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ALAMEDA POINT
SSIC NO. 5090.3

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CLEAN Contract Number N62474-88-D-5086 (CLEAN I)
Contract Task Order 0316

Subject: Background Areas Needed to Quantitatively Evaluate Naval Air Station (NAS) Alameda, Alameda, California

Dear Ms. Bernhard and Ms. Garibaldi:

PRC Environmental Management, Inc. (PRC) has evaluated the remedial investigation data collected at NAS Alameda to determine how many statistically different soil areas are present across the base. The purpose of this analysis was to determine how many background data sets are needed to conduct background comparisons for NAS Alameda Installation Restoration Program (IRP) sites. This letter is to document the process applied to statistically identify different "fill zones" and report the results of the statistical analyses.

More than 20 inorganic analytes commonly occur in soils; two analytes were chosen for this statistical evaluation for expediency and to reduce redundant testing. The two analytes chosen were iron and manganese, for the following reasons:

- Both iron and manganese are common soil components
- Neither chemical is related to any site activity at NAS Alameda based on site histories
- Both chemicals are present at quantities well above detection limits at all sites (that is, they have 100 percent frequencies of detection), eliminating the potential problem of differing detection limits between sampling efforts at NAS Alameda. (Multiple detection limits can be a confounding factor in the interpretation of results.)
- U.S. Environmental Protection Agency (EPA)-established analytical methodologies for these two analytes have not changed between sampling efforts at NAS Alameda

Iron and manganese were evaluated to determine how many distinct areas of fill exist at NAS Alameda. All sites except Sites 4, 5, 10A and 10B were included in these analyses; histories of these four sites indicate that metals are likely to be chemicals of concern (COCs). Although iron and

manganese are not likely to be COCs at these sites, they were excluded to retain objectivity in the statistical tests.

First, data for each site were compared to the Site 1/College of Alameda data set using the Wilcoxon Rank Sum Test; this test is not dependent on underlying data distributions. Soil samples collected in the 0 to 10 feet below ground surface (bgs) depth interval were used. The results of this comparison indicated that data for Site 2 were statistically similar to the Site 1/College of Alameda data set for both analytes. Other sites showed either similarity for one chemical or no similarity. Based on these results, it was assumed that the Site 1/College of Alameda data would be appropriate background data for the Site 1 landfill and for Site 2, but that the remaining areas of NAS Alameda would not be adequately represented by that data set. The cumualtive probability plots of the Site 2 and Site 1/College of Alameda data for iron and manganese are shown in Figures 1A and 1B, using natural logarithmic transformed data in units of parts per million.

Next, sites were divided by chronological fill deposition history into the following groups to further evaluate combinability:

- Sites 3, 6, 7B, 7A, 8, 11, and 12 were grouped together because they are in the same fill area (fill deposition occurred between 1930 and 1939) (Group A)
- Sites 9 and 16 were grouped together because fill was deposited between 1942 and 1946 (Group B)
- Sites 7C, 13, and 19 were grouped together because they are composed of fill soil overlying native Merritt Sands (Group C)
- The runway area was considered separately from the other groups because fill was deposited mainly during 1940 and 1942 (Runway)

Figure 2 shows the geographic boundaries of the four grouped areas, as well as Sites 1 and 2. Data from each of these groups have been plotted on a cumulative probability plot using log-transformed data so that they could be visually inspected. Figures 3A through 6B present the plots for each group, using natural logarithmic transformed data in units of parts per million.

The groups were then compared to each other to determine whether they were statistically similar and could be represented by a single background data set. A Kruskal-Wallis Test, followed by a Wilcoxon (Mann-Whitney) Rank Sum Test, was used to determine whether the groups were combinable. The results of the Kruskal-Wallis test when comparing Groups A, B, and C indicated that one group was statistically different from the others ($p < 0.0001$). A Wilcoxon Rank Sum Test confirmed that Group A was statistically different from Groups B and C; Groups B and C were not statistically different at $p = 0.05$. Based on these results, it was decided that Groups B and C could

be represented by one background data set, but that Group A would require a separate background data set.

Finally, the runway area was compared to Groups A, B, and C using a Wilcoxon Rank Sum test for each pair of data sets. Results of this analysis showed that data for manganese were not significantly different between the runway area and Group A, but were significantly different between the runway area and Groups B and C. Data for iron were not significantly different between the runway area and any other group. Based on these results, it appears that the runway area could be represented by the same background data set as the Group A sites.

In conclusion, it appears that three background data sets will be needed for background comparisons at NAS Alameda: one for Sites 1 and 2, which could be represented by the Site 1/College of Alameda data set; one for the runway and central portion of the base; and one for the southeast industrial portion of the base. Although the southeast industrial area of the base consists of native Merritt Sands covered with fill, the deeper soils did not appear different from the overlying fill. Data representing soil depths of 0 to 10 feet were used in the analyses described above. This indicates that the source of fill overlying the southeast area was probably also Merritt Sand.

Please call me at (303) 312-8843 if you have any questions regarding these analyses or would like to discuss the statistical analysis in greater detail.

