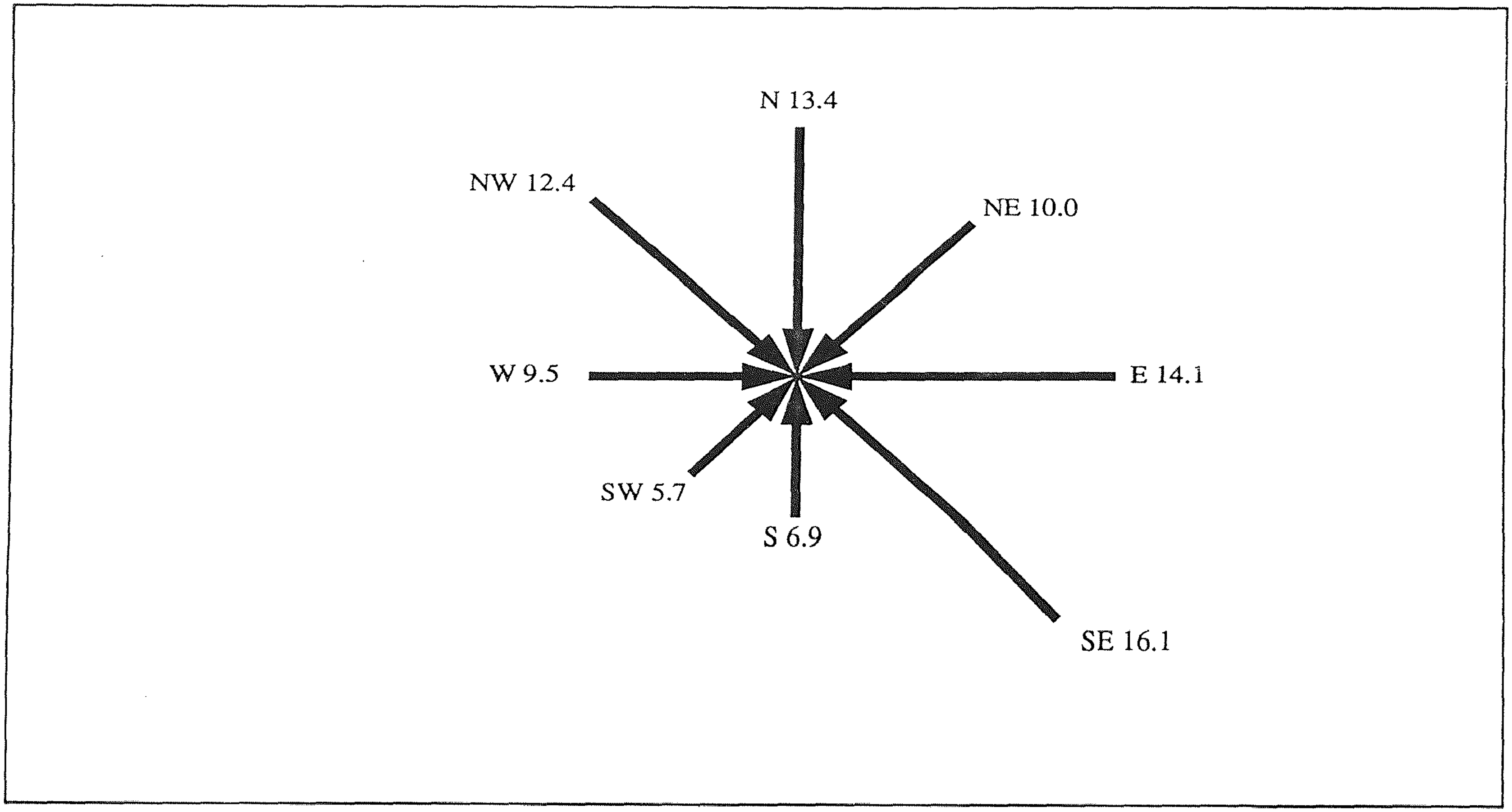


Figure 6.10.1

Site: Carteret **Units - ng/m^3**

METAL:CO CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Carteret 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	0.0	6.4	32.0	12.8	0.0	0.0	0.0	0.0
2	24.6	0.0	0.0	0.0	0.0	0.0	0.0	41.0
3	6.6	0.0	13.2	19.8	13.2	0.0	0.0	0.0
4	7.4	0.0	0.0	0.0	14.8	7.4	0.0	29.6
5	0.0	0.0	6.7	20.1	20.1	6.7	0.0	0.0
6	0.0	9.0	3.0	0.0	0.0	6.0	3.0	0.0
7	0.0	0.0	0.0	55.8	9.3	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	17.6	17.6	0.0
9	0.0	0.0	0.0	0.0	15.4	46.2	0.0	0.0
10	115.8	0.0	0.0	0.0	77.2	115.8	0.0	0.0
CONC VECTORS	154.4	15.4	54.9	108.5	150.0	199.7	20.6	70.6
WIND VECTORS	19.3	3.9	6.1	7.8	12.5	11.7	4.1	7.8

Processing complete...Press...<<ENTER>>...<f2>>.....to repeat.

ok This is your completed concentration vector and wind vector table.

Metal: Cobalt
Spring (April - June) 1988

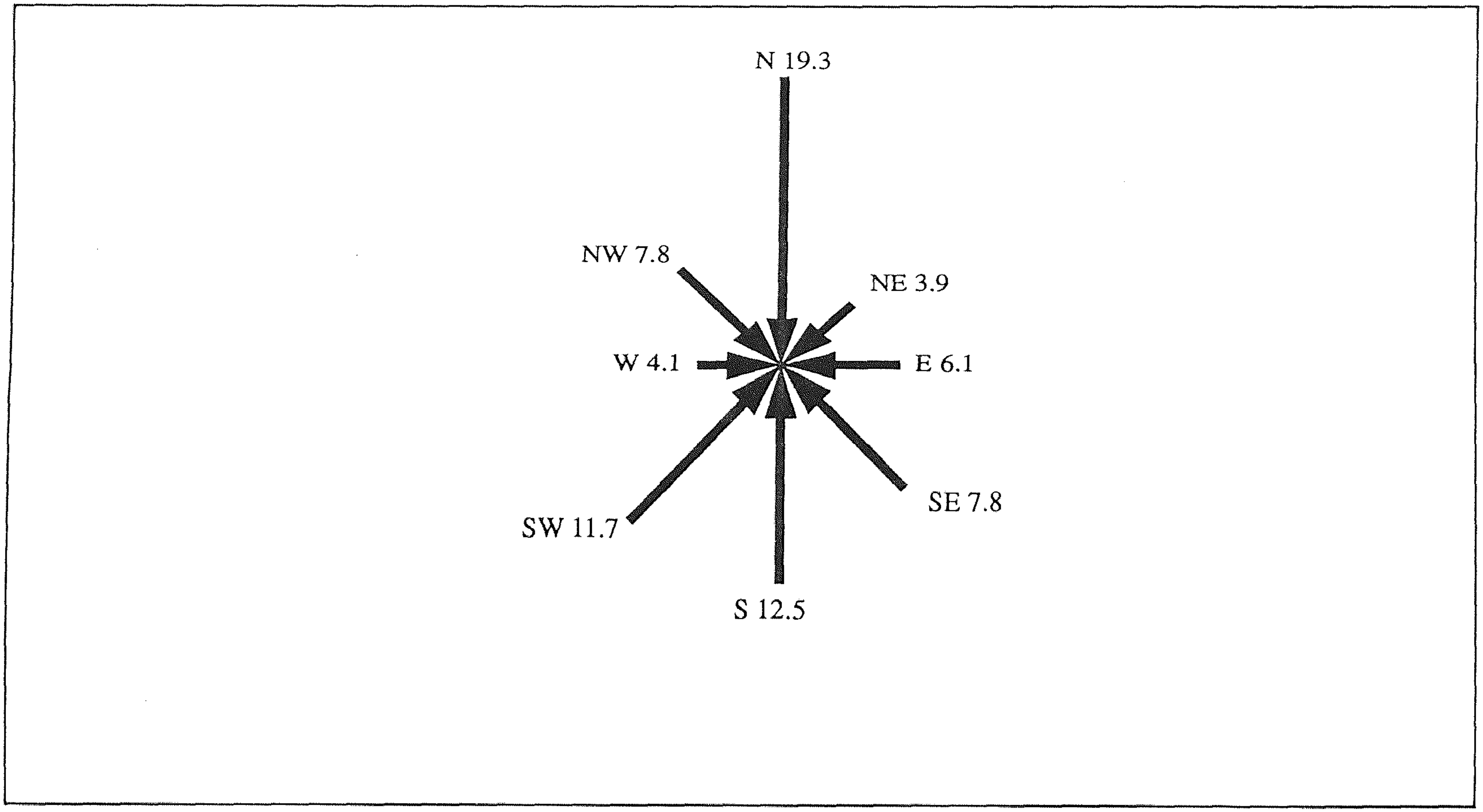


Figure 6.10.2

Site: Carteret Units - ng/m^3

METAL:CO CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Carteret 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	30.9	0.0	0.0	0.0	0.0	0.0	0.0	216.3
2	0.0	0.0	4.0	16.0	0.0	8.0	4.0	0.0
3	0.0	0.0	0.0	8.7	17.4	43.5	0.0	0.0
4	0.0	0.0	0.0	4.2	5.6	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	1.7	0.0	8.5	3.4
6	0.0	0.0	0.0	0.0	0.0	55.2	18.4	0.0
7	18.8	0.0	0.0	0.0	9.4	4.7	0.0	0.0
8	9.3	0.0	0.0	27.9	37.2	0.0	0.0	0.0
9	35.4	11.8	0.0	0.0	0.0	11.8	11.8	23.6
10	0.0	0.0	0.0	0.0	0.0	0.0	13.8	23.0
11	2.7	0.0	0.0	0.0	5.4	5.4	2.7	2.7
12	0.0	0.0	0.0	0.0	0.0	45.5	6.5	0.0
13	44.0	0.0	0.0	0.0	0.0	8.8	8.8	8.8
14	0.0	0.0	0.0	0.0	8.7	60.9	0.0	0.0
CONC VECTORS	141.1	11.8	4.0	56.8	85.4	243.8	74.5	277.8
WIND VECTORS	9.4	11.8	4.0	5.2	5.3	7.6	5.0	15.4

Processing complete...Press...<<ENTER>>...<f2>>.....to repeat.

Ok This is your completed concentration vector and wind vector table.

6.10.3

Metal: Cobalt
Summer (July - September) 1988

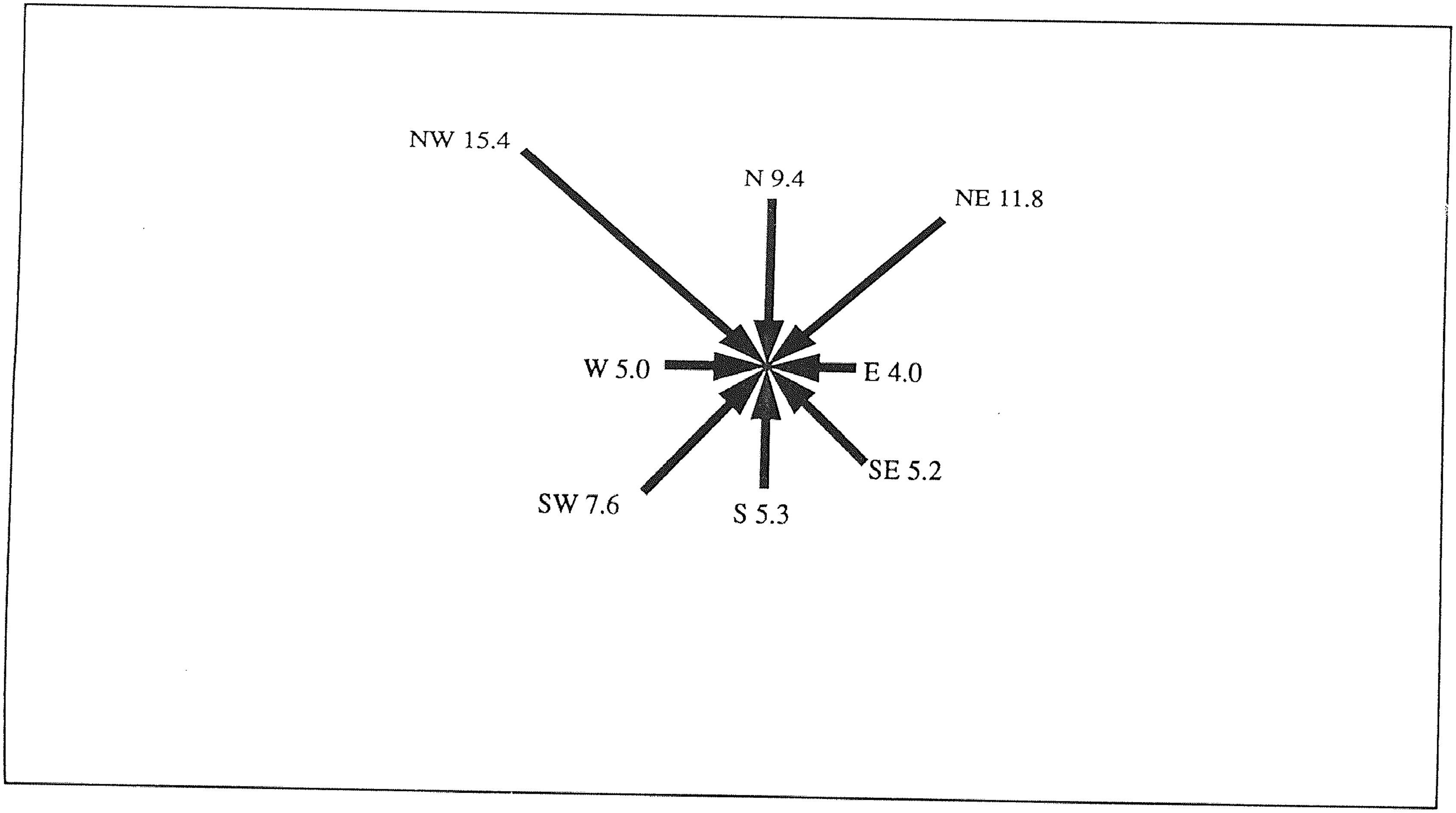


Figure 6.10.3

Site: Carteret Units - ng/m3

ELIZABETH SITE

Table - 6.11

SITE- Elizabeth Year-1988

Metal-Lead

Period - June 1988- Dec 1988

Sam. No.	Date	Pb Conc. ng/m3	N	NE	E	SE	S	SW	W	NW
			Wind Direction *							
1	6/14/88	11.6	0	0	0	0	0	4	4	0
2	6/20/88	13.7	0	0	0	0	2	6	0	0
3	6/28/88	39.5	3	0	0	0	2	3	0	0
4	7/02/88	73.6	1	0	0	0	0	0	0	7
5	7/08/88	13.2	0	0	1	4	0	2	1	0
6	7/14/88	58.3	0	0	0	1	2	5	0	0
7	8/01/88	33.9	0	0	0	3	4	0	0	0
8	8/07/88	9.2	0	0	0	0	1	0	5	2
9	8/13/88	13.2	0	0	0	0	0	6	2	0
10	8/19/88	45.9	4	0	0	0	2	1	0	0
11	8/25/88	33.8	1	0	0	3	4	0	0	0
12	8/31/88	36.8	3	1	0	0	0	1	1	2
13	9/06/88	27.1	0	0	0	0	0	0	3	5
14	9/12/88	33.6	1	0	0	0	2	2	1	1
15	9/18/88	31.6	0	0	0	0	0	7	1	0
16	9/24/88	23.0	5	0	0	0	0	1	1	1
17	10/06/88	39.9	0	0	0	0	0	1	2	5
18	10/12/88	39.5	0	0	0	0	0	2	6	0
19	10/18/88	44.2	1	0	0	1	4	2	0	0
20	10/24/88	16.5	0	0	0	0	4	1	2	1
21	10/30/88	41.2	3	0	0	0	0	0	1	4
22	11/05/88	42.2	1	0	3	3	1	0	0	0
23	11/11/88	35.6	1	0	0	0	0	2	1	4
24	11/17/88	57.9	0	0	0	0	3	0	4	1
25	11/23/88	39.6	1	1	0	0	1	2	2	0
26	11/29/88	21.8	0	0	0	0	0	2	5	1
27	12/05/88	37.1	0	0	0	0	0	4	4	0
28	12/11/88	33.3	2	0	0	0	0	1	0	5
29	12/17/88	41.5	5	0	1	0	0	0	0	2
30	12/23/88	42.7	1	2	1	2	0	1	1	0
31	12/29/88	37.0	0	0	0	0	0	1	4	3

* # of 3 hour periods per 24 hour period that the wind originated from indicated direction.

Data from National Weather Service Data Station Newark Airport.

AL:pb CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Eliza 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	0.0	0.0	0.0	0.0	0.0	39.9	79.8	199.5
2	0.0	0.0	0.0	0.0	0.0	79.0	237.0	0.0
3	44.2	0.0	0.0	44.2	176.8	88.4	0.0	0.0
4	0.0	0.0	0.0	0.0	66.0	16.5	33.0	16.5
5	123.6	0.0	0.0	0.0	0.0	0.0	41.2	164.8
6	42.2	0.0	126.6	126.6	42.2	0.0	0.0	0.0
7	35.6	0.0	0.0	0.0	0.0	71.2	35.6	142.4
8	0.0	0.0	0.0	0.0	173.7	0.0	231.6	57.9
9	39.6	39.6	0.0	0.0	39.6	79.2	79.2	0.0
10	0.0	0.0	0.0	0.0	0.0	43.6	109.0	21.8
11	0.0	0.0	0.0	0.0	0.0	148.4	148.4	0.0
12	66.6	0.0	0.0	0.0	0.0	33.3	0.0	166.5
13	207.5	0.0	41.5	0.0	0.0	0.0	0.0	83.0
14	42.7	85.4	42.7	85.4	0.0	42.7	42.7	0.0
15	0.0	0.0	0.0	0.0	0.0	37.0	148.0	111.0
NC VECTORS	602.0	125.0	210.8	256.2	498.3	679.2	%1185.5	963.4
ND VECTORS	40.1	41.7	42.2	42.7	38.3	35.7	37.0	37.1

ocessing complete...Press...<<ENTER>>...<f2>>.....to repeat.
This is your completed concentration vector and wind vector table.

6.11.1

Metal: Lead
Spring & Summer (April - September) 1988

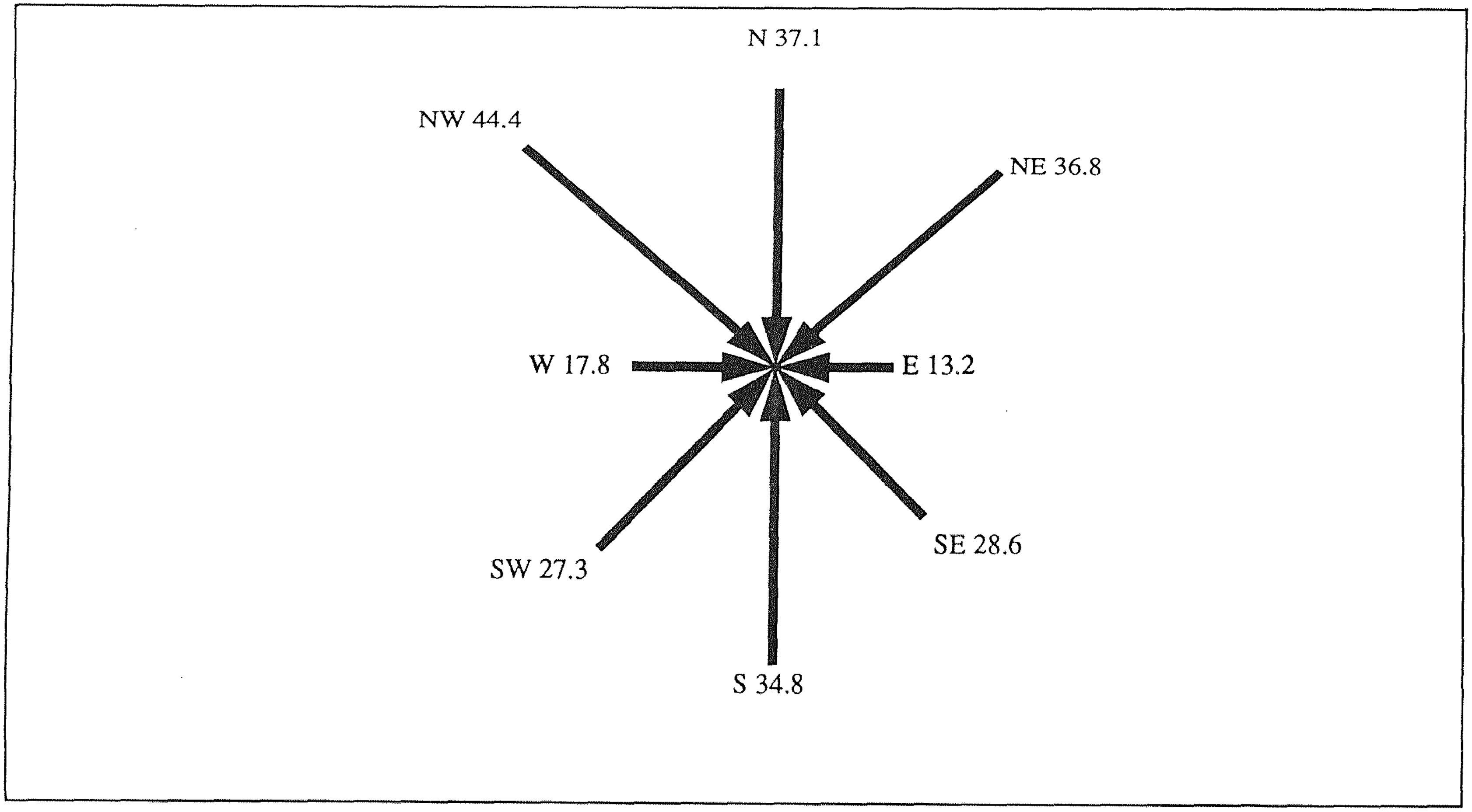


Figure 6.11.1

Site: Elizabeth Units - ng/m3

CAL:pb CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Eliz 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	0.0	0.0	0.0	0.0	0.0	46.4	46.4	0.0
2	0.0	0.0	0.0	0.0	27.4	82.2	0.0	0.0
3	118.5	0.0	0.0	0.0	79.0	118.5	0.0	0.0
4	73.6	0.0	0.0	0.0	0.0	0.0	0.0	515.2
5	0.0	0.0	13.2	52.8	0.0	26.4	13.2	0.0
6	0.0	0.0	0.0	58.3	116.6	291.5	0.0	0.0
7	0.0	0.0	0.0	101.7	135.6	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	9.2	0.0	46.0	18.4
9	0.0	0.0	0.0	0.0	0.0	79.2	26.4	0.0
10	183.6	0.0	0.0	0.0	91.8	45.9	0.0	0.0
11	33.8	0.0	0.0	101.4	135.2	0.0	0.0	0.0
12	110.4	36.8	0.0	0.0	0.0	36.8	36.8	73.6
13	0.0	0.0	0.0	0.0	0.0	0.0	81.3	135.5
14	33.6	0.0	0.0	0.0	67.2	67.2	33.6	33.6
15	0.0	0.0	0.0	0.0	0.0	221.2	31.6	0.0
NC VECTORS	668.5	36.80	13.20	314.20	662.00	%1038.3	338.30	799.30
ND VECTORS	37.1	36.8	13.2	28.6	34.8	27.3	17.8	44.4

ocessing complete...Press...<<ENTER>>...<f2>>.....to repeat.
This is your completed concentration vector and wind vector table.

6.11.2

Metal: Lead

Fall (October - December) 1988

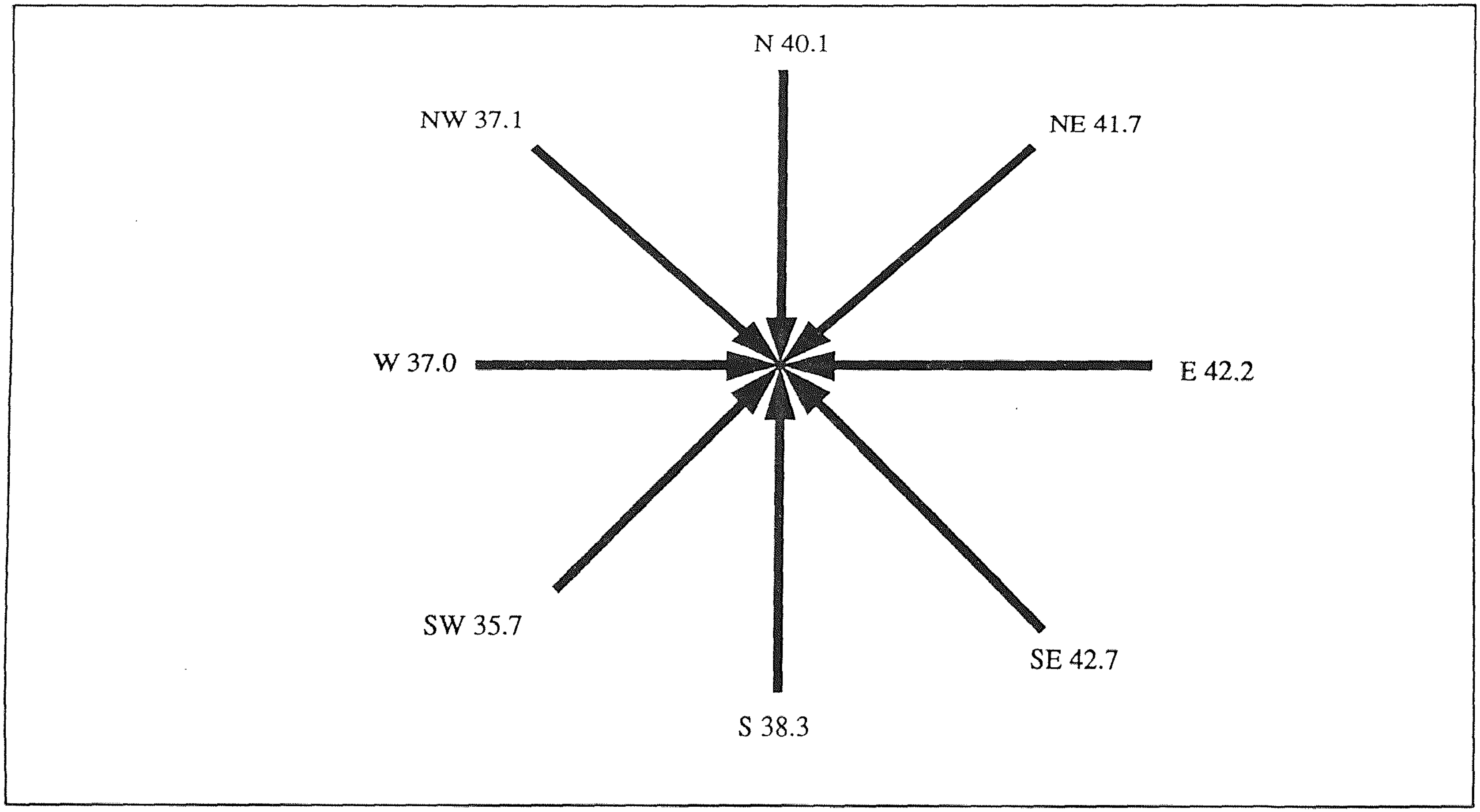


Figure 6.11.2

Site: Elizabeth   Units - ng/m^3

Table - 6.12

SITE - Elizabeth Year - 1988

Metal - Iron

Period: June 1988- Dec 1988

Sam. No.	Date	Fe Conc. ng/m3	N	NE	E	SE	S	SW	W	NW
			Wind Direction *							
1	6/14/88	801.8	0	0	0	0	0	4	4	0
2	6/20/88	596.6	0	0	0	0	2	6	0	0
3	6/28/88	584.7	3	0	0	0	2	3	0	0
4	7/02/88	1027.3	1	0	0	0	0	0	0	7
5	7/08/88	400.7	0	0	1	4	0	2	1	0
6	7/14/88	841.7	0	0	0	1	2	5	0	0
7	8/01/88	682.0	0	0	0	3	4	0	0	0
8	8/07/88	242.1	0	0	0	0	1	0	5	2
9	8/13/88	448.0	0	0	0	0	0	6	2	0
10	8/19/88	918.5	4	0	0	0	2	1	0	0
11	8/25/88	698.9	1	0	0	3	4	0	0	0
12	8/31/88	519.5	3	1	0	0	0	1	1	2
13	9/06/88	410.8	0	0	0	0	0	0	3	5
14	9/12/88	520.1	1	0	0	0	2	2	1	1
15	9/18/88	327.4	0	0	0	0	0	7	1	0
16	9/24/88	80.5	5	0	0	0	0	1	1	1
17	10/06/88	443.5	0	0	0	0	0	1	2	5
18	10/12/88	269.7	0	0	0	0	0	2	6	0
19	10/18/88	320.5	1	0	0	1	4	2	0	0
20	10/24/88	401.3	0	0	0	0	4	1	2	1
21	10/30/88	173.6	3	0	0	0	0	0	1	4
22	11/05/88	324.9	1	0	3	3	1	0	0	0
23	11/11/88	115.5	1	0	0	0	0	2	1	4
24	11/17/88	697.3	0	0	0	0	3	0	4	1
25	11/23/88	328.4	1	1	0	0	1	2	2	0
26	11/29/88	191.7	0	0	0	0	0	2	5	1
27	12/05/88	400.7	0	0	0	0	0	4	4	0
28	12/11/88	227.5	2	0	0	0	0	1	0	5
29	12/17/88	378.3	5	0	1	0	0	0	0	2
30	12/23/88	233.1	1	2	1	2	0	1	1	0
31	12/29/88	120.5	0	0	0	0	0	1	4	3

* # of 3 hour periods per 24 hour period that the wind originated from indicated direction.

Data from National Weather Service Data Station Newark Airport.