Sincerely,

Theresa K. Lopez

Theresa K. Lopez
Senior Toxicologist

enclosure

cc: Steven Edde, NADEP
Susan Willoughby, PRC
Duane Balch, PRC

FIGURE 1A
NAS ALAMEDA
CUMULATIVE PROBABILITY PLOT FOR IRON USING SITE 1, SITE 2, AND COLLEGE OF ALAMEDA DATA

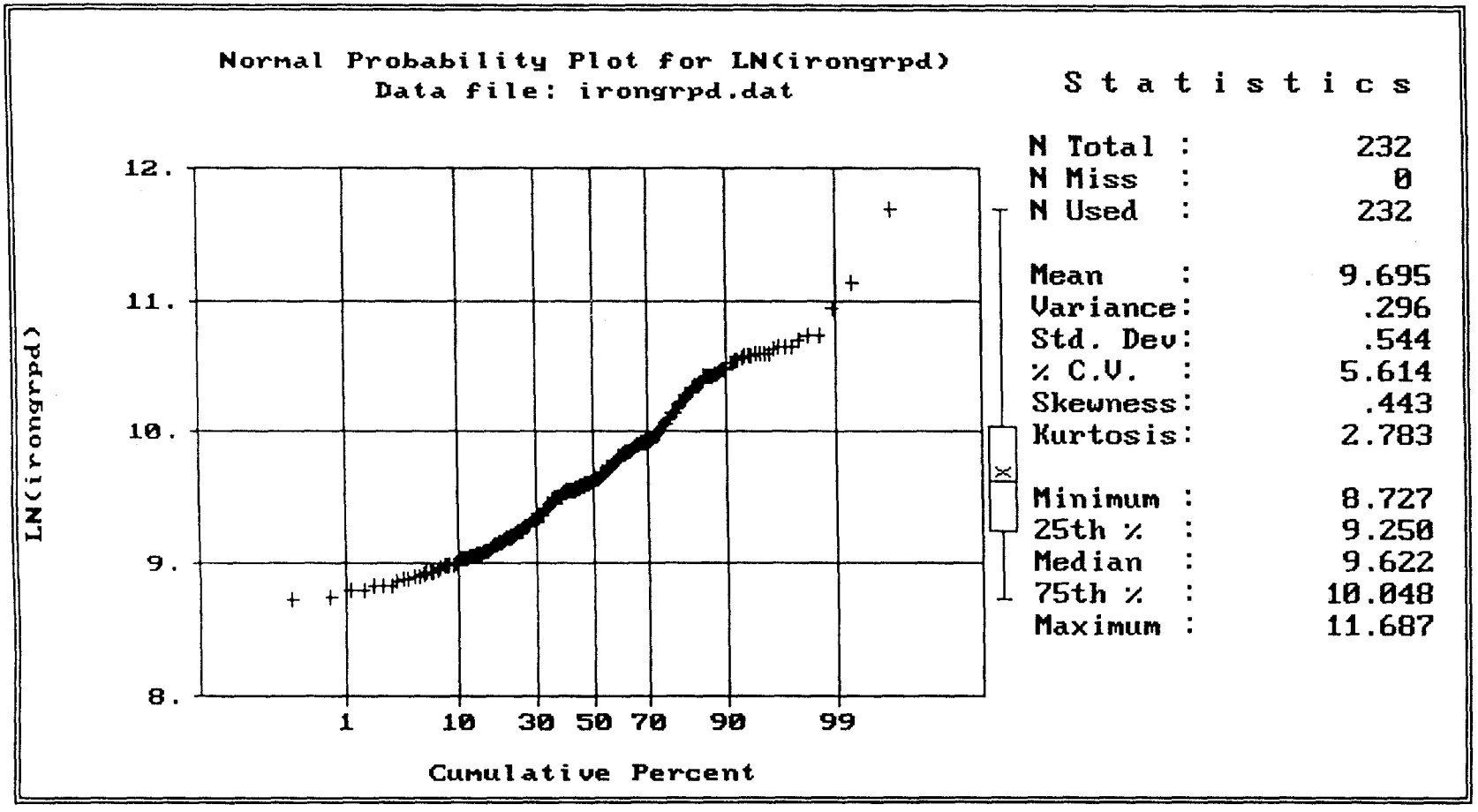
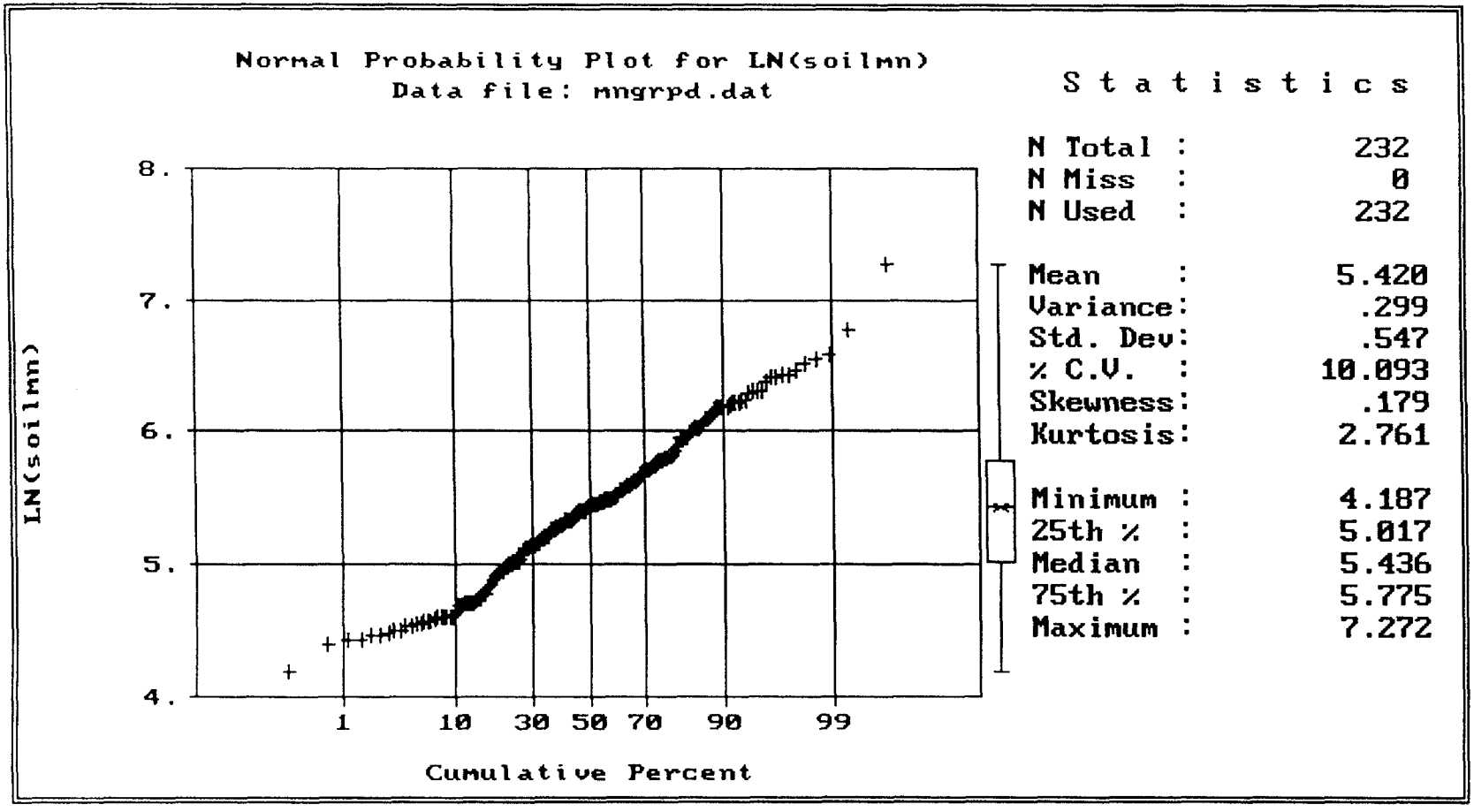


FIGURE 1B
NAS ALAMEDA
CUMULATIVE PROBABILITY PLOT FOR MANGANESE USING SITE 1, SITE 2, AND COLLEGE OF ALAMEDA DATA



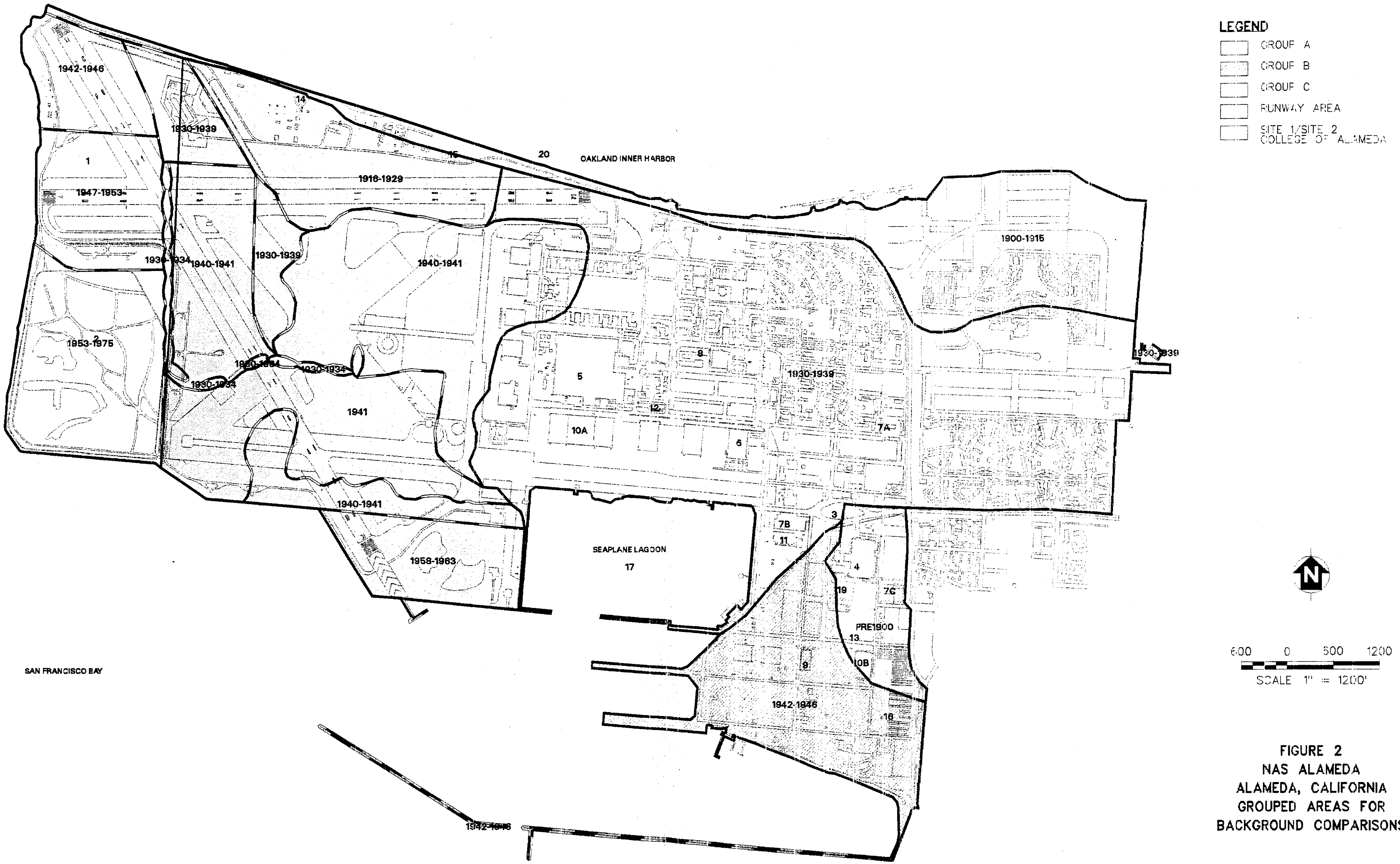


FIGURE 2
NAS ALAMEDA
ALAMEDA, CALIFORNIA
GROUPED AREAS FOR
BACKGROUND COMPARISONS

PRC Environmental Management, Inc.