TAL:fe CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Eliz 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	0.0	0.0	0.0	0.0	0.0	3207.2	3207.2	0.0
2	0.0	0.0	0.0	0.0	1193.2	3579.6	0.0	0.0
3	1754.1	0.0	0.0	0.0	1169.4	1754.1	0.0	0.0
4	1027.3	0.0	0.0	0.0	0.0	0.0	0.0	7191.1
5	0.0	0.0	400.7	1602.8	0.0	801.4	400.7	0.0
6	0.0	0.0	0.0	841.7	1683.4	4208.5	0.0	0.0
7	0.0	0.0	0.0	2046.0	2728.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	242.1	0.0	1210.5	484.2
9	0.0	0.0	0.0	0.0	0.0	2688.0	896.0	0.0
10	3674.0	0.0	0.0	0.0	1837.0	918.5	0.0	0.0
11	698.9	0.0	0.0	2096.7	2795.6	0.0	0.0	0.0
12	1558.5	519.5	0.0	0.0	0.0	519.5	519.5	1039.0
13	0.0	0.0	0.0	0.0	0.0	0.0	1232.4	2054.0
14	520.1	0.0	0.0	0.0	1040.2	1040.2	520.1	520.1
15	0.0	0.0	0.0	0.0	0.0	2291.8	327.4	0.0
NC VECTORS	%9635.4	519.50	400.70	%6587.2	%12688.9	%21089.3	%8394.3	%11368.9
ND VECTORS	535.3	519.5	400.7	598.8	667.8	555.0	441.8	631.6

ocessing complete...Press...<<ENTER>>...<f2>>.....to repeat.
This is your completed concentration vector and wind vector table.

6.12.1 16

Metal: Iron
Spring & Summer (April - September) 1988

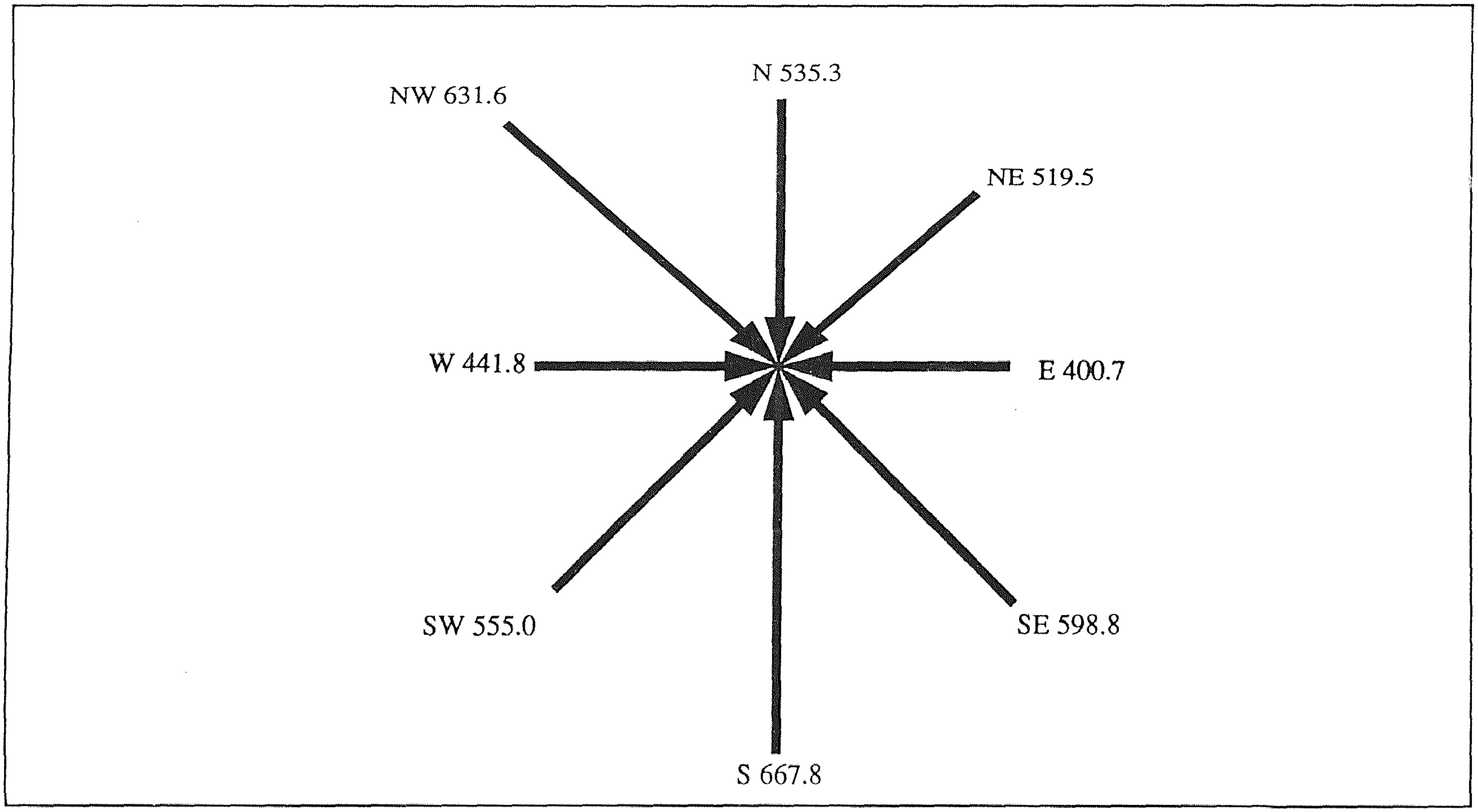


Figure 6.12.1

Site: Elizabeth Units - ng/m^3

TAL:fe CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Eliz 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	0.0	0.0	0.0	0.0	0.0	443.5	887.0	2217.5
2	0.0	0.0	0.0	0.0	0.0	539.4	1618.2	0.0
3	320.5	0.0	0.0	320.5	1282.0	641.0	0.0	0.0
4	0.0	0.0	0.0	0.0	1605.2	401.3	802.6	401.3
5	520.8	0.0	0.0	0.0	0.0	0.0	173.6	694.4
6	324.9	0.0	974.7	974.7	324.9	0.0	0.0	0.0
7	115.5	0.0	0.0	0.0	0.0	231.0	115.5	462.0
8	0.0	0.0	0.0	0.0	2091.9	0.0	2789.2	697.3
9	328.4	328.4	0.0	0.0	328.4	656.8	656.8	0.0
10	0.0	0.0	0.0	0.0	0.0	383.4	958.5	191.7
11	0.0	0.0	0.0	0.0	0.0	1602.8	1602.8	0.0
12	455.0	0.0	0.0	0.0	0.0	227.5	0.0	1137.5
13	1891.5	0.0	378.3	0.0	0.0	0.0	0.0	756.6
14	233.1	466.2	233.1	466.2	0.0	233.1	233.1	0.0
15	0.0	0.0	0.0	0.0	0.0	120.5	482.0	361.5
INC VECTORS	%4189.7	794.6	%1586.1	%1761.4	%5632.4	%5480.3	%10319.3	%6919.8
IND VECTORS	279.3	264.9	317.2	293.6	433.3	288.4	322.5	266.1

ocessing complete...Press...<<ENTER>>...<f2>>.....to repeat.
This is your completed concentration vector and wind vector table.

6.12.2

Metal: Iron
Fall (October - December) 1988

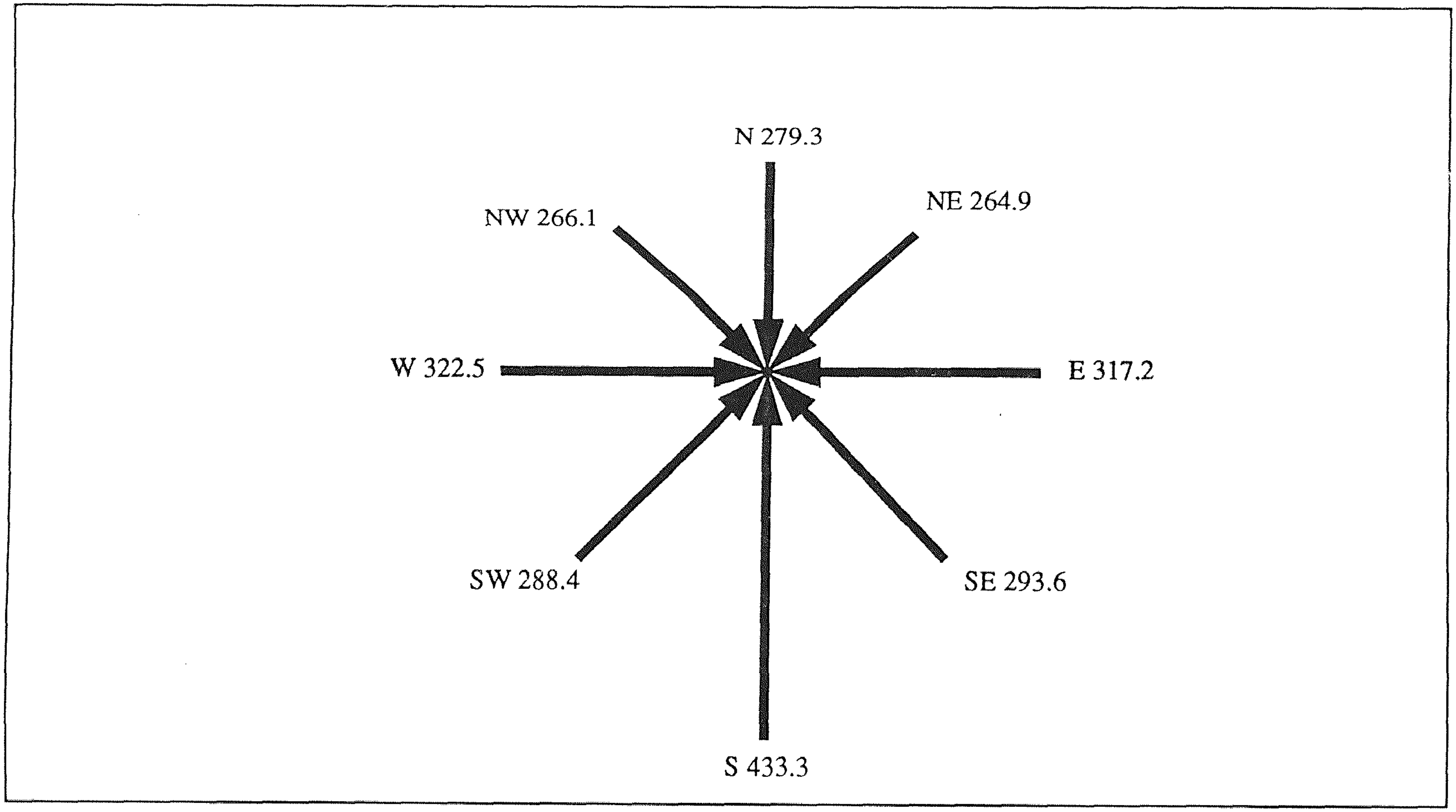


Figure 6.12.2.

Site: Elizabeth   Units - ng/m^3

Table - 6.13

SITE - Elizabeth Year 1988

Metal- Zinc

Period: June 1988 - Dec 1988

Sam. No.	Date	Zn Conc. ng/m3	N	NE	E	SE	S	SW	W	NW
			Wind Direction *							
1	6/14/88	77.5	0	0	0	0	0	4	4	0
2	6/20/88	92.0	0	0	0	0	2	6	0	0
3	6/28/88	65.6	3	0	0	0	2	3	0	0
4	7/02/88	144.3	1	0	0	0	0	0	0	7
5	7/08/88	48.7	0	0	1	4	0	2	1	0
6	7/14/88	186.6	0	0	0	1	2	5	0	0
7	8/01/88	119.0	0	0	0	3	4	0	0	0
8	8/07/88	68.2	0	0	0	0	1	0	5	2
9	8/13/88	65.0	0	0	0	0	0	6	2	0
10	8/19/88	231.9	4	0	0	0	2	1	0	0
11	8/25/88	155.7	1	0	0	3	4	0	0	0
12	8/31/88	113.7	3	1	0	0	0	1	1	2
13	9/06/88	51.6	0	0	0	0	0	0	3	5
14	9/12/88	81.0	1	0	0	0	2	2	1	1
15	9/18/88	84.4	0	0	0	0	0	7	1	0
16	9/24/88	32.7	5	0	0	0	0	1	1	1
17	10/06/88	193.5	0	0	0	0	0	1	2	5
18	10/12/88	74.5	0	0	0	0	0	2	6	0
19	10/18/88	85.9	1	0	0	1	4	2	0	0
20	10/24/88	61.3	0	0	0	0	4	1	2	1
21	10/30/88	41.8	3	0	0	0	0	0	1	4
22	11/05/88	96.5	1	0	3	3	1	0	0	0
23	11/11/88	57.1	1	0	0	0	0	2	1	4
24	11/17/88	321.5	0	0	0	0	3	0	4	1
25	11/23/88	100.5	1	1	0	0	1	2	2	0
26	11/29/88	64.9	0	0	0	0	0	2	5	1
27	12/05/88	117.2	0	0	0	0	0	4	4	0
28	12/11/88	46.5	2	0	0	0	0	1	0	5
29	12/17/88	154.5	5	0	1	0	0	0	0	2
30	12/23/88	286.0	1	2	1	2	0	1	1	0
31	12/29/88	66.7	0	0	0	0	0	1	4	3

* # of 3 hour periods per 24 hour period that the wind originated from indicated direction.

Data from National Weather Service Data Station Newark Airport.

CTAL:zn CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Eliz 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	0.0	0.0	0.0	0.0	0.0	310.0	310.0	0.0
2	0.0	0.0	0.0	0.0	184.0	552.0	0.0	0.0
3	196.8	0.0	0.0	0.0	131.2	196.8	0.0	0.0
4	144.3	0.0	0.0	0.0	0.0	0.0	0.0	1010.1
5	0.0	0.0	48.7	194.8	0.0	97.4	48.7	0.0
6	0.0	0.0	0.0	186.6	373.2	933.0	0.0	0.0
7	0.0	0.0	0.0	357.0	476.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	68.2	0.0	341.0	136.4
9	0.0	0.0	0.0	0.0	0.0	390.0	130.0	0.0
10	927.6	0.0	0.0	0.0	463.8	231.9	0.0	0.0
11	155.7	0.0	0.0	467.1	622.8	0.0	0.0	0.0
12	341.1	113.7	0.0	0.0	0.0	113.7	113.7	227.4
13	0.0	0.0	0.0	0.0	0.0	0.0	154.8	258.0
14	81.0	0.0	0.0	0.0	162.0	162.0	81.0	81.0
15	0.0	0.0	0.0	0.0	0.0	590.8	84.4	0.0
INC VECTORS	%2010.0	113.70	48.70	%1205.5	%2481.2	%3610.3	%1296.3	%1745.6
IND VECTORS	111.7	113.7	48.7	109.6	130.6	95.0	68.2	97.0

rocessing complete...Press...<<ENTER>>...<f2>>.....to repeat.
This is your completed concentration vector and wind vector table.