FIGURE 3A
NAS ALAMEDA
CUMULATIVE PROBABILITY PLOT FOR IRON USING SITES 3, 6, 7A, 7B, 8, 11, AND 12 DATA

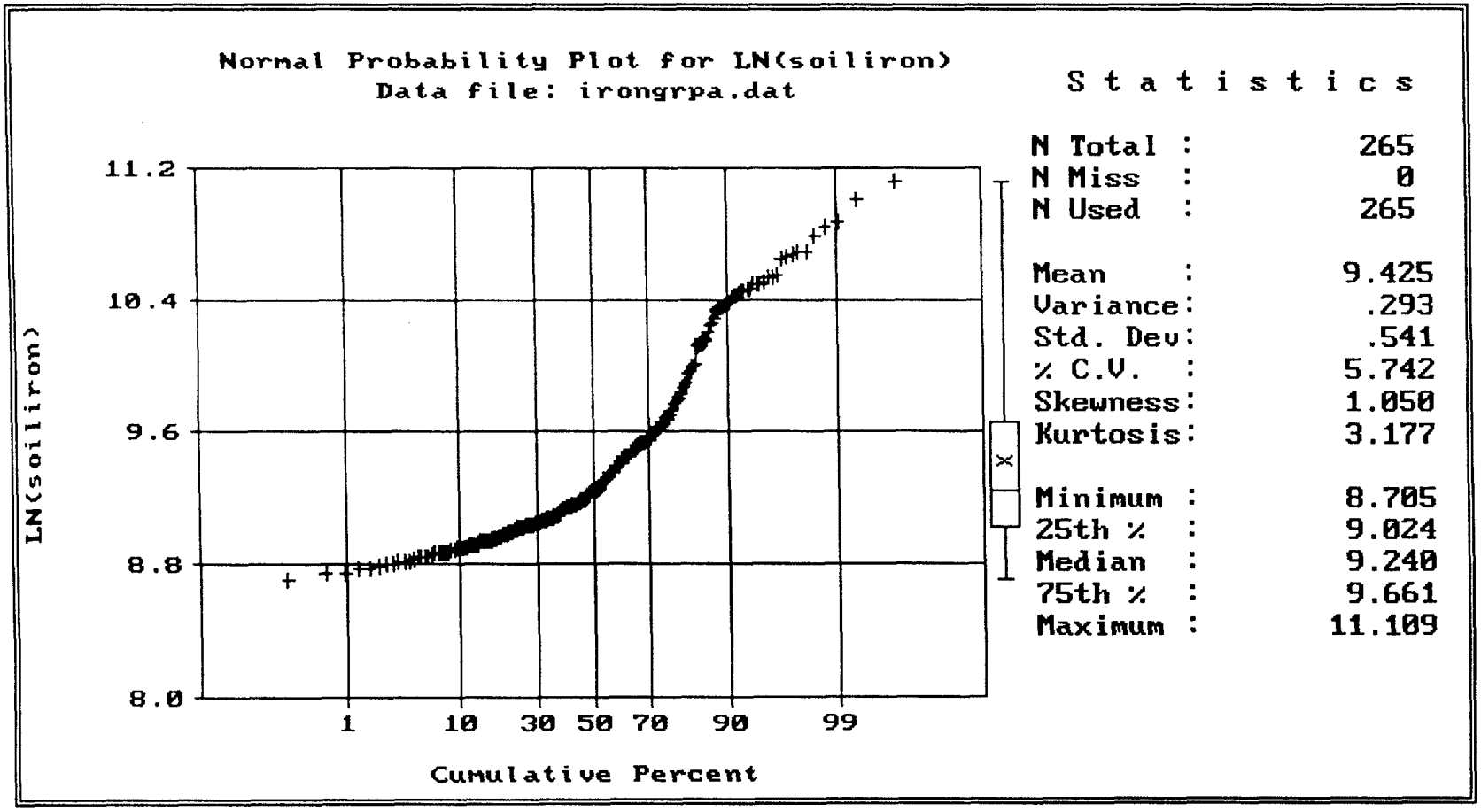


FIGURE 3B
NAS ALAMEDA
CUMULATIVE PROBABILITY PLOT FOR MANGANESE USING SITES 3, 6, 7A, 7B, 8, 11, AND 12 DATA

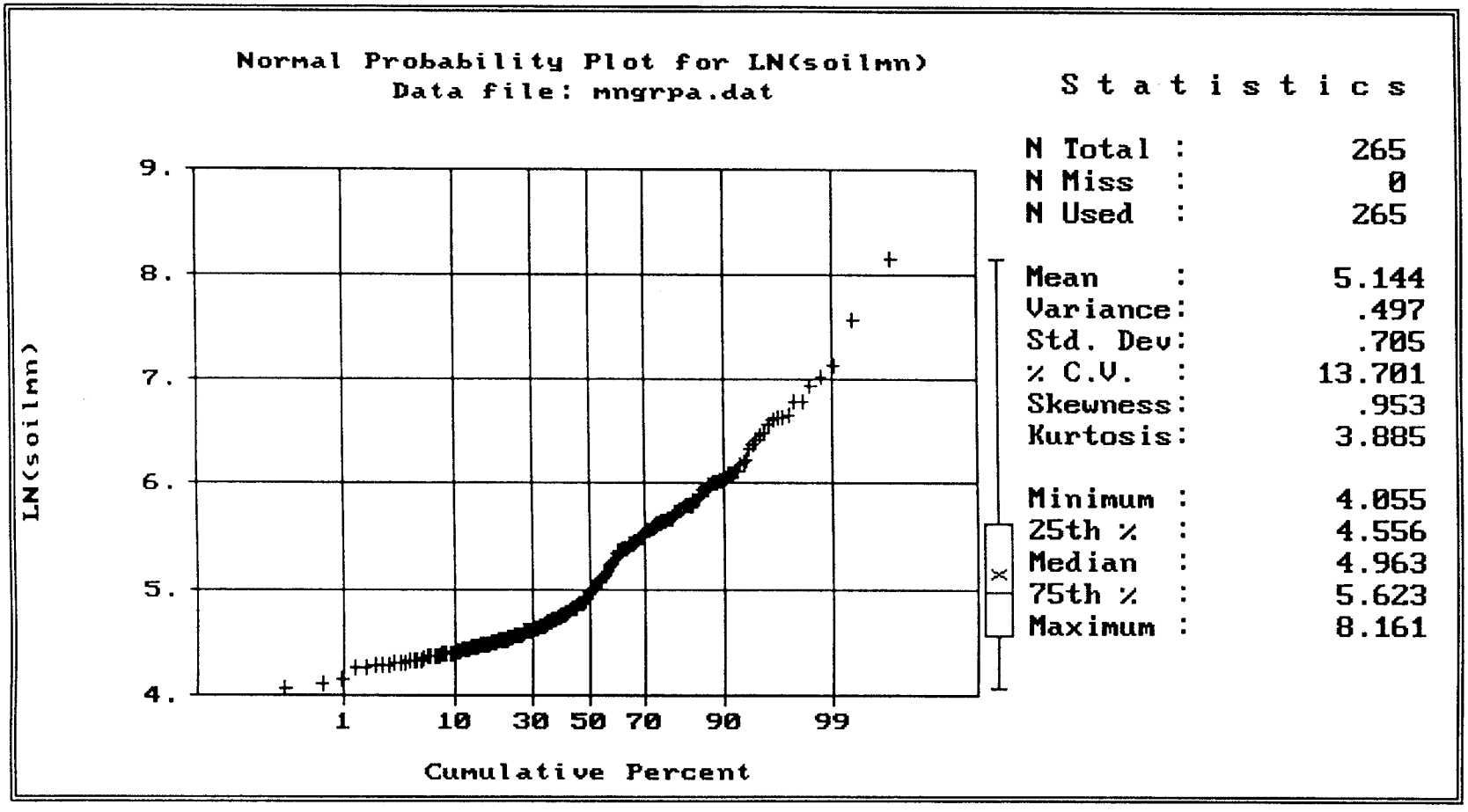


FIGURE 4A
NAS ALAMEDA
CUMULATIVE PROBABILITY PLOT FOR IRON USING SITES 9 AND 16 DATA

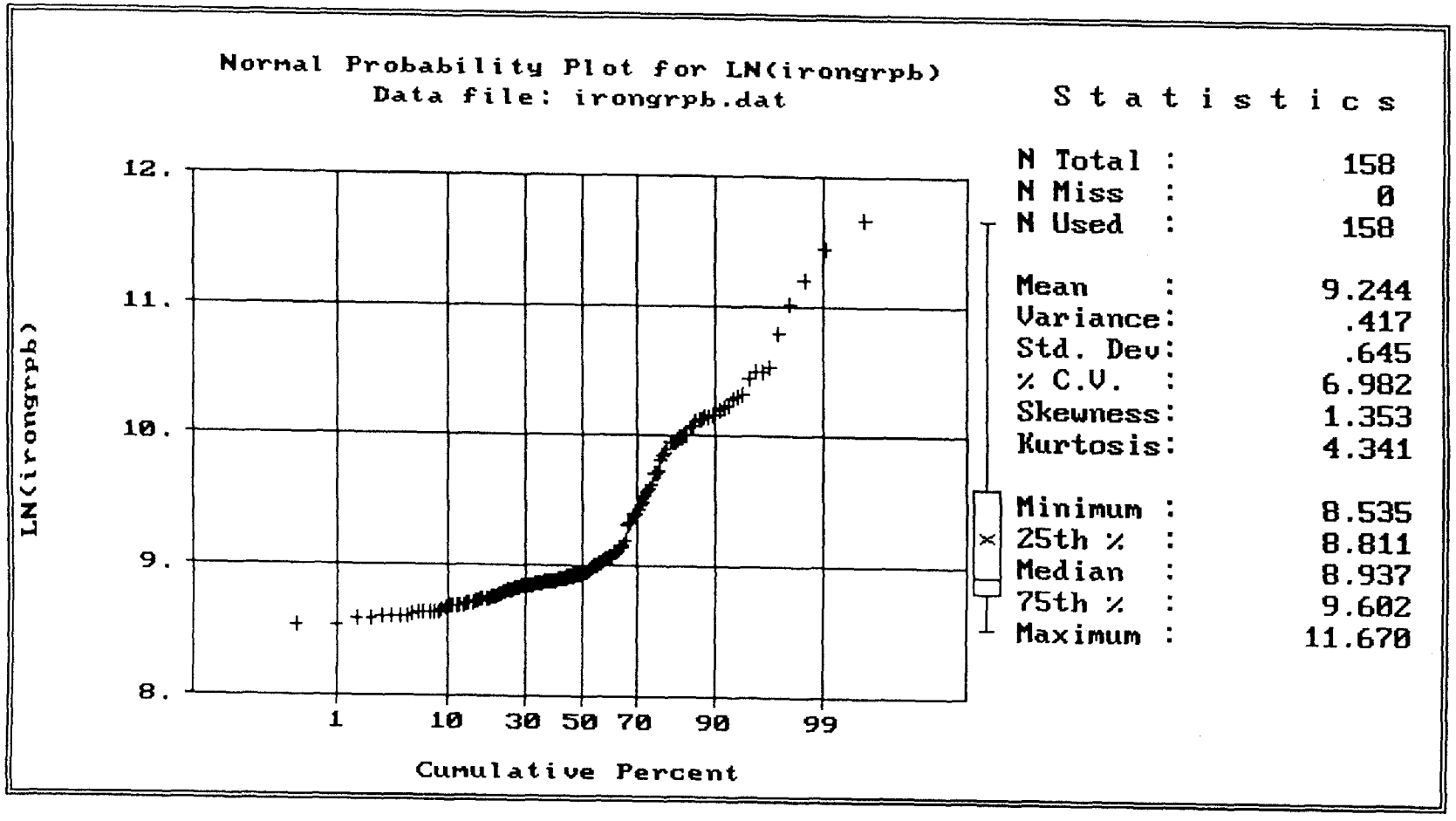