6.13.1

Metal: Zinc
Spring & Summer (April - September) 1988

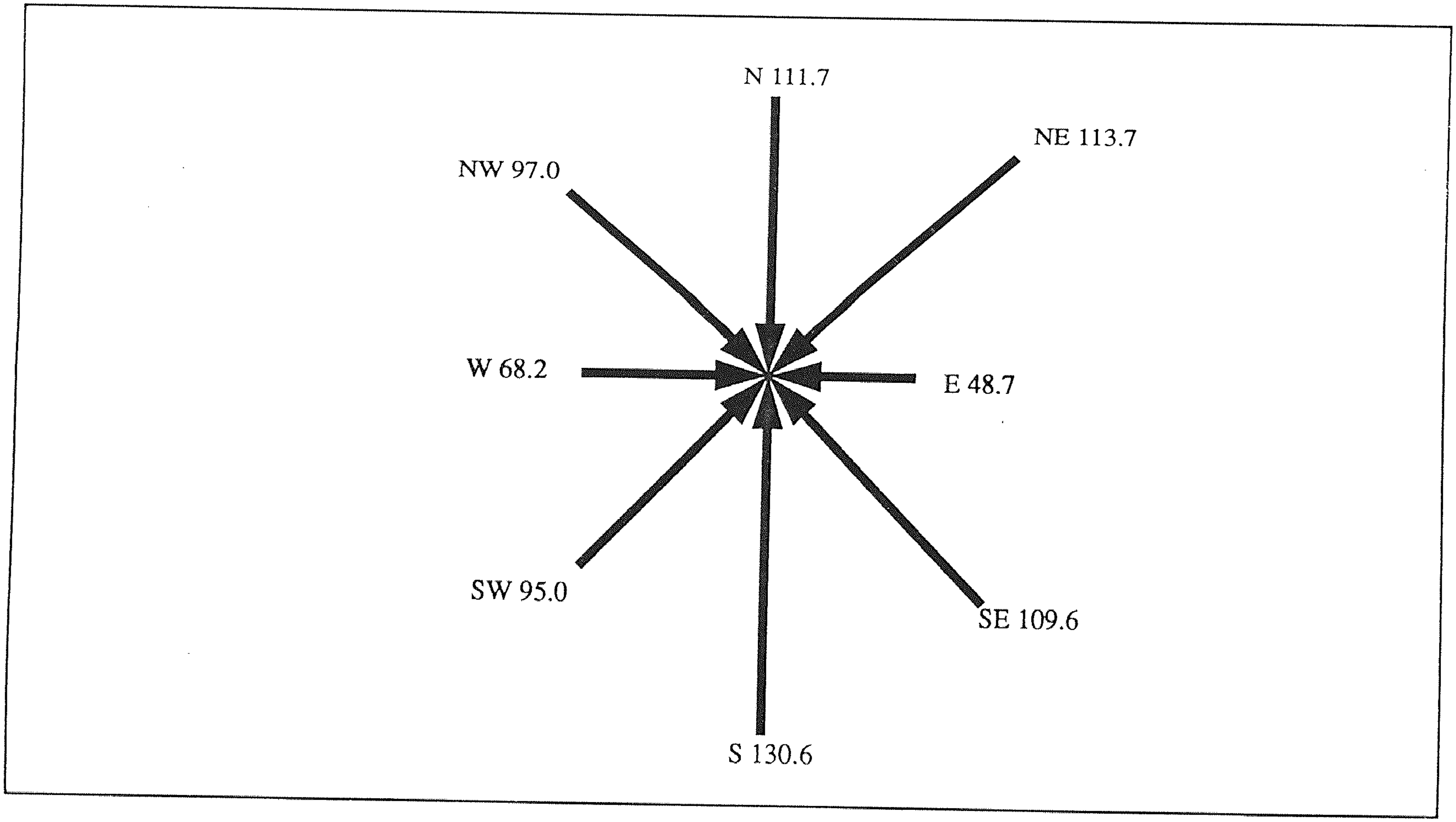


Figure 6.13.1

Site: Elizabeth   Units - ng/m3

:Zn CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Eliz 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	0.0	0.0	0.0	0.0	0.0	193.5	387.0	967.5
2	0.0	0.0	0.0	0.0	0.0	149.0	447.0	0.0
3	85.9	0.0	0.0	85.9	343.6	171.8	0.0	0.0
4	0.0	0.0	0.0	0.0	245.2	61.3	122.6	61.3
5	125.4	0.0	0.0	0.0	0.0	0.0	41.8	167.2
6	96.5	0.0	289.5	289.5	96.5	0.0	0.0	0.0
7	57.1	0.0	0.0	0.0	0.0	114.2	57.1	228.4
8	0.0	0.0	0.0	0.0	964.5	0.0	1286.0	321.5
9	100.5	100.5	0.0	0.0	100.5	201.0	201.0	0.0
10	0.0	0.0	0.0	0.0	0.0	129.8	324.5	64.9
11	0.0	0.0	0.0	0.0	0.0	468.8	468.8	0.0
12	93.0	0.0	0.0	0.0	0.0	46.5	0.0	232.5
13	772.5	0.0	154.5	0.0	0.0	0.0	0.0	309.0
14	286.0	572.0	286.0	572.0	0.0	286.0	286.0	0.0
15	0.0	0.0	0.0	0.0	0.0	66.7	266.8	200.1
IC VECTORS	%1616.9	672.5	730.0	947.4	%1750.3	%1888.6	%3888.6	%2552.4
ID VECTORS	107.8	224.2	146.0	157.9	134.6	99.4	121.5	98.2

cessing complete...Press...<<ENTER>>...<f2>>.....to repeat.
This is your completed concentration vector and wind vector table.

6.13.2

Metal: Zinc
Fall (October - December) 1988

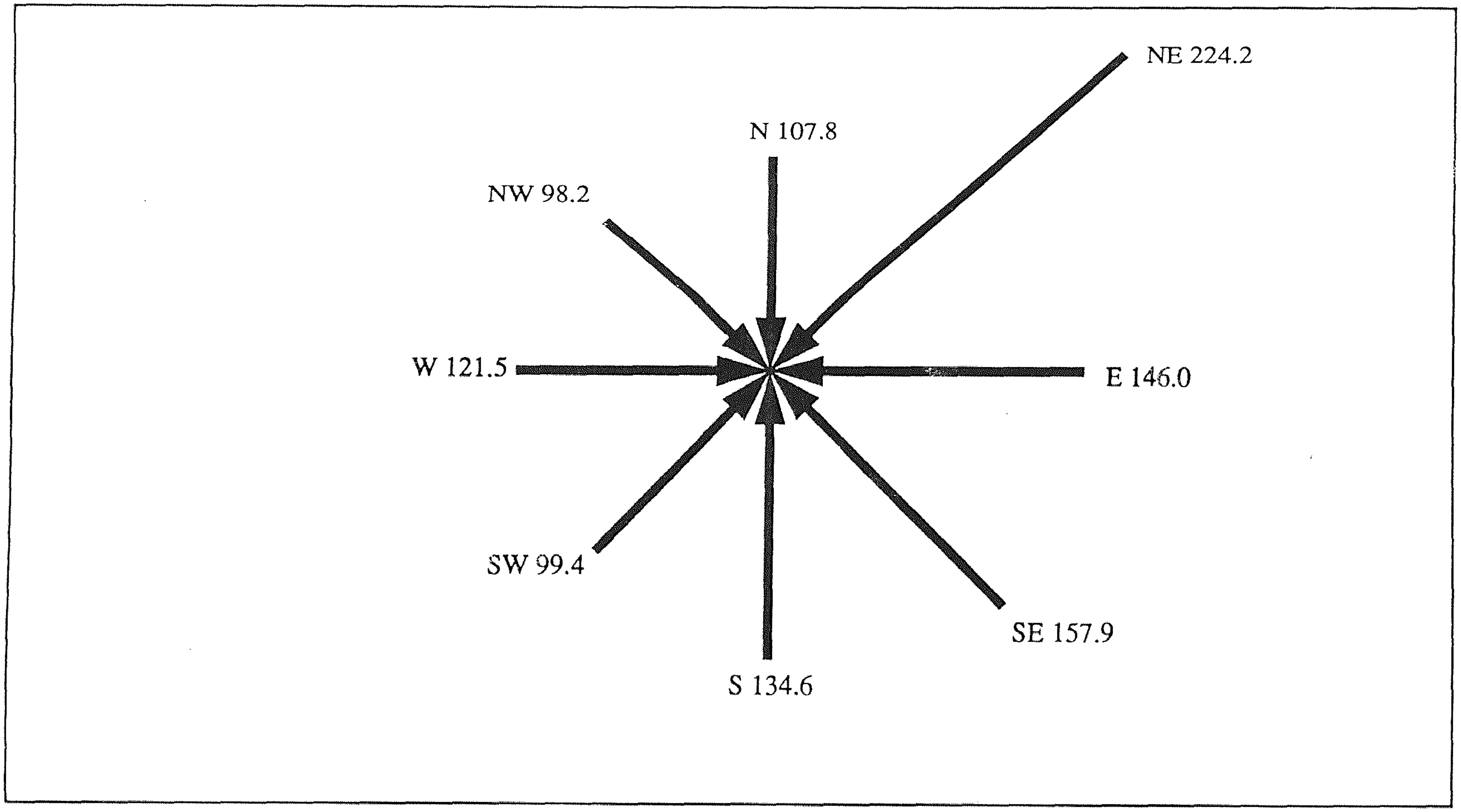


Figure 6.13.2.

Site: Elizabeth Units - ng/m3

Table - 6.14.

SITE - Elizabeth Year 1988

Metal - Manganese

Period: June 1988 - Dec 1988

Sam. No.	Date	Mn Conc. ng/m3	Wind Direction * N	NE	E	SE	S	SW	W	NW
1	6/14/88	28.6	0	0	0	0	0	4	4	0
2	6/20/88	18.3	0	0	0	0	2	6	0	0
3	6/28/88	22.4	3	0	0	0	2	3	0	0
4	7/02/88		1	0	0	0	0	0	0	7
5	7/08/88		0	0	1	4	0	2	1	0
6	7/14/88		0	0	0	1	2	5	0	0
7	8/01/88		0	0	0	3	4	0	0	0
8	8/07/88		0	0	0	0	1	0	5	2
9	8/13/88		0	0	0	0	0	6	2	0
10	8/19/88		4	0	0	0	2	1	0	0
11	8/25/88		1	0	0	3	4	0	0	0
12	8/31/88		3	1	0	0	0	1	1	2
13	9/06/88		0	0	0	0	0	0	3	5
14	9/12/88		1	0	0	0	2	2	1	1
15	9/18/88		0	0	0	0	0	7	1	0
16	9/24/88		5	0	0	0	0	1	1	1
17	10/06/88	39.9	0	0	0	0	0	1	2	5
18	10/12/88	39.5	0	0	0	0	0	2	6	0
19	10/18/88	44.2	1	0	0	1	4	2	0	0
20	10/24/88	42.0	0	0	0	0	4	1	2	1
21	10/30/88	16.5	3	0	0	0	0	0	1	4
22	11/05/88	42.2	1	0	3	3	1	0	0	0
23	11/11/88	35.6	1	0	0	0	0	2	1	4
24	11/17/88	57.9	0	0	0	0	3	0	4	1
25	11/23/88	39.6	1	1	0	0	1	2	2	0
26	11/29/88	21.8	0	0	0	0	0	2	5	1
27	12/05/88	37.1	0	0	0	0	0	4	4	0
28	12/11/88	33.3	2	0	0	0	0	1	0	5
29	12/17/88	41.5	5	0	1	0	0	0	0	2
30	12/23/88	42.7	1	2	1	2	0	1	1	0
31	12/29/88	37.0	0	0	0	0	0	1	4	3

* # of 3 hour periods per 24 hour period that the wind originated from indicated direction.

Data from National Weather Service Data Station Newark Airport.

TAL:mn CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Eliz 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	0.0	0.0	0.0	0.0	0.0	39.9	79.8	199.5
2	0.0	0.0	0.0	0.0	0.0	79.0	237.0	0.0
3	44.2	0.0	0.0	44.2	176.8	88.4	0.0	0.0
4	0.0	0.0	0.0	0.0	168.0	42.0	84.0	42.0
5	49.5	0.0	0.0	0.0	0.0	0.0	16.5	66.0
6	42.2	0.0	126.6	126.6	42.2	0.0	0.0	0.0
7	35.6	0.0	0.0	0.0	0.0	71.2	35.6	142.4
8	0.0	0.0	0.0	0.0	173.7	0.0	231.6	57.9
9	39.6	39.6	0.0	0.0	39.6	79.2	79.2	0.0
10	0.0	0.0	0.0	0.0	0.0	43.6	109.0	21.8
11	0.0	0.0	0.0	0.0	0.0	148.4	148.4	0.0
12	66.6	0.0	0.0	0.0	0.0	33.3	0.0	166.5
13	207.5	0.0	41.5	0.0	0.0	0.0	0.0	83.0
14	42.7	85.4	42.7	85.4	0.0	42.7	42.7	0.0
15	0.0	0.0	0.0	0.0	0.0	37.0	148.0	111.0
NC VECTORS	527.9	125.0	210.8	256.2	600.3	704.7	%1211.8	890.1
ND VECTORS	35.2	41.7	42.2	42.7	46.2	37.1	37.9	34.2

ocessing complete...Press...<<ENTER>>...<f2>>.....to repeat.
This is your completed concentration vector and wind vector table.