FIGURE 4B
NAS ALAMEDA
CUMULATIVE PROBABILITY PLOT FOR MANGANESE USING SITES 9 AND 16 DATA

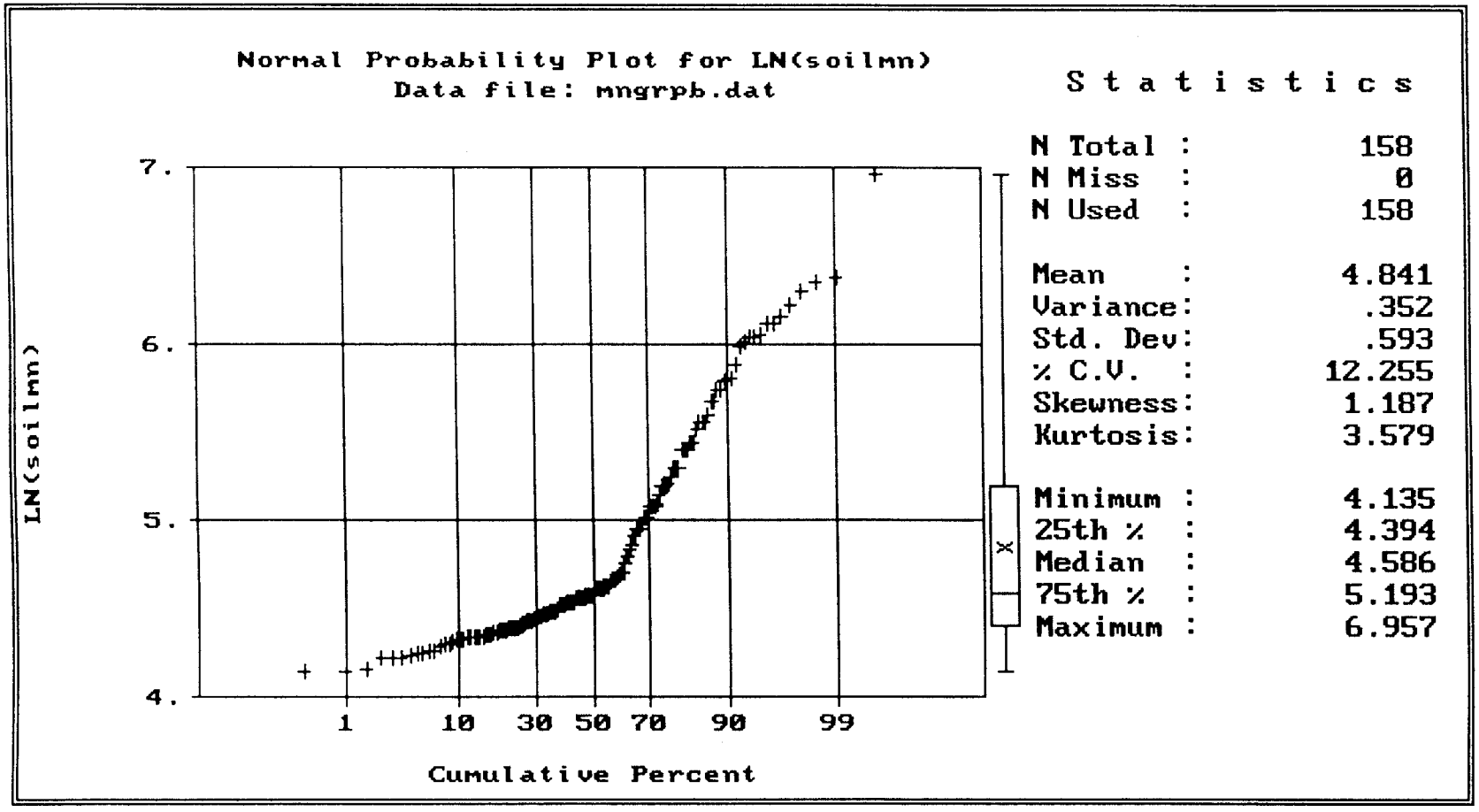


FIGURE 5A
NAS ALAMEDA
CUMULATIVE PROBABILITY PLOT FOR IRON USING SITES 7C, 13, AND 19 DATA