6.14.1

Metal: Manganese
Fall (October - December) 1988

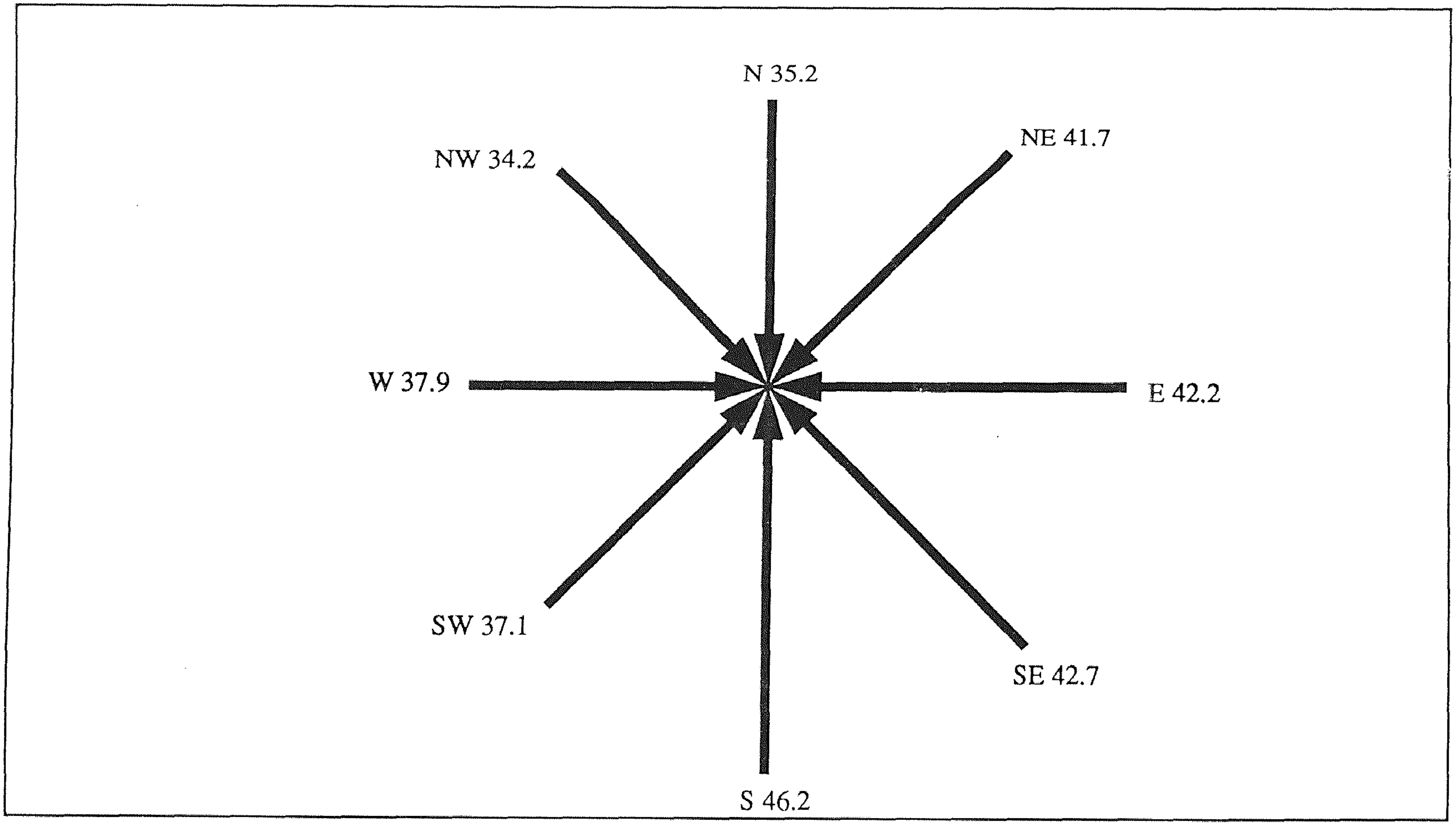


Figure 6.14.1

Site: Elizabeth Units - ng/m^3

Table - 6.15

SITE - Elizabeth Year -1988

Metal - Chromium

Period: June 1988 - Dec 1988

Sam. No.	Date	Cr Conc. ng/m3	N	NE	E	SE	S	SW	W	NW
			Wind Direction *							
1	6/14/88	63.8	0	0	0	0	0	4	4	0
2	6/20/88	14.3	0	0	0	0	2	6	0	0
3	6/28/88	23.8	3	0	0	0	2	3	0	0
4	7/02/88		1	0	0	0	0	0	0	7
5	7/08/88		0	0	1	4	0	2	1	0
6	7/14/88		0	0	0	1	2	5	0	0
7	8/01/88		0	0	0	3	4	0	0	0
8	8/07/88		0	0	0	0	1	0	5	2
9	8/13/88		0	0	0	0	0	6	2	0
10	8/19/88		4	0	0	0	2	1	0	0
11	8/25/88		1	0	0	3	4	0	0	0
12	8/31/88		3	1	0	0	0	1	1	2
13	9/06/88		0	0	0	0	0	0	3	5
14	9/12/88		1	0	0	0	2	2	1	1
15	9/18/88		0	0	0	0	0	7	1	0
16	9/24/88		5	0	0	0	0	1	1	1
17	10/06/88	7.7	0	0	0	0	0	1	2	5
18	10/12/88	7.7	0	0	0	0	0	2	6	0
19	10/18/88	3.4	1	0	0	1	4	2	0	0
20	10/24/88	8.2	0	0	0	0	4	1	2	1
21	10/30/88	2.1	3	0	0	0	0	0	1	4
22	11/05/88	1.7	1	0	3	3	1	0	0	0
23	11/11/88	6.8	1	0	0	0	0	2	1	4
24	11/17/88	7.7	0	0	0	0	3	0	4	1
25	11/23/88	9.8	1	1	0	0	1	2	2	0
26	11/29/88	7.7	0	0	0	0	0	2	5	1
27	12/05/88	5.7	0	0	0	0	0	4	4	0
28	12/11/88	2.0	2	0	0	0	0	1	0	5
29	12/17/88	5.5	5	0	1	0	0	0	0	2
30	12/23/88	6.7	1	2	1	2	0	1	1	0
31	12/29/88	5.6	0	0	0	0	0	1	4	3

* # of 3 hour periods per 24 hour period that the wind originated from indicated direction.

Data from National Weather Service Data Station Newark Airport.

DEAL:cr CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Eliz 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	0.0	0.0	0.0	0.0	0.0	7.7	15.4	38.5
2	0.0	0.0	0.0	0.0	0.0	15.4	46.2	0.0
3	3.4	0.0	0.0	3.4	13.6	6.8	0.0	0.0
4	0.0	0.0	0.0	0.0	32.8	8.2	16.4	8.2
5	6.3	0.0	0.0	0.0	0.0	0.0	2.1	8.4
6	1.7	0.0	5.1	5.1	1.7	0.0	0.0	0.0
7	6.8	0.0	0.0	0.0	0.0	13.6	6.8	27.2
8	0.0	0.0	0.0	0.0	23.1	0.0	30.8	7.7
9	9.8	9.8	0.0	0.0	9.8	19.6	19.6	0.0
10	0.0	0.0	0.0	0.0	0.0	15.4	38.5	7.7
11	0.0	0.0	0.0	0.0	0.0	22.8	22.8	0.0
12	4.0	0.0	0.0	0.0	0.0	2.0	0.0	10.0
13	27.5	0.0	5.5	0.0	0.0	0.0	0.0	11.0
14	6.7	13.4	6.7	13.4	0.0	6.7	6.7	0.0
15	0.0	0.0	0.0	0.0	0.0	5.6	22.4	16.8
CONC VECTORS	66.2	23.2	17.3	21.9	81.0	123.8	227.7	135.5
WIND VECTORS	4.4	7.7	3.5	3.6	6.2	6.5	7.1	5.2

Processing complete...Press...<<ENTER>>...<f2>>.....to repeat.
This is your completed concentration vector and wind vector table.

6.15.1

Metal: Chromium

Fall (October - December) 1988

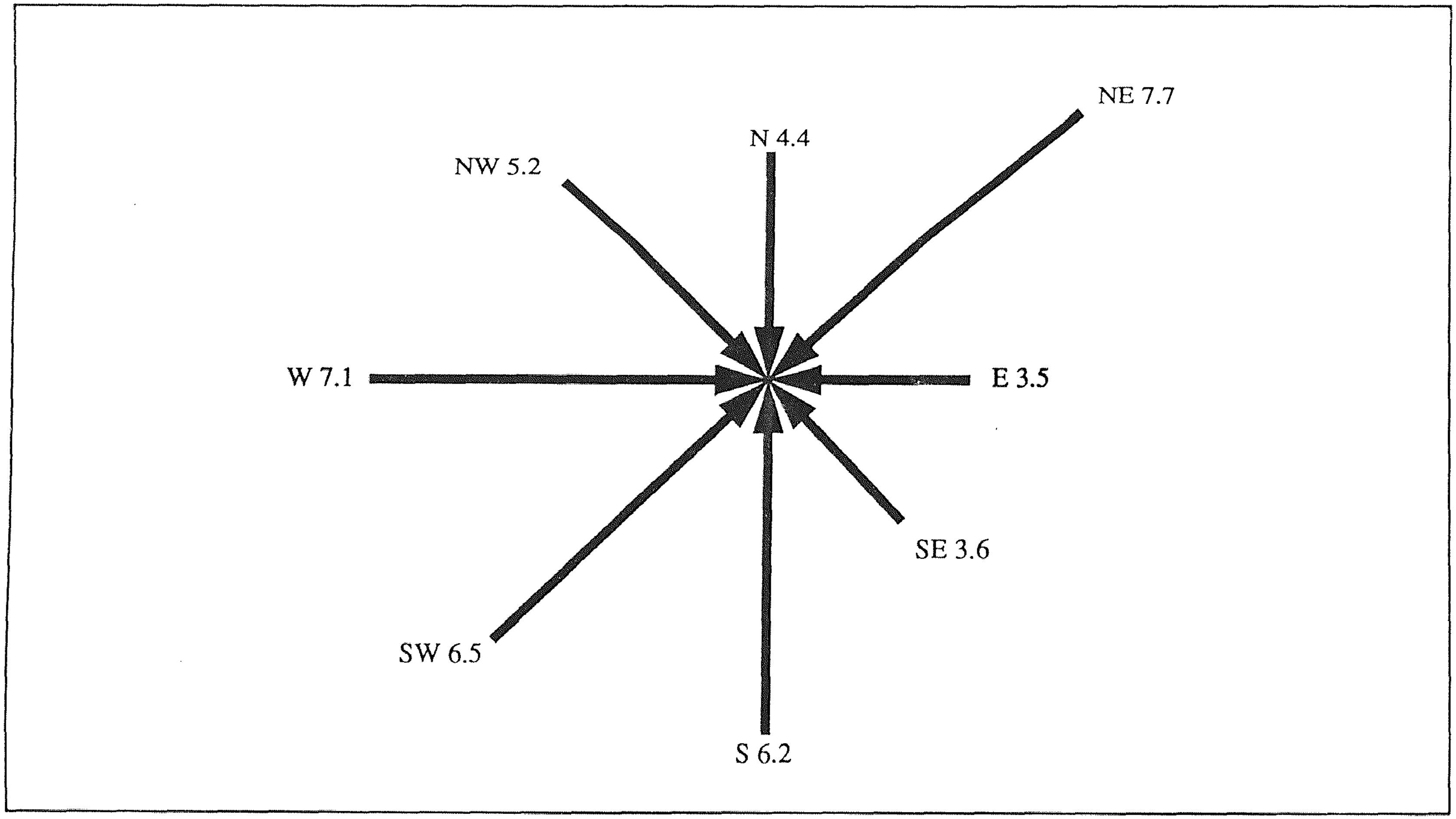


Figure 6.15.1

Site: Elizabeth Units - ng/m3

Table - 6.16

SITE - Elizabeth Year 1988

Metal - Cadmium

Period: June 1988 - Dec 1988

Sam. No.	Date	Cd Conc. ng/m3	Wind Direction * N	NE	E	SE	S	SW	W	NW
1	6/14/88	2.4	0	0	0	0	0	4	4	0
2	6/20/88	1.5	0	0	0	0	2	6	0	0
3	6/28/88	0.8	3	0	0	0	2	3	0	0
4	7/02/88	1.7	1	0	0	0	0	0	0	7
5	7/08/88	0.2	0	0	1	4	0	2	1	0
6	7/14/88	2.9	0	0	0	1	2	5	0	0
7	8/01/88	2.2	0	0	0	3	4	0	0	0
8	8/07/88	6.1	0	0	0	0	1	0	5	2
9	8/13/88	0.7	0	0	0	0	0	6	2	0
10	8/19/88	3.1	4	0	0	0	2	1	0	0
11	8/25/88	5.8	1	0	0	3	4	0	0	0
12	8/31/88	3.7	3	1	0	0	0	1	1	2
13	9/06/88	4.2	0	0	0	0	0	0	3	5
14	9/12/88		1	0	0	0	2	2	1	1
15	9/18/88	2.2	0	0	0	0	0	7	1	0
16	9/24/88	2.1	5	0	0	0	0	1	1	1
17	10/06/88	0.4	0	0	0	0	0	1	2	5
18	10/12/88	0.2	0	0	0	0	0	2	6	0
19	10/18/88	1.8	1	0	0	1	4	2	0	0
20	10/24/88	1.6	0	0	0	0	4	1	2	1
21	10/30/88	0.6	3	0	0	0	0	0	1	4
22	11/05/88	0.5	1	0	3	3	1	0	0	0
23	11/11/88	0.5	1	0	0	0	0	2	1	4
24	11/17/88	2.0	0	0	0	0	3	0	4	1
25	11/23/88	0.6	1	1	0	0	1	2	2	0
26	11/29/88	0.1	0	0	0	0	0	2	5	1
27	12/05/88	0.9	0	0	0	0	0	4	4	0
28	12/11/88	0.8	2	0	0	0	0	1	0	5
29	12/17/88	0.6	5	0	1	0	0	0	0	2
30	12/23/88	1.3	1	2	1	2	0	1	1	0
31	12/29/88	0.1	0	0	0	0	0	1	4	3

* # of 3 hour periods per 24 hour period that the wind originated from indicated direction.

Data from National Weather Service Data Station Newark Airport.

TOTAL:cd CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Eliz 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	0.0	0.0	0.0	0.0	0.0	9.6	9.6	0.0
2	0.0	0.0	0.0	0.0	3.0	9.0	0.0	0.0
3	2.4	0.0	0.0	0.0	1.6	2.4	0.0	0.0
4	1.7	0.0	0.0	0.0	0.0	0.0	0.0	11.9
5	0.0	0.0	0.2	0.8	0.0	0.4	0.2	0.0
6	0.0	0.0	0.0	2.9	5.8	14.5	0.0	0.0
7	0.0	0.0	0.0	6.6	8.8	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	6.1	0.0	30.5	12.2
9	0.0	0.0	0.0	0.0	0.0	4.2	1.4	0.0
10	12.4	0.0	0.0	0.0	6.2	3.1	0.0	0.0
11	5.8	0.0	0.0	17.4	23.2	0.0	0.0	0.0
12	11.1	3.7	0.0	0.0	0.0	3.7	3.7	7.4
13	0.0	0.0	0.0	0.0	0.0	0.0	12.6	21.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	15.4	2.2	0.0
CONC VECTORS	43.9	3.70	0.20	27.70	54.70	64.41	62.31	54.61
WIND VECTORS	2.4	3.7	0.2	2.5	2.9	1.7	3.3	3.0

Processing complete...Press...<<ENTER>>...<f2>>.....to repeat.
This is your completed concentration vector and wind vector table.