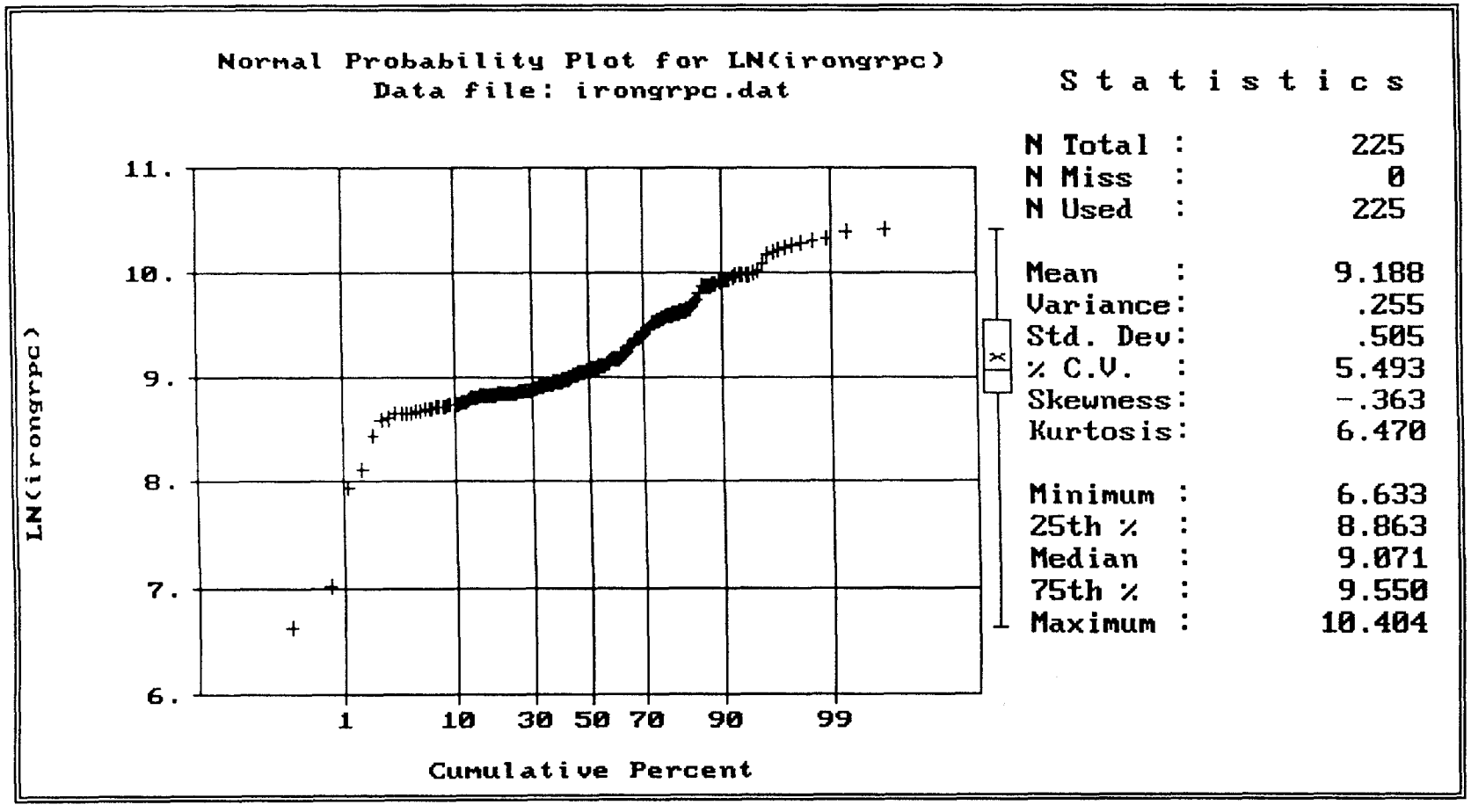


FIGURE 5B
NAS ALAMEDA
CUMULATIVE PROBABILITY PLOT FOR MANGANESE USING SITES 7C, 13, AND 19 DATA

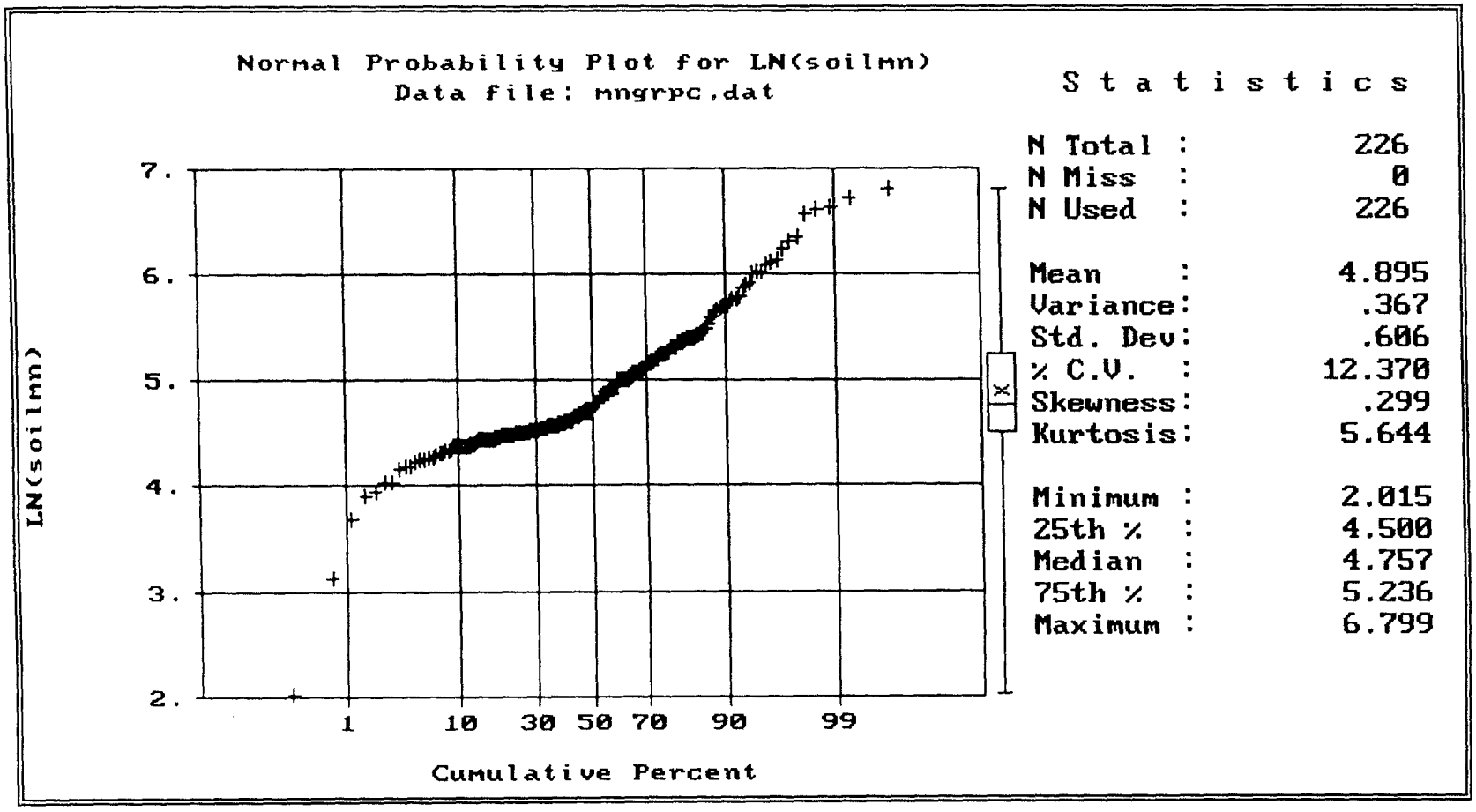