Metal: Cadium

Spring & Summer (April - September) 1988

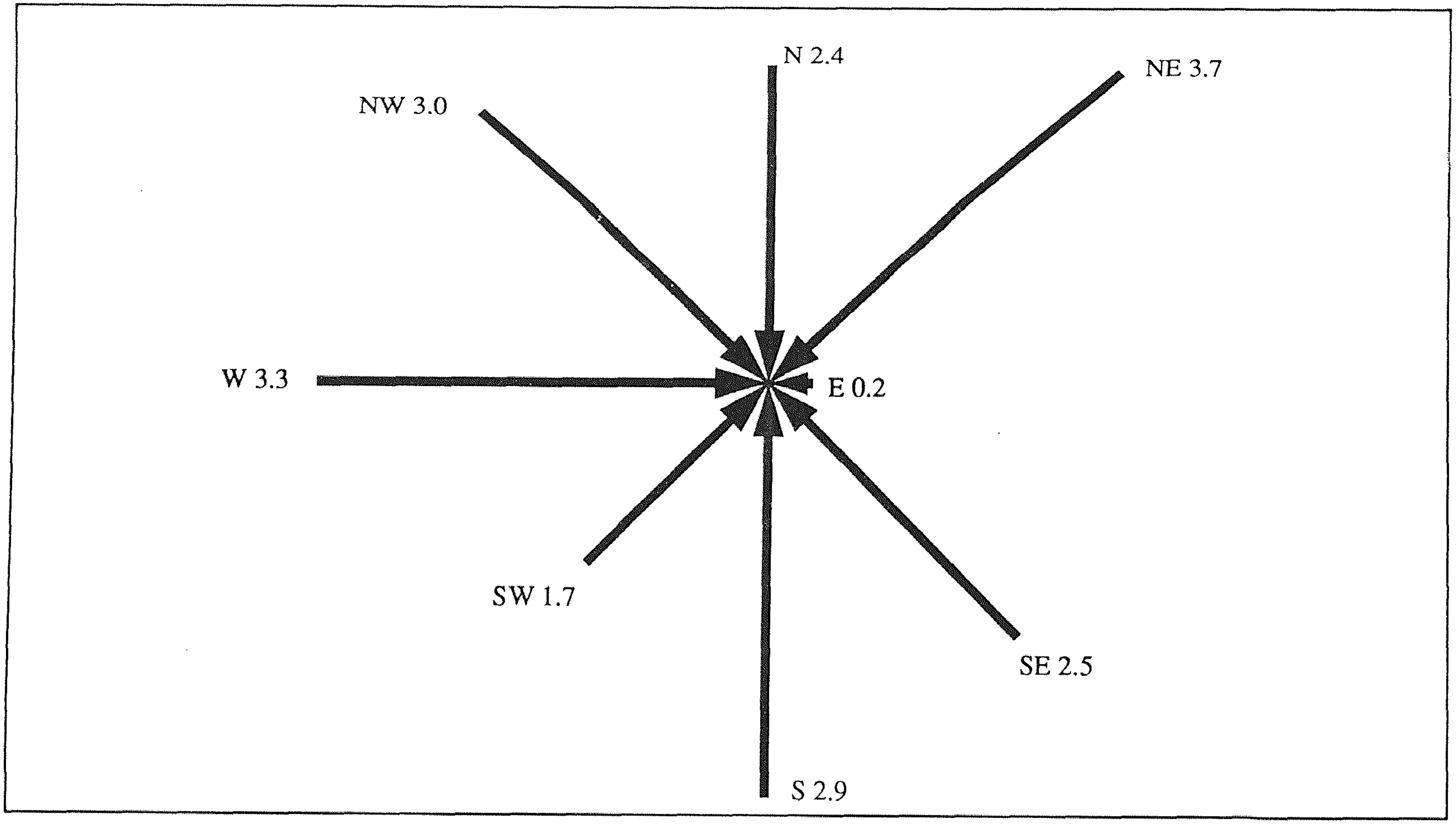


Figure 6.16.1

Site: Elizabeth   Units - ng/m3

AL:cd CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Eliz 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	0.0	0.0	0.0	0.0	0.0	0.4	0.8	2.0
2	0.0	0.0	0.0	0.0	0.0	0.4	1.2	0.0
3	1.8	0.0	0.0	1.8	7.2	3.6	0.0	0.0
4	0.0	0.0	0.0	0.0	6.4	1.6	3.2	1.6
5	1.8	0.0	0.0	0.0	0.0	0.0	0.6	2.4
6	0.5	0.0	1.5	1.5	0.5	0.0	0.0	0.0
7	0.5	0.0	0.0	0.0	0.0	1.0	0.5	2.0
8	0.0	0.0	0.0	0.0	6.0	0.0	8.0	2.0
9	0.6	0.6	0.0	0.0	0.6	1.2	1.2	0.0
10	0.0	0.0	0.0	0.0	0.0	0.2	0.5	0.1
11	0.0	0.0	0.0	0.0	0.0	3.6	3.6	0.0
12	1.6	0.0	0.0	0.0	0.0	0.8	0.0	4.0
13	3.0	0.0	0.6	0.0	0.0	0.0	0.0	1.2
14	1.3	2.6	1.3	2.6	0.0	1.3	1.3	0.0
15	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.3
NC VECTORS	11.1	3.2	3.4	5.9	20.7	14.2	21.3	15.6
ND VECTORS	0.7	1.1	0.7	1.0	1.6	0.7	0.7	0.6

ocessing complete...Press...<<ENTER>>...<f2>>.....to repeat.
This is your completed concentration vector and wind vector table.

6.16.2

Metal: Cadium
Fall (October - December) 1988

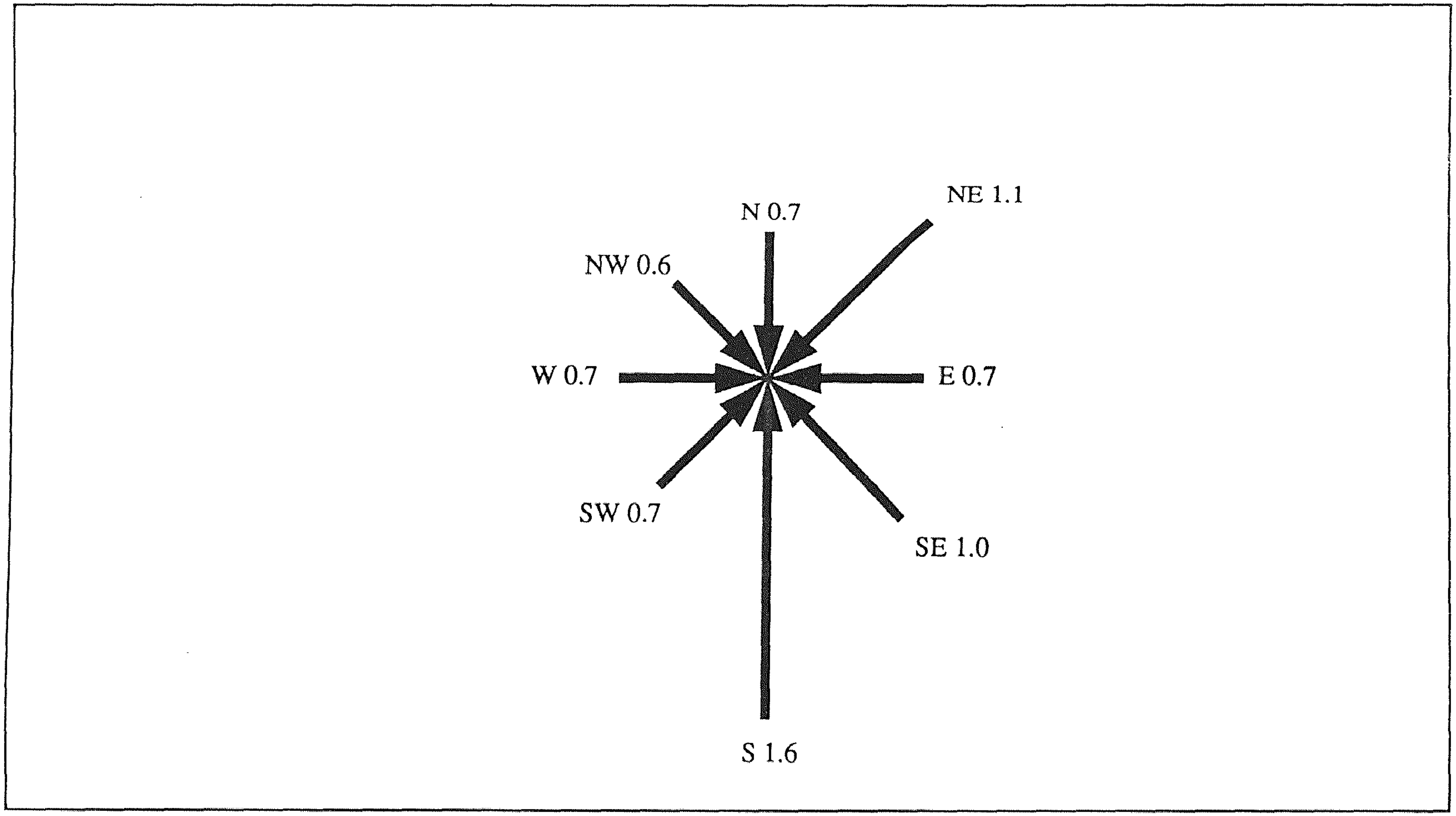


Figure 6.16.2

Site: Elizabeth Units - ng/m^3

Table - 6·17

SITE - Elizabeth Year - 1988

Metal - Nickel

Period: June 1988 - Dec 1988

Sam. No.	Date	Ni Conc. ng/m3	N	NE	E	SE	S	SW	W	NW
			Wind Direction *							
1	6/14/88	24.4	0	0	0	0	0	4	4	0
2	6/20/88	13.4	0	0	0	0	2	6	0	0
3	6/28/88	2.9	3	0	0	0	2	3	0	0
4	7/02/88		1	0	0	0	0	0	0	7
5	7/08/88		0	0	1	4	0	2	1	0
6	7/14/88		0	0	0	1	2	5	0	0
7	8/01/88		0	0	0	3	4	0	0	0
8	8/07/88		0	0	0	0	1	0	5	2
9	8/13/88		0	0	0	0	0	6	2	0
10	8/19/88		4	0	0	0	2	1	0	0
11	8/25/88		1	0	0	3	4	0	0	0
12	8/31/88		3	1	0	0	0	1	1	2
13	9/06/88		0	0	0	0	0	0	3	5
14	9/12/88		1	0	0	0	2	2	1	1
15	9/18/88		0	0	0	0	0	7	1	0
16	9/24/88		5	0	0	0	0	1	1	1
17	10/06/88	1.7	0	0	0	0	0	1	2	5
18	10/12/88	3.4	0	0	0	0	0	2	6	0
19	10/18/88	8.5	1	0	0	1	4	2	0	0
20	10/24/88	3.3	0	0	0	0	4	1	2	1
21	10/30/88	1.7	3	0	0	0	0	0	1	4
22	11/05/88	11.5	1	0	3	3	1	0	0	0
23	11/11/88	9.5	1	0	0	0	0	2	1	4
24	11/17/88	17.7	0	0	0	0	3	0	4	1
25	11/23/88	9.2	1	1	0	0	1	2	2	0
26	11/29/88	4.5	0	0	0	0	0	2	5	1
27	12/05/88	12.1	0	0	0	0	0	4	4	0
28	12/11/88	8.9	2	0	0	0	0	1	0	5
29	12/17/88	20.6	5	0	1	0	0	0	0	2
30	12/23/88	10.4	1	2	1	2	0	1	1	0
31	12/29/88	1.5	0	0	0	0	0	1	4	3

* # of 3 hour periods per 24 hour period that the wind originated from indicated direction.

Data from National Weather Service Data Station Newark Airport.

ITAL:ni CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Eliz 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	0.0	0.0	0.0	0.0	0.0	1.7	3.4	8.5
2	0.0	0.0	0.0	0.0	0.0	6.8	20.4	0.0
3	8.5	0.0	0.0	8.5	34.0	17.0	0.0	0.0
4	0.0	0.0	0.0	0.0	13.2	3.3	6.6	3.3
5	5.1	0.0	0.0	0.0	0.0	0.0	1.7	6.8
6	11.5	0.0	34.5	34.5	11.5	0.0	0.0	0.0
7	9.5	0.0	0.0	0.0	0.0	19.0	9.5	38.0
8	0.0	0.0	0.0	0.0	53.1	0.0	70.8	17.7
9	9.2	9.2	0.0	0.0	9.2	18.4	18.4	0.0
10	0.0	0.0	0.0	0.0	0.0	9.0	22.5	4.5
11	0.0	0.0	0.0	0.0	0.0	48.4	48.4	0.0
12	17.8	0.0	0.0	0.0	0.0	8.9	0.0	44.5
13	103.0	0.0	20.6	0.0	0.0	0.0	0.0	41.2
14	10.4	20.8	10.4	20.8	0.0	10.4	10.4	0.0
15	0.0	0.0	0.0	0.0	0.0	1.5	6.0	4.5
NC VECTORS	175.0	30.0	65.5	63.8	121.0	144.4	218.1	169.0
ND VECTORS	11.7	10.0	13.1	10.6	9.3	7.6	6.8	6.5

ocessing complete...Press...<<ENTER>>...<f2>>.....to repeat.
This is your completed concentration vector and wind vector table.

6·17·1

Metal: Nickel
Fall (October - December) 1988

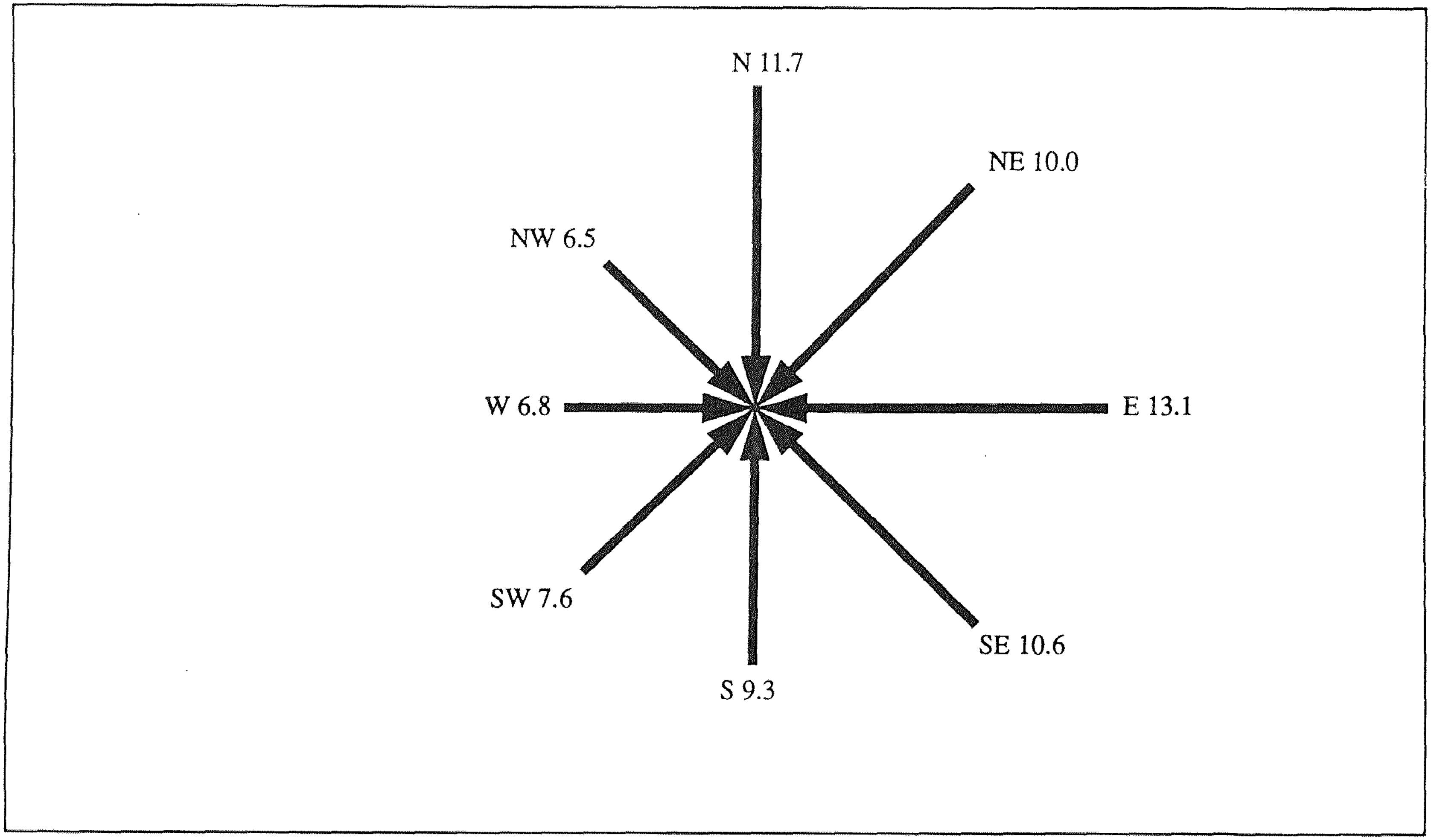


Figure 6.17.1

Site: Elizabeth   Units - ng/m3

Table - 6.18

SITE - Elizabeth Year -1988

Metal - Copper

Period: June 1988- Dec 1988

Sam. No.	Date	Cu Conc. ng/m3	Wind Direction *							
			N	NE	E	SE	S	SW	W	NW
1	6/14/88	54.7	0	0	0	0	0	4	4	0
2	6/20/88	104.6	0	0	0	0	2	6	0	0
3	6/28/88	69.9	3	0	0	0	2	3	0	0
4	7/02/88		1	0	0	0	0	0	0	7
5	7/08/88		0	0	1	4	0	2	1	0
6	7/14/88		0	0	0	1	2	5	0	0
7	8/01/88		0	0	0	3	4	0	0	0
8	8/07/88		0	0	0	0	1	0	5	2
9	8/13/88		0	0	0	0	0	6	2	0
10	8/19/88		4	0	0	0	2	1	0	0
11	8/25/88		1	0	0	3	4	0	0	0
12	8/31/88		3	1	0	0	0	1	1	2
13	9/06/88		0	0	0	0	0	0	3	5
14	9/12/88		1	0	0	0	2	2	1	1
15	9/18/88		0	0	0	0	0	7	1	0
16	9/24/88		5	0	0	0	0	1	1	1
17	10/06/88	32.0	0	0	0	0	0	1	2	5
18	10/12/88	23.0	0	0	0	0	0	2	6	0
19	10/18/88	32.1	1	0	0	1	4	2	0	0
20	10/24/88	29.8	0	0	0	0	4	1	2	1
21	10/30/88	69.9	3	0	0	0	0	0	1	4
22	11/05/88	17.5	1	0	3	3	1	0	0	0
23	11/11/88	23.4	1	0	0	0	0	2	1	4
24	11/17/88	59.6	0	0	0	0	3	0	4	1
25	11/23/88	21.8	1	1	0	0	1	2	2	0
26	11/29/88	17.6	0	0	0	0	0	2	5	1
27	12/05/88	159.5	0	0	0	0	0	4	4	0
28	12/11/88	16.6	2	0	0	0	0	1	0	5
29	12/17/88	28.9	5	0	1	0	0	0	0	2
30	12/23/88	25.8	1	2	1	2	0	1	1	0
31	12/29/88	28.7	0	0	0	0	0	1	4	3

* # of 3 hour periods per 24 hour period that the wind originated from indicated direction.

Data from National Weather Service Data Station Newark Airport.

TAL:cu CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Eliz 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	0.0	0.0	0.0	0.0	0.0	32.0	64.0	160.0
2	0.0	0.0	0.0	0.0	0.0	46.0	138.0	0.0
3	32.1	0.0	0.0	32.1	128.4	64.2	0.0	0.0
4	0.0	0.0	0.0	0.0	119.2	29.8	59.6	29.8
5	209.7	0.0	0.0	0.0	0.0	0.0	69.9	279.6
6	17.5	0.0	52.5	52.5	17.5	0.0	0.0	0.0
7	23.4	0.0	0.0	0.0	0.0	46.8	23.4	93.6
8	0.0	0.0	0.0	0.0	178.8	0.0	238.4	59.6
9	21.8	21.8	0.0	0.0	21.8	43.6	43.6	0.0
10	0.0	0.0	0.0	0.0	0.0	35.2	88.0	17.6
11	0.0	0.0	0.0	0.0	0.0	638.0	638.0	0.0
12	33.2	0.0	0.0	0.0	0.0	16.6	0.0	83.0
13	144.5	0.0	28.9	0.0	0.0	0.0	0.0	57.8
14	25.8	51.6	25.8	51.6	0.0	25.8	25.8	0.0
15	0.0	0.0	0.0	0.0	0.0	28.7	114.8	86.1
ONC VECTORS	508.0	73.4	107.2	136.2	465.7	%1006.7	%1503.5	867.1
IND VECTORS	33.9	24.5	21.4	22.7	35.8	53.0	47.0	33.3

rocessing complete...Press...<<ENTER>>...<f2>>.....to repeat.

k This is your completed concentration vector and wind vector table.

6·18·1

Metal: Copper
Fall (October - December) 1988

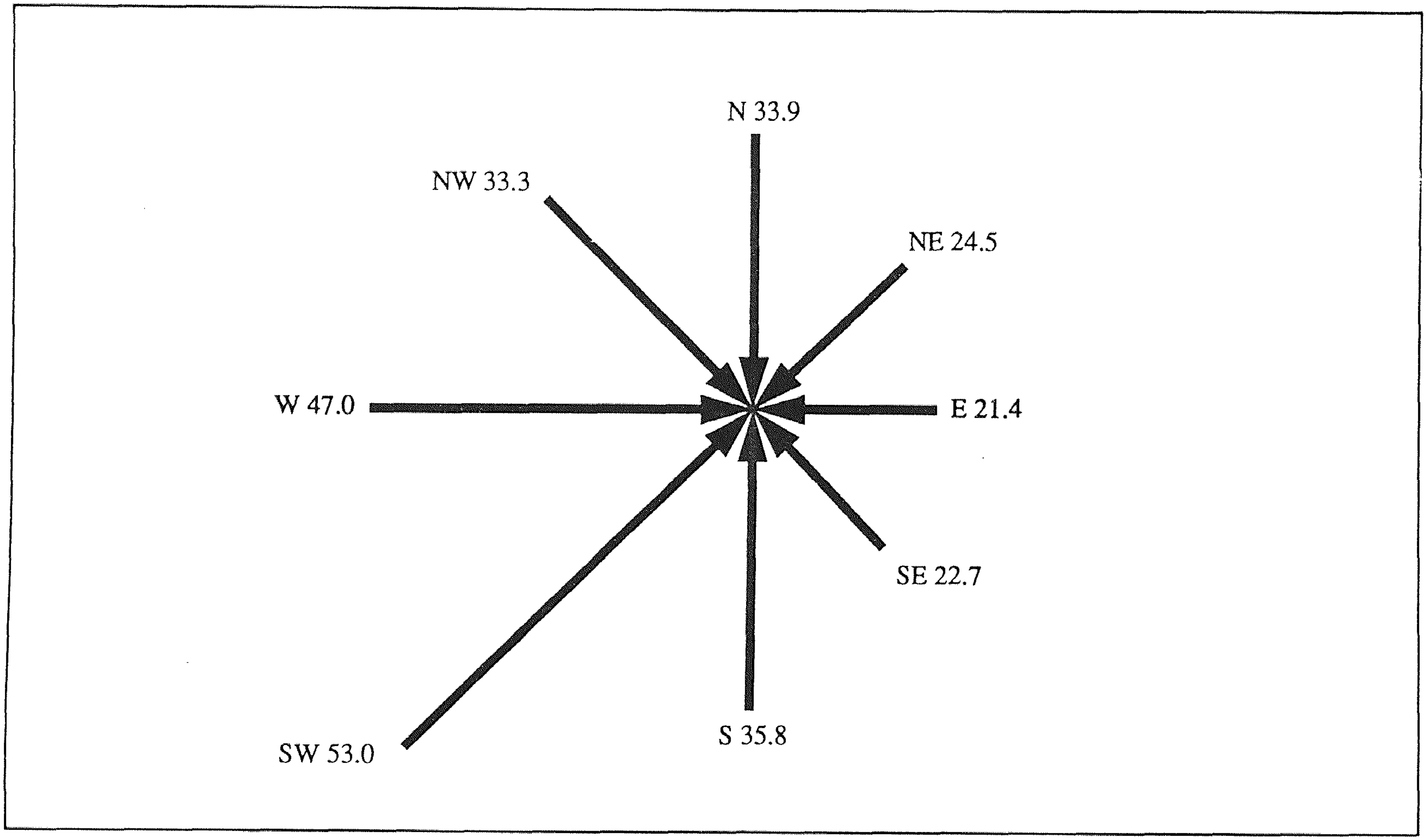


Figure 6.18.1

Site: Elizabeth Units - ng/m^3

Table- 6.19

SITE-Elizabeth Year-1988

Metal- Mercury

Period: June 9188 - Dec 1988

Sam. No.	Date	Hg Conc. ng/m3	Wind Direction * N	NE	E	SE	S	SW	W	NW
1	6/14/88	1.6	0	0	0	0	0	4	4	0
2	6/20/88	0.6	0	0	0	0	2	6	0	0
3	6/28/88	0.6	3	0	0	0	2	3	0	0
4	7/02/88		1	0	0	0	0	0	0	7
5	7/08/88		0	0	1	4	0	2	1	0
6	7/14/88		0	0	0	1	2	5	0	0
7	8/01/88		0	0	0	3	4	0	0	0
8	8/07/88		0	0	0	0	1	0	5	2
9	8/13/88		0	0	0	0	0	6	2	0
10	8/19/88		4	0	0	0	2	1	0	0
11	8/25/88		1	0	0	3	4	0	0	0
12	8/31/88		3	1	0	0	0	1	1	2
13	9/06/88		0	0	0	0	0	0	3	5
14	9/12/88		1	0	0	0	2	2	1	1
15	9/18/88		0	0	0	0	0	7	1	0
16	9/24/88		5	0	0	0	0	1	1	1
17	10/06/88	0.6	0	0	0	0	0	1	2	5
18	10/12/88	1.0	0	0	0	0	0	2	6	0
19	10/18/88	0.8	1	0	0	1	4	2	0	0
20	10/24/88	0.6	0	0	0	0	4	1	2	1
21	10/30/88	0.7	3	0	0	0	0	0	1	4
22	11/05/88	0.7	1	0	3	3	1	0	0	0
23	11/11/88	0.6	1	0	0	0	0	2	1	4
24	11/17/88	0.9	0	0	0	0	3	0	4	1
25	11/23/88	0.7	1	1	0	0	1	2	2	0
26	11/29/88	1.3	0	0	0	0	0	2	5	1
27	12/05/88	0.5	0	0	0	0	0	4	4	0
28	12/11/88	0.5	2	0	0	0	0	1	0	5
29	12/17/88	0.8	5	0	1	0	0	0	0	2
30	12/23/88	0.5	1	2	1	2	0	1	1	0
31	12/29/88	0.6	0	0	0	0	0	1	4	3

* # of 3 hour periods per 24 hour period that the wind originated from indicated direction.

Data from National Weather Service Data Station Newark Airport.

TAL:hg CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Eliza 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	0.0	0.0	0.0	0.0	0.0	0.6	1.2	3.0
2	0.0	0.0	0.0	0.0	0.0	2.0	6.0	0.0
3	0.8	0.0	0.0	0.8	3.2	1.6	0.0	0.0
4	0.0	0.0	0.0	0.0	2.4	0.6	1.2	0.6
5	2.1	0.0	0.0	0.0	0.0	0.0	0.7	2.8
6	0.7	0.0	2.1	2.1	0.7	0.0	0.0	0.0
7	0.6	0.0	0.0	0.0	0.0	1.2	0.6	2.4
8	0.0	0.0	0.0	0.0	2.7	0.0	3.6	0.9
9	0.7	0.7	0.0	0.0	0.7	1.4	1.4	0.0
10	0.0	0.0	0.0	0.0	0.0	2.6	6.5	1.3
11	0.0	0.0	0.0	0.0	0.0	2.0	2.0	0.0
12	1.0	0.0	0.0	0.0	0.0	0.5	0.0	2.5
13	4.0	0.0	0.8	0.0	0.0	0.0	0.0	1.6
14	0.5	1.0	0.5	1.0	0.0	0.5	0.5	0.0
15	0.0	0.0	0.0	0.0	0.0	0.6	2.4	1.8
NC VECTORS	10.4	1.7	3.4	3.9	9.7	13.6	26.1	16.9
ND VECTORS	0.7	0.6	0.7	0.7	0.7	0.7	0.8	0.7

ocessing complete...Press...<<ENTER>>...<f2>>.....to repeat.
This is your completed concentration vector and wind vector table.