FIGURE 6A
NAS ALAMEDA
CUMULATIVE PROBABILITY PLOT FOR IRON USING RUNWAY AREA DATA

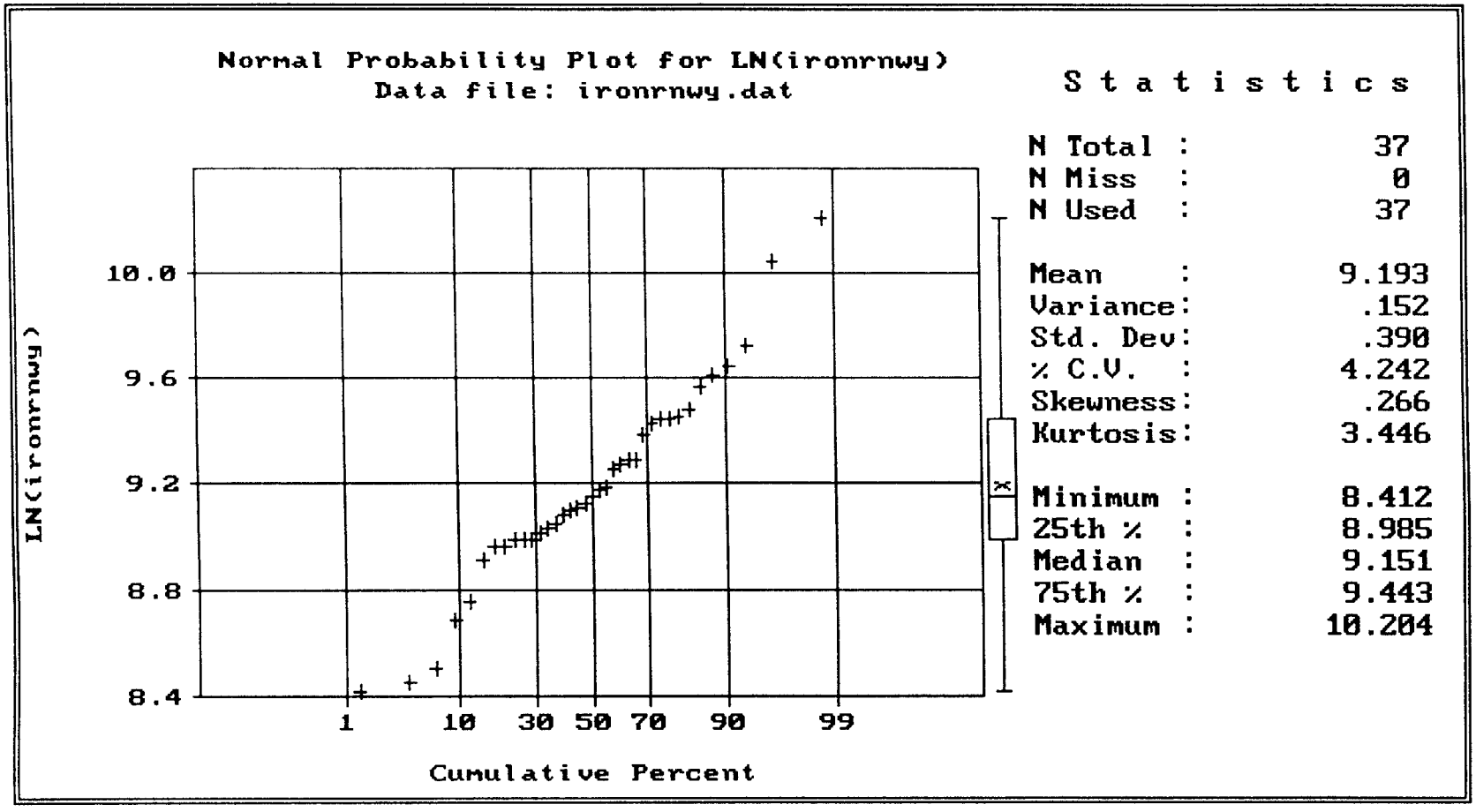


FIGURE 6B
NAS ALAMEDA
CUMULATIVE PROBABILITY PLOT FOR MANGANESE USING RUNWAY AREA DATA