6.19.1

Metal: Mercury
Fall (October - December) 1988

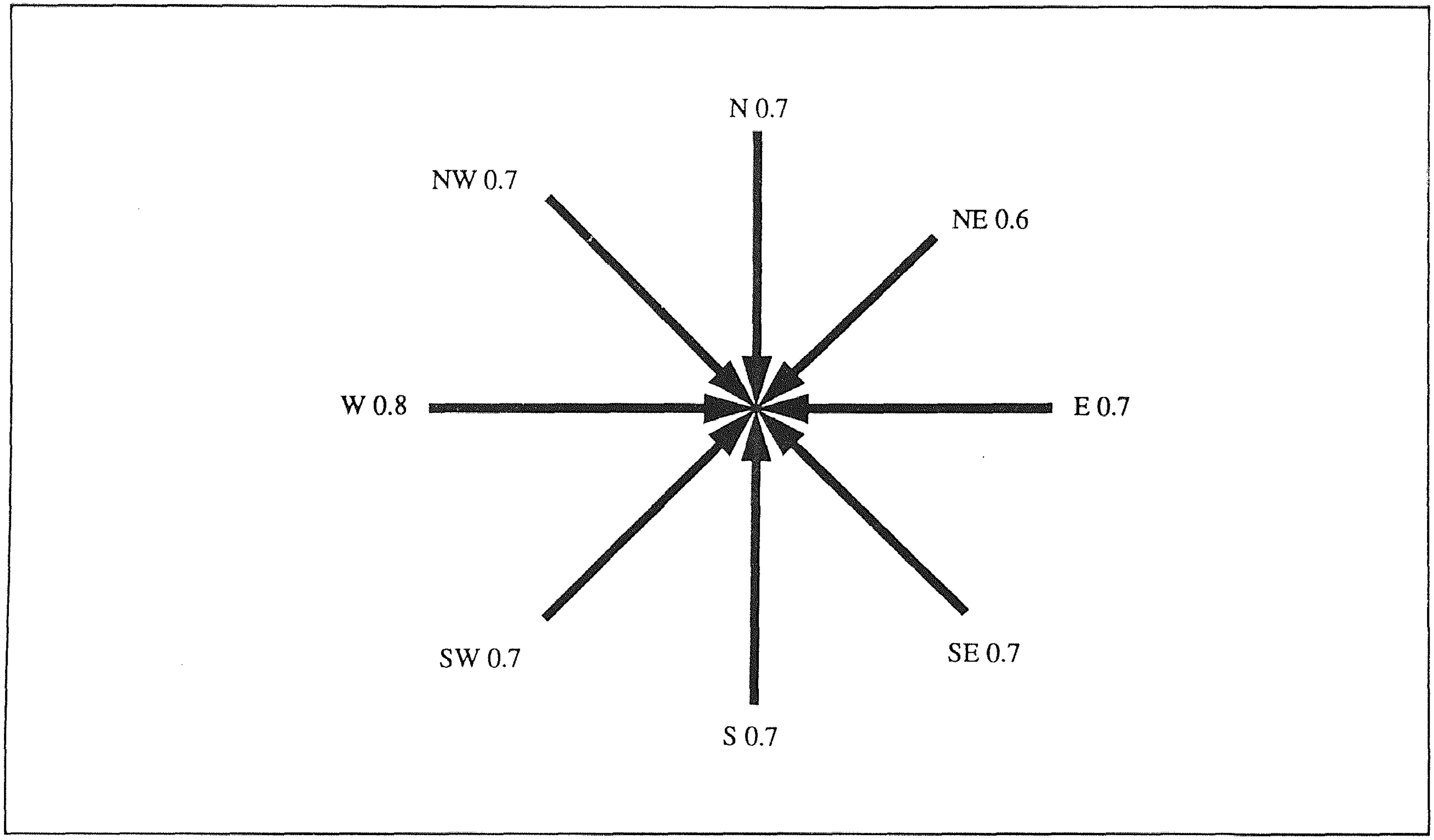


Figure 6.19.1

Site: Elizabeth   Units - ng/m^3

Table - 6.20

SITE - Elizabeth   Year - 1988

Metal _ Cobalt

Period: June 9188- Dec 1988

Sam. No.	Date	Co Conc. ng/m3	N	NE	E	SE	S	SW	W	NW
			Wind Direction *							
1	6/14/88	5.9	0	0	0	0	0	4	4	0
2	6/20/88	9.0	0	0	0	0	2	6	0	0
3	6/28/88	18.8	3	0	0	0	2	3	0	0
4	7/02/88	20.2	1	0	0	0	0	0	0	7
5	7/08/88	3.4	0	0	1	4	0	2	1	0
6	7/14/88	6.6	0	0	0	1	2	5	0	0
7	8/01/88	17.2	0	0	0	3	4	0	0	0
8	8/07/88	7.8	0	0	0	0	1	0	5	2
9	8/13/88	5.4	0	0	0	0	0	6	2	0
10	8/19/88	7.7	4	0	0	0	2	1	0	0
11	8/25/88	12.4	1	0	0	3	4	0	0	0
12	8/31/88	2.1	3	1	0	0	0	1	1	2
13	9/06/88	8.6	0	0	0	0	0	0	3	5
14	9/12/88	4.5	1	0	0	0	2	2	1	1
15	9/18/88	8.4	0	0	0	0	0	7	1	0
16	9/24/88	4.2	5	0	0	0	0	1	1	1
17	10/06/88	2.2	0	0	0	0	0	1	2	5
18	10/12/88	1.8	0	0	0	0	0	2	6	0
19	10/18/88	2.3	1	0	0	1	4	2	0	0
20	10/24/88	2.2	0	0	0	0	4	1	2	1
21	10/30/88	3.3	3	0	0	0	0	0	1	4
22	11/05/88	1.2	1	0	3	3	1	0	0	0
23	11/11/88	47.3	1	0	0	0	0	2	1	4
24	11/17/88	11.4	0	0	0	0	3	0	4	1
25	11/23/88	13.0	1	1	0	0	1	2	2	0
26	11/29/88	2.2	0	0	0	0	0	2	5	1
27	12/05/88	4.3	0	0	0	0	0	4	4	0
28	12/11/88	4.2	2	0	0	0	0	1	0	5
29	12/17/88	4.2	5	0	1	0	0	0	0	2
30	12/23/88	3.2	1	2	1	2	0	1	1	0
31	12/29/88	4.2	0	0	0	0	0	1	4	3

* # of 3 hour periods per 24 hour period that the wind originated from indicated direction.

Data from National Weather Service Data Station Newark Airport.

AL:CO CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Eliz 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	0.0	0.0	0.0	0.0	0.0	23.6	23.6	0.0
2	0.0	0.0	0.0	0.0	18.0	54.0	0.0	0.0
3	56.4	0.0	0.0	0.0	37.6	56.4	0.0	0.0
4	20.2	0.0	0.0	0.0	0.0	0.0	0.0	141.4
5	0.0	0.0	3.4	13.6	0.0	6.8	3.4	0.0
6	0.0	0.0	0.0	6.6	13.2	33.0	0.0	0.0
7	0.0	0.0	0.0	51.6	68.8	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	7.8	0.0	39.0	15.6
9	0.0	0.0	0.0	0.0	0.0	32.4	10.8	0.0
10	30.8	0.0	0.0	0.0	15.4	7.7	0.0	0.0
11	12.4	0.0	0.0	37.2	49.6	0.0	0.0	0.0
12	6.3	2.1	0.0	0.0	0.0	2.1	2.1	4.2
13	0.0	0.0	0.0	0.0	0.0	0.0	25.8	43.0
14	4.5	0.0	0.0	0.0	9.0	9.0	4.5	4.5
15	0.0	0.0	0.0	0.0	0.0	58.8	8.4	0.0
NC VECTORS	151.6	2.10	3.40	109.00	219.40	288.02	121.82	212.92
ND VECTORS	8.4	2.1	3.4	9.9	11.5	7.6	6.4	11.8

ocessing complete...Press...<<ENTER>>...<f2>>.....to repeat.
This is your completed concentration vector and wind vector table.

6.20.1

Metal: Cobalt
Spring & Summer (April - September) 1988

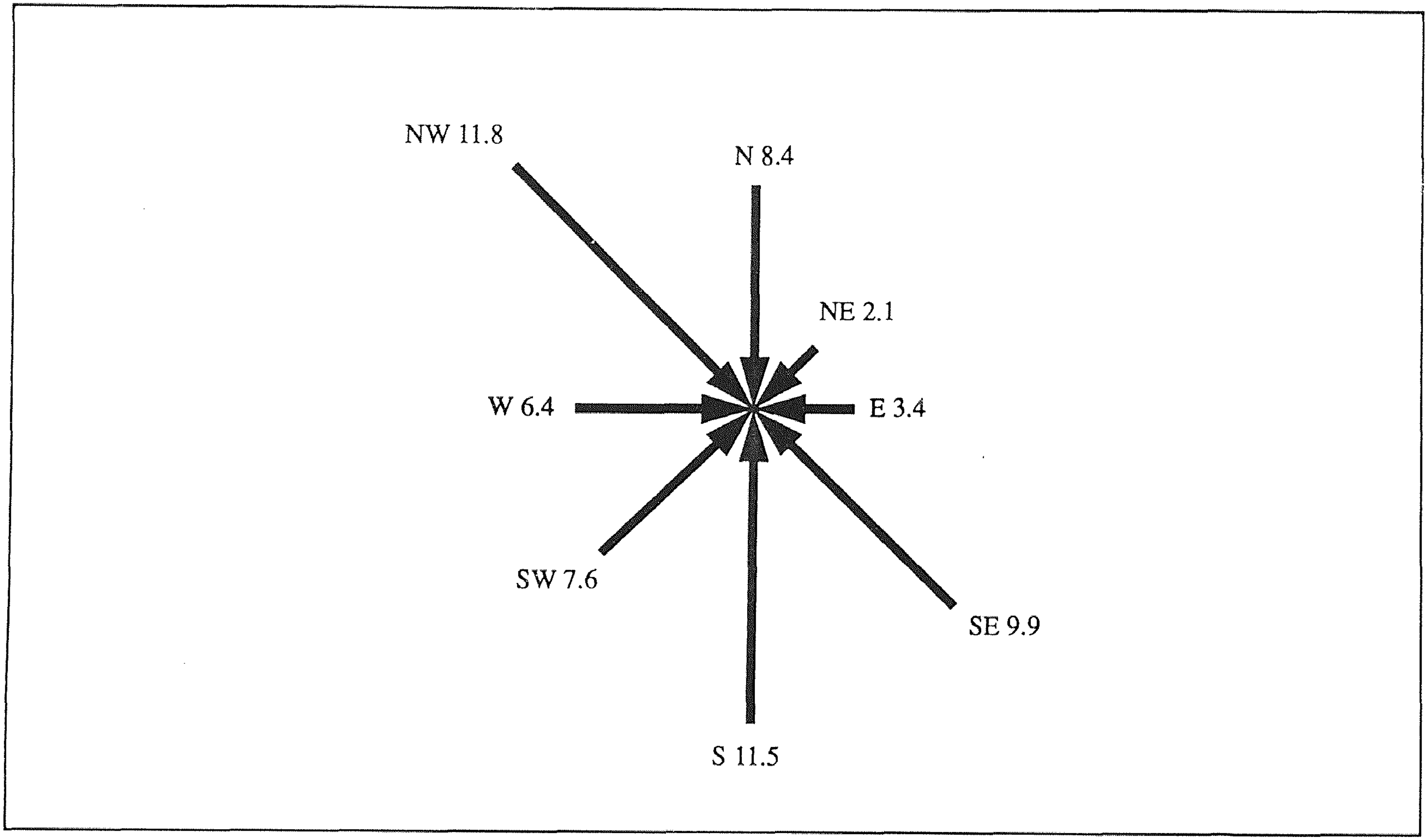


Figure 6.20.1

Site: Elizabeth Units - ng/m^3

TAL:CO CONCENTRATION AND WIND VECTORS TABLE SITE NAME:Eliz 88

SAMPLE	N	NE	E	SE	S	SW	W	NW
1	0.0	0.0	0.0	0.0	0.0	2.2	4.4	11.0
2	0.0	0.0	0.0	0.0	0.0	3.6	10.8	0.0
3	2.3	0.0	0.0	2.3	9.2	4.6	0.0	0.0
4	0.0	0.0	0.0	0.0	8.8	2.2	4.4	2.2
5	9.9	0.0	0.0	0.0	0.0	0.0	3.3	13.2
6	1.2	0.0	3.6	3.6	1.2	0.0	0.0	0.0
7	47.3	0.0	0.0	0.0	0.0	94.6	47.3	189.2
8	0.0	0.0	0.0	0.0	34.2	0.0	45.6	11.4
9	13.0	13.0	0.0	0.0	13.0	26.0	26.0	0.0
10	0.0	0.0	0.0	0.0	0.0	4.4	11.0	2.2
11	0.0	0.0	0.0	0.0	0.0	17.2	17.2	0.0
12	8.4	0.0	0.0	0.0	0.0	4.2	0.0	21.0
13	21.0	0.0	4.2	0.0	0.0	0.0	0.0	8.4
14	3.2	6.4	3.2	6.4	0.0	3.2	3.2	0.0
15	0.0	0.0	0.0	0.0	0.0	4.2	16.8	12.6
ONC VECTORS	106.3	19.4	11.0	12.3	66.4	166.4	190.0	271.2
IND VECTORS	7.1	6.5	2.2	2.1	5.1	8.8	5.9	10.4

rocessing complete...Press...<<ENTER>>...<f2>>.....to repeat.

K This is your completed concentration vector and wind vector table.

6.20.2

Metal: Cobalt
Fall (October - December) 1988

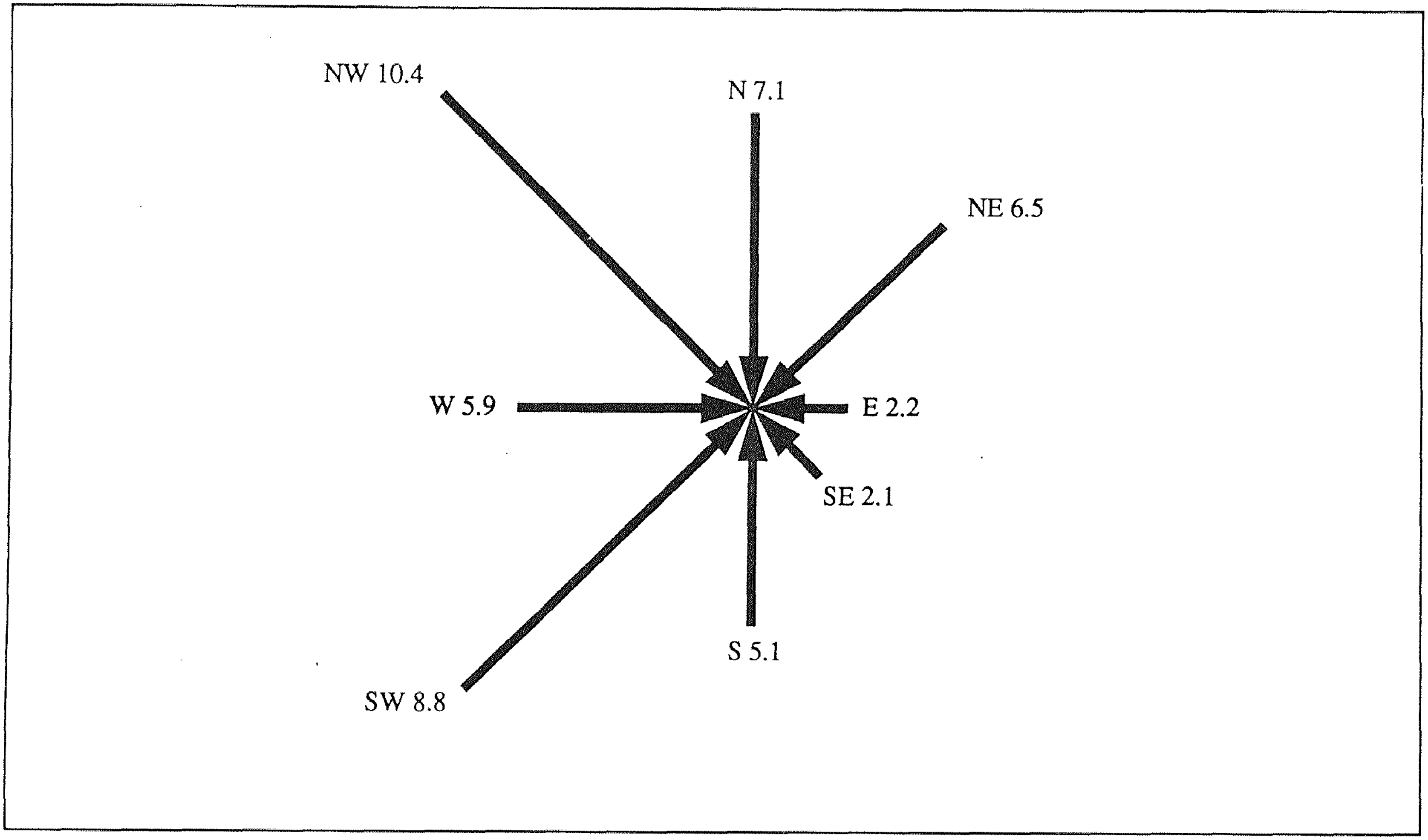


Figure 6.20.2

Site: Elizabeth Units - ng/m^3

